MEMOIRS

OF THE

MUSEUM OF COMPARATIVE ZOÖLOGY

AT

HARVARD COLLEGE.

VOL. XXXVII.

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Memoirs of the Museum of Comparative Zoölogy
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REPORTS ON THE SCIENTIFIC RESULTS OF THE EXPEDITION TO THE EASTERN TROPICAL PACIFIC, IN CHARGE OF ALEXANDER AGASSIZ, BY THE U. S. FISH COMMISSION STEAMER "ALBATROSS," FROM OCTOBER, 1904, TO MARCH, 1905, LIEUT. COMMANDER L. M. GARRETT, U. S. N., COMMANDING.

XVI.

THE MEDUSAE.

By HENRY B. BIGELOW.

WITH FORTY-EIGHT PLATES.

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INTRODUCTION.

The collection of Medusae obtained during the cruise of the "Albatross" in the Eastern Tropical Pacific in 1904–05 is to be ranked as among the more important of recent years. Not only is the number of species large (72), but it includes two new intermediate genera of great interest from their systematic relationships, as well as excellent examples of several previously little-known genera, such as Atorella, Periphyllopsis, Aeginura, Pegantha, Halicreas, Homoeonema, Sibogita, and Heterotiara. The number of new species (17) may seem comparatively small, but it must be remembered that the greater part of the collection consists of holoplanktonic forms, organisms now known to be of general distribution in the warmer waters of all oceans. The fact that the greater portion of the cruise led through an oceanic area far from land no doubt explains the total absence of rhizostomes from the collection. Intermediate genera, both craspedote and acraspedote, are especially well represented.

Among the features of morphologic interest I may call attention here to the discovery of a new halicreid, Halitrephes, with numerous radial canals; of a new trachynemid, Tetrorchis, with four gonads on the subumbrella; of a Cunina lacking peripheral canal system; of a Cunoctantha, *C. tenella*, in which, unlike previously known members of this genus, a canal system is well developed; and of the development of free medusa buds in the region of the gonads in a new species of Eirene. From the developmental standpoint the discovery of an almost complete series of stages in the development of *Pegantha smaragdina* is of especial importance, since nothing was previously known of the early stages of this interesting genus; and of equal importance is the demonstration of the occurrence of internal budding in Cunina and Pegantha.

To the student of geographic distribution the collection is especially timely, since although the explorations of the recent deep-sea expeditions of the "Valdivia," the "Siboga," and those of the Prince of Monaco had given us a fairly good idea of the holoplanktonic Medusa fauna of the Tropical Atlantic and Indian oceans, the eastern half of the Pacific still remains practically a *mare incognitum* in this respect.

The collection (20 species) made in Acapulco Harbor is likewise important from the distributional standpoint, for the Medusa fauna of the west coast of Central America was previously almost unknown. When compared with the West Indian Medusae it illustrates in striking fashion the close relationship between the littoral faunae on the two sides of Central America.

Owing to the rapid growth of our knowledge of the structure and relationships of the Medusae the classification of both Acraspedae and Craspedotae is in a state of such constant change that no system as yet proposed can be expected to remain permanent. The scheme adopted in the present memoir is based in its essentials, as all future attempts must be, on the classifications outlined by Gegenbaur, Agassiz, and Haeckel. But I have not hesitated to adopt the very extensive modifications which recent authors have shown to be necessary; and several new changes are proposed, to which attention will be called in the appropriate connections.

Perhaps a few words are called for to explain a presentation of the subject-matter in the reverse of the so-called "natural order" now usually adopted. The present arrangement was adopted for purely practical reasons connected with the preparation of the drawings and plates, and for the sake of preserving a parallel arrangement of text and plates; it is not to be taken as indicating the author's idea of phylogeny. Within the several orders, where supposed relationships rest on a much firmer basis than they do between the orders, I have preserved what I believe to be the natural sequence of families and genera.

Throughout the cruise, the care and preservation of the Medusae fell to my special lot, so that I had the opportunity to study the great majority of the specimens in life, or at least in the fresh condition; a privilege of the greatest value, as any student of this group will recognize. I was also able to prepare colored sketches of many of the species, a few of which are reproduced in this memoir. Colored drawings of Atolla and Ptychogena were likewise made by Mr. A. M. Westergren, artist on the expedition.

The great majority of specimens were preserved in 5% formalin in sea water, a method which has proved satisfactory both for gross anatomy and for histology, its only drawback being that otoliths are frequently dissolved. A few individuals were preserved in alcohol, and still others in various of the acid histologic fixing reagents. I may call attention here to the value of chloretone as a stupefying reagent for Medusae. A few cubic centimeters of a 1% solution of chloretone were usually added to the receptacle in which the "tow" was contained, and proved most satisfactory, not only for Medusae, but also for Siphonophorae. Excellent and concise directions for the treatment of Medusae on shipboard have been published by Browne (: 06).

In the preparation of this report I have been much assisted by having access to the extensive collection of Medusae in the Museum of Comparative Zoölogy, which, besides being rich in West Indian species, contains many of the specimens from Puget Sound described by A. Agassiz ('65), as well as those from the Fiji Islands reported upon by Agassiz and Mayer ('99). The Pacific Medusae of the U. S. National Museum, including the Hawaiian collection reported upon by Mayer (: 06), have likewise been at my disposal.

It is a pleasure to acknowledge my obligations to the following gentlemen for their assistance: — to Mr. Alexander Agassiz, to whom I am indebted not only for the opportunity to accompany the "Albatross" on her cruise, but for constant encouragement, advice, and criticism in the preparation of this report; to Mr. Richard Rathbun of the U. S. National Museum for placing at my disposal the collections of the National Museum; to Messrs. G. H. Parker, Thomas Barbour, H. L. Clark, and O. Bryant for interesting specimens of Medusae; to Mr. E. T. Browne, Dr. C. W. Hargitt, Dr. O. Maas, and Dr. A. G. Mayer, for information, and counsel on knotty questions of nomenclature.

Museum of Comparative Zoölogy,
Cambridge, Mass., June, 1908.

THE MEDUSAE.

Scyphomedusae.

Students of the Scyphomedusae are so generally agreed that Haeckel's ('80) classification of the group is in many ways unsatisfactory, that several attempts have been made recently to work out a more natural grouping of the various members of the class. These have been thoroughly reviewed by Maas (: 07), so that I need not dwell here on the historic aspect of the subject. By far the most satisfactory classification which has yet been proposed is the result of the successive studies of Claus ('83), Vanhöffen ('92, : 02[a]), and Maas (: 03, : 07). As provisionally outlined by the last author, (: 07, p. 193), it is as follows: —

A. Charybdeida.

B. Three groups which together form a phylogenetic series.

  1. Stauromedusae, exclusive of the Tesserida.
  2. Coronata.
  3. Discophora.

This scheme shows an important advance over the one proposed by Vanhöffen ('92, p. 20), in abandoning the division of the Scyphomedusae into Cathammata and Acathammata. Such a separation of the class into two opposed groups, based on the presence or absence of septal nodes, is probably of no phylogenetic significance, since, as Claus has shown, it is doubtful whether the septal nodes of the Coronata and the long "Septalleisten" of Stauromedusae and Charybdeida are homologous, it being altogether likely that the septae, at least of the latter group, are not homologues of the primitive taeniolae of the scyphistoma, but are new formations on the part of the endoderm. Another serious objection to his grouping is that it results in the close association, under the heading Acoronata, of the widely divergent Charybdeida and Stauromedusae, an association which Vanhöffen (: 02[a], : 06) has himself admitted to be irrational. Lastly, employment of the presence or absence of septal nodes as the chief criterion results in laying too strong emphasis on the distinction between Coronata and Discophora.

I fully agree with Maas (: 07), indeed, I think that no actual student of the Scyphomedusae will now dispute, that the Charybdeida are a very aberrant group. But I think it very doubtful whether the three remaining groups which he enumerates — Stauromedusae, Coronata, and Discophora — do actually form a phylogenetic series as he suggests (: 07, p. 193). To assume this seems unwise until we have a clearer idea of the affinities of the Lucernarida. For even if we accept the view that the Lucernarida are in reality not Medusae at all but Scyphistomata which attain sexual maturity, and that their fixed habit is therefore a primary, not a secondary, character, we cannot safely assume that they are necessarily ancestral forms. On the contrary, it is entirely possible that they ought rather to be regarded as offshoots of one of the more highly developed groups. Furthermore, although it will, I think, be generally admitted that the relationship between Coronata and Discophora is closer than Vanhöffen's separation of the Scyphomedusae into Cathammata and Acathammata suggests, yet there is strong evidence against regarding these groups as connected by a direct genetic relationship. Though we may not regard the presence or absence of septal nodes as of the first importance in classification, yet these structures are of morphologic importance and of regular occurrence among the Coronata; and there is considerable evidence, as we know from the studies of Claus ('83) on the development of Nausithoë, for regarding them in the Coronata at least, even if not in the Charybdeida, as partly, if not wholly, homologous with the original taeniolae of the scyphistoma. Like so many problems in medusology, this is a question requiring further embryologic study; but should the septal nodes of the Coronata actually prove to represent the taeniolae, their phylogenetic significance in classification would, of course, be very great. At any rate, their presence in the Coronata and absence in the Discophora suggests a parallel, rather than a serial, relationship between the two groups.

Maas's provisional scheme shows an apparent shortcoming in that it provides no place for the Tesserida, since he states that the Stauromedusae are "Tesserida auszuschliessen" (: 07, p. 193); but in any formal classification of the Scyphomedusae some place must, of course, be found for this group. Considering the fact that their affinities, and even many points in their structure, are very problematical, it seems to me as well, to retain them provisionally among the Stauromedusae. Various ideas as to their significance have been entertained. It is by no means necessary to suppose, with Haeckel ('80), that they are primitive Scyphomedusae; on the contrary, there are some grounds for concluding, with Hickson (:06), that they really represent precocious Scyphistomata, such as the Lucernarida, which have secondarily acquired the free swimming habit. But to come to any sound conclusion on this point, it is absolutely necessary to have fresh material. Further speculation based on Haeckel's ('80) description and figures seems not only unprofitable but misleading.

For these reasons it seems best to modify the scheme proposed by Maas (:07), as follows, and to refrain from assigning to the various orders of the class any serial phylogenetic relationships: —

Order 1. Charybdeida, a very aberrant group.
Order 2. Stauromedusae (Lucernarida and Tesserida).
Order 3. Coronata.
Order 4. Discophora (Saemaeostomata and Rhizostomata).

CHARYBDEIDA.

Charybdeidae Gegenbaur.

Charybdea Péron et Lesueur, 1809.

The ten species which have been described under this genus differ so slightly one from another, and that only by characters of whose systematic importance different opinions may reasonably be held, that it is difficult to pass judgment on their validity. Maas ('97) has already expressed a doubt as to whether all the species enumerated by Haeckel ('80) are really distinct, suggesting that we may, at least in part, be dealing with geographic races, a conclusion supported by the fact that a different species has been described for almost every locality from which the genus has been recorded. But, on the other hand, these races, even if they be nothing more, often seem to be constant, as is the case for *C. marsupialis* from the Mediterranean; while enough specimens of *C. xaymachana* have now been examined by Conant ('98) and by myself to suggest that this form is also well founded.

We must bear in mind, in deciding what characters and differences are best fitted to serve as the bases for specific distinctions, that Charybdea should be judged from a different standpoint from Pelagia, or the trachyline Hydromedusae. Although Charybdea and Pelagia, if viewed merely from the descriptive standpoint, seem to show a close parallel in that in both genera numerous closely allied species or races have been described from different localities, yet a study of the distribution and development of the two genera shows that this parallel is only apparent. Pelagia is a truly oceanic genus, in which the so-called species are probably not geographically constant. Charybdea, on the other hand, almost certainly passes through a scyphistoma stage (Haacke, '87), and is usually recorded from harbors, inlets, or, at the most, from but a few miles off-shore. Furthermore, its races seem to be constant and are often isolated from one another. It is very doubtful whether such slight and geographically inconstant variations as those of Pelagia and many such oceanic Hydromedusae as Rhopalonema, deserve any recognition in nomenclature. But in the case of such a geographically restricted and local genus as Charybdea equally small variations, when not representing mere developmental differences, are of much greater systematic importance, and, if they prove to be constant for different localities, may well be regarded as the basis for specific distinctions. Differences due to different stages in growth must however be carefully guarded against; it was such a one, simple or branched condition of the velar canals, on which Haeckel ('80) founded the subgenera Charybdella and Charybdusa.

The characters of greatest specific importance in the genus are size and general form of adults, structure of the phacelli, number of the velar canals, and their condition, whether branched or simple, if, indeed, simple canals should prove to be characteristic of the adult of any species of the genus, which at present seems doubtful.

Owing to the facts that most of the older species were founded on such unstable characters as the relative proportions of different parts of the bell, that many of the specific descriptions are altogether inadequate, and that practically nothing is known of the younger stages in growth of most of the species, it would be hopeless to attempt any revision of the genus without a study of extensive series of specimens from the type localities of the various forms.

I believe that it is very important that descriptions of specimens of such genera as Charybdea should be as detailed and specifically diagnostic as possible, whether new or old species be in question. Neglect of this precaution, particularly in the case of Pacific Medusae, and the practice which some writers follow of giving no reasons for their specific identifications, even when these form the bases for important generalizations, have made the study of the geographic distribution of the Medusae much more difficult than it need have been.

Charybdea rastonii Haacke.

Charybdea rastonii Haacke, '87, p. 591, taf. 35; Mayer, :06, p. 1134, pl. 1, figs. 1–1 c.
? **Charybdea arborifera** Maas, '97, p. 86, taf. 14, figs. *7–10*.

Plate 1, Fig. *4*; Plate 10, Figs. *1–7*.

Three specimens, Mangareva Harbor, surface.

I have likewise had the privilege of examining the considerable series from the Hawaiian Islands, including various stages in growth, on which Mayer based the record noted above.

The specimens present immature characters in the structure of the phacelli and velar canals, and agree very closely with Haacke's ('87) description of the young of this species from near Adelaide, Australia, as well as with Hawaiian specimens of a corresponding size. The measurements of the present specimens are, 13 mm. in diameter by 14 mm. high; 13 mm. in diameter by 13 mm. high; 8 mm. in diameter by 9 mm. high. In the largest specimen, which, from the condition of the gonads, is apparently about half grown, the bell is rather cubical, and the exumbrella shows the sculpture characteristic of the genus (Pl. **10**, figs. *2*, *3*). The pedalia, which have often been considered of systematic importance in this genus, are narrow and ovate in all the specimens, being but slightly deeper along their inner than along their outer sides. The stomach, as is shown in a somewhat ideal section (Pl. **10**, fig. *6*), is very flat, without any trace of the mesenteries characteristic of the allied genus Tamoya.

The canals. — In every specimen there are sixteen canals, four between every two frenula, the two near the tentacles being larger and longer than the two near the sense organs. In the two smaller specimens from Mangareva all the canals are simple, but in the largest individual one of them shows signs of branching, thus indicating that the simple condition is merely a temporary one, as Haacke ('87) has pointed out. In larger specimens, Hawaiian, the branching is more complex, resembling Haacke's figures of adults.

The phacellae. — In the smallest specimen these consist of ovoid thickenings at the four corners of the stomach, each bearing from ten to fifteen simple filaments. The largest specimen shows a much more advanced condition. The filaments in each phacella (Pl. **10**, fig. *7*) have become collected into three or four groups, each group arising from a distinct stalk. The filaments, furthermore, arise from the stalk at different levels, and some of them are apparently branched, so that they present a tree-like appearance. In the largest Hawaiian specimens each phacella consists of from six to eight groups of filaments.

The sense organs show the structure apparently universal at least among the young of this genus, having two large single median and four small paired lateral ocelli. But it is of course impossible to determine whether the paired ocelli would be lost with growth, as Haacke ('87) found to be the case in his Australian specimens.

The Mangarevan as well as the Hawaiian specimens, agree closely with Haacke's account of corresponding stages. Haacke ('87) and Mayer (: 06) have described all the canals in the adult as branched, but the former author has observed that in rather small specimens the eight canals next the sense organs were entirely simple, while the eight next the tentacles showed only a very faint trace of branching, a condition already attained in one quadrant of our largest specimen. It is true that branching of the canals appears to take place rather earlier in the Australian than in the Mangarevan specimens; but this slight difference, even if it prove to be constant, can hardly be considered anything more than a local peculiarity.

The phacellae also closely agree with Haacke's account of corresponding stages in their growth in his specimens. In the youngest which he examined they presented exactly the same condition as that which I have just described for our smallest individual, the simple filaments of each phacella arising in a single row from a thickening at the corner of the stomach. The phacellae of our largest specimen resemble those of Haacke's half-grown individuals, while in the large Hawaiian specimens they agree with his account of the adult stage. There are no important differences between our specimens and those described by Haacke other than such as may be accounted for by different stages in growth.

Since this species was first described by Haacke, the only record of its occurrence is that given by Mayer (: 06) from the Hawaiian Islands. The identity of *C. arborifera* Maas, which I have classed as a probable synonym of this species, is not altogether clear. The strong general likeness of this form, taken at the exact locality, Honolulu Harbor, from which Mayer (: 06) has since recorded *C. rastonii*, to the latter species, has already been noted by Maas ('97) himself. His specimens, however, showed two striking differences from the typical *C. rastonii:* — the exumbrella was without sculpture; and the phacellae were dendritic, all the filaments of each arising from a single stalk. The lack of exumbral sculpture seems less important than Maas supposed, since it was observed only on alcoholic specimens. Nor does the condition of the phacellae appear to be sufficient ground for establishing a new species, since the dendritic structure which he describes is not essentially different from that of the phacellae of the half-grown *C. rastonii* in the present collection, and Maas's specimens seem to have been at about the same stage in development. Maas ('97) also believes that the sense organs of *C. arborifera* show a marked deviation from those of *C. rastonii*, since paired ocelli were present in all his specimens. But we know from Haacke that it is only in individuals of the former species more than 20 mm. in height ('87, p. 603, two thirds grown) that the paired ocelli disappear, and it is by no means certain that the same may not be true of *C. arborifera*, inasmuch as the largest specimen which Maas examined was only some 15 mm. high. Finally, the geographic distribution of these forms offers an additional argument against regarding *C. arborifera* as separate from *C. rastonii*, since it seems unlikely that two distinct, yet so closely allied, species should occur side by side in such a restricted locality as Honolulu Harbor.

For the sake of mapping out the distribution of the Medusa fauna of the Pacific, it would be of great importance to know the true status of three other species of Charybdea, *phillipina* Semper, *grandis* Agassiz and Mayer, and *moseri* Mayer, all of which are very closely allied in so far as regards the structure of the phacellae and the number (24) of velar canals. Mayer (: 06) believes that his new species *C. moseri* is very close to *C. phillipina*. But it seems to me that this is probably an error, since the two are sharply separated by a constant difference in size, *C. phillipina* having gonads when 30 mm. high, while *C. moseri* shows no trace of them until some 60 mm. high. *Charybdea moseri* and *C. grandis*, however, show such close affinities to each other that it may be questioned whether they are not really two stages in the growth of one species. Maas (: 03) has, it is true, suggested that *C. grandis* is in reality a Tamoya, not a Charybdea. But Mayer's figures, though not altogether conclusive, indicate the short flat manubrium characteristic of the latter genus. There is no doubt of the correctness of Mayer's contention that *C. moseri* is a typical Charybdea, a contention I have myself been able to substantiate on a considerable series of well-preserved specimens from the Hawaiian Islands. The only important difference between *C. grandis* and *C. moseri* is that in *C. grandis* the twenty-four canals are slightly branched, whereas in all the specimens of *C. moseri* they are simple. But since we now know that in other species of Charybdea in which the canals in adults are branched, the same structures in the young are simple, it is altogether probable that this difference is due merely to the difference in the stages of development of the two series. Nor does the very slight difference in the shape of the pedalia which Mayer has described seem of much importance, since he studied *C. grandis* on fresh, *C. moseri* on preserved, specimens. On the other hand, a peculiar crescentic form appears characteristic of the phacellae of both forms; and since they so closely resemble each other in other particulars, *e. g.*, large size, form, and number of canals, I believe that they represent but a single species.

I have likewise been able to examine two specimens of a very large Charybdea from the Society Islands, in the collection of the Museum of Comparative Zoölogy, which also appear to belong to *C. grandis*. They are both about 170 mm. high and of the same general form, with short pedalia, and with the rhopalar niches high above the bell-margin. The phacellae, though not in very good condition, form rather crescentic areas, each containing many filaments, and the velar canals are branched, but unfortunately it was impossible to count them, owing to the contracted condition of the circular muscles of the velarium.

If my view that these specimens and *C. moseri* both really belong to *C. grandis* be correct, that species would extend from the Hawaiian Islands on the north to the Paumotus on the south, and thus show in its distribution a close parallel to *C. rastonii*.

Coronata.

In considering this order we may adopt the classification into families proposed by Vanhöffen (: 02^{a}). This scheme, it is true, is based chiefly on a single character, that is, number of sense organs and of tentacles, and may therefore be regarded as somewhat artificial. But this criticism is less serious in such a structurally homogeneous group as the Coronata than it would be in most other orders of Medusae; while, on the other hand, the scheme which he has outlined is not only suggestive of the apparent relationships of the various genera, but is also convenient in actual practice, besides readily allowing of future additions. One such addition has already become necessary, the formation of a new subfamily, Paraphyllininae (Maas, : 03), to include Paraphyllina (Maas, : 03) and the fossil genus Paraphyllites (Maas, : 06^{a}), in both of which the usual radial arrangement of the marginal organs is reversed. Another recent advance in our knowledge of the order has been the demonstration by Maas (:03) that in Linerges, as in Nausithoë, the two canals which enter each marginal lappet unite, thus forming a continuous festoon canal, instead of ending blindly, as early students of the genus supposed. This discovery, already made by Vanhöffen (:02ᵃ) and since substantiated by myself on excellent specimens of *L. mercurius* from the West Indies and of *L. aquila* from the Fiji Islands, brings the vascular system of Linerges into fundamental agreement with that of all other genera belonging to the order.

Under the Coronata we may distinguish the following families:—

Periphyllidae, with four sense organs. Under this family are two sub-families:—
  a. Periphyllinae, with the ordinary radial arrangement.
  b. Paraphyllininae, with the radial arrangement of the marginal organs reversed.

Atorellidae, with six sense organs.

Ephyropsidae, with eight sense organs.
  a. Nausithoinae, lappet-canals simple, without subumbrellar sacs.
  b. Linerginae, lappet-canals branched, with subumbrellar sacs.

Atollidae,[1] with more than eight sense organs, and with an irregular number of metameres.

Recently Kassianow (:01) has proposed another classification of this group, based on unfamiliar, even if not wholly novel, grounds, which differs so essentially from the one outlined above that I cannot pass it by without brief notice, even though Maas (:07) has already reviewed it in detail. Kassianow gives to the condition of the marginal lappets a much higher importance than other students of the group have usually attached to them, and he believes that in the homologies of these structures he finds reason to discard the otherwise homogeneous order Coronata. According to his view the rhopalar lappets of Periphylla and the eight lappets of Pericolpa are not homologous; nor are the eight adradial lappets of the latter the true rhopalar lappets of that form. On the contrary, following Claus ('86), he believes that he can find evidence in Haeckel's ('80) figures of Pericolpa of the existence at the base of each of the four sense organs of a small, undivided lappet. According to his theory these masked, and but slightly

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[1] The name Collaspidae has usually been employed for this family, but since the genus Collaspis has been shown by Fewkes to be a synonym of Atolla I follow the International rules of zoological nomenclature in substituting Atollidae.

developed, structures are the true rhopalar lappets of Pericolpa, corresponding to the rhopalar lappets of Periphylla. The large adradial lappets of Pericolpa are, then, in reality tentacular lappets, which correspond, from their position, to the eight adradial arms of the Lucernarida, and to what he believes, from Haeckel's ('80) figures, to be the primitive lappets in the Charybdeida. They are not, however, homologous with the tentacular lappets of Periphylla, but are replaced in this and all higher genera by the adradial tentacles. The tentacular lappets in Periphylla are wholly new formations. The relation, according to Kassianow, of Periphylla to Nausithoë is one of direct descent, the perradial tentacles of the former being replaced by the perradial sense organs of the latter. To this view there are, to my mind, vital objections. To begin with, students are now very generally agreed that the Charybdeida are an aberrant group, showing no close relationship either to the Stauromedusae or to the Coronata. In the second place, there is strong reason to believe that his interpretation of the lappets in Pericolpa is erroneous. The supposed "sense lappets" of this genus which he believes to be shown on Haeckel's figure are very problematic. Haeckel makes no mention of them, and the structures which he shows might more easily be interpreted as prolongations of the rhopalar pedalia, a view to which, as it seems to me after examining the figures, there is no objection. Furthermore, and of great importance, is the fact that Maas (: 03), who has recently had an opportunity of examining specimens of this genus, makes no mention of these lappets, although he would certainly have been on the lookout for them. It is, then, very improbable that any such lappets exist. Even aside from this essential objection, there are strong drawbacks to any classification based in its essentials on the homologies of such irregular serial parts as the marginal lappets. Indeed, his scheme can hardly include the newly discovered genera Atorella and Periphyllopsis, which, as Maas (: 07) has pointed out, show a numerical condition of the tentacles and lappets incompatible from any reasonable standpoint with Kassianow's concept of their homologies. Still more important is the discovery by Maas (: 03, : 06^{a}) of two genera, one (Paraphyllina) recent, the other (Paraphyllites) fossil, which, while closely allied to Periphylla in every anatomical respect, show in the radial arrangement of their marginal organs an exact reversal of the ordinary condition. This of course indicates that the significance of the distinction between per- and inter-radial rhopalia and tentacles is, from the standpoint of phylogeny, not a fundamental one. I cannot better express my views of the actual importance of the supposed homologies represented in the number and arrangement of these organs than in the words of Maas: "Zudem darf vom moderneren Standpunkt aus geltend gemacht werden, dass auch die theoretischen Voraussetzungen für solche spitzfindige phylogenetische Ableitungen keineswegs genügend gesichert erscheinen, sondern dass sprunghafte Veränderungen und Vermehrungen solcher adventiven Randgebilde auch auf anderer Basis, nach Gesetzen der Variation und Mutation möglich sind" (:07, p. 195).

Periphyllidae Haeckel, 1880.

sens. em. Vanhöffen (:02^a).

This family, according to Vanhöffen (:02^a), includes all Coronata with four sense organs, the generic distinctions within the family being based on the number of tentacles, which, so far as known, always occur in multiples of four. Maas (:03, :07), however, has retained Haeckel's family Pericolpidae to include Pericolpa, with only four tentacles. But if, as Maas himself agrees, Periphylla with 3 × 4 and Periphyllopsis with 5 × 4 tentacles both belong to the Periphyllidae, it seems to me irrational to separate from this family Pericolpa with 1 × 4 tentacles, inasmuch as in the number of tentacles this genus bears to Periphylla precisely the same relation that the latter genus bears to Periphyllopsis. With regard to Nauphantopsis Fewkes ('86), which Vanhöffen (:02^a) includes in this family on the supposition that it has four sense organs and 7 × 4 tentacles, it is impossible to reach any decision without studying fresh material, since Fewkes was unable to count definitely the number of sense organs.

In the typical members of the family the four sense organs are interradial, the four tentacles, or groups of tentacles, as the case may be, being perradial. In the recently described Paraphyllina (Maas, :03), however, and in the fossil genus Paraphyllites (Maas, :06^a) this radial arrangement is reversed, the sense organs being perradial, and the central one of each of the four groups of tentacles interradial. Their closest relationship is with Periphylla; they must be regarded, I believe, as offshoots of that genus.

It appears that Periphylla may be derived from Pericolpa by the development, in each quadrant of the margin, of a new adradial tentacle on either side of the primitive perradial tentacle; and arguing from this conclusion it is reasonable to assume that Periphyllopsis in the same manner is derived from Periphylla by the development of a new tentacle on either side of each tentacle group of the latter genus. Whether or not this has actually been the line of development of these three genera is impossible to determine without studying their young stages. But the evidence afforded by the adults suggests that such is the case.

Periphylla Steenstrup, 1837.

sens. em. Vanhöffen (:02^{a}).

Periphyllinae with 3 × 4 tentacles.

The anatomical and histological structure of this, the best-known genus of the family, has been so carefully studied, since Haeckel's ('80) description, by Maas ('97, :03, : 04^{c}) and Vanhöffen ('92, : 02^{a}), on satisfactory material, that repetition here is unnecessary.

The species described by Haeckel ('80) under the genera Peripalma and Periphylla, and by Fewkes as *P. humilis*, have been successively reduced, until Vanhöffen (: 02^{a}) and Maas (: 04^{c}) recognize only three: *P. dodecabostrycha* Brandt, '38, *P. hyacinthina* Steenstrup, '37, and *P. regina* Haeckel, '80. The considerable number of specimens taken on the expedition of the "Valdivia" and those of the Prince of Monaco have afforded ample opportunity to these two students to make careful comparisons between these three species. Mayer (: 06), on the other hand, argues that *P. dodecabostrycha* and *P. hyacinthina* are in reality synonymous, the differences in form of the bell and in extent of pigmentation being, according to his view, the result merely of different stages in growth, or of individual variation. This view has much to recommend it; and although I realize that further studies on more extensive series of the two forms must be made before any final conclusion can be reached, I think it wisest to accept it provisionally, even though it be sharply opposed to the opinions of two such eminent authorities as Maas and Vanhöffen. In support of the thesis that the two species are identical I may cite the following important observations on the part of previous students. So far as I can learn, no specimen of *P. hyacinthina*, showing the characteristic form and pigmentation, has been recorded smaller than 35 mm. high, or than 21 mm. in diameter. On the other hand, we know, from recent studies at least, of no specimen of *P. dodecabostrycha* larger than 27 mm. high, or than 18 mm. in diameter. Furthermore, no *typical* specimen of *P. hyacinthina* has been observed without well-developed gonads, although such specimens have been recorded several times for *P. dodecabostrycha*. Considering how many individuals of the two so-called species have been examined, this fact alone argues very strongly in favor of their identity.

Both Vanhöffen (: 02^{a}) and Maas (: 03, : 04^{c}) have agreed that the two forms are characterised as follows: — in *P. dodecabostrycha* the bell is low and only the central portion of the gastrovascular system is pigmented, so that the gonads are visible from without. In *P. hyacinthina* the bell is high and the distal portions of the canals are so heavily pigmented as to conceal the gonads. As to the first of these distinctions, the evidence seems to be by no means convincing, although there is no doubt that specimens described as *P. hyacinthina* do average rather higher than *P. dodecabostrycha.* Vanhöffen (: 02^{a}, p. 23) has given the following proportions of height to diameter for the two species:— for *P. hyacinthina* 44 : 23, 39 : 26, 35 : 21, for *P. dodecabostrycha* 27 : 18, 12 : 10, 20 : 13. These figures as they stand are misleading, since they suggest too great a diversity in the case of the larger (*P. hyacinthina*) measurements. By reducing them to a common standard, *i. e.* in terms of the diameters, we can form a better judgment of their true meaning. We then find the proportions of *P. hyacinthina* to be 1.9 : 1, 1.7 : 1, 1.5 : 1, and of *P. dodecabostrycha* 1.55 : 1, 1.5 : 1, 1.2 : 1. It is clear, then, from these figures, to which, as I have found, more might be added without changing their import, that in this character there is no discontinuity between the two; indeed, one specimen of *P. dodecabostrycha* is rather higher in proportion to its diameter than one of *P. hyacinthina.* This character seems to be subject to considerable individual variation. Certainly when it is analyzed it forms no basis for any safe specific distinction, and all we can safely say is that large individuals are as a rule rather higher than small ones. The form of the bell is probably no more important in this connection, for Maas (: 04^{c}, p. 47) has already recorded a typical specimen of *P. hyacinthina* of which he says, " ombrelle dans sa mésoglée pas ci pointue que cela est dessiné généralement pour *hyacinthina.*"

The extent of the endodermic pigmentation does not seem much more valuable as a specific criterion, for not only is this character variable among Medusae in general, but also there is evidence that in Periphylla the amount of pigmentation increases with growth. Thus while in two very small specimens in the present collection the pigment is entirely restricted to the central stomach, not even the ring sinus showing any trace of color, in five somewhat larger specimens from the Gulf Stream, and four, all about 20 mm. in height, from off the Alaskan coast, as well as in most described specimens of *P. dodecabostrycha*, the ring sinus is somewhat pigmented, though not enough to hide the gonads; and in all large specimens of the genus yet recorded, at least by recent authors (except those referable to *P. regina*) the entire endodermal system is described as densely pigmented. The fact that the two forms, *P. dodecabostrycha* and *P. hyacinthina*, have both often been taken not only at the same locality, but even in the same haul, is a further, even if indirect, argument in favor of the view that they represent nothing more than different stages in the growth of but one species. If this be the case, the older name, *P. hyacinthina* Steenstrup, '37, must be retained.

As to the validity of *P. regina* Haeckel, which both Maas ('97, :04^{c}) and Vanhöffen (:02^{a}) retain as a good species, I am not able to form any final opinion, since I have at hand only a single rather fragmentary alcoholic specimen from the Gulf Stream, which can be referred to this species. The fact, however, that in this form the gonads do not appear until a size of some 70 mm. in diameter is attained (Vanhöffen, :02^{a}) argues strongly for the view that it is a distinct species. There appears, also, to be a definite difference in its color from that of the other species, although this difference is not shown in Vanhöffen's figure.

Periphylla hyacinthina Steenstrup.

Periphylla hyacinthina Steenstrup, '37; Haeckel, '80, p. 419; Vanhöffen, :02^{a}, p. 23, taf. 2, fig. *9;* Maas, :04^{c}, p. 47, pl. 5, fig. *35*, pl. 6, figs. *45, 46.*

? **Charybdea bicolor** Quoy et Gaimard, '33, p. 293, pl. 25, figs. *1–3.*

Quoyia bicolor L. Agassiz, '62, p. 173.

Charybdea periphylla Péron et Lesueur, :09, p. 332; Blainville, '34, p. 275, pl. 31, fig. *1;* L. Agassiz, '62, p. 173.

Periphylla peronii Haeckel, '80, p. 420.

If we accept the view that *P. hyacinthina* and *P. dodecabostrycha* are in reality but one species, the following synonyms must also be included: —

? **Chrysaora (dodecabostrycha ?) dubia** Brandt, '38, p. 387, taf. 29, 30.

Dodecabostrycha dubia L. Agassiz, '62, p. 173.

Cassiopia dubia Lesson, '43, p. 408.

Periphylla dodecabostrycha Haeckel, '80, p. 421; Vanhöffen, '92, p. 10, taf. 2, fig. *1;* :02^{a}, p. 23; Maas, '97, p. 63, taf. 9; :04^{c}, p. 47, pl. 5, figs. *36, 37.*

Plate 1, Fig. *3;* Plate 9, Fig. *2.*

Station 4652; 200 fathoms to surface; one specimen, very fragmentary, 15–20 mm. in diameter.

Station 4669; 300 fathoms to surface; two specimens; diameter about 10 mm.; fair condition.

Station 4707; 300 fathoms to surface; one specimen, 80 mm. in diameter by 90 mm. high.

Also twenty-three other specimens ranging from 20 mm. to 40 mm. in height previously collected by the "Albatross" in the Pacific, including those recorded by Mayer (: 06) from the Hawaiian Islands.

The only large Periphylla taken during the expedition was alive, and swam vigorously by pulsations of the bell when placed in an aquarium jar. So far as the pigmentation is concerned, it is a typical *P. hyacinthina*, the peripheral canal system being so densely pigmented that no trace of the gonads can be seen from without. In outline, however, it more nearly resembles *P. dodecabostrycha*, the proportion of height to diameter being only about 1.1 : 1. Moreover, the bell is much less pointed than Vanhöffen (: 02^a, taf. 2, fig. 9) has represented it, a condition already noted by Maas (: 04^c, p. 47) for a specimen collected by the Prince of Monaco. After watching the alternate contractions and expansions of the living specimen, I feel sure that small differences in the form of the bell are to be regarded merely as due to different degrees of contraction. As has often been described for the species, the present specimen shows an apical projection of the stomach into the mesogloea. But that the presence of this structure is good evidence that Periphylla passes through an attached scyphistoma stage seems to me very doubtful. The general color, which is that characteristic of the genus, is very well represented in Vanhöffen's figure.

The three small specimens from Stations 4652 and 4669 would be referred to *P. dodecabostrycha* if the latter were recognized as a separate species from *P. hyacinthina*. The measurements of the two better-preserved specimens are about 4 mm. high by 8 mm. in diameter, both being somewhat flattened. None of them show any trace of gonads. They are in all respects typical *P. dodecabostrycha*, having the low bell and the endodermal pigment wholly restricted to the central stomach, as is characteristic of that form.

I have reproduced, in Pl. 9, fig. 2, a colored sketch made from the fresh specimen to illustrate more fully this limited pigmentation. It is interesting to observe that although the peripheral canal system is entirely hyaline, the rhopalia are pigmented. The ring muscle is already well developed, as are the pedalia, and the ring furrow is deeply marked. Unfortunately all three are too much battered to determine whether a "Stielcanal" was present, a question of great interest in such small specimens.

Periphyllopsis Vanhöffen, 1902.

Periphyllinae with four sense organs, 5 × 4 tentacles and 6 × 4 marginal lappets.

This genus was founded by Vanhöffen (: 02ª, p. 27) for a new Medusa taken by the "Valdivia" in the Indian Ocean. Unfortunately the single specimen was so fragmentary that although it showed the most important generic character, *i. e.* the number of marginal organs, and its close structural affinity to Periphylla, it did not allow of any detailed description. Undoubtedly belonging to this same genus is a specimen in the present collection which is in sufficiently good condition for me to add considerable to Vanhöffen's account. It is impossible to be confident of the specific relationship of the "Valdivia" to the "Albatross" specimen, because of the poor condition of the former; yet, since the few differences between the two can easily be explained as due to differences in preservation, I identify the present specimen as Vanhöffen's species.

Periphyllopsis braueri Vanhöffen.

Periphyllopsis braueri Vanhöffen, : 02ª, p. 27, taf. 2, fig. 7.

Plate 9, Fig. *1;* Plate 12, Fig. *1.*

Station 4652; 400 fathoms to surface; one specimen, 60 mm. in diameter by 25 mm. high.

The single specimen is fairly well preserved, but a large part of the stomach and several of the marginal lappets are torn away, while all of the sense organs are battered.

The bell is flattened, so that at first glance the specimen, like the "Valdivia" example, resembles an Atolla rather than a Periphylla. But in the present case this condition is apparently normal, instead of being the result of imperfect preservation, as Vanhöffen believed. The ring furrow is deep, the pedalia are prominent, and all, both tentacular and rhopalar, of the same breadth. The central disc is about 50 mm. in diameter, its gelatinous substance thick, and its exumbrellar surface smooth. As stated above, there are twenty tentacles, arranged in four groups of five each, each group alternating with a rhopalium. Alternating with rhopalia and tentacles are twenty-four ovate marginal lappets. The radial arrangement of the different series of organs is the same as in Periphylla, each rhopalium lying in the radius of the centre of one of the sides of the stomach, being thus interradial, while the central one of each group of five tentacles is perradial, lying in the radius of one of the gastric ostia (Pl. **21**, fig. *1*).

The tentacles are about as long as the bell-diameter, and taper gradually from base to tip (Pl. **9**, fig. *1*). The sense organs are all so much damaged that I can give no description of their structure.

The ring muscle, though distinguishable, is very weak, as in Atorella, a condition apparently normal, since it shows no sign of injury, but presents a very uniform condition throughout its entire course. This structure was not distinguished in the "Valdivia" specimen.

The distal portion of the stomach is much battered, but both its basal part and the entire peripheral canal system are intact. In its basal outline the stomach resembles Atolla rather than Periphylla. The four septal nodes forming its sides (Pl. **12**, fig. *1*) extend so far centrally that they nearly divide the floor of the stomach into as many petal-like compartments. The gastric cirri, between eighty and one hundred in number, are arranged in continuous series as is shown on Pl. **12**, fig. *1*. The peripheral canal system, shown in Pl. **12**, fig. *1*, corresponds closely to that of Periphylla, and is typical of the family. The ring sinus is about 10 mm. broad. Twenty-four broad radial canals, one in the radius of each rhopalium and of each tentacle extend outward from it (Pl. **12**, fig. *1*, cr., ct.). Each canal divides at the base of its corresponding rhopalium or tentacle, one branch running into the lappet on either side, and there uniting with the branch of the neighboring canal, thus forming a continuous festoon canal. In two instances the septum between two adjacent radial canals is partially subdivided by a short blind canal arising from the ring sinus. The occurrence of these structures does not, in my opinion, point to a future formation of new tentacles, since the structure of the gonads shows clearly that the specimen was senescent; but probably indicates merely sporadic local delamination of the essentially double vascular endoderm layer in the septal regions.

The distal part of the stomach, though much torn, was evidently of considerable length, with thick, stiff walls. The lips are entirely destroyed.

The gonads are empty, but their positions and form are clearly visible, and their covering layers of tissue are intact, a fact suggesting that their emptiness is due to the natural discharge of their contents. They are oval in outline, eight in number as in all Periphyllidae, and equidistant one from another (Pl. **12**, fig. *1*).

The color of the species, as it appeared in the fresh specimen, is represented on Pl. **9**, fig. *1*. The entire endodermal system is pigmented, the stomach densely and the peripheral canals more faintly, with the deep chocolate-red color so characteristic of the Medusae of the intermediate depths.

Atorellidae Vanhöffen.

This family, founded by Vanhöffen (: 02^a, p. 51) for the new genus Atorella with six rhopalia and six tentacles, occupies an obscure position among the Coronata. Not only is the number of marginal organs unusual, but the fact that there are only four gonads, and these, as we shall see (p. 32) without any anatomical evidence of a double nature, is remarkable. The number of tentacles and sense organs may readily be derived, either through duplication, a process which has apparently played an important part in the phylogeny of the different genera of the Periphyllidae, or by reduction. But the condition of the gonads is less easy to account for. So far as we know, eight is the primitive number of these organs in every other genus of the order; and although in certain forms, *e. g.* Palephyra, pairs of adjacent gonads may become secondarily apposed, or even partially united, yet such pairs always show evidence of their double origin. Whether we are to regard the gonads in Atorella as a further step in such a process of fusion, or as the primitive condition for this form, must remain problematic until their development can be studied.

Atorella Vanhöffen, 1902.

Atorellidae with 1 × 6 tentacles and with only four gonads.

The single specimen for which Vanhöffen (: 02^a) founded the genus was exceedingly fragmentary, allowing of little more than a determination of the number of tentacles and of rhopalia. More recently Maas (: 03, p. 10) has described, from the collections of the "Siboga," a second specimen in a better state of preservation, which he has identified as Vanhöffen's *A. subglobosa.* Three specimens in the present collection undoubtedly belong to this same genus, but differ so markedly from the "Siboga" specimen in the sculpture of the exumbrella, structure of the tentacles, and general form, that I believe they belong to a distinct species.

Atorella vanhöffeni, sp. nov.

Plate 1, Fig. *2* Type; Plate 11, Figs. *1–8*; Plate 12, Figs. *2–4*.

Station 4619, surface. Three specimens, one in excellent, the other two in fair, condition. Their dimensions are: — two 5 mm. high and 6 mm. in diameter, the third more flattened, 3 mm. high and 7 mm. in diameter. In all three the ring furrow is deeply marked (Pl. **11**, fig. *1*). In *A. subglobosa* both Vanhöffen and Maas describe the exumbrellar surface as smooth. In the present species, however, it is set with numerous very prominent nettle warts, the whole bell looking much like a small Pelagia (Pl. **1**, fig. *2*; Pl. **11**, figs. *1–3*). These warts are not confined to the central disc, but extend over the marginal region and lappets as well. They are merely rounded eminences; it is not likely that their outline will prove of specific importance. Structurally they consist of closely crowded ectoderm cells among which lie nematocysts (Pl. **11**, fig. *3* n.).

The marginal lappets are oval, and very much longer than Maas represents them (: 03, taf. 3, fig. *16*); but since he states that in the "Siboga" specimen they were damaged, it is doubtful how closely the outlines in his figure represent the natural condition. In the number of lappets, likewise, the condition of his specimen was probably misleading, since he figures twenty-four, two alternating with every tentacle and sense organ. Vanhöffen, however, figures (: 02^a, taf. 3, fig. *11*) the original specimen of the genus with one lappet between each tentacle and sense organ, as is the case in the present specimens, and this condition is, I believe, normal for the genus.

The tentacles are about as long as the diameter of the bell. In *A. subglobosa* Maas figures them as simply tapering; in the present species, however, each tentacle bears at its tip a knob-like swelling (Pl. **1**, fig. *2*). In longitudinal section it is seen (Pl. **11**, fig. *5*) that this swelling involves both cell layers and that the ectoderm contains many nematocysts. Similar, though less pronounced, nematocyst swellings may also occur at other regions along the tentacles.

The sense organs very closely resemble those of Atolla, in which genus their structure has been so carefully worked out by Vanhöffen (: 02^a) that repetition here is unnecessary. Their general form is shown in Pl. **11**, figs. *6*, *7*, and a somewhat diagrammatic longitudinal section in Pl. **11**, fig. *8*. The octocyst and ventral bulbus, as well as the covering scale, are large and prominent, but there are no ocelli, as already noted by Maas (: 03), who also notes the resemblance to the rhopalia of Nausithoë. In finer structure there is one important difference from the condition in Atolla. In the latter, as figured by Vanhöffen (: 02^a, taf. 7, fig. *57*) the exumbral surface of the scale is covered with ordinary ectoderm, while in Atorella, in the same region, the cells are so closely crowded as to form a well-defined thickening; but whether this is sensory in function is doubtful.

The stomach is shallow and flattened (Pl. **12**, fig. *4*), the mouth parts short, and the mouth opening with a slightly thickened lip. The four septal nodes (Pl. **12**, fig. *4* ca) are narrow, the intervening ostia (os) correspondingly broad.

The gastric cirri present a somewhat different condition from that figured by Maas (: 03, taf. 3, fig. *16*). They are arranged in four groups, each group arising from a single stout stalk (Pl. **11**, fig. *4*). There are in all from eighty to one hundred filaments.

The peripheral canal system was easily demonstrated in one specimen by injection with carmine. In general, as is shown in Pl. **12**, fig. *4*, it resembles the type of Periphylla, there being twelve broad radial canals, six rhopalar and six tentacular, separated one from another by narrow septal regions. At the bases of the marginal organs the canals divide, the branches of adjacent canals uniting in the marginal lappet to form a festoon canal.

The specimens are especially valuable for the light which they throw on the structure of the gonads. These, four in number, are apparently double structures (Pl. **12**, fig. *2*). Such a double appearance has already been noted both by Vanhöffen (: 02^{a}) and Maas (: 03); but while Vanhöffen believes that they are actually paired structures (: 02^{a}, p. 30), Maas doubts if this is the case, though he could not determine whether the lighter zone in the middle of each was the line of division between two of a pair of gonads, or was the region where the genital products are released. To settle this point definitely I prepared a series of cross sections of one of the gonads of a male individual, from which it was at once evident that the gonad (Pl. **12**, fig. *3*) is a single leaf-like structure, so folded as to leave a deep groove along its middle line, on the inner surface. It is this groove, extending throughout the entire length of the gonad, which forms an apparent line of separation. Furthermore, there is but a single line of attachment for each gonad. The gonads of a female individual are filled with a comparatively small number of large eggs (Pl. **11**, figs. *1*, *2*) so that the double appearance is not so evident. The specimens are so perfect that there is no doubt that four is the normal number of gonads, as Maas (:03) has stated, not six, as Vanhöffen (:02^{a}) believed.

The ring muscle is very weak, indeed hardly distinguishable as such, much as in Periphyllopsis. Subumbral plates, such as have been described for Nausithoë (Maas, : 03, p. 20) are, on the contrary, very prominent, particularly at the bases of the tentacles (Pl. **11**, fig. *3*).

The gonads are orange-yellow; otherwise the specimens are entirely colorless.

A. vanhöffeni is no doubt a surface species, and it is possible that the same is true of *A. subglobosa*, since both captures of the latter were made with open nets.

Ephyropsidae Claus.

sens. em. Vanhöffen (:92).

The only members of this family taken during the expedition belong to the subfamily Nausithoinae and to the genus Nausithoë.

Nausithoë Kölliker, 1853.

sens. em. Vanhöffen (:02[a]); Maas (:03, :04[c]).

Nausithoidae with round gonads; the eight gonads separate and equally spaced.

The condition of the peripheral canal system of this genus has been the subject of much confusion. Haeckel ('80) describes the "Lappentaschen" as ending blindly in the marginal lappets, the rhopalar canals alone dividing and sending branches into the lappets. Claus ('83), however, showed that this was erroneous, and by his studies, as well as those of Vanhöffen ('92, :02[a]) and Maas (:03), it has been conclusively shown that the system as a whole follows essentially the same plan in Nausithoë that it does in the Periphyllidae. Other structures which have been obscure are the pedalia and ring furrow. But Vanhöffen ('92, :02[a]) and Maas (:03) have recently shown that these, though hardly to be distinguished in immature specimens, are progressively developed with age.

The history of this genus is an interesting example of the series of changes through which so many medusan genera and species have passed. It was founded for certain specimens, not altogether mature, from the Mediterranean, named *N. punctata* (Kölliker, '53). Larger specimens from the Atlantic were set apart as a different species, *N. marginata* (Kölliker, '53). Others, differing slightly in form and color, were described by Gegenbaur ('56) as still another species, *N. albida*. Finally, when at last large mature individuals did come to light, they were made the basis of a new genus, Nauphanta (Haeckel, '80). Under this new genus, four species, *N. challengeri*, *N. polaris*, *N. vettoris pisani*, and *N. albatrossi*, have been described by Haeckel ('80), Fewkes ('88[a]), Vanhöffen ('92), and Maas ('97); while still a third genus, Ephyroides, was instituted by Fewkes ('86). Within more recent years, as more and more specimens have been gathered from different localities by the various deep-sea exploring expeditions, the different species were successively reduced, and the three genera reunited, by Vanhöffen ('92, :02[a]). Meanwhile a distinct geographic color race of the original *N. punctata*, not previously observed, has been recorded by Agassiz and Mayer ('99, : 02) and by Bigelow (: 04), while two new and easily distinguished species of the genus, *N. picta* Agassiz and Mayer (: 02) and *N. rubra* Vanhöffen (: 02^{a}), the first a surface, the second an intermediate form, have been discovered.

According to Vanhöffen (: 02^{a}) five species of Nausithoë are to be distinguished: — *N. punctata* Kölliker ('53), *N. clausi* Vanhöffen ('92), *N. challengeri* Haeckel ('80), *N. albatrossi* Maas ('97), and *N. rubra* Vanhöffen (: 02^{a}). To these must be added *N. picta* Agassiz and Mayer (: 02); while I agree with Maas (: 03) that the status of *N. clausi* is doubtful, my own conclusion on this point being that Vanhöffen's single specimen of *N. clausi* was certainly immature and of which *N. picta* is probably the adult.

The status of *N. challengeri* Haeckel ('80), is also doubtful. The only feature distinguishing the two specimens of this species from specimens of *N. punctata* of equal size (12 mm. in diameter) seems to be the occurrence in *N. challengeri* of slight radial furrows at the margin of the central disc. In all other respects the figures represent typical *N. punctata* of large size and with well-marked pedalia and ring furrow. Vanhöffen (: 02^{a}) and Maas (: 03) both consider the sculpture of the central disc a good specific character, but it seems to me, on the contrary, that it is by no means a certain one in the case of alcoholic specimens. This question cannot be settled without an examination of fresh material of *N. challengeri*, but I am of the opinion that the latter name will probably prove to be a synonym either of *N. punctata* or of *N. picta*. *N. albatrossi* Maas seems to be a good species; it is distinguished from all other species of the genus not only by its very much greater size (40 mm. in diameter), but also by a different arrangement of the gastric cirri, which, as is shown in a figure from life (Maas, '97, pl. 14, fig. *2*), are associated in bundles. *N. picta*, likewise, is considered by Maas (: 03), who has examined typical specimens, a good species. Although showing no anatomical features to separate it from other members of the genus, it seems easily distinguished by its size and by a very characteristic pigmentation of the gonads. There are, then, probably only four distinct species of Nausithoë, which may be briefly diagnosed as follows: —

N. punctata Kölliker; small (12 mm. in diameter), endodermal system colorless; gonads yellow or brown. Gastric cirri simple. Found in all oceans.

N. picta Agassiz and Mayer; with large, brilliantly pigmented gonads, red or brown, with very short and broad tentacles; simple gastric cirri; larger than *N. punctata* (22 mm. in diameter).

N. rubra Vanhöffen. Entire endodermal system pigmented, of red color. Simple gastric cirri.

N. albatrossi Maas. Very large (30–40 mm. in diameter). Gastric cirri arranged in bundles.

Nausithoë punctata Kölliker.

Nausithoë punctata Kölliker, '53, p. 323; Haeckel, '80, p. 486; Claus, '83, p. 24, taf. 6–8; Vanhöffen, '92, p. 13, taf. 3, figs. *8*, *9*, : 02ᵃ, p. 29; Maas, : 04ᶜ, p. 54.
Nausithoë punctata var. pacifica Agassiz and Mayer, '99, p. 170; : 02, p. 155, pl. 7, fig. *32*.
Nausithoë marginata Kölliker, '53, p. 323.
Nausithoë albida Gegenbaur, '56, p. 211.
Ephyropsis species Gegenbaur, '53, p. 494.
Nauphanta polaris Fewkes, '88ᵃ, p. 40, pl. 1, figs. *1*, *2*.
Nauphanta vettoris pisani Vanhöffen, '92, p. 15, taf. 3, fig. *10*.
Ephyroides rotaformis Fewkes, '86, p. 949, pl. 7, figs. *1*, *2*.
? **Nauphanta challengeri** Haeckel, '80, p. 487.

Plate 12, Fig. *5*.

Station 4588; surface; 12 specimens.

Station 4696; surface; 1 specimen.

It would seem that in the region explored by the "Albatross" this species comes to maturity in late autumn and early winter, for the latest capture was on December 23, and all the specimens were large and with ripe gonads. In all the ring furrow and pedalia are strongly marked, a condition which appears to be usual in large specimens of this species. None of the specimens show any trace of the brown pigment spots on the exumbrella, which are so characteristic of the Atlantic representatives of the species, but inasmuch as it is doubtful whether this pigmentation is universal in the case of Atlantic specimens, although it is certainly very usual, and since slight color differences are seldom of much systematic significance among Medusae, it seems best, as I have already concluded for specimens from the Indian Ocean (Bigelow, : 04), to include Pacific as well as Atlantic forms under the one name, *N. punctata*. At the same time, however, it is important to recognize that there do occur these two comparatively constant and well-marked geographic races.

The differences of outline, degree of development of ring furrow, and pedalia, and the like, which have been supposed to separate Mediterranean from Atlantic specimens, and to distinguish the species of Nauphanta from those of Nausithoë, are, as Vanhöffen ('92, : 02ᵃ) has shown, merely evidences of different stages in growth, and bear no relation to geographic occurrence.

Nausithoë punctata is one of the most, if not the most, widely distributed of surface Medusae. Unlike most other species it does not seem to be limited by temperature, but has been found in the far north (Fewkes, '88^a, Vanhöffen, : 02^a) as well as in various parts of the temperate and tropical Atlantic, Indian, and Pacific oceans.

Nausithoë rubra Vanhöffen.

Nausithoë rubra Vanhöffen, : 02^a, p. 30, taf. **1**, figs. *4*, *5*.

Plate 12, Fig. *6*.

Station 4655; 300 fathoms to surface; 1 specimen; 15 mm. in diameter.
Station 4633; 300 fathoms to surface; 1 specimen; 10 mm. in diameter.
Station 4672; 400 fathoms to surface; 1 specimen; 18 mm. in diameter.

Unfortunately all three specimens of this interesting species were in a fragmentary condition, but still I am able to add somewhat to Vanhöffen's (: 02^a) brief description. The bell is arched, a specimen 15 mm. in diameter being 9 mm. high; the ring furrow well marked, and the pedalia prominent (Vanhöffen, : 02^a, p. 30). The marginal lappets, as Vanhöffen remarks, are narrow and pointed, though, in view of the condition of the material it may be questioned whether this is a constant character.

The structure of the sense organs in this species is of great interest, since it is no doubt an intermediate and not a surface form. In *N. punctata*, as is well known, each sense organ bears on the ventral bulbus an ocellus with well-developed lens. In *N. rubra*, however, I was able to make certain that on several well-preserved rhopalia there is no such structure. Each sense organ, on the contrary, consists (Pl. **12**, fig. *6*) merely of otocyst, covering scale, and ventral bulbus; and the latter, though somewhat pigmented, shows no more trace of any definite light-perceptive organ than is to be found in Periphylla. This adaptation to a deep-water existence is even more significant than the characteristic pigmentation of the species, to which Vanhöffen (: 02^a, p. 30) has already called attention.

The four septal nodes are broadly triangular, and so long that the gastric ostia are narrow. The gastric cirri are rather more numerous than in *N. punctata*, there being about one hundred in all. They are simple, and arranged in single and continuous series along the four sides of the stomach. Owing to the dense pigmentation of the entire endoderm, the peripheral canal system is much more easy to follow than it is in *N. punctata*, with which it agrees in all essentials. At the bases of the marginal organs the sixteen canals branch, the branches of adjacent canals uniting in the marginal lappets. Thus there are, as Maas (: 03, p. 19) has shown for *N. picta*, two canals running into each marginal lappet. The radial septa extend inward about as far as the ring furrow, where the canals become continuous, to form the ring sinus. This arrangement of canals is in no way different from the canal system of the Periphyllidae. Unfortunately both the distal portion of the stomach and the gonads were destroyed in all three specimens. The color of the entire gastro-vascular system of *N. rubra* is a deep amber red. The jelly is pale yellowish. Vanhöffen has reproduced (: 02ª, taf. 1, figs. *4*, *5*) two excellent figures of this species from sketches made from the fresh specimens.

Atollidae.

The only representatives of this family yet known belong to the genus Atolla, Haeckel's genus Collaspis having been shown by Fewkes to be a synonym.

Atolla Haeckel, 1880.

sens. em. Fewkes, '86; Vanhöffen, : 02ª; Maas, '97, : 03.

Coronata with a large and variable number of antimeres; the tentacles inserted much higher on the exumbrella than are the rhopalia.

Our knowledge of this genus since its discovery by Haeckel ('80) has been gained only step by step. And although, thanks to the studies of Maas ('97, : 03, : 04ᶜ) and Vanhöffen (: 02ª), the general anatomy and the more important features in the histology of the genus have now been thoroughly worked out, the systematic relationships and specific characters of its members are still by no means clear. The most important contribution to this subject is that of Vanhöffen (: 02ª), who was able to study a larger series of fresh specimens from the collections of the "Valdivia" than any other student has had access to. His conclusion, accepted in the main by Maas (: 03, : 04ᶜ), is that neither proportions of different parts, nor the number of antimeres is of any specific importance, but that the characters which form the best bases for separating species are the presence or lack of radial furrows on the central disc, and their number and form if present; the presence or lack of exumbral nettle warts; and the size of the septal nodes. The presence or absence of radial furrows appears, not only from Vanhöffen's studies but those of Fewkes, ('89ª), Maas, (: 04ᶜ), Mayer (: 06), and from the present collection, to be an exceedingly stable character. It is true that with growth the furrows become confined to the margin of the disc; but in species in which they occur they are still distinguishable even in the largest specimens. Whether the number of the furrows can be regarded as of specific importance is doubtful. All recent authors agree that when furrows are present they are one less in number than the tentacles. Haeckel ('80), however, described *Collaspis achillis* as having twice as many furrows as tentacles. But considering the "suspicious circumstances" (Fewkes, '89^a, p. 531) under which this species was described, it is best, I think, not to lay any stress on this character. The difference in form of the furrows, whether narrow or broad, the basis for the distinction of *A. verrillii* from *A. wyvillei*, is, according to Vanhöffen, a constant one; but, as we shall see, specimens in the present collection present conditions which throw doubt on this conclusion. Therefore it is best to reserve final judgment on this point until larger series have been studied.

Maas (: 03, : 04^c) has described a hitherto unnoticed character in specimens of *A. valdiviae* and *A. bairdii*, *i. e.* the presence of septal areas subdividing the tentacular canals near their bases, the presence or absence of which may prove, when more fully known, to be a specific character of great importance. Ground for this belief is afforded by the fact that these structures are lacking in *A. wyvillei*, as well as in specimens from the Hawaiian Islands described by Mayer (: 06) under the name *A. alexandri*.

Whether the species which Vanhöffen and Maas recognize are all distinct, or whether such differences between them as the different sizes of the septal nodes of *A. bairdii* and *A. valdiviae* are not, at least in part, due to different stages in growth or to individual variation seems to me very doubtful. But it is hopeless to attempt any revision without large series of the different forms. The following species seem to be the best founded, and may be characterized thus: —

Central disc flat. With small septal nodes, *A. bairdii* Fewkes. With large septal nodes, *A. valdiviae* Vanhöffen.

Central disc, with radial furrows, lappets smooth. With narrow furrows, *A. verrillii* Fewkes. With broad furrows, *A. wyvillei* Haeckel.

These may later prove to be synonymous, in which case the earlier name, *A. wyvillei*, must be retained.

Central disc, with narrow radial furrows and marginal lappets with nettle warts, *A. chuni* Vanhöffen. This species, since its discovery by the "Valdivia," has been taken by the "Scotia" (Browne : 08).

Two other species, *A. gigantea* and *A. alexandri*, described by Maas ('97) from alcoholic specimens, seem to me rather problematical. *A. alexandri*, it is true, has since been recorded by Agassiz and Mayer (: 02) and by Mayer (: 06) from the Pacific; but examination of the three specimens on which these two records were based has shown that, instead of having the extremely broad central disc characteristic of *A. alexandri* (Maas, '97, : 03, p. 16), their proportions agree with those of the present series; and that they all show broad radial furrows, for which reasons they must be referred to *A. wyvillei*, not to *A. alexandri*.

The specimens taken during the expedition of the "Albatross" to the Eastern Pacific are all of one species, which I have identified as *A. wyvillei* on account of the form of the radial furrows of the central disc.

Atolla wyvillei Haeckel.

Atolla wyvillei Haeckel, '80, p. 488; '82, p. 113, pl. 29, figs. *1–9;* Vanhöffen, : 02^{a}, p. 13, taf. 5, fig. 22; Browne, : 08, p. 241.

Plate 8, Fig. *1;* Plate 9, Fig. *3;* Plate 10, Figs. *8, 9.*

Station.	Depth, fathoms.	Diameter of central disc, mm.	Number of antimeres.	Preservation.
4645	In trawl, 2955	55	24	Excellent.
4646	300 to surface	8	22	Good.
4647	Trawl, 2005	28	25	Poor.
4651	Trawl, 2222	about 40	?	Very fragmentary.
4651	800 to surface	20	?	Very fragmentary.
4652	400 to surface	16	22	Fair.
4655	300 to surface	15	24	Good.
4672	400 (bottom of Tanner net)	7	23	Good.
4675	300 to surface	20	22	Good.
4726	Trawl, 1700	25	28	Fragmentary.

In addition there have been available nine other specimens, previously collected by the "Albatross" at various localities in the Eastern Pacific including the Hawaiian Islands and coast of Southern California. All of them show radial furrows more or less clearly.

In the largest specimen, 95 mm. in total diameter, the only visible traces of furrows are very slight notches on the margin of the disc. In somewhat smaller specimens, particularly in the remarkably well-preserved individual with the disc 55 mm. in diameter, from Station 4645, the furrows, restricted to the marginal region of the disc, show exactly the condition figured by

Haeckel ('81, pl. 29) and by Vanhöffen (: 02a, taf. 5, fig. *22*) for this species (fig. 1). In the small specimens there is considerable variation in the breadth of the furrows. In a specimen with the disc 20 mm. in diameter the condition, as represented on Pl. **10**, fig. *9*, is that described by Vanhöffen (: 02a) as typical of *A. verrillii* Fewkes, the furrows being very narrow. I should have thought that this specimen belonged to that species had it not been that other small specimens showed more or less intermediate conditions. One, 15 mm. in disc diameter, is especially instructive, since in it about half of the furrows are broad, the remainder narrow, while in the two smallest specimens with discs respectively 7 and 8 mm. in diameter, most of the furrows are broad, but in both a few are narrow. Apparently, then, not all the radial furrows in this species attain their typical "broad" condition until a considerable size is attained. It is interesting to note that both specimens of this species recorded by Vanhöffen (: 02a, p. 13) were large, the central discs measuring respectively 37.5 and 47 mm. in diameter.

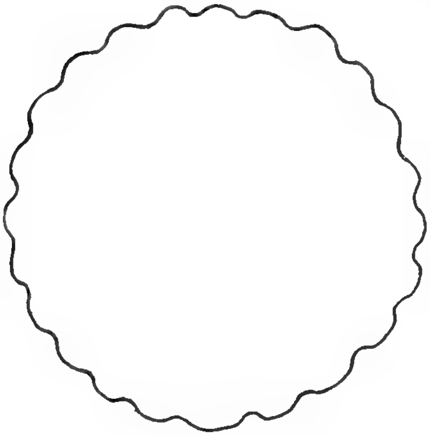

Fig. 1.

At first such variability in the form of the radial furrows would suggest that they were of little systematic importance. Such, however, does not seem to be the case, for Vanhöffen (: 02a) has found that in a large series (nineteen specimens) of *A. verrillii* they are constantly narrow, both in large and in small individuals. This discovery suggests the very interesting conclusion — one, however, which may have to be modified later — that *A. verrillii* retains permanently a character which occurs, it may be only irregularly, in the young of the closely related *A. wyvillei;* but whether the two are really valid species can hardly be settled without studies on still more extensive series from all oceans.

The present specimens support Vanhöffen's (: 02a) contention that there is normally one less furrow than tentacle (Pl. **10**, fig. *9*), and that the full number of antimeres is attained at an early stage.

Maas's recent (: 03, : 04c) discovery of areas of adhesion subdividing the tentacular canals at their bases in *A. valdiviae* and *A. bairdii* gives fresh interest to a study of the canals.

In the present series the general condition of the canal system is that described by Maas, the rhopalar canals being narrow, the tentacular canals broad; but there are no traces of any septal divisions in the tentacular canals, a result also reached by Mayer (: 06). This I was able to establish beyond doubt by examining all the canals in several excellent specimens. Absence of adhesion areas in *A. wyvillei* suggests that the occurrence of such structures in other species may prove to be a character of taxonomic importance. The tentacular canals divide some distance before reaching the base of the tentacle, a branch running into the lappet on either side, and a third lobe extending to the base of the tentacle. This latter lobe ends blindly at the base of the tentacle, as Maas (: 04[c]) describes, but instead of gradually dwindling, forms on the aboral side a definite pocket, which is apparently the result of the extreme development of the tentacular musculature, being squeezed down, as it were. between the muscular masses on either side of it.

No colored figure of *A. wyvillei* has previously appeared. The general coloration (Pl. **8**, fig. *1*; Pl. **9**, fig. *3*) is the same which has so often been described for other members of the genus.

A. wyvillei has previously been recorded only from antarctic and subantarctic stations.

DISCOPHORA.

Only two representatives of this order were taken during the expedition, — a Pelagia, and a species apparently belonging to the remarkable new genus Poralia described by Vanhöffen (: 02[a]) from the collection of the "Valdivia."

Pelagiidae.

Pelagia Péron et Lesueur, 1809.

Pelagiidae with 1 × 8 tentacles.

I am in considerable doubt as to what specific name to apply to the specimens of Pelagia in the collection. In no genus of Medusae is revision more needed than in Pelagia; but most of the descriptions of the different species are so unsatisfactory in regard to just those features which may reasonably be supposed to be of specific importance, that any attempt at rearrangement is hopeless, without the study of extensive collections from all oceans. It seems certain, however, especially from the studies of Vanhöffen (: 02[a]) on the "Valdivia" collection, that not all of the fourteen described species have a basis in fact. The features on which most of them have been based — proportions of the bell, length of the mouth parts, color, and form of the nematocyst papillae — were long ago shown by Haeckel ('80) to be so variable as to make him doubt whether the various forms are anything more than geographic races; but whether they deserve even this rank is by no means certain, inasmuch as it appears that the different types are not constant for different oceans. Thus, specimens with a very short manubrium have been described from the European coast and tropical Atlantic (*P. perla* Haeckel, '80; Maas, : 04^{c}); from Bering Sea (*P. denticulata* Brandt, '38), and from Zanzibar, the Philippine Islands, and the coast of Peru (*P. placenta* Haeckel, '80, p. 510; Vanhöffen, '88, p. 12). A like condition is also true of specimens with a long manubrium (*P. panopyra*, *P. cyanella*) and for those with a manubrium of medium length.

So variable, moreover, is this character, and also the form of the nettle warts, even in a single swarm, that Vanhöffen (: 02^{a}) found it impossible to distinguish more than one species in the vast region, including both Atlantic and Indian oceans, traversed by the "Valdivia." Fortunately Vanhöffen (: 02^{a}, p. 36) has given us measurements of a very considerable series, — a precaution neglected by most previous authors, — and from these I am able to determine that the present specimens show no deviation from his, but stand at about the middle of his series. Neither do they show any important difference from his account in the form of the nettle capsules. From Mayer's (: 06) figures this is evidently true also for specimens from the Hawaiian Islands, and apparently also for the specimens recorded by Maas from the collections of the "Siboga," and from Amboina.

It appears, then, that one species of Pelagia occurs in the warmer regions of the Pacific, Indian, and Atlantic oceans, — a conclusion easily reconciled with its mode of development without any fixed stage, and in entire harmony with the known distribution of such other oceanic Medusae as *Periphylla hyacinthina*, *Rhopalonema velatum*, and *Aglaura hemistoma*, as well as with the uniformity of the holoplanktonic fauna in general; but that it is the only species of the genus in these regions is by no means certain. In deciding what specific name to apply to this form, it seems to me best to follow Maas (: 03, : 06^{c}) and Mayer (: 06) in using the name of the earliest described Pacific species, *P. panopyra* Péron, inasmuch as there is still reason to believe that the two Atlantic species *P. perla* Slabber and *P. noctiluca* Pér. et Les. are specifically distinct. Maas (: 04^{c}), who had previously had an opportunity (:03) of studying specimens of *P. panopyra*, believes that the extremely short manubrium and the fact that the mouth arms are separated almost to its base serve to distinguish *P. perla* from the latter, and it is therefore best to retain these two species as well as *P. cyanella*, at least for the present; for we must bear in mind that it is quite as possible to reduce species too much as increase them too much, and that reduction so excessive as to result in the masking of constant varieties, no matter how closely related they may be to one another, is much more harmful than any degree of reduplication in nomenclature.

Pelagia panopyra Péron.

Medusa panopyra Péron, :07, pl. 31, fig. *2*.
Pelagia panopyra Péron et Lesueur, :09, p. 349; Brandt, '38, p. 382, taf. 14, fig. *1*, taf. 14 a, figs. *1–5*; Haeckel, '80, p. 509; Maas, :03, p. 29; Mayer, :06, p. 1139, pl. 2, figs. *3*, *4*.
Pelagia phosphora Haeckel, '80, p. 506; Vanhöffen, :02ª, p. 36.
Pelagia placenta Haeckel, '80, p. 510; Vanhöffen, '88, p. 12.
Pelagia tuberculosa Couthouy, in L. Agassiz, '62, p. 164.
Cyanea labiche Quoy et Gaimard, '24, p. 571, pl. 84, fig. *1*.
? Pelagia tahitiana Agassiz and Mayer, :02, p. 158, pl. 8, figs. *34*, *35*.

Plate 1, Fig. *1*.

So long as our knowledge of the various other species of the genus remains as incomplete as it is at present, it does not seem worth while to attempt any fuller synonomy of *P. panopyra* than that given above.

Station 4587; 300 fathoms to surface; 5 specimens, 5–7 mm. in diameter.

Station 4675; surface; 1 specimen, 60 mm. in diameter, fragmentary.

Station 4692; surface; 1 specimen, 40 mm. in diameter, excellent condition.

Station 4696; surface; 1 specimen, 20 mm. in diameter, excellent condition.

Acapulco Harbor; surface; many ephyrae, probably referable to this species.

Measurements of two specimens are: —

Station.	Diameter.	Length of manubrium.	Length of mouth arms.
4692	40	13	33
4696	20	10	25

Neither of these two specimens shows the very long manubrium which Haeckel ('80) believed to be the chief characteristic of this species. So far as the above dimensions are concerned, they fall well within the limits of Vanhöffen's (: 02[a]) more extensive series. The nettle warts are nearly round in the smaller specimen, more oval in the larger, and in both of moderate prominence. The marginal lappets, structures to which the earlier authors attributed considerable systematic value, are about as broad as long, and slightly incised at the margin so as to form two lobes; but the depth of the incision varies even in the different lappets of a single specimen, and therefore cannot be considered of much importance. The bell is less globular than it is usually described for *P. cyanella*, being considerably flattened at the aboral pole. The gonads in the larger specimens are well developed.

The ephyrae, taken in Acapulco Harbor, which I refer to this species, closely resemble the ephyra of *P. cyanella* (L. Agassiz, '62).

Color. — In the specimen from Station 4692 the disc was colorless, the gonads, tentacles, subumbrellar surface, and the four perradial ridges of manubrium and mouth arms pink-violet. The specimen from Station 4696 was of the same general color but much paler. An excellent colored figure has been given by Brandt ('38).

Poralia Vanhöffen, 1902.

This genus was founded by Vanhöffen (: 02[a], p. 41) for a single fragmentary discophore remarkable because of its apparently octoradial type and simple canal system. Unfortunately the entire margin, with all the tentacles and rhopalia, was destroyed, so that he was unable to suggest any systematic relationship for the genus.

Two specimens in the present collection seem best referred to this genus, although, if this identification be correct, it would seem that the "Valdivia" specimen was immature, and, therefore, that the description of the genus given by Vanhöffen must be modified. Unfortunately none of the three specimens, so far referable to the genus, has been in good enough condition to allow of any satisfactory description, so that it is impossible to tell whether or not the present ones are specifically identical with *P. rufescens* Vanhöffen, the type of the genus; but it is best, at least until better material is available, to include them under that name rather than to add a new name on doubtful grounds.

Poralia rufescens Vanhöffen.

Poralia rufescens Vanhöffen, : 02ᵃ, p. 41, taf. 4, figs. *15, 16*.

Plate 13, Figs. *1–5*.

Station 4647; trawl; 2005 fathoms to surface; 1 specimen, about 250 mm. in diameter.

Station 4701; 300 fathoms to surface; fragments (about half) of a smaller specimen, about 75 mm. in diameter.

The larger specimen of the two is much the better preserved, and, although part of the margin, all the tentacles, and nearly the entire mouth parts are destroyed, allows of the description of several very important features, especially with regard to the gonads, canal system, and rhopalia.

The canal system, as already noted by Vanhöffen (: 02ᵃ), is exceedingly simple, but the canals are nearly twice as numerous in the present specimen as in that of the "Valdivia." Forty-one canals arise from the periphery of the circular gastric cavity; but since two of these anastomose, only forty extend to the margin of the disc (Pl. **13**, fig. *1*). They are broad, and for the most part nearly straight, though several of them show short blind branches. Unfortunately it is impossible to state certainly the normal number of rhopalia, only five being intact. However, I feel confident that I have been able to determine the positions of twelve such organs (Pl. **13**, fig. *1*), and since a considerable space along the margin is destroyed, it is probable that, as in Callinema, there were sixteen. Fortunately, enough of the margin is intact to allow me to trace the outer portions of the canals with some accuracy. Some little distance within the margin these unite (Pl. **13**, fig. *1*) to form a continuous ring canal. Distal to the ring canal the intermediate (tentacular?) canals extend out into the marginal lappets and end blindly. The rhopalar canals branch trichotomously, a narrow median branch running into the rhopalium (Pl. **13**, fig. *5*, r. c.), while the two lateral branches end blindly.

It is impossible to give any accurate account of the marginal lappets, but from such portions of the margin as are intact it appears that the latter is deeply incised in the radii of the rhopalia, while between these organs it seems to have a rather wavy outline.

The rhopalia (Pl. **13**, figs. *4, 5*) very closely resemble the sense organs described by the Hertwigs ('78) for *Phacellophora sicula* Haeckel. The sense organ is covered by a prominent scale, beneath which it stands in an almost vertical position. The terminal otocyst is large, but the ventral bulbus is only slightly developed. Just proximal to the sense organ is a deep exumbral pit (Pl. **13**, figs. *4*, *5*, p.) as in many discophores, perhaps sensory in function.

The gonads, which, fortunately, are in very good condition, are by far the most interesting feature of the specimen. They are not located in genital pouches, but form a practically continuous band surrounding the basal portion of the stomach proper. Close examination shows that this band is not truly continuous, but is broken by eighteen or nineteen thickened vertical ridges of the gastric wall (Pl. **13**, figs. *1*, *3*). The gonads themselves consist of a series of outpocketings of the gastric wall projecting out into the subumbrella cavity, their cavities (Pl. **13**, fig. *3*, g o.) opening freely into the basal part of the stomach (Pl. **13**, figs. *2*, *3*). The very numerous gastric cirri are arranged in a single continuous series, arising from the wall just distal to the genital folds (Pl. **13**, figs. *1–3*). The gonads are mostly emptied of their contents.

The smaller specimen includes about half of the central portion of the disc, the entire margin and distal mouth parts being destroyed. There are twenty-one canals in the fragment, therefore the total number was probably about forty, as in the larger specimen. In the present specimen, however, they are much narrower, and the intercanal spaces much broader, than in the latter. The gonads present the same appearance, but, on the fragment, there are four pillars subdividing the gonads, so that probably there were only about eight in the complete medusa, instead of eighteen or nineteen as in the larger specimen.

In the larger specimen the subumbrellar surface is reddish brown; the gonads very pale brownish. In the smaller the entire fragment is of a deep reddish-brown tint.

The remarkable structure of the gonads outlined above may be easily derived as the result of an advanced stage in growth from the more primitive condition described by Vanhöffen for his much smaller specimen. He has described and figured (:02^a, p. 41, taf. 4, figs. *15*, *16*) seven (eight ?) gonads, each consisting of three or four outpocketings of the gastric wall, lying, not in gastric pouches, but directly at the base of the gastric cavity, exactly as in the present specimens. To attain the condition exhibited by the smaller "Albatross" specimen, we need only suppose that with growth the gonads increase in width by the formation, on either side, of new sexual folds, until the adjacent gonads practically unite. The spaces between them would then be narrowed until represented merely by the eight (?) ridges or pillars seen in our smaller specimen. The fact that in the larger specimen there are eighteen or nineteen such gastric ridges, instead of seven or eight, is difficult to explain.

The affinities of this peculiar genus must remain problematical until more satisfactory material with tentacles intact can be studied. In the structure of the canals and of the bell margin the present specimens closely resemble *Callinema ornata* Verrill, especially the fragmentary specimen recently recorded by Browne (: 08) under that name from the "Scotia" collection. The structure of the gonads (apparently not preserved in Browne's individual) puts identity, or even close relationship, with that species out of the question.

The most remarkable feature of Poralia is, of course, that it is probably octoradial in its younger stages, a conclusion of which the "Valdivia" specimen leaves little doubt, although the latter had only seven gonads. As Vanhöffen (: 02^{a}, p. 41) has pointed out, octoradial Medusae had previously been known among discophores only as abnormalities of *Aurelia aurita.* Since however they are extremly rare even in this form, this second capture of Poralia practically eliminates the possibility that this genus can be abnormal. The structure of the gonads gives us but little assistance in this question, as the development of the genital folds directly from the aboral wall of the stomach, without the formation of gastro-genital pockets or well-marked subgenital pits, appears to be the primitive condition among the Discophora, occurring among Cyanidae and the more primitive Pelagidae and Ulmaridae.

CRASPEDOTAE.

NARCOMEDUSAE Haeckel, 1879.

The collection contains twelve species of Narcomedusae, representing ten genera, on which to test the classifications of the order recently proposed by Maas (: 04^{a}, : 04^{c}) and Vanhöffen (: 07). These two plans rest on radically different bases; for while Maas has discarded the presence or absence of a peripheral canal system as sound ground even for generic diagnosis, Vanhöffen believes that this character, in conjunction with the mode of development, whether direct or indirect, is sufficiently important to warrant the division of the Narcomedusae into two suborders, Diocheteumena having, and Adiocheteumena lacking, canals. There are, however, strong objections to assigning such importance to the presence or absence of the canal system, for not only do species otherwise closely allied differ in this respect (*e. g.* in the genera Cunoctantha and Cunina), but different genera may exhibit gradations in the degree of development of the canals; so that it is impossible to draw any sharp line between those in which they are developed and those in which they are rudimentary. Furthermore, it has already been shown conclusively that in at least one species with canals, *i. e. Cunina proboscidea* Metschnikoff, a secondary generation of medusae without canals is developed, — an observation I have been able to repeat on a second species, *Pegantha smaragdina*, sp. nov. A further criticism is that it is, to say the least, questionable whether either Aegina or Aeginura, included by Vanhöffen in the Diocheteumena, ever possesses a well-developed canal system, Maas (: 05) having found it rudimentary in both. The use of the mode of development as a basis for classification in this order would seem at least premature, since as yet in only three genera (Cunoctantha, Cunina, and Pegantha) do we know positively that it is indirect; and if this feature should be employed, it is incompatible with Vanhöffen's scheme, since one of the species in which it is known to be indirect, *Cunoctantha octonaria* McCrady, which should therefore belong to the Diocheteumena, has been shown by the miscroscopic studies of Wilson ('87) to lack any trace of a canal system, a character placing it in the Adiocheteumena.

A much more important character, since it is more constant and apparently more closely correlated with the natural relationships between species, and one on which Maas (: 04^{a}, : 04^{c}, : 05) has laid special stress, is the presence or absence of gastric pockets.

It is true that there is some evidence (*e. g.* in *Cunina proboscidea*) that these structures, like the canals, may be present in one generation while absent in the other. But this evidence is not altogether conclusive, since it is now well known that in at least one species, *Cunoctantha octonaria*, the pockets are not formed until a stage in growth much more advanced than that to which either Metschnikoff ('86^{a}) or Stchelkanowzew (: 06) have traced the secondary generation of *Cunina proboscidea*. Vanhöffen (: 07) has himself employed this character to separate two families, Aeginidae and Peganthidae, under the suborder Diocheteumena (with peripheral canal system), but he has entirely neglected it in the second suborder, Adiocheteumena, apparently believing that Solmaris may have gastric pockets, whereas all previous students agree that in this genus, as well as in the well-known Mediterranean *Solmoneta flavescens*, the conditions of the gastric cavity exactly parallels that in Pegantha, there being no true gastric pockets at any stage in development. Finally, I may call attention to the fact that the employment by Vanhöffen of a single character, *i. e.* number of tentacles as the sole basis of generic separation in this complex group, has resulted, as might have been expected, in such unnatural combinations as Cunoctantha with Aeginura and Cunina with Aegineta, genera with which they are but distantly related as is shown by the condition of the gastric pockets, and by the otoporpae; and of Solmissus with Solmaris, genera sharply separated by the presence of gastric pockets in the former and their absence in the latter.

On the whole, the scheme proposed by Maas (:04ᵃ, :04ᶜ) much more nearly represents what I believe to be the probable natural relationships among the Narcomedusae. According to Maas Narcomedusae in which gastric pockets are present are to be subdivided into two families, Cunanthidae and Aeginidae, according as the pockets are radial and equal in number to the tentacles, or adradial and twice as numerous as the latter; but as to whether the latter condition is actually derived from the former by the secondary division of pockets primarily radial, it is perhaps best to reserve judgment, since the present collection contains one species with interradial pockets equal in number to the tentacles, a condition hardly to be derived from one with radial pockets. Opposed to these two families are the Solmaridae, in which there are no gastric pockets.

There are, as Maas (:04) points out, strong reasons for believing that the two families with gastric pockets are more nearly related to each other than is either of them to the Solmaridae; and Dr. A. G. Mayer, who holds this same view, has suggested to me the desirability of uniting all Narcomedusae with gastric pockets into a single family, reducing the Cunanthidae and Aeginidae to the rank of subfamilies. I doubt, however, whether to take this step would result in advancing our knowledge of the true phylogenetic relationships of the various members of this complex group; for although the similarity of the Cunanthidae as a whole to the Aeginidae is no doubt close, yet Solmissus, a cunanthid, so closely simulates certain Solmaridae, *e. g.* Solmaris and Solmoneta, in the peculiar form of its sense organs, that it is hard to believe that the resemblance is accidental. In all probability our knowledge of the development of the Narcomedusae will be greatly widened within the next few years, with the result of giving a much firmer basis for revision than is possible from the descriptions of the adult stages as yet published. In the meantime it seems to me that we may well retain Maas's provisional diagnosis of the families composing the order, as follows: —

1. Cunanthidae; gastric pockets undivided, equal in number to the tentacles; with or without peripheral canal system; with or without otoporpae.

2. Aeginidae; gastric pockets adradial (in adult), usually twice (or four times) as numerous as the tentacles (an exception to the rule is seen in *Aegina alternans*); with or without canals; without otoporpae so far as known.

3. Solmaridae; without gastric pockets; with or without canal system and otoporpae.

Besides the light which the collection throws on the classification of the group, it is very important, since it contains examples of two methods of reproduction: — internal budding, and development of a secondary, parasitic generation of medusae. Since the first of these has never been conclusively demonstrated, the discovery that a form of internal budding does occur in this order is of unusual interest, even though only the earlier stages in the process can be traced. The development of a parasitic generation directly from the egg in the body of the parent host has already been described by Metschnikoff ('86^{a}), under the name "sporogony," and by Stchelkanowzew (: 06), for *Cunina proboscidea* Metsch. The process is so rare, and so remarkable on account of the occurrence in the one species of two alternating generations of medusae of different anatomical characters, that a repetition of the observations for another family (Solmaridae) is of great interest. I should add that in addition to the modes of development outlined above there have been described for various Narcomedusae direct development from the egg, budding from stolons parasitic in various medusae (Cunina, Cunoctantha), and the ordinary external formation of medusa buds (Cunoctantha, Browne, : 06).

Cunanthidae Haeckel, 1879.

sens. em. Maas (:04^{a}, :04^{c}).

Narcomedusae with undivided radial gastric pockets, equal in number to the tentacles.

Of the five genera distinguished by Haeckel under this family, Maas has shown that two only, Cunoctantha and Cunina, really belong here. Of the three remaining, Cunarcha and Cunissa belong to the Aeginidae, since they have divided gastric pockets twice as numerous as the tentacles, while the third, Cunantha, seems almost certainly to be based on larval stages of either Cunoctantha or Cunina. According to Maas's classification, which I have adopted, Solmissus, classed by Haeckel ('79) under the Solmaridae because it has neither canal system nor otoporpae, must be referred to the present family because of the conformation of its gastric pockets.

Cunoctantha and Cunina differ from each other only in the number of tentacles, for while it had previously seemed that the presence of canals in Cunina and their absence in Cunoctantha might be a good generic character, the occurrence in the present collection of a typical Cunina without any trace of canal system, and of a typical Cunoctantha with canals well developed, proves that this view is untenable. More important, perhaps, than the difference in the number of metameres in these two genera, though previously less emphasized, is the fact that in one, Cunoctantha, they are determinate in number; in the other, variable in all species so far known. Solmissus differs from both in the absence of otoporpae,—structures which occur in all species of Cunoctantha and Cunina, at least in the primary generation.

Cunoctantha Haeckel, 1879.

Cunanthidae with only eight tentacles; with otoporpae; with or without peripheral canal system.

Maas (: 05) has shown that the several supposed forms which can be grouped under this genus probably form not more than two distinct species. These are *C. octonaria* McCrady ('57), including *C. köllikeri* F. Müller ('61ᵃ) and *C. incisa* Mayer (: 00ᵇ); and *C. discoidalis* Keferstein and Ehlers ('61), synonyms of the latter being *C. parasitica* Metschnikoff ('81), and *C. polygonia* Haeckel ('79). For the latter Maas has used Metschnikoff's name, *C. parasitica*, but from an examination of the figures given by Keferstein and Ehlers ('61, taf. 14, figs. *12–14*), I am convinced that the specimens which they examined were early stages of *C. parasitica*, from which they differ only in having but one otocyst per lappet and very short gastric pockets, both of which characters were observed by Metschnikoff ('81) in the development of the latter species, so that it seems best to retain the older name *C. discoidalis*.

Maas (: 05) has expressed some doubt as to whether *Cunoctantha octonaria* and *C. discoidalis* will finally prove to be distinct. The chief reason for their separation, is the supposition that different methods of development occur in the two forms, *C. parasitica* forming stolons, while the medusae of *C. octonaria* develop directly, but F. Müller ('61ᵃ) observed stolons in the development of *C. köllikeri* (certainly a synonym of *C. octonaria*), and Mayer (: 04) found a free floating stolon of some species of this genus at Tortugas, Florida, where he has also taken *C. octonaria* (*incisa*). Unfortunately Mayer was unable to raise the medusae far enough for specific determination, but the stolon closely resembled the one described by Müller.

Even if this supposed difference in development does not exist, there is another character, of considerable value, which does distinguish the two species and this is the number of otocysts per marginal lappet. It is true that Maas considers this feature of no systematic importance, because in *C. octonaria*, as well as in *C. parasitica* an increase, with development, of from one to three per lappet has been observed (McCrady, '57; Brooks, '86; Müller, '61^a); but this number (three) appears from the studies of Brooks ('86), Mayer (: 00^b), and Maas himself (: 05) to be the normal limit which is reached in *C. octonaria;* for although Maas observed occasional lappets with four octocysts, it is likely, since three have so usually been observed in adult specimens of this species, that a greater number is, as Maas suggests, a sporadic variation. In *C. parasitica*, however, Metschnikoff has observed stages in development up to the formation of five per lappet, and suggests the possibility of a still further increase; while Haeckel had already observed seven per lappet (*C. polygonia*). In neither of these species is there any peripheral canal system (Wilson, '87, p. 99; Maas, : 05^a). Browne (: 06) has described recently another Cunoctantha, *C. fowleri*, from the Bay of Biscay, but his specimen, which showed external budding, had no gonads, so that its final disposition must remain doubtful.

To these species there must now be added *C. tenella*, sp. nov., from the present collection, in which a canal system is well developed. I do not hesitate to place this species in Cunoctantha, since, though only one of the specimens is sexually mature, all (seven) have eight tentacles. In view of the fact that in Cunina species with and species without canals (*C. peregrina*) occur, and that even in one species (*C. proboscidea*) one generation may have, the other lack, canals (Metschnikoff, '86^a; Stchelkanowzew, : 06), there is nothing surprising in finding a parallel series of forms in the closely related genus Cunoctantha.

Cunoctantha octonaria McCrady.

Cunina octonaria McCrady, '57, p. 211, pl. 12, figs. *4, 5*.
Cunoctantha octonaria Haeckel, '79, p. 316; Brooks, '86, p. 361, pls. 43–44; Maas, : 05, p. 67, taf. 12, figs. 77, 78, taf. 13, figs. *83–85*.
Cunoctantha incisa Mayer, : 00^b, p. 66, pl. 44, figs. *145, 146*.
Foveolia octonaria A. Agassiz, '65, p. 51.

Plate 14, Fig. *4;* Plate 15, Figs. *5, 6;* Plate 17, Figs. *2, 4, 5*.

Acapulco Harbor; many specimens, 1.5–4 mm. in diameter.

The largest specimens (Pl. **14**, fig. *4*), none of which are sexually mature, very closely resemble the figure given by McCrady ('57, pl. 12, fig. *4*) of a half-grown specimen of this species, 6 mm. in diameter. The bell is high, either rounded or somewhat pointed; the exumbrellar surface smooth. The margin is deeply incised in the radii of the peroniae, so that the latter are comparatively short. Below the point of insertion of each tentacle there is a nematocyst pad. The adult number of otocysts, three per lappet, has already been attained, but the central one in each lappet is still much larger and shows structurally a later stage of development than the two lateral ones (Pl. **17**, fig. *2*). Each otocyst is connected with an otoporp or "auditory clasp," the ones in the centres of the lappets being the longest. These otoporpae form very pronounced ridges on the gelatinous exumbrella, and are undoubtedly what McCrady ('57[b]) and Maas (: 05) have described as "fleshy tubercles." They have likewise been observed in this species by Brooks ('86) and Mayer (: 00). McCrady ('57[b]) was correct in supposing that they contained "thread cells." The otocysts themselves are of the usual "Cunina" type; those furthest developed contain one or two otoliths, and the low prominences of the urticating ring on which they stand bear bristles (Pl. **17**, fig. *2*). In the small specimens 1.5–2 mm. in diameter (Pl. **15**, fig. *6*) there is, as McCrady ('57), Brooks ('86), and Maas (: 05) have noted, only one otocyst per lappet, but this octocyst is already connected with an otoporp.

The gastric system resembles the figures given by McCrady ('56, '57), and Brooks ('86) for corresponding stages. In the smallest specimen no gastric pockets have yet been formed, although the future appearance of these is already suggested by a slight lobing of the margin of the stomach in the radii of the tentacles (Pl. **15**, fig. *6*). In a specimen 4 mm. in diameter the pockets are already developed, but are still shallow, and separated by wide septal regions. This is practically the condition found by McCrady ('57, pl. 12, fig. *4*). We know, however, from the studies of Brooks ('86), who was able to follow the development of this species further, that this condition is not the final one, but that in adults the pockets are nearly rectangular, rather longer than broad, and separated only by very narrow, almost linear, septal areas, an observation confirmed by Maas (: 05) for large specimens in the "Siboga" collection.

None of the specimens as yet show any trace of gonads.

Color. — The margin of the gastric cavity is brown (Pl. **14**, fig. *4*); this region is described by McCrady as being yellow; evidently, then, the pigmentation is variable. Otherwise, the medusa is colorless.

This species is widely distributed, having been recorded from the eastern coast of North America (McCrady, '57^b, Brooks, '86), the Gulf of Mexico (Mayer, : 00^b), the Malay Archipelago (Maas, : 05), the Fiji Islands (Agassiz and Mayer, '99), and from the west coast of Mexico by the present expedition.

Cunoctantha tenella, sp. nov.

Plate 15, Fig. *4* Type; Plate 16, Fig. *2*; Plate 17, Figs. *6, 7*.

Acapulco Harbor, surface. Many specimens, 2–7 mm. in diameter.

The bell in a specimen 5 mm. in diameter is 3.5 mm. high, its surface smooth. The marginal zone and lappets are very narrow and but slightly incised in the radii of the tentacles. The peroniae are correspondingly short, and consist chiefly of kidney-shaped nematocyst pads underlying the bases of the tentacles, such as occur in *C. octonaria* and *Cunina peregrina*. These structures have been described and figured in detail for *C. octonaria* by Wilson ('87). There are eight tentacles in every specimen whether small or large, good evidence that this is the typical number, and that the species belongs to the genus Cunoctantha, not to Cunina. In the larger specimens there are three otocysts per lappet; in the smallest, however, 2 mm. in diameter, there is only one in each lappet (Pl. **16**, fig. *2*). No lappet in any specimen bore more than three, but inasmuch as it is doubtful whether any of them had reached their extreme size it is possible that more might be developed. The sense organs themselves (Pl. **17**, fig. *7*) closely resemble those of *C. octonaria*, containing, like the latter, one or two otocysts, and being situated on low prominences of the nerve ring. Each otocyst is connected with a short otoporp, although in the present species these do not form such prominent ridges as they do in *C. octonaria*.

C. tenella is interesting chiefly for the fact that while in the number of its tentacles, gastric pockets, and marginal lappets it is a typical Cunoctantha, it yet exhibits a well-developed peripheral canal system, a feature entirely lacking in the two species of this genus previously known. The peronial canals are very short, corresponding to the short peroniae; but they and the festoon canal are both rather broad (Pl. **17**, fig. *7*). The central stomach also shows an interesting feature in that the gastric pockets, instead of being nearly rectangular, as in most other members of the Cunanthidae, are almost triangular, as is shown in the general sketch of the Medusa (Pl. **15**, fig. *4*). This form of the pockets is to be seen even in the smallest specimen, only about 2 mm. in diameter (Pl. **16**, fig. *2*). Although there is no proboscis, the mouth being surrounded by a simple circular lip, the stomach cavity is deeper than is usual in this family, owing to the arched form of its aboral wall (Pl. **15**, fig. *4*).

The only specimen showing any trace of gonads was the largest (7 mm. in diameter). In this individual, apparently a male, the sexual products form thickenings of the ventral surfaces of the gastric pockets.

The medusa is entirely colorless.

Cunina Eschscholtz, 1829.

sens. em. Maas (: 04^a : 04^c).

Cunanthidae with otoporpae and with nine or more tentacles and marginal lappets.

In attempting an identification of the two species of Cunina in the present collection I have been forced to attempt a rough revision of the genus; a difficult task on account of the unsatisfactory nature of most of the early (and even some of the later) descriptions and figures, as well as because our knowledge of the young stages is still too scanty to be of much assistance in the systematic study of the genus. To make a final revision is entirely out of the question, unless one has access to much more extensive collections than I have studied; but so puzzling is this genus that I have thought it well to add certain conclusions which I have myself reached, in the hope that they may help to clear the ground for future students.

In Haeckel's ('79) "system" ten species are listed with numerous synonyms. It is evident, however, that the distinctions between them are by no means satisfactory, and that his treatment of the older species is in some cases misleading. To begin with, it seems to me essential to eliminate entirely as *nomina nuda* such names as are based on unrecognizable figures or descriptions; on descriptions equally applicable to any member of the genus; or on specimens so poorly preserved as to be specifically unrecognizable. From this standpoint I have concluded to abandon the following, since there seems no possibility of ever certainly identifying them: — *C. vitrea* Gegenbaur, because the only figure and description are insufficient, *C. mucillaginosa* de Blainville, for the same reason, the description being equally applicable to any member of the genus; *C. oligotis* Haeckel and *C. striata* Metschnikoff, because they are evidently founded on larval specimens, whose connection with adult species it is impossible to determine; and probably *C. multifida* Haeckel, because founded for a very fragmentary alcoholic specimen, which may not belong to the present genus at all. The remaining species enumerated by Haeckel ('79) are *C. globosa* Eschscholtz, *C. campanulata* Eschscholtz, *C. lativentris* Gegenbaur, *C. prolifera* Gegenbaur, *C. rubiginosa* Kölliker, and *C. rhododactyla* Haeckel. Eschscholtz's figures and description of *C. globosa* are, as usual, recognizable, and agree with one of the species in the present collection. Haeckel has classed *C. globosa* Gegenbaur as a synonym of this species. Stchelkanowzew (:06) has doubted the correctness of this conclusion, chiefly it seems on grounds of geographic distribution; but there seems to be nothing in Gegenbaur's figure to show that his specimens differ from Eschscholtz's species, and as differences in distribution certainly are not fit grounds for specific distinctions, I shall include it as a synonym of the latter, unless, indeed, it might be better to regard Gegenbaur's name as a *nomen nudum*, on account of the rather insufficient nature of his description. *C. globosa* is certainly very closely allied to *C. lativentris* Gegenbaur, the main differences being merely in the form of the bell and of the otoporpae. *C. lativentris* Gegenbaur is the best known and most often recorded member of the genus. It is taken regularly in the Mediterranean, and has recently been recorded by Maas (:04^c) from the Atlantic. Strange to say, however, no altogether satisfactory figures of it have ever appeared. As to the status of *C. campanulata* Eschscholtz, not recorded, so far as I can learn, since first described, it seems impossible to reach any conclusion of value without a study of fresh material. There is good reason for believing that *C. rubiginosa* Kölliker and *C. rhododactyla* Haeckel are identical, since Metschnikoff ('86^b) has found all intermediate stages between the two, and concludes that Haeckel's specimens of *C. rhododactyla* were merely small *C. rubiginosa*. This view is likewise held, though with reservation, by Maas (:04^c), but the latter author prefers to retain the name *C. rhododactyla* instead of the older name *C. rubiginosa*, because of the excellence of Haeckel's figures of the former. This species, which appears well characterized, has been recorded frequently from the Mediterranean and recently (Maas :04^c), from the Atlantic. *C. prolifera* Gegenbaur is a doubtful species. In many respects, *e. g.* number of radial parts and number of otocysts per lappet, it resembles *C. rubiginosa* and may perhaps be a synonym of that form.

It is very important to know the true status of *C. proboscidea* Metschnikoff, since it has been the basis of the very valuable embryological studies of Metschnikoff ('86^a), and more recently of those of Stchelkanowzew (: 06), which have resulted in the demonstration that an alternation of generations of medusae occurs among the Narcomedusae. Haeckel ('80, p. 652) has rather cavalierly referred it to *C. vitrea,* and Uljanin ('76) to *C. lativentris.* Metschnikoff, however, in a more recent publication ('86^b), argues that this is not the case, and Stchelkanowzew (: 06), who has been able to study a large series of *C. proboscidea,* has given evidence that it is a valid species. He bases this conclusion chiefly on two characters,—the short, club-shaped otoporpae, very different in outline from the long, narrrowly-oval otoporpae of *C. lativentris,* and on the presence, in sexually mature individuals as well as in small specimens, of a marked proboscis supported by a pronounced prominence of the gelatinous disc which he likens to the "Stiel" of the Geryonidae. Since Stchelkanowzew has had a very favorable opportunity to study this form, we will do well to accept his conclusion that *C. proboscidea* is distinct.

Finally, we have the case of *C. duplicata* Maas. This species has recently been referred by Maas (: 04^c, p. 34) to the family Aeginidae. But his original figures ('93, taf. 5, figs. *9, 10*) show clearly that the gastric pockets are undivided, and equal in number to the tentacles, as is characteristic of the Cunanthidae, while the large number of radial parts (sixteen) and the presence of otoporpae show that it is a typical Cunina. Maas ('93, p. 52) believes that it has a determinate number (sixteen) of radial parts, and if this should prove to be the case, it would require, as he suggests, the establishment of a new genus; but, since he was able to examine only a single specimen, it is not safe to assume the validity of this supposed character.

All the foregoing species agree in the possession of a well-developed peripheral canal system, at least in the primary generation. A form in the present collection, however, entirely lacks these structures and must therefore be regarded as a new species.

Cunina globosa Eschscholtz.

Cunina globosa Eschscholtz, '29, p. 117, taf. 9, fig. *3*; Haeckel, '79, p. 319.
? **Aegineta globosa** Gegenbaur, '56, p. 263, taf. 10, fig. *8*.

Plate 15, Fig. *3;* Plate 17, Figs. *3, 8*.

Station 4546 Hyd.; surface; 4 specimens, all about 15 mm. in diameter. These specimens agree with Eschscholtz's account in general form, in the breadth of the gastric pouches, and in the number (three) of otocysts on each lappet, a character which appears to be constant, at least for the present specimens. The bell is rather high, and somewhat conical; the gelatinous substance thick. In life the bell is seldom circular, but usually more or less triangular, the result of the weakness of the mesogloea and the vigorous contractions of the subumbrellar muscles, a condition common in *C. lativentris* (Maas, :04^c, p. 31). The exumbrellar surface is smooth, without ridges or other sculpture. In one specimen there are fourteen, in each of the others thirteen tentacles about as long as one third the diameter of the bell, and frequently recurved into the cavity of the latter. In consequence of the shortness of the marginal lappets the tentacles arise but a short distance from the margin. There are no nematocyst pads at the bases of the tentacles such as occur in *C. peregrina*, the other member of the genus taken during the expedition. It is probable that the presence or absence of these pads will prove, when more fully known, to be an important specific character. Another constant difference between the two species is in the structure of the tentacles. In *C. globosa* the endoderm cells forming the core of the tentacle preserve the chordate form out to the tip of the tentacle, and near the tip, which is slightly swollen, the ectoderm is crowded with nematocysts (Pl. **17**, fig. *3*). In *C. peregrina*, on the other hand, the endoderm cells become nearly cubical near the tip, and there is no such nematocyst swelling. This difference does not seem to be due to different degrees of contraction, since it was to be seen in all the tentacles of the two species which I examined. It may perhaps be correlated with the difference in the flexibility of the tentacles in the two species, these organs being much more mobile in *C. globosa* than in *C. peregrina*. The marginal lappets are very short, and but slightly rounded in outline. The peroniae are correspondingly short and covered over by the union of the gelatinous substance of the two adjacent lappets.

The number of otocysts, three per lappet, is unusually small for the genus. This number is constant in all the lappets of these four specimens, and since all are sexually mature, there is no reason to suppose that the number of these organs would increase further. The otocysts themselves (Pl. **17**, fig. *8*) are of the usual Cunina type, so well known through the studies of the Hertwigs ('78) in *C. lativentris*. Each contains two or three large otoliths. It is probable that in life the otoliths were more prismatic than I have represented them (Pl. **17**, fig. *8*), since they were not examined until after preservation. The otocysts are situated on prominent ectodermic swellings, which in life bear a number of bristles; but after preservation most of these have disappeared. The otoporpae (Pl. **17**, fig. *8*) are of the usual type, but so short that they hardly reach across the ring canal, and very broad, — a form which is constant, and very different from those of *C. peregrina*. The gastro-vascular system is of the usual Cunina type, the peripheral canal system being well developed (Pl. **15**, fig. *3*). The stomach is flat, but the simple lip is capable of being considerably protruded. The gastric pouches, thirteen or fourteen in number, are about as broad as long, nearly square in outline, and separated from one another by very narrow septal regions.

The gonads form thickenings covering the distal half or three fourths of the gastric pockets. All the four specimens appear to be males.

The specimens are colorless and hyaline, except for the gastro-vascular system, which is opaque and of a faint bluish tint.

Cunina peregrina, sp. nov.

Plate 1, Fig. *6;* Plate 15, Figs. *1*, *2;* Plate 28, Figs. *1-7;* Plate 45, Fig. *8*.

Station.	Depth.	No. specimens.	Diam., mm.	Tentacles.	Otocysts per lappet.	Gonads.	Preservation.
4588	Surface	1	2	8	3–4	None	Good.
4590	300 fms. to surface	1	3	9	?	None	Good.
4646	Surface	1	14	12	?	Small, sex ?	Fair.
4661	Surface	1	10	10	4–5	None	Fair.
4663	Surface	4 at this station	9	10	4–5	None	Fair.
4663	Surface		5	10	4–6	None	Good.
4663	Surface		13	10	5–6	♂	Good.
4663	Surface		13	11	4–5	Small ♂	Good.
4669	Surface	3 at this station	10	11	6–8	♂	Good.
4669	Surface		3	8	3–4	None	Fragmentary.
4669	Surface		9	10	4 in one lappet	None ?	Fragmentary.
4671	Surface	19 at this station	10	10	4–6	♂	Fair.
4671	Surface		9	10	5 in one	None	Fragmentary.
4671	Surface		12	12	5–7	♀	Good Type.
4671	Surface		8	10	5 in one	None	Fragmentary.
4671	Surface		13	9	?	?	Fragmentary.
4671	Surface		3	8	4 in one	None	Fair.
4671	Surface		5	9	?	None	Fragmentary.
4714	Surface	1	12	10	5 in one	. . .	Fragmentary.
4716	Surface	1	10	12	?	. . .	Fragmentary.
4725	Surface	1	11	10	6 in one	None	Fair.

As appears from the above table, this species was comparatively common throughout the entire expedition.

The largest specimen measures 14 mm. in diameter and has twelve tentacles. This appears to be the maximum number of tentacles, the majority of specimens having from nine to eleven. The smallest specimens, 2 mm. and 3 mm. in diameter, have only eight and nine respectively, and a specimen 5 mm. in diameter has nine; all the larger specimens have at least that number, while a large specimen, 13 mm. in diameter, has only nine. It appears, then, that in this species the adult number of tentacles is early attained.

The bell is rather high (Pl. **1**, fig. *6;* Pl. **15**, fig. *1*) and varies much in outline according to the state of contraction of the specimen. The gelatinous disc is thick and highly arched. The marginal lappets are short and broad (Pl. **1**, fig. *6*), the radial incisions separating them shallow, and the peroniae short and covered over by the gelatinous substance of the adjacent lappets. The surface of the bell is smooth, except for the ridges near the margin which mark the course of the otoporpae. The tentacles are about as long as the bell radius, and in life carried stiflly extended (Pl. **15**, fig. *1*). Underlying the base of each tentacle, at its point of origin from the bell, is an oval or kidney-shaped pad (Pl. **28**, fig. *4*, np.), consisting of crowded ectoderm cells, among which are many nematocysts. These pads appear to afford a good specific character, since they are constant in occurrence.

The number of otocysts is variable, but in large specimens the number in each marginal lappet is always much greater than three, the number characteristic of *C. globosa.* The greatest number observed in any one lappet was eight, the smallest, in a large specimen, four. The most usual number is five or six. In the smallest specimen, 2 mm. in diameter, there were three in some lappets, four in others. The otoporpae vary considerably in length, but never extend over much more than half of the marginal lappets. They are narrower than in *C. globosa*, and of nearly uniform breadth throughout their length (Pl. **45**, fig. *8*). The sense organs themselves are rather small, broadly oval in outline, and contain each a single large otolith (Pl. **45**, fig. *8*). None of these organs were examined before preservation, and it is probable that the rounded form of the otoliths is due to the corrosive action of the formalin. In life many of the spindle-shaped cells of the "auditory pads" bear bristles (Pl. **45**, fig. *8*), but most of these are destroyed by preservation.

The central portion of the gastro-vascular system is of the usual Cunina type, the stomach flat, the mouth surrounded by a simple circular lip, often broadly open. The gastric pockets are about as broad as long, and nearly square in outline, as is to be seen in the photograph reproduced in Pl. **1**, fig. *6*.

The most interesting feature of this species, and the one which serves to distinguish it from all *large* species of Cunina previously described, is that it entirely lacks any trace of a peripheral canal system. From a surface view it might well seem that a festoon canal was present (Pl. **1**, fig. *6*); but the structure which causes this appearance is in reality not a canal, but the very prominent marginal urticating ring. This I was able to demonstrate on series of sections of the marginal lappets.

Only two specimens, one a male, the other a female, were approaching sexual maturity. In the male, in which the spermatozoa are nearly ripe, the sexual products form ridge-like thickenings of the subumbral gastric wall along the margins of the gastric pockets, there being no trace of their development in other portions of the floor of the stomach (Pl. **28**, fig. *4*). On the different pockets these ridges are variously subdivided. In cross section the sharp separation between the ridge, consisting of various generations of male sex cells, and the remainder of the gastric wall is very striking. The female above mentioned is less mature. In this specimen the developing eggs, instead of occupying such a restricted region, form a uniform thickening over the whole surface of the gastric pockets. Thus in the males and females of this species the gonads differ in form and location.

Another interesting anatomical feature of this Medusa is the extremely powerful musculature of the subumbrellar surface of the lappet region. Probably associated with this muscular development is the fact that this is a very active Medusa, swimming with strong pulsations of the bell and much more rapidly than any other Narcomedusa which I have observed alive.

All the specimens were entirely colorless.

A very young specimen of this species, measuring only 2 mm. in diameter, was taken on the surface at Station 4588. The bell is flat and disc-like, the gelatinous substance very thin, and the marginal zone hardly if at all recurved. In general appearance and in the number of tentacles (8), it closely resembles early stages in the development of *Cunoctantha octonaria* as figured by Brooks ('86, pl. **44**, fig. *3*). The marginal lobes are much shorter than in the adult, and the incisions between them extend almost to the bases of the tentacles, so that the peroniae can as yet hardly be distinguished. Nematocyst pads are already developed below the bases of the tentacles. Unfortunately the stomach is so much damaged that the form of the mouth cannot be determined. There are three otocysts in some, four in other lappets, all of them already connected with otoporpae.

This is undoubtedly a surface species. The list of captures shows that it is of very general distribution throughout the Eastern Tropical Pacific.

Cunina peregrina is, as already noted (p. 9), one of the two species in the collection which exhibit stages in a process of internal budding. This process, which was observed in six individuals, none of which had gonads, takes place *within* the gastric cavity, and is restricted to the oral surface of the gastric lobes. In an individual in which budding is in progress various ridges and thickenings are to be seen in surface views. These swellings vary greatly in form, being either ridges, or more papilliform processes, or even globular eminences (Pl. **28**, fig. *2*). Many of them, moreover, bear secondary prominences, the true buds (Pl. **28**, fig. *6*, b^2). In sections (Pl. **28**, fig. *7*) the swellings or stolons, as they may aptly be termed, are seen to be wholly of endodermic nature, the ectoderm, at least as a distinct layer, taking no part in their formation. It is possible, however, though not demonstrated, that amoeboid ectoderm cells may pass through the mesogloea and wander into them. I have found no evidence that these large swellings ever become detached; on the contrary, they are apparently nothing more than the proliferating regions which give off the true buds. Three successive stages in the formation of buds are represented, from sections, in Pl. **28**, figs. *5—7*. The bud, a solid morula-like mass of about twenty-four cells, is constricted off from the stolon, and set free in the gastric cavity, where a considerable number were observed. I can say nothing as to their later history, except that since no stages more advanced in development were discovered, probably they are passed out through the mouth of the parent, to pass through their larval stages either free or as parasites on some other organism.

Cunina species?

Plate 27, Fig. *8*; Plate 45, Figs. *3–7*.

A Cunina stolon found attached to the subumbrellar surface of a *Rhopalonema velatum* from Station 4640, and several young medusae evidently recently detached from it, may belong to *Cunina peregrina*. The stolon itself (Pl. **45**, fig. *3*), about 1.5 mm. in length, bears buds in all stages of development. Since these closely resemble the stolon-buds described by many other authors, they need not be described here further than to note that a long proboscis is developed very early, whereas the tentacles remain short and rudimentary until after the young medusae have been liberated (Pl. **45**, fig. *4*). This feature is probably of specific significance. The smallest liberated medusa, represented in Pl. **45**, fig. *4*, has six rudimentary tentacles. The marginal lappets are already of considerable size, and each bears, on its margin, two prominences, the young otocysts. The proboscis is very long. Three views of a larger medusa, about .5 mm. in diameter, are shown in Pl. **45**, figs. *5*, *6* (from a photograph), and *7*. The bell is now proportionately much broader, though the gelatinous layer is still very thin. The number of tentacles is now eight. There are two otocysts per lappet, each connected with an otoporp (Pl. **45**, fig. *7*). Peroniae are as yet hardly visible. The velum is well developed; and the proboscis still long. There is no trace of any peripheral canal system, nor are any gastric pockets as yet developed.

The identity of this stolon with *C. peregrina* seems not unlikely, because in the only other related species, *Cunoctantha incisa*, taken during the expedition which lacks a canal system a single median otocyst appears first in each lappet, the lateral otocysts being developed later (p. 53).

A second Cunina stolon (Pl. **27**, fig. *8*) was taken from the stomach of a *Solmundella bitentaculata*. Unfortunately this stolon, which certainly belongs to a different species from the one just described, was not far enough advanced for even provisional identification. The buds in this case are nearly globular in outline and have no distinct proboscis. The tentacles, on the other hand, appear soon after the earliest formation of the bud, and are very long in the larger buds. In development a single tentacle first appears, and this may reach a considerable length before the rudiment of a second appears. In larger buds there are four, five, or six tentacles, six being the largest number observed. In one bud the bell margin is already marked as a ridge connecting the tentacles but there are as yet no traces of otocysts.

Solmissus Haeckel, 1879.

sens. em. Maas (:04^a).

Cunanthidae without peripheral canal system or otoporpae.

This genus was instituted by Haeckel ('79) to include *Cunina albescens* described by Gegenbaur ('56), and the two new species, *S. faberi* and *S. bleekii*, which he himself described ('79, pp. 350, 351). So far as I can learn, only two additional species have been recorded since. Fewkes ('86) has described, from the Gulf Stream, *Solmaris incisa,* which certainly is not a Solmaris but belongs to the present genus; and Agassiz and Mayer (: 02) have described, *S. marshalli,* from the Pacific. The members of the genus are so closely allied anatomically that we are forced to turn to such features as form of the bell, number of tentacles, and number of otocysts, for specific characters. Of these characters, probably the first, and certainly the second and third, are subject to much individual variation. To add to the confusion, Haeckel's account of *S. faberi* and *S. bleekii,* are altogether insufficient, while *S. incisa* was described by Fewkes from fragmentary specimens. Fortunately, the present collection contains series of two species, *S. marshalli* and a second probably identical with *S. incisa,* extensive enough to allow me to work out the variability of the several characters and their probable specific value more fully than has previously been done.

Solmissus marshalli Agassiz and Mayer.

Solmissus marshalli Agassiz and Mayer, : 02, p. **151**, pl. **5**, figs. *23–25.*
Solmaris punctatus Mayer, : 06, p. 1133.

Plate 16, Figs. *5, 6;* Plate 21, Figs. *4, 6–8.*

Ten specimens of this species were taken at the following stations:—

Station.	Depth, fathoms.	Diameter, mm.	Tentacles and gastric pockets.	Otocysts per lappet.	Gonads.	Preservation.
4646	300 to surface	34	13	?	?	Very fragment'y.
4663	300 to surface	14	9, and 3 more tentacles in process of formation	3 in one	None	Fragmentary.
4671	Surface	48	16	9–13	♀	Good.
4675	Surface	35	16	7, 9	♂	Good.
4675	Surface	46	16	10, 9, 5	♂	Good.
4704	Surface	15	11	3, 3, 4	None	Fragmentary.
4711	Surface	13	12	2, 3, 3, 1	None	Fair.
4717	300 to surface	32	16	9 in one	♂	Fair.
4722	300 to surface	62	16	15, 14, 13, 12 14, 12, 12, 12 14, 12, 11, 8, 10	♂	Good.
4724	300 to surface	28	8	?	None	Fair.
4730	300 to surface	30	14	7, 6, 7	?	Fragmentary.

The gelatinous disc is thick and rigid; the marginal lappet zone, on the other hand, very thin. The bell is flat, hardly if at all arched, and about half as high as broad; its exumbrellar surface is smooth. In life the "collar" region is always so much recurved that, when seen from above, the zone at which the tentacles arise seems to form the extreme margin. Seen from below (Pl. **16**, fig. *5*) the lappet region and velum entirely conceal the gastric pockets. The lappets are about as broad as long, square, with the margin hardly if at all incised in the radii of the peroniae. The number of tentacles is variable, the maximum number observed being sixteen. The specimen described by Agassiz and Mayer had fourteen, a number found in one of the present specimens also. The smallest number observed was eight; this, strangely enough, was in a moderate-sized individual, 28 mm. in diameter, (Pl. **16**, fig. *6*), and it appears to be the adult number in this specimen, since there is no trace of any further development of tentacles. Rudimentary tentacles are, however, present in small specimens. It is interesting to note that in the development of new tentacles the new peroniae appear first, and then the tentacles; in one specimen such a peronia is visible while the tentacle has not commenced to grow. In no case was a developing tentacle observed in a large specimen. It appears, then, that the full number of tentacles, though not very early developed, is attained long before the medusa attains its full size and sexual maturity. The tentacles are carried radiating stiffly outward from the bell in life.

The number of otocysts per lappet is variable, and appears to increase constantly with the growth of the medusa. The largest number observed in any one lappet was fifteen, in the case of the largest specimen, but it is doubtful whether this is the maximum. This is about twice as many as are known to occur in *S. albescens*, the greatest number recorded for one lappet of that species, so far as I can learn, being seven. In small specimens the number of otocysts per lappet is much smaller. Thus, in the smallest specimen, 13 mm. in diameter, there are two, three, three, and in one very narrow lappet, evidently recently formed by the development of a new peronia and tentacle, only one. In medium sized individuals there are usually from seven to ten per lappet. Agassiz and Mayer (:02) were able to find only one otocyst, on account of the poor condition of their specimen.

The sense organs themselves so closely resemble the condition described and figured by the Hertwigs ('78) for *S. albescens* that no detailed account is necessary here. The sensory pad supporting the sense organ is large and some at least of the spindle-shaped ectoderm cells bear bristles (Pl. **21**, figs. *4*, *8*). The otocyst is small in comparison with the pad, and contains a single otolith, which is not crystalline but rounded, even in fresh specimens. There are no otoporpae.

The gastro-vascular system is typical of the genus, the stomach being flat, the mouth surrounded by a simple circular lip, and usually widely opened. The gastric pockets, which vary in breadth, are nearly square in outline. The aboral gastric wall is evidently very delicate, for in all the specimens it is more or less torn over the central regions of the pockets (Pl. **16**, fig. *5*). When the wall is entirely torn away over the pockets, as is often the case in battered specimens, it is seen that the convexity of the pockets is caused by swellings or prominences of the aboral side of the gelatinous disc, comparable to the genital prominences which occur in the same region in the Solmaridae (p. 86). There is no trace of either peronial or ring canals. Neither is there any definite cell-strand which might be supposed to represent a circular canal. Such a cell-strand has been described and figured by the Hertwigs ('78) for *S. albescens*, but the only approach to such a structure which I have been able to find in the present species is a slight crowding of the endoderm cells (Pl. **21**, fig. *8*).

The sexual products are located on the gastric pockets chiefly near their margins, never, so far as I have observed, occurring on other regions of the gastric wall. In a mature female the gonads consist of a number of oval swellings, lying as a rule in radial folds, each swelling inclosing a single very large egg (Pl. **21**, fig. *7*). Considering the very great size of the eggs (1 mm. in length), and the thinness of the ectodermal layer which encloses them, it seems probable that they are set free by the breaking down of the latter, which would account for the fact that the gastric wall is so often torn in the neighborhood where the gonads develop. In the male the sexual products are developed more evenly over the surface of the pockets. Agassiz and Mayer (:02) described the gonads in this species as horseshoe-shaped and lying in the interradii, *i. e.* between the tentacles; but from their figures (:02, pl. 5, figs. *23*, *24*), it is evident that in their single specimen the entire aboral gastric wall was torn away over the region of the pockets, and that the structures they have described as gonads were, in reality, nothing more than those portions of the wall which remain adhering in the regions of the interradial septa which separate the pockets. This condition was seen in several fragmentary specimens in the present collection.

This species is entirely colorless.

Solmissus marshalli is a surface form.

The present captures, together with the ones recorded by Agassiz and Mayer (:02) from the Marshall Islands, and by Mayer (:06, p. 1134) from

Hawaii under the name *Solmaris punctatus*, show that the species is generally distributed throughout the Tropical Pacific.

Whether *S. marshalli* is truly distinct from *S. albescens*, which it resembles in every respect except for the considerably greater number of otocysts, or is a geographic race of the latter, is not clear. To decide this question requires more extensive knowledge than we now possess concerning the constancy of the number of the otocysts, and whether or not they increase indefinitely in number with growth, as some conditions in the present specimens suggest. Although the Mediterranean species *S. albescens* has so long been known, neither Gegenbaur ('56), the Hertwigs ('78), nor Haeckel ('79) have given us any definite information on this point. Before any final decision can be reached it will be necessary to correlate the number of otocysts with the diameter of the bell in a considerable series of specimens of *S. albescens.* I have examined the two fragmentary specimens from the Hawaiian Islands recorded by Mayer under the name *Solmaris punctatus.* They show clearly the outlines of gastric pockets, and therefore belong not to Solmaris, but to Solmissus, and there is nothing about them to justify separating them from *S. marshalli.*

Solmissus incisa Fewkes.

Solmaris incisa Fewkes, '86, p. 954, pl. 9.
Solmissus faberi Haeckel, '79, p. 350.
Solmissus bleekii Haeckel, '79, p. 351.

Plate 21, Figs. *1–3, 5.*

Station.	Depth, fathoms.	Diameter, mm.	Number of tentacles.	Otocysts per lappet.	Remarks.
4652	400 to surface	68	31	. . .	Broken, but the fragments together make up entire disc.
4655	300 to surface	75	29	. . .	Fragmentary, but all the tentacles are intact.
4657	300 to surface	about 50	24 or 25	. . .	One or two of the tentacles are lacking.
4657	300 to surface	65	2 in ¾ of the bell	. . .	Only about three-quarters of the disc is intact.
4665	300 to surface	80	32	. . .	In three pieces, which together make up entire disc.
4668	300 to surface	80	?	. . .	Very fragmentary.
4673	300 to surface	70	27	. . .	Fragmentary.
4702	300 to surface	about 100	32	?	This is the best large specimen.
4702	300 to surface	40	20–21	. . .	Very fragmentary.
4718	Surface	17	21	2, 3, 2	In fair condition, but stomach much torn.
4743	Surface	10	16, and 3 more developing	2 in one	Fair.

In addition to *Solmissus marshalli* the collection contains the eleven specimens tabulated above, which I believe to be identical with the *S. incisa* of Fewkes. The disc is flat; the gelatinous substance much softer than in *S. marshalli,* and not nearly so thick in proportion to its breadth. As appears from the above table, the number of tentacles is very much greater, the largest number observed being thirty-two, the smallest eighteen. The complete number of tentacles is early attained. Thus, in the specimen only 10 mm. in diameter there are already sixteen tentacles well developed, and three more in early stages of development (Pl. **21**, figs. *2*, *3*). In a slightly larger specimen, 17 mm. in diameter, there are twenty-one large tentacles, and two more in early stages of development. Unfortunately the margins of all the large specimens were too much damaged for me to be able to count the otocysts. In the specimen 17 mm. in diameter there are two each in two lappets, and in the smallest, 10 mm. in diameter, two in one lappet. In the larger individuals, also, the number in each lappet seems to be small, apparently not more than four or five. The otocysts themselves closely resemble those of *S. marshalli,* the supporting pads being large and somewhat triangular, and each sense organ containing a single large rounded otolith (Pl. **21**, fig. *5*).

The gastric cavity in all the specimens was much battered; enough, however, remained in several to show that they certainly belong to Solmissus, not to Solmaris. The gastric pockets were mostly torn away, but their outlines could be traced, owing to the fact that in this species, as in *S. marshalli,* the gastric wall, even in very fragmentary specimens, persists in the regions of the septa between the pockets. The gelatinous prominences causing the convexity of the pockets are particularly evident in such individuals. No trace of any canal system was visible.

In none of the specimens could the gonads be seen, on account of their fragmentary condition.

This species must be an exceedingly fragile one, since most of the specimens seem to have undergone their injuries in the net, even when taken on the surface. In several cases the marginal zone is split along the lines of the peroniae, exactly as in many of the specimens from the Gulf Stream, which Fewkes ('86, '89ᵃ) has described.

It is probable that the present specimens are identical with *S. incisa* Fewkes. He, it is true, placed this species in Solmaris on the assumption that it had no gastric pockets, and Maas ('93) has accepted this identification; but in all Fewkes's specimens the gastric wall was entirely torn away, so that since he was ignorant of the true interpretation of the subumbral prominences which he describes on the gelatinous disc, he had no direct evidence on this point. It seems to me, however, that the occurrence of elevations in the radii of the tentacles shows conclusively that gastric pockets did exist, inasmuch as these elevations are exactly the same structures which occur in the regions of the gastric pockets and cause their convexities in *S. marshalli.* The radial furrows which Fewkes observed alternating with the prominences occur in the present specimens also, and occupy the septal regions between the pockets; while the "white structure" ('89^a, p. 529) which he found lining certain of these furrows, is nothing more than a portion of the gastric wall persisting in these regions, as I have often found it; although destroyed elsewhere. It is the same structure which Agassiz and Mayer (: 02) mistook for gonads in *S. marshalli.* In short, Fewkes's specimens showed exactly the appearance of those in the present collection in which the subumbral gastric wall is entirely torn away. In such characters as may be considered of specific importance the agreement between the Pacific and Gulf Stream specimens is close. Thus, in both the number of tentacles is large, and the maximum in each appears to be thirty-two; in both a very large diameter, 100 mm. or more, is attained; in both the gelatinous disc is thin, soft, and very fragile; and both show the same tendency to split along or between the peroniae, so as to divide the marginal zone into separate lappets. Since Fewkes was unable to distinguish the octocysts in any of his specimens, it is very desirable that fresh specimens from the Gulf Stream be examined, the number of octocysts being probably of specific importance in this genus.

The status of Haeckel's ('79) two species is doubtful, since his descriptions are so brief and lacking in detail that the only characters on which we can rely are size and the number of tentacles. He has mentioned the number of otocysts per lappet, but since each species was described from a single alcoholic specimen, I do not believe his counts of the otocysts (he found three per lappet in *S. faberi* and one per lappet in *S. bleekii*) can be relied on further than to show that in both, as in the present specimens, the number of these organs is rather small. *S. faberi* is 20 mm. in diameter with twenty-four tentacles; *S. bleekii* 40 mm. in diameter with thirty-two tentacles. The differences between the two are, then, no greater than occur between different specimens of the present species, or of *S. marshallii*, and can be explained as the result of the individual variation which, as I have shown, occurs in the number of tentacles, or of different stages in growth. Since furthermore, the two were recorded from the same general region of the South Atlantic, it is altogether probable that they are in reality identical and show no important characters distinctive from the present series; but until the question of the identity of *S. faberi* with *S. incisa* can receive a final answer based on a fresh study of South Atlantic specimens, I have thought it best to use the latter name for the present species. In the meantime it may not be amiss to point out that *Solmissus incisa* will probably be found, like *Rhopalonema velatum, Aglaura hemistoma, Nausithoë punctata, Periphylla hyacinthina*, and so many other oceanic Medusae, to be of practically universal distribution in the warmer portions of all oceans.

To make any final statement of the bathymetric range of this species would be premature. The only specimens taken at the surface are the two very small ones; all the large specimens, nine in number, from eight different stations, come from between three hundred (four hundred in one case) fathoms and the surface. It is probable, then, that this will prove, at least when adult, to be an intermediate, not a surface form.

Aeginidae Gegenbaur, 1856.

sens. em. Maas (: 04^a, : 04^c).

Narcomedusae with a precise number of antimeres and with gastric pockets adradial, usually twice as numerous as the tentacles.

Peripheral canals may (Aegina) or may not (Solmundella) be present; so far as known, no member of the family has otoporpae.

It is in this family that the recent classification of Maas shows the greatest divergence from the earlier system of Haeckel ('79), and the greatest improvement over it. Unlike the Cunanthidae, the genera of Aeginidae have precise, determinate numbers of tentacles; and in this family this character is a very constant and reliable one. It is used by Maas (: 04^a, : 04^c), and I believe reasonably, as the chief generic distinction in the family. The number of gastric pockets is less reliable; for while *in the adult* they are always at least twice as numerous as the tentacles, in some instances, as in Aegina, they are known to undergo still further subdivision, so that they become four times as numerous as the tentacles.

Maas (: 04^{a}, : 04^{c}) believes that the adradial pockets of the Aeginidae are derived by a process of subdivision from radial pockets. But the occurrence in the present collection of a young specimen of Aegina with *interradial* pockets equal in number to the tentacles suggests that Haeckel ('79) may after all have been correct in maintaining that an interradial location of the gastric pouches is the primitive one in this family.

Recognition of the fact that the presence or absence of a canal system is not of so much systematic importance as Haeckel supposed, and that the condition of the gastric pockets, whether simple or divided, is very significant, has lead Maas to remove from the Cunanthidae those genera with bifid pockets which Haeckel has included in that family on account of the (supposed ?) presence of peripheral canals; and to transfer them to the Aeginidae. When this is done it appears that at least two of them are identical with genera which Haeckel himself has classed under the latter family.

Taking the number of radial parts as the chief generic character, the following well-defined genera may be distinguished: —

1. Four tentacles ; eight or sixteen gastric pockets in adult	Aegina (Cunarcha).
2. Eight tentacles ; sixteen or thirty-two gastric pockets	Aeginura (Cunoctona, Aeginodiscus).
3. Two tentacles ; four peroniae ; eight gastric pockets	Solmundella (Aeginella).
4. Four tentacles ; eight peroniae ; sixteen gastric pockets	Aeginopsis.

Solmundella and Aeginopsis are made by Vanhöffen (: 07) the basis of a separate family, Aeginopsidae ; but their affinities with the other Aeginidae, in conformation of the gastric pockets and lack of otoporpae, are very close. I have already (pp. 48, 49) discussed Vanhöffen's disposition of the other genera here grouped in this family.

The problematic species *Cunissa polypora* Haeckel, with sixteen tentacles and thirty-two gastric pockets, would form the basis of still another genus should it ever be demonstrated that there is any such Medusa. And it is probable that the extraordinary genus Hydroctena of Dawydoff (: 04), if it proves to be anything but a larval Solmundella, as is suggested by its resemblance to the stages in the development of that genus described by Woltereck (: 05), must find a resting place in this family.

It seems to me that the following genera and species, included provisionally by Maas (: 04^{c}) among the Aeginidae, may as well be removed from this family at once: — *Cunissa duplicata* Maas, as I have already stated (p. 57), the number of gastric pockets and presence of otoporpae in this species are good reasons for accepting Maas's original ('93) diagnosis of it as a Cunina as correct. It is doubtful whether the species described by Forbes as *Aeginodorus* (*Polyxenia*) *alderi* was a craspedote at all; and it is doubtful also whether radial parts ever occur in the combination described for *Aegineta hemispherica* Gegenbaur and *Aegineta octonema* Haeckel (eight tentacles *alternating* with eight gastric pockets); at any rate, it seems certain that these two names were given to larval forms, whose connections with the adult cannot be determined. Finally, *Aeginorhodus rosarius* Haeckel ('79) must be classed as a *nomen nudum*, since it has subsequently been rejected, as unfounded, by Haeckel himself ('81).

Aegina Eschscholtz, 1829.

sens. em. Maas (: 04c, : 05).

(non. Aegina, Vanhöffen, : 07).

Aeginidae with four tentacles and with eight (or sixteen) gastric pockets in the adult.

This genus, though long known, has seldom been recorded. I agree with Maas (: 05) that the three new species instituted by Haeckel ('79), *A. rhodina*, *A. canariensis*, and *A. eschscholtzi*, all from the Tropical Atlantic, are really but one species, *A. rhodina*. Similarly, the two Pacific species described by Eschscholtz ('29), *A. citrea*, and *A. rosea*, represent only a single species, *A. rosea* having been based on an abnormal individual of *A. citrea*. The Atlantic and Pacific forms are exceedingly close to each other; they present one of those cases where it is difficult to decide whether it is best to regard them as distinct species or merely as two geographic races of one species. Since, however, the differences between the two, *i. e.* lobing of the gastric pockets, number of otocysts, and color, are constant, so far as known, I retain both names. To these two species must now be added a third, from the present collection, of which only a young stage was taken, and for which therefore no final specific diagnosis can yet be made. Haeckel's two genera, Cunarcha and Solmundus, each with one species, belong, according to the present classification, to Aegina. *Cunarcha aeginoides* is certainly an immature stage, and since it was taken in the Canaries, and since, moreover, Haeckel's very brief account agrees closely with figures given by Mayer of young *Aegina rhodina* (: 04, pl. 4, fig. *28*), it is safe to identify it with that species. It is probable that the same is true of *Solmundus tetralinus*.

Aegina citrea Eschscholtz.

Aegina citrea Eschscholtz, '29, p. 113, taf. 10, fig. *3;* Haeckel, '79, p. 338; Maas, : 05, p. 71, taf. 11, fig. *72*, taf. 13, figs. *79–82*.
Aegina rosea Eschscholtz, '29, p. 115, taf. 11, fig. *4;* Haeckel, '79, p. 338.

Plate 1, Fig. *5;* Plate 14, Fig. *5*.

Station 4663; 300 fathoms to surface; one fragmentary specimen, 6 mm. in diameter.

Station 4672; bottom of Tanner net, 400 fathoms; one specimen, very fragmentary, about 15 mm. in diameter.

Station 4717; 300 fathoms to surface; one poor specimen, 12 mm. in diameter.

Station 4719; 300 fathoms to surface; one specimen, 20 mm. in diameter. This is the specimen photographed (Pl. **1**, fig. *5*) and from which the colored figure (Pl. **14**, fig. *5*) was drawn from life.

Although I have four specimens of *Aegina citrea* at hand, I am not in much better position to give a satisfactory diagnosis of the species than was Maas (: 05). His suggestion that the secondary subdivision of the eight main gastric pockets into sixteen minor lobes may prove to separate the Pacific from the Atlantic species is borne out by the fact that this feature appears in the two larger specimens in the present collection, as is shown in the photograph (Pl. **1**, fig. *5*). It seems probable that the number of otocysts may likewise prove to be of specific importance. Haeckel ('79) records sixteen (four per quadrant) for *A. rhodina;* and since he found the same number in *A. canariensis*, which is certainly nothing but a young stage of the latter, this number may be taken as characteristic of that species. In *A. citrea*, on the other hand, Maas (: 05) could distinguish only eight; while I find two per lappet, in every case in which the margin is in good enough condition to allow of counting. Maas has suggested, though without actual evidence, that there may be secondary tentacles such as are present in Aeginura, as well as otocysts on the margin in this genus; but I find no indications of these structures in the present specimens.

I am unfortunately unable to state certainly whether or not there is a canal system, such as Maas (: 05) has described from a study of sections in the "Siboga" specimens.

The color of this species is characteristic and striking, stomach and pockets being lemon yellow, tentacles orange or pink. This is the coloration described by Eschscholtz.

A. citrea is one of the few species taken during the expedition in the closing net, a specimen having been captured in the Tanner net at station 4672 from about 400 fathoms. It is widely distributed over the Pacific (present captures and those of Eschscholtz), and was taken in the Malay Archipelago by the "Siboga" expedition.

It is probable that a specimen 5.5 mm. in diameter, taken at Station 4671 from between 300 fathoms and the surface, is to be regarded as a very young stage of *A. citrea.* In this individual the radial septa between the gastric pockets are deep. The interradial notches, however, are much shallower; in one quadrant there is a true septum; in two others merely very shallow notches such as subdivide adradially the eight pockets of adult specimens of Aegina. In the fourth quadrant there is no interradial division at all, but only a single undivided pocket occupying an interradial position.

Aegina alternans, sp. nov.

Plate 17, Fig. *1.*

Station 4649; in the trawl, 2235 fathoms to surface; 1 specimen, 40 mm. in diameter.

This very interesting specimen was in fairly good condition. The bell is high and rounded, its surface smooth, the marginal zone broad, the peroniae correspondingly long, and the margin only slightly incised in their radii (Pl. **17**, fig. *1*). Unfortunately the margin was too much damaged to count the otocysts; in one quadrant I observed one, in the next apparently two; but in the remaining two quadrants none were to be seen. The sense organs are of the type usual among the Aeginidae, without otoporpae. By far the most important feature of this species is the condition of the gastric pockets. These, as is shown in the general view (Pl. **17**, fig. *1*) are only four in number, interradial in position, without any trace whatever of interradial notches; the radial notches, however, are very deep. Fortunately the oral gastric wall is entire, so that it was very easy to follow out the structure of the pockets on such a large specimen by probing and injecting air. The central stomach is flat, the mouth large, wide open, and the lip, if any was present, is torn off. Not wishing to destroy the single specimen of this remarkable species, I was not able to settle definitely the question of presence or absence of canals. Surface views, however, strongly suggest the presence of peronial and festoon canals. There are no traces of the development of sexual products, the gastric wall being uniformly thin over its entire surface. The Medusa is entirely colorless. Apparently, from the entire absence of gonads and the number of gastric pockets, this is an immature stage of some very large species. I refer it provisionally to Aegina on account of the number of tentacles, though it is possible that when the adult is known this generic identification may require revision. The most important feature of the specimen is, of course, the fact that the four gastric pockets though only equal in number to the tentacles are interradial in position and alternate with the latter.

Solmundella Haeckel, 1879.

sens. em. Maas (: 04 [a], : 04 [c]).

Aeginopsis J. Mueller, '51; Gegenbaur, '56; etc. (*non.* Brandt, '38).
Aeginella and **Solmundella** Haeckel, '79.
Aeginella Mayer, : 00 [b]; Bigelow, : 04.

Aegindae with four peroniae, but with only two tentacles; with eight gastric pouches and without canal system.

There is, since the studies of Browne (:05[b]) and Maas (: 05), no longer any doubt that Haeckel's ('79) description of a canal system in his genus Aeginella was an error, and that Aeginella and Solmundella are, therefore, synonyms. Since the name Aeginella is already preoccupied for a crustacean genus, a fact which I had overlooked at the time I published my paper (: 04) on the Medusae from the Maldives, it must be abandoned in the present connection and the name Solmundella must be retained. This has already been pointed out by Maas, : 04[c].

Of the various species of this genus (Haeckel, '79, enumerates four for his two genera, and Maas, '93, has since added another) probably only two, *S. bitentaculata* and *S. mediterranea*, are valid. And even these two are so closely related to each other that, although the evidence at present indicates that they are distinct, we must recognize the possibility that further research may prove that they are really only two varieties of a single species. Among the differences between them which Maas (: 06b, : 06c) enumerates, are size, color, stage of development at which the gonads appear, and number of otocysts. It seems to me that the last of these is of much the greatest systematic importance. No doubt *S. bitentaculata* is larger than *S. mediterranea*, and as a rule more highly colored, but both size and color are well known to be variable characters among Hydromedusae, and to be dependent largely on the food supply of the specimens in question. The question of the time of appearance of the gonads is likewise an unsafe criterion, because it is very variable, for it has been conclusively shown by Browne (: 05b) that even very small specimens of *S. bitentaculata* (size unfortunately not given) possess gonads on the gastric pouches, although it is only large specimens (9 mm. in diameter) which have them developed on the central portion of the stomach; and Maas himself has stated that, while some specimens 8 mm. in diameter have no gonads at all (: 05, p. 75), others of the same size are sexually mature (: 06c, p. 99).

The question of the number of otocysts seems to me much more important. In the case of *S. mediterranea* we have the positive statement of the brothers Hertwig ('78) that there are never more than eight otocysts, two to each quadrant. In *S. bitentaculata*, however, Maas (: 05) has found as many as thirty-two of these organs in large specimens. Furthermore, not only is the number in *S. mediterranea* strictly determinate, but the total number is very early attained, while there is reason to believe that in *S. bitentaculata*, on the contrary, the number increases constantly with growth, as noted by both Browne (: 05b) and Maas (: 05, : 06c). It is important also to note that the number of sense organs does not increase with equal rapidity in all quadrants of the margin, a phenomenon I am able to trace in the present specimens.

The identity, with one or the other of these two species, of the various specimens described by Haeckel ('79) and Mayer (: 00b) under the name *S. dissonema* is not easy to settle; but inasmuch as all these specimens agree in having only eight otocysts whatever their size, and since all are of comparatively small size, the largest, from the Canaries, being only 8 mm. in diameter (Haeckel, '79), and may become sexually mature when only 3 mm. in diameter (Mayer, : 00b), it is probable that they really belong to *S. mediterranea*, not to *S. bitentaculata*. The same is true also of *Aeginella mülleri* Haeckel, which is certainly only a younger stage of his *A. dissonema*, at the type locality of which species it was taken. *Aeginella dissonema* Bigelow (: 04) from the Maldive Islands, is, however, a synonym of *A. bitentaculata.*

Solmundella mediterranea has been recorded under its own name not only from the Mediterranean and from the Tropical Atlantic (Maas, '92), but from the Antarctic Ocean as well (Maas, : 06^{b}); and since Agassiz and Mayer's record of *S. dissonema* from the Fiji Islands probably belongs to *S. mediterranea* its range apparently extends to the Pacific. *S. bitentaculata* seems to have an almost parallel distribution, since it has been found in the Atlantic (Maas, '93, *Solmundella henseni*), in the Indian Ocean (Browne, : 04, : 05^{b}; Bigelow, : 04), in the Malay Archipelago (Quoy et Gaimard, '33; Maas, : 05, : 06^{c}), and in the Tropical Pacific by the present expedition of the "Albatross."

Solmundella bitentaculata Quoy et Gaimard.

Charybdea bitentaculata Quoy et Gaimard, '33, p. 295, taf. 25, figs. *4, 5.*
Solmundella bitentaculata Browne, : 04, p. 741, pl. 56, fig. *3*, : 05^{b}, p. 153, pl. 4, figs. *1–6;* Maas, : 05, p. 73, taf. 11, fig. *74*, taf. 12, fig. *75*, taf. 13, figs. *86–89.*
Aeginella bitentaculata Haeckel, '79, p. 341.
Aeginella dissonema Bigelow, : 04, p. 261.
Campanella capitulum de Blainville, '34, p. 286; L. Agassiz, '62, p. 169.
Solmundella henseni Maas, '93, p. 55, taf. 5, fig. *11.*

Plate 2, Fig. *3.*

Station.	Depth, fathoms.	Diameter, mm.	Otocysts per quadrant.	Remarks.
4583	300 to surface	1.5	2 in each	1 good specimen.
4587	300 to surface	3.5	3, 2, others too torn to count.	This is the specimen photographed, Plate **2**, fig. 3.
4588	Surface	1.5	2, 2, 2, 2	
4588	Surface	2.5	4, 2, 2, 2	Many specimens 1.5 to 3 mm. in diameter were taken at this station.
4588	Surface	3	?	
4640	Surface	2	?	1 fragmentary specimen.
4644	Surface	3	4 in one	2 rather fragmentary specimens.
4655	Surface	1.5	2 in one	1 fragmentary individual.
4671	Surface	1	2, 2, 2, 2	Good specimen.
4671	Surface	2.5	2, 2	Several specimens of this size.
4680	Surface	1–1.5	?	2 very fragmentary specimens.
4713	300 to surface	4	?	Margin torn off the single specimen.
4716	Surface	3	4, 4, 4	1 fair specimen.
4735	Surface	2.5	?	Very fragmentary.

This widely distributed species was taken at eleven stations. All the specimens are small or medium sized. Unfortunately many of the specimens were so battered that it was impossible to count the otocysts, but this could usually be done in one or more quadrants. In the smaller specimens the number per quadrant is two, eight in all. In larger specimens there are three or four per quadrant, as Maas (:06^c) and Browne (:05^b) have already observed. The increase is, however, irregular, there being often different numbers in the different quadrants of a single specimen, as is seen in several cases in the above table.

Aeginura Haeckel, 1879.

sens. em. Maas (:04^c, :05).

Cunoctona Haeckel ('79).
Aeginodiscus Haeckel ('79).

Aeginidae with eight tentacles and sixteen (or thirty-two) gastric pockets; with secondary tentacles situated on the margins of the lappets.

This interesting genus of Narcomedusae, since its discovery, has been described twice by Maas, from the collections of the Prince of Monaco (:04^c) and from those of the "Siboga" expedition (:05). Maas has been able to study the anatomy in such detail that I can add but little to his account from the rather fragmentary specimens in the present collection. The most interesting feature of this genus is the presence, demonstrated by Maas (:05) on the "Siboga" specimens, of a series of secondary tentacles (three per lappet) on the bell margin. These are solid, with endoderm core, and are connected with the vascular lamella (:05, p. 79). They are not known to occur normally in any other Narcomedusa, but I have found that such a secondary tentacle may sporadically replace an otocyst in *Pegantha smaragdina* (p. 91), evidence supporting the essential identity of otocysts and tentacles in this group. Otocysts are also present. Specific diagnosis of the members of the genus is uncertain, because the specimens both of the "Challenger" and of the Prince of Monaco were rather fragmentary. There seems no doubt that the surface form, *A. lanzerolae* Haeckel, is distinct from the two or three intermediate species, since it differs from the latter in the form of the stomach, presence of a proboscis, and especially in lacking the very characteristic endodermal pigmentation. Moreover, it is doubtful whether it has the secondary tentacles on the bell margin, for Haeckel saw no such structures, although he studied living specimens ('79, p. 318).

The differences between the three intermediate forms, *A. myosura* Haeckel, *A. grimaldii* Maas, and *A. weberi* Maas, are more doubtful, inasmuch as the first two, at least, were described from such fragmentary specimens that Maas (: 04^c) himself admits the possibility that some of the apparent differences may be due to imperfect preservation. *A. myosura*, according to Haeckel's ('81) account, appears to differ from the other two species in having eight of the gastric pockets large and eight small, and he makes no mention of the pigmentation, a character so striking and so permanent even in alcoholic specimens that it could hardly have escaped him. His failure to mention secondary tentacles cannot, however, be construed as indicating their absence, on account of the condition of his material.

Maas (: 05) cites as taxonomic characters separating *A. grimaldii* from *A. weberi*, size, arrangement of the gonads, and presence or absence of a peripheral canal system. It seems to me, however, that in the present case none of these are very significant. According to Maas (: 05) *A. weberi* is 35–45 mm. in diameter; *A. grimaldii* only 12 mm; but his figure from the fresh specimen of the latter, said to be life-size (: 04^c, pl. 3, fig. *19*), measures 23.5 mm. in diameter. This discrepancy may perhaps be explained by the fact that the "Monaco" specimens were preserved with osmic acid, which almost invariably shrinks Medusae considerably. Furthermore, there is no evidence to show that even 23.5 mm. is the largest size attained by *A. grimaldii.*

The gonads in *A. grimaldii*, of which a female only was observed, are described as consisting of large eggs, irregularly scattered over the gastric pockets, whereas in *A. weberi* (male), as in *A. myosura* (likewise male), the sexual products are evenly distributed, but there is good reason to believe that this is a *sexual*, not a specific difference, inasmuch as the two sexes of *Solmissus marshalli* exhibit precisely the same divergence.

The question of canals, said by Maas to be absent in *A. grimaldii* (: 04^c, p. 40) but present in *A. weberi* (: 05, p. 78), is less easily settled. His conclusion for *A. grimaldii* seems to be supported by good evidence, afforded by the study of sections, but the occurrence of true canals in *A. weberi* is more doubtful. According to his account, gained from sections of the margin, the canal system is so nearly obliterated that no definite endothelial layer is to be found, although there is an open lumen. His chief reason for considering this lumen as normal and not an artifact, is its regular occurrence (: 05, p. 79), but as the second possibility still exists, it seems to me unwise to lay much stress on this supposed character until it has been more fully tested on more extensive and better preserved material.

Whatever decision may eventually be reached as to the relationship of these two species, the specimens in the present collection resemble Maas's figures of *A. grimaldii* so closely that they are best referred to that species.

Aeginura grimaldii Maas.

Aeginura grimaldii Maas, : 04^c, p. 38, pl. 3, figs. *19–28*.
? **Aeginura weberi** Maas, : 05, pp. 77, taf. 11, fig. *73*, taf. 12, fig. *76*, taf. 14, figs. *90–99*.

Plate 9, Fig. *4*.

Station 4646 ; 300 fathoms to surface ; 1 specimen, 21 mm. in diameter, ♀.

Station 4655 ; 300 fathoms to surface ; 1 specimen, 20 mm. in diameter, sex ? Very fragmentary.

Station 4669 ; 300 fathoms to surface ; 1 specimen, 13 mm. in diameter.

Station 4676 ; 300 fathoms to surface ; 1 specimen, 16 mm. in diameter. Fragmentary.

All these specimens agree closely with Maas's (: 04^c) description of *A. grimaldii.* In only one specimen, a female, can the sex be determined from a surface view. In this individual (Pl. 9, fig. *4*) the eggs are very large and irregularly distributed over the surface of the gastric pockets. Another specimen, 13 mm. in diameter, appears from a surface view to be a male, and in it the oral wall of the gastric pockets is uniformly thickened. Apparently, then, here, as in *Solmissus marshalli*, the different arrangement of the genital products which Maas (: 05) believed to be of systematic importance is only a sexual difference. Unfortunately the margins of all the specimens are so much damaged that I can give no detailed account of the marginal organs, though it appears that in each octant there are three structures of considerable size, corresponding to the secondary tentacles described by Maas (: 05) for *A. weberi ;* also in one specimen I found a single otocyst, too fragmentary for any accurate description. No other marginal organ was visible in that particular octant, so that I can say nothing as to relative positions of secondary tentacles and otocysts ; probably, however, they agree with Maas's description of *A. weberi.*

Gastro-vascular system. — I was unable, on surface views, to demonstrate the presence of any canal system, but the margins of all the specimens were too fragmentary to settle this question definitely. The interradial incisions between the gastric pockets are deeper than the incisions in the radii of the tentacles, just as Maas has figured them; a feature suggesting that the former are more primitive than the latter.

Color. — The pigmentation of this species (Pl. 9, fig. 4) is one of its most characteristic features; it closely resembles the figures given by Maas of *A. grimaldii* and of *A. weberi.* As in those species, it is entirely confined to the endoderm. The central stomach and gastric pockets are deep chocolate red, which is almost black after preservation. The large eggs appear white, apparently because they are so opaque as to hide the heavily pigmented endoderm. The marginal zone is of a pale reddish tint.

It appears that, like other intermediate Medusae, this is a widely distributed species, having been taken in the Atlantic and in the Eastern Tropical Pacific.

Solmaridae Haeckel, 1879.

sens. em.

Narcomedusae without gastric pockets, the genital products being developed, either as thickenings or diverticula in the oral wall of the central stomach; with or without peripheral canals and otoporpae.

As modified above, this family includes the Solmaridae and Peganthidae of Haeckel, which were separated by the presence or absence of a canal system; a feature I believe to be of but slight systematic importance. This character does, however, seem to be at least of generic value in this group (even if not in the Cunanthidae); and it, together with presence or absence of otoporpae, separates the family into two subfamilies, one with, the other without, canals and otoporpae. These two subfamilies, the former corresponding to the Peganthidae, the latter to the Solmaridae of Haeckel, bear to each other much the same relation as do the two subdivisions of the Cunanthidae, *i. e.* on one hand Cunina and Cunoctantha with canal system and otoporpae, and on the other Solmissus without canals or otoporpae.

Under the first of these subdivisions (Peganthidae) Haeckel ('79) has distinguished four genera, viz., Polycolpa, Polyxenia, Pegasia, and Pegantha, distinguishing between them by differences in the conformation of the gonads. The distinctions between these genera are so slight, even if not due, in part at least, to different stages in the growth of the gonads, that it seems to me very doubtful whether all of them are valid. Thus Polycolpa, with a simple ring-like gonad, is probably nothing more than an early stage in the development of Polyxenia, in which the gonads form, in addition to the ring, interradial diverticula, as in Pegantha. Polyxenia presents a very puzzling case of nomenclature, since it has been used in different senses by various writers. Eschscholtz, who established the genus for *P. cyanostylus,* makes no reference in his notice to a canal system or to marginal sense organs, thus failing to mention the only characters which would help us to locate the species in the family. So far as the gonads are concerned (Eschscholtz, '29, taf. 10, fig. *1*), it might equally well belong to Solmoneta. The same is likewise true of the *Medusa mollicina* of Forskål, since the original figures of Forskål (1776, p. 109; tab. 33, fig. c) resemble in the form of the gonads the well-known *Solmoneta flavescens* of the Mediterranean. *Foveolia diadema* Péron et Le Sueur and *P. cyanogramma* Quoy et Gaimard are based on even less recognizable notices. Therefore there is good room to doubt whether Haeckel's identification of these early names, with specimens which he himself observed, was of much value. Haeckel has described one new species of Polyxenia, *P. cyanolina,* but very briefly and without figures. Previous to Haeckel's work the name Polyxenia had been used in a very different sense by Forbes ('48), who applied it to *P. alderi,* a form probably not a craspedote Medusa at all; and by Metschnikoff ('74), who has described under the name *Polyxenia leucostyla* Will, specimens probably identical, generically at least, with the long-known *Solmoneta flavescens* Kölliker.

In view of the fact that the type species of Polyxenia (*P. cyanostyla* Eschscholtz), is unrecognizable generically, and to avoid further confusion, it seems best to abandon the name Polyxenia altogether. If this be done, Polycolpa, which is probably not distinguishable generically from Polyxenia, might well be retained.

Pegasia has, it seems to me, a better claim to generic standing, if any specimens normally exhibit the conformation of the gonads described by Haeckel ('79). The only one of the four genera of which a satisfactory account has appeared is Pegantha.

Vanhöffen (:07), abandoning the conformation of the gonads as a taxonomic character in this family, makes the number of tentacles the chief generic character, distinguishing Pegantha with 10–13, Polyxenia with 16–18, and Polycolpa with 25–30 tentacles. The series in the present collection show that this character is so variable that such slight differences cannot be considered of much importance; for, according to this scheme, some specimens of *Pegantha triloba* would belong to Pegantha, others (p. 87), to Polyxenia; while of four specimens of *P. laevis* two would fall in Polyxenia, and two would be intermediate between that genus and Polycolpa. For this reason it seems better to neglect this character entirely as the basis of generic diagnosis, and to follow Haeckel in including in Pegantha all species in which the gonads are restricted to the marginal region of the gastric wall, and localized in interradial pouches.

Pegantha Haeckel, 1879.

Solmaridae with canal system and otoporpae; the gonads forming diverticula of the margin of the oral gastric wall. 8–32 tentacles.

This genus, since first described by Haeckel ('79), has been recorded by Fewkes ('89[a]) from the Gulf Stream; Maas ('93) from the Tropical Atlantic; Bigelow (: 04) from the Indian Ocean; and by Mayer (: 06), under the name *Solmaris insculpta*, from the Hawaiian Islands. It is now well known anatomically from the studies of Maas and Haeckel, but up to the present time no early stages in its development have been observed. Therefore I am fortunate in being able to trace in detail in a new species, *P. smaragdina*, a form of parasitic development from the egg, very closely resembling that known to occur in *Cunina proboscidea* (Metschnikoff '86[a], Stchelkanowzew : 06), and in demonstrating the occurrence of internal budding in a second species, *P. laevis*.

The distinctions between the various described species of the genus, as is so often the case with oceanic Medusae, are by no means clear. The difficulty is caused chiefly by the unsatisfactory nature of Haeckel's original descriptions, and by the fact that he based his various species chiefly on differences in the conformation of the gonads, a feature which may change with growth.

The present collection contains four easily distinguishable species. Two of these can be referred to *P. martagon* Haeckel and to *P. triloba* Haeckel. The other two differ so markedly from any species as yet known that they are described as new.

Pegantha martagon Haeckel.

Pegantha martagon Haeckel, '79, p. 332.
Pegantha simplex Bigelow, : 04, p. 260, pl. 5, figs. *19*, *20*.

Plate 18, Figs. *1-8*.

Station 4634; 300 fathoms to surface; 1 large specimen; good condition.
Station 4637; 300 fathoms to surface; 1 large specimen; good condition.

Station 4646; 300 fathoms to surface; 2 small fragmentary specimens.
Station 4650; 300 fathoms to surface; 2 large specimens; fair condition.
Station 4652; 100 fathoms to surface; 4 large specimens; fair condition.
Station 4654; 300 fathoms to surface; 2 large specimens; good condition.
Station 4661; 300 fathoms to surface; 1 fragmentary specimen.
Station 4663; 300 fathoms to surface; 2 small fragmentary specimens.
Station 4667; 300 fathoms to surface; 1 good specimen.
Station 4668; 300 fathoms to surface; 1 specimen; good condition.
Station 4671; surface; 1 large specimen; perfect.
Station 4673; surface; 2 specimens; fair condition.
Station 4708; surface; 2 small specimens.
Station 4717; 200 fathoms to surface; 1 fragmentary specimen.
Station 4719; 300 fathoms to surface; 1 specimen; good condition.
Station 4723; surface; 4 small specimens.
Station 4725; surface; 1 small specimen; fragmentary.

The dimensions and the numbers of marginal lappets and tentacles of a series of specimens, including the largest and smallest taken, are given in the following table:—

Station.	Diameter.	Height.	Lappets and tentacles.
	mm.	mm.	
4663	5	3	9
4646	9	4	12
4667	11	8	10
4659	13	8	11
4671	13	10	10
4659	14	7	13
4719	14	6	13
4650	15	9	11
4650	16	10	9
4668	16	9	11
4637	20	10	12

It is fortunate that I was able to study living specimens of this species, inasmuch as, for some reason or other, they were very difficult to preserve, and at the time of writing, after a lapse of only two years, already show marked signs of deterioration. The bell is rounded; the gelatinous substance thick (Pl. **18**, fig. *1*) and considerably higher than Haeckel ('79) has stated; but since his description was taken from alcoholic specimens, this difference cannot be considered of importance. Moreover, the proportion between diameter and height varies, and in life was constantly changing, with changes in the state of contraction of the Medusae. Above the line of insertion of the tentacles the surface of the bell is smooth, showing neither nematocyst warts nor radial ridges. Sculpture is, however, present on the marginal lappets, there being a slightly marked ridge in the median line of each lappet, and fainter ones in the lines of the otoporpae, all being much less prominent in this species than in *P. triloba.* The marginal lappets are ovate in outline, rather longer than broad, the incisions between them deep, and the peroniae correspondingly short (Pl. **18**, fig. *4*). In adults the peroniae are covered by the gelatinous substance of the adjacent marginal lobes.

The number of lappets and tentacles is variable, as is usual in Pegantha, the largest number observed being thirteen, in a specimen 14 mm. in diameter, the smallest nine, in specimens 5 and 16 mm. in diameter. In one small specimen, 9 mm. in diameter, from Station 4646, in which the gonads have not yet appeared, one of the twelve tentacles is much smaller, and evidently of more recent formation, than the others (Pl. **18**, fig. *4*); but in large specimens in which the gonads are formed I have not found any trace of the development of interstitial tentacles. It appears, then, that the full number of tentacles in this species is early attained and does not continue to increase with growth. The tentacles are of the usual narcomedusan type, about as long as the bell diameter, and in life carried trailing, or recurved into the bell cavity. The only feature in which the present specimens differ markedly from Haeckel's description is in the number of octocysts. Haeckel ('79, p. 332) states that there are from thirteen to fifteen of these organs on each marginal lappet, but the greatest number which I have found in any lappet is nine, while most lappets have only from six to eight. It is, however, questionable whether Haeckel's counts of the octocysts are reliable, since he states that his description of this species was taken from strongly contracted alcoholic specimens; and I find from my own experience that it is almost impossible to count these organs on such material. Even if such a difference does exist in different groups of individuals, it does not seem to me of much systematic importance, because the number of octocysts increases with growth, and is variable in the different lappets of any one individual. Renewed examination of the specimens from the Maldives has convinced me that the number of octocysts which I recorded for them, twenty-five per lappet, was an error, being much too large, — an error due to the contracted condition of the preserved material. The sense organs themselves (Pl. **18**, fig. 7) are of the usual type, each containing two or three otoliths. They are situated on "auditory pads"; thickenings of the nerve ring, consisting of spindle-shaped ectoderm cells some at least of which bear bristles, though most of the latter are destroyed by preservation; and, as in all members of this genus, each octocyst is connected with a long otoporp containing nematocysts (Pl. **18**, fig. 7, op.). At their distal ends these structures are bounded by cap-like series of columnar ectoderm cells.

Gastro-vascular system. — The stomach is flat, its ventral wall without any trace of such folds or ridges as Haeckel ('81) has figured for *P. pantheon.* Indeed, I doubt whether such a conformation is anything more than the result of alcoholic contraction. The mouth is surrounded by a simple and very distensible lip. In life it is often opened so wide as to occupy half the area of the stomach, or again contracted, as in Pl. **18**, fig. *2*. There are no traces of gastric pockets (Pl. **18**, fig. *4*). The canal system is typical of the genus, both peronial and ring canals being well developed (Pl. **18**, fig. *4*).

Gonads. — Since the conformation of these structures has been used by both Haeckel ('79, '81) and Maas ('93) as a specific criterion in Pegantha, it is fortunate that I can describe them from life. Haeckel ('79) describes them in *P. martagon* as neither folded nor incised, but while this is true for young specimens in which they are simple sac-like structures (Pl. **18**, fig. *5*), in larger ones they are more or less lobed and irregular (Pl. **18**, fig. *6*), though never definitely and regularly subdivided as in *P. biloba* and in *P. dactyletra* (Maas, '93). There is one important structural feature of the gonads in this, as well as in the other species of the genus which I have examined, mentioned neither by Haeckel nor Maas probably because of the methods of preservation of their specimens. This is that the gonad is not a sac with large open cavity, but is supported, and its convexity chiefly caused, by a rounded prominence of the gelatinous substance of the disc (Pl. **18**, fig. *8*, g. pn.), just such as is present in the corresponding location in *Solmissus marshalli* and in *S. incisa* (p. 68). These prominences are absent in young specimens and appear, in both sexes, only with the formation of the gonads. They do not extend into the subdivisions of the gonads, but occupy their central regions only.

This species is colorless; the bell hyaline, the endodermal structures opaque.

Pegantha martagon is widespread, having been taken in the Indian Ocean

(Bigelow, :04), in the China Sea (Haeckel, '79), and very generally throughout the course of the "Albatross" in the Eastern Pacific. It is probably a surface form.

Pegantha triloba Haeckel.

Pegantha triloba Haeckel, '79, p. 333, taf. 19. figs. *4–7*.
Solmaris insculpta Mayer, :06, p. 1140, pl. 3, figs. *8, 9*.
? **Pegantha quadriloba** Haeckel, '79, p. 333.

Plate 14, Fig. *3;* Plate 16, Fig. *3;* Plate 20, Figs. *1–3;* Plate 45, Figs. *1, 2*.

Station.	Depth.	Diameter.	Height.	Tentacles.	
		mm.	mm.		
4650	300 fathoms to surface	22	12	12	1 excellent specimen.
4661	300 fathoms to surface	5	3	12	1 good specimen.
4712	Surface	11	6	12	1 excellent specimen.
4733	Surface	2.5	1	7	1 good specimen.

I have been able to settle the identity of Mayer's species, *Solmaris insculpta*, by a study of the original specimens from the Hawaiian Islands, kindly entrusted to me by the United States National Museum. The presence of a well-developed and very obvious canal system and of long otoporpae shows beyond doubt that they are typical specimens of Pegantha, not of Solmaris as Mayer supposed. Specifically they are indistinguishable from the specimens in the present collection.

The largest specimen in the present collection is about 22 mm. in diameter by 12 mm. high; approximately the dimensions given by Haeckel (20–25 mm. in diameter, 7–8 mm. high). The gelatinous substance is extremely rigid, and the exumbrella bears a well-marked and characteristic sculpture (Pl. **14**, fig. *3;* Pl. **16**, fig. *3*). From the base of each tentacle a deep furrow runs nearly to the apex of the bell; on either side of these furrows there are ridges which extend down to the margin of the lappets; in the middle lines of the lappets, and also extending to the apex, are a second series of ridges; and finally there are less prominent ridges confined to the lappets along the lines of the otoporpae. This sculpture, very constant in all the specimens both Eastern Pacific and Hawaiian, agrees with Haeckel's account. It is already developed in a specimen only 2.5 mm. in diameter (Pl. **16**, fig. *3*). The marginal lappets are ovate, pointed, rather longer than broad; the incisions between them deep. Three of the four specimens, ranging in diameter from 5 to 22 mm., have twelve lappets and tentacles; one, the smallest 2.5 mm.

in diameter, has seven (Pl. 16, fig. *3*). Of the Hawaiian specimens, several have twelve, thirteen, and fourteen each, and one sixteen. The tentacles, of the usual structure, are about as long as the diameter of the bell, stiff, and in life carried recurved into the bell cavity. There are no such nematocyst pads at their bases as Haeckel ('81) has figured for *P. pantheon.*

In the largest specimen there are from eighteen to twenty otocysts per lappet (Pl. 45, fig. *1*), the same number that Haeckel records. Mayer (:06) observed only three per lappet; but I find that his large Hawaiian specimens also have about eighteen to twenty. In the smallest specimen there are only four or five per lappet (Pl. 16, fig. *3*). In a slightly larger one, 5 mm. in diameter, five was the largest number counted in any lappet; but in a specimen 11 mm. in diameter there are from seven to nine per lappet.

The octocysts themselves are of the usual type, containing two or three otoliths and situated on ectodermic pads (Pl. 20, fig. *3*). The otoporpae vary in length, the lateral ones, reaching to about the level of the bases of the tentacles, being longest; they anastomose somewhat; those of one lappet are shown in Pl. 45, fig. *1.* They are not bounded by definite caps of ectoderm cells, as is the case in *P. martagon* (p. 86), but grow narrower and narrower, until finally they become indistinguishable. They seem to have been overlooked entirely by Mayer.

Gastro-vascular system. — The mouth in all the specimens is widely opened; there is no trace of proboscis. The canal system is well developed and unusually prominent. In a small specimen 5 mm. in diameter the endoderm layer is thickened along the proximal face of the ring canal (Pl. 20, fig. *1*), forming a ridge, variously folded, running lengthwise of the canal. In the adult specimen there is no trace of this structure, the endodermic lining of the canal being of uniform thickness throughout.

Gonads. — These, in all the large specimens, are definitely three-lobed; each consisting of a central and two lateral lobes (Pl. 20, fig. *2*). In the largest specimen the central lobe is rounded and supported by a prominent gelatinous eminence (Pl. 45, fig. *2*, g. pr.), while the lateral lobes, which are the chief sexual portions of the gonads, are flat, leaf-like, and variously subdivided. There is considerable variation in the conformation of these organs in large specimens, though all agree in having them definitely three-lobed. In the largest Hawaiian specimen, which is in a rather more advanced state, the three lobes are of about equal size, sausage-shaped, the lateral ones being only wavy in outline, not definitely subdivided, while the genital prominence is much smaller than in the individual just described. In another specimen from the same collection however, the lateral lobes show a considerable amount of secondary lobing. In specimens about 12 mm. in diameter (of which the Hawaiian collection contains several) the gonads are very small; each, however, already consists of three distinct lobes. Mayer's figure (: 06, pl. 3, fig. *8*) is incorrect in that it represents the gonads as lying at about the mid zone of the stomach surface. In reality they are at its margin and hang into the lappet cavities, in the Hawaiian as well as in the Eastern Pacific specimens. Our small specimens show no trace of gonads.

This conformation of the gonads agrees with Haeckel's ('79) account in its main feature, *i. e.* the three-lobed condition; it differs, however, in that Haeckel described and figured the lobes of the gonad as rounded, smooth, and without subdivisions; but since his account was taken from alcoholic specimens it is doubtful whether it represents the normal aspect of the organ.

Color. — The entire Medusa (adult) is of a delicate violet pink (Pl. **14**, fig. *3*), the endodermal system being more deeply tinted and more opaque than the remainder of the bell. The distal portions of the exumbral ridges and the otoporpae are deep purple. These purple exumbral lines were observed by Mayer (: 06, p. 1140), but he failed to realize their connection with otoporpae.

There seems to be no doubt as to the identity of this form with *P. triloba* Haeckel, the only divergence from Haeckel's account, apart from a slightly greater number of tentacles in some specimens, being that in the present series the lateral lobes of the gonads may be secondarily lobed. This difference, however, cannot be of specific significance, in view of the fact that gonads of different individuals vary widely in this respect, even, indeed, to the extent of lacking the secondary lobing altogether, as is the case in one of the Hawaiian specimens. I have been able to examine a specimen collected by the "Hassler" expedition at Rio Janeiro, which in number of otocysts, sculpture, etc., so closely agrees with the "Albatross" and Hawaiian specimens that I have no doubt of their identity. In the "Hassler" specimen however, while most of the gonads have three lobes, one has four. It is this fact which has made me discard the character, three or four lobes, as a specific one and to class *P. quadriloba* as a synonym of *P. triloba.* The same conclusion might be reached, perhaps, in the case of *P. biloba* Haeckel, were it not for the facts that in *P. triloba* the gonads are three-lobed from their first appearance, and that I have not been able to find a gonad with less than three lobes.

The occurrence of a specimen from the Atlantic shows that *Pegantha triloba* is a species of extremely wide distribution. It is of general occurrence throughout the Eastern Tropical Pacific, both north and south of the equator, and has been taken in the Indian Ocean (Zanzibar, Haeckel), and in the Tropical Atlantic, near the island of Ascension (Haeckel, *P. quadriloba*) and off Rio Janeiro (" Hassler " expedition). It is undoubtedly a surface form, since all the Hawaiian specimens were taken on the surface (Mayer, : 06, p. 1140).

Pegantha smaragdina, sp. nov.

Plate 14, Figs. *1*, *2* ; Plate 19, Figs. *1–9* ; Plates 22–26.

Station.	Depth.	Diameter.	Tentacles.	Gonads.	
		mm.			
4663	Surface	73	34	♂	1 perfect specimen. Type.
4671	Surface	50	28	None	1 perfect specimen.

Both specimens of this very striking and easily distinguishable species were alive when taken.

The bell is very low, only about one fifth as high as broad, and in its flat outline much resembles Solmissus, differing correspondingly from other species of Pegantha (Pl. **14**, fig. *2*). The aboral surface is entirely without sculpture, and even the otoporpae are so flat that they can hardly be said to form ridges. The lappets are quadrate, about as long as broad; the incisions between them so shallow that the peroniae are almost as long as the lappets (Pl. **19**, fig. *5*).

Tentacles. — There are thirty-four tentacles and lappets in the larger specimen. Three of the tentacles are much smaller and evidently of more recent growth than the others, but they are already associated with well-developed peronial canals, and bear the same spacial relations to the adjacent gonads as do the larger tentacles. In life, when the animal is idly floating, the tentacles are carried projecting stiffly outward from all sides of the bell, a feature heightening its Solmissus-like appearance.

Otocysts. — There are usually six, sometimes seven or eight otocysts per lappet; thus in the largest specimen a total of about two hundred. The sense organs themselves are of the usual type, containing from three to five otoliths (Pl. **19**, figs. *3*, *8*). They stand on well-marked pads consisting, as is seen in a radial section (Pl. **19**, fig. *8*), of thickly crowded spindle-shaped ectoderm cells, some at least of which bear bristles in life. In one instance an otocyst is replaced by a small tentacle (Pl. **19**, fig. *1*), — a structure differing in no way, except for its small size and rudimentary condition, from any normal tentacle, but connected at its base with an otoporp. This replacement of an otocyst by a tentacle is evidence of the close relationship between these two classes of structures among the Narcomedusae. The otoporpae (Pl. **19**, fig. *3*), though less prominent than in other species of Pegantha, are of the usual structure, consisting of densely crowded ectodermal cells enclosing nematocysts; they extend about half the length of the marginal lappets (Pl. **19**, fig. *5*).

Gastro-vascular system. — The stomach is flat, its outline circular in the smaller specimen, in which no gonads have appeared (Pl. **19**, fig. *5*). The mouth, which is widely open, is surrounded by a simple circular lip (Pl. **14**, fig. *1*). The fact that the oral wall of the stomach is thin and but poorly supplied with musculature makes it doubtful whether the mouth is ever closed. The canals, both peronial and circular, are so broad that they easily admit of the entrance of a stout probe. In the smaller specimen the ring canal in several of the lappets shows a triangular centripetal process suggesting the future formation of a new pair of peronial canals.

Gonads. — These are simple in this species, each consisting merely of a rounded swelling without lobes or processes, the only subdivisions being an occasional shallow furrow or notch (Pl. **19**, fig. *2*). In one instance, however, it seems that a previously existing gonad has been secondarily divided into two, with the formation of a new tentacle and peronia. In the one specimen, a male, in which gonads are present, the sexual products are nearly mature, so that it appears that this conformation represents the adult condition in this species. As in other members of the genus, the gonads are supported by gelatinous prominences, which, though large in the adult specimen, do not appear until the gonads develop (compare Pl. **19**, fig. 7 with fig. *9*).

Color. — One of the most striking features of this species is its color, the stomach, canals, and gonads being of a deep, opaque, lemon yellow, as is shown in the sketches from life reproduced in Pl. **14**, figs. *1* and *2*. This is a pigment color caused by minute and highly refractive orange or yellow pigment granules which crowd the ectoderm cells over the regions of the gastrovascular system. A study of sections shows that these same granules occur in the ectoderm in other regions as well; but it is only over the stomach and canals that the ectoderm layer is thick enough for them to produce a visible color. I have been unable to find any pigment granules in the endoderm.

Pegantha smaragdina, like *Cunina proboscidea,* as already stated, exhibits an alternation of generations of medusae, our smaller specimen showing an almost complete series of stages in the development of the secondary generation. These will be described in detail in the ensuing pages. For the sake of completing the systematic description of the species I must, even at the cost of repetition, insert here an account of its most advanced stage. The oldest medusae of this secondary generation were ready for independent existence, and were taken in the same haul with their parent-host. They measure about 3 mm. in diameter and are very flat. An aboral view of one is shown in Pl. **26**, fig. 5. Their most important structural feature is that they lack canal system and otoporpae. There are from ten to twelve tentacles and from one to three otocysts per marginal lappet. The lappets are short and broad, the incisions between them hardly marked. The stomach is a simple circular sac. A section of the oral gastric wall (Pl. **24**, fig. 7) shows that it already consists of many layers of densely crowded ectoderm cells, — a fact which suggests an early formation of sexual products, such as takes place in the corresponding generation of *Cunina proboscidea,* as described by both Metschnikoff ('86^{a}) and Stchelkanowzew (: 06). Apparently the sex cells are developed generally over the stomach surface — a fact which, taken together with the absence of gastric pockets, canals, and otoporpae, would throw the specimens into the genus Solmaris, were their parentage not known.

The only described species of Pegantha at all approaching *P. smaragdina* in either size or number of tentacles is *P. magnifica* Haeckel, which is 50 mm. in diameter, with thirty tentacles; but the two species are so sharply separated by form, shape of the marginal lappets, conformation of the gonads, and number of otocysts (Haeckel, '79, p. 333, records 900–1000 of these organs for *P. magnifica*) that there can be no question that they are distinct. It is perhaps possible that *P. smaragdina* may be identical with the specimen described by Brandt ('38, p. 364, taf. 7) from Mertens's figures as *Polyxenia flavibrachia;* but since his figures show neither canals, stomach, gonads, nor sense organs, it is absolutely impossible to tell definitely even the family to which this form belongs.

DEVELOPMENT OF THE PARASITIC GENERATION OF PEGANTHA SMARAGDINA.

Plates 22–26.

Up to the present time the only accounts of the development of a secondary, parasitic generation of medusae within the parent which have appeared are those by Metschnikoff ('86^a) and Stchelkanowzew (:06) for *Cunina proboscidea* Metsch., and these two, though agreeing as to the main features, differ from each other in many details. An important difference between Cunina and Pegantha is the region in which development takes place; for in the former, according to both authors above cited, it is restricted to the mesogloea and endoderm of the subumbrella in the region of the gastric pockets and peronial canals, while in Pegantha I have found it only in the gelatinous substance of the exumbrella, in the region of, and close to the margin of the gastric cavity. It occurs only in the smaller of our two specimens; *i. e.* the one in which no gonads are to be seen.

Although I have not been able to trace the earliest stages, or to find anything suggesting fertilization, there is no reason to doubt that the development is that of a fertilized ovum, as Stchelkanowzew (:06) has shown to be the case in *Cunina proboscidea;* for although no discrete gonads are present in the specimen, yet it is possible that the ova in this species as well as in *C. proboscidea* develop, not in localized masses, but irregularly over the oral surface of the gastric wall, where their small size and resemblance to ordinary ectoderm cells would render them difficult to recognize. Amoeboid cells such as Metschnikoff describes are very common in various regions of the jelly of the present species, and I can strongly support the accuracy of his observations that they divide by mitosis (Pl. **22**, fig. *8*), and may unite in pairs (Pl. **22** figs. *10*, *11*). I have found no evidence, however, that such pairs are the two resultants of the previous division of a single parent cell, or that the union is anything more than an accidental one. Stchelkanowzew has suggested (:06, p. 459) that these amoeboid cells (which he did not observe) are in reality the spermatozoa. The facts that they differ enormously in size (cf. Pl. **22**, fig. *1* with figs. *2–4*), and especially that they show mitotic division, suggest that this explanation is not correct.

The earliest stage undoubtedly belonging to the developmental series is represented in Pl. **22**, fig. *12*. It contains two nuclei, and study of several specimens has shown beyond question that it consists of two cells, one enclosing the other. The inner cell, the future larva, is spherical, its nucleus large, its cytoplasm dense and homogeneous. The outer cell, which, following Metschnikoff, we may call the nurse-cell, and which appears to have only a nutritive function, has vacuolated cytoplasm. The boundaries of the two cells are easily distinguished, the sharpness of limitation in the figures being no exaggeration of that in the specimens. The inner cell divides by mitosis (Pl. **22**, fig. *13*); two and four-cell stages were frequently observed (Pl. **22**, fig. *14*; Pl. **23**, figs. *1*, *2*); and through successive divisions a typical morula is formed (Pl. **23**, figs. *5–7*). The cleavage closely resembles the process as described by Metschnikoff, except that he found no stages in mitosis. Division of the cells is complete, and the boundaries of the blastomeres distinct and easily seen. Stchelkanowzew describes the cleavage of Cunina as superficial, the nuclei alone dividing, and thus forming a syncytium; but his figures suggest that his material was not very satisfactory, so that in view of the close correspondence of the present material with Metschnikoff's account, I am inclined to believe that cleavage is normally total. During all these stages the nurse-cell persists, and in all favorable examples its cytoplasmic body can easily be distinguished by its vacuolated nature and clearly visible outline from the cells of the larva which it encloses. The nucleus of the nurse-cell grows until its diameter is two or three times that of the nuclei of the morula, and becomes flattened until it forms a sort of cap to the latter (Pl. **23**, figs. *6*, *7*). It may remain single, or may divide directly once or twice, and there is some evidence that one or more of the nuclei resulting from such division may degenerate. This history of the nurse-cell agrees closely with Metschnikoff's account. Stchelkanowzew, however, could find no such structure in the early stages, while in the morula stage he observed two nurse-cells (: 06, taf. 30, figs. *32*, *33*, *35*, n, n′), which he believes are modified ectoderm cells of the larva, situated at the two poles of the latter. According to his view, the cells which Metschnikoff described as nurse-cells in early cleavage stages are nothing more than blastomeres. I feel certain that Metschnikoff's interpretation is the correct one, at least for the present species, since the history of the nuclei as well as the structure of the cytoplasm clearly distinguishes nurse-cell from blastomere; while the preparations are so clear as to leave no doubt that the former encloses the latter.

The embryo up to now lies within the jelly, close to the endoderm layer. Later stages, however, are to be seen only in the gastric cavity, or in the peripheral canals. The nurse-cell is apparently destroyed during the passage of the larva through the endoderm; at least it is absent in larvae which have penetrated into the gastric cavity.

The endoderm originates, as both Stchelkanowzew and Metschnikoff agree, by secondary delamination, there being no trace of any invagination. Even in such an early stage as that represented in Pl. **23**, fig. *7*, the four or five central cells are already sharply defined from the surrounding layer, and as development progresses the distinction is made more and more evident both by the differentiation of the endoderm cells, and by the development of a gelatinous layer between the two germ layers. The process in all respects agrees with the descriptions of Metschnikoff, the resemblance between his figures and corresponding stages in Pegantha being very striking.

Later development. — After entering the gastric cavity of the parent, the larva grows rapidly in size and becomes spindle shaped. The ectoderm cells multiply proportionately with the growth; but the endoderm cells multiply very slowly, but increase in bulk (Pl. **23**, figs. *7–11*), and gradually assume a chordate outline until they resemble the cells of the endodermic core of an adult tentacle. Indeed larvae at this stage very much resemble small detached tentacles. The earliest stage in which I have found a gastric cavity is represented in Pl. **24**, fig. *2*. I have been unable to find stages in the formation of the cavity. At a slightly more advanced stage the mouth, already foreshadowed by the thinness of the wall in Pl. **24**, fig. *2*, breaks through. At about this same time the development of the primary tentacle commences. Apparently the main portion of the larva goes to form the tentacle, as is the case with the two primary tentacles in Solmundella (Metschnikoff, '86^a). A second tentacle is developed opposite the first; other tentacles then appear irregularly, specimens having been observed with three, four, and five.

Budding. — Larvae with four or more tentacles often show stages in budding very similar to those described in detail by Metschnikoff ('74) for *Cunina prolifera*. He likewise seems to have observed one or two instances of this mode of multiplication in *Cunina proboscidea* ('86^a, taf. 12, figs. *4*, *13*), although Stchelkanowzew, not having found any himself, doubts their occurrence. In *Pegantha smaragdina* budding larvae are very numerous in the peronial and ring canals of the parent-host (Pl. **19**, fig. *5*). Budding takes place at the aboral pole, and comprises both germ layers, as well as a portion of the gastric cavity (Pl. **24**, figs. *3*, *5*). Surface views of a number of stages are represented on Pl. **25**. The bud may become constricted and separate from the parent larva while still a mere sac (Pl. **25**, fig. *6*), or it may remain attached and develop tentacles and a mouth which breaks through at the pole opposite that of attachment (Pl. **24**, fig. *6*); the tentacles are developed in the sequence already described. A second bud may be formed from the aboral plate of the parent while the first is still attached (Pl. **24**, fig. *6;* Pl. **25**, figs. *7–9*), but I have never seen more than two; nor have I seen any trace of the development of tentacles in the second while the first was still attached to it. Bud larvae being indistinguishable after detachment from larvae developed directly from the egg, it is impossible to tell how many generations of polyps may be formed by budding, or whether all develop into medusae.

The metamorphosis of the polyp larvae into medusae consists chiefly of a flattening caused by disproportionate growth on the part of the aboral disc between the bases of the tentacles. Successive stages in this process, which has been described by Metschnikoff ('86^{a}), are shown in Pl. **26**, figs. *1* to *5*. As noted by that author, the collar region first appears as a ridge surrounding the larva just oral to the tentacles. The collar, then, does not pass through a lobed stage, but is continuous from the beginning. We must, however, regard the peroniae as representing obliterated incisions between ancestral lobes. Thus it appears that, although morphologically the tentacles may be regarded as standing on the bell margin, in this species they never do so in actual development, since they are already some distance within the margin when the latter is first distinguishable as such. In this respect *P. smaragdina* differs from *Cunoctantha octonaria*, in which, according to both Brooks ('86) and H. V. Wilson ('87), the marginal lappets result from an outgrowth of the aboral surface *between* the tentacles, phylogenetically a more primitive condition.

The flattening continues with growth until the largest specimens, 12 mm. in diameter, are disc-like (Pl. **26**, fig. *5*), and at the same time the number of tentacles increases, the greatest number observed being thirteen. Octocysts are first distinguishable in the stage represented in Pl. **26**, fig. *4*, where they are merely papilliform processes of the margin, comprising both germ layers exactly like rudimentary tentacles (Pl. **26**, fig. *6*). Soon from one to five otoliths are formed, appearing first at the distal end (Pl. **24**, fig. *8*), and as the sense organ attains its mature form the connection of its endodermic core with the vascular endodermic layer is lost (Pl. **24**, fig. *7*). There are no otoporpae.

The gelatinous substance of the disc, always thin, first appears at about the stage represented in Pl. **26**, fig. *4*. As already noted (p. 92), no canal system is developed. The velum first appears as a ridge-like ectodermic thickening just oral to the nerve ring (Pl. **24**, fig. *8*). With further development it increases in breadth until it attains the practically adult condition represented in cross section (Pl. **24**, fig. *7*).

The medusa is now ready for independent existence, and swims vigorously, as I observed in living specimens. Metschnikoff ('86^a) has found a similar active condition in *Cunina proboscidea*. But Stchelkanowzew, writing of the same species, declares (: 06, p. 478) that the young are mere sacs full of genital products, never fitted for independent existence. Both these authors agree that in Cunina the parasitic generation becomes sexually mature at a stage no more advanced than that above described (Pl. **26**, fig. *5*). This is not the case in Pegantha, although the fact that at this stage the ectoderm of the oral gastric wall is already many cells deep (Pl. **24**, fig. *7*) very strongly suggests that the medusae are nearly mature and that the sexual products would soon be developed. The important systematic feature of the oldest medusae, *i. e.* lack of canals and of otoporpae, has already been noted (p. 92) in the systematic account of this species.

Pegantha laevis, sp. nov.

Plate 16, Fig. *1* ; Plate 20, Figs. *4–6* ; Plate 27, Figs. *1–7*.

Station.	Depth.	Diameter.	Tentacles and lappets.	Gonads.	
		mm.			
4650	Surface	41	22	Large ♂	1 fair specimen. Type.
4650	300 fathoms to surface	34	19	Large ♀	1 fragmentary specimen.
4650	300 fathoms to surface	30	16	None	1 fair specimen.
4729	Surface	28	18	None	1 fair specimen.

I likewise found an example of this species in the collection made by the "Albatross" in the Hawaiian Islands.

The bell is very flat for this genus, being only about one fourth as high as broad ; the disc lenticular ; the exumbrellar surface of the disc smooth, without any trace of sculpture (Pl. **16**, fig. *1*) ; but, as in all other members of the genus, there are slight ridges on the marginal lappets along the lines of the otoporpae. There is also a slight coronal furrow, separating the central disc from the marginal zone. The gelatinuous substance is softer than in other species of Pegantha which I have examined. It is possible, however, that this feature may be due to the rather unsatisfactory condition of the specimens. The marginal lappets are about as broad as long, and somewhat pentagonal in outline (Pl. **20**, fig. *5*), though less so than Maas has figured them for *P. dactyletra* ('93, taf. 5, figs. *1*, *2*). The incisions between the lappets are shallow and the peroniae correspondingly long.

Tentacles. — The greatest number of tentacles and lappets is twenty-two, in the largest specimen, while the only other individual with gonads has nineteen. The number, though variable, is thus considerably larger than in either *P. martagon* or *P. triloba.* A specimen 30 mm. in diameter, which as yet shows no trace of gonads, has only sixteen tentacles, one of them evidently of much more recent formation than the others (Pl. **20**, fig. *4*); but since no trace of the sexual organs is yet visible in this specimen, it is by no means certain that sixteen would have been the final number. The tentacles are of the usual type; about two thirds as long as the diameter of the bell, and in life carried projecting stiffly (Pl. **16**, fig. *1*).

Otocysts. — There are usually seven otocysts per lappet in the larger specimens; but unfortunately the margins of both adult individuals were so battered that I could count them in only a few lappets. The sense organs themselves (Pl. **20**, fig. *6*) are oval in outline, contain two or three otoliths, and are situated on small ectodermic pads. The otoporpae are much shorter than in other members of the genus which I have examined, extending hardly across the ring canal (Pl. **20**, fig. *4*; Pl. **27**, fig. *1*).

Gastro-vascular system. — The stomach is flat. In young specimens, in which its form is not obscured by the gonads, it is circular (Pl. **20**, fig. *4*). The mouth is surrounded by a simple circular lip, in all the present specimens widely opened. The canal system is well developed, both peronial and ring canals being very broad.

Gonads. — The gonads are not definitely subdivided, but, as in *P. martagon*, each consists of a single main swelling, which, in the present species, bears a variable number of oval or papilliform processes (Pl. **20**, fig. *5*). On comparison with Maas's figure ('93, taf. 5, fig. *1*) it will be seen that this type of gonad very closely resembles that of *P. dactyletra*, differing only in that the finger-like processes in *P. laevis* are smaller, — a difference of doubtful importance, since it is by no means certain that the gonads of any of the present specimens have reached their maximum development. As in the three other species of Pegantha described in this paper, each gonad is supported by a rounded prominence of the gelatinous disc.

P. laevis is entirely colorless; the disc hyaline, the endodermic system nearly opaque.

This species differs from all of the forms described by Haeckel ('79) in form of gonads, number of otocysts, number of tentacles, and lack of exumbrellar sculpture. It is, on the other hand, very closely related to the *P. dactyletra* described by Maas ('93, p. 47) from the Tropical Atlantic. As already pointed out, the gonads of the two forms are very similar, the slight differences between his account and the present specimens being easily explicable as the result of different stages in growth. The number of otocysts (five to seven per lappet) and the pentagonal form of the marginal lappets likewise agree in the two species. There is an apparent difference in the number of tentacles, Maas recording only sixteen for *P. dactyletra;* but I doubt whether this indicates anything more than individual variation, since one of the two adult specimens in the present collection has only eighteen, and since Maas had only a single specimen of *P. dactyletra.* Of no more importance is the apparent difference in size, for the "Plankton" specimen was described by Maas after preservation (with osmic acid), and therefore the diameter which he gives, 30 mm., is no doubt smaller than the Medusa actually was in life. The only important distinction seems to be the presence of a well-marked exumbrellar sculpture in *P. dactyletra,* and its entire absence in *P. laevis.* It is, of course, impossible to state whether this feature is constant until more specimens, particularly of *P. dactyletra,* are examined; but since sculpture is an important character in other members of the genus, it seems best to recognize the present form as a distinct species, at least for the present.

The capture of a specimen of this species by the "Albatross" among the Hawaiian Islands shows that it, like *P. triloba,* is of very general distribution throughout the Eastern Pacific.

Pegantha laevis, as already noted (p. 9), shows the early stages in a type of internal budding very similar to that which I have described (p. 62) for *Cunina peregrina.* In the present species, however, the process takes place, not in the gastric cavity proper, as in Cunina, but in the peripheral canals (ring canal alone?). In a budding individual the oral wall of the ring canal bears irregular ridges and swellings (Pl. **27**, fig. *1*), which vary in form. On sections it is seen that these ridges are purely endodermic structures, the ectoderm taking no part in their formation; but here, as in Cunina, I must acknowledge the possibility of a migration into the budding region of amoeboid ectoderm-cells, although I have seen no indication of the occurrence of such a process. The ridges, as in Cunina, are proliferating regions, from which the true buds or planulae are given off, but, in Pegantha, budding instead of being restricted to them, may take place from the undifferentiated endoderm in other regions of the canal (Pl. **27**, fig. *5*). The buds are solid, ciliated, morula-like structures, in which the cell boundaries are easily distinguishable (Pl. **27**, figs. *6*, *7*). A considerable number were found lying free in the gastric cavity, but since no further advanced stages were observed, it is probable that they now pass out through the mouth of the parent, to continue their development either independently or in some other host.

TRACHOMEDUSAE.

Most authors now recognize in this order six families:—Petasidae, Pectyllidae, Geryonidae, Halicreasidae, Aglauridae, and Trachynemidae. Of these the first four are well marked, and probably represent natural phylogenetic groupings, but the separation between the last two seems to be based on unsatisfactory grounds. Thus, as Maas (: 06^d, p. 494) has already pointed out, the presence or absence of a gelatinous peduncle, considered by Haeckel ('79) the most important character separating Aglauridae from Trachynemidae is of much less taxonomic importance than has usually been supposed, — a conclusion strongly supported by the fact that the new genus Tetrorchis in the present collection, very closely related to Aglaura in so far as the structure of the gonads is concerned, lacks a peduncle.

The conformation of the gonads, whether extending along the radial canals or hanging free in the bell cavity, seems to me of but little more systematic significance, since this criterion, if rigidly applied, must lead to the removal of Agliscera from the Aglauridae, although its closest natural allies are undoubtedly the genera Aglaura and Aglantha. The form of the bell is certainly not a family characteristic, for either a high or a low bell may be associated with a peduncle, or with either linear or pendent gonads; nor can we use the otocysts, whether free or enclosed, as a family character, as Browne (: 04) has done, without confusing other structural characters which apparently are fully as important. There is one character which seems to me to be more significant than has usually been supposed; that is, whether the tentacles are of one or of two kinds, but even this can hardly be made the basis of family distinction, since to do so would result in separating Rhopalonema from genera to which it is universally believed to be closely related.

On the whole, it is best to discard the separation between Trachynemidae and Aglauridae, and to unite the component genera of the two into one family, for which the older name Trachynemidae may be retained. This family will then be characterized as: — Trachomedusae with eight radial canals; without blind centripetal canals; with well-developed manubrium; with numerous tentacles arranged in a single series, but of either one or two kinds; gonads either pendent or linear.

The collection contains fifteen genera and eighteen species of Trachomedusae, of which two genera, three species and one variety are believed to be new.

Petasidae Haeckel, 1879.

sens. em. Browne (: 04).

Trachomedusae with four or six radial canals on which the gonads are borne; with either enclosed sense capsules or free sensory clubs.

We may well follow Browne in separating the Petasidae into two subfamilies, Petachninae and Olindiinae, according as the otocysts are free clubs or enclosed capsules. The present collection contains members of the Olindiinae only. Indeed, so far as I can learn, no one since Haeckel has observed any members of the Petachninae.

Although Goto (: 03) believes, from his studies on the development of Olindioides, that the sense organs of Olindioides are ectodermic, and that the Olindiinae therefore belong to the Leptomedusae, recent students (Browne, : 04, Mayer, : 04, Maas, : 05) agree in classing them among the Trachomedusae. Certainly in all respects, except possibly the origin of the otocysts, they are typical of this order; and very recently doubt has been thrown on Goto's conclusion, that the sense organs are ectodermic, by Murbach, who makes the positive statement (: 07, p. 2, footnote) that in *Gonionemus murbachii*, at least, they are of endodermic tissue. I therefore retain the Olindiinae among the Trachomedusae, where I believe they undoubtedly belong.

Mayer (: 04) makes the presence of sucking discs one of the distinguishing features of this family, thus excluding Gossea and Aglauropsis. Both of these genera, however, are in other respects closely allied to Gonionemus; Aglauropsis even being believed by Maas (: 05) to be a synonym of the latter, so that it is better to consider this character, with Browne (: 04), as of generic value only. I regret that my account of rudimentary sucking discs in *Gonionemus pelagicus* should have led Maas (: 05) to believe that these structures may be variable in any genus, for a renewed examination of the original specimens has shown that my description was erroneous in this respect. Maas, arguing from this conclusion, believes that the status of Aglauropsis and of Vallentinia is doubtful; the former he is inclined to unite with Gonionemus, the latter with Cubaia. I see no reason to doubt the diagnoses of these two genera, given from new material, by such a careful student as Browne, and therefore retain them. The characters of greatest taxonomic value within the family are, as all recent students agree, the presence or absence of centripetal canals; the presence of one or of two distinct series of tentacles; the arrangement of tentacles, whether uniform or in groups; and (although Maas dissents from this) the presence or absence of sucking discs on certain of the tentacles. As to which of these are of greater, which of less value, it is difficult to determine. It seems to me that considerable weight is to be laid on whether the tentacles are in a single series or in two series; this character being, as we know from the studies of Mayer (: 04), one intimately connected with ontogeny. The same is likewise true, though in less degree, of the presence or absence of centripetal canals. Mayer has given taxonomic weight to the conformation of the gonads, whether papilliform or sac-like; but this is a character which changes much with growth, and one which I believe to be of minor importance.

The genera may be tabulated in the following artificial key: —

- A. With one kind of tentacles.
  - 1. Tentacles without suckers; no centripetal canals.
    - Tentacles not in groups. Aglauropsis (? Maeotias, Ostroumoff).
    - Tentacles in groups. Gossea.
  - 2. Tentacles with suckers. Gonionemus.
- B. With two kinds of tentacles.
  - 1. Without centripetal canals.
    - Four perradial tentacles alone with sucking discs. Vallentinia.
    - Two series of tentacles; the numerous primary tentacles all with sucking discs. Cubaia.
  - 2. With centripetal canals. Primary tentacles with sucking discs.
    - Four radial canals. Olindias.
    - Six radial canals. Olindioides.

We must bear in mind that the tentacles of group A correspond (as Mayer : 04 has shown) to the primary tentacles of group B.

The present collection contains specimens of three of these genera, Gossea, Gonionemus, and Olindias.

Gossea L. Agassiz, 1862.

sens. em. Browne (:04).

Olindiinae with tentacles of one kind only, arranged in eight groups, and with other single tentacles or cirri; without sucking pads on any of the tentacles; without centripetal canals.

Gosse ('53, p. 407, pl. 21) has given us an excellent description and unusually beautiful figures of his *Thaumantias corynetes*, for which L. Agassiz later founded the genus Gossea; and a second species has been described by Haeckel ('79) under the name *G. circinata*, from the coast of France, but the latter is almost certainly nothing more than an older stage of *G. corynetes*. The only important differences between the two are the presence of three members in each tentacle group in *G. circinata* instead of two and a small spur, as in *G. corynetes;* and the presence in the former of adradial cirri, which are lacking in the latter; but these differences are merely developmental characters, since Gosse ('53) has himself mentioned the discovery of a few specimens of *G. corynetes* in which the third tentacle in each group was considerably larger than it appears in his figures.

Gossea brachymera, sp. nov.

Plate 30, Figs. *1–10.*

Acapulco Harbor; surface; 1 specimen, 5 mm. in diameter, 4 mm. high.

Fortunately the single specimen was in such excellent condition as to enable me to study and illustrate it in detail.

The bell is high, dome-shaped (Pl. **30**, fig. *1*); the gelatinous substance stiff and so thick that the umbrellar cavity is very shallow. The manubrium, supported on a short, broad peduncle, is very short. In *G. corynetes* there is no peduncle. There are four triangular, slightly fimbriated lips.

Bell margin. — The arrangement of the tentacles is of course the most characteristic feature of Gossea, and in this respect the present specimen shows a condition either less advanced (if it prove to be merely an early stage of development) or more primitive (if it be the final condition) than does *G. corynetes.* There are eight groups of tentacles, four perradial and four interradial, and in addition eight adradial tentacles which are single. Each tentacle group consists of two members, rising side by side from a single bulb (Pl. **30**, figs. *7–9*); one about as long as the bell diameter, ringed with nettle cells, solid, arising from the surface of the exumbrella some distance above the actual margin, and connected with the ring canal by an endodermic root just as are the exumbral tentacles of Olindias, with a nettle cluster at the tip, but no sucking disc (Pl. **30**, fig. *6*); the other is so short as to be hardly more than a spur, and arises directly from the nematocyst pad. It shows, however, the earliest stages in the development of nettle rings, and bears at its tip a nettle pad, clearly visible in the photographs. Alternating with these eight groups are eight simple tentacles, resembling in structure the large members of the tentacle groups, though smaller than the latter. Finally, alternating with these sixteen tentacles and groups are sixteen swellings or papillae clearly seen in the photograph (Pl. **30**, fig. *2*). In *G. corynetes*, according to Haeckel ('79), there are the same number of groups of tentacles, *i. e.* eight; but each contains three nearly equal members, while Gosse's figures of younger specimens show three, two large and one very small. It is evident, then, that the full number is not attained until an advanced stage in development is reached. The single adradial tentacles evidently correspond to the adradial cirri of *G. corynetes*, but are much larger. The latter species appears to lack the rudimentary bulbs or papillae seen in the present specimen. If Haeckel's ('79) account be correct, another important difference between the two species is in the structure of the tentacles, for while he describes them as hollow in *G. corynetes*, in the present species they are solid, with a core of chordate endoderm cells (Pl. **30**, fig. *10*).

Otocysts. — In spite of the good condition of the specimen I am unable to give any account of the otocysts. Most careful search with the microscope failed to reveal any on the bell margin, although both Gosse ('53) and Haeckel ('79) agree that in *G. corynetes* two or three otocysts occur on the margin between every two groups of tentacles. In the present species, however, they appear to be replaced by the rudimentary tentacular papillae, which are solid and bear no resemblance to sense organs. In one case I distinguished near the base of one of the primary members of a tentacle group what appears to be an otocyst (Pl. **30**, fig. *5*), so that, although I was unable to find any in connection with other tentacles, it is not unlikely that the otocysts in this species occupy the same position that they do in Olindias.

Gonads. — These, as in *G. corynetes*, are simple folds extending along the oral surfaces of the radial canals, without papillae or secondary plications. They occupy about the central third of the canals. In the single specimen they are full of moderate-sized ova.

Color. — The specimen was not examined until after preservation. Gonads, tentacles, and manubrium are pale yellowish brown, and the bell hyaline. In *G. corynetes* there are one or two red or brown spots at the base of each tentacle group, but these are lacking in *G. brachymera.*

The presence of a well-marked peduncle serves to separate this species from *G. corynetes*, and may be considered its most important specific character. The condition of the tentacles is also of taxonomic value, the large size of the single perradial tentacles, and the presence of rudimentary papillae on the bell margin sharply distinguishing it from the North Atlantic species. If, as seems probable from the advanced state of the sexual organs, the number (two) of members in each tentacle group is the final one, this forms another important difference between the two species.

Gonionemus A. Agassiz, 1862.

Olindiinae with four radial canals; without centripetal canals; with a single series of tentacles not in groups; each tentacle with a sucking disc.

Since the description of the original species of this genus, *Gonionemus vertens*, by A. Agassiz ('65), six additional species have been described: — *G. murbachii* Mayer (: 04), *G. suvaensis* Agassiz and Mayer ('99), *G. depressum* Goto (: 03), *G. agassizii* Murbach and Shearer (: 03), *G. pelagicus* Bigelow (: 04), and *G. hornelli* Browne (: 05^b^). Fortunately, all these have been well described and figured. I have been able to examine specimens of *G. vertens* (type), *G. suvaensis* (type), *G. pelagicus* (type), and a very considerable series of *G. murbachii*, in addition to the specimens in the present collection.

The species fall into two well-marked groups: —

A. With sixteen otocysts; with the gonads distal, occupying from one fourth to one third of the radial canals. This includes *G. suvaensis*, *G. hornelli*, *G. pelagicus.*

B. With at least as many otocysts as tentacles; number of otocysts variable; gonads occupying nearly the entire length of the radial canals; *G. vertens*, *G. agassizii*, *G. depressum*, *G. murbachii.*

I have not been able to find good distinctions between the three "species" of group A. All have about the same number of tentacles (seventy to eighty), about the same bell outline and conformation of gonads, and essentially similar coloration. Browne states that in *G. hornelli* the tentacles are arranged in sixteen groups; but from an examination of his figure (: 05^b, pl. 1, fig. 6) it appears that this grouping indicates the location of the sixteen otocysts, and is in no way comparable to such a grouping of tentacles as is seen in Gossea (p. 103). In my description of *G. pelagicus* (: 04, p. 256) I considered the small size of the sucking discs of this species sufficient to separate it specifically from *G. suvaensis;* but a second examination of the specimen has shown that this supposed character is variable in different tentacles, and perhaps due largely to preservation, so that I was not justified in making a new species for this form, which is really *G. suvaensis.*

In the second group, characterized by the form of the gonads and by having a large and variable number of otocysts, it appears that several good species can be distinguished. The number of otocysts, even though variable, is apparently of specific significance, for while *G. vertens* and *G. murbachii* have about as many otocysts as tentacles or slightly fewer, *G. depressum* and the specimens described by Kirkpatrick (: 03) under the name *G. agassizii* have nearly or quite twice as many, and this difference is apparently constant, for very considerable series of *G. vertens* and *G. murbachii* have now been examined by various observers; the latter, owing to its common use as laboratory material and as subject for experiment, being very well known indeed. The differences between *G. vertens* and *G. murbachii* are slight, consisting of a slightly higher bell in the former and stouter tentacles in the latter; but they appear to be constant, and must therefore be recognized in the nomenclature of the genus.

Gonionemus depressum Goto, and the specimens described by Kirkpatrick (: 03) as *G. agassizii* Murbach and Shearer, both from Japan, are undoubtedly identical, agreeing as they do in the form of the gonads, number and form of the tentacles, and number of otocysts; but it is doubtful whether Kirkpatrick's identification of his specimens with Murbach and Shearer's (: 03) species is correct; for, while the latter authors state that *G. agassizii* has rather fewer otocysts than tentacles (though without giving actual figures), Kirkpatrick (: 03) finds the otocysts almost twice as numerous as the tentacles. For this reason I prefer, at least for the present, to retain both *G. depressum* and *G. agassizii* as distinct species, classing Kirkpatrick's specimens as *G. depressum.* The distinction between *G. agassizii* and *G. vertens*, the greater number of tentacles of the former, must be tested in a larger series before a final decision can be reached.

Gonionemus suvaensis Agassiz and Mayer.

Gonionemus suvaensis Agassiz and Mayer, '99, p. 164, pl. 5, figs. *14–16*.
Gonionemus pelagicus Bigelow, : 04, p. 256, pl. 4, figs. *12–14*.
Gonionemus hornelli Browne, : 05^b, p. 149, pl. 1, fig. *6*, pl. 2, fig. *4*.

Plate 3, Figs. *4, 5;* Plate 32, Figs. *1–7*.

Mangareva Harbor; surface; 12 specimens, ranging in diameter from 4 mm. to 10.5 mm.

The high arched bell and the considerable length of the manubrium are shown in the photograph Pl. **3**, fig. *5*. As in Browne's specimens, the manubrium is situated on a very low peduncle, which is just visible in the side view in Pl. **3**, fig. *5*.

In the smallest specimen there are fifty-two, in the largest about eighty tentacles; all have sixteen otocysts, four per quadrant (Pl. **32**, fig. *1*). Each otocyst contains a single spherical otolith (Pl. **32**, fig. *6*). The tentacles are of different sizes, the longest about one third as long as the bell diameter, and stout; their sucking discs, very prominent (Pl. **32**, fig. *3*), at about midway of their length; but the exact position of these organs depends somewhat on the state of contraction of the tentacles. Even in the small specimens gonads are present, while in the larger ones they are well developed and approaching sexual maturity. Their characteristic location, restricted to the distal fourth or third of the radial canals, is well shown in the photographs of side and oral views (Pl. **3**, figs. *4* and *5*). In small specimens the sexual organs consist of a more or less wavy fold on the oral surfaces of the radial canals, but with advancing development the plications of the fold increase, until finally they become very complex (Pl. **32**, fig. *5*). The essentially ribbon-like structure is always retained, there being no papilliform processes, such as are formed in the closely allied genus Olindias. My figure of the gonad of the Maldive specimen (: 04, pl. 4, fig. *13*) was incorrect in this respect. An interesting abnormality was exhibited by one specimen which had only a single radial canal, with one very large gonad (Pl. **32**, fig. *7*).

Color. — The gonads are brownish red; tentacles and tentacular bulbs pale yellowish. The Fiji specimens figured by Agassiz and Mayer ('99) had green pigment spots at the bases of the tentacles, while in the Maldive specimen (Bigelow, : 04) these pigment spots were brown. There is thus considerable local variation in the pigmentation of this species.

Gonionemus suvaensis differs from the *G. vertens* group not only structurally but in its habits. While the latter have usually been recorded from land-locked ponds or harbors, where they often cling to Algae, *G. suvaensis* is more truly pelagic, occurring in open sounds and lagoons, or on the surface of the open sea (Bigelow, : 04). Although it has been observed in life at Mangareva, among the Maldive Islands (Bigelow, : 04), and among the Fiji Islands (Agassiz and Mayer, '99), it has never been seen to exhibit the peculiar "turning" habit of swimming so characteristic of *G. vertens*, *G. murbachii*, and *G. depressum* (Goto, : 03).

This species is widely distributed over the Tropical Pacific and Indian Oceans, but appears to be restricted to shoal-water regions in the close neighborhood of land.

Olindias F. Müller, 1861.

Halicalyx Fewkes, '82^{a}.
Halicalyx Mayer, : 00^{b}.

Olindiinae with four radial canals, with two kinds of tentacles, the primary tentacles bearing sucking discs; with blind centripetal canals.

Maas (: 05) has pointed out that the Atlantic forms of this genus, *O. phosphorica* Della Chiaje (*mülleri* Haeckel), *O. sambaquensis* F. Müller, and *O. tenuis* Mayer (Fewkes ?), can hardly be distinguished, since the various characters which have been supposed to separate them, *i. e.* conformation and lobing of the gonads, and number of marginal organs, not only change with advancing development, but are subject to great individual variation (see Table, p. 109). As a variety of this one Atlantic species, he identifies specimens in the "Siboga" collection, from the Malay Archipelago, under the name *O. phosphorica*, var. *malayensis*.

Browne (: 04) has recently described under the name *O. singularis* another species distinguishable from *O. mülleri* and its varieties by the presence of distinct bulbs at the bases of the secondary (velar) tentacles, and of only one otocyst, instead of a pair, at the base of each primary tentacle. The present specimens, as well as an excellently preserved specimen from Dutch Papua, appear to belong to *O. singularis* Browne, although this large series shows that Browne's original description, taken from but a single specimen, must be somewhat modified.

Maas (: 05, p. 48) has compiled a table of the numerical condition of canals and tentacular structures; but since his figures, though illustrating very well their variability, do not altogether agree with my observations on a considerable series from different localities, the following table is appended. The chief difference is that I have found a proportionately greater number of primary (exumbral) tentacles than either Haeckel ('79), Maas (: 05), or Mayer (: 00^{b}, : 04) have recorded, and proportionately fewer secondary tentacles and tentacular bulbs.

Species, Locality, Authority.	Primary tentacles.	Secondary tentacles.	Bulbs.	Otocysts per primary tentacle.	Canals per quadrant.	Diameter, mm.
müllleri. Mediterranean, Haeckel	50–60	100–120	100–120	2	11–19	40–60
mülleri. Mediterranean, mihi	109	84	143	2	12, 14, 16, 11	61
mülleri. Mediterranean, Goto	. . .	35	140–170	2	. . .	50
mülleri. var. malayensis, Maas	20–30	30–40	120	2	7–9	25–35
sambaquensis. Brazil, Müller	80–100	200–300	100–120	2	21–27	70–100
tenuis. Tortugas, Mayer	32	60	64	2	7	35
tenuis. Key West, mihi	51	38	64	2	10, 6, 10, 8	27
tenuis. Bermuda, mihi	54	56	69	2	9, 7, 7, 8	23
singularis. Maldives, Browne	30–40	16–20	30–40	1	4–5	13
singularis. Maldives, mihi	ab't 45	ab't 30	ab't 50	1 at most	6–7	20
singularis. Mangareva, mihi	86	50	104	1 at most 2 at a few	12, 11, 11, 11	36
singularis. Mangareva, mihi	69	48	98	1 at most 2 at a few	9, 8, 8, 9	25
singularis. Mangareva, mihi	47	29	70	1 at 44 2 at 3	6, 7, 7, 7	17
singularis. Dutch Papua, mihi	62	27–30	72	1 at most 2 at 6 or 7	7, 8, 8, 8	34

Olindias singularis Browne.

Olindias singularis Browne, : 04, p. 737, pl. 56, fig. *2*, pl. 57, fig. *1*.

Plate 4, Fig. *1*; Plate 31, Figs. *1–10*; Plate 32, Fig. *8*.

Mangareva Harbor; surface; 23 specimens, 16 to 36 mm. in diameter.

The general form of this graceful species, as seen in side view, and the extent of the gonads, are shown in the photograph reproduced on Pl. **4**, fig. *1*. In all structural features, except for the arrangement of the otocysts, it so closely resembles *O. phosphorica* that no extended account is necessary here. Browne was unable to find any sucking pads on the primary tentacles in the Maldive specimen, and has therefore raised the question whether Olindias does actually possess such organs; but inasmuch as the claw-like terminations of the primary tentacles which he describes undoubtedly correspond to the structures interpreted as suckers by other authors, and which occur in the present specimens (Pl. **31**, fig. *8*), the distinction is apparently one of definition rather than of observation. To determine conclusively whether these terminal organs do exercise an adhesive function requires observations on living specimens. They do in *O. phosphorica*, a phenomenon I have myself observed at Bermuda.

The presence or absence of basal bulbs on the secondary tentacles is closely connected with the state of contraction of the latter. When the tentacles are extended, their bases, which are free from nematocyst bands, are pear-shaped, and of considerably larger calibre than the distal portions. In a state of contraction, however, the filamentous, nematocyst-bearing portions of the tentacles increase so much in thickness, corresponding to the decrease in length, that the basal swelling may be entirely masked, and that region may actually be of smaller calibre than the remainder of the tentacle. Intermediate conditions are of course more numerous than either of these extremes. Thus it is evident that the presence of basal bulbs is a less important character than Browne's single specimen might suggest; yet, inasmuch as none of the numerous excellently preserved West Indian specimens of *O. phosphorica* which I have examined show any trace of basal enlargements on even the most extended tentacles, it is not unreasonable to retain this feature as one of the distinctive characters of *O. singularis*.

The secondary tentacles terminate in nematocyst knobs (Pl. **31**, fig. *7*). The finer structure of the two types of tentacles has been fully described by Goto (:03).

The number of otocysts is an important specific character in this form. In the small specimens, 16–17 mm. in diameter, there is usually only one in connection with each of the primary tentacles. In larger specimens, however, more of them are paired. In the largest specimens, 30–36 mm. in diameter, single and paired otocysts are in the proportion of about four to one (Pl. **31**, fig. *4*). When but a single otocyst is present at the base of a primary tentacle it usually lies in the plane of the tentacle root (Pl. **31**, figs. *3–5*); and though there is some irregularity in this respect, I have never seen a *single* otocyst lying at one side of the base of a tentacle. The numerical condition of the otocysts is to be interpreted as phylogenetically more primitive in *O. singularis* than in *O. phosphorica;* for while all authors agree that in adults of the latter species the otocysts are invariably *paired*, Mayer (:04) has found that in the young they first appear singly, opposite the bases of the primary tentacles. Each otocyst may contain either one or two spherical otoliths (Pl. **31**, fig. *10*).

Gonads. — In the largest specimens the gonads, which first appear near the ring canal, and with increasing development extend centripetally, occupy the distal half of the radial canals. Since in *O. phosphorica,* in an advanced stage, the gonads occupy nearly the entire length of the canals, it is possible that the extent of these organs may afford another specific character.

The number of blind centripetal canals increases rather irregularly with growth, as Mayer (: 04) has described for the young stages of *O. phosphorica.* The largest number observed in any one quadrant was twelve, in the entire bell, forty-six. Large specimens have, as a rule, from eight to eleven canals per quadrant.

Color. — The gonads are reddish brown to brick red. Otherwise the Medusa is colorless.

An interesting abnormality of this species (Pl. **32**, fig. *8*) has two separate gastric cavities and no less than nine gonads; of these, four lie on the radial canals, and the other five, which are much smaller, are situated on blind canals which run outward from the gastric cavity.

Geryonidae Eschscholtz, 1829.

sens. em. Haeckel, '79.

Trachomedusae with four or six radial canals; with blind centripetal canals; with long gelatinous peduncle; tentacles in the young, of two kinds; gonads borne on the subumbrella.

Two genera are now generally recognized in this family, Liriope with four, and Geryonia with six radial canals. Both of these are represented in the collection.

Liriope Lesson, 1843.

sens. em. Maas, '97.

Geryonidae with four radial canals.

I agree with Vanhöffen (: 02^b) and Maas (: 05) that of the various characters which have been used to separate species in this genus, *e. g.* persistence of embryonic tentacles, number of blind canals, form, size, color, and conformation of the gonads, all but the last are subject to such great individual variation as well as to such great changes with growth as to be wholly useless. The shape of the gonads, however, seems more reliable, so long as employed with due regard to the various stages through which these organs pass with the progress of development.

The present collection contains two well-marked forms with regard to the shape of the gonads; one with these organs primarily triangular, the other with them elongate, narrow, and oval. The series shows clearly that Vanhöffen had good ground for maintaining that the forms, heart-shaped and triangular, are but variations, often caused by contraction and preservation, of a single ground form, and that this difference is not indicative of specific divergence. I have no doubt that *L. tetraphylla* of the present collection is identical with the form from the Pacific described by Maas under the name *L. rosacea*, and of which he has given an excellent figure ('97, taf. 3, fig. *7*), and with those recorded by him (: 05) under the same name from the collections of the "Siboga"; and at the same time there seems to be no stable character to separate it from the specimens of Liriope with triangular gonads from both Atlantic and Indian oceans, which Vanhöffen (: 02^b) has united under the name *L. tetraphylla.* It is doubtful whether all the species included by Vanhöffen in the "tetraphylla" group, particularly *L. cerasus*, *L. eurybia*, and *L. bicolor*, really belong there, since in the form of the gonads they suggest close affinity with *L. scutigera.*

Maas (: 05) distinguishes three varieties in the "Siboga" collection,—*L. tetraphylla* with ovoid, *L. rosacea* with triangular, and *L. compacta* with rhomboid gonads, but inasmuch as the present series shows all gradations between the two extremes, there is good reason to believe that these represent merely three successive stages in the development of a single species.

I am puzzled to find any satisfactory identification for the second species contained in the collection, that with narrow oval gonads; and since an incorrect identification is worse than none, because it may prove misleading to students of the geographic distribution of this troublesome genus, I hesitate to assign any specific name to it.

Liriope tetraphylla Chamisso.

Geryonia tetraphylla Chamisso, '20, p. 357, taf. 27, fig. *2.*
Liriope tetraphylla Gegenbaur, '56, p. 257; Vanhöffen, : 02^b, p. 82; Maas, : 05, p. 61.
Liriantha tetraphylla Haeckel, '79, p. 286.
Xanthea tetraphylla L. Agassiz, '62, p. 365.
Liriope crucifera Haeckel, '79, p. 290.
Geryonia rosacea Eschscholtz, '29, p. 89.
Liriope rosacea Gegenbaur, '56, p. 257; Maas, '97, p. 26, taf. 3, figs. *7, 8;* : 05, p. 62, taf. 9, figs. *58, 59.*
Glossocodon lütkenii Haeckel, '79, p. 293, taf. 18, fig. *5.*
Liriope lütkeni Vanhöffen, : 02^b, p. 79.
Liriope compacta Maas, '93, p. 37, taf. 3, fig. *11;* : 05, p. 62, taf. 9, figs. *55–57.*
Glossocodon agaricus Haeckel, '79, p. 293.
Liriope agaricus Vanhöffen, : 02^b, p. 79.

The synonymy given above seems to me fairly well established. It is probable that the following names should also be added, but their identity is somewhat less assured: — *L. appendiculata* Forbes, *L. conirostris* Haeckel, *L. cerasiformis* Lesson, and *L. mucronata* Gegenbaur. The identity of *L. hyalina* Agassiz and Mayer ('99), and of *L. indica*, and *L. hemisphericus* Bigelow (: 04), which, as Maas (: 05) has pointed out, are probably not good species, cannot be settled because of the immature condition of their gonads; it is probable, however, that they likewise belong here.

Plate 3, Figs. *6, 7;* Plate 4, Figs. *2, 3.*

Station 4574; 300 fathoms to surface; 3, small.
Station 4575; surface.
Station 4587; 300 fathoms to surface; several, small.
Station 4588; surface; several, early stages.
Station 4592; surface; many small specimens.
Station 4596; surface; 3, 3–10 mm. in diameter.
Station 4605; 300 fathoms to surface.
Station 4607; 300 fathoms to surface; several, small.
Station 4609; 300 fathoms to surface; 1, 2 mm. in diameter.
Station 4611; surface; swarm; large specimens and several early stages.
Station 4613; 300 fathoms to surface; 2, fragmentary.
Station 4634; 300 fathoms to surface.
Station 4638; 300 fathoms to surface.
Station 4640; surface; several, 5–10 mm. in diameter.
Station 4643; surface; 3 specimens, large, *L. rosacea* stage.
Station 4644; surface; several.
Station 4648; 300 fathoms to surface; several.
Station 4655; surface; early stages.
Station 4657; surface; several small specimens.
Station 4659; surface; 3.
Station 4661; surface; 3 large specimens, *L. rosacea* stage.
Station 4663; surface; swarm, various sizes.
Station 4664; surface; 2 specimens, gonads just appearing.
Station 4665; surface; several.
Station 4667; surface; several.
Station 4667; 800 fathoms to surface.
Station 4669; surface; several.

Station 4670; in trawl, from 320 fathoms; 1, fragmentary.
Station 4671; surface; swarm, *L. compacta* stage.
Station 4673; 300 fathoms to surface.
Station 4673; surface; 2 large specimens, *L. compacta* stage.
Station 4673; 300 fathoms to surface; 2.
Station 4680; surface; 1 specimen.
Station 4682; surface; 2 specimens.
Station 4702; surface; 2 specimens.
Station 4708; surface; 6 specimens.
Station 4710; surface; swarm, *L. rosacea* stage.
Station 4712; surface; several.
Station 4714; surface; 1 large specimen, *L. rosacea* stage.
Station 4716; surface; 2 specimens.
Station 4718; surface; 1, fragmentary.
Station 4724; 300 fathoms to surface; 1, 20 mm. in diameter.
Station 4735; surface; 2 specimens.
Station 4741; surface; 1 specimen.
Acapulco Harbor; surface; many specimens, early stages and *L. rosacea* stage.

The collection contains a series showing different stages in the development of the gonads. The commonest condition, and one which from its resemblance to the figures of Eschscholtz ('29, taf. 11, fig. *2*) and Maas ('97, taf. 3, fig. *7*), we may term the *L. rosacea* stage, is represented in the photograph (Pl. **3**, fig. *7*). In a majority of cases the triangular form of the gonads showed clearly; but in a few instances, apparently as the result of muscular contraction, the gonads are heart-shaped, the basal border being more or less deeply incised. The occurrence of a complete series connecting the two forms demonstrates that Vanhöffen (: 02^b) was correct in believing them to be merely variations of one type. I never, however, observed truly ovate gonads except in the case of *very* small individuals (Pl. **4**, fig. *3*). It is most interesting that the collection contains a number of specimens showing in a typical degree the form of gonads believed by Maas ('93, : 05) to be characteristic of *L. compacta*, in which these organs are rhomboid, truncate, and in contact with one another; but since these were invariably the largest individuals, and since I found every conceivable grade between slightly truncate triangular gonads to pentagonal ones of an even more pronounced form than is shown in the photograph (Pl. **3**, fig. *6*), it seems to me clear that the latter is merely the final condition of the former and therefore deserves no recognition in nomenclature.

The gonads in very small specimens are ovate (Pl. **4**, fig. *3*), such as are believed by Maas to characterize the species *L. tetraphylla;* but this is only a transitory stage, for with growth the gonads broaden at their basal end, while remaining of about the same breadth at the distal end, — a change resulting in the attainment of the triangular form. An interesting feature connected with the growth of the gonads is that the radial canal distal to the sex organ is very much broader than it is proximal to the latter.

This character, as well as the form of the gonads, separates *L. tetraphylla* from the second species of Liriope in the collection, and it is because of the form of the canals (broadest at their distal ends) that I have included in *L. tetraphylla* such larval stages as that represented on Pl. **4**, fig. *2*.

The series shows clearly that the number of blind canals per quadrant is of no taxonomic significance, for although seven seems to be the normal final number, large specimens may have fewer, there being much variation in this respect.

The color is variable; most specimens are colorless, but in others the gonads and manubrium are yellowish.

L. tetraphylla seems to be a typical oceanic species; it has, under its various synonyms, been recorded from the tropical and subtropical waters of all oceans. It occurred regularly over the entire area traversed by the "Albatross."

Liriope species ?

Station 4571; 300 fathoms to surface; various stages.
Station 4575; surface.
Station 4605; 300 fathoms to surface.
Station 4634; 300 fathoms to surface.
Station 4638; 300 fathoms to surface.
Station 4640; surface.
Station 4648; 300 fathoms to surface.
Station 4664; surface.
Station 4710; surface.
Station 4712; surface.

Several specimens at each station.

The series contains all stages from the first appearance of gonads up to specimens some 15 mm. in diameter. They are distinguished from *L.*

tetraphylla by the narrow, oval form and distal position of the gonads, and by the narrowness of the radial canals. In all the specimens, moreover, the gelatinous substance is thinner and softer than in *L. tetraphylla,* but whether this can be considered a specific character is doubtful.

Geryonia Péron et Lesueur, 1809.

Geryonidae with six radial canals.

Like the collections of most of the previous deep-sea expeditions, that of the "Albatross" contains very few specimens of this genus compared to the vast numbers of Liriope, — a fact interesting because the two genera are now known to be of parallel distribution in the warmer waters of all oceans. I follow Vanhöffen (: 02^{b}) in referring the present specimens to the oldest species, *G. proboscidalis* Forskål. Probably, as he suggests, the number of centripetal canals per sextant will prove to be an important specific character, in which case *G. umbella* Haeckel with nine, and *G. giltschii* Haeckel with eleven, must be distinguished from *G. proboscidalis* with seven. But whether *G. umbella* and *G. giltschii* represent two good species, or only a single one, cannot be determined without an examination of extensive material. It is certain that the slight differences in form, size, shape of the gonads, and color, which have been used as the bases of specific distinctions in this genus, merely indicate different stages in growth.

Geryonia proboscidalis Forskål.

Medusa proboscidalis Forskål, 1776, p. 108, taf. 36, fig. *1.*
Geryonia proboscidalis Eschscholtz, '29, p. 88; Haeckel, '79, p. 295; Vanhöffen, : 02^{b}, p. 85.
Dianaea proboscidalis Lamarck, '16, p. 505.
Liriope proboscidalis Lesson, '43, p. 331.
Leuckartia proboscidalis L. Agassiz, '62, p. 364.
Leuckartia brevicirrata Haeckel, '64^{b}, p. 462.
Geryonia hexaphylla Brandt, '38, p. 389, taf. 18.
Carmarina hexaphylla Haeckel, '79, p. 298.
Geryonia conoides Haeckel, '64^{b}, p. 466.
Geryonia fungiformis Haeckel, '64^{b}, p. 465.
Carmarina fungiformis Haeckel, '79, p. 297.
Geryonia umbella Haeckel, '64^{b}, p. 464.
Geryonia hastata Haeckel, '64^{a}, p. 327.
Carmarina hastata Haeckel, '79, p. 297.
Geryones elephas Haeckel, '79, p. 294, taf. 18, fig. *7.*
? **Dianaea endrachtensis** [**-gaberti**] Quoy et Gaimard, '24, p. 566, pl. 84, fig. *2.*
? **Dianaea gaberti** Blainville, '34, p. 289, pl. 34, fig. *2.*
? **Eirene endrachtensis** Eschscholtz, '29, p. 94.
? **Orythia viridis** L. Agassiz, '62, p. 363.
? **Geryonia dianaea** Haeckel, '79, p. 295.

Station 4574; surface; 1 specimen, with only five radial canals.

Station 4681; 300 fathoms to surface; 1 very fragmentary specimen.

Station 4707; surface; 1 specimen, 35 mm. in diameter.

Station 4740; 300 fathoms to surface; 1 specimen, 40 mm. in diameter.

All of these specimens have seven blind canals per octant, and the gonads are lanceolate in outline. A surface form, from the warm regions of all oceans.

Trachynemidae Gegenbaur, 1856.

(Including Aglauridae Haeckel.)

Trachomedusae with eight radial canals; without blind centripetal canals; with numerous tentacles, of either one or two kinds, but arranged in a single series; with or without gelatinous peduncle; gonads either linear or pendent.

Some confusion has been caused to students of this family by the divergent views and accounts which have been published of the genera Pentachogon and Homoeonema, both of which were originally described by Maas ('93) from the collections of the "Plankton" expedition. Later studies of the same author (:05, :06^b) demonstrated that the species which he united under Homoeonema belong to two different families, and that since the type species, *H. platygonon*, is a halicreid, the name Homoeonema must be removed to the Halicreasidae. This left the remaining species without any generic name; to remedy this deficiency Maas (:06^b) has proposed Isonema. Unfortunately this name is already preoccupied by a genus of Mollusca, so that the generic name Arctapodema proposed by Dall (:07) must be used, if the two species in question, *Homoeonema amplum* Maas and *H. macrogaster* Vanhöffen, are to be separated generically from Pentachagon, as both Maas and Vanhöffen believe is necessary.

Aglaura Péron et Lesueur, 1809.

An examination of considerable series of this genus from the Atlantic as well as from the Pacific has convinced me that my former grouping of the species (:04, p. 257) was erroneous, and that Maas and Vanhöffen are no doubt correct in maintaining that neither the form of the gonads nor the length of the peduncle, which I believed to characterize *A. octagona*, are of any taxonomic significance in this genus. Vanhöffen (:02^b) maintains that all described forms of Aglaura in reality belong to but one species, *A. hemistoma.* According to Maas (: 05, : 06^c), however, *A. prismatica*, described by him ('97) from the Gulf of Panama, and since recorded by Agassiz and Mayer ('99, : 02) from the Fiji Islands and Tropical Pacific, as well as by himself from the collections of the "Siboga" and from Amboina, is so well characterized by prismatic, octagonal outline, small size (3–4 mm. high by about 3 mm. broad) and early appearance of the gonads, as to be worthy of recognition. Since the octagonal outline is considered by Maas (: 05, p. 58) the most distinctive character of *A. prismatica* I studied living material with especial care and found that the outline is variable; for though most of the specimens were nearly circular in cross section, a few were distinctly prismatic; and these conditions are retained after preservation. Because of this variation I believe that this character is no more important than the general outline of the bell, which is well known to be subject to great diversity in this genus in different states of muscular contraction.

I have been able likewise to test the supposed difference in time of appearance of the gonads on specimens both from the Atlantic and from the Pacific. According to Maas (: 05) the Atlantic (Mediterranean) species shows no gonads until about 3 mm. high; but I have observed gonads (spherical) in a specimen from the West Indies not more than 1.5 mm. high; while in several specimens 2.5–3 mm. high they were already large and sausage-shaped. This character, then, is no doubt variable, as Maas suggests (: 05, p. 59) and cannot be considered as separating an Atlantic from a Pacific form.

Since I am unable to find any constant characters distinguishing the present specimens from others from the West Indies, I refer them to *A. hemistoma;* and inasmuch as many of the specimens were taken near the type locality of *A. prismatica,* I see no reason to retain the latter longer as a distinct species, or even variety. In all probability the present series is specifically identical also with the specimens recorded by Agassiz and Mayer (: 02, p. 150) as *A. prismatica,* and stated by them to be generally distributed over the tropical regions of the Pacific; but which, according to their earlier figure ('99, Pl. 4, fig. *13*), are circular, not prismatic, in outline. Comparison shows that the specimens recorded by me (: 04) from the Maldives as *A. prismatica* are also identical with the present series.

Aglaura hemistoma Péron et Lesueur.

Aglaura hemistoma Péron et Lesueur, 1809, p. 351; Haeckel, '79, p. 275, taf. 16, figs. *3*, *4*; Vanhöffen, : 02^{b}, p. 78.
Aglaura peronii Leuckart, '56, p. 10, taf. 1, figs. *5–7*.
Aglaura nausicaa Haeckel, '79, p. 274, taf. 16, fig. *1*.
Aglaura laterna Haeckel, '79, p. 274, taf. 16, fig. *2*.
Aglaura hemistoma var. **nausicaa** Maas, '93, p. 26.
Aglaura prismatica Maas, '97, p. 24, taf. 3, figs. *4*, *5*; : 05, p. 58; Agassiz and Mayer, '99, p. 165, pl. 4, fig. *13*; Bigelow, : 04, p. 257.
Aglaura octagona Bigelow, : 04, p. 257, pl. 2, fig. *9*.
Aglaura vitrea Fewkes, '82, p. 277, pl. 7, fig. *10*.
? **Lessonia radiata** Eydoux et Souleyet, '52, p. 643, pl. 2, fig. *16*.
? **Aglaura radiata** Haeckel, '79, p. 276.

Plate 2, fig. *6*.

Station 4580; 300 fathoms to surface.
Station 4583; 300 fathoms to surface.
Station 4587; 300 fathoms to surface.
Station 4588; surface.
Station 4594; 300 fathoms to surface.
Station 4596; surface.
Station 4598; 300 fathoms to surface.
Station 4607; surface.
Station 4609; 300 fathoms to surface.
Station 4611; surface.
Station 4613; 300 fathoms to surface.
Station 4615; surface.
Station 4638; 300 fathoms to surface.
Station 4646; 300 fathoms to surface.
Station 4657; 300 fathoms to surface.
Station 4659; 300 fathoms to surface.
Station 4661; surface.
Station 4663; 300 fathoms to surface.
Station 4664; surface.
Station 4665; 300 fathoms to surface.
Station 4667; 300 fathoms to surface.
Station 4669; 300 fathoms to surface.
Station 4671; 300 fathoms to surface.
Station 4673; surface.

Several specimens at each station.

Station 4676; 300 fathoms to surface.
Station 4688; 300 fathoms to surface.
Station 4707; surface.
Station 4708; surface.
Station 4714; surface.
Station 4716; surface.
Station 4721; 300 fathoms to surface.
Station 4733; surface.
Station 4734; 300 fathoms to surface.
Station 4741; surface.

The specimens vary considerably in outline, and in the proportion between breadth and height. In life most of them were about as high as broad, as figured by Mayer (:00^b); but when preserved many of the specimens contract so strongly as to take on a very tall, narrow outline (Pl. **2**, fig. *6*). The great majority are circular in cross section; a few, however, show, more or less distinctly, the octagonal outline thought by Maas to be characteristic of *A. prismatica.* Since, however, I have seen the same prismatic form in a few specimens from the West Indies, it cannot be supposed to indicate a geographic race. The largest specimen measures (preserved in formalin) 6 mm. high by 4 broad, dimensions approaching those of Atlantic specimens, and considerably greater than those of any Pacific Aglaura previously recorded. The greatest number of tentacles was about eighty-five, in the specimen just mentioned, and since there is no reason to suppose that this is the maximum, it is not unlikely that Pacific as well as Atlantic specimens (Haeckel, '79, Vanhöffen :02^b) may occasionally have as many as one hundred tentacles. The great majority of the specimens are from 3–4 mm. high and have from forty-five to fifty-five tentacles. Specimens about 1.5 mm. high have only about thirty.

Gonads. — In a specimen 1.5 mm. high the gonads are already visible as minute spherical swellings at the point of junction of peduncle with manubrium; a condition corresponding, as noted above, to that of an Atlantic specimen of about the same dimensions. In a specimen 2 mm. high by about 2 mm. broad they have already attained the "sausage" shape characteristic of later stages.

In the smaller specimens the peduncle is very short, but in the larger ones is almost as long as half the bell height. I observed no specimens with the extremely long peduncle which I have recorded for two individuals from the Maldive Islands (:04) under the name *A. octagona*. There are eight otocysts.

The specimens were all colorless.

The present captures, together with those already recorded by Agassiz and Mayer ('99, :02), show that *Aglaura hemistoma* occurs commonly over the entire Tropical Pacific. It is already known from both sides of the Atlantic, both Tropical and subtropical, from the Gulf Stream, from the Gulf of Mexico, the Mediterranean, the Indian Ocean, and from the Malaysian region (*A. prismatica* Maas, :05, :06[c]). Thus it is an inhabitant of the warmer regions of all oceans. It is unknown, however, in cold seas.

Aglantha Haeckel, 1879.

Trachynemidae with long peduncle; the gonads situated on the oral wall of the subumbrella surface, *not* on the peduncle with either four or eight otocysts.

This genus has recently been revised by Maas (:06[d]), to whose work I refer the reader for a full account of its rather confused synonymy. From his studies, as well as from those of Browne ('97), Chun ('97), and Vanhöffen ('97), it is now clear that it contains at least two well-defined species, *A. digitale* Fabricius and *A. rosea* Forbes, of rather different geographic range. The first of these, distinguished by large size and by the possession of only four otocysts, is of circumpolar distribution (Chun, '97). Within it three geographic varieties, *A. occidentalis* (Maas, '93), *A. digitale*, and *A. camtschatica* (Brandt, '38; Birula, '96), can be distinguished.

A. digitale occurs throughout the arctic zone of the Atlantic, *A. occidentalis*, in the northwestern Atlantic, from the Banks of Newfoundland south at least as far as the northern margin of the Gulf Stream (A. Agassiz, '65; Hargitt, :05[b]), and *A. camtschatica*, so far as is known, only in Behring Sea and on the northwest coast of America. *A. rosea* Forbes, with eight otocysts (Browne, '97), is a much smaller species. The recently described *A. conica* (Hargitt, :02) is apparently a synonym of this form, which is of boreal or temperate occurrence, being known from the British coast, Heligoland (Hartlaub, under the name *A. digitalis*), coast of New England (Hargitt), and from Norway, where its range overlaps that of *A. digitale*. Up to the present time the genus has been known only from northern, if not actually subarctic regions. But since the "Albatross" collection contains a considerable series of the genus, this range must now be extended to the Tropical Pacific.

Unfortunately the otocysts, the one character of greatest importance, are destroyed in all the present specimens, and therefore they might equally well be referred either to *A. digitale* or to *A. rosea* so far as this character is concerned. Their size, however, suggests that their closest affinity is with *A. digitale;* but inasmuch as they are distinctly smaller than adults of the latter, they probably belong to a new variety of that species.

Aglantha digitale var. **intermedia,** var. nov.

Plate 29, figs. *4–10.*

Station 4583; 300 fathoms to surface; 2 specimens.
Station 4605; 200 fathoms to surface; 1 specimen.
Station 4609; 300 fathoms to surface; 4 small specimens.
Station 4613; 200 fathoms to surface; 3 specimens.
Station 4638; 300 fathoms to surface; 5 specimens.
Station 4652; 200 fathoms to surface; 5 specimens.
Station 4652; 400 fathoms to surface; 2 specimens.
Station 4659; 300 fathoms to surface; 1 very small specimen.
Station 4669; 300 fathoms to surface; 3 specimens.
Station 4671; 300 fathoms to surface; 8 specimens, Type.
Station 4673; 300 fathoms to surface; 1 specimen.
Station 4676; 300 fathoms to surface; 1 specimen.

In general form, and in the presence of a gelatinous apical proportion the specimens agree very closely with the various accounts of *A. digitale.* The outline varies, largely depending upon the state of contraction of the muscular subumbrella, the bell being either broad, or narrow and constricted. The largest specimen is about 14 mm. in diameter by about 15 mm. high, the smallest (Pl. **29**, fig. *9*) only 2.5 mm. high. In the large specimens there are from eighty to ninety tentacles. In the smallest there are only about thirty-five. This number is rather larger than Agassiz ('65) and Vanhöffen ('97) have observed in *A. digitale* at corresponding stages, and it may prove to be a character of specific significance. In all the specimens the tentacles are broken short off.

In the smallest specimens, as A. Agassiz ('65) has observed, the short manubrium hangs directly from the subumbrella surface (Pl. **29**, fig. *9*). With advancing growth, however, the gelatinous peduncle develops, becoming very prominent in adults (Pl. **29**, fig. *4*). The manubrium likewise grows longer, until it is finally about as long as the peduncle, but as its length is variable, this character is probably not of taxonomic importance. The mouth opening is simple (Pl. **29**, fig. *6*); but when it is closed the manubrium is folded in such a way that there appear to be four long lips (Pl. **29**, fig. *7*). The peculiar course of the radial canals on the peduncle (Pl. **29**, figs. *6*, *7*) is apparently constant.

The long, sausage-shaped gonads, well developed in the larger specimens, hang from the canals at the apex of the bell cavity. The smallest specimens show no trace of them, and they are first visible as minute spherical swellings in specimens about 5 mm. high (Pl. **29**, fig. *10*). The entire subumbrella surface, as well as the velum, is very muscular.

Color. — The Medusa is colorless except that the entodermic lining of the manubrium, visible only when the distal portion of the manubrium is everted (Pl. **29**, fig *8*), is pink.

This race is decidedly larger than *A. rosea*, especially at the time that the gonads appear. The rather larger number of tentacles seems to separate it from the previously known varieties of *A. digitale*.

The present captures indicate that in the tropics Aglantha belongs to the intermediate, not to the surface fauna. This is a marked divergence from the northern forms, which are frequently recorded from the surface, though apparently at times penetrating to a considerable depth (Guenther, :03). Off the coast of Greenland, according to Vanhöffen ('97), the young live at a depth of thirty or more metres, and rise to the surface with the formation of the gonads.

The very broad horizontal distribution of the present series from 13° S. to 20° N. is also of importance, for this considerable extension northward in the intermediate zone suggests a possible overlapping with *A. digitale* var. *camtschatica*, which is common on the surface in the Gulf of Georgia, in latitude 48° N. (A. Agassiz, '65).

Tetrorchis, gen. nov.

Trachynemidae without peduncle; with four gonads attached to as many radial canals *near their junction with the ring canal.*

This genus is established to include a single species, apparently new, which is distinguished from all other Trachynemidae, to which family it undoubtedly belongs, by the number and position of the gonads, as well as by a peculiar radial arrangement of the tentacles described below.

Tetrorchis erythrogaster, sp. nov.

Plate 29, figs *1-3*.

Station 4665; 300 fathoms to surface; 1 specimen.
Station 4675; 300 fathoms to surface; 1 specimen.
Station 4689; 300 fathoms to surface; 1 specimen.
Station 4716; 600 fathoms to surface; 1 specimen.
Station 4717; 800 fathoms to surface; 1 specimen, Type.
Station 4721; 300 fathoms to surface; 1 specimen.

All the specimens are of about the same size, some 10–12 mm. in diameter by about 8 mm. high; and all have large gonads. They are in fair condition, although the margins of all are somewhat battered.

Bell. — The bell is about two thirds as high as broad; the gelatinous substance very thick apically, though not forming a definite projection, but thinner toward the margin. On account of this thickness the bell cavity is shallow (Pl. **29**, fig. *1*).

Tentacles. — The tentacles, all of which are solid, are interesting characters of the species. The four opposite the four fertile radial canals are very stout (Pl. **29**, figs. *1*, *2*), and provided with prominent entodermal roots. These are the only *perradial* tentacles, for the remaining ones, which are much smaller than those just described though resembling them structurally, have no connection with the sterile canals. These small tentacles vary in number, but there are usually about three of them per octant. In all the specimens the tentacles are broken short off, only the stumps remaining. In the allied genus Persa, as well as in Aglaura and Aglantha, the tentacles are more numerous and all of one kind, the differences in size in these genera being without any radial significance such as connection with the radial canals, but merely the expression of differences in age. I have been unable to find any otocysts; but from the condition in other Trachynemidae it seems certain that some such structures are normally present in this species, and that their apparent absence is due to poor preservation.

Gastrovascular system. — The proboscis, which is cylindrical, about as long as the depth of the bell cavity and with four inconspicuous lips, hangs directly from the subumbrella surface without any trace of peduncle (Pl. **29**, fig. *1*). The four fertile radial canals are stout and easily traced; but the four sterile ones are, in all the specimens, less well defined, and, though well preserved proximally, can hardly be traced at all as they approach the ring canal. The constancy of this appearance suggests the possibility that they may lack a well-developed lumen; but this cannot be determined except on better material than the present.

Gonads. — These, four in number as stated, and located on four of the radial canals, about two thirds of the length of the latter from the oral pole, are sausage-shaped and attached to the canal by only a narrow stalk (Pl. **29**, fig. *2*). They are about 1 mm. in length, and are well developed in all the specimens. The four sterile canals show no trace whatever of gonads.

Color. — This species exhibits a very characteristic and unusual pigmentation, the entire manubrium being brilliant carmine, except for the margins of the four lips, which are opaque white (Pl. **29**, fig. *1*). The remainder of the Medusa is colorless.

This interesting form no doubt belongs to the intermediate fauna, since it was never taken on the surface.

Tetrorchis is evidently closely allied to Persa, from which it differs only in having four instead of two gonads, and in the smaller number and peculiar radial arrangement of the tentacles. It is true that Haeckel ('79, taf. 16, fig. *12*) figures a short gelatinous peduncle for *P. lucerna* Haeckel, but inasmuch as there appears to be no such structure in *P. incolorata* (McCrady, '57, pl. 12, fig. *3*), its presence or absence is not of much taxonomic value in that genus. In the number of gonads (four) it agrees with Stauraglaura, but the location of these organs near the *distal* ends of the radial canals, instead of near the junction of the latter with the manubrium, as well as the peculiar radial arrangement of the tentacles, seems to me sufficiently important to indicate separate generic rank. The type species is distinguished from all other Trachomedusae by these two features, as well as by the absence of any gelatinous peduncle and by its characteristic coloration.

Amphogona Browne, 1901.

Trachynemidae with peduncle; with numerous tentacles all alike; the eight gonads spherical, pendant, borne on subumbrella near distal end of radial canals; bell low and saucer-shaped.

Browne has already pointed out (: 04, p. 740) that *Pentachogon apsteini* Vanhöffen, for which he has instituted this genus, is to be separated from Agliscera, its closest ally, by the form of the gonads and of the bell, as well as by the much more remarkable fact that the Maldive specimens of *P. apsteini* were hermaphroditic. Inasmuch as hermaphroditism has never been observed, so far as I can learn, in any other Trachomedusa, I was of course particularly glad of the opportunity to test its occurrence in a second series of *A. apsteini* from a different locality. The result of this study, prosecuted on cross sections of the gonads, has been to show that these Pacific specimens are *not* hermaphroditic, but follow the more usual plan, all the gonads of any given individual being either male or female. The explanation of this remarkable dimorphism in different lots of this one species must be sought on more extensive material from various regions.

Amphogona apsteini Vanhöffen.

Pentachogon apsteini Vanhöffen, : 02^{b}, p. 65, taf. 10, fig. *18*, taf. 11, fig. *28*.
Amphogona apsteini Browne, : 04, p. 740, pl. 54, fig. *5*, pl. 55, fig. *5*, pl. 56, fig. *1*, pl. 57, figs. *10–15*.

Plate 2, Figs. *1, 2*; Plate 34, Figs. *12–15*; Plate 45, Fig. *10*.

Acapulco Harbor, February 28; surface; 6 specimens, from 2.5 mm. to 6 mm. in diameter.

Browne has given us such a good account of this species that I have but little to add to his description, with which the present specimens closely agree except for the gonads, as noted above.

The diameter of the largest specimen, 6 mm., is somewhat greater than is recorded by Browne (4.25 mm.). In outline the living specimens were less flattened, being about twice as broad as high (Pl. **2**, fig. *1*), and slightly conical. The gelatinous substance is thin, but rigid. In the large specimens the peduncle hangs about to the bell opening, and is rather narrow (Pl. **34**, fig. *15*).

Tentacles. — In the largest specimen, 6 mm. in diameter, there are about sixty-four tentacles, usually eight per octant, though the number varies somewhat. Browne has recorded seventy tentacles for a rather smaller specimen, so it is evident that as in most Trachynemidae the number is individually variable. In the smallest specimen, 2.5 mm. in diameter, there are only about forty. All the tentacles are of one type, though, from their different sizes, evidently of different ages (Pl. **34**, fig. *14*), and in all the specimens all of them are broken short off.

The club-shaped otocysts (Pl. **34**, fig. *13*; Pl. **45**, fig. *10*) have been well described by Browne (: 04, p. 740, pl. 57, fig. *15*). In a specimen 4 mm. in diameter there are three otocysts each in six of the octants, and in the smallest specimen apparently only one per octant. Vanhöffen (: 02^b) records two otocysts per octant in an individual 3.5 mm. in diameter. The manubrium is short and barrel-shaped, the mouth surrounded by four narrow, pointed lips (Pl. **34**, fig. *15*). The gonads, which are nearly spherical, are attached to the radial canal only at a small area. This character, clearly indicated in Browne's figures (: 04, pl. 57, figs. *11*, *13*), might easily be overlooked on surface views on account of the small size of the gonads, but is easy to demonstrate on serial sections. In the adult all gonads are of about the same size, but in the small specimens small and large gonads alternate, as Vanhöffen observed (: 02^b, taf. 10, fig. *18*); but since in any of our specimens all gonads are of one sex, this alternation is not connected with hermaphroditism, as appeared to be the case in the specimens described by Browne (: 04).

The specimens were entirely colorless.

Amphlogona apsteini is a surface form. It has previously been recorded only from the Indian Ocean (Maldive Islands, Browne; west coast of Sumatra, Vanhöffen).

Rhopalonema Gegenbaur, 1856.

sens. em. Vanhöffen (: 02^b).

Trachynemidae with thirty-two tentacles, of two kinds, *i. e.* radial clubs, and inter- and adradial cirri; with enclosed otocysts; without peduncle.

The above definition is that of Vanhöffen (: 02^b, p. 59), who has shown very clearly that the species of Marmema enumerated by Haeckel ('79), and the majority, at any rate, of those of Trachynema, represent nothing more than two successive stages in the development of Rhopalonema.

The present collection contains two well-defined species of the genus, one a surface, the other an intermediate form. The first of these is no doubt identical with the species described by Vanhöffen (: 02^b) and Maas ('93, :05) under the name *R. velatum* Gegenbaur, and with specimens from the West Indies in the Museum of Comparative Zoölogy. I believe that it is also identical with the specimens from the Bay of Biscay identified by

Browne (: 06) as *R. coeruleum* Haeckel, as well as with Haeckel's specimens of *R. coeruleum* from the Canary Islands. It is to be distinguished by its small size (8–10 mm. in diameter), by the form of the gonads, which are cylindrical and occupy only the central third of the radial canals, and by the number of otocysts, which never normally surpasses sixteen. Even this number seems to be reached only in very large individuals, most specimens having only eight. Another character on which Browne has laid stress, and which I find very constant in the present large series is the presence of an apical thickening or "top knot" of the gelatinous disc (Pl. **2**, fig. *8*). This character, although perhaps trivial, sharply distinguishes this species from the ensuing one. Regarding the name to be adopted for this species, it seems to me best to retain *R. velatum.* For although adult specimens were first described as *R. coeruleum* by Haeckel ('79), yet the individuals on which Gegenbaur based his earlier account of *R. velatum* were sufficiently advanced for specific determination.

I have no difficulty in identifying the second species with the *R. funerarium* of Vanhöffen (: 02^b), from his excellent figures. The "Siboga" specimens recorded by Maas under the name *R. coeruleum* Haeckel are likewise identical with this form (Maas, : 05, p. 51). This species is distinguished from *R. velatum* by large size (30 mm. in diameter), long gonads, absence of an apical thickening, greater number (thirty-two) of otocysts, and by the brilliant iridescence of its subumbrella surface. Maas doubts whether this form can be identified with the very unsatisfactory figures given by Quoy et Gaimard of *Dianaea funerarium,* and therefore includes it in *R. coeruleum* Haeckel, which he believes resembles it more closely than does any other known species. To this identification Browne (: 06) objects that the "Siboga" specimens have very long gonads, and entirely lack the apical "top knot," so prominent in Haeckel's figures ('79, taf. 17, fig. *3*). Indeed there is little resemblance between the two except the bluish iridescence; and I believe, as already stated, that *R. coeruleum* Haeckel is in reality a synonym of *R. velatum.* Following this conclusion I shall retain for the present species Vanhöffen's name, *R. funerarium,* dating it, however, from Vanhöffen (: 02^b), not from Quoy et Gaimard. This seems one of the cases where it is unprofitable to endeavor to identify the specimens in question with any of the older accounts, for, being an intermediate and not a surface form, it is altogether probable that it had never been observed until taken by the "Valdivia," unless it may be identical with the poorly preserved specimens of the "Plankton" expedition described by Maas ('93) under the name *R. striatum.* Could this be shown to be the case, the name *R. striatum* should be substituted for *R. funerarium.*

It is probable that all of the species referable to Rhopalonema which have yet been described belong to either one or other of these two species. So many of the names, *e. g.* all those referred by Haeckel to Marmema, and the majority of those referred by him to Trachynema, were based on larval stages or on poorly preserved material that the synonymy of the species is difficult. The size and habitat of most of the described forms, however, make it almost certain that they fall under *R. velatum.*

I have been able to satisfy myself by an examination of specimens that this is likewise true of *R. typicum* Agassiz and Mayer (: 02), supposed by them to be identical with *Homoeonema typicum* Maas ('97), which, however, belongs to a different genus; and also of the specimens from the Maldive Islands, which I recorded under the same name (: 04, p. 256). The case of *R. typicum* Hargitt (: 02) from the Gulf Stream must remain doubtful, since Hargitt states (: 05^b, p. 54) that it has numerous cirri between the radial tentacles, a character showing that it certainly is not related to Maas's *H. typicum.*

Rhopalonema velatum Gegenbaur.

Rhopalonema velatum Gegenbaur, '56, p. 251, taf. 9, figs. *1–5;* Haeckel '79, p. 264; Vanhöffen, : 02^b, p. 59, taf. 10, figs. *16, 28,* taf. 11, fig. *32.*
Rhopalonema coeruleum Haeckel, '79, p. 264, taf. 17, figs. *3–6;* Browne, : 06, p. 172 (*non* Maas, : 05).
Rhopalonema polydactylum Haeckel, '79, p. 265, taf. 17, figs. *7–11.*
Rhopalonema typicum Agassiz and Mayer, : 02, p. 152, pl. 5, figs. *21, 22;* Bigelow, : 04, p. 256.

The following are undoubtedly young stages of this species: —

Trachynema octonarium Haeckel, '79, p. 260.
Sminthea tympanum (*et* **globosa**) Gegenbaur, '56, p. 246, taf. 9, figs. *17, 18.*
Marmema tympanum Haeckel, '79, p. 262.
Sminthea globosa Keferstein und Ehlers, '61, p. 89.
Marmema clavigerum Haeckel, '79, p. 263, taf. 17, figs. *1, 2.*
Calyptra umbilicata Leuckart, '56, p. 14, taf. 1, figs. *9, 10.*
Rhopalonema umbilicatum L. Agassiz, '62, p. 366.
Marmema umbilicatum Haeckel, '79, p. 263.
Marmema velatoides Maas, '93, p. 13, taf. 1, fig. *6.*

Plate 2, Fig. *8;* Plate 45, Fig. *11.*

Station 4571; surface; 1 small specimen.
Station 4580; 300 fathoms to surface; 1 specimen.
Station 4587; 300 fathoms to surface; 1 specimen.
Station 4598; surface; 1 specimen.
Station 4605; 300 fathoms to surface; several small individuals.
Station 4611; surface; swarm of large specimens.
Station 4634; 300 fathoms to surface; 2 specimens.
Station 4635; surface; several.
Station 4637; 300 fathoms to surface; several.
Station 4638; 300 fathoms to surface; several.
Station 4640; surface; several.
Station 4644; surface; swarm of large individuals.
Station 4646; 300 fathoms to surface; 1 small specimen.
Station 4647; in trawl from 2,005 fathoms; 1 specimen.
Station 4650; 300 fathoms to surface; 1 specimen.
Station 4652; 400 fathoms to surface; 1 specimen.
Station 4654; surface.
Station 4655; surface.
Station 4656; surface.
Station 4657; surface; 2 specimens.
Station 4659; 300 fathoms to surface; several.
Station 4663; surface; 1 specimen.
Station 4664; surface; swarm of large individuals.
Station 4665; 300 fathoms to surface; 1 specimen.
Station 4667; 300 fathoms to surface; 1 specimen.
Station 4669; surface; 1 small specimen.
Station 4669; 300 fathoms to surface; 1 small specimen.
Station 4671; 300 fathoms to surface; 3 specimens.
Station 4673; 300 fathoms to surface; several.
Station 4675; surface; several.
Station 4676; 300 fathoms to surface; 1 specimen.
Station 4685; surface; several.
Station 4687; in trawl from 2,100 fathoms; 1 small specimen.
Station 4687; 300 fathoms to surface; 1 specimen.
Station 4688; surface
Station 4690; surface } at each several specimens.
Station 4691; surface

Station 4695; 300 fathoms to surface; 1 specimen.
Station 4700; surface; 1 specimen.
Station 4702; surface; 1 specimen.
Station 4706; surface; 1 specimen.
Station 4710; surface; 1 specimen.
Station 4713; 300 fathoms to surface; several.
Station 4715; 300 fathoms to surface; 2 specimens.
Station 4716; surface; 1 specimen.
Station 4717; 300 fathoms to surface; 1 specimen.
Station 4721; 300 fathoms to surface.
Station 4722; 300 fathoms to surface.
Station 4725; surface; 2 specimens.
Station 4728; 300 fathoms to surface.
Station 4729; surface; 1 specimen.
Station 4731; surface; 1 specimen.
Station 4732; 300 fathoms to surface; 1 specimen.
Station 4733; surface; 1 specimen.
Station 4734; 300 fathoms to surface; 1 specimen.
Station 4736; 300 fathoms to surface; several.
Station 4737; 300 fathoms to surface; several.
Station 4743; surface; several specimens.

Most of the specimens have only sixteen tentacles (Pl. **45**, fig. *11*); a few of the largest, however, 8–9 mm. in diameter, show the stumps of thirty-two, as already noted by Vanhöffen (:02[b]) and by Browne (:06). In none could I distinguish more than eight otocysts, although Browne has shown that sixteen is probably the final number of these organs.

Rhopalonema velatum shares with *Liriope tetraphylla* the distinction of being the most abundant Medusa of the expedition. It was previously known to be very generally distributed throughout the warmer waters of both Atlantic and Indian oceans; and the present collection, together with specimens from the Hawaiian Islands and from Fiji shows that it is characteristic of the entire Eastern Tropical Pacific. Although often taken in vertical hauls, it is a typical surface form, there being no evidence that it ever occurs below 100 fathoms (Browne, :06). It is restricted to warm waters.

Rhopalonema funerarium Vanhöffen (*non* Quoy et Gaimard).

Rhopalonema funerarium Vanhöffen, :02^b, p. 61, taf. 9, fig. *2*, taf. 10, fig. *17*, taf. 11, fig. *31*.
Rhopalonema coeruleum Maas, :05, p. 51, taf. 10, figs. *67*, *68* (*non* Haeckel, '79).
? **Rhopalonema striatum** Maas, '93, p. 15, taf. 1, fig. *3*.

Station 4673; 300 fathoms to surface; fragments.
Station 4707; 300 fathoms to surface; 3 specimens; fragmentary.
Station 4713; 300 fathoms to surface; 1 specimen; fair condition.
Station 4715; 300 fathoms to surface; 1 large specimen; fragmentary.
Station 4719; 300 fathoms to surface; 3 specimens.
Station 4724; 300 fathoms to surface; 2 specimens.

None of the present specimens are preserved well enough for me to count the otocysts or tentacles, but the elongated shape of the gonads, the general form and size, and the brilliant iridescence of the subumbrella all indicate that they belong to *R. funerarium*. None of the specimens were taken on the surface; a fact supporting the conclusion arrived at by recent students of this species (Vanhöffen, :02^b; Maas, :05) that it belongs to the intermediate fauna. The localities at which it was taken all lie within the course of the Humboldt Current. The geographic distribution of the species, so far as yet known, parallels that of *R. velatum*.

Colobonema Vanhöffen, 1902.

Trachynemidae with tentacles all of one kind, thirty-two in number, of which the eight perradial, the sixteen adradial, and finally the eight interradial develop in succession. It is probable that there are no otocysts in this genus.

The successive studies of Vanhöffen (:02^b) and of Maas (:05) have given us a good understanding of this interesting genus; and we must thank Vanhöffen for a very beautiful figure of the type species, *C. sericeum*. The present collection contains several specimens which are clearly identical with the "Valdivia" specimens; also identical with them, according to Browne (:06), is a series of this genus from the Bay of Biscay. The case of the "Siboga" specimens is not quite so clear, since they all possessed a much longer proboscis than Vanhöffen observed; but inasmuch as one large specimen, 39 mm. high, in the present series has a proboscis over 10 mm. long, while in all the others it is very short indeed, it is evident that this character is subject to considerable individual variation, and is not of specific importance, as Maas has suggested (: 05, p. 53). Since in other respects, *i. e.* general form, form of the gonads, number of tentacles, and color, the "Siboga" specimens agree with Vanhöffen's account of *C. sericeum,* they probably belong to that species.

Maas believes that *Colobonema sericeum* is identical with a Medusa from the Gulf of California, described by him under the name *Homoeonema typicum* ('97, p. 22, pl. 3, figs. *1–3*), and that the name *C. typicum* instead of *C. sericeum* should therefore be employed. I agree with Browne, however (: 06), in thinking that the connection between these two forms is doubtful. All recent examples show that the number of tentacles, *i. e.* thirty-two, and the type of their succession is one of the most constant characters of *Colobonema sericeum.* In *C. typicum,* however, according to Maas's original figures, there are not only many more tentacles, but a variable number in different octants (three to seven between every two radial canals). The shape of the gonads, too, is different, for while in *C. sericeum* these are linear, and occupy almost the entire length of the radial canals, in *C. typicum* they are cylindrical. Maas believes that these differences are, at least in part, due to the poor condition of the material from which *C. typicum* was described, but they appear to me quite sufficient to indicate specific difference.

Colobonema sericeum Vanhöffen.

Colobonema sericeum Vanhöffen, :02^{b}, p. 57, taf. 9, fig. *1*, taf. 12, figs. *39–42;* Browne, :06, p. 172.

? **Colobonema typicum** Maas, :05, p. 53, taf. 10, figs. *62–65.*

Plate 2, Figs. *4*, *5;* Plate 45, Fig. *12.*

Station 4646; 300 fathoms to surface; 1 rather fragmentary specimen.

Station 4655; 300 fathoms to surface; 1 specimen, fragmentary, 20 mm. high.

Station 4661; 300 fathoms to surface; 1 excellent specimen, 22 mm. high.

Station 4670; in trawl from 3,209 fathoms; fragments.

Station 4679; 300 fathoms to surface; 1 excellent specimen, 35 mm. high.

Station 4715; 300 fathoms to surface; 1 fragmentary specimen.

Station 4721; 300 fathoms to surface; 1 specimen, 18 mm. high.

Station 4743; 300 fathoms to surface; 2 specimens, 10 and 39 mm. high.

The general aspect of this species is shown in the photograph (Pl. **2**, fig. 5), and its color in Vanhöffen's beautiful figure (: 02^b, taf. 9, fig. *1*). I was unable to find any octocysts; and as I, like Vanhöffen, examined excellent specimens in the fresh condition, with negative results, and since neither Maas nor Browne were able to find any otocysts on preserved specimens, it is probable that this genus actually lacks these organs. The specimens corroborate Maas's (: 05) statement that in the formation of the tentacles the perradial appear first, then the *adradial,* and finally the *interradial;* indeed even in large specimens the latter remain much the smallest (Pl. **45**, fig. *12*). This type of succession is so unusual that it may well be considered of generic significance.

This species has a more brilliant iridescence than any other Medusa with which I am acquainted.

Colobonema sericeum is undoubtedly an intermediate form. It is one of the few species which have been taken in closing nets, a single specimen being recorded by Vanhöffen (: 02^b) from the "Valdivia" collection, from 820–500 fathoms. Its geographic range, so far as yet known, includes the north Atlantic (Bay of Biscay, Browne); the Tropical Atlantic; the south Atlantic to 42° S. Lat.; the Indian Ocean (Vanhöffen); the Malay Archipelago (Maas); and the Eastern Tropical Pacific.

Pectyllidae Haeckel, 1879.

Trachomedusae with numerous tentacles arranged in several rows; with well-developed manubrium.

Only one member of this family, a species of the little-known genus Crossota, is represented in the collection.

Crossota Vanhöffen, 1902.

Pectyllidae with numerous tentacles arranged in several continuous horizontal rows, but not in groups; gonads borne on the upper umbrella portion of the radial canals; without mesenteries.

This definition is essentially that given by Maas (: 06^d), who follows Vanhöffen in pointing out the close resemblance of this genus to Pectyllis and Pectis. It is, however, simpler than either, being easily distinguished from them by the absence of mesenteries, as well as by showing no trace of a radial grouping of the tentacles. The genus has so far been recorded only from the collections of the "Valdivia" Expedition and from Norway.

Vanhöffen distinguishes two species, *C. brunnea,* the type, and *C. norvegica,* but the only distinction between the two is that the single specimen of *C. norvegica* "ist charakterisiert . . . bei geringerer Grösse, durch weiter entwickelte Gonaden" (Vanhöffen, : 02^b, p. 76), and by a slightly brighter red color than that of *C. brunnea,* distinctions which Vanhöffen himself admits are "nicht bedeutend." His main basis for separating the two seems to be their geographic distribution:—"Weil ein Zusammenhang zwischen den Tiefseegebieten, in denen die südliche und die arktische Form vorkommen, nicht besteht und weil keiner unserer tiefen Vertikalnetzfänge im nördlichen Atlantischen Ocean uns ein Exemplar von *Crossota* lieferte" (Vanhöffen: 02^b, p. 76).

I must strongly protest against the use of *supposed geographic isolation* as the basis for specific separation in cases like the present in which there are no structural differences of sufficient taxonomic value to separate the two forms. This practice may perhaps be of service to the ornithologist, though this I doubt, but when applied to Medusae it is worse than useless. The assumption that no connection exists between southern and arctic "Tiefseegebieten" is far from being proved. On the contrary, the distribution of Atolla and of Periphylla, and the recent capture of Colobonema in the north Atlantic suggest exactly the contrary, while evidence is continually being adduced to show the general continuity, not isolation, of the distribution of intermediate organisms in general. Such a criterion might be of service were isolation of oceanic areas established; but until the ranges of the intermediate Medusae are better known it is not only valueless but misleading. Therefore, I do not hesitate to include *C. norvegica* as a synonym of *C. brunnea,* where it should remain, at least until some actual divergence is detected between the two supposed species.

Crossota brunnea Vanhöffen.

Crossota brunnea Vanhoffen : 02^b, p. 73, taf. 9, figs. *11–13*, taf. 12, figs. *34–38*, *43*, *47*.
Crossota norvegica Vanhöffen, : 02^b, p. 75.

Plate 2, Fig. *7*; Plate 45, Fig. *9*.

Station 4646; 300 fathoms to surface; 3 specimens.
Station 4648; 300 fathoms to surface; 1 specimen.
Station 4655; 300 fathoms to surface; 1 specimen.
Station 4657; 300 fathoms to surface; fragments.
Station 4663; 300 fathoms to surface; 2 specimens.

Station 4668; 300 fathoms to surface; 2 specimens.

Station 4670; in trawl from 3,209 fathoms; 1 large specimen; fragmentary.

Station 4672; in trawl from 2,845 fathoms; 1 large specimen.

Station 4672; 400 fathoms to surface; 1 specimen.

Station 4675; 300 fathoms to surface; 1 specimen.

Station 4676; 300 fathoms to surface; 2 specimens.

Station 4716; 600 fathoms to surface; 1 fragmentary specimen.

Station 4721; 200 fathoms to surface; fragments.

Station 4722; 300 fathoms to surface; fragments.

I can add but little to the excellent description and beautiful figures of this species given by Vanhöffen. The largest specimen in the series measured 27 mm. in diameter and 20 mm. high; it had large gonads (Pl. **45**, fig. *9*). In searching for otocysts I was no more successful than Vanhöffen, who has carefully studied the arrangement in rows of tentacles of various ages. The high-arched bell, the sausage-like form of the gonads, the considerable length of the proboscis, and the color are probably characters of specific importance. The last is one of the most characteristic features of this species. The entire subumbrella surface, gonads, and proboscis are densely pigmented with deep reddish brown. *Crossota brunnea* was taken by the "Valdivia" in the Atlantic from the equator to 60′ S. Lat., and in the Indian Ocean. Under the name *C. norvegica* it is recorded also from 69° 13′ N. and 10° 40′ E. It undoubtedly belongs to the intermediate fauna. I find no record of its capture in a closing net.

Halicreasidae Fewkes, 1886.

Halicreidae Vanhöffen (: 02^b).

Trachomedusae with eight broad radial canals; with numerous tentacles, of different sizes but all of the same structure 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 successive studies of Vanhöffen (: 02^b) and of Maas (: 05) have given us a good idea of the general organization of these remarkable Medusae; but on account of the condition of their specimens neither of these authors has been able to study the structure of the tentacles, which proves to be one of the most important characters of the family.

Vanhöffen distinguished two genera, Halicreas Fewkes and Haliscera, basing the separation on the number of tentacles, Halicreas having more than fifteen, Haliscera twelve or less per octant; but I agree with Maas (: 05, p. 56) that a much more important character than the number of tentacles is the presence or absence of the remarkable exumbral papillae. If we employ this criterion the members of the family fall into two groups: — on one hand the stem genus Halicreas with papillae, and on the other all species without these structures. Maas believes that two genera should be distinguished for the species *H. platygonon* Maas, *H. rotundatum* Vanhöffen, *H. alba* Vanhöffen, *H. conica* Vanhöffen, and *H. racovitzae* Maas, according as their gonads are proximal, or occupy the central one third of the radial canals; but the degree to which the positions of the gonads may change with age in other families (Geryonidae, Petasidae) suggests that this character is of no more taxonomic value than the number of tentacles; thus, all Halicreasidae with eight canals, with the tentacles uniformly arranged, but without exumbral papillae, may be included in a single genus. It seems to me that according to the ordinary rules of nomenclature the name Homoeonema of Maas must be adopted for this genus rather than Haliscera of Vanhöffen, inasmuch as Maas has demonstrated by a fresh examination of the type specimens of *Homoeonema platygonon*, which he has designated as the type species (: 06^b, p. 3), is at least congeneric with the *Haliscera alba* of Vanhöffen. The position of the two species referred by Vanhöffen (: 02^b) to Homoeonema has already been discussed.

It is probable that the new genus Botrynema, recently described by Browne (: 08) from the collection of the "Scotia," in which the tentacles are in groups, likewise belongs to this family.

All of these three genera of Halicreasidae have eight canals. There is, however, one species in the present collection undoubtedly to be referred to this family because of the structure of its tentacles and otocysts, but which has twenty-eight canals; for this I propose the new genus Halitrephes.

Halicreas Fewkes, 1882.

sens. em. Maas, : 05.

Halicreasidae with exumbral warts; with eight radial canals.

The original specimens for which Fewkes ('82^b) founded this genus were so fragmentary that little more than the chief generic character, the exumbral warts or papillae, could be distinguished. Fortunately, since these structures are so far unparalleled among Medusae, the generic identity of his material is not in doubt; but his description ('82^b, '86) and figures are so incomplete, omitting as they do any reference to tentacles or sensory clubs, that I prefer to follow Maas (: 05) in adopting *H. papillosum* as proposed by Vanhöffen. Vanhöffen's other species, *H. glabrum*, and *H. rotundatum* must be transferred to the genus Homoeonema, because they lack the exumbral papillae.

Halicreas papillosum Vanhöffen.

Halicreas papillosum Vanhöffen, : 02^b, p. 68, taf. 9, figs. *7*, *8*, taf. 11, fig. *30*; Maas, : 05, p. 57, taf. 10, fig. *70*, taf. 11, fig. *71*.

? **Halicreas minimum** Fewkes, '82^b, p. 306; '86, p. 953, pl. 8.

Plate 3, Fig. *3*; Plate 33, Figs. *8*, *9*; Plate 34, Figs. *1–3*, *5*, *8*, *10*, *11*.

Station 4621; 1 specimen.
Station 4631; in trawl from 774 fathoms; 1 fragmentary specimen.
Station 4647; in trawl from 2,005 fathoms; 3 specimens; fair condition.
Station 4653; in trawl from 536 fathoms; 1 specimen.
Station 4654; in trawl from 1,036 fathoms; 2 specimens; fragmentary.
Station 4665; 300 fathoms to surface; 1 fragmentary specimen.
Station 4666; in trawl from 2,600 fathoms; 1 large specimen.
Station 4668; 300 fathoms to surface; 3 specimens.
Station 4669; 300 fathoms to surface; 2 small specimens.
Station 4670; in trawl from 3,209 fathoms; 1 specimen; fair condition.
Station 4671; 300 fathoms to surface; 1 specimen, 6 mm. in diameter.
Station 4676; 300 fathoms to surface; 2 specimens; fair condition.
Station 4685; surface; 1 specimen; the disc only.
Station 4691; 300 fathoms to surface; 3 fragmentary specimens.
Station 4707; 300 fathoms to surface; 1 specimen.
Station 4709; in trawl from 2,035 fathoms; fragments.
Station 4711; 300 fathoms to surface; 2 fragmentary specimens.

Station 4715; 300 fathoms to surface; 1 fragmentary specimen.
Station 4716; 800 fathoms to surface; 1 good specimen.
Station 4717; 300 fathoms to surface; 1 good, and 1 fair specimen.
Station 4717; in trawl from 2,153 fathoms; 1 fair specimen.
Station 4719; 300 fathoms to surface; fragments.
Station 4721; 300 fathoms to surface; fragments.
Station 4724; in trawl from 1,841 fathoms; fragments.

The numbers of tentacles and otocysts per octant, and the conformation of the apical projection, in the five best-preserved specimens are shown in the following table: —

Station.	Diameter. mm.	Tentacles per octant.	Otocysts per octant.	Apical projection.
4676, 300 fms. to surface	24	26, 27, 27, 30	4 in one	high, triangular, pointed.
4668, 300 fms. to surface	24	24, 22, 21, 22, 20, 23, 26, 23	2, 3	high, narrow, cylindrical.
4717, 300 fms. to surface	26	23, 23, 26, 19	4 in one	broad, low, rounded.
4654, in trawl, 1,036 fms.	29	30, 29, 29, 33, 29, 35	4, 3,	high, narrow, pointed.
4665, 300 fms. to surface	42	31, 26, 17, 30	4, 3, 3	hardly a trace.

The form of the apical projection varies greatly, all stages being represented in the collection, from a very tall pyramid to an inconspicuous knob; and one specimen shows no trace of any projection. This feature, then, as Maas has already surmised (: 05, p. 56), is not of specific significance. The bell is stiff and the gelatinous substance thick, as described by all students who have examined the species.

The eight peculiar radial gelatinous projections of the exumbrella are represented in the photographs (Pl. **34**, figs. *1* and *3*, *p. ra*). Each prominence bears from five to nine rounded conical projections (Pl. **34**, fig. *3*); the whole forming a structure totally unlike anything seen in any other Medusa. They are much more prominent in large than in small individuals. The portion of the bell below the level of the prominences is thin and flexible, sharply defined from the stiff gelatinous disc above. When, as is often the case, the entodermic system is torn away, a very definite sculpture of the oral surface of the disc, consisting of a ridge along the line of each radial canal and of a rounded prominence between the bases of every two canals, is revealed (Vanhöffen, : 02^{b}, p. 69).

Tentacles. — The number of tentacles per octant is variable, as appears from the preceding table. The largest number observed in any octant was thirty-five; the smallest, seventeen. Curiously enough this very small number was counted in one of the largest specimens, 42 mm. in diameter, whence it appears that the number of these organs is not closely connected with the size of the Medusae. Vanhöffen (: 02^b) has found from twenty-three to forty-seven per octant, the latter number in a specimen only 32 mm. in diameter. According to Maas (: 05) a specimen in the "Siboga" collection 44 mm. in diameter had from seventy to eighty tentacles per octant. The radial tentacles show a constant difference in size from those between the radial canals, as already noted by both Vanhöffen and Maas, the former being about twice as long and as stout as the latter (Pl. **34**, fig. *2*). In structure, however, both classes are alike. The tentacles are solid; the endodermic layer composed of chordate cells, the ectoderm layer crowded with nematocysts. Since in all the large "Valdivia" specimens the tentacles were broken short off, Vanhöffen failed to observe their most characteristic feature; this is that each tentacle consists of two portions, — a flexible proximal region in which the endoderm cells are cubical, and a spine-like distal part, in which the cells of the core are flat and tile-like. The latter is so stiff as to be more like a bristle than an ordinary tentacle. These two are sharply separated (Pl. **34**, fig. *11*). In most cases the ectoderm layer is destroyed; in the few instances in which it persists it is densely crowded with nematocysts (Pl. **33**, fig. *9*). It appears from Vanhöffen's (: 02^b) studies that in this species, as in the genus Homoeonema, tentacles of very young specimens do not show the separation into two regions characteristic of adults.

Marginal Clubs. — In large specimens there are three or four of these structures per octant. They are free clubs (Pl. **33**, fig. *8*), standing on the bell margin, consisting of ectodermic sheath and a core composed of chordate endoderm cells. None of the specimens, all of which are preserved in formalin, now contain any otoliths; but from the large size of the distal endoderm cells it seems probable that one or two otocysts were present, as Maas (: 06^b) believes to be the case in *Homoeonema racovitzae.*

The radial canals are extremely broad, the stomach flat and without any trace of manubrium or definite lip.

Gonads. — Vanhöffen has described these organs in the female as "lang-elliptischen" (: 02^b, p. 69) and containing about fourteen large eggs. In the male (Pl. **34**, fig. *1*) they are proximal and more circumscribed than he figures them (: 02^b, taf. 9, fig. *8*).

Color. — All the present specimens are colorless. This is in contrast to Vanhöffen's observations, inasmuch as he describes and figures the entire entodermic system as red, and states that only such specimens as have lost the entire gastro-vascular structures are colorless. Maas (: 05) likewise represents them as of a pale reddish tint. This difference, however, is not, to my mind, of specific significance, but is probably such a local color variation such as occurs in *Nausithoe punctata.*

The present captures show that *Halicreas papillosum* is very widely distributed throughout the tropical and subtropical waters of all oceans. It is recorded from the Eastern Tropical Atlantic ("Valdivia"), and probably from the western Atlantic, (Gulf Stream *H. minima*, Fewkes), from the Indian Ocean ("Valdivia"), the Malay Archipelago ("Siboga"), and is of very general occurrence throughout the Eastern Tropical Pacific. Browne (: 08) has likewise recorded a variety, *H. antarcticum*, from the Antarctic. It is certainly an intermediate form, although a single very fragmentary disc was taken on the surface.

Homoeonema Maas, 1897 (*non* Vanhöffen).

Haliscera Vanhöffen, 1902.

Halicreasidae without exumbral papillae; gonads either proximal or occupying the central one third of the radial canals.

Following this definition two species, *H. glabrum* and *H. rotundatum*, included by Vanhöffen in Haliscera because of the large number of tentacles, fall into Homoeonema.

Maas (: 06^b, p. 9) maintains that a new genus should be established for these two, distinguished from Homoeonema by the position of the gonads and by the large number of tentacles; but considering how slight is our knowledge of the two species, this separation seems to me of doubtful value.

Specific distinctions between the members of Homoeonema are difficult to draw, because most of the species are so far known only from Vanhöffen's brief descriptions and figures. He lays stress on the form of the gonads as a distinguishing character between *H. glabrum*, *H. rotundatum*, and *H. conica*, but in his figures (: 02^b, taf. 9) these structures are very similar in the three species. The position of the gonads, whether proximal or occupying the central one third of the canals, may well be of specific, even if it is not of generic, importance, and likewise the number of tentacles per octant; but this has been counted on so few specimens of *H. glabrum*, *H. rotundatum*, and *H. conica* that we cannot yet lay much stress on it. Form of the bell is not of much value, because in the present series of *Haliscera papillosum* and of Homoeonema it varies greatly. In short, I am led to agree with Maas (: 06^{b}) that we may as well unite *H. glabrum* and *H. rotundatum*. But whether or not *H. conica* is also a synonym of *H. glabrum* is doubtful. It appears to be separated from *H. racovitzae* by the position of the gonads. The specimens in the present collection, which appear, on account of size at maturity and number of tentacles, to belong to two species, all have proximal gonads, as have *H. platygonon*, *H. alba*, and *H. racovitzae*,— all of which Maas, from recent studies, believes to be distinct. *H. platygonon* is easily recognized by its very small size at maturity (4 mm. in diameter); *H. racovitzae*, so far as we can judge from Maas's single specimen, by a characteristic intense purple pigmentation of the entodermic system. *H. alba* is larger (30 mm. in diameter) and colorless. Structurally all three are extremely close together.

The majority of the present specimens seem best referred to *H. alba*, because of the position of the gonads, number of tentacles per octant, general form, and lack of pigmentation. The second species is probably identical with *H. racovitzae*, but since the specimens differ from this species in pigmentation the identification can be no more than provisional.

Homoeonema alba Vanhöffen.

Haliscera alba Vanhöffen, : 02^{b}, p. 71, taf. 9, fig. *5*.

Plate 3, Figs. *1*, *2*; Plate 33, Figs. *6*, *11*; Plate 34, Fig. *9*.

Station 4663; 300 fathoms to surface; 1 specimen, 20 mm. in diameter.

Station 4668; 300 fathoms to surface; 1 specimen, 13 mm. in diameter.

Station 4671; 300 fathoms to surface; 1 specimen, 5.5 mm. in diameter.

Station 4676; 300 fathoms to surface; the specimen photographed, 17 mm. in diameter.

Station 4677; 300 fathoms to surface; 1 specimen, 23 mm. in diameter; fragmentary.

Station 4679; 300 fathoms to surface; 1 fair specimen, 22 mm. in diameter.

Station 4691; 300 fathoms to surface; 2 fragments.

Station 4717; 300 fathoms to surface; 1 specimen, 10.5 mm. in diameter; gonads already developed.

The general form of the bell is shown, in side view, in the photograph (Pl. **3**, fig. *2*). The central portion of the gelatinous disc is thick and rounded, the marginal zone thinner. The specimens are all rather flatter, and have a shallower bell cavity than in Vanhöffen's figure (: 02^b, taf. 9, fig. *5*); but since this figure was taken from a preserved specimen (he had only one specimen), and since the outline varies in different specimens in the present collection, it is best not to lay much stress on this difference.

Tentacles. — These show the same differentiation into proximal and distal regions, as well as the same differentiation in size, as do those of *Halicreas papillosum;* the radial ones are much stouter and longer than those between the canals. Most of the tentacles are broken short off, as is usual in this family. There are from ten to thirteen tentacles per octant (Pl. **33**, fig. *11*), this being about the same number that Vanhöffen (: 02^b) has recorded; and even in the smallest specimen (5.5 mm. in diameter) there are twelve tentacles in the only octant in which counting was possible. The number of tentacles is thus only about one half as great as in *Halicreas papillosum.* This appears to be a fairly constant difference, and, since the full number is so early attained, may well be accorded specific value.

Sense organs. — These (Pl. **33**, fig. *6*) closely resemble the otocysts of *Halicreas papillosum.* I have not been able to determine certainly whether or not they contain otoliths. Browne, who has observed the sense organs in *H. platygonon,* merely says that "they are external, fairly large, and have a short stalk" (: 06, p. 175). The greatest number that I have counted in any octant is three.

Gastrovascular system. — The stomach is broad and flat (Pl. **3**, fig. *1*). The mouth is usually wide open, but in one large specimen, 20 mm. in diameter, it was tightly closed, and easily separable into proximal and distal (lip) regions. Maas (: 06^b, p. 10) considers the conformation of the gastric cavity a good distinction between different species of this genus; but inasmuch as different specimens of *H. alba* show so much diversity, I doubt whether this character is of any greater taxonomic importance in this family than it is in the Aequoridae. The radial canals are broad (Pl. **3**, fig. *1*), though narrower than in *Halicreas papillosum* (Pl. **3**, fig. *3*).

Gonads. — These (Pl. **3**, figs. *1*, *2*) are proximal, though not actually continuous with the central gastric cavity. They vary in position in different specimens, being either closer to or farther from the stomach. It is this variation which has led me to unite *H. alba* with *H. conica*, which differ in this respect alone. In form they strongly resemble Maas's figure (: 06^b, pl. 1, figs. *3*, *4*) of *H. racovitzae*, being rounded and deep (not flat, as in the Geryonidae). They are thus very different from the sexual organs of Halicreas. Vanhöffen (: 02^b, taf. 9, fig. *5*) figures them for the "Valdivia" specimen as proximal, but lanceolate or oval, not circular; he does not state whether they were flat or globular. They are visible, though very small, even in the smallest specimen, and in the large ones they are very prominent. In the specimen represented in the photographs (Pl. **3**, figs. *1*, *2*) each gonad contains many large eggs.

Color. — The majority of the specimens were entirely colorless in life; but in one individual the entire entodermic system was of a very pale orange. Vanhöffen states that the single "Valdivia" specimen was colorless.

Homoeonema alba is undoubtedly an intermediate form. Vanhöffen has recorded it from the southeastern Atlantic (42° 18′ S.; 14° 1′ E.), while the present collection shows that it is of wide distribution throughout the Eastern Tropical Pacific. *H. platygonon* is so far known only from the north Atlantic (Maas, between Iceland and Greenland; Browne, Norway and Bay of Biscay), while *H. racovitzae* is recorded from the Antarctic (Maas, : 06^b).

Homoeonema racovitzae Maas.

Homoeonema racovitzae Maas, : 06^b, p. 10, pl. 1, figs. *3*, *4*; pl. 2, fig. *13*.

In addition to *Homoeonema alba* the collection contains two specimens of a second species of the genus taken at Stations 4667, 300 fathoms to surface, and 4676, 300 fathoms to surface. In most respects they closely resemble the *H. racovitzae* of Maas; but since they lack the characteristic pigmentation of the latter, as well as on account of the widely separated localities of capture, identification with that species is only provisional.

They are much smaller than *H. alba*, the two specimens, both of which have well-developed gonads, measuring respectively 7.5 and 10 mm. in diameter. The most important difference from *H. alba* is in the very small number of tentacles per octant, neither specimen having more than six in any octant. This is precisely the number recorded by Maas (: 06^b) for *H. racovitzae*, and is a strong reason for believing that the present specimens belong to that species. Specimens of *H. alba* of the same size already have about twice as many tentacles (ten to twelve per octant). The structure of the tentacles is that typical of the family, the differentiation into proximal and distal regions being well marked.

Both of the specimens are entirely colorless; Maas's specimen, on the other hand, had the gonads and entire entodermal system heavily pigmented.

Homoeonema species ?

Plate 34, Figs. *4*, *6*, *7*.

The collection contains a single very small specimen of this genus, taken at Station 4676, 300 fathoms to surface, too young for specific identification. A general oral view of this individual is shown in the photograph (Pl. **34**, fig. *6*). In outline the bell is flat, the gelatinous substance thin. In diameter it measures 7.5 mm., a size at which *H. alba* already has ten to twelve tentacles per octant. There are very few tentacles, the numbers per octant being 3, 2, 3, 3, 3, 3, 4, 3. In the octants in which there are three there is an interradial tentacle flanked on either side by a very rudimentary adradial one. Structurally the tentacles differ from those of adults of this genus, in that they do not show any differentiation into two regions, but are soft and flexible throughout their entire length. There is a single otocyst, of the typical halicreid form, in each octant (Pl. **34**, fig. *4*).

The stomach is flat, mouth open, radial canals broad (Pl. **34**, fig. *6*); two of the latter unite at their bases.

There is as yet no trace of gonads.

Color. — In life, the entire entodermic system was of a pale orange tint.

Halitrephes, gen. nov.

Halicreasidae with numerous (twenty-eight) radial canals; without exumbral papillae.

This genus is proposed to contain a new species which on account of the structure of tentacles and otocysts, the breadth of the radial canals, and conformation of the gastric cavity, undoubtedly belongs to the Halicreasidae, but which differs from all other members of the family in having a large number of radial canals. The general appearance is so much like that of Aequorea that, until I examined the marginal organs, I believed that it belonged to that genus. I take pleasure in naming the one species after Prof. Otto Maas, in recognition of the valuable results of his studies on this family.

Halitrephes maasi, sp. nov.

Plate 33, figs. *1–5, 7, 10;* Plate 45, fig. *13.*

Station 4646; 300 fathoms to surface; fragmentary, only the disc.

Station 4653; 300 fathoms to surface; fragmentary, only the disc.

Station 4668; bottom of Tanner net; from about 300 fathoms; type specimen, in fairly good condition.

Unfortunately the type specimen alone is in good condition, the other two being so fragmentary that their identification is doubtful.

Diameter of the type 55 mm. The exumbrella surface is smooth and rounded; the bell low; the gelatinous substance thin and very brittle; the subumbrella cavity shallow.

Tentacles. — These are of different sizes, though structurally all alike (Pl. **45**, fig. *13*). They show the characteristic separation into proximal and distal portions in less marked degree than other members of the family. This may, however, be due to the rather soft condition of the specimen. The distal portion of the tentacles, though thinner and stiffer than the proximal (Pl. **33**, fig. *2*), is less spine-like than in Halicreas. The differentiation of the entodermal core into two regions is sharp. The ectodermic layer of the distal portion, which is rather thick and densely crowded with nematocysts (Pl. **33**, fig. *7*), is preserved in many of the tentacles. When it is partially destroyed the stiff core is revealed. All the tentacles, even the smallest, arise from triangular entodermic roots; those of the larger ones extending across the circular canal. There are about seventy tentacles of various sizes; usually one lies opposite each canal. Many of them are broken short off, as is seen in the general view (Pl. **33**, fig. *4*).

Otocysts. — These, as in other members of the family, are free clubs, consisting of an ectodermic sheath and entodermic core. I have not been able to determine on the specimen (preserved in formalin) whether otoliths were present, but the appearance of the sense organs suggests that they contained one or two such structures (Pl. **33**, fig. *10*). They are easily distinguished from small or rudimentary tentacles by their definite form, uniform size, and by the fact that they lack the entodermic roots characteristic of the latter. On account of the condition of the margin I was unable to count the otocysts; but they are certainly much less numerous than the tentacles (Pl. **45**, fig. *13*).

Gastrovascular system. — The central stomach is small, only about 15 mm. in diameter; the mouth widely open, without any sign of proboscis, and surrounded by a simple circular thickening. Twenty-eight radial canals arise from the stomach; five of these then branch dichotomously so that thirty-three extend to the margin. The canals, both radial and circular, are very broad (Pl. **33**, fig. *4*).

Gonads. — The gonads are proximal (Pl. **33**, fig. *4*); small, circular, and flat. Several of the canals appear to lack them, but it is doubtful whether this is a normal condition. Sexual products are not mature: the specimen is apparently a male.

The specimen is entirely colorless, the entodermic system being merely more opaque than the hyaline disc.

Halitrephes maasi must be regarded as an intermediate form. It is one of the few members of this class which has been taken in a closing net at a known depth. The occurrence of this colorless form at three hundred fathoms shows the danger of speculating on pigmentation as an indication of bathymetric range.

LEPTOMEDUSAE.

The genera of Leptomedusae without otocysts have recently been rearranged by Maas (:04^b) and Browne (:07), who, though differing as to whether condition of canals or of marginal organs is the more important, agree that the two families, Cannotidae and Thaumantidae, between which Haeckel ('79) divided these genera, are purely artificial groupings. Indeed, one subfamily of the Cannotidae, the Williinae, has been shown by Browne (:'96) to belong to the Anthomedusae, since the gonads lie on the walls of the manubrium, not on the radial canals. According to Maas (:04^b) the remaining Cannotidae are to be divided into two families, Berenicidae and Polyorchidae, according as they have branched or pinnate canals; but Browne (:07) has recently maintained, and I believe correctly, that a more important character than the condition of the canals is the presence or absence of the peculiar marginal clubs known as cordyli, their presence characterizing the family Laodiceidae, which includes most of the genera grouped by Maas under the heading Berenicidae, as well as several from the Thaumantidae as defined by Haeckel ('79). The systematist must recognize the weakness of a classification based upon a single character, especially when such grouping runs exactly counter to previous classification based upon another single character (in this case the branching of the radial canals). Nevertheless, I believe that the condition of the marginal organs is of greater taxonomic value than that of the canals, and that Browne's (: 07) revision therefore marks a decided advance over previous schemes. It must be noted, however, — and this is a point of some importance, — that if we adopt the presence or absence of cordyli as a character of prime importance, the two resultant groups show parallel series, each falling into two divisions, the one with simple and the other with branched canals; while, on the other hand, if we were to retain the classification based on the condition of the canals, whether branched or simple, similar parallel series with reference to the presence or absence of cordyli would result. Those members of the old family Thaumantidae which remain after the removal of the genera with cordyli stand in need of further revision.

The genera of Leptomedusae with otocysts show their family relations much more clearly than do those without such organs, it being now very generally agreed that they represent two families, Eucopidae and Aequoridae, though the position of one or two genera, whether in one or the other, has been a subject of discussion. There is little doubt that these two families are much more intimately related to each other than is either of them to any of those members of the order which lack otocysts.

No representatives of the genera with neither cordyli nor otocysts, nor of those with branched canals, are contained in the collection; and there is only one genus of Laodiceidae, Ptychogena. Eucopidae and Aequoridae, on the other hand, are well represented.

Laodiceidae L. Agassiz, 1862.

sens. em. Browne (: 07).

Leptomedusae without otocysts, but with cordyli on the margin of the bell.

For generic definitions of the members of this family we may well follow Browne (: 07), especially since his revision, though resulting in the suppression of several species, has not necessitated a general transfer of the well-known members of the family. According to Browne six genera of Laodiceidae are recognizable: — Laodice, with four radial canals, central mouth, and ocelli on the basal bulbs of the tentacles; Staurophora, differing from Laodice by the peculiar and extensive development of the mouth; Ptychogena, resembling Laodice except in lacking ocelli; Saurodiscus, in which each of the four radial canals has two lateral branches; Toxorchis, with six branched radial canals; and Melicertissa with eight unbranched canals. The present collection contains examples of one only of these genera, Ptychogena.

Ptychogena A. Agassiz, 1865.

sens. em. Browne (: 07).

Laodiceidae with four unbranched radial canals; with central mouth and stomach; without ocelli on the basal bulbs of any of the tentacles.

According to Browne's revision of this genus three species can be recognized: — *P. lactea* A. Agassiz ('65), *P. longigona* Maas ('93), and *P. antarctica* Browne (: 02), of which only a preliminary account has yet appeared. *P. pinnulata* Haeckel ('79, '81) appears to be indistinguishable from *P. lactea*, since the slight differences in the form of the gonads supposed by Haeckel to separate the two species represent nothing more than different stages in development. Indeed an intermediate step between the two has been described by Linko (: 00). As Browne says (: 07, p. 473), *P. lactea* is probably an arctic species, and there is no evidence that it belongs to the intermediate fauna. *P. longigona* is distinguishable from *P. lactea* by the length of the gonads, which extend along the entire course of the radial canals, and by the fact that there are no distinct lateral diverticula on the radial canals, although the gonads are arranged in folds. Unfortunately the margin has not been figured, so that I can say nothing as to the form of the basal bulbs of the tentacles, a feature which appears to be of some systemic significance in this genus. In *P. antarctica*, founded for a single fragmentary specimen, the radial canals have wavy margins corresponding to the principal folds of the gonads; but no true diverticula such as are seen in *P. lactea* (Browne, : 07, p. 474), and the red color of the tentacles of *P. antarctica* further serves to separate the two; the tentacular bases, however, like those of *P. lactea*, are laterally compressed. From *P. longigona* it is apparently distinguishable by the shortness of the gonads; but Browne (: 07) states that, owing to the brevity of Maas's description of the latter, the relationship of the two is doubtful. For a final decision on this point we must await the full description and figures of *P. antarctica*.

The series in the present collection is certainly very distinct from *P. lactea*, but closely related to *P. longigona* and *P. antarctic.* From the former, however, it can be distinguished by the much smaller number of tentacles, and from the latter by the shape of the tentacular bulbs.

Ptychogena erythrogonon, sp. nov.

Plate 5, Fig. *1;* Plate 38, Figs *8, 9;* Plate 39, Figs. *1–7.*

Station 4646; 300 fathoms to surface; 1 good specimen.

Station 4650; 300 fathoms to surface; 1 small specimen, fair condition.

Station 4653; trawl from 336 fathoms; 3 specimens, somewhat battered.

Station 4654; trawl from 1,036 fathoms; 3 fragmentary specimens.

Station 4655; 300 fathoms to surface; 1 large specimen, good condition.

Station 4661; 300 fathoms to surface; 1 immature specimen, excellent condition.

Station 4666; trawl from 2,600 fathoms; 1 specimen, fragmentary.

Station 4671; 300 fathoms to surface; 1 good specimen. Type.

Station 4675; 300 fathoms to surface; 1 fair specimen.

The series is particularly interesting in containing several successive stages in the development of the gonads. Several of the specimens are in excellent condition, and even the fragmentary ones allow most of the details of structure to be made out.

The form of the bell is characteristic, its gelatinous substance being so thick, and the umbrella cavity so shallow, that the Medusa is almost globular (Pl. 39, fig. *1*). This character is probably of specific significance, for it is very constant in the series (both in the fresh condition and after preservation), while the three other members of the genus are of more moderate outline. The largest specimen is 38 mm. in diameter by about 25 mm. high.

Tentacles. — The number of tentacles is much smaller than in either *P. lactea* or *P. longigona*. In the only specimen in which the entire margin was preserved, 30 mm. in diameter, Station 4671 in the above table, there were forty-three; the numbers in each quadrant, counting the tentacles opposite the canals, being twelve, ten, ten, and eleven. In larger specimens the number is greater, the largest number counted in a single quadrant being sixteen, in a specimen 36 mm. in diameter. In the smallest individual, 18 mm. in diameter, there are about twenty-four tentacles in all; and in one slightly larger (24 mm.), but still without any trace of gonads, about twenty-two. In addition to the well-developed tentacles several specimens have one or two small ones, evidently in process of development (Pl. **39**, fig. *5*). The tentacles are very short and stout; their conical basal bulbs (Pl. **39**, fig. *5*) are not laterally compressed as they are in *P. lactea* and *P. antarctica*, but more nearly resemble in outline the corresponding structures as they are described in the various species of Laodice. This difference in the form of the basal bulbs in different species of the genus is probably correlated with difference in the number of tentacles; the bulbs are laterally compressed in species in which the tentacles are crowded, and conical when these organs are widely spaced.

Cirri. — In addition to the tentacles there are a small number of solid cirri (Pl. **39**, fig. *5*), which bear nematocyst clusters at their tips (Pl. **38**, fig. *9*). In none of the specimens did I find more than three of these structures; several had only one or two, and others had none at all.

Cordyli. — These organs (Pl. **39**, fig. *5*, *co*; Pl. **38**, fig. *8*) are of the structure so well described by Brooks ('95) for Laodice. They contain no otolithic concretions of any kind. As a rule there is one cordylus between every two tentacles; but occasionally there are two, so that in every individual in which they were counted the number of cordyli slightly exceeds that of tentacles (Pl. **39**, fig. *5*). It is evident, then, that the question whether there are one or two between every two tentacles is of no greater systematic importance in Ptychogena than Browne (: 07) considers it in Laodice.

Manubrium. — The manubrium is quadrate basally; in young specimens it is very large (Pl. **39**, fig. *6*), but its growth does not keep pace with that of the bell, so that in adults it is proportionately much smaller. It is barrel-shaped in outline, and the mouth is surrounded by a simple circular thickening, widely open in all the specimens (Pl. **39**, fig. *7*). In oral view it much resembles the figure given by Maas ('93, taf. 6, fig. *7*) for *P. longigona*, as well as for *Laodice fijiana* (Maas, : 05, taf. 5, fig. *34*).

Radial canals and gonads. — In the smallest specimen the radial canals, though broad, are simple in outline, without diverticula or even waviness (Pl. **39**, fig. *6*); but in the specimen 24 mm. in diameter they have developed a series of short lateral diverticula along the narrow lines by which they are attached to the subumbrella (Pl. **39**, fig. *2*). The main bodies of the canals, however, are so stout that they extend out as far as the ends of these short branches. The gonads develop in the spaces between the diverticula, and are confined to the aboral surfaces of the canals, close to the subumbrella, as is seen in side view (Pl. **39**, fig. *4*). As the genital folds grow larger and larger they gradually obscure the diverticula of the canals (Pl. **39**, fig. *3*) until finally it appears as though the latter were merely wavy in outline, as Browne (: 02) has described them for *P. antarctica*. This structure of the canals and gonads is similar to that found in *P. longigona* by Maas, who states that the canals "sind an und für sich einfach und zeigen Ausbuchtungen nicht selbständig, sondern nur in Zusammenhang mit Gonaden entwickelt" ('93, p. 66). The gonads extend for nearly the entire length of the canals, but do not quite reach their distal extremities.

Color. — The color of this species is one of its most striking characters. The basal parts of radial canals and manubrium as well as the tentacular bulbs are of a very brilliant opaque brick-red; while gonads, distal portions of the canal system, and extremities of the tentacles are of a paler shade of the same color. Along the central line of each radial canal is a pale band, these four bands forming a cross on the base of the stomach (Pl. **39**, fig. *7*). The pigmentation is both ectodermic and endodermic. The endoderm cells contain masses of red, yellow, and black pigment spherules of large size, while the ectoderm cells in the pigmented regions are crowded with minute red granules.

Ptychogena erythrogonon is evidently an intermediate form. So far as the present collection illustrates its range, it appears to be confined to the Humboldt Current, in the neighborhood of the Peruvian coast. Of the three other members of the genus, one, *P. antartica*, is from the Antarctic; two, *P. lactea* and *P. longigona*, from the north Atlantic. *P. lactea* is probably a surface form; *P. longigona* is almost certainly from the intermediate waters, while we have as yet no data as to the bathymetric occurrence of *P. antarctica*.

Eucopidae Gegenbaur, 1856.

Leptomedusae with closed otocysts; with four, six, or eight radial canals; with gonads lying along the canals; with well-developed barrel-shaped manubrium.

Only one of the four subfamilies of Eucopidae proposed by Haeckel, ('79) the Eutiminae (Maas, : 05), has stood the test of time. This subfamily, including forms with a long peduncle and with only eight otocysts, seems sufficiently well characterized. The other subfamily with a peduncle, Eireninae (Haeckel), with more than eight otocysts, must be abandoned, for the peduncle is a feature which is variable, and may even be present to a slight degree in adults of such genera as Phialidium and Phialucium, so that among the species with numerous otocysts there is no break in the series from forms without peduncle to others in which this organ is well developed. The interrelationships of these genera are so puzzling that no altogether satisfactory subdivision of them has yet been devised.

Maas (: 05) has recently transferred the subfamily Octocanninae, with eight radial canals, from the Aequoridae to the Eucopidae, and on sufficiently good grounds.

Phialium Haeckel, 1879.

Eucopidae, with twelve otocysts, and four chief radial tentacles flanked at their swollen bases by lateral cirri; with or without additional tentacular bulbs on the margin; without peduncle.

This genus was instituted by Haeckel ('79) to contain the *Eucheilota duodecimalis* of A. Agassiz ('65), which, as A. Agassiz had pointed out, differs from the *Eucheilota ventricularis* of McCrady ('57) in having twelve instead of eight otocysts, and which A. Agassiz thought would be found, when better known, to belong to another genus. Haeckel added a second species, *P. dodecasema*, from one of Agassiz's figures, believing that the latter had observed two distinct species; but Fewkes ('82[b]) has shown that the two supposed forms represent merely two contraction phases of the one species. The genus has been accepted by Fewkes ('82[b]), but so far as I can learn it has not appeared elsewhere in literature, both Mayer (: 00[b]) and Hargitt (: 05[b]) having used the name Eucheilota in a broad sense to include both species with eight and those with twelve otocysts. It is best to retain Haeckel's genus, as distinguished from Eucheilota, inasmuch as it is separated from the numerous species with eight otocysts (Eucheilota), not only by the number of these organs, but also by the limited number of developed tentacles (four radial) and by the extreme development of the gonads.

I have been able to find no other species which can certainly be referred to this genus, although it is possible that *Mitrocomium assimile* Browne (: 05[b]), from Ceylon, may belong here. The present collection contains a considerable series of specimens indistinguishable from *Phialium duodecimalis* from the Atlantic coast of the United States.

Phialium duodecimalis A. Agassiz.

Eucheilota duodecimalis A. Agassiz, '62, p. 353; '65, p. 75, figs. *106, 107, 107a;* Hargitt, : 05^b, p. 46, pl. 4, fig. *3*.
Phialium duodecimale Haeckel, '79, p. 180; Fewkes, '82^b, p. 297, pl. 1, figs. *17–21*.
Phialium dodecasema Haeckel, '79, p. 181.

Plate 6, Fig. *4;* Plate 38, Figs. *4, 5*.

Acapulco Harbor; surface; many specimens, 1 to 2 mm. in diameter.

It has been my good fortune to have access to a large series of *P. duodecimalis*, from Newport, R. I., for comparison with the present specimens, and, as in the case of *Phialidium discoida*, I have been unable to find that there are any constant differences to separate the two. The Pacific series, none of which are full grown, agree closely in general form, and in the size and shape of the gonads, with Atlantic specimens of about the same size.

The most important specific characters are to be looked for on the marginal organs. In each specimen there are four radial tentacles, with swollen conical basal bulbs flanked with from one to four pairs of cirri; and twelve otocysts, three per quadrant, each containing a single large otolith exactly as is figured for *P. duodecimalis* by A. Agassiz ('65, fig. *107*) and by Fewkes ('82^b, figs. *17–21*). There are no rudimentary tentacular swellings on the margin in any of the specimens. Such structures, alternating with the otocysts, have, it is true, been recorded, but not figured, by Fewkes ('82^b) for very large specimens from Newport; but inasmuch as Hargitt (: 05^b) has not observed any, but states expressly that there are only four tentacles, and since the writer has never seen any in the numerous large specimens from the Atlantic coast of the United States which he has examined, it is probable that the specimens with more than four developed tentacles, which Fewkes records, in reality belonged to *Eucheilota ventricularis*, a species which might easily be confused with the present if the otocysts were not counted.

In all the specimens gonads were developed, but in none were they of such large size as they finally become. In some of the Newport specimens they are so swollen that they fill almost the entire bell.

The Medusae are entirely colorless.

So far as I have been able to learn, the only species known from the Indo-Pacific region which resembles this species is the *Mitrocomium assimile* described by Browne (: 05^b, p. 137, pl. 1, fig. *3*) from Ceylon. Unfortunately his single specimen was in such poor condition that he was unable to count the otocysts with any certainty, being able to find only five, so that positive generic identification was impossible. From its general form, and from the form and extent of the gonads, I think it probable that it is either a Phialium or a Eucheilota, not a Mitrocomium; but it differs from the present series in having a large interradial bulb and from four to six small adradial bulbs in each quadrant in addition to the four primary radial tentacles. Fewkes's ('82[b]) account would suggest, as noted above, that this distinction was of doubtful value, but from my own studies I conclude that it is probably quite as significant in this genus as it is in Phialidium.

Phialidium Leuckart, 1856.

Haeckel, 1879.

Eucopidae with numerous otocysts, one or two between every two of the numerous tentacles; without marginal cirri or papillae; no well-developed peduncle.

This genus has commonly been called Oceania by American authors, but the name Phialidium is preferable in the interests of stable nomenclature, because identification of the species to which Oceania was originally applied is very doubtful; while Oceania has been employed in widely different senses by later authors (*e. g.* for Anthomedusae Vanhöffen, '89).

The Atlantic species referable to this genus are so puzzling in their synonymy, owing to their great variability, that they have long been a thorn in the side of the student of Leptomedusae. The following species have been described from the Pacific: — *P. gregaria* A. Agassiz; *P. pacifica* Agassiz and Mayer; *P. ambigua* Agassiz and Mayer; and *P. brunescens* Bigelow. Another Pacific species of Oceania, *P. virens* Bigelow (: 04), has since been made the type of the new genus Phialucium by Maas (: 05).

The present collection contains one species of the genus indistinguishable, on comparison with actual specimens, from the West Indian *P. discoida* of Mayer.

Phialidium discoida Mayer.

Oceania discoida Mayer, : 00[b], p. 51, pl. 20, figs. *53–55*.

Plate 6, Fig. *8;* Plate 38, Figs. *6, 7.*

Acapulco Harbor; surface; many specimens, 1 to 3.5 mm. in diameter.

The resemblance between these specimens and a collection of *P. discoida* from the West Indies is so close that I have been unable to find a single feature to separate them.

The largest specimen measures 3.5 mm. in diameter; but inasmuch as this individual has several tentacles only partly developed, it is evident that this is not the extreme size, but that Pacific like Atlantic specimens grow much larger. The largest West Indian specimen is 5.5 mm. in diameter. This is larger than any recorded by Mayer; and the fact that the specimens which he described were immature no doubt explains the few discrepancies between his account and the West Indian specimens which I have studied.

The bell is flat; seldom circular, but usually irregularly rectangular in outline, from muscular contraction; its cavity very shallow.

Tentacles. — The largest number counted, in a specimen 2.5 mm. in diameter, was thirty-nine, of which one was rudimentary. The smallest number was twenty-four, one rudimentary; the majority of specimens, 2 to 2.5 mm. in diameter, have from thirty to thirty-six tentacles, with from one to four rudimentary. In a larger specimen from the West Indies, 3.5 mm. in diameter, there are forty-six tentacles, and in another, of 3 mm., forty. The tentacular bases form swollen, almost spherical bulbs, very sharply separated from the slender distal portion of the tentacle, a characteristic feature which is one excellent mark of the species (Pl. **38**, fig. *6*). In contracted specimens these bulbs are usually in close contact with one another; and even when the bell is expanded, though they are then separated by considerable spaces, they are more crowded than in any other species of the genus which I have studied. A similar form of the tentacles in Maas's (: 06^c, pl. **2**, fig. 7) figure suggests that his *P. pacifica,* from Amboina, is really not the *Oceania pacifica* of Agassiz and Mayer ('99), but is more nearly related to *P. discoida,* if not identical with it.

Otocysts. — In both Pacific and West Indian specimens there is usually only a single otocyst between every two tentacles. Mayer (: 00^b), however, has recorded from one to three otocysts between every pair of tentacles; but this discrepancy of observation is probably due to the fact that all of his specimens were immature and that the final number of tentacles had not yet developed. The number of otoliths in each otocyst varies from one to four; possibly even more. Counting the otocysts is somewhat uncertain, because of the crowded condition of the basal bulbs of the tentacles; and perhaps in some cases there may be more otocysts than I have been able to find.

Gonads. — The large size of the gonads is a specific character of as much importance as is the form of the tentacular bulbs. They usually occupy the distal two thirds of the canals, but occasionally extend the entire length of a canal. Such a variation is to be seen on the different gonads of the specimen photographed (Pl. **6**, fig. *8*). Gonads are present, though of small size, even in specimens only 1.5 mm. in diameter. In females the ova are very large. The collection contains both males and females.

The manubrium is short, and quadrate in outline; the mouth surrounded by four simple lips.

Color. — The Medusae were entirely colorless in life.

The difference in number of tentacles and of otocysts between the present specimens and Mayer's (: 00^b) account of *P. discoida* might perhaps have seemed of specific importance had I not had access to a West Indian series, from near the type locality. I am now convinced that these differences are due to different stages in growth, a conclusion in no way negatived by the large size (4 mm.) of Mayer's specimens, since his description was written from fresh specimens, while the measurements in the present account were taken from preserved material; but whether or not my identification of this series with the form described by Mayer is correct, the significant fact of the identity of the Pacific with a West Indian form remains.

Phialucium Maas, 1905.

sens. em.

Eucopidae with numerous tentacles and otocysts (number indeterminate); with rudimentary as well as large tentacles; with or without cirri. Rudimentary tentacles may be developed at a late stage in growth.

Phialucium was proposed by Maas (: 05) as a subgenus; but it is worthy of full generic rank.

As defined by Maas it lacks cirri; but a species in the present collection which has cirri flanking the tentacles, in other respects so closely resembles the type species, *P. virens* Bigelow (: 04), that it is best to discard the presence or absence of these organs as a generic character. The genus may be regarded as intermediate between Phialidium and Eirene, since West Indian specimens, to be described below, acquire a rudimentary peduncle when fully grown, but only long after the appearance of the gonads. Up to the present time two species only have been described which are referable to this genus, *Oceania virens* Bigelow (: 04)

(*Phialidium tenue* Browne, : 04) and *Oceania carolinae* Mayer (: 00^a). These two are clearly separable by the number of marginal organs; for though the number of tentacles and tentacular bulbs is variable, they are considerably more numerous in *P. virens* than in *P. carolinae*, while the number of otocysts in the former is only about one half as great as it is in the latter. *P. carolinae* has been recorded but once, from Charleston, S. C.; while *P. virens* is now known to be widely distributed over the Indian Ocean and Malaysian region (Bigelow, : 04, Browne, : 04, Maas, : 05, : 06^c), and it is perhaps the same species as *Mitrocoma mbengha* which was described by Agassiz and Mayer ('99) from the Fiji Islands. The present collection contains a series referable to this same genus, but differing in an important character, *i. e.* presence of cirri, from both *P. virens* and *P. carolinae*. This species is, however, closely allied to, if not identical with, certain specimens from the Island of Guadaloupe, West Indies, in the collection of the Museum of Comparative Zoölogy, and is apparently undescribed.

Phialucium comata, sp. nov.

Plate 5, Figs. *6, 7;* Plate 6, Fig. *9;* Plate 37, Figs. *9, 10, 12.*

Acapulco Harbor; surface; 5 specimens, 3 mm. to 6 mm. in diameter. Type 6 mm. in diameter (also Guadeloupe Island, West Indies; surface; 9 specimens, 3.5–12 mm. in diameter).

In general outline the bell is high (Pl. 5, fig. 7), the gelatinous substance thick, and the umbrella cavity deep. In none of the Pacific specimens is there any trace of peduncle or even any swelling of the gelatinous substance at the point where the manubrium is situated. The same is true of the West Indian specimens from 3 mm. to about 9 mm. in diameter; but in the largest, 12 mm. in diameter, the manubrium is situated on a broad but very low swelling. This, however, is not sufficiently pronounced to warrant referring the species, on the ground of its possessing a distinct peduncle, to Eirene.

The only difference between the Pacific and the West Indian specimens is afforded by the number of tentacles and tentacular knobs. In the largest specimen from Acapulco there are seventeen tentacles and twenty-three knobs; in the smallest, eight tentacles and eight knobs; but in specimens of corresponding sizes (6 mm. and 3 mm.) and stages of development from the Atlantic the number of knobs is considerably greater, there being from thirty-nine to fifty and from twenty to twenty-two respectively. This divergence seems to indicate the existence of two distinct varieties of the species. The number of tentacles, although variable, is about the same in both collections. In specimens 12 mm. in diameter the knobs have largely increased in number, there being as many as sixty-two; but the largest number of tentacles observed was nineteen. It appears, then, that no great further increase in tentacles is to be looked for; and therefore it is almost certain that the great majority of knobs in this species, as in *P. virens* and *P. carolinae,* never develop into tentacles. The tentacles are short, with swollen basal bulbs, and are flanked with from one to three pairs of lateral cirri (Pl. **37**, fig. *10*). The same is likewise true of the larger knobs. The small knobs, however, have no cirri.

Otocysts. — The sense organs are so large and prominent (Pl. **37**, fig. *9*), that I suspected at first that they might be open; but a study of sections has demonstrated that they are merely closed vesicles of large size. It is impossible to tell the normal number of otoliths on preserved specimens. The number of otocysts is variable, but apparently always small, and not subject to increase with the later growth of the medusa. In the two largest Pacific specimens, 5 mm. and 6 mm. in diameter, there are fourteen and nine respectively. In West Indian specimens the numbers counted are: — 3.5 mm., seven otocysts; 7 mm., eleven otocysts; 12 mm., nine otocysts; 12 mm., ten otocysts. They are irregularly arranged, in several cases three in one quadrant, with only one in the adjoining quadrant, while in one individual one quadrant altogether lacked otocysts.

The manubrium is short, and flask-shaped; the mouth is surrounded by four slightly crenulated lips.

Gonads. — The gonads first appear as small globular swellings at the middle points of the radial canals, and with the growth of the medusa they grow distally. In the largest Pacific individual they occupy the central one third of the canals; and in the still larger West Indian specimens they extend out nearly to the extremities of the canals. They remain linear, however, increasing but slightly in thickness, while even in small specimens large ova are to be seen. Their general appearance, therefore, apart from size, gives no clue to the stage of development of the specimen. The collection contains both males and females.

Color. — In life the gonads in both collections were slightly greenish, but the specimens otherwise were colorless.

The difference between the two series of specimens, Pacific and West Indian, consisting merely of a slight divergence in such a variable character as the number of rudimentary tentacular knobs, seems to me too slight to warrant separating them specifically. To determine whether it even indicates the existence of two distinct geographic races of the one species requires an examination of additional large specimens, particularly from the Pacific.

P. comata is clearly distinguished from the other members of the genus by the presence of lateral cirri at the bases of the tentacles, a very constant and reliable character; and by the small number of otocysts. In the large size of the latter, however, it resembles *P. virens.*

Eirene Eschscholtz, 1829.

Haeckel, 1879.

Eucopidae with well-developed gelatinous peduncle; with numerous otocysts and tentacles; gonads restricted to the subumbrella.

Haeckel ('79) enumerated only four species of this genus: *E. pellucida* Will, *E. viridula* Lamark, *E. gibbosa* McCrady, and *E. coerulea* L. Agassiz. To these must be added the *Eutima pyramidalis* of L. Agassiz, which has since been redescribed by Mayer (:00^{b}) under the name *Phortis pyramidalis.* All these are Atlantic forms. Since Haeckel wrote, five new species have been described:—*E. lactea* Mayer (:00^{b}), from the West Indies, *E. kambara* Agassiz and Mayer ('99), from the Fiji Islands, and *E. danduensis* Bigelow (:04), *E. ceylonensis* Browne (:05^{b}), and *E. palkensis* Browne (:05^{b}), from the Indian Ocean. It is, however, doubtful whether all of these are truly distinct; indeed the status even of the two longest known species, *E. pellucida* and *E. viridula,* is not yet satisfactorily determined. The probability is that they are specifically identical, but as Mediterranean and Atlantic specimens are known to have a wide range of variation in size, tentacle number, and form of the peduncle (Haeckel, '79; Maas, '93), it is possible that the *E. viridula–E. pellucida* group may in reality comprise two or more geographic races. This species, or group, is apparently the most widely distributed of the genus; but though it has been recorded twice from the Indian Ocean (Chun, '96; Goette, '86), there seems to be no record of its occurrence on the western side of the Atlantic. *E. danduensis* and *E. palkensis* show many features in common; in both there are comparatively few tentacles, with a large number of rudimentary tentacular knobs; in both the peduncle is long and in both the gonads are linear. The only important differences between the two are the facts that *E. palkensis* has a much shorter manubrium than *E. danduensis*, and that Browne was unable to find any lateral cirri at the bases of the tentacles in the former, while I have recorded such structures for the latter; but neither of these differences is as important as it might seem at the outset, for the first character is subject to great variation owing to contraction; the absence of cirri in *E. palkensis* may perhaps be explained by the fact that the bell margins of all the specimens were much damaged (Browne, :05^b). I therefore believe that in all probability the two are identical.

Browne was no doubt justified in separating *E. ceylonensis* from *E. palkensis* (*danduensis*) in spite of the close general resemblance between the two, on the grounds that the former has a very much larger number of tentacles (100), but neither cirri nor tentacular knobs. It appears to represent a good species. Both of these Indo-Pacific species (or three if *E. palkensis* be recognized as separated from *E. danduensis*) are sufficiently well distinguished by anatomical characters from any of the Atlantic members of the genus. The status of *E. kambara* Agassiz and Mayer is less easily settled. From their figure ('99, pl. 8, fig. *29*) it is evident that the specimen was immature; although they mention gonads, the figure shows none; and the fact that the margin bears neither cirri nor knobs suggests that it may be the young of *E. ceylonensis*. If this is the case, however, the peduncle must grow very considerably in length during the later stages of development, for it is figured by them as very short in *E. kambara*.

The present collection contains two species referable to Eirene; one, represented by only a single specimen, from the open ocean, is indistinguishable from *E. viridula*. The other represented by a considerable series, is apparently new.

Eirene medusifera, sp. nov.

Plate 37, Figs. *1–8*.

Acapulco Harbor; surface; 23 specimens, 2.5–8 mm. in diameter. Type 7 mm. in diameter.

The specimens are all in excellent condition.

The bell is of moderate height, the jelly rather thin. The peduncle (Pl. **37**, fig. *6*) is conical, and hangs about to the opening of the bell.

The manubrium is short and nearly spherical, the mouth surrounded by four simple lips.

Tentacles. — The largest number of tentacles observed was twenty-one, in a specimen 8 mm. in diameter. In small specimens 2–4 mm. in diameter there are from eleven to fifteen tentacles. Besides the developed tentacles all the specimens, even the largest, have tentacles in process of formation, which vary from small rudimentary swellings to fully formed tentacles of small size. In small specimens the rudimentary knobs are about as numerous as the tentacles (Pl. **37**, fig. *1*); but in large specimens they are fewer, one specimen with seventeen large tentacles having only ten knobs, several of which already clearly show that they are young tentacles. Since the knobs show all stages in growth, it seems that none of them permanently retain the rudimentary character seen in the knobs of *E. danduensis* and *E. viridula*, but that probably the adult specimens have fully formed tentacles only.

All the tentacles, whether fully formed or rudimentary, are flanked at their bases by a pair (sometimes two pairs) of lateral cirri (Pl. **37**, fig. *2*), but there are no cirri scattered along the bell margin such as are characteristic of *E. viridula.* The tentacles have swollen, conical bases, and very delicate, thread-like extremities. When fully expanded they are about as long as the radius of the bell, but in the preserved specimens most of them are contracted.

Otocysts. — The otocysts are about as numerous as the tentacles (large and rudimentary), and alternate with them. In the early stages in the growth of a new tentacle the new rudiment is formed between the otocyst and one of the tentacles flanking it, and a second otocyst is developed later. Thus, succession is of course a further argument in favor of the view that all the knobs in this species represent merely the early stages of developing tentacles. The largest number of otocysts observed was twenty-seven in the specimen above mentioned which had twenty-one large tentacles and eight rudimentary ones. The sense organs, which are of small size, each contain from two to five or more spherical otoliths.

Eirene medusifera is the second known case of a Leptomedusa giving rise to free medusa buds, the first being afforded by *Eucheilota parodoxica* (Mayer, : 00^{b}, : 04), and in it, as in this latter species, the buds are developed from the region of the gonads. These organs occupy the distal third of the radial canals (not, however, extending quite to the bell margin); and are cylindrical in form. A photograph of a gonad with several growing buds is represented in Pl. **37**, fig. *8*. Seventeen out of the twenty-three specimens show various stages in budding. The process takes place in the usual fashion, both germ layers being concerned in the formation of the buds. When set free, the young medusa has a well-developed manubrium (Pl. **37**, fig. *7*) but no peduncle, and four primary tentacles with stout basal bulbs. Even at this early stage the tentacles are flanked by lateral cirri.

Color. — The gonads and manubrium are of a pale yellowish tint; otherwise this species is colorless.

Eirene medusifera is separated from all other species of this genus by the structure of the marginal organs. The method of reproduction by budding which it exhibits likewise distinguishes it from all its near relatives. In the latter respect it is one of the most interesting medusan finds of the Expedition.

Eirene viridula Eschscholtz.

For synonymy of this species, see Haeckel, '79, pp. 201, 202.

Plate 36, Figs. *1–4*.

Station 4708; surface; 1 specimen, 15 mm. in diameter.

Fortunately the single specimen was in good condition. The bell is rather low, only about 3–4 mm. high; the jelly thin. The peduncle is short, hanging only about to the bell opening, but very broad basally (Pl. **36**, fig. *1*). The manubrium is extremely short, indeed rudimentary; the mouth is surrounded by four slightly crenulated lips.

Bell margin. — In addition to otocysts, the margin bears tentacles, tentacular knobs, and cirri (Pl. **36**, fig. *4*). There are twenty-two developed tentacles, which have stout conical basal bulbs, and are very short, perhaps the result of contraction. The tentacular knobs are triangular, of about the same shape as the basal bulbs of the tentacles, and about three times as numerous as the tentacles. Having only a single specimen, I am unable to determine whether they represent, in their present state, the final stage in their development, or whether some or all of them are merely tentacles in early stages in growth; but as I have found no intermediate stages, and since the specimen is sexually mature, it is probable that the first surmise is the correct one. The cirri (Pl. **36**, figs. *2*, *4*) are irregularly scattered along the margin, and are about as numerous as the tentacles. There are no cirri flanking the tentacles.

Otocysts. — There are about thirty-five otocysts (on part of the margin they are destroyed so that accurate counting is impossible), each containing from three to five otoliths (Pl. **36**, fig. *2*).

Gonads. — These are linear and occupy the entire length of the canals from their distal extremities to the base of the broad peduncle. There are no sexual organs on the peduncle. The specimen is a male.

Color. — The gonads and manubrium in life were opaque and milky; otherwise the Medusa was colorless.

Eirene viridula is to be distinguished from the other Indo-Pacific members of the genus by the presence of cirri scattered along the bell margin; for, although both *E. danduensis* (*palkensis*) and *E. ceylonensis* have cirri, they occur only at the sides of the tentacular bulbs. The present specimen differs from most descriptions of the Atlantic form in having a very broad peduncle and few tentacles. It is possible therefore that it may represent a distinct Pacific race; but since Maas ('93) has shown that the form of the peduncle is variable in *E. viridula*, and since the number of tentacles increases with growth, it is best not to lay stress on these apparent differences until a larger series is studied. The occurrence of this species in the Pacific is not surprising in connection with the fact that it has twice been recorded from the Indian Ocean (Chun, '96; Goette, '86).

Eutiminae Maas, 1905.

Eutimidae Haeckel ('79).

Eucopidae with only eight octocysts; with long gelatinous peduncle.

Modern researches indicate that Haeckel's genera Eutimium and Eutimeta represent merely temporary stages (in the condition of the marginal organs) of Eutima. Octorchis, Octorchandra, and Octorchidium, in which sexual products are developed on the peduncle as well as on the subumbrella, certainly represent only a single genus Octorchis. And this one is of questionable validity; for although it is retained by Browne (: 05^b), it seems to me that the discovery by Maas (: 05) that some individuals of *Eutima levuka* Agassiz and Mayer have gonads both on the subumbrella and on the peduncle, while others have them only on the subumbrella, throws doubt on its claim to recognition. Respecting Eutimalphes I cannot agree with Maas (: 05) that it is closely allied to Tima; for it has the number of otocysts characteristic of Eutima, from which genus it is separable only by the somewhat shorter peduncle and the much greater number of tentacles.

Eutima McCrady, 1857.

Sensu Maas (: 05).

Eucopidae with long peduncle; with only eight otocysts; with only a small number of tentacles (four, eight, or twelve); gonads on subumbrella, on peduncle, or on both.

Eutima levuka Agassiz and Mayer.

Eutimeta levuka Agassiz and Mayer, '99, p. 163, pl. 9, figs. *30*, *31*.
Eutima levuka, var. **occellata** Maas, : 05, p. 35, taf. 7, figs. *43*, *44*.

Plate 5, Figs. *2*, *3*; Plate 35, Figs. *1*, *2*.

Acapulco Harbor; surface; 3 specimens, all about 6 mm. in diameter.

The specimens all represent a younger stage than was observed either by Agassiz and Mayer or by Maas, for they are considerably smaller (the "Siboga" specimens, several of which were sexually mature, ranged from 12–20 mm. in diameter) and have only four tentacles. The number of tentacles appears to be subject to great individual variation, since although large specimens usually have eight, Maas (: 05) has noted that they may have only four or six; on the other hand, very small specimens may have more than eight. The marginal bulbs have not yet attained their maximum number, there being only eight to ten per quadrant, instead of sixteen to twenty, as recorded by Maas (: 05, p. 36); but they, as well as the tentacles, already show the adult structure, the former being flanked by a pair, the latter by a larger number (three to five pairs) of cirri.

Maas (: 05, p. 36) considers the pigmentation of the rudimentary tentacular bulbs such a valuable specific character that he makes it the basis for his new variety, *E. occellata.* But it evidently is not so constant as he supposed, for while all of the bulbs are deeply pigmented in two of our specimens, in the third, equally well preserved, several of the bulbs are entirely colorless and the pigmentation of the remainder is faint. Agassiz and Mayer ('99) do not appear to have observed any pigmentation in the Fiji specimens.

Eutima levuka is apparently widely distributed over the Tropical Pacific and Malaysian regions. No doubt when the Medusa fauna of this region is more fully known it will be found to occur, in season, at many localities besides those from which it has yet been recorded.

It would be of much interest to know the true relationship of this form to the three species from the Ceylon-Maldive region, *E. lactea* Bigelow (: 04), *E. curva* Browne (: 05^b), and *Octorchis orientalis* Browne (: 05^b). All of these are undoubtedly closely allied to one another as well as to *E. levuka*, but they appear to be separated from the latter by the condition of the marginal organs, *E. lactea* having cirri flanking the tentacles, but not the marginal bulbs, while in *E. curva* and *Octorchis orientalis* there are cirri flanking the papillae, but none at the bases of the tentacles. *O. orientalis*, and *E. curva* (known from only one specimen) seem to be separable chiefly by the position of the gonads; but since Maas (: 05) has found that in *E. levuka* gonads are sometimes developed on the peduncle in addition to those on the subumbrella, it is questionable whether the difference in this respect is really of specific significance rather than an indication of local, individual, or perhaps seasonal variation. Unfortunately all of these species except *E. levuka* are known from only a few specimens each. No final disposition of them is possible until something is known of their life histories.

Eutimalphes Haeckel, 1879.

Eucopidae with gelatinous peduncle; with eight otocysts and numerous tentacles.

Up to the present time, so far as I can learn, only three species have been referred to this genus, viz., *E. pretiosa* Haeckel ('79), *Tiaropsis indicans* Romanes ('76), and *Eirene coerulea* L. Agassiz ('62). The first of these, however, seems to be closely related to Tima, for it has the extensive development of lips characteristic of that genus, while Haeckel's statement that it has only eight otocysts is at least open to question, inasmuch as he himself says that part of the margin of the single specimen was destroyed. Unfortunately Romanes ('76, '77) in the description of *T. indicans* gives no details as to the tentacles or whether or not the margin bears either knobs or cirri; but he explicitly states that there are only eight large otocysts, and his figure ('77, pl. 15, fig. *1*) shows the long peduncle. The gonads also are represented as situated on the subumbrella and extending from the bell margin to the base of the peduncle. *E. coerulea* L. Agassiz is the best-known member of the genus. In this species the gonads extend over both subumbrella surface and peduncle, the thirty-two tentacles are flanked by lateral cirri, and there are a large number of rudimentary tentacular knobs in addition to the developed tentacles.

The collection contains a large series which, on account of the presence of a peduncle, and the number of otocysts and tentacles, must be placed in this genus; they differ so much from the foregoing forms, both in the extent of the gonads and in the absence of marginal knobs and cirri, as to justify making them the basis for a new species.

Eutimalphes scintillans, sp. nov.

Plate 5, Figs. *8*, *9;* Plate 37, Fig. *11.*

Acapulco Harbor; surface; many specimens. Type 10 mm. in diameter.

The largest specimens are about 10 mm. in diameter by 5 mm. high. The general form, with thin gelatinous substance and shallow bell cavity, as seen in side view, is shown in the photograph (Pl. **5**, fig. *8*). The peduncle is short, only about 4 mm. in length in specimens 10 mm. in diameter, and never, so far as I have observed, hangs below the opening of the bell. This is considerably shorter than it is described by Romanes ('77) and Mayer (:00^b) for *E. indicans* and *E. coerulea.* It is questionable, however, whether this difference can be regarded as sufficiently constant to be of any specific value, inasmuch as Maas has shown that in Eirene the peduncle is variable both in length and in outline. The manubrium is short and nearly globular, the mouth surrounded by four short, simple lips. In this character it, like the two species above mentioned, differs markedly from *E. pretiosa* Haeckel.

Tentacles. — The largest number of tentacles observed was thirty-six, of which two were evidently of recent growth, being much smaller than the others. Most of the large specimens have from twenty-nine to thirty-two tentacles, usually with two or three of them in early stages of growth. The smallest number counted was thirteen, in a specimen some 2.5 mm. in diameter. There are no tentacular knobs on the margin, except such growing tentacles as are mentioned above, nor do the tentacles bear lateral cirri at their bases, such as Mayer has figured (:00^b, pl. 11, fig. *22^a*) for *E. coerulea.* The tentacles are short, and have swollen, conical bases. There are no ocelli.

Otocysts. — There are eight otocysts, as is typical of the genus, two per quadrant (Pl. **37**, fig. *11*). They are rather large, and contain each from two to five otoliths. After preservation in formalin for two years most of the otoliths are destroyed.

Gonads. — All the specimens have gonads, though in the smaller ones they are but slightly developed. Their position appears to be an important specific character, for like the length of their extent along the radial canals it is remarkably constant. They commence close to the bell margin and occupy the distal one third to one fourth of the radial canal on the subumbrella surface. None of the specimens showed any trace of the formation of gonads on the peduncle. Even at early stages they occupy this same portion of the canals, and they increase in size chiefly by thickening, their increase in length only keeping pace with the general growth of the individual. The series contains both males and females.

Color. — In life the gonads were pale green; in the preserved specimens, however, both they and the manubrium have faded to a pale opaque yellow.

The absence of marginal knobs and of lateral cirri at the bases of the tentacles, and the shortness of the gonads, clearly separate this species from the West Indian form, *E. coerulea.* The number of tentacles, though a variable feature, may likewise prove to be of specific significance, since L. Agassiz ('62) states that in large specimens of *E. coerulea* measuring 1¼ in. in diameter by 1 in. high there may be as many as thirty-five per quadrant. In specimens of *E. coerulea* 10 mm. in diameter he counted only thirty-two tentacles, but there were in addition ninety-six bulbs, which may later develop into tentacles, thus producing the large number seen in adults. The exact relation of *E. scintillans* to *E. indicans* cannot be determined until the marginal organs of the latter are more fully described, but the form of the gonads and that of the peduncle appear to separate the two.

Octocanninae Maas, 1905.

Octocannidae Haeckel ('79).

Eucopidae with eight radial canals.

Octocanna Haeckel, 1879.

sens. em. Maas (: 05); Browne (: 05^b).

Octocanninae with eight simple radial canals; with well-developed manubrium with octagonal basal region; mouth with eight lips.

The descriptions of adult specimens of this genus by Maas (: 05) and

Browne (: 05^b) entirely disprove the view advanced by Claus ('80) that Octocanna is merely the young of Aequorea; and on account of the form of the stomach and the determinate number of radial canals there is good reason to believe that this genus is more closely related to the typical Eucopidae than it is to the Aequoridae, with which it was classed by Haeckel. The large number of canals, however, together with the presence of excretory papillae and pores at the bases of the tentacles, suggest that Maas (: 05, p. 38) is correct in calling it an "Übergangsgruppe" between the two families. The discovery by Browne (: 05^b) of small specimens of *O. polynema* with only eight tentacles, though with developed gonads, shows conclusively that Maas (: 05) was correct in suggesting that *O. octonema* Haeckel with eight tentacles was nothing more than the young of *O. polynema* Haeckel with sixteen or more tentacles. Since both the "Siboga" specimens and those recorded from Ceylon by Browne (: 05^b) are referable to *O. polynema*, this species now stands alone in the genus. In the present collection there are two specimens of Octocanna of which the specific identity is hard to determine. In several important features, especially in the form of the bell, and in the having only eight tentacles, they differ from adult *O. polynema;* but on account of the small number of specimens it is possible that the final number of tentacles is not yet attained in spite of the fact that the gonads contain large ova. For this reason it seems best to class them provisionally as *O. polynema*, at least until their affinities can be more definitely determined from the study of a larger series.

Octocanna polynema Haeckel.

Octocanna polynema Haeckel, '79 p. 214; Maas, : 05, p. 38; Browne, : 05^b, p. 144, pl. 2, figs. *8–10*.
Octocanna octonema Haeckel, '79, p. 213.

Plate 6, figs. *6, 10;* Plate 38, figs. *1–4*.

Acapulco Harbor; surface; 2 specimens, 10 mm. high by 8 mm. in diameter.

In both specimens the gelatinous substance is so thick that the bell is higher than broad, while the bell cavity is extremely shallow (Pl. 6, fig. *10*). In most of the specimens of *O. polynema* which have previously been recorded the bell was rather low; but Browne (: 05^b, p. 144) found a single specimen in which the umbrella was very thick and the cavity of the bell shallow. Apparently, then, the form of the bell, striking though it may seem in the present specimens, is not a constant nor an important character.

Both the specimens have eight large radial tentacles, and between every two tentacles from one to three triangular bulbs (Pl. **38**, fig. *2*); but there is no evidence that any of the latter are developing into tentacles. Both tentacles and bulbs bear excretory papillae (Pl. **38**, fig. *2*, p. ex) on the oral side of their bases, such as have been described by Browne (: 05^b). There are from three to five otocysts between every two radial tentacles.

The manubrium is very short, the mouth surrounded by eight pointed lips (Pl. **38**, fig. *1*).

The specimens were entirely colorless in life.

These Medusae would readily be referred to *O. polynema* as immature stages were it not for the fact that the gonads and ova are far advanced. As it is, it seems to me at least open to question whether the rudimentary marginal swellings between the radial tentacles would in the Acapulco form grow into tentacles; but it is impossible to answer this without more material. Unfortunately it is exactly this information which is requisite to determine their specific identity.

Aequoridae Eschscholtz, 1829.

sens. em. Maas ('93, : 05).

Leptomedusae with numerous radial canals (more than eight); with numerous closed otocysts; tentacles with basal bulbs and excretory papillae.

There is no question but what Haeckel ('79) went much too far in splitting up this family, since some at least of his genera were undoubtedly based on conditions of the stomach which were either accidental or the result of contraction. On the other hand, Claus ('80) has probably gone too far the other way in uniting all aequorids in the single genus Aequorea. Browne (: 04, : 05^b) and Maas (: 05), in recent publications, distinguish two genera, Aequorea with well-developed stomach and a mouth capable of being closed, and Mesonema, in which the gastric wall is rudimentary, and the mouth not capable of being closed but of almost as great diameter as the stomach; but although there are probably two (or even more) genera of Aequoridae, this separation, based on the condition of the mouth, seems to me no real advance over the previous attempts. In the first place, I doubt whether the non-closable mouth actually occurs in any aequorid. The specimens on which both authors based their diagnoses were preserved and therefore undoubtedly more or less contracted; furthermore, neither Maas's figure of *M. macrodactylum* nor the figures given by Browne (: 05^b, Pl. **2**, figs. *11–15*) of *M. pensile* seem to me to indicate such a condition; indeed, in the former the gastric wall is but slightly narrower than in the Atlantic species referred by Maas to *Aequorea forskalea* (: 04^c, Pl. **2**, figs. *12–14*). Finally, my own investigations on living specimens of three species identified as *A. macrodactylum*, *A. coerulescens*, and *A. tenuis*, and on an undescribed species from the Gulf Stream, show that the mouth may rapidly pass from the Aequorea to the Mesonema condition; and, perhaps most important, that when in the latter condition, whether normally or as the result of preservation, there is often no evidence, either in plications, folds, or obvious thickening, of contraction. Thus the Mesonema condition might readily be taken for the usual one even if only momentarily assumed.

Though I am forced to conclude from these experiments that the diagnosis of the two genera as expressed by Browne (: 05^b) and by Maas (: 05) is artificial, yet I believe it by no means improbable that the degree of development of the mouth may yet be of generic importance in species, such as *A.* (*Zygodactyla*) *groenlandica*, in which it is extensible as a long manubrium or curtain. However, until some student is able to examine larger series of living specimens I doubt whether any generic diagnosis founded chiefly on this character will be of much value.

To retain any of the previous generic distinctions not only preserves an unnatural order, but results in making any sound specific identification almost impossible, since different individuals of a single swarm, or even one individual under different external conditions or in different stages of contraction, might readily be referred to different genera; but to attempt any generic revision of the members of this family without studying a much larger series of living specimens than that to which I have had access seems futile. It is to be hoped that such a study will soon be made. In the meantime I believe that the most satisfactory course is to recognize only one genus, Aequorea; though at the same time admitting that this reduction is probably excessive, and that it is only temporary.

In identifying the two species of Aequoridae in the present collection I have necessarily attempted a provisional revision of the Indo-Pacific species; and although this is by no means final, I give it here, without attempting a correlation with the Atlantic species, in the hope of simplifying the course of other students of this perplexing family.

First let us consider what characters may reasonably be supposed to be of specific importance.

The number of tentacles is well known to be variable in all species, so much so indeed that Claus ('80) and Browne discard it. I am inclined, however, to think that if employed with caution it may be of some value. Thus in *Rhegmatodes tenuis* A. Agassiz it is always small (forty-eight to sixty-four); in *Zygodactyla groenlandica* always much greater (up to four hundred). The proportional numbers of tentacles to canals is also significant, for although Claus contends that it is so variable as to be of no service yet all recent descriptions show that in *Mesonema pensile* there are always many fewer tentacles than canals; in *Zygodactyla groenlandica* and *A. norvegica* (Browne, : 03) always many more; while in other species the numbers are more nearly equal. My own studies suggest that the proportion continues fairly constant with growth. A character of great constancy and one not subject to much distortion with contraction, but the importance of which has been overlooked, is the diameter of the stomach. Thus a very small stomach is constantly found in *Rhegmatodes tenuis* and *R. floridanus*, a very large one in *M. pensile*. Finally, Browne (: 03, : 04, : 05^b) has urged the taxonomic importance of the form of the basal bulbs of the tentacles, and Maas (: 05), though admitting that they are subject to contraction, believes them to be of value. In many species this is undoubtedly correct, and this discovery is an important advance. In others, however, the bulbs are simply conical, so that they are not by themselves distinctive, though in connection with other characters they may become so.

We may leave out of consideration Haeckel's ('79) genera Zygocanna, Zygocannota, and Zygocannula, which are somewhat problematic, and have not, so far as I am aware, been observed since first described; and the following species, *A. ciliata* Eschsch., *A. eurhodina* Péron and Lesueur, and *A. thalassina* Péron and Lesueur, which were founded on such unsatisfactory figures and descriptions that identification with actual specimens is hopeless. Fortunately the remaining Pacific forms are all fully described and well figured. They seem to represent at least seven fairly well-defined species.

1. A species with very few (twelve to sixteen) tentacles in comparison with a large number (ninety to one hundred) of canals; with very thick, stiff, lenticular gelatinous disc, broad stomach, and tentacular bulbs with

wings extending in either direction along the bell margin. This form was first recorded from the Pacific as *Polycanna purpurostoma* Agassiz and Mayer ('99, p. 169); more recently, however, Browne (: 04) and Maas (: 05) have identified specimens answering the same description with the *Mesonema pensile* of Modeer. I have myself examined the type of *P. purpurostoma*, and find that the basal bulbs, not especially described by Agassiz and Mayer, are reducible to the type figured by Browne (: 04, pl. 57, figs. 6–8) and by Maas. Identical also with it, as Maas has shown, is *Rhegmatodes lacteus* Agassiz and Mayer (: 02, p. 147). For this species the name *M. pensile* may be retained.

2. *Mesonema macrodactylum* Brandt has since been recorded by Goette ('86), Chun ('96), Agassiz and Mayer (: 02), and Maas (: 05), and is represented by several specimens in the present collection. In this species each tentacular bulb bears a triangular spur-like process clasping the exumbrella; there are about one half as many tentacles as canals. The species described by Browne as *Aequorea maldivensis* has, as noted by Maas, the same form of tentacular bulb and about the same proportional number of tentacles and canals. The two are separable only by the form of the mouth, which is described as slightly wider in *A. maldivensis* than in *M. macrodactylum;* but since both Maas's and Browne's accounts were taken from preserved specimens, and since in the present series of *M. macrodactylum* various breadths of the lower gastric wall are represented, I have no hesitation in uniting the two under the older name *M. macrodactylum.*

3. *A. globosa* Eschscholtz is recorded by Maas (: 05). It is possible that one of Browne's specimens of *A. maldivensis* with fifty tentacles and only fifty-four canals, in reality belongs to *A. globosa.* In this species the number of tentacles about equals that of the canals; the basal bulbs are conical; the stomach broad.

4. *Rhegmatodes floridanus* L. Agassiz. I have examined a series of this species from Australia, from the Fiji Islands (Agassiz and Mayer, '99), as well as from the West Indies, and am unable to find any constant differences between the Atlantic and Pacific specimens. The total diameter of the stomach is very small; the number of canals is small, not as yet known to surpass twenty-eight; the disc is thin and soft. This species is closely allied to *Rhegmatodes tenuis* A. Agassiz, common along the east coast of North America; but the differences in number of radial parts which separate the two have been found to be constant in very large series by various observers.

5. *Zygodactyla flava* A. Agassiz. *Mesonema victoria* of Murbach and Shearer is apparently identical with this species, whose account agrees even in minor particulars with that of A. Agassiz ('65). In this species the number of tentacles and canals (about equal) is very large (up to one hundred); and there is a gelatinous peduncle.

6. *Mesonema coerulescens* Brandt, which, like *Z. groenlandica* A. Agassiz, has many more tentacles than canals, and the basal bulbs laterally compressed. It is probable that *Mesonema dubia* Brandt is a synonym of this form, as Mertens believed (Brandt, '38, p. 362), but the description of *M. dubia* is not sufficiently detailed for accurate determination.

7. *A. conica* Browne is easily distinguishable from any of the preceding species by its short, deep, proximal gonads and by the high conical form of the bell. Tentacles twenty-six to thirty, radial canals about sixteen. The *A. abbreviatum* of Eschscholtz has a similar conformation of the gonads, but the description and figures of it are so unsatisfactory that it seems impossible to determine whether or not it is synonymous with Browne's species.

Finally, one more species has been described by Browne, *A. parva*, distinguished from all other Aequoridæ by having only four developed tentacles; but since Browne himself has suggested (:05^b, p. 146) the possibility that it may eventually develop more tentacles, its status cannot yet be determined.

Aequorea macrodactylum Brandt.

Mesonema macrodactylum Brandt, '38, p. 359, taf. 4; Maas, :05, p. 40, taf. 8, figs. *51^a*, *51^b*.
Aequorea maldivensis Browne, :04, p. 732, pl. 56, figs. *4–12*.

Plate 36, Figs. *5–10*.

Station 4667; surface; 1 specimen, fair condition.
Station 4668; 300 fathoms to surface; 1 specimen, good condition.
Station 4671; 300 fathoms to surface; 4 specimens.
Station 4676; 300 fathoms to surface; 1 fragmentary specimen.
Station 4679; 300 fathoms to surface; 1 fair specimen.
Station 4683; 300 fathoms to surface; 1 specimen.
Station 4685; surface; 1 specimen.
Station 4728; 300 fathoms to surface; 1 fragmentary specimen.

The specimens agree very well with the accounts given by Browne (:04) and by Maas (:05) except that the number of radial canals and tentacles is rather smaller, as is the diameter of the bell. Browne records from fifty-two to sixty-nine radial canals; and from twenty-one to fifty tentacles; while Maas counted in various specimens from sixty-two to one hundred and three canals and from sixteen to thirty tentacles. The largest number of canals in any specimen in the present series is forty-two, in an individual 22 mm. in diameter with about eighteen tentacles. The smallest number observed was twenty-nine, with sixteen (?) tentacles, in a specimen with no gonads, 8 mm. in diameter. In most of the specimens the margins were so much damaged that it was impossible to be confident of the complete number of tentacles; but apparently they were never more than half as numerous as the radial canals. Between every two tentacles are a considerable number (five to eight or more) of rudimentary tentacular bulbs, much as Browne has figured them for the Maldive specimens (:04, pl. 56, figs. *10–12*). The tentacular bulbs are of an unusual outline, and it is largely because of their form that I have identified the present specimens as *A. macrodactylum.* When seen from without they are broadly triangular, and extend in a somewhat triangular or spur-like process up over the exumbrella surface of the bell (Pl. **36**, figs. *5*, *6*). This process shows especially well in a side view of the bulb (Pl. **36**, fig. *8*). This is essentially the conformation described by both Maas and Browne, and is apparently characteristic of all specimens, though varying considerably as to the exact form of the exumbral clasp. In most of our specimens this is less well defined, perhaps as the result of preservation, than Browne found it in the Maldive specimens. The essential similarity of the bulbs in *A. maldivensis* and *A. macrodactylum* has already been commented upon by Maas (:05). He has, it is true, considered these two forms as belonging to different genera on account of differences in the form of the mouth; but this is a difference which, as we shall see, is of very little real importance.

Between every two tentacles there are from seven to fifteen otocysts, a number agreeing with Browne's account.

Gastrovascular system. — It was particularly fortunate that I was able to study the collection in the fresh condition, for after preservation the lower gastric wall is often so strongly contracted that if we recognized the character of the mouth as of generic importance we might readily class different specimens in different genera. When first taken the usual condition of the mouth was that shown in Pl. **36**, fig. *9*. I never saw any suggestion of such a proboscis as has been described for some other Aequoridae, nor was the mouth closed in any of the specimens. In the preserved specimens the mouth usually shows the Mesonema condition, with the gastric wall forming merely a narrow fringe around the periphery of the stomach; though in some specimens this wall is as broad as in life (Pl. **36**, fig. 9). The contraction is deceptive, for the wall shows no apparent evidences of distortion, and might readily be supposed to be in its normal condition. In comparing the figures of *A. macrodactylum* and *A. maldivensis* given by Maas and Browne the only difference in the condition of the mouth is that in *A. maldivensis* the gastric wall is somewhat broader than in *A. macrodactylum;* and in view of the contractility of this organ, and the fact that both descriptions were taken from preserved specimens, I am convinced that this is due merely to the Maldive being less contracted than the "Siboga" specimens. I may also call attention to the fact that the original and very excellent figures of this species published by Brandt ('38) show the lower gastric wall of considerable breadth, and by no means "rudimentar; Mund daher fast so gross wie Magendurchmesser" (Maas, : 05, p. 40).

The small number of canals in the present individuals cannot, in my judgment, be supposed to indicate specific difference from *A. macrodactylum,* inasmuch as there is no evidence that any of our specimens had reached their maximum development. The presence of gonads does not necessarily indicate a close approach to maturity in this family, for it has been shown that in several species a very considerable number of canals may be added after the sexual organs on the earlier formed canals are of considerable size. Fewkes ('81^b) indeed has found that in *A. groenlandica* gonads begin to develop when only a very few canals are formed. The sterile canals described as alternating with fertile canals in various species are to be thus explained; no doubt they would finally develop gonads. They are particularly evident in medium-sized specimens of *A. tenuis,* and have been figured by Maas (: 05) as well as by Brandt ('38) in *A. macrodactylum,* while I have myself observed them in several of the present specimens.

All our specimens were entirely colorless, the gonads and entodermic system opaque and milky.

Aequorea macrodactylum is widely distributed over the Tropical Pacific and the Malaysian region; it has likewise been recorded from various stations in the Indian Ocean (Maldives, Browne; Zanzibar, Chun, Goette).

Aequorea coerulescens Brandt.

Mesonema coerulescens Brandt, '38, p. 360, taf. 5.
? **Mesonema dubium** Brandt, '38, p. 361, taf. 26.

Plate 4, fig. *4*; Plate 35, figs. *3–8*.

Station 4652; 100 fathoms to surface; 1 large specimen, 60 mm. in diameter.

Station 4655; 300 fathoms to surface; 1 specimen, 12 mm. in diameter.

The general appearance of this species is so well represented in Mertens's beautiful figure (Brandt, '38, taf. 5) that no extended account is necessary here. Certain details, however, need slight correction.

The gelatinous disc is thick, the bell shallow, in the adult specimen about 60 mm. in diameter by 20 mm. high.

Tentacles. — These are rather more numerous than Brandt believed there being from three to six between every two canals, instead of only two as Mertens represented them (Brandt, '38, taf. 5, fig. *3*), a total of about four hundred and fifty. As Brandt states, the tentacles are of different sizes; they do not, however, form two distinct series as he supposed, but large and small ones are irregularly arranged (Pl. **35**, figs. *6*, *8*). Evidently they merely represent different stages in growth, exactly the condition that is to be seen in the Atlantic species *A. groenlandica* L. Agassiz. In addition to developed tentacles there are a considerable number of rudimentary bulbs (Pl. **35**, fig. *5*), which are most numerous on regions of the margin where the tentacles are the least crowded. The tentacular bulbs are long, only slightly swollen, laterally compressed (Pl. **35**, figs. *6*, *7*, *8*), and very closely resemble the bulbs of *A. groenlandica.* Connected with the inner side of each, at its base, is a prominent excretory papilla (Pl. **35**, figs. *6*, *7*, p. ex). These organs are evidently the structures described by Brandt as "tassenförmiger, an Gestalt der Cupula einer Eichel nicht unähnlicher Körperchen" ('38, p. 361). The tentacles are short and become exceedingly slender toward their extremities. In the small specimen the tentacular bulbs are of the same outline, a fact which has rendered practically certain the specific identification of the specimen; but the tentacles are much less numerous, there being in all only about one hundred and forty, of which from forty-five to fifty are much larger, and evidently of earlier origin than the remainder.

Otocysts. — These are very numerous, but they are so crowded among the tentacles that it is impossible to count them. Double examples are often seen (Pl. **35**, fig. *5*).

Gastrovascular system. — The stomach in the large specimen is about 30 mm. in breadth, *i. e.* one half the diameter of the bell, and unchanged in its preserved state from the condition seen while alive. The lower gastric wall is well developed, far from rudimentary; but the mouth nevertheless is widely open, although the gastric wall shows no sign of contraction. In view, however, of my observations on *A. macrodactylum,* I hesitate to assume that it may not be much more extensible than it appears to be. There are thirty-one lips or oral prominences, about one third as many as there are canals. They are rather smaller than Brandt has figured them (Pl. **35**, fig. *4*), but the difference is not greater than might easily be caused by slight contraction.

Canals. — In the large specimen there are ninety-four canals, which are as obviously of different generations as are the tentacles. Many of them are stout, and others very slender; but there is no definite arrangement of different sizes. The irregular arrangement is clearly seen in the photograph (Pl. **35**, fig. *4*). One of the canals is dichotomously branched near its base; all the others are simple. All of the larger canals bear gonads (which seem to be mostly emptied of their contents), but many of the more slender ones are sterile. This difference was noted by Mertens; but the two kinds of canals are irregularly arranged instead of regularly alternating, as represented (Brandt, '38). In the small specimen there are only forty-seven or forty-eight canals, but they show the same divergence in size as do those of the mature individual. Fourteen of the larger ones already bear gonads; the remainder, however, are sterile.

Color. — Both our specimens show the characteristic pigmentation described by Brandt, the tentacular bulbs being of a very deep bluish black, which now after preservation is black and very opaque. Otherwise the specimens are entirely colorless.

So far as I can learn, no undoubted record of this species has appeared since its original description in 1838 by Brandt, for although a specimen was recorded by me from the Maldive Islands (: 04, p. 256) under the name *A. coerulescens,* its fragmentary condition made positive identification impossible. The type specimen was taken by Mertens in the Pacific in about 35° N. and 144° W.

ANTHOMEDUSAE.

Codonidae Haeckel, 1879.

sens. em. Vanhöffen ('89); Hartlaub ('07).

Anthomedusae with gonads in the form of one or more rings surrounding the manubrium; with simple unbranched tentacles; with simple mouth opening without lips.

Sarsia Lesson, 1843.

sens. em. Hartlaub ('07).

Codonidae with four perradial tentacles, equally developed and armed with nettle swellings; gonad in the form of a single ring or tube entirely surrounding the manubrium, and not interrupted in either per- or inter-radii. With or without stiel canal and apical projection. Exumbrella in adult without nemocyst ridges, though these are often present in young stages. Hydroid stage, the genus Syncoryne.

For a review of the present state of our knowledge concerning Sarsia I refer the reader to the excellent summary and revision of Hartlaub (: 07).

Previously there have been described from the Pacific five species referable to Sarsia: — *S. rosaria* A. Agassiz ('65), *S. radiata* Von Lendenfeld ('84), *S. minima* Von Lendenfeld ('84), *S. apicula* Murbach and Shearer (: 03), *S. occidentalis* Fewkes ('89^b), and *S.* species? Agassiz and Mayer (: 02). In addition the common Atlantic *S. eximia* is now known, in the hydroid stage, from Alaskan waters (Nutting, : 01). The present collection contains specimens of two well-marked species of this perplexing genus, both of which appear to be undescribed. They are sufficiently distinguished by anatomical characters from all the other Pacific species, but whether they are equally distinct from all of the numerous Atlantic forms is less certain.

Sarsia coccometra, sp. nov.

Plate 7, fig. *8;* Plate 40, fig. *1;* Plate 43, figs. *8, 9.*

Station 4615; surface; 1 specimen.
Station 4617; surface; 5 specimens.
Station 4619; surface; 3 specimens. Type.

The largest specimen measures 5 mm. in height by 4 mm. in diameter; the smallest, 2 mm. high by 1.5 mm. in diameter. The bell has a triangular, pointed, apical projection; the gelatinous substance is very thin.

Tentacles. — The tentacles, when extended, are about as long as twice the bell height. Close to the base they are naked; but for the remainder of their length they are clothed with well-developed nematocyst swellings which often form rings entirely surrounding them (Pl. **43**, fig. *8*). When the tentacles are extended these rings present the appearance of strings of small beads. At the tip of each tentacle is a broader terminal swelling crowded with nematocysts. The tentacles arise from swollen bases, each of which bears an ocellus on its outer (aboral) face (Pl. **43**, fig. *8*).

The manubrium hangs about to the bell opening in all the specimens; but as in several it is evidently distorted by contraction, it is probable that it could be considerably protruded in life. The mouth is surrounded by a simple circular lip (Pl. **43**, fig. *9*). There is no peduncle. There is a broad triangular, apical extension of the manubrium, above the level of the origin of the radial canals, conforming in outline to that of the apical projection of the bell, and at its tip sufficiently attenuated to suggest the remnants of the "stiel canal."

Gonads. — A study of transverse sections of the manubrium has demonstrated that the gonads are uninterrupted in either the perradial or interradial planes, and are thus of the typical Sarsia type. In surface views of the manubrium of several specimens there appear to be definite interradial swellings (Pl. **40**, fig. *9*), which I at first believed indicated the location of the gonads; but sections show that these apparent swellings are nothing more than longitudinal ridges caused by contraction. In females the eggs are very large. Two specimens had discharged their sexual products, leaving the manubrium thin-walled and flexible. The gonads occupy nearly the entire length of the manubrium, leaving only a short basal region bare.

Color. — In life the region of the gonads is reddish brown; the entoderm of the tentacle bulbs Vandyke brown; the ocelli black (Pl. **40**, fig. *1*).

Sarsia coccometra differs from the typical members of the genus in the apical prolongation of the manubrium, in which it resembles Stauridium, and in the possession of a well-marked apical projection, as well as in the high development of the tentacular nematocyst bands. Its relationship, among described genera, is evidently closest with Sarsia, and, on account of the presence of the apical projection, with those species of the genus formerly grouped by Haeckel ('79) in the genus Codonium; but it is not unlikely that its peculiarities may finally warrant instituting a new genus. It is clearly separated from all of the various species of Sarsia found in the Pacific.

Sarsia resplendens, sp. nov.

Plate 7, fig. *1;* Plate 40, fig. *8.*

Acapulco Harbor; surface; 6 specimens.

The largest specimen (Type) is 2 mm. high by 1.5 mm. in diameter; all have nearly mature gonads.

The bell is rather high, rounded, of about equal thickness throughout, without any trace of apical projection or even of an aboral gelatinous thickening. The exumbral surface is entirely smooth, the appearance of radial nematocyst ridges seen in the colored figure (Pl. **40**, fig. *8*) being caused merely by a wrinkling of the surface, due either to artificial or to muscular contraction.

Tentacles. — The shortness of the tentacles is a very characteristic feature of the species, and one unusual in Sarsia. Although the specimens were studied alive the tentacles were never observed to extend to a length greater than one half the bell height. The tentacles bear prominent nematocyst swellings, which are variable in form, but never form rings; they are few in number, six to ten per tentacle, corresponding to the shortness of the tentacles. They occupy nearly the entire length of the tentacle, only a very short basal region being naked (Pl. **7**, fig. *1*). At the tip of each tentacle is a spherical nematocyst pad.

The tentacle bases are swollen and brilliantly pigmented; on the outer surface of each is a large ocellus.

The manubrium is very short; in none of the specimens was it seen to extend lower than the mid level of the bell; but inasmuch as it is contractile, it may perhaps be protruded as far as the bell opening. It varies greatly in form with different states of contraction. In four of the specimens it is circular basally (Pl. **40**, fig. *8*); in two, however, it is contracted so as to take a cruciform outline, the four ridges being perradial. The mouth is circular, surrounded by a simple lip which may temporarily assume a cruciform outline (Pl. **40**, fig. *8*). There is no trace of a "stiel canal."

Gonads. — The gonad is in the form of a ring completely surrounding the manubrium, which it clothes from its base almost to the lip.

Color. — This Medusa is most brilliantly pigmented. Near the base of the manubrium there are eight adradial groups of vermilion and yellow pigment granules; the entoderm of the tentacles is vermilion, surmounted by a spot of ochre yellow; the ocelli are black; the ectoderm of the tentacles and of the manubrium is milky white. This scheme of coloration is constant in all six specimens.

Sarsia resplendens is related, by the shortness of its manubrium and its total lack of apical canal, to *S. brachygaster* Grönberg ('98), *S. flammea* Linko (: 00), and *S. angulatum* Mayer (: 00^a), species which Hartlaub (: 07) suggests should be grouped together in a new genus distinguished from typical Sarsia by these two characters; but from these, as well as from all other species of Sarsia, it is sufficiently well distinguished by the shortness of its tentacles, by the small number of tentacular nematocyst pads, and by the brilliant and characteristic pigmentation.

Purena Hartlaub, 1907.

Codonidae with gonads in the form of separate rings surrounding the manubrium; long tentacles set with nettle swellings (not rings).

The necessity for a new genus to include those species of Sarsia and of Dipurena which are separated from typical representatives of Sarsia by having the gonads in the form of separate rings, and from Slabberia and Dipurena by the long tentacles set throughout most of their length with nettle swellings, was indicated by Browne (: 05^b). It was to fill this want that Hartlaub (: 07) has proposed the genus Purena.

The numerous examples of this genus in the present collection all belong to one species identical with the *Dipurena* sp.? described from Ceylon by Browne (: 05^b), to whose excellent account and figures there is but little to add. Browne was unable to find any constant character to separate this species from the European *Sarsia strangulata* Allman (*Dipurena ophiogaster* Haeckel), and has given it no specific name. There seem, however, to be certain differences in the form of the gonads, which in the Indo-Pacific form are cylindrical rather than ovate, and in the length of the manubrium, which is much shorter in the Indo-Pacific form than in most of the figures of *S. strangulata*. Inasmuch as these characters are constant in the present large series, it seems to me that they are worthy of recognition, at least until the hydroid stage is known.

Purena brownei, nom. nov.

Dipurena sp.? Browne, :05^{b}, p. 133, pl. 2, figs. *1, 2.*

Plate 7, Fig. *7;* Plate 44, Figs. *8–10.*

Mangareva Harbor; surface; many specimens. Type.

Acapulco Harbor; surface; 37 specimens.

The largest specimens measure 5 mm. in diameter.

The bell is moderately high and rounded; there is no apical projection; the gelatinous substance is rather thick (Pl. **7**, fig. 7); the bell cavity deep.

Tentacles. — The four tentacles when extended are much longer than the height of the bell. Near their bases they are smooth (Pl. **44**, figs. *8–10*); but throughout the rest of their length they are thickly set with oval, transversely placed nematocyst clusters, which are irregularly arranged and none of which form rings. The basal bulbs have been well described by Browne (: 05^{b}). They are globular, imbedded in the jelly (Pl. **44**, fig. *10*), and surrounded basally by a circular swelling or band which is crowded with nematocysts and bears a prominent ocellus on its outer face (Pl. **44**, fig. *10*, o).

The manubrium is moderately long, hanging a short distance below the bell-opening. In the Ceylon specimens Browne has described it as rather longer, "two to three times the length of the cavity of the umbrella" (: 05^{b}, p. 134); but in none of our specimens is it so long. At its proximal end it bears a triangular projection into the gelatinous substance of the bell (Pl. **7**, fig. 7). The stomach proper is terminal, and barrel-shaped (Pl. **7**, fig. 7). The mouth is circular, with simple lip.

Gonads. — The gonads form rings, which are entirely separate from one another and surround the manubrium; I have not found them occurring on the stomach proper. The number of rings is variable, the greatest number counted being five, the least, one; and this variation is independent of differences in the sizes of the medusae. The collection contains both males and females.

Color. — The ocelli are yellowish, the gonads opaque white; otherwise the species is colorless.

Purena brownei has a very wide range over the Pacific and Indian oceans, a distribution suggesting that it reproduces by budding; but this process has not yet been observed.

Ectopleura L. Agassiz, 1862.

Codonidae with either two or four perradial tentacles; tentacles with nematocyst batteries on the outer face only; manubrium short; exumbrella with eight radial nematocyst ribs.

Four species of Ectopleura have been described: — *E. dumortii* Van Beneden ('44), from the European coast, *E. ochracea* A. Agassiz ('62), from the Atlantic coast of North America, *E. minerva* Mayer (: 00^{b}), from the Tortugas, and *E. pacifica* Thornely (: 00), from New Britain, the latter known from the hydroid only.

E. minerva is sufficiently well characterized by having only two tentacles. *E. ochracea* and *E. dumortii* are so closely allied that it is hard to find any good characters to separate them; indeed Dr. A. G. Mayer assures me that he was unable to distinguish specimens of *E. dumortii* taken off Cornwall from *E. ochracea* from New England.

The present collection contains a considerable series of the genus which I have compared with numerous specimens of *E. ochracea*, the result being that I am unable to find any characters distinguishing the two except such as may depend on state of contraction or on differences in preservation. I therefore refer the Pacific series to *E. ochracea.*

Ectopleura ochracea A. Agassiz.

Ectopleura ochracea A. Agassiz, '62, p. 343; '65, p. 191, figs. *320–323;* Hargitt, : 05^{b}, p. 32, pl. 2, fig. *1.*

Plate 6, Fig. *5;* Plate 38, Figs. *12, 13.*

Acapulco Harbor; surface; many specimens.

The largest specimen measures 1 mm. in height by about 1 mm. in diameter.

The bell is high; the gelatinous substance is thick at the apex but it does not form a distinct apical projection. It is possible, as Hartlaub (: 07) suggests, that the form of the bell may prove a good distinction between this species and *E. dumortii,* in which it is rounded, not thickened, aborally. In all the specimens there is a well-developed apical canal. The tentacles of *E. ochracea* are described (A. Agassiz, '65, p. 191) as having the nettle cells arranged irregularly, not in definite clusters as they are in *E. dumortii.* But in a series from New England, in the collection of the Museum of Comparative Zoölogy, I have found them forming quite as definite swellings along the outer sides of the tentacles as they do in the present specimens (Pl. **38**, fig. *12*). It appears, then, that this character is a variable one, and therefore not of much taxonomic importance. At any rate, specimens both from the Atlantic and from the Pacific exhibit the same features in this respect. Hargitt (: 05^b^) has described ocelli in this form; but in neither Atlantic nor Pacific specimens have I been able to find anything more definite in the way of light perceptive organs than the brilliant pigmentation in the centres of the basal bulbs of the tentacles. *E. dumortii* is said to have no ocelli (Hartlaub, : 07).

Color. — I was unable to examine the specimens in life. After preservation in formalin the manubrium is ochre yellow, the tentacle bulbs pale yellowish. Preserved specimens from the Atlantic have about the same color, but in life they are very brilliant, the tentacular bulbs being yellow with bright red centres.

Pennaria Goldfuss, 1820.

Globiceps Ayers, 1852.

Codonidae with all four tentacles entirely rudimentary; manubrium short, not extending beyond bell-opening; no ocelli. Hydroid stage, genus Pennaria Goldfuss.

In this genus specific characters are to be sought in the hydroids rather than in the very rudimentary medusae of those species in which they are developed, and both hydroids and medusae, at least of *P. tiarella*, are very variable. The present collection contains two species of Pennaria, from widely separated localities, each represented by but a single specimen. One of these agrees so well with the account of *P. vitrea* Agassiz and Mayer ('99), from the Fiji Islands, that I refer it to that species. The other most nearly resembles *P. tiarella*, yet differs from it in so many respects that it probably belongs to a different species. As yet, so far as I can learn, no species of this genus has been recorded from the west coast of America although two species, *P. rosea* and *P. adamsia*, have been described from Australia by Von Lendenfeld ('84), so that there is no clue, except that afforded by the medusa itself, to its identity, and since in this genus, where the medusae are little more than detached gonophores, such clues, especially when taken from only one specimen, cannot be relied upon without a knowledge of the hydroid, it is best to leave it for the present without specific identification.

Pennaria vitrea Agassiz and Mayer.

Pennaria vitrea Agassiz and Mayer, '99, p. 161, pl. 1, figs. *1–2*.

Plate 7, Fig. *4*.

Station 4696; surface; 1 specimen, 4 mm. high by 3 mm. in diameter.

These dimensions are slightly larger than those given by Agassiz and Mayer, to whose account I have little to add. The specimen had discharged its sexual products, and the manubrium was somewhat shrivelled. The four tentacular bulbs are extremely rudimentary; exumbrella surface smooth; radial canals unpigmented.

Color. — The tentacle bulbs are yellowish; the manubrium opaque and milky. Agassiz and Mayer ('99) state that the entoderm of the manubrium in both sexes is green; but Hargitt has shown that color is a variable character in this genus.

Pennaria species?

Plate 7, Fig. *6;* Plate 40, Fig. *7*.

Acapulco Harbor; surface; one specimen, 2 mm. high.

This specimen, which had discharged its sexual contents so that the manubrium is much shrivelled, closely resembles the medusae of *P. tiarella*, which I have examined in large numbers, except for its more brilliant coloration, and for the fact that the radial canals have swellings about midway of their lengths. These swellings appear to have nothing to do with the formation of sexual products, but are merely crowded with pigment granules.

The bell is high and narrow; the gelatinous substance stiff and opaque; the tentacle bulbs very rudimentary; the manubrium about half as long as the bell height.

Color. — The color of this Medusa is very brilliant, the manubrium and radial canals being brick-red. Tentacle bulbs colorless.

This specimen differs from any Medusa previously referred to Pennaria;

but it seems hardly more serviceable to describe it as a new species without the knowledge of the hydroid than it would be to name a new siphonophore from the medusoid gonophore alone.

Cladonemidae Haeckel, 1879.

sens. em. Vanhöffen ('89); Hartlaub (: 07).

Anthomedusae in which the tentacles are either branched, or bear stalked cnidoblasts; with 4–8 radial canals.

Zanclea Gegenbaur, 1856.

Gemmaria McCrady, 1857.

sens. em. Hartlaub, : 07.

Cladonemidae with either two or four hollow tentacles, which bear on the aboral side nematocysts mounted on contractile filaments; four simple radial canals; manubrium without apical extension; gonads primarily interradial; no ocelli.

This definition is that proposed by Hartlaub (: 07). Hargitt (: 08), who agrees with him in uniting Gemmaria with the genus Corynites as defined by A. Agassiz ('65) and later authors (*non* Corynites McCrady), believes that the number of tentacles is a character of sufficient importance to warrant the retention of Gemmaria with two, as distinguished from Zanclea with four; but although he found only two tentacles in the Mediterranean species *Z. implexa* Alder, Hartlaub (: 07) has recorded four tentacles in occasional very large specimens of this species. However, as Hartlaub (: 07) says, the question is still an open one; and the present series does not supply the answer.

The medusae of the various species of Zanclea are so similar one to another that it is difficult to find satisfactory characters by which to separate them; for the certain identification of a given series a knowledge of the hydroid stage is essential. Characters which have been regarded as of taxonomic importance in the medusae are the form of the bell, the form and extent of the exumbral nematocyst ridges, the form of the tentacular nematocyst batteries, the structure of the mouth, whether with or without lips, and the number of tentacles; but this last character, as pointed out above, may perhaps be of generic significance.

The present collection contains five specimens, which closely resemble

Z. gemmosa McCrady, except that the exumbral nettle ridges are rather longer. This slight difference seems hardly sufficient to warrant specific separation, especially inasmuch as the specimens were not examined until after preservation. It would be most interesting to know the relation of the present medusae to the hydroid stage described from Juan Fernandez by Hartlaub under the name of *Z. nitida;* it is possible that the two Pacific forms may prove to represent but one species.

Zanclea gemmosa McCrady.

Zanclea gemmosa McCrady, '57, p. 151, pl. 8, figs. *4*, *5*.
Gemmaria gemmosa McCrady, '57, p. 151; A. Agassiz, '65, p. 184, fig. *306;* Mayer, :00^b, p. 35, pl. 41, figs. *137*, *138*.

Plate 7, Fig. *3;* Plate 44, Figs. *1*, *2*.

Acapulco Harbor; surface; 5 specimens.

The largest specimen is 1 mm. in diameter.

As in Atlantic specimens the gelatinous substance is thin and the bell rounded, an outline very different from that of *Z. cladophora* A. Agassiz, in which the gelatinous substance is thick. There are two stout perradial tentacles, and alternating with them there are two small tentacular knobs. Since these latter structures are very rudimentary in all the specimens, although several have mature gonads, it is probable that they do not develop into tentacles. In the contracted condition of the tentacles it is impossible to distinguish the normal form of the nematocyst batteries or cnidoblasts, which are closely crowded along their aboral sides (Pl. **44**, fig. *1*), or to determine the extent to which their fibrils are extensible.

The manubrium is sac-like, hanging about to the opening of the bell when extended; the mouth is surrounded by a simple circular lip (Pl. **44**, fig. *2*).

The gonads are probably primarily interradial, as in other members of the genus (Vanhöffen, '89; Hartlaub, :07); but in the female the eggs grow so large that they obscure this arrangement, and finally come to occupy the entire wall of the manubrium (Pl. **44**, fig. *2*). In the male the location of the sexual products seems to remain permanently interradial.

Color. — The manubrium and the swollen bases of the tentacles are salmon pink.

Cytaeidae L. Agassiz, 1862.

Anthomedusae with interradial gonads; with solid tentacles; with labial nettle knobs or tentacles; marginal tentacles simple, not in groups.

As thus defined, the family includes not only the Thamnostomidae Haeckel, Podocorynidae Hincks, and Cytaeidae L. Agassiz, already united under the name Podocorynidae by Délage et Herouard (: 01), but also the Dendroclavidae. Délage et Herouard retain the latter group as a separate family, on account of the presence in it of a peduncle of peculiar chordate cells; but the degree to which this structure varies in the various species of the genus Lymnorea (p. 193), indicates that it is not a character of the importance they supposed. In all other respects Cytaeidae and Dendroclavidae are much more closely related to each other than is either to any other family; so closely, indeed, that their natural relationships are probably better expressed by reducing them to the rank of subfamilies of the one family, rather than retaining them as separate families.

Cytaeinae.

Cytaeidae Haeckel ('79); Maas (: 05).

Cytaeidae with simple marginal tentacles, not in groups; labial nettle swellings stalked (forming tentacle-like structures). No peduncle.

Cytaeis Eschscholtz, 1829.

Labial tentacles simple; marginal tentacles permanently four, stout, solid.

Maas (: 04^c) has pointed out that the several Atlantic species of this genus which have been described are certainly not all distinct, *C. tetrastyla* Eschscholtz being probably an immature stage of *C. nigritina* Steenstrup, while *C. pusilla* is certainly a very young stage, and perhaps belongs to this same species. *C. macrogaster* Haeckel seems to Maas well founded, because of the size and shape of the stomach. From the Indo-Pacific region two species have been described: *C. vulgaris* Agassiz and Mayer ('99), and *C. herdmani* Browne (: 05^b). Since the present series shows intermediate stages between the two, it appears that they in reality represent only a simple species, for which the older name *C. vulgaris* must be retained. In addition to the species above mentioned Mayer (: 00^b) has referred still another, *C. gracilis* from the Tortugas, to this genus; but inasmuch as this form already has eight tentacles at the stage when the first medusa buds are formed, it clearly does not belong to Cytaeis.

Cytaeis vulgaris Agassiz and Mayer.

Cytaeis vulgaris Agassiz and Mayer, '99, p. 161, pl. 2, figs. *3–5*; Maas, :05, p. 8, taf. 1, figs. *4–7*.

Cytaeis herdmani Browne, :05^b, p. 135, pl. 1, fig. *1*, pl. 4, fig. *12*.

Plate 6, Fig. *3*; Plate 40, Figs. *2, 5* · Plate 43. Fig. *4*.

Station 4644; surface
Station 4646; surface
Station 4646; 300 fathoms to surface
Station 4648
Station 4655
Station 4667
Station 4678
Station 4681
Station 4682
Station 4694
Station 4704
Station 4712
Station 4716
All at surface
Station 4717; 300 fathoms to surface
Station 4731; surface
Station 4733; surface
Station 4735; surface
Station 4741; surface

At stations 4646 and 4648 swarms; at each of the other stations several specimens were taken.

The series is of various sizes up to 5 mm. in diameter.

The general characteristics of this widely distributed Indo-Pacific species have been so well described by Agassiz and Mayer ('99, : 02), by Maas (: 05), and by Browne (: 05^b), that repetition here is unnecessary. Reference must, however, be made to the number of oral tentacles, since Browne has maintained that the great number (fifty to sixty) of these organs in his specimens is distinctive of *C. herdmani*. In the present series the number proves to be very variable, yet in general increasing with the growth of the Medusae. The maximum observed, in a specimen 5 mm. in diameter, was forty-two, thus approaching so closely to Browne's minimum that I have no doubt as to the common identity of Pacific and Ceylon specimens. Maas counted only thirty-two; Agassiz and Mayer in their largest individual only sixteen. Small specimens have even fewer, their least advanced specimen having only four (Agassiz and Mayer, '99).

A second feature thought by Browne (: 05^b) to distinguish *C. herdmani* from the Atlantic species *C. nigritina* and *C. macrogaster* is the structure of the tentacles, in which in *C. herdmani* the pigment is restricted to the endoderm cells; but since these same conditions appear to occur in the "Siboga" specimens of *C. vulgaris*, it gives no ground for a specific separation of *C. herdmani* from *C. vulgaris*. In size the present series agrees closely with Maas's account, the largest individual in this, as in the "Siboga" collection, measuring about 5 mm. in diameter.

Maas and Browne both took their accounts from specimens with sexual products in process of development, and neither they nor Agassiz and Mayer observed budding, although Maas (: 05) has suggested that such a process probably occurs. In the present series, however, most of the specimens (all the larger ones) show stages in budding, while none bear any trace of gonads. The buds, as is usual in the Anthomedusae, are borne on the walls of the manubrium, and in the larger specimens crowd it densely (Pl. **43**, fig. 6). In its details the process of budding presents no remarkable features, but agrees closely with similar stages in the Atlantic *C. nigritina*. It is of importance to know that this method of sexual reproduction occurs in *C. vulgaris*, since it allows us to look at its geographic distribution from a point of view quite different from that to which we must needs be limited, did we suppose its only mode of multiplication to be the sexual process with a fixed hydroid stage. Knowing that budding does occur, it is not surprising that the species is found to range over the whole Tropical Pacific and Indian oceans.

Color. — In life the coloration of this species is brilliant. The entodermic core of both tentacles and tentacular bulbs is deep salmon or chocolate red, their ectodermic sheaths pale lemon yellow; manubrium pale salmon red. This does not altogether agree with the account given by Agassiz and Mayer, for they found only the basal bulbs of the tentacles and the base of the proboscis red, the tips of both organs being greenish; but since their account was taken from small specimens it is probable that the difference is due to difference in the stage of development. The descriptions of Maas (: 05) and Browne (: 05^b) were taken from preserved material in which most of the color had been lost.

Dendroclavinae.

Dendroclavidae Vanhöffen ('89); Délage et Herouard (: 01).

Cytaeidae with the labial nettle swellings sessile; with more or less pronounced peduncle composed of chordate entoderm cells.

The best known genus of this subfamily is Turritopsis, a representative of which, *T. nutricula* McCrady, is common along the east coast of North America, and has been described in great detail by Brooks ('86).

Other forms, allied to Turritopsis, but generically separable from it on the one hand by a less pronounced development of the peculiar peduncle and on the other by greater complexity of the labial nematocyst knobs, have recently been described by Mayer (: 00^a) and by Broch (: 05) as species of Limnorea Péron et Lesueur. Whether or not these forms are actually congeneric with the *L. triedra* of Péron et Lesueur is extremely doubtful, for the description of the latter is most unsatisfactory, while the figure by Lesueur (published by Milne Edwards '49) is so evidently distorted as regards manubrium and mouth-arms that any identification of it with actual specimens is apparently out of the question.

Very recently Brooks and Rittenhouse (: 07) have suggested the generic name McCradia for "a number of medusae, from various parts of the world, which are very similar to Turritopsis, . . . and are placed together in the genus Modeeria" (: 07, p. 435). The member of this genus which they figure (: 07, pl. 31, fig. *8*), though without specific name, is evidently congeneric and probably conspecific with *Lymnorea alexandri* Mayer (: 04), and is from near the type locality of that species. Apparently they have overlooked the fact that both Broch and Mayer had already used the name Lymnorea for the Medusae which they call McCradia.

There is reasonable doubt as to whether Lymnorea or McCradia is the better name for this genus. On the whole, however, it seems that the former has the stronger claim, since both Mayer's and Broch's descriptions antedate Brooks and Rittenhouse, and are so good as to leave no doubt as to the generic identity of their specimens. In this case, however, Lymnorea must be dated from Mayer (: 00^a), not from Péron et Lesueur, as the *L. triedra* is unrecognizable. Since no species seems to have been designated as its type, I suggest *L. alexandri* Mayer.

In so far as regards the position of the gonads, Brooks and Rittenhouse take a stand opposite to that held by Vanhöffen ('89), maintaining that these organs, as Haeckel ('79) supposed, "are, no doubt, fundamentally radial, but the halves are pushed apart by the channels through which the radiating canals open into the stomach, so that each half joins the half of the adjacent reproductive organ in the interradial plane. There are, in effect, four interradial gonads, although each is to be regarded as the halves of two perradial gonads" (Brooks and Rittenhouse, : 07, p. 435). They have offered no evidence, however, that this is the actual course of development, while their own figures suggest that the gonads are truly interradial, since they are perfectly continuous in the interradii, while entirely discontinuous in the perradii. The fact that the furrows in the interradii along which they suppose the union of the gonads to have taken place are deeper in adults than in the young is further evidence in support of the latter explanation. What little evidence is afforded by the present specimens, as well as by a series of *Turritopsis nutricula* which I have myself examined, is to the same effect, *i. e.* that the gonads are interradial.

Lymnorea Mayer, 1900.

(Non Péron et Lesueur, : 09.)

Dendroclavinae with but slight development of peduncle; with numerous tentacles; oral nematocyst knobs numerous, and branched.

The four species of Lymnorea, as thus limited, *L. borealis* Mayer (: 00^a), *L. ocellata* Agassiz and Mayer (: 02), *L. norvegica* Broch (: 05), and *L. alexandri* Mayer (: 04), are distinguished from one another only by such minor characters as number of tentacles, length and form of proboscis, and extent of branching of the labial arms, characters all of which change with growth. It is doubtful whether all the species are distinct; but it is impossible to revise them from the published accounts. The description of *L. alexandri* agrees so well with the specimens in the present collection that I have little hesitation in referring them to that species.

Lymnorea alexandri Mayer.

Lymnorea alexandri Mayer, : 04; p. 10, pl. 1, figs. *1–5*^{a}.
McCradia species Brooks and Rittenhouse, : 07, p. 435, pl. 31, fig. *8*.

Plate 40, Figs. *3*, *4*; Plate 44, Figs. *11*, *12*.

Acapulco Harbor; surface; 4 specimens.

The largest specimen measures 2.5 mm. in height by almost 2.5 mm. in diameter, and has forty-six tentacles. The smallest is about 2 mm. high, with thirty-three tentacles.

The bell is high; its apex flattened; the gelatinous substance thin.

The tentacles are solid, about as long as the bell height; coiled spirally when contracted. They have swollen bases, each of which bears an ocellus on its inner (velar) side.

The manubrium is highly contractile; it does not extend to the bell-opening. After preservation it presents the condition represented in Pl. **44**, fig. *12*. The mouth arms are more simple than they are described for any adult species except *L. borealis*, being very short, and each branching only twice, so that at each corner of the mouth there are four nettle knobs (sixteen in all). The peduncle of chordate cells, so well described by Brooks and Rittenhouse, is short (Pl. **40**, fig. *3*), and in preserved specimens almost entirely masked by the contraction of the manubrium.

Gonads. — The gonads are interradial, and entirely discontinuous in the perradii (Pl. **44**, fig. *12*). They are oval and prominent.

Color. — The gonads are pink, tentacle bulbs reddish, ocelli black (Pl. **40**, figs. *3*, *4*).

The specimens closely resemble Mayer's (:04) account of *L. alexandri* except that the branching of the labial tentacles is less complex, there being only four instead of eight knob-like terminations to each; but the fact that there are many small marginal tentacles among the larger ones suggests that specimens have not yet reached the final stage in their development so that further development of labial tentacles might be expected.

The specimen figured by Brooks and Rittenhouse presents an even simpler condition of the mouth arms, which are simply bifid. Inasmuch as Mayer has found that the branching of these organs increases in complexity with growth, we may assume that the three conditions represent as many stages in development, rather than specific differences. In all the bell is high and flattened, manubrium short, and the peduncle much reduced.

In *L. ocellata* Agassiz and Mayer (:02), from the Paumotus Islands, the gelatinous peduncle is longer, the basal dilations of the radial canals being so prominent as to more nearly resemble the condition in Turritopsis. The labial arms likewise are more highly developed, the branching progressing even further, and the arms themselves being long and tentacular instead of mere nematocyst knobs. Furthermore, the tentacles in this species are described as short and stiff. It is possible that these differences are to be explained as concomitant with a still more advanced stage in growth. I hesitate, however, to unite the two species until more specimens of the *L. ocellata* form are examined, or until such individuals are found within the range of *L. alexandri*.

L. borealis Mayer (:00^a) has a much longer manubrium, and the peduncle even more reduced than in either *L. alexandri* or *L. ocellata;* but since only three specimens of this species, all males, were examined, it is an open question whether these differences are constant. The description by Broch (:05) of *L. norvegica* is brief and without figures; but it appears that this species most closely resembles *L. borealis* in the small number of tentacles, length of manubrium, and simplicity of labial arms.

Bougainvilleidae Gegenbaur, 1856.

Vanhöffen ('89); Maas (:05).

Hippocrenidae McCrady, 1857.

Anthomedusae with four interradial gonads; with branched labial tentacles; marginal tentacles in bundles.

The family divides into three sections according as there are four, eight, or sixteen groups of tentacles. The genera of the last two groups, Rathkea, Lizzia, and Chiarella, are sufficiently well defined, but those of the first, Margelis, Bougainvillea, and Nemopsis, merge into one another to such a degree that it is doubtful whether they should represent more than one genus. The final answer to this question cannot be given, however, until more thorough comparative studies have been made, and especially until the life histories of the various species, their hydroid stages, and the changes which the medusae undergo with growth, have been traced. The family is represented in the "Albatross" collection by a series referable to *Bougainvillea fulva* Agassiz and Mayer.

Bougainvillea fulva Agassiz and Mayer.

Bougainvillea fulva Agassiz and Mayer, '99, p. 162, pl. 2, fig. *6*; :02, p. 145, pl. 2, fig. *8;* Maas, :05, p. 10, taf. 1, fig. *8*, taf. 2, figs. *9*, *10*; :06^c, p. 87, pl. 2, figs. 4, 5.

Plate 6, Fig. *7;* Plate 44, Figs. *5–7*.

Acapulco Harbor; surface; many specimens, from 1 to 7 mm. in diameter.

The specimens range from very small up to about the stage represented by the Amboina specimens recently described by Maas (: 06^c). The collection from the "Siboga" (Maas, : 05) belongs to a still further advanced stage. The bell is higher than broad, the gelatinous substance thick, especially at the apex. Maas (: 05, p. 11) states that in large individuals the outline is somewhat prismatic; but the great majority of the present specimens are circular in cross section, although a few are more or less distorted by preservation.

The largest number of tentacles per bundle in our series is thirteen (Pl. **44**, fig. *7*), in a specimen 7 mm. high. Maas (: 05) has noted twenty in still larger specimens. In specimens 1–2 mm. in diameter there are only three or four per bundle; but the number increases steadily with growth. It appears that shortness of the tentacles is distinctive of this species, as Maas has suggested, for even in life I have never seen them reach a length greater than one half the height of the bell. Such excessive reduction of these organs as he has figured (: 05, taf. 1, fig. *8*) for the "Siboga" specimens is probably due in part to contraction and preservation. The ocelli lie on the inner (oral) faces of the tentacular bases; but I have seen no actual evidence that this location is associated with a habit of carrying the tentacles curved upward as he has suggested, and as Agassiz and Mayer have figured them (: 02, pl. 2, fig. *8*). On the contrary, in life the tentacles were very flexible, being alternately expanded and contracted, and often streaming behind the bell, as in the common *B. superciliaris* from the Atlantic.

The form of the manubrium is variable. Maas has already noted that "Man könnte das lebende Tier . . . für eine *Margelis*, das conservierte für eine *Hippocrene* halten" (: 05, p. 11), the manubrium in life being long, after preservation very short. This species, when small, passes through what may be called a Margelis stage. In the smallest specimens the manubrium is barrel-shaped, its base being narrow. In larger specimens it is broader basally, though showing much variation with different degrees of contraction. In the largest specimens its base becomes very broad, an outline associated with the appearance of the gonads; as Maas has shown, even when it is broadest the radial canals do not originate at its corners, but can always be traced to its centre where they meet in a cross. In outline, as viewed aborally, the manubrium of larger specimens varies from nearly circular to cruciform, a variation correlated with contraction and perhaps with the state of nutrition of the organ. The mouth is usually cruciform (Pl. **44**, fig. *6*).

Color. — The base of the manubrium and the tentacular bulbs in the Acapulco specimens varied from yellowish green to ochre yellow; they are described by Agassiz and Mayer as rosin yellow (: 02, p. 145). The tentacles are milky; the bell is transparent.

This species is widely distributed over the Tropical Pacific Ocean and the Malaysian region.

Amphinemidae Haeckel, 1879.

sens. em. Vanhöffen, '89.

Anthomedusae with interradial gonads and with hollow tentacles; with only two developed tentacles, although there may also be numerous rudimentary tentacles.

This family was included by Haeckel ('79) in the Tiaridae as a subfamily, but we may well follow Vanhöffen ('89) in classing it as a separate family, for, although it is more closely allied to the Tiaridae, from which it is to be distinguished only by the restricted number of tentacles, than it is to any other family of Anthomedusae, its members form an extremely homogeneous group. This classification is likewise accepted by Maas.

Vanhöffen has united the three genera of Amphinemidae which Haeckel distinguished under the oldest name, Stomotoca, believing that the differences in the extent and form of the gonads which formed Haeckel's basis for separating Amphinema from Codonorchis are merely the expression of different stages in development, and that the presence of a gelatinous peduncle which serves to characterize Stomotoca is at most of specific, not of generic, importance. With the union of Amphinema with Codonorchis I entirely agree. According to Haeckel the gonads of the former are restricted to the walls of the manubrium, while in the latter they extend from the manubrium over the surface of the subumbrella; but since in at least one species in the present collection, *A. turrida* Mayer, moderate-sized individuals show the former, larger ones the latter condition, it is evident that the difference represents nothing more than successive stages in development, and therefore should not be given generic significance. It may be, however, a *specific* character, should it prove that the simpler condition is the final one in any species of the genus. The ground for Vanhöffen's combination of Amphinema with Stomocota is less certain. A peduncle, when it occurs, is a very constant character; and, inasmuch as it distinguishes several species, may reasonably be accorded generic value. I therefore retain two genera in this family, Amphinema and Stomotoca.

Amphinema Haeckel, 1879.

Amphinemidae without gelatinous peduncle.

Probably there are described five or six species which must be referred to this genus, but it is questionable whether all of them are distinct. Three have been described from the South Atlantic coast of North America, and are recorded by Mayer under the names *Stomotoca apicata* McCrady ('57), *Stomotoca rugosa* Mayer (: 00^a), and *Stomotoca australis* Mayer (: 00^b). Inasmuch as the present collection contains several specimens which agree closely with Mayer's latest figure of *S. australis* (: 04, pl. 1, fig. 9), I have attempted to reach a decision as to the relationships of these three forms, which present rather a confused case of synonymy. The earliest account of any American species is that by McCrady ('57, p. 129) of *Saphenia apicata*, since recorded by Agassiz ('65), Fewkes ('81), Brooks ('83), and Mayer (: 00^a). But Mayer (: 00^a) contends that the *S. apicata* of Fewkes ('81) and Brooks ('83) is in reality a different species to which he has given the name *S. rugosa*, and that the *Dinatella cavosa* of Fewkes ('81) is identical with *S. apicata* McCrady.

Mayer, in distinguishing *S. apicata* from *S. rugosa*, lays stress on the difference in color, the tentacle bulbs of the former being purple or ochre according to the sex, and of the latter brick-red, a difference which appears to be fairly constant and on the more complexly folded lips of the latter; but inasmuch as McCrady describes the basal bulbs of his original specimens of *S. apicata* as red, it seems doubtful whether Mayer's choice of names for the two is correct. *S. australis* Mayer (: 00^b) very closely resembles *S. apicata*, indeed his figures of the two agree almost exactly, except that the former has definite brilliant red ectodermic ocelli at the bases of the rudimentary tentacles, while in the latter there are no ocelli but only scattered entodermic pigment granules; this difference Dr. Mayer assures me is a very constant one. We cannot hope to reach any definite and lasting conclusion as to the interrelationships of these three forms until the hydroid stages of *S. apicata* and *S. australis* are known; that of *S. rugosa* according to Mayer (: 00^b, p. 33) is a Perigonimus much like *P. minutus* Allman ('71). In the meantime it seems best to retain all three names. In all these forms, and in the *A.*

dinema from the coast of Europe, which is very closely allied to them, the gonads appear to be permanently limited to the manubrium.

One other American species, *Dissonema turrida* Mayer (: 00[b]), must also be referred to Amphinema. This species was placed by Mayer in the leptomedusan genus Dissonema on the supposition that the gonads were not situated on the walls of the manubrium, but lay along the radial canals. An examination of Mayer's original specimens has convinced me that this interpretation is erroneous, and that the gonads in reality belong to the walls of the manubrium, whence, in large specimens, they extend out on to the subumbrella, exactly as Haeckel ('79) describes them in Codonorchis.

The present collection contains two species of Amphinema, one identical with *A. australis* Mayer, the other with *A. turrida* Mayer. The series of the latter is particularly instructive, since it illustrates several successive stages in the growth of the gonads.

Amphinema australis Mayer.

Stomotoca australis Mayer, : 00[b], p. 32, pl. 1, fig. *2* ; : 04, p. 9.

Plate 7, Fig. *5;* Plate 38, Figs. *10*, *11*.

Acapulco Harbor ; surface ; many specimens.

The largest specimens measured 3 mm. in height by 2.5 mm. in diameter.

The specimens agree very closely with Mayer's account, and the general form, with high apical projection, is well shown in his figures. In the photograph (Pl. **7**, fig. *5*) this is much less prominent than in life. The presence of ectodermic ocelli at the bases of the rudimentary tentacles is a distinguishing feature of this species, and one very constant in all the specimens. The number of rudimentary tentacles is also important, for I have never found more than six, even in large individuals with ripe sexual products, while in *A. rugosa*, according to Mayer (: 00[a]), there may be as many as fourteen.

The gonads, not shown clearly in Mayer's figures, are interradial (Pl. **38**, fig. *11*), though in large specimens only slightly interrupted in the perradii. They are always smooth, without distinct folds or lobes such as are found in *A. turrida*, and are restricted chiefly to the basal region of the manubrium. The collection contains both males and females. While in *S. apicata* the two sexes differ from each other both in color and in form (Mayer : 00[a]), in *S. australis* they are indistinguishable externally.

The lips, though simple, are considerably longer than Mayer has represented them, and extend almost across the bell cavity.

Color. — The ocelli are reddish brown, the manubrium and gonads faintly greenish. This is the same color that Mayer has recorded. This species has previously been recorded from the West Indian region only.

Amphinema turrida Mayer.

Dissonema turrida Mayer, : 00^b, p. 44, pl. 2, figs. *3*, *4*; : 04, p. 8, pl. 2, fig. *10*.

Plate 7, fig. *2*; Plate 40, fig. *6*; Plate 43, fig. *3*; Plate 44, figs. *3*, *4*.

Acapulco Harbor; surface; 4 specimens, the largest being 4 mm. in diameter.

Fortunately the specimens of this interesting species illustrate several stages in the development of the gonads and show conclusively that they belong primarily to the walls of the manubrium as already stated (p. 199), and that their later outgrowth over the subumbrella surface is secondary.

The general form has been well represented by Mayer (: 00^b); the apical projection is high and stiff, the bell walls very thin. The largest specimen measures 3 mm. in diameter.

Tentacles. — The two main tentacles are very stout, and rather longer than the extreme height of the bell. The conformation of the rudimentary tentacles separates this species very definitely from *A. australis*. The two radial ones are of considerable size and length. Between the radial canals in each quadrant there are three rudimentary tentacles (Pl. **43**, fig. *3*), which, according to the state of contraction, or possibly in part to individual variation, are either mere bulbs, or are prolonged into short filaments, as Mayer figures them (: 00^b). I have observed both conditions in a single quadrant of one specimen. Thus there are sixteen tentacular structures in all. On the base of each of these, on its outer surface, there is an ectodermic ocellus (Pl. **43**, fig. *3*).

The gonads of this species are its most interesting feature. In adult specimens these structures appear, at first sight, to lie on the subumbrella along the radial canals, as Mayer has represented them. It was this supposition which led him to include this species in the anthomedusan genus Dissonema. Dissection shows, however, that in reality they likewise occupy the walls of the manubrium. A study of the youngest medusa shows that they originate on the manubrium, where they form eight thickenings (Pl. **44**, fig. *3*). These, in surface view, appear to be discontinuous in both per- and interradii, but on sections it is seen that near the base of the manubrium the gonad tissue is continuous across the interradial areas (Pl. **44**, fig. *4*). At this stage, then, the gonads, being horseshoe-shaped, correspond to those of Pandea and Tiara. They already show definite transverse folds; and in the adults (Pl. **40**, fig. *6*) these folds are very prominent. The further growth of the gonad is difficult to follow on the few available specimens. Apparently the arms of each horseshoe become attached to the subumbrella surface along the sides of the radial canals, thus forming subdivisions of the bell cavity comparable to those in various Tiaridae; but in the present case the division is apparently caused by outgrowths of the walls of the manubrium, and not by dilations of the radial canals such as Vanhöffen ('89) has shown to be the true nature of the "mesenteries" described by Haeckel ('79).

Color. — In life (Pl. **40**, fig. *6*) the manubrium, gonads, and two primary tentacles are salmon red, each of the latter with a deeper band along its inner surface. The ocelli are claret red.

So far as I have been able to learn, the only other species of Amphinemidae in which a type of gonad similar to that in *A. turrida* has been described is the *A. octaedrus* of Haeckel, though the same condition occurs, according to Brooks (: 03), in the genus Dichotomia. Unfortunately Haeckel has not figured *A. octaedrus*, but as far as one can determine from his very brief description it is certainly very closely allied to *A. turrida*, from which it is separated by the octohedral form of the bell, and the smaller number (ten) of rudimentary tentacles all of which are apparently of one size. It is very desirable that this species be studied afresh. Meanwhile it seems best to retain both *A. octaedrus* and *A. turrida* as distinct species in spite of their close resemblance to each other. *A. turrida* has been recorded only from the West Indian region, *A. octaedrus* from the European coast.

Stomotoca L. Agassiz, 1862.

Amphinemidae with the stomach situated on a gelatinous peduncle.

Besides having a peduncle, *S. atra* A. Agassiz, *S. pterophylla* Haeckel, and *S. divisa* Maas are distinguished from the various species of Amphinema by having a much larger number of tentacles. The distinctions between the three species are slight. Maas ('97) himself recognizes the close relationship between *S. pterophylla* and *S. divisa*, but believes a new species necessary for the Panamic form, because of three features,—the presence of an attenuated apical projection, the fact that the gelatinous dome of the disc is divided by a coronal furrow, and because the tentacles are swollenbasally so as to form distinct bulbs, which is not the case, according to Haeckel's figure ('79, taf. 4, fig. *10*), in the West Indian *S. pterophylla*. Fortunately, I have been able to test these three characters in a considerable series of Stomotoca in the present collection, from near the type locality of *S. divisa*, and with the following results: — the presence of an apical projection proves to be a character belonging to an immature state of development, and not one diagnostic of the species; for while it is present and more or less prominent in small specimens, 15–20 mm. in diameter, it is entirely absent in the largest specimens, which, not only from their size but also from the condition of the gonads, are evidently further advanced than any examined by Maas. The coronal furrow is present in some specimens (though in none very marked), absent in others, apparently irrespective of stages in development, — a variation showing beyond question that the furrow is not in any way comparable, with reference to constancy or systematic importance, to the coronal furrow of the Coronata. None of the present specimens show such an extreme development of the tentacular bases as Maas ('97, taf. 1, fig. *3*) has figured, yet on the other hand there is always a definite thickening, so that in this respect they stand intermediate between the accounts of Maas and Haeckel. Inasmuch as the latter author drew his description solely from alcoholic specimens it is a question how much stress to lay on this slight difference; for tentacles and even their bulbs often contract greatly, and even become entirely distorted after preservation in alcohol. It is most unfortunate that Haeckel could give no account of the color in *S. pterophylla*, for from comparison with *S. atra* it appears that this character may be of specific importance in this genus. From the above facts it appears that the resemblance between *S. pterophylla* and *S. divisa* is so close that it is doubtful whether the separation of the two species is sound; but since it is impossible to answer this question definitely without a fresh study of West Indian specimens of *S. pterophylla*, and since there is a possibility that the slight difference in the form of the basal bulbs of the tentacles, and the occasional occurrence of a coronal furrow in the Panamic form, may prove to distinguish it from *S. pterophylla*, it seems to me better to retain both names.

S. atra, though closely allied to *S. pterophylla* and *S. divisa*, seems to be characterized by a much darker coloration than that of the West Indian or the Panamic species, the ovaries in *S. atra* being dark brown or blackish (Agassiz, '65, p. 169), while in *S. divisa* they are pinkish; and by the fact, which I have been able to corroborate on the original specimens now in the collection of the Museum of Comparative Zoölogy, that there are fewer rudimentary tentacles, the maximum observed being forty in *S. atra* as against about one hundred and twenty in *S. divisa*.

Stomotoca divisa Maas.

Stomotoca divisa Maas, '97, p. 11, taf. 1, figs. *1–9*.

Plate 7, fig. *9;* Plate 43, figs. *6, 7*.

Station 4600; surface, October 15; many specimens, 8 mm. to 12 mm. in diameter.

Station 4644; surface, November 7; 15 specimens, up to 25 mm. in diameter.

The specimens in the first capture were all rather small; but when the species was taken again, three weeks later, all but one were much more advanced, the largest measuring about 25 mm. in diameter.

The gonads present a very interesting condition. In the smaller specimens the condition is very similar to that described by Maas ('97). As he states, the gonads are continuous interradially at the base of the manubrium, though so deeply cleft in the interradii as to be horseshoe-shaped; the arms of the horseshoe, lying on either side of the perradii, are complexly folded. This is essentially the same condition as in Tiara and other Tiaridae, in all of which the gonads are primarily interradial. So far as I know, no student has demonstrated that the gonads in any Tiaridae or Amphinemidae are ever *entirely subdivided* in the interradii. It is therefore of great interest to find that such is their final state in the largest specimens of *S. divisa;* and I believe that the number of specimens (fourteen) in which I have found this extreme type is sufficient to establish it as the normal adult condition. There is no doubt, however, from the conditions in younger specimens, that the gonads are primarily interradial; and it is to be noted that in their final condition they are not in any sense radial, since they always remain entirely separated in the perradii. The complete separation of the two arms of each horseshoe-shaped gonad is probably the result of rapid growth on the part of the walls of the manubrium, and is merely the end-stage in the process by which simple interradial gonads are transformed into horseshoe-shaped structures.

The folding of the gonads is complex, yet more regular and considerably more pronounced than Maas has represented it. A typical example is represented in Plate **43**, figure *6*.

I have already called attention to the fact that the tentacular bases in the present series (Pl. **43**, fig. 7) are less swollen than Maas ('97) represents them. The number of rudimentary tentacles is important, inasmuch as it may prove to be of some taxonomic value. In the largest specimens there are from twenty-five to thirty of these per quadrant, *i. e.* from one hundred to one hundred and thirty on the entire margin. In life the lips are long, and folded in an extremely complex manner.

Color. — In life the gonads vary from orange to brownish red; manubrium, lips, and radial canals pale lemon yellow; tentacles yellowish. Since the present specimens agree closely in this respect with those described by Maas ('97) from notes and sketches made from life by Mr. A. Agassiz, it appears that the coloration of this species is fairly constant.

One of the two localities at which *S. divisa* was taken, Station 4644, is near the type locality, being just south of the Galapagos Islands. The other locality is close to the Mexican coast, southeast of Acapulco. In the Atlantic, *S. pterophylla* is recorded from the West Indies, between Cuba and the Bahama Islands (Haeckel, '79), and Dr. A. G. Mayer informs me that he has since taken it himself in the West Indies.

Tiaridae Haeckel, 1879.

sens. em. Vanhöffen ('89).

Anthomedusae with gonads primarily interradial, though this location may be masked secondarily by growth; with from four to many hollow tentacles; radial canals broad, basally dilated, secondarily uniting with the manubrium, thus forming the so-called mesenteries.

The following genera of Tiaridae seem sufficiently well established: — Turris, Conis, Tiara, Pandea, Catablema, and Tiarocodon Browne (:02). Vanhöffen ('89), it is true, has argued that Pandea, Turris, and Tiara should all be united, the differences between them in the form of the gonads being at most gradual, if not largely due to different stages in development; but

I agree with Hartlaub ('92) and Maas (: 04^c) that the conformation of the sexual organs is sufficiently divergent in these three to warrant their retention as separate genera. To express the confusion which reigns within these genera I cannot do better than quote the following words of Maas: — "il est impossible de démêler dans l'état présent de nos connaissances les espèces différentes décrites sous les synonymes divers (*Oceania* incl.) et, certainement en plusieurs cas, la même espèce se trouve cataloguée dans des genres différents" (: 04^c, p. 12). The present collection contains specimens referable to Pandea, Tiara, and Turris, the latter apparently representing a new species.

Pandea Lesson, 1837.

sens. em. Haeckel ('79).

Tiaridae with horseshoe-shaped gonads, not transversely folded, and only slightly interrupted in the perradii.

Pandea violacea Agassiz and Mayer.

Pandea violacea Agassiz and Mayer, '99, p. 160; Mayer, : 00^b, p. 34, pl. 1, fig. *1*.

Plate 41, figs. *10*, *11*.

Acapulco Harbor; surface; 7 specimens, all about 4 mm. in diameter by 4 mm. high.

These specimens differ from the Fiji examples described by Agassiz and Mayer ('99) and those from the Tortugas described by Mayer (: 00^b) in having a smaller number of rudimentary tentacles. In each there are eight well-developed tentacles, extensible to a length greater than the height of the bell (Mayer, : 00^b, p. 34), though usually strongly contracted. In addition, the present specimens have only eight rudimentary tentacles, alternating with the well-developed ones, while in Mayer's specimens there were twenty-four of these. This difference appears, however, to be one of development, not of species, since in the regular course of the formation of additional rudimentary tentacles the next stage would be that found by Mayer. Mayer merely says of the gonads that they distend the proximal part of the manubrium; and inasmuch as he figures them as simple ovate perradial swellings it seems that he overlooked their essentially interradial nature; this can be clearly traced in the present specimens, for though at first sight the gonads look like radial structures, closer examination shows that there is no break in the formation of sexual products in the interradii, although in these planes they are restricted to the basal end of the manubrium. The gonads, as Maas (: 04^{c}) has pointed out, are horseshoe-shaped structures, their arms lying along the side of the radial canals. I have been unable to determine whether there is any interruption in the perradii; and it is probable that there is not, but that in *P. violacea*, as in *P. conica* (Maas, : 04^{c}) the four primary gonads form a practically continuous ring surrounding the manubrium. The surface of the gonads is smooth, without transverse folds.

The manubrium is shorter and broader, and the mouth broader than Mayer has figured them (: 00^{b}, pl. 1, fig. *1*), but the difference is no greater than can readily be explained as due to different states of contraction or to the preservation of the Acapulco specimens. There is no peduncle. The mouth is surrounded by four simple lips. There is an ocellus at the base of each developed or rudimentary tentacle (Pl. **41**, fig. 10, o).

Color. — The ocelli were vandyke brown in life; the gonads opaque, slightly pinkish. Mayer observed a green streak running along the outer surface of the endodermal lining of each radial canal, but this was absent in the present specimens.

The chief difference between *Pandea violacea* and the well-known *P. conica* of the Atlantic is that the former entirely lacks the exumbral nematocyst ribs which appear to be specifically characteristic of the latter.

Tiara Lesson, 1837.

sens. em. Hartlaub ('92).

Tiaridae with horseshoe-shaped interradial gonads, their concavities directed distally, their arms transversely folded. Tentacles in one series; radial canals with only small glandular evaginations, if any; lips complexly folded.

To the above definition, which is essentially that of Hartlaub ('92), Maas has added: — "Tentakel in regelmässiger Weise auf die 4-Zahl zurückführbar" (: 05, p. 14). This statement is no doubt true in general; but inasmuch as I have found a variation from it in two of the four specimens of the genus in the present collection, I hesitate to adopt it as one of the distinctive characteristics of the genus. The present series agrees well with Maas's account of the "Siboga" specimens, which he refers to *T. papua* Lesson. This identification cannot be made positive, on account of the unsatisfactory nature of the older illustrations of *T. papua;* but so far as one can judge from them, it has strong probability of correctness, and as, from the nature of these figures it is unlikely that any more satisfactory identification can ever be made, it will add to stability of nomenclature if it be adopted.

I have no doubt that *T. oceanica* Agassiz and Mayer (: 02) is merely a more advanced stage of the same species, its larger number of tentacles being easily explicable as a concomitant of growth, and the small size of the single specimen seeming of but little significance in view of the extreme variability of this character. Moreover Dr. Mayer has recently informed me that he now believes *T. oceanica* to be identical with *T. papua* if not with *T. pileata*. The same is true also, according to my view, of *T. intermedia* Browne (: 02) from the Falkland Islands, a conclusion already reached by Maas (: 05). Browne has described the rudimentary tentacles of *T. intermedia* as mere bulbs; whereas in the "Siboga" specimens they are true tentacles, though small. These two states, however, are shown by the conditions in the present series to be successive stages in development, the bulbular preceding the tentacular; therefore they afford no ground for specific separation.

The relationship of the Indo-Pacific species, *T. papua*, to the common Atlantic *T. pileata* cannot be decided at present. As Maas (: 05) has pointed out, it is possible, especially since *T. papua* has been recorded from the South Atlantic (*T. intermedia* Browne) that the two may grade into each other; but from the evidence now available it does not seem to me that such is likely to be the case, for, so far as is known, adult *T. pileata* always has a very much larger number of tentacles than has ever been recorded for *T. papua*.

T. suberba Mayer, from the Tortugas, appears to be a sufficiently well-characterized species.

Tiara papua Lesson.

Turris papua Lesson, '37, no. 36; '43, p. 283; Eydoux et Souleyet, '52, p. 639, pl. 2, figs. *1–3*.
Tiara papua Maas, : 05, p. 14, taf. 2, fig. *13*.
Tiara oceanica Agassiz and Mayer, : 02, p. 141, pl. 1, fig. *1*.
Tiara intermedia Browne, : 02, p. 277.

Pl. 42, figs. *1* to *4*.

Station 4605; 300 fathoms to surface; 1 specimen, 5 mm. in diameter.

Station 4652; 200 fathoms to surface; 1 specimen, 7 mm. high by 5 mm. in diameter.

Station 4694; surface; 2 specimens, one 6 × 5 mm., the other very immature, 3 × 2 mm.

The number of tentacles in the different specimens is as follows: — 5 mm. in diameter, sixteen tentacles, eight large (radial and interradial), eight rudimentary, bulbular (Pl. **42**, fig. *3*); 7 × 5 mm., twenty, of which nine large and eleven bulbular (Pl. **42**, fig. *4*); 6 × 5 mm., seventeen, nine large and eight small, of the latter several tentacular, others bulbular; 3 × 2 mm., eight, four large and four bulbular. The maximum observed both by Browne (: 02) and by Maas (: 05) was sixteen, eight large and eight small; Agassiz and Mayer (: 02), however, have recorded a stage with thirty-two, eight long, eight short, and sixteen bulbular. There is an ectodermic ocellus at the base of every tentacle, and, as a rule, of every bulb; but in one specimen these structures were lacking in several of the bulbs, and in the youngest specimen they are present on the four large tentacles only. Absence of ocelli on a bulb is therefore evidence of the recent origin of the latter.

In one specimen, Station 4605, diameter 5 mm., the radial canals are somewhat jagged along their edges in their middle regions as they are described by Maas (: 05) and by Agassiz and Mayer (: 02). In all the remaining specimens the canals are smooth.

The smallest specimen is of especial interest as being the youngest individual of the species yet recorded. In outline (Pl. **42**, fig. *1*) it differs markedly from older specimens, the apical projection, which in the latter is low and triangular, being long and rodlike, with a well-marked apical canal running its entire length and terminating in a dilatation. The manubrium is very short; the lips as yet simple, though folded; there are no traces of gonads. Tentacles eight, four large radial, four bulbular interradial. Ocelli present on the four large radial tentacles only.

Color. — In life the manubrium, gonads, and tentacles are pink violet; the ocelli are brownish red.

Tiara papua has been recorded under its various names from New Guinea (Lesson); the Indian Ocean (Eydoux et Souleyet); the Malaysian region (Maas); near the Marquesas Islands (Agassiz and Mayer); Falkland Islands (Browne). The present captures are from the Humboldt Current off the west coast of Central America and from the neighborhood of Easter Island.

Turris Lesson, 1837.

sens. em. Hartlaub ('92); Maas (: 04^c).

Tiaridae with complex gonads, each consisting of two adradial series of regular transverse folds which are often bifurcate; connected with one another near the base of the manubrium by a series of irregular thickenings, and throughout the interradii by a network; radial canals with large glandular diverticulae.

To the above diagnosis Maas (: 04^c) has added the statement that new tentacles are interpolated in a fashion different from the course of development in Tiara, but he gives no description of the process. Another feature which may prove distinctive is the fact that in Turris the glandular diverticulae of the radial canals are much more highly developed, and more complex than they have been described in any species of Tiara. Indeed, they may closely resemble the condition figured by Maas (: 04^c, pl. **2**, fig. *10*) for *Catablema vesicaria* A. Agassiz. Turris is easily distinguishable from Catablema by the form of the gonads.

The present collection contains a single specimen of Turris. On general principles I am strongly averse to basing a new species on one specimen; but in the present case it is justified, inasmuch as the specimen in question differs in several important particulars from either of the two known Pacific species, *T. pelagica* Agassiz and Mayer (: 02), and *T. brevicornis* Murbach and Shearer (: 03), as well as from the Atlantic species. It is especially interesting from the possession of ectodermic pits apparently of a sensory nature.

Turris fontata, sp. nov.

Plate 39, fig. *8;* Plate 42, figs. *5–11.*

Station 4576; surface; 1 specimen in excellent condition.

The single specimen is 22 mm. high; and the complexity of the gonads and great size of the ova make probable that it is close to maturity. The bell is of the outline usual in the genus, being high; with a low rounded apical projection; gelatinous substance thin.

Tentacles. — There are sixteen large, five intermediate, and about forty very small tentacles. The latter show all gradations from mere knobs to tentacles with developed filaments (Pl. **42**, fig. *6*), and the intermediate tentacles connect them with the fully developed stage. The large tentacles arise from large basal bulbs which are laterally compressed (Pl. **42**, figs. *6*, *11*), and bear distinct spurs which curve over the exumbrella surface of the bell margin (Pl. **42**, fig. *11*). On the outer surface of each bulb is an opening connecting the cavity of the tentacle with the exterior (Pl. **42**, fig. *11* os.). At first I thought that these openings were accidental tears or punctures; but finding that they occurred on all the large tentacles, I prepared several series of longitudinal sections of tentacular bulbs, the study of which has convinced me that they are perfectly normal structures. Such a section (Pl. **42**, fig. *7*) shows that at the margin of the opening the ectoderm and endoderm are continuous, so that it does not present at all the appearance of an accidental tear. So far as I can learn, such ostia have not previously been described.

Ocelli. — It is questionable whether the pigment spots in this species can fairly be called ocelli, since they are clusters of separate granules rather than discrete spots. They are present on the bases of the rudimentary tentacles but absent from the large ones. In two tentacles of intermediate size, in which very small openings have broken through in the region of the spots, the pigment granules are scattered on either side of the slit-like opening; and it is possible that their absence from the large tentacles is the result of such a scattering accompanying the further development of the ostia. If this be true, then we might look forward to a stage in which, with the growth of all the rudimentary into large tentacles, there would be no pigment spots; but from the advanced condition of the specimen I think it improbable that such a growth of all the rudimentary tentacles would take place.

Sense pits. — The ectodermal pits (Pl. **42**, figs. *9*, *10*), to which, on account of their resemblance to the sensory pits of many Acraspeda, I attribute a sensory function, lie on the exumbrella surface, near the margin, usually one just above the basal spur of each of the large tentacles (Pl. **42**, fig. *6*, s.). Several tentacles, however, do not have them. Structurally they are simple pits, lined with ectodermic bristle cells (Pl. **42**, fig. *10*). I have not been able to find any similar organs described in any other Craspedotae. In many Acraspeda, however, as is well known, similar pits occur, on the exumbrella near the bases of the rhopalia, an example being figured in the present memoir for *Poralia rufescens* (Pl. **13**, figs. *4*, *5*).

The manubrium is long; the lips folded and crenulated in an extremely complex manner. The radial canals bear glandular diverticulae throughout their length; these diverticulae (Pl. **42**, fig. *5*) may or may not be branched, as Hartlaub ('92) has described them for *T. coeca.* The circular canal bears no diverticulae, though its margin is somewhat jagged (Pl. **42**, fig. *5*). The canals are very deep basally, their inner faces being connected in the perradii with the walls of the manubrium. It was this conformation of the canals in various Tiaridae which was responsible for Haeckel's description of mesenteries; his interpretation was shown by Vanhöffen ('91) and by Hartlaub ('92) to be erroneous.

Gonads. — The gonads are typical of the genus. Each consists (Pl. **39**, fig. *8*) of two adradial series of transverse folds, often subdivided into two hree, or even more minor folds; the two series are connected in the interradii, throughout their length by a scattered development of ova, and at the base of the manubrium by a series of irregular folds. In the perradii, the two adjacent series of folds are closely in contact, but separated by a narrow zone in which no ova are developed. They thus closely resemble, except for rather greater complexity and irregularity, the description and figure given by Hartlaub ('92) of the sexual organs in the Mediterranean and Atlantic *T. coeca.*

Color. — In life the gonads were deep orange; manubrium and tentacles pale ochre yellow; bell bluish, hyaline.

All members of the genus Turris are closely allied. *T. fontata* in general closely resembles both of the Pacific species, *T. pelagica* and *T. brevicornis*, yet is distinguishable by several characters. It differs from both in its greater development of glandular diverticulae of the radial canals, and in the fact that these are often branched, for though diverticulae are described for both *T. pelagica* (Agassiz and Mayer, : 02) and *T. brevicornis* (Murbach and Shearer, : 03), in both they are short and simple. From both, moreover, it differs in the marginal organs and in color. *T. pelagica* and *T. brevicornis* have all the tentacles alike; and although it is true that the present species might perhaps arrive at such a condition, did its growth and that of the rudimentary tentacles continue far enough, yet we have no right to assume that this is the case in view of the advanced condition of its gonads. The presence of pigment spots at the bases of the rudimentary tentacles, even if not of distinct ocelli, is a further characteristic feature, although we must bear in mind that did all the rudimentary bulbs develop into tentacles these pigment spots would probably be lost. Furthermore, and most important, in no other species of the genus have tentacular ostia or exumbral sense-pits been described. The nearest ally appears to be the Atlantic species *T. coeca*, of which Hartlaub ('92) has given an excellent account.

Bythotiaridae Maas, 1905.

sens. em.

In 1905 Maas described, from the collections of the "Siboga" expedition, the new genus Sibogita, for a single specimen of a new species related, in tentacle structure, to the Tiaridae, but, like Bythotiara Guenther (:03), apparently having branched canals. In the present collection there are two specimens which very closely resemble Sibogita in general form and structure of bell margin, gonads and manubrium, but which differ from the type of that genus in the structure of the canals. These are not branched, but in addition to the four radial canals there are eight blind adradial canals extending from the margin centripetally almost to the apex of the bell. Fortunately both specimens show this feature so clearly that it is easily demonstrable by photography. Dr. Maas, on examination, pronounced these specimens at least generically distinct from his Sibogita, and suggested that they might be the adult of his provisional genus Heterotiara; but the discovery, in the present collection, of adult specimens of the latter genus resembling his original account of Heterotiara in all characters, except those of growth, renders that solution improbable. It seemed to me so unlikely that the close general resemblance between the present specimens and Sibogita could be connected with generic difference that I was in doubt as to what disposition to make of them when I received from the United States National Museum a specimen which threw an entirely new light on the question. This specimen, which is more advanced than those collected by the "Albatross," though less so than the single "Siboga" specimen, seems to show that the appearance which led Maas to conclude that the canals are branched is *not the primary one;* but is secondarily induced by a union of the blind canals with the four arms of the cruciform base of the manubrium by further centripetal growth. If the canals of Sibogita are not primarily branched, we must either remove it from the Bythotiaridae or modify Maas's (:05) diagnosis of that family. Of the two courses the latter seems to me preferable, inasmuch as Sibogita so closely resembles both Bythotiara Guenther and Heterotiara, in the permanently interradial location of its gonads, the structure of the bell margin, the hollow tentacles, and the absence of tentacular bulbs, that there is good reason to believe that the three genera form a natural association. Furthermore it may be pointed out that it is unwise to lay much weight on the supposed branching of the canals in Bythotiara, since there is a possibility of the same explanation there as in Sibogita. Bythotiara, like Sibogita, was founded for a single specimen, and, so far as I am aware, has not been recorded since. Dichotomia Brooks and Netocertoides Mayer (: 00^b) probably belong to this family, although in the former the structure of the gonads more nearly resembles that in *Amphinema turrida* and *A. octaedra.*

The closest relationship of the Bathytiaridae is undoubtedly with the Tiaridae: but they are easily distinguished from 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 Tiaridae; by the structure of the bell margin; and by the fact that the tentacles have no distinct bulbs or ocelli.

Sibogita Maas, 1905.

sens. em.

Bythotiaridae with four primary radial canals, and, in addition, with twelve (or more) centripetal canals, which secondarily come to join the cruciform base of the stomach; gonads transversely folded; bell laterally flattened.

Although the specimens are undoubtedly congeneric with Sibogita, I question their specific identity with *S. geometrica* Maas, since the chief difference between the two, order of development of canals and tentacles, is probably not to be explained as caused by differences in growth. It is unfortunate that the series of this genus so far examined have been so small; and for that reason final decision is still uncertain; but on the whole it seems best to institute a new species for the three "Albatross" specimens.

Sibogita simulans, sp. nov.

Plate 5, figs. *4*, *5*, Type; Plate 41, figs. *8*, *9*; Plate 43, figs. *1*, *2*.

Station 4635; surface; 2 specimens.

Also one specimen, from the United States National Museum, collected by the "Albatross" in Behring Sea, at Station 3325, in 121 fathoms of water.

Size. — Both the specimens in the present collection are of about the same dimensions, measuring about 30 mm. in height by 22 mm. in greatest diameter. One is perfect; in the other the manubrium is torn away.

The Behring Sea individual of about the same size is contracted, but is further advanced, as is shown by the condition of the gonads.

The bell is high, the gelatinous substance thick at the apex, but without apical projection. As in *S. geometrica* (Maas : 05) the bell in all three specimens is laterally flattened so that one diameter is much greater than the other (Pl. **5**, fig. *5*).

The manubrium is barrel-shaped; readily separable into basal, gastric, and labial portions (Pl. **43**, fig. *1*). It is about one third as long as the bell cavity is deep. Its base is cruciform, an outline particularly pronounced in the Behring Sea specimen (fig. *2*), with its four arms passing gradually into the four radial canals, as Maas has noted (: 05, p. 17).

Canal system. — In the two younger specimens there are, in addition to the four radial canals, eight adradial blind canals which extend centripetally from the ring canal almost to the base of the manubrium. Their blind terminations are clearly visible in the photograph of an oral view (Pl. **5**, fig. *5*). Owing to the excellent condition of both specimens this important feature could be demonstrated beyond question. The adradial, like the radial canals, have no diverticulae, nor are they branched. However, one of the blind canals showed an irregularity in being connected with the neighboring radial canal by a transverse bridge.

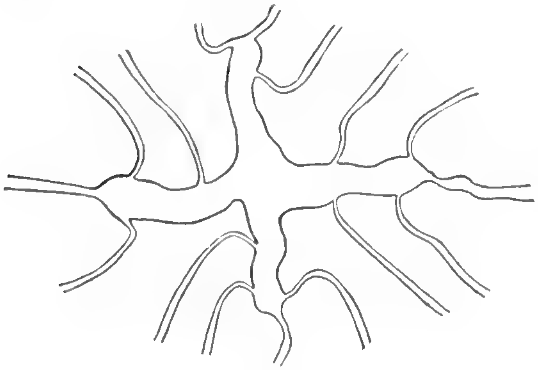

FIG. 2.

In the older specimen, from Behring Sea, the condition of the canals more nearly suggests that described by Maas (: 05). In place of ending blindly, the adradial canals now connect with the four arms of the cruciform basis of the manubrium (fig. *2*). They have increased in number to twelve and are somewhat irregularly arranged. None of them are branched. When taken in connection with the conditions in the younger specimens in which the adradial canals end blindly, it is evident that the adult state results from a union of the blind canals with the manubrium caused by further centripetal growth; this view is supported by the fact that all the adradial canals are narrowest at the point of union with the stomach. There seems no objection to this explanation; for if the growth of the blind canals takes place far enough they can do nothing except come into contact with the manubrium; and in the case of one of the canals of one of the younger specimens the growth requisite to cause such a union would be less than .5 mm.

In the "Siboga" specimen of *S. geometrica* there were thirty-two canals; of which sixteen of the smallest join the other canals, radial and adradial, at varying heights, instead of reaching the base of the manubrium. Their condition is probably the result of the centripetal growth of blind canals; but whether this is the case cannot be determined except from study of immature specimens.

Tentacles. — In each of the two young specimens there are twelve tentacles, one opposite each of the canals, radial or blind. In the older specimen there are thirty, one opposite each of the sixteen canals; the others arranged somewhat irregularly between the canals. In *S. geometrica*, notwithstanding the larger number of canals, there were only sixteen tentacles. In structure the tentacles, which are hollow, long, flexible, and tipped with nematocyst clusters (Pl. **41**, fig. *9*), agree closely with those of *S. geometrica.* They have no basal bulbs (Pl. **43**, fig. *2*), nor is there any pigment in their bases. As in *S. geometrica,* they arise from the exumbrella some little distance above the margin, — a feature seen also in Heterotiara. Connected with the prolongation of the gelatinous substance of the exumbrella beyond the level at which the tentacles arise is a slight lobing, alternating with the tentacles (Pl. **43**, fig. *2*), and as this was seen in life as well as in the preserved specimens it is probably a normal feature.

Gonads. — The four gonads are permanently interradial, and, as in Heterotiara (p. 217), entirely discontinuous in the perradii. They are confined to the walls of the manubrium, and each, as already described by Maas (: 05^a), consists of a double series of regular transverse folds (Pl. **43**, fig. *1*). In the Behring Sea specimen they are very large.

Color. — In life the gonads were reddish brown, the bell faintly tinged with blue.

The capture of the two Eastern Tropical Pacific specimens on the surface shows that this genus is not so purely intermediate as Maas (: 05) supposed.

Unfortunately the label on the Behring Sea specimen gives no information as to the depth from which it was taken, but at the station where it was captured the depth is only 121 fathoms. If the surface is its usual habitat, and its occurrence there not merely sporadic, its horizontal range is remarkable in extending from tropical to cold waters.

Heterotiara Maas, 1905.

sens. em.

Bythotiaridae with four simple radial canals; with only short blind canals if any; gonads purely interradial, without tranverse folds.

The collection contains two specimens which agree very closely with the provisional genus Heterotiara proposed by Maas (: 05) to include a single immature specimen in the "Siboga" collection. In this specimen the four canals were unbranched; but Maas has suggested that inasmuch as the gonads were but slightly developed, branching might later appear. Since the present specimens, both of which are sexually mature, have unbranched canals, it is evident that in Heterotiara the simple condition of these structures is permanent. Neither are there any blind centripetal canals, such as are developed in Sibogita.

The true specific relationship between the present and the "Siboga" specimens is hard to determine, because of the immaturity of the latter; but inasmuch as the differences between the two appears no greater than can be readily accounted for as due either to individual variation, or to differences in the stages of growth, I include the present specimens under Maas's species *H. anonyma.*

Heterotiara anonyma Maas.

Heterotiara anonyma Maas, :05, p. 19, taf. 3, figs. *19-21.*

Plate 41, figs. *12, 13.*

Station 4650; 300 fathoms to surface; 1 specimen.

Station 4652; 400 fathoms to surface; 1 specimen.

The two specimens are of about the same size, 22 mm. high by 20 mm. broad, and both are in fair condition. As in the "Siboga" specimen the bell is high, the gelatinous substance thick at the apex; but there is no apical projection.

Tentacles. — In one specimen there are eleven tentacles, in the other twelve (Pl. **41**, fig. *12*), four radial and eight adradial. In the "Siboga" specimen Maas (: 05) records eight tentacles, four radial and four interradial; but as he had only a single specimen it is by no means safe to assume that eight was the final number. On the contrary, in view of the variation in number in the two specimens in the present collection it is probable that with further growth more tentacles would have been formed. The tentacles are long (not broken off as Maas found them), hollow, and flexible. There are no distinct basal bulbs.

As in Sibogita, the gelatinous substance of the bell margin extends outward and partially encloses the tentacle bases; a similar condition is described and figured by Maas (: 05^e) for Heterotiara. Maas has mentioned endodermic pigment at the bases of the tentacles; but none was to be distinguished in the "Albatross" specimens, perhaps on account of their condition or preservation.

Manubrium. — The manubrium, as noted by Maas, is very different from that of Tiara and more nearly resembles the condition in the Leptomedusae. In both specimens it is barrel-shaped; in one hanging to the bell opening, in the other contracted; it is seated directly on the subumbrella surface, without peduncle. The mouth is quadrate and surrounded by simple lips.

The vascular system consists of four broad unbranched radial canals, and of the ring canal. In one specimen there appears to be a rudimentary triangular centripetal canal, such as is described by Maas (: 05, p. 19, taf. 3, fig. *20*), opposite one of the adradial tentacles; but the condition of the margin is such that it is impossible to make certain whether this structure is really a canal or not.

Gonads. — The permanently interradial location of the gonads is one of the strongest reasons for classing this genus in the Bythotiaridae in spite of the simplicity of the canal system. They are entirely discontinuous in the perradii and limited entirely to the manubrium. They have no definite transverse folds, such as are characteristic of Sibogita. Both specimens are females, with ova so large that they are visible even to the unassisted eye.

Color. — In both specimens the gonads were opaque yellowish; otherwise they were colorless.

The main differences between the "Albatross" and the "Siboga" specimens, apart from the more advanced condition of the gonads in the former, are that the former have eleven or twelve tentacles, the latter only eight, and that the latter are considerably the larger. The number of tentacles, when differing so little, as pointed out above, cannot be made the basis of specific separation on the scanty evidence afforded by only four specimens; and size, except when proved to be constant in large series, is even more unreliable, being a character subject to great variation in Medusae. As an example of its variability I need only refer to the well-known case of *Cyanea arctica.*

The present captures, from between 300 and 400 fathoms and the surface, and that of the "Siboga" specimen from between about 475 fathoms and the surface, show that Heterotiara is an intermediate form. Its horizontal range is extended by the "Albatross" from the Malay Archipelago to the Humboldt Current.

Williidae Forbes, 1848.

sens. em. Browne ('96, : 04).

Hydrolaridae Allman, 1872.

Anthomedusae with either four or six branched radial canals; tentacles solid; manubrium highly developed, separable into basal, gastric, and oral portions, as among Leptomedusae; with exumbral nettle strands.

We owe to Browne ('96) the knowledge of the hydroid of *Willia stellata*, and also the demonstration, from a study of sections, that the gonads belong to the walls of the manubrium, not to the radial canals, and that the family therefore belongs to the Anthomedusae, not to the Leptomedusae as Haeckel ('79) supposed. According to both Browne (: 04) and Maas (: 05) two genera are to be distinguished in this family: — Willia with six, Proboscidactyla with four, main radial canals. The present collection contains examples of the latter only.

Proboscidactyla Brandt, 1838.

sens. em. Browne, : 04; Maas, : 05.

Williidae, with four main radial canals.

The specimens of this genus in the collection appear to represent the sexual stage of the form described by Maas (: 05) as *P. flavicirrata*, var. *stolonifera*, which is no doubt the *P.* species of Huxley, for which Browne (: 04) has proposed the name *P. tropica.* I cannot agree with Maas (: 05) that this form is a variety of *P. flavicirrata* Brandt, because the type of branching of the radial canals in the two species is very different, as has been already pointed out by Browne (: 04). In *P. flavicirrata* the final number of canals and tentacles is very great (up to seventy-two); on the other hand, in the present series, in sexually mature specimens, the maximum is nineteen, and Maas (: 05, p. 21) has recorded a maximum of eighteen or more for the "Siboga" specimens. In both mode of branching and number of radial canals they closely resemble *P. ornata* McCrady, the common representative of the genus on the Atlantic coast of North America, of which the *P. gemmifera* of Fewkes and of Mayer is beyond question merely the budding stage. Maas, it is true, has maintained that a different location of the medusa-bearing stolons separates Atlantic from Pacific species, they being more proximal in the former, more distal in the latter, though in both occurring either on stomach wall or canals; but this character is variable in *P. ornata,* while in the Pacific variety Huxley ('77) found them at the *first,* Maas (: 05) at the *second,* branching of the radial canals. It seems to me, therefore, that this character is of much less systematic importance than the mode of branching of the canals, which, though more or less variable, follows two fundamentally different types in *P. ornata* and *P. flavicirrata.*

In studying the present series I was fortunate enough to have at hand for comparison numerous specimens of *P. ornata,* and also one of A. Agassiz's ('65) specimens of *P. flavicirrata,* which, in spite of its age, is still in fair condition. The conclusion I have reached is that the present series is hardly to be distinguished from *P. ornata,* except that the growth of the gonads and the multiplication of the tentacles progresses rather further in the Pacific than it normally does in the Atlantic species. I have been unable to find a single characteristic, except that of budding, to separate it from Maas's variety *P. stolonifera.* In type of branching of the canals, number of the tentacles, arrangement of the exumbral nettle ridges, form, and size they are indistinguishable. I have, therefore, no hesitation in maintaining that they both represent two stages in the life history of one form, which is a variety of *P. ornata,* not of *P. flavicirrata.* It seems to me that the question of geographic distribution has no force as an argument against this conclusion, because, as Maas (: 05, p. 20) has pointed out, the occurrence of budding practically puts this genus, like Cytaeis, in the same class with the holoplanktonic forms in so far as its dispersal is concerned, and it is therefore in no way remarkable to find close allies in both the Atlantic and the Pacific.

Proboscidactyla ornata McCrady var. **stolonifera** Maas.

Willsia ornata McCrady, '57, p. 149, pl. 9, figs. *9–11*.
Willia ornata A. Agassiz, '65, p. 177, figs. *174 a–279 ;* Fewkes, '82^b, p. 299, figs. *22–24*.
Willetta ornata Haeckel, '79, p. 157.
Discannota dysdipleura Haeckel, '79, p. 152.
Proboscydactyla ornata Browne, : 04, p. 726.
Proboscydactyla flavicirrata var. **stolonifera** Maas, : 05, p. 21, taf. 4, figs. *24–28*.
Proboscydactyla tropica Browne, : 04, p. 727.
Willia occidentalis Fewkes, '89^b, p. 109, pl. 5, fig. *3*.
Proboscydactyla varians Browne : 04, p. 728, pl. 54, figs. *1, 2*.

Plate 6, Figs. *1, 2;* Plate 41, Figs. *1–7*.

Acapulco Harbor; surface; many specimens, 2.5–5 mm. in diameter.

There has likewise been available for comparison a series of excellently preserved specimens of *P. ornata* from Newport, R. I. Specimens from 2.5–3 mm. in diameter are indistinguishable from the Newport series, the extent of the gonads, and the number of canals and tentacles (12–16), as well as the mode of branching of the canals being the same in both forms. So far as I can learn sixteen is the normal limit to the number of canals and tentacles in the Atlantic *P. ornata;* many of the Acapulco specimens, however, have seventeen, eighteen, or even nineteen tentacles, and the same is true, according to Maas (: 05) of the "Siboga" specimens. And since these numbers were counted in the largest specimens (4.5 mm. in diameter) it is fair to assume that this increase is normal for the Pacific race. Such an increase would not be at all surprising as a variation in *P. ornata*, since exactly this same type of variation has been described by Browne ('97) for the European *Willia stellata;* but I have been unable to find any evidence that it actually occurs in *P. ornata* from the Atlantic.

The only other difference (except in size) between the present series and *P. ornata* is afforded by the gonads. In Atlantic specimens the limit of development of these organs appears to be a stage in which they have extended from the gastric wall outward along the line of the radial canals nearly to the first bifurcation of the latter. This stage, however, seen in *P. ornata* var. *stolonifera* of about 3 mm., is not the final one in that form, for with the further growth of the Medusa the sexual organs extend further, until they not only reach the division of the canals, but even pass beyond it, so that finally a portion of the gonad comes to lie in each of the four angles formed by the branching of the canals (Pl. **41**, fig. *4*).

The mode of branching of the canals agrees closely with that described for *P. ornata*, the resemblance to McCrady's figure being extremely close, and it is the same as has been described by Maas (: 05). Each of the four radial canals bifurcates about one-fourth of the distance from its origin to the margin. This condition, with eight tentacles opposite the eight canals, is seen in specimens in which gonads have not yet appeared. The eight canals thus formed branch then again, the second bifurcation being the locality where stolons occur in the specimens described by Maas (: 05). This is the normal limit to the branching in the Atlantic *P. ornata*. But in *P. ornata* var. *stolonifera* most of the larger specimens have the canals still further subdivided, in the manner shown diagrammatically (Pl. **41**, fig. 7). This is a very different type of branching from that exhibited by *P. flavicirrata* Brandt, from the northwest coast of North America, in which each radial canal branches once dichotomously, each of the two resulting canals sending off numerous lateral branches from one side only (Brandt, '38; A. Agassiz, '65).

Color. — In life the gonads and tentacle bases are usually pale green; other portions are colorless; some specimens however are entirely without color.

Proboscydactyla ornata has been recorded only from the Atlantic coast of North America, where its range is known to extend from the West Indies to Cape Cod. The variety *stolonifera* was described by Maas from the Malaysian region, and Huxley's specimen was taken in the Louisiade Archipelago. Together with the present captures these records show that it is very generally distributed over the Tropical Pacific. In the colder regions of the north Pacific its place is taken by the much larger *P. flavicirrata.*

GEOGRAPHICAL DISTRIBUTION.

The oceanic region traversed by the "Albatross" in 1904–05 is of great interest to the student of zoogeography, for two reasons. In the first place, it is bounded on one side by the great Humboldt, or Chili-Peruvian, Current; a current of much lower temperature than the adjacent regions, and comparable in size, in volume, and in regularity of flow to the Gulf Stream, to the Guinea, the Benguela, or to the Japanese Current. In the second place, it is one of the largest uninterrupted oceanic areas on the globe, so that here, if anywhere, we might expect to find the pelagic fauna unaffected by the disturbing elements, such as vertical circulation of water, food supply, and the like, which are associated with every coast line, no matter how abrupt it may be.

I cannot pass over without mention the extraordinary richness of the Humboldt Current in pelagic life of all kinds; a richness which has already been noted in the account of the general oceanographic features of the Eastern Tropical Pacific by its leader, who speaks of "such masses of Salpae, of Cytaeis, or Cymbulia, or swarms of other pelagic animals as to make a thick soup" (A. Agassiz, :06, p. 15), and of enormous quantities of copepods, schizopods, Doliolum, and Medusae. Nor can I omit to recall the discovery, immediately to the west and southwest of the Current, of an area as barren in all forms of life, bottom as well as pelagic, as the latter is rich. Thus "As soon as we ran outside of this [the Humboldt Current] the character of the surface fauna changed; it became less and less abundant as we made our way to Easter Island, the western half of the line from Callao becoming gradually barren" (A. Agassiz, :06, p. 9). On entering the Current again from the barren area the reverse change was equally striking. Thus, to quote further: — "The pelagic and intermediate fauna from Easter Island to 12° south latitude was very poor, and the serial temperatures show that we were outside and to the westward of the great Humboldt current. But near the 12th degree of southern latitude a sudden change took place; the pelagic and intermediate fauna became quite abundant again and soon fully as rich as at any time in the Humboldt current. There was also a marked change in the temperature of the water as indicated by the serials, showing that from the 12th degree of southern latitude to the Galapagos we were cutting across the western part of the Humboldt current" (A. Agassiz, :06, p. 9).

The surface holoplanktonic Medusae in their quantitative distribution well illustrate the general conditions thus outlined. Several species of this group were so regularly taken that the Expedition may be said to have given a comprehensive survey of their occurrence in the region traversed, and the captures of four of these, which may be taken as typical of the group, *Liriope tetraphylla*, *Rhopalonema velatum*, *Aglaura hemistoma*, and *Cytaeis vulgaris*, are graphically indicated on the chart, Plate **47.** All of these species occurred on all the lines, both within the Current and in the barren area, while all but *Cytaeis vulgaris* were likewise taken off the west coast of Mexico, and in the Gulf of Panama. I should mention that the small number of records on the passage from Manga Reva to Acapulco is due to the fact, already mentioned by Agassiz (: 06, p. x), that unfavorable weather prevented making many hauls on this line. Though none of the species was lacking in the barren area, yet all occurred more regularly in the Current. The difference in mass of individuals of the various species, taken within and outside the Current, was quite as striking in the case of the Medusae as of other pelagic organisms. While within its sweep Liriope, Rhopalonema, and Cytaeis occurred in swarms on several occasions, and while the nets invariably yielded many specimens of other species of Medusae, ctenophores, and siphonophores, to the westward of the Current but few living Medusae were taken, the hauls containing, instead of perhaps several hundred individuals, not more than five or ten specimens of living acalephs of all kinds. On the other hand, in the barren area considerable numbers of dead Medusae as well as dead animal detritus of other kinds were taken (A. Agassiz, : 06).

This decrease, though most sudden along the zone indicated by the serial temperatures as the margin of the Current, progressed steadily to the westward, the region surrounding Easter Island being the poorest. Indeed in this neighborhood several successive surface hauls yielded no Medusae at all, something that did not happen elsewhere during the Expedition.

The intermediate Medusae show the same quantitative decrease from east to west as do the surface species, but in much more extreme fashion. On the chart, Plate **48**, is represented the occurrence of six of the commoner species: — *Halicreas papillosum*, *Atolla wyvillei*, *Periphylla hyacinthina*, *Crossota brunnea*, *Colobonema typicum*, and *Ptychogena erythrogonon*. To these *Nausithoë rubra*, *Homoenema alba*, and *Aeginura grimaldii* might be added without altering the general import. Although none of these intermediate species were taken so regularly as were several of the surface forms, yet all, except *Ptychogena erythrogonon* which was restricted to the neighborhood of the Peruvian coast, occurred frequently on all our lines so long as we were within the sweep of the Current, both in its north and south course and in its westward extension; but, as is shown on the chart, there is no record of a single individual of any of these species in the barren area to the westward of the fairly well-defined outer limit of the Current. This lack is especially striking in the case of *Halicreas papillosum*, inasmuch as this species, in the regularity of its occurrence, occupies among the intermediate forms the same position that *Liriope tetraphylla* and *Rhopalonema velatum* do among the surface species. We have no right, however, to assume that this disappearance is absolute, the evidence afforded by hauls one hundred and fifty miles apart being far too scanty to warrant such a conclusion. On the contrary, it is hardly conceivable that some or all of these species do not occasionally occur in the barren area as does *Tetrorchis erythrogaster;* and even with this reservation, the difference in degree, if not in kind, between the gradual east-west diminution of the surface forms, and this sudden disappearance of the common intermediate species, is as striking as it is unexpected.

The occurrence of the holoplanktonic surface Medusae is about what might be expected in any oceanic region traversed by a well-marked ocean current. Indeed a very similar diminution in number of individuals is constantly to be seen on leaving the Gulf Stream; but to account for the conditions which obtain in the distribution of the intermediate Medusae is by no means easy.

I must confess that I have been unable to find any satisfactory explanation for the apparent limit to their westward dispersal. This limit, I might add, is more or less effective not only in the case of Medusae, but of the bathypelagic fauna as a whole; for in all classes of organisms the diminution, whether or not approaching total disappearance, was much more sudden among the intermediate than among the surface forms. Furthermore, comparison with chart 3^c of the general report of the Expedition (A. Agassiz, :06) shows that the line of disappearance of the intermediate Medusae coincides almost exactly with the line of southern limit of good trawl hauls, so that it appears that, as might be expected, this quantitative diminution is not limited to the pelagic fauna alone, but holds true also for the bottom species, which depend ultimately upon the pelagic fauna and flora for their food supply. Temperature, so frequently a barrier to the dispersal of marine organisms, offers no satisfactory explanation of the present case. For although the surface temperature showed a very wide range from the coast westward, the extremes observed being 65° and 82°, below the depth to which the diurnal warming of the sun may be expected to penetrate (say 50 fathoms), the temperatures were remarkably uniform throughout the entire area traversed during the cruise. Thus at 200 fathoms the extremes of temperature recorded are 56.7° and 48.5°, a range of 8.2°; at 300 fathoms, 48.2° and 42.7°, a range of 5.5° (omitting one record of 53.2°, due no doubt to some local disturbance); while at 400 fathoms, with extremes of 42.5° and 41.9°, there was a range of only .6° (A. Agassiz, : 06, p. 24). Furthermore, even these slight variations were fluctuating, and not in any way connected with the line of faunal diminution. Another factor which must be considered is salinity. But it is unlikely that this is any more important than temperature in the present connection; for although the density decreases with the increase in surface temperature from the South American coast westward, this decrease is extremely gradual and without any sudden changes. And it is well known that many Medusae, for example Aurelia and Gonionemus, can undergo much greater fluctuations in salinity without suffering the slightest ill effects.

The question of food supply is no doubt effective in checking the increase of intermediate organisms in the barren area; for the surface fauna and flora are quantitatively much less abundant here than within the Humboldt Current. But since the diminution in the food supply is gradual, it cannot explain the much more sudden and extreme diminution of the intermediate fauna. On the contrary, the abundance of dead animal and plant detritus (belonging for the most part to surface forms) taken in the intermediate nets far beyond the limit of abundance of the intermediate fauna, compared with the absence of such material within the Current where the latter is abundant, suggests in a striking way that it is not scarcity of food that limits the effective barrier, but that the food supply outside the Current is more than sufficient for the few intermediate organisms which occur there.

It has been suggested to me that variations in the degree of oxygenation of the sea-water might be a more important factor in the ecology of the intermediate fauna than has generally been supposed. Our actual knowledge of the gaseous content of the deeper waters of truly oceanic areas is, on account of the difficulty of working on shipboard, still so limited that the suggestion may be worth consideration. On theoretic grounds it would seem not unlikely that vertical circulation must be much more active in regions where the water is in constant horizontal motion, on account of the much greater disturbance of the surface layer caused by storms in such regions; and that such overturning must favor the absorption of oxygen in oceanic regions just as it does in fresh-water rivers. It is most unlikely, however, that the slight fluctuations which might thus be produced could influence the distribution of Medusae when we consider what extensive changes in oxygenation several genera of Medusae undergo in their normal habitat.

One of the more important features of the collection is the support which it affords to the theory, urged particularly by Chun and by Vanhöffen, of the unity of the holoplanktonic fauna in the warmer regions of all oceans. Thus, in part through new records and in part as the result of fresh identification of long known forms made possible by better material, the ranges of *Rhopalonema velatum, Aglaura hemistoma, Liriope tetraphylla, Solmundella bitentaculata, Cunoctantha octonaria,* and *Eirene viridula* are extended to the Eastern Pacific; and since all of these were previously known from both the Atlantic and the Indian oceans, their occurrence in the tropical regions of all oceans is now demonstrated. Equally extended are the geographic ranges of *Geryonia proboscidalis,* and probably of *Pegantha triloba* and *Solmissus incisa,* while *Nausithoë punctata,* found in Arctic as well as temperate and tropical waters, is even more widely dispersed. *Solmissus marshalli* may eventually prove to belong to the Atlantic as well as to the Pacific when its specific relationship to its close Mediterranean ally *S. albescens* is better understood. *Pegantha martagon* is so far known only from the Pacific and Indian oceans and from the China Sea; but it is not unlikely that its range may be further extended. As to the ranges of the four new species of Narcomedusae, which may naturally be expected to be widely dispersed, nothing can be said as yet.

The ranges of the following intermediate forms are likewise extended to the Pacific: — *Periphyllopsis braueri, Aeginura grimaldii, Crossota brunnea, Homoeonema alba, Halicreas papillosum, Colobonema sericeum, Rhopalonema funerarium,* and *Nausithoë rubra.* *Atolla wyvillii* has not previously been recorded under this name from this region; but at least one of the Pacific records of *A. alexandri* belong to this species (p. 39).

Many of the intermediate Medusae are much more widely distributed than most of the surface forms, *Periphylla, Crossota,* and *Homoeonema* extending from the tropics to the Arctic (or Antarctic) regions in all oceans. This phenomenon is no doubt correlated with the freedom of the intermediate zone from the violent changes in temperature which limit the migration of the great majority of surface animals. Thus the temperature range at 300 fathoms in all oceanic areas is much smaller than that occupied by certain holoplanktonic surface Medusae, for example, *Rhopalonema velatum* and *Liriope tetraphylla,* both of which were found in temperatures of from 64° to 82° on the present Expedition.

Although the tendency of modern study is to show that the great majority of intermediate Medusae are practically universal in oceanic regions, yet there is reason to believe that some few may be local, or even littoral. A case in point is *Ptychogena erythrogonon.* This species was taken only in a restricted area off the coast of Peru, and although fairly common, never at any great distance from the land. In all probability, judging from analogy with its natural allies, the species passes through a hydroid stage; and if this be the case it is probably the hydroid, not the medusa, which is the factor limiting its dispersal.

Apart from the undoubted holoplanktonic forms but few species of Hydromedusae were taken during the oceanic portion of the cruise, the only species which can be classed here, under the supposition that they pass through a fixed hydroid stage, being *Tiara papua, Aequorea macrodactylum, Aequorea coerulescens, Eirene viridula, Purena brownei, Gonionemus suvaensis,* and *Olindias singularis.* All of these were previously known from the Pacific or from the Indian ocean, or from both; none however, except *Eirene viridula,* are as yet known certainly from the Atlantic, although all are represented there by close allies.

The collection made in Acapulco Harbor is most instructive on account of the affinities of its members; for of the fifteen species previously known, excluding the holoplanktonic genera Liriope, Aglaura, Solmundella, and Cunoctantha, only seven were previously recorded from either the Pacific or Indian oceans alone; one, *Proboscydactyla ornata,* is known in its two varieties from both Indian and Atlantic oceans; while no less than seven species, *Ectopleura ochracea, Phialidium discoida, Phialium duodecimalis, Amphinema turrida, Amphinema australis, Lymnorea alexandri,* and (probably) *Zanclea gemmosa,* are known from the Atlantic alone. Furthermore, all of these Atlantic forms, with the possible exception of *Ectopleura ochracea,* are, so far as we yet know, limited to the western coast of the Atlantic south of Cape Cod. And the same is true also of the Atlantic distribution of *Proboscydactyla ornata;* while *Stomotoca divisa,* not taken in Acapulco Harbor itself but off the coast of Mexico and in the Gulf of Panama, is so closely allied to the West Indian *S. pterophylla* as to be hardly separable from it (p. 202). Up to the present time our knowledge of the leptoline Medusa fauna of the tropical west coast of America, north or south, has been almost *nil;* while the same is true to-day of that of the east coast of Mexico, and of the north and northeast coasts of South America.

Mayer has already called attention to a resemblance between the leptoline fauna of the Fiji Islands and that of the Tortugas. In part his statement requires revision, as the claim to similarity is largely based on correspondence of genera; a correspondence mainly explicable on grounds of the close agreement between the physical features of these two groups of coral islands. But although the resemblance when analyzed proves to be less close than Mayer supposed, the fact remains that there are found in the Fiji Islands two species, *Halitiara formosa* and *Pandea violacea*, common in the West Indies but known neither from the Indian Ocean nor from the Pacific, until the capture of the latter species by the "Albatross" at Acapulco.

The affinity between the littoral faunae of the two sides of Central America is much closer in the case of the Medusae, and probably of the hydroids also (S. F. Clarke, '94, : 07), of which group several species occur both in the Gulf of Panama and in the Carribean, than in the higher groups of animals such as echinoderms and fishes, in which the parallelism, at first supposed to be one of species, has since been shown to be chiefly one of genera only (Verrill, '67; Agassiz, : 04; Jordan, : 08).

The facts of distribution disclosed by the "Albatross" expedition of 1904–1905 suggest that the Pacific, so far as its littoral Medusa fauna is concerned, is separable into two more or less clearly defined areas; its western half being closely connected to, if indeed at all separable from, the Malaysian region, a fact already known to be true for echinoderms, crustaceans (Ortmann), and for stony corals (Verrill, Vaughan); and its eastern shores on the other hand having a close affinity to the Gulf of Mexico and to the Tropical Atlantic. It would appear that although these two areas undoubtedly overlap, the broad oceanic belt separating the west coast of America on the one hand from Polynesia and the Hawaiian Islands on the other, has proved an effective barrier to the dispersal of many of the hydroid Medusae.

BATHYMETRIC RANGE.

The work of the recent deep-sea expeditions, American and European, has demonstrated that a considerable series of Medusae, both craspedote and acraspedote, undoubtedly belong to the intermediate depths. These species are often termed "deep sea," "Tiefsee," especially by the German investigators; but since this term is ambiguous from its common application to abyssal bottom animals, I prefer to adopt for such Medusae, as well as for other organisms of similar bathymetric occurrence, the term "intermediate."

Although it is now generally admitted that, in spite of occasional records of the sporadic appearance of such genera as Atolla and Periphylla on the surface, they are not normally surface forms, the question at what particular zone they are most abundant, or whether they are indifferently distributed from top to bottom, or even live just above the bottom, as recently suggested by Maas (:04^c), has not as yet been answered conclusively. In general two views have been held, though not, it is true, always clearly defined: first, that they belong for the most part to abyssal depths, as both Maas (:04^c, :05) and Vanhöffen (:02^a) have in general maintained; and secondly, that they reach their greatest abundance in the upper layers, between the surface and a depth of about 300 fathoms. Discussions of this question have, for the most part, been rather inadequate, due largely to the use of the much-abused term "deep sea," largely to differences of opinion as to what constitutes "great depths." And inasmuch as the location of the normal range of this group of organisms is of much interest in the general ecology of the intermediate fauna, a re-examination of the evidence, most of which unfortunately is indirect, is desirable.

In so far as concerns the occurrence of intermediate Medusae on the surface, it is to be noted that although both Atolla and Periphylla have been taken there, none of the recent exploring expeditions have captured any of this group on the surface, with the exception of one fragmentary specimen of *Halicreas papillosum* in the present collection, in spite of the great number of surface hauls which have been made both by day and by night; on the other hand, all recent expeditions have taken intermediate Medusae in considerable numbers in vertical and intermediate hauls. Probably, then, the occurrence of these genera at the surface is to be interpreted, not as an indication of their normal habitat, but as the manifestation of some such physical phenomenon as unusually violent vertical circulation of the water, or a peculiar condition of oceanic temperatures.

The most important direct evidence to show the exact depth from which individual specimens were taken is of course that afforded by closing-net hauls. Unfortunately, however, the captures of Medusae in such hauls have been comparatively few, the following being the only records which I have been able to find: — on the "Valdivia" expedition, so far as the results of Vanhöffen's researches are yet published, Medusae were taken but three times in closing nets; namely, one specimen of Periphylla at 810–540 fathoms (1,500–1,000 meters), one specimen of Colobonema at 810–485 fathoms

(1,500–900 meters), and *Rhopalonema velatum* at 165–105 fathoms (300–200 meters). The following captures are recorded by Browne (: 06), from the cruise of H. M. S. "Research" in the Bay of Biscay: — Periphylla, 400–300 fathoms, and *Atolla bairdii,* 1,500–750 fathoms. In addition to these two intermediate genera, one well-known surface form, *Aglantha rosea,* was also taken in eight closing-net hauls, as follows: — 150–50 fathoms, seven specimens; 200–100 fathoms, five specimens; 300–200 fathoms, one specimen; 500–400 fathoms, two specimens; 750–500 fathoms, 1 specimen, 1,000–500 fathoms, 1 specimen; 1,250–1,000 fathoms, one specimen. This was the commonest epiplanktonic species of the Expedition, and for this reason it is probable, as Fowler (: 06, p. 183) has suggested, that the deeper captures were merely dead specimens sinking to the bottom; the species, however, was apparently alive down to 100 fathoms. A large number of closing-net hauls have been made by the "Princess Alice," those containing Medusae from known depths (Maas, : 04^c) being 1,700 meters, Atolla and Agliscera; 300–350 meters, Phialidium; 800 meters, Periphylla; 1,000 meters, Periphylla; and 781 meters, Aeginura. During the "Albatross" expedition of 1904–05 the following closing-net captures were made: — at Station 4668 Tanner net towed, at 300 fathoms, Halitrephes and Rhopalonema, the latter too fragmentary for specific identification; Station 4672, Tanner net towed, at 400 fathoms, Aeginura, Atolla, Crossota, Aegina. Both the Chun-Petersen and Tanner nets were used on other occasions, but only in these two hauls were Medusae taken.

When these various closing-net hauls are analyzed it appears that they are not such strong evidence in favor of abyssal occurrence in truly oceanic areas as might at first be supposed. Thus, two of the "Princess Alice" captures, those of Periphylla from 800 and 1,000 meters were within the Mediterranean, an enclosed sea in which the temperature conditions are very different from those of oceanic regions; and the deepest haul, 1,700 meters (about 880 fathoms), was made only some fifty miles off the coast of Spain. More strictly oceanic is the record of Aeginura, from about 420 fathoms. Neither of the "Valdivia" records are from very great depths, and the greatest, Periphylla, from between 540 and 810 fathoms, is based on a specimen so fragmentary that it is questionable whether it was not dead and sinking at the time of capture. Both the "Albatross" records, one of which comprises the greatest number of different genera of Medusae yet taken in one haul of a closing net, are from moderate depths (300 and

400 fathoms). It is very desirable that more hauls be made with closing nets adapted to the capture of large organisms, many of those now in use being, as Apstein (: 06, p. 277) points out, unfitted for this purpose.

Next in value to closing-net hauls are serial hauls, based on the comparative method, with open tow-nets; that is, hauls from different depths made at one station at the same time or in immediate succession with nets of the same diameter and size of mesh. This method, owing to the amount of time necessary to carry it out, has seldom been used comprehensively. Far the most important instance, in the present connection, is afforded by the investigations of Murray ('99) in the North Atlantic. Though none of the typical intermediate Medusae were taken during this Expedition, *Aglantha digitale* is recorded (Guenther, : 03, p. 427) as reaching its greatest abundance at the very great depth of over 1,000 fathoms. But the fragmentary condition of all the specimens (*minus* manubrium, gonads, tentacles), together with the season of the year (November) when the hauls were made, strongly suggests that the captures are not to be taken as indicating the normal occurrence of this surface form at such a depth, but rather that the net encountered swarms of dead specimens in the process of sinking to the bottom after the discharge of their sexual products.

The evidence afforded by captures made in ordinary open tow-nets from considerable depths is much more extensive, but must be analyzed with even greater discrimination than that of the closing nets. Especially must we guard against any tendency to locate specimens from the lowest point of vertical hauls, as has often been done in the past. Such a method is of course entirely misleading; the actual evidence given by any one haul is no more precise than that its contents came from somewhere between the lowest point attained and the surface. Obviously the shorter the column of water through which the net is towed the more accurately is the zone of origin of its contents located. Conversely, when vertical hauls are made from near the bottom to the surface they indicate merely that the contents came from somewhere between the bottom and the top. Such hauls are often of great value in obtaining material; they are of little (unless used in conjunction with the comparative method already mentioned) in locating the level from which the contained specimens were taken. And of course even less instructive, from this point of view, are sporadic records of captures of pelagic animals in the trawl or dredge, unless such records are checked by some other class of observations. The importance of this precaution seems to have been overlooked in much of the general discussion of the range of the bathypelagic fauna.

The captures of intermediate Medusae recorded by the recent European deep-sea expeditions have been for the most part from comparatively deep hauls, — usually from below 500 fathoms, and often from very much greater depths. From less than 300 fathoms very few intermediate Medusae are recorded either by the "Valdivia" or "Siboga" expeditions, or by those of the "Princess Alice." It seems that this absence is to be explained largely by the fact that on all these expeditions but few comparatively shallow hauls, except from such trivial depths as 20 or 30 fathoms, were made with nets of a type fitted for the capture of large organisms. In estimating the value of such negative evidence it must be borne in mind that the fine-meshed Plankton net, especially after being used a few times, is admirably calculated to miss all large specimens when in use at the speed of a steamer under way. We cannot, then, interpret the scarcity of records from these expeditions of intermediate Medusae from the upper 300 fathoms as indicating absence of these organisms in that zone. On the contrary, there is good evidence that they not only occur, but are abundant between 300 fathoms and the surface. Thus the few captures of intermediate Medusae in open nets on the "Research" expedition are all from moderate depths, — the records being, Colobonema from 250 fathoms to surface; *Homoeonema platygonon*, 100 fathoms to surface, 200 to surface, 250 to surface, and 350 to surface; and of Periphylla, from 350 fathoms to the surface (Browne, : 06). And even more positive evidence to the same effect is afforded by the present collection.

During the expeditions of the "Albatross," particularly that of 1904–05, the method of towing has been to make frequent hauls from 300 fathoms to the surface, and occasional deeper hauls, which, together with the numerous trawl hauls, might be expected to reveal pelagic organisms confined to the region below 300 fathoms. The results from this method of collection were particularly positive and instructive on the Expedition of 1904–05. During this trip intermediate Medusae were taken in forty hauls at thirty-five stations, the depths being: — at twenty-three stations, 300 fathoms to surface; two stations, 400 fathoms to surface; one station, 600 fathoms to surface; one station, 800 fathoms to surface; and at nine stations in the trawl.

A significant feature of the case is that in every instance in which a 300 fathom haul was made at the same station where intermediate Medusae were taken in the trawl, the same genus was taken in the vertical haul as in the trawl, — a fact indicating of how little value a "trawl" record is in locating these intermediate organisms; and a still more important fact connected with these records is that not a single species was taken in hauls from below 300 fathoms, which was not also taken in other hauls between 300 fathoms and the surface, although the majority of the genera of Medusae as yet known to belong to the intermediate fauna were taken during the Expedition, and several of them in considerable abundance.

These positive results show beyond question that in the Eastern Tropical Pacific the intermediate Medusae are by no means characteristic of abyssal depths, but attain a high degree of development in the comparatively shallow zone between 300 fathoms and the surface, — a result already mentioned by the leader of the expedition for the intermediate fauna in general (A. Agassiz, :06). Furthermore, considering how much more important is this considerable body of positive results, which might be enlarged by adding thereto the records of the "Albatross" expedition of 1891 and the shallow hauls of the "Valdivia," "Siboga," and "Research" expeditions, than any amount of negative evidence of the kind afforded by the contents of open nets towed from abyssal depths to the surface at isolated stations, and in view of the uniformity in physical conditions below the upper 50–100 fathoms in all oceans, there is good reason to extend this generalization to all tropical oceanic areas removed from the disturbing influence of neighboring coast lines. The question of bathymetric range in such enclosed seas as the Mediterranean is quite a different question, and one outside the scope of the present discussion.

I do not, however, mean to imply that the intermediate fauna is restricted to this zone. On the contrary, while I believe that there is good evidence of the existence of a limit to its upward dispersal, there is apparently no such barrier to its downward movement. Therefore intermediate organisms may be expected to occur, though according to my view in much less abundance, even to near the ocean floor in very great depths.

With regard to the limit to their upward migration the questions of light and temperature are, no doubt, of prime importance, most investigators now agreeing that in the case of such organisms as Medusae pressure cannot be supposed to be an active factor. While but few experiments have been made upon the penetration of light in sea water, it is probably safe to assume that the last of the sun's rays are dissipated at about 500 meters, somewhat more than 250 fathoms; and that light below 100 fathoms must be very faint indeed, — a result in entire accordance with the vertical range of littoral Algae.

Since the intermediate Medusae do not normally come to the surface in cold any more than in warm regions, it is probable that it is not the increase in temperature, but light, which is the more important factor of the two in limiting their dispersal. Whether, however, the region most favorable for them is that of absolute darkness, or whether they, like some copepods, are positively phototropic to light of faint intensity, while negatively so to darkness on the one hand and brilliant light on the other, cannot be answered until experiments have been made with this end in view. But in consideration of the fact that captures in closing nets from greater depths than 300 fathoms have several times been recorded, I believe that the former suggestion is the correct one, and that the normal upper limit to the vertical range of these species will eventually be found to coincide approximately with the lower limit to which the sun's rays can penetrate with appreciable strength. This, however, by no means indicates that their upper limit is necessarily as deep as 250 fathoms. On the contrary, it is well known that the penetration of light depends very largely on the clearness of the water; and in a region with such a rich fauna and flora as the Humboldt Current the lower limit of appreciable light may be expected to lie at a much smaller depth than in the clearer waters where it has been tested. Judging from the fluctuations in the penetration of light, the upper limit of the intermediate Medusae probably differs greatly in different regions, being nearest the surface in the courses of the densely inhabited ocean currents, and deeper in regions where pelagic life is less dense and the water consequently clearer.

Besides the actual evidence afforded by the "Albatross" captures, there is strong theoretic ground, judging from the nature of their food supply, for expecting this group of organisms to be most abundant near the upper limit of their vertical range. In the last resort, sustenance, for the intermediate fauna as well as for the abyssal bottom fauna, must be derived indirectly or directly from the pelagic flora of the surface and of slight depths; intermediate as well as bottom animals must largely depend for their food on sinking detritus. It would then be only natural to expect them to congregate and multiply in greatest abundance in close proximity to this supply; that is, near or at the upper limit of their range. This consideration seems to me of very great significance.

The establishment of the upper limit of the normal vertical range of the intermediate Medusae is of quite as much importance to the oceanographer as to the zoölogist, since these organisms are among the most important natural buoys to show the flow of oceanic currents. In the present case their apparent absence or at least great rarity in the barren area west of the Humboldt Current indicates that the general west or northwest movement of the surface waters of that portion of the south-tropical eastern Pacific within the trade-wind belt, correlated with the general southeasterly direction of the trades, to which attention has already been called by Agassiz (: 06), does not extend downward much below the upper limit of their range, but is limited to a shallow surface zone, probably not extending below about 200 fathoms. Otherwise the intermediate, like the surface Medusae, would be dispersed from the Current throughout the barren area.

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EXPLANATION OF THE PLATES.

PLATE 1.

PLATE 1.

All figures from unretouched photographs of preserved specimens.

Fig. 1. Pelagia panopyra, seen obliquely from the oral side. × 2.

Fig. 2. Atorella vanhöffeni, sp. nov. Especially worthy of notice are the phacelli, gonads, subumbral plates, coronal furrow, and exumbral nematocyst warts. × 8.

Fig. 3. Periphylla hyacinthina, natural size.

Fig. 4. Charybdea rastonii. × 2.

Fig. 5. Aegina citrea. × 1.5.

Fig. 6. Cunina peregrina, sp. nov. The form of the gastric pockets is particularly well shown. × 3.

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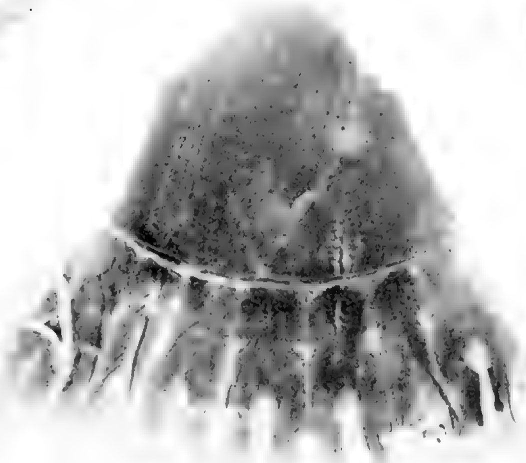

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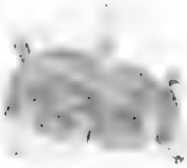

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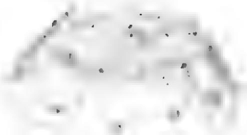


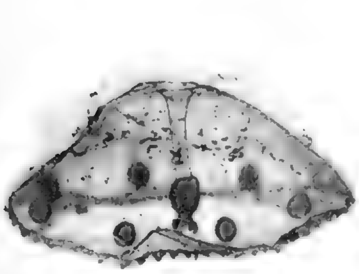
BIGELOW PHOTO.

PLATE 2.

Plate 2.

All figures from unretouched photographs of preserved specimens.

Fig. 1. Amphogona apsteini; side view. × 8.
Fig. 2. Amphogona apsteini; oral view.
Fig. 3. Solmundella bitentaculata. × 12.
Fig. 4. Colobonema sericeum; oral view. × 1.5.
Fig. 5. Colobenema sericeum. × 1.5.
Fig. 6. Aglaura hemistoma. × 8.
Fig. 7. Crossota brunnea. × 2.
Fig. 8. Rhopalonema velatum. × 5.



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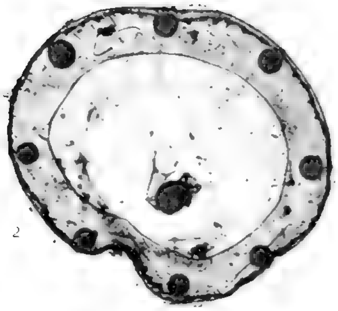

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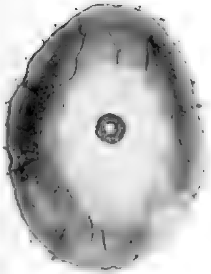

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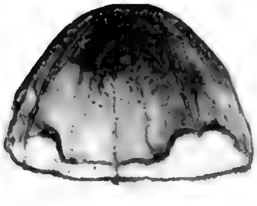

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BIGELOW PHOTO

PLATE 3.

PLATE 3.

All figures from photographs of specimens preserved in formol.

Figs. 1–2. Homoeonema alba. × 2.

In these two figures the form and extent of the gonads, and of the manubrium, is well shown.

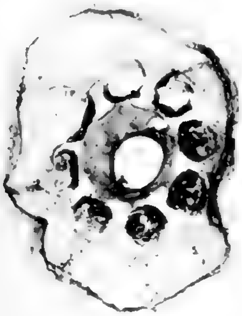
Fig. 3. Halicreas papillosum; oral view of immature specimen, especially to show the conformation of the gastrovascular system. Exumbral papillae are as yet but slightly developed. × 3.

Fig. 4. Gonionemus suvaensis; oral view, illustrating especially the extent of the gonads along the radial canals. × 4.

Fig. 5. Gonionemus suvaensis; side view. × 4.

Fig. 6. Liriope tetraphylla; side view. The gonads exhibit the rhomboid form characteristic of the "compacta" stage. From a specimen 22 mm. in diameter.

Fig. 7. Liriope tetraphylla, a younger specimen. The gonads are triangular; "rosacea" stage. From a specimen 15 mm. in diameter.



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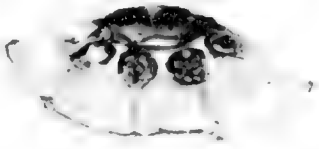

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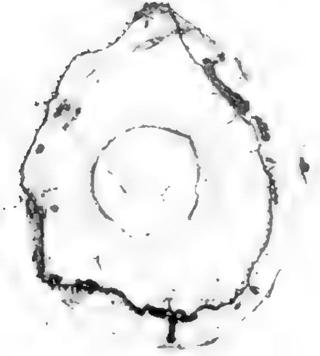

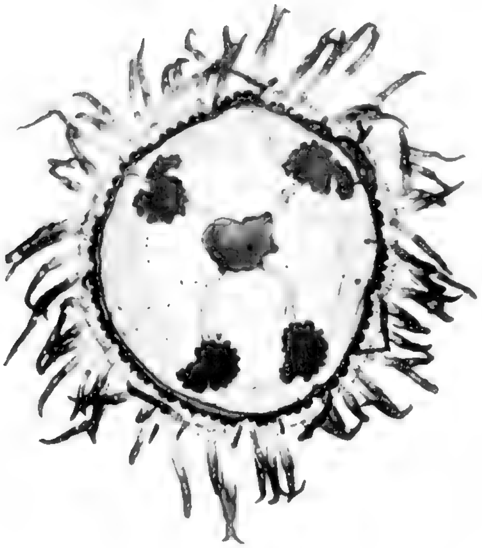

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PLATE 4.

PLATE 4.

All figures from unretouched photographs of preserved specimens.

Fig. 1. Olindias singularis. × 2.

Fig. 2. Liriope tetraphylla, young specimen 4 mm. in diameter, before appearance of gonads.

Fig. 3. Liriope tetraphylla, older individual 7 mm. in diameter; gonads are broad — oval or squarish.

Fig. 4. Aequorea coerulescens, specimen 45 mm. in diameter; oral view, showing particularly the condition of the lower gastric wall, and the numerical relation of radial canals to tentacles.

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PLATE 5.

All figures from unretouched photographs of specimens preserved in formol.

Fig. 1. Ptychogena erythrogonon, sp. nov.; oral view of a mature specimen 30 mm. i diameter.

Fig. 2. Eutima levuka, immature specimen; side view. × 4.

Fig. 3. Eutima levuka; oral view of another specimen, showing four large tentacles, an the form of the peduncle and manubrium. × 4.

Fig. 4. Sibogita simulans, sp. nov.; side view of type. × 1.5.

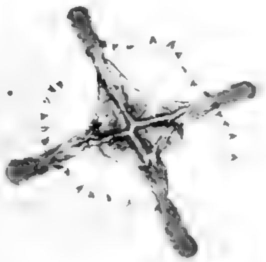
Fig. 5. Aboral view of the same specimen. The blind terminations of seven of the eigh adradial canals are clearly visible. The lateral flattening of the bell is norma and was observed in life.

Fig. 6. Phialucium comata, sp. nov.; oral view of type specimen 7.6 mm. in diameter.

Fig. 7. Side view of same specimen. This photograph gives a good idea of the form o the bell in life, as well as of the extent of the gonads along the radial canals.

Fig. 8. Eutimalphes scintillans, sp. nov.; side view of type specimen 10 mm. in diameter showing form of bell, peduncle and manubrium, and location of gonads o radial canals.

Fig. 9. Eutimalphes scintillans; oral view of another specimen of about the same size.



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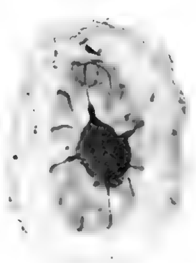

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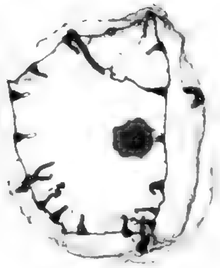

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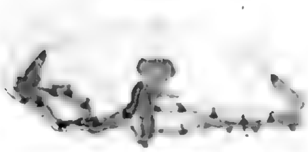

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HELIOTYPE

PLATE 6.

PLATE 6.

All figures from unretouched photographs of preserved specimens.

Fig. 1. Proboscidactyla ornata var. stolonifera. × 8.
Fig. 2. Proboscidactyla ornata var. stolonifera; oral view. × 8.
Fig. 3. Cytaeis vulgaris. × 8.
Fig. 4. Phialium duodecimalis. × 20.
Fig. 5. Ectopleura ochracea. × 20.
Fig. 6. Octocanna polynema; aboral view. × 4.
Fig. 7. Bougainvillea fulva. × 8.
Fig. 8. Phialidium discoida. × 20.
Fig. 9. Phialucium comata, sp. nov., immature specimen 5 mm. in diameter; oral view.
Fig. 10. Octocanna polynema. × 4.


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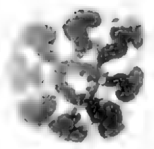
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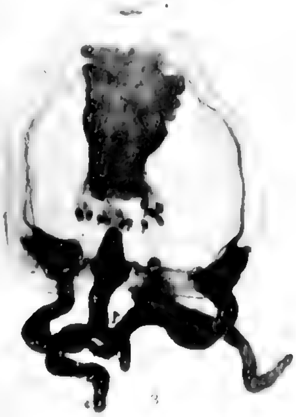
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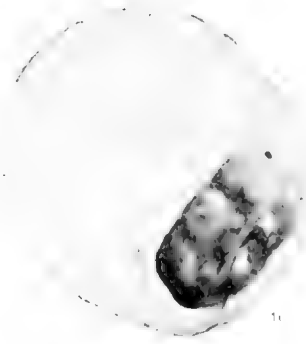
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PLATE **7**.

PLATE 7.

All figures from unretouched photographs of preserved specimens.

Fig. 1. Sarsia resplendens, sp. nov., type. × 20.
Fig. 2. Amphinema turrida. × 10.
Fig. 3. Zanclea gemmosa. × 25.
Fig. 4. Pennaria vitrea. × 8.
Fig. 5. Amphinema australis. × about 20.
Fig. 6. Pennaria species (?) × 12.
Fig. 7. Purena brownei. × 8.
Fig. 8. Sarsia coccometra, sp. nov., type. × 6.
Fig. 9. Stomotoca divisa, natural size.

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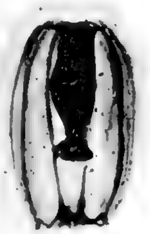

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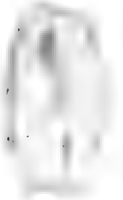

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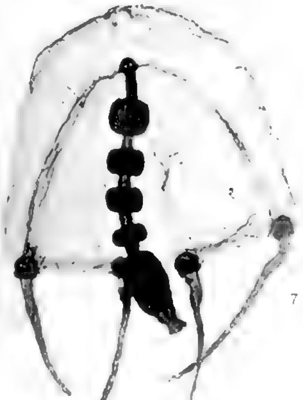

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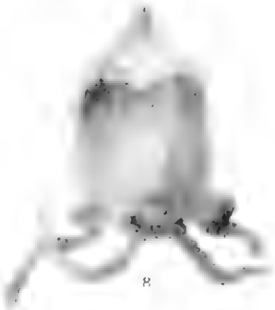

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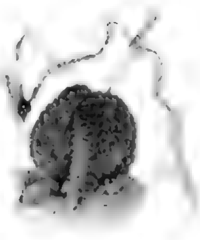

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PLATE 8.

PLATE 8.

Atolla wyvillei; aboral view. From colored sketches taken from life on board the "Albatross" by A. M. Westergren and the author. Natural size.

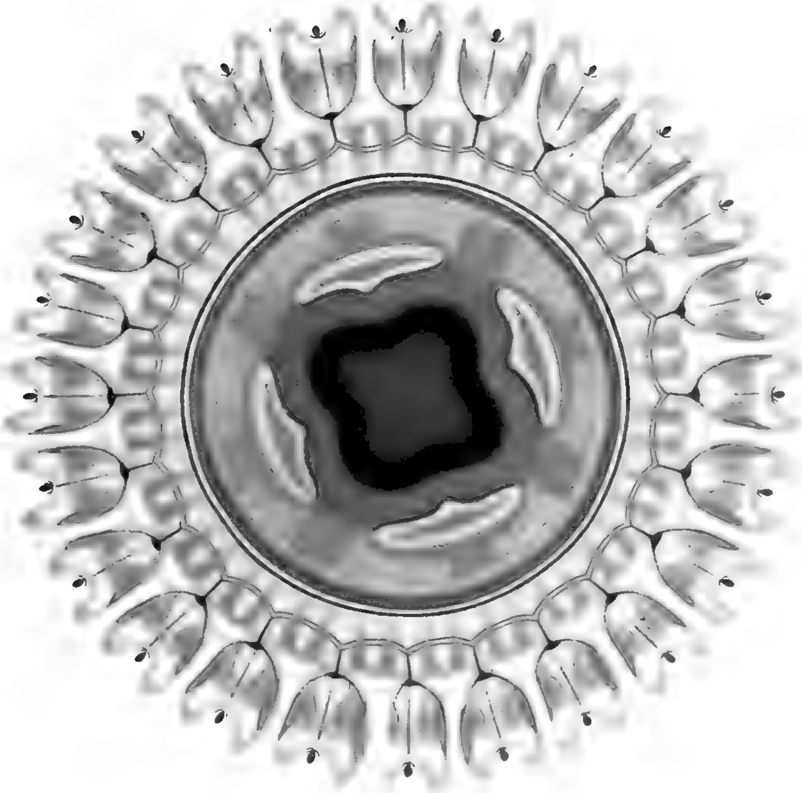

PLATE 9.

All figures based on colored sketches made from life on board the "Albatross."

Fig. 1. Periphyllopsis braueri, natural size. The marginal lappets are somewhat restored. The coronal furrow is well marked.

Fig. 2. Periphylla hyacinthina ("dodecabostrycha" stage); oral view of very young specimen, 10 mm. in diameter, to show restriction of endodermic pigment to the central stomach and rhopalia.

Fig. 3. Atolla wyvillei; seen obliquely from the side, showing exumbral furrows of central disc. From a specimen 20 mm. in diameter.

Fig. 4. Aeginura grimaldii; oral view of female specimen. The secondary tentacles on the margins of the lappets are somewhat restored. × 4.


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PLATE 10.

PLATE 10.

Charybdea rastonii, from preserved specimens.

Fig. 1. Side view of half grown specimen, 13 mm. in diameter.

Fig. 2. Aboral view of same, showing exumbral sculpture.

Fig. 3. Oral view of same, with tentacles cut off; (c.v) velar canal; (fr) frenulum; (t) stump of tentacle.

Fig. 4. Side view of rhopalium in its natural position in the exumbral nitch; (oc), otocyst. × 20.

Fig. 5. Oral view of rhopalium, × 40. (o^1, o^1) single ocelli; (o^2, o^2) paired ocelli.

Fig. 6. Somewhat ideal dissection of apex of bell, to show depth of gastric cavity and absence of mesenteries.

Fig. 7. One of the gastric phacellae, × 30; to show type of branching.

Atolla wyvillei.

Fig. 8. Oral view of central portion of the disc. On the right-hand side the lower gastric wall and the gonads are dissected away to show the gastric filaments (g.f); gastric ostia (g.os); ring sinus (r.s); and septal node (s.n); (go) gonad. Natural size.

Fig. 9. Aboral view of central portion of disc of a specimen 8 mm. in diameter, in which the radial furrows are narrow, as in A verrillii; the number of furrows is one less than of tentacles. (ped) pedalium; (t) tentacle.

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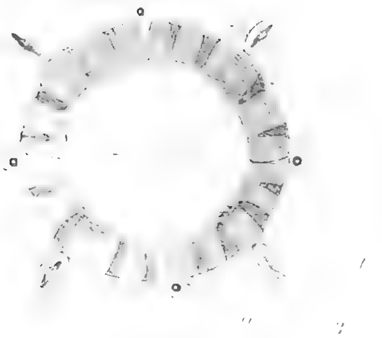

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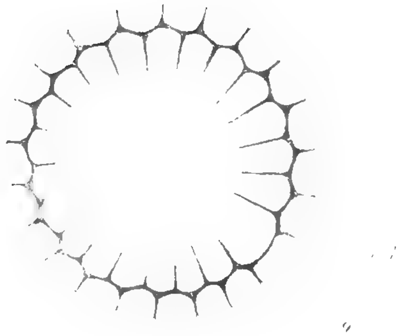

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PLATE **11**.

Plate 11.

Atorella vanhöffeni, sp. nov.

Fig. 1. Side view of the type specimen, 5 mm. in diameter. The coronal furrow is deeply marked. The color of the gonads is taken from a sketch from life made on board the "Albatross."

Fig. 2. Aboral view of the same specimen, to show the radial arrangement of the four gonads and phacellae, and the six tentacles.

Fig. 3. Aboral view of exumbrella surface and base of tentacle, showing triangular endodermal root of the latter (en.r); the exumbral nematocyst warts (n); and the outlines of the subumbral plates (deeply shaded). × 50.

Fig. 4. Side view of one phacella. × 70.

Fig. 5. Longitudinal section of the distal portion of a tentacle, showing the terminal nematocyst swelling (n). (en) endodermic core; (ec) ectoderm. × 125.

Fig. 6. Rhopalium by transmitted light. × 100.

Fig. 7. Rhopalium by reflected light; (oc) otocyst; (s) covering scale; (b) bulbus. × 70.

Fig. 8. Radial section through margin in plane of a rhopalium; (oc) otocyst; (s) covering scale; (en) endoderm; (ec) thickened ectoderm; (g) mesogloea. × 200.


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PLATE 12.

PLATE 12.

Fig. 1. Periphyllopsis braueri; oral view, showing canal system. The walls of the stomach are torn away, leaving only its base with the gastric cirri (ci.g). (c.t) tentacular canal; (c.r) rhopalar canal; (c.l) lappet canal; (go) position of gonad; (r) rhopalium. Natural size.

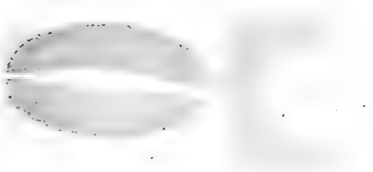
Fig. 2. Atorella vanhöffeni, sp. nov.; oral view of gonad. × 35.

Fig. 3. Atorella vanhöffeni. Transverse section of gonad (go), showing that it is a single leaf-like structure attached to the endoderm (en) along one line only, at ×. (g) mesogloea. From a photograph. × 70.

Fig. 4. Atorella vanhöffeni; oral view to show canal system; (c.r) rhopalar canal; (c.t) tentacular canal; (os) gastric ostium; (go) gonad; (r) rhopalium. The adjacent tentacular and rhopalar canals unite in the marginal lappets. × 14.

Fig. 5. Nausithöe punctata. Rhopalium showing ocellus (o) and otocyst (oc.) (sc) covering scale. × 125.

Fig. 6. Nausithöe rubra; rhopalium. (oc) otocyst; (sc) covering scale. There is no ocellus. From a photograph. × 60.



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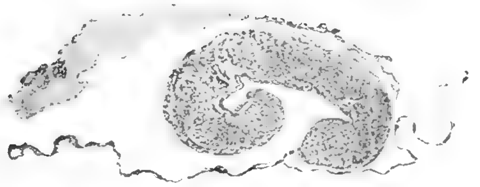


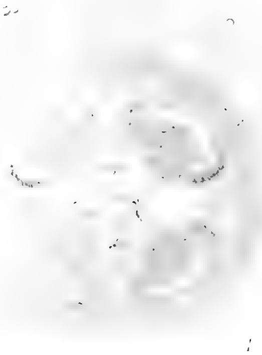


PLATE 13.

PLATE 13.

Poralia rufescens.

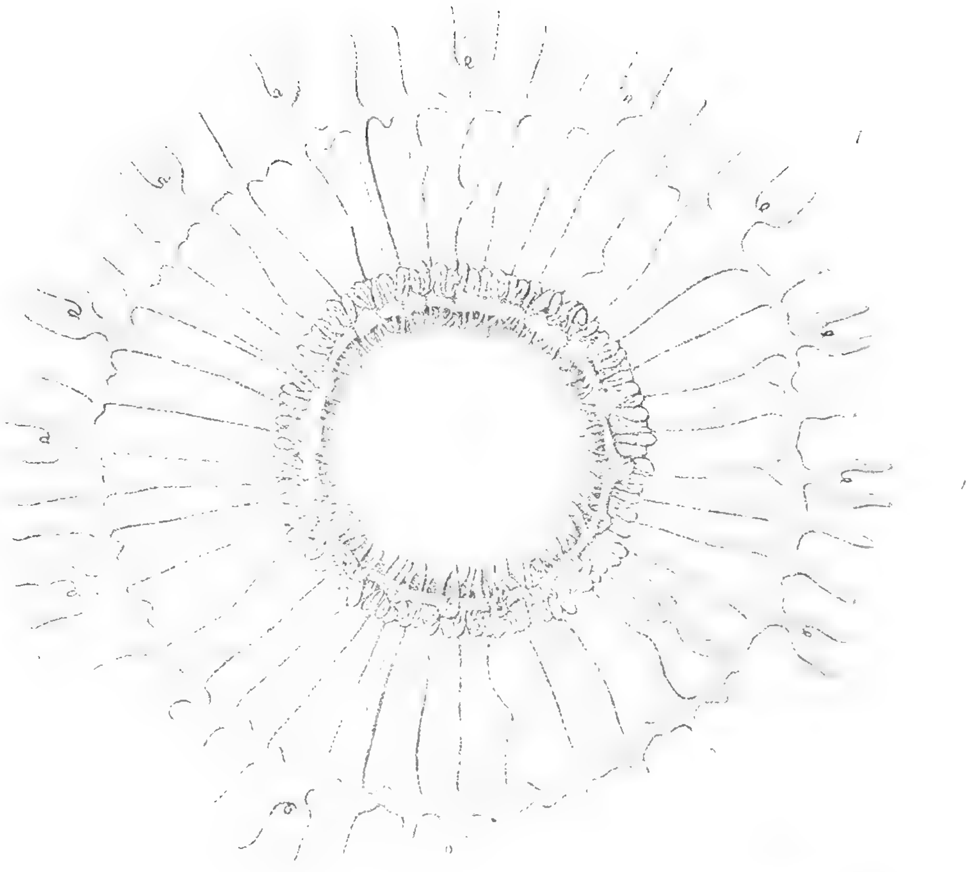
Fig. 1. Oral view of the best-preserved specimen. Those portions of the margin which have been reconstructed are indicated by dotted outlines. Reduced one half.

Fig. 2. Oral view of a small segment of the gastric wall, with gonads (go); gastric filaments (g.f) and bases of canals (c.ra). × 1.5.

Fig. 3. Portion of the gastric wall, viewed from within; (g.os) gastric ostia (openings of the radial canals); (go) gonad; (g) gelatinous substance of the disc. × 2.

Fig. 4. Rhopalium, aboral view; (p) exumbral sensory pit; (s) covering scale; (r) rhopalium. × 15.

Fig. 5. Dissection of margin with side view of sense organ; (p) sensory pit, seen through a thin layer of the mesogloea; (s) covering scale; (oc) otocyst at the tip of the rhopalium; (r.c) rhopalar canal. × 30.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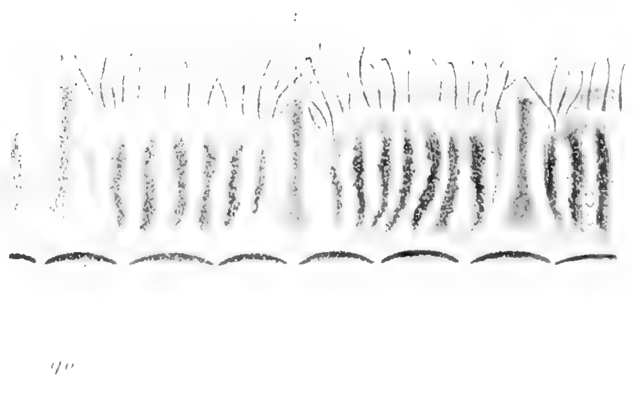
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PLATE **14**.

PLATE 14.

All the figures are from sketches of living specimens made on board the "Albatross."

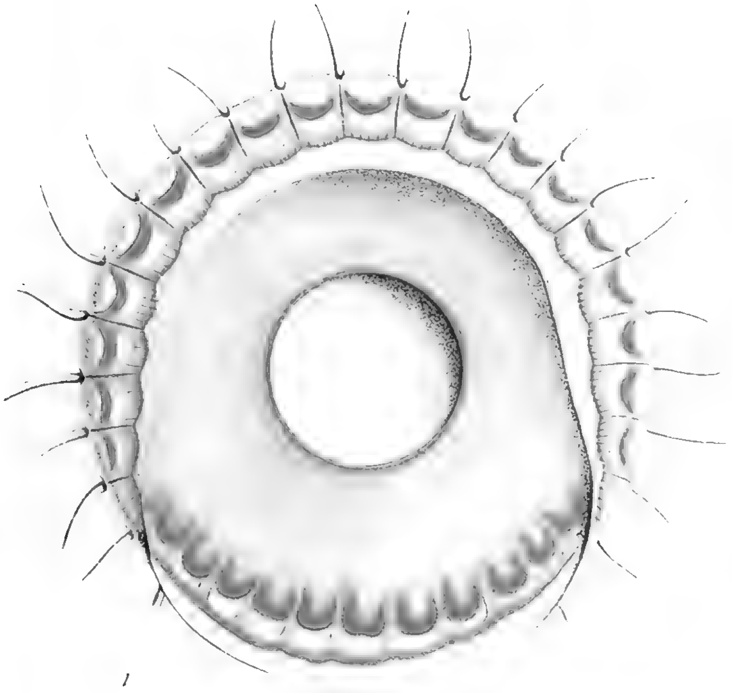
Fig. 1. Pegantha smaragdina, sp. nov., type; natural size.

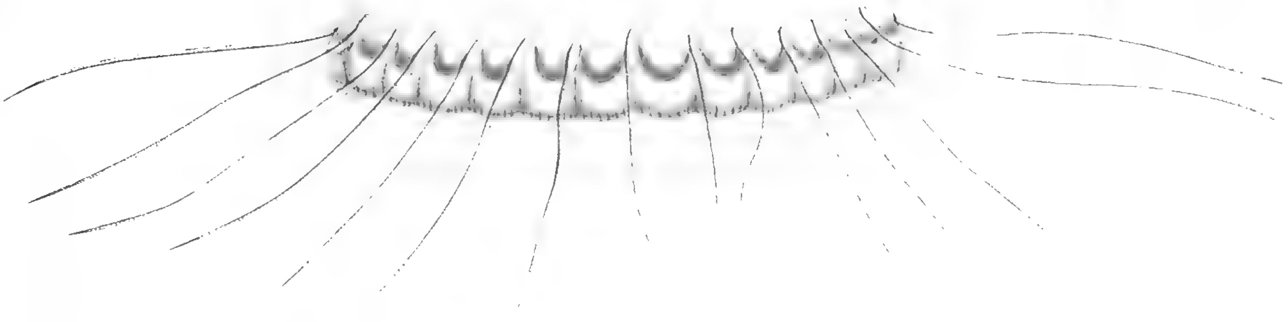
Fig. 2. The same; side view.

Fig. 3. Pegantha triloba. × 3.

Fig. 4. Cunoctantha octonaria. × 15.

Fig. 5. Aegina citrea; specimen 16 mm. in diameter.





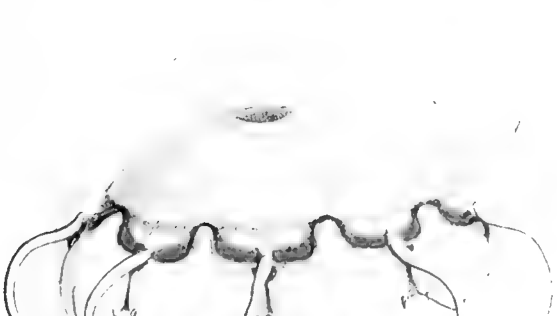


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PLATE 15.

PLATE 15.

Fig. 1. Cunina peregrina, sp. nov., type; side view; from a sketch from life made on board the "Albatross." × 5.

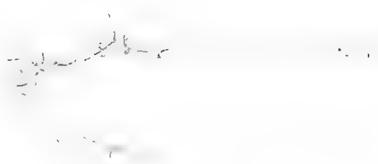
Fig. 2. Cunina peregrina; immature individual, 3 mm. in diameter, aboral view. At this stage there are only three or four otocysts per marginal lappet.

Fig. 3. Cunina globosa, oblique side view, from life. × 5.

Fig. 4. Cunoctantha tenella, sp. nov., type; from life. × 10.

Fig. 5. Cunoctantha octonaria; immature individual, 1 mm. in diameter. At this stage there is only one otocyst per marginal lappet; there is as yet no trace of the formation of gastric pockets.

Fig. 6. Cunoctantha octonaria; aboral view of another specimen at about the same stage of development.



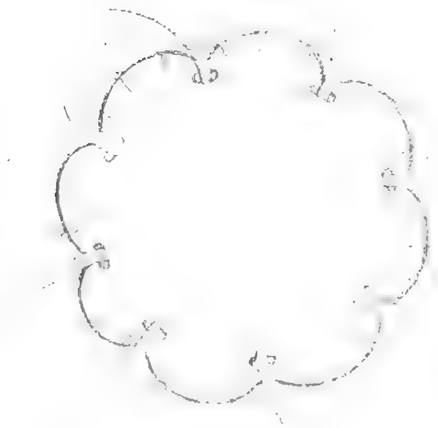


PLATE 16.

PLATE 16.

Fig. 1. Pegantha laevis, sp. nov., type; side view, from life. × 2.

Fig. 2. Cunoctantha tenella, sp. nov.; immature individual, 2 mm. in diameter, in which there is as yet only one otocyst per marginal lappet.

Fig. 3. Pegantha triloba; immature individual, 2.5 mm. in diameter, with seven antimeres.

Fig. 4. Aegina species (?); immature individual, 5.5 mm. in diameter (see p. 74). This figure is incorrect as it does not show the interradial septa which are present in three of the four quadrants and separate the gastric pouches.

Fig. 5. Solmissus marshalli. In the lower half of the drawing the marginal zone is dissected away to show the form of the gastric pockets. Only the basal portions of the tentacles are shown. Natural size.

Fig. 6. Solmissus marshalli; immature individual, 28 mm. in diameter, with only eight antimeres.

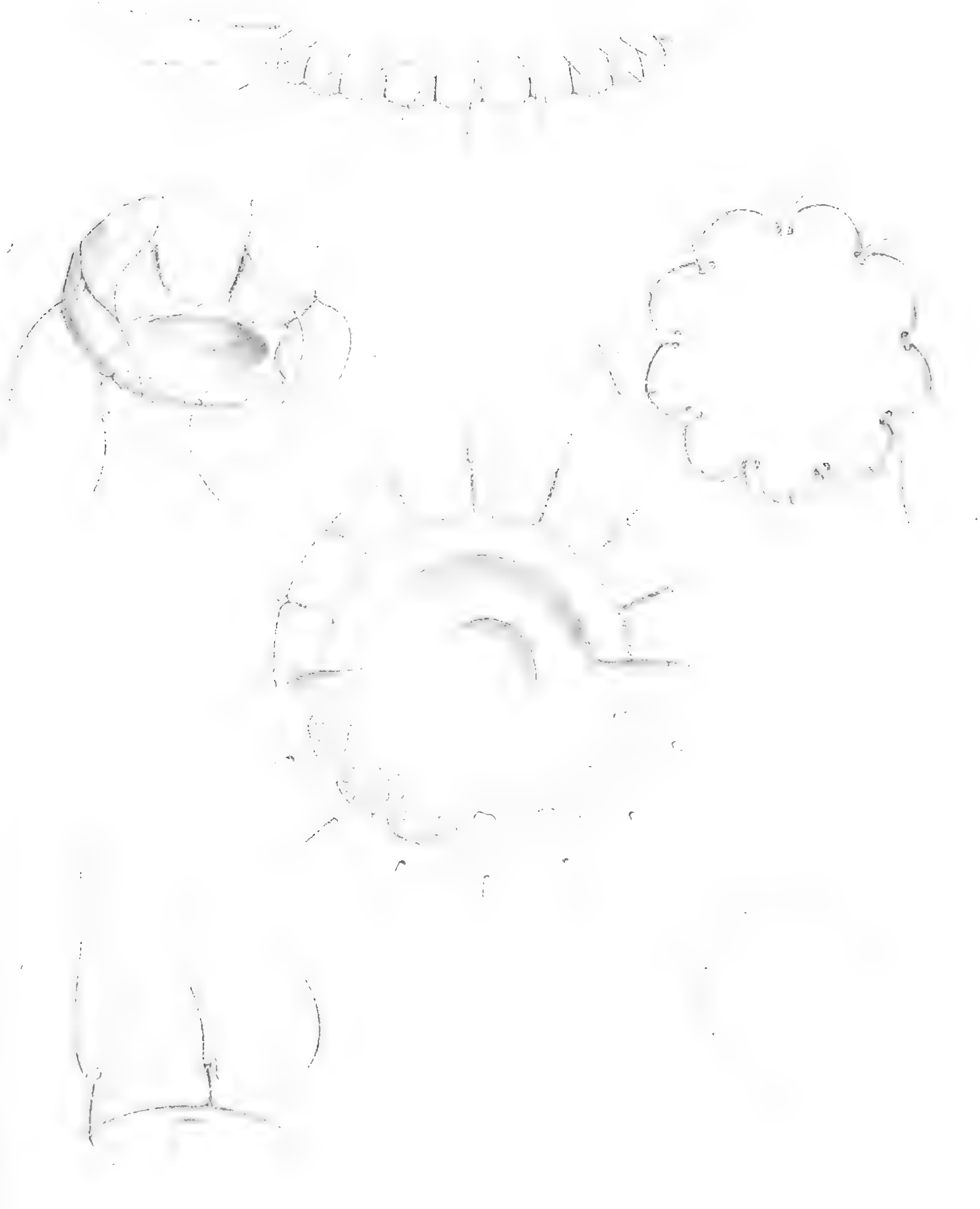


PLATE 17.

Plate **17**.

Fig. 1. Aegina alternans, sp. nov., type; showing the undivided gastric pockets interradial in position, and equal in number to the tentacles. × 1.5.

Fig. 2. Cunoctantha octonaria. Marginal lappet of half-grown individual showing the well-developed median and rudimentary lateral otocysts (oc), and otoporpae (op) × 60.

Fig. 3. Cunina globosa; tip of tentacle densely packed with nematocysts (n).

Fig. 4. Cunoctantha octonaria; rudimentary lateral otocyst, in which no otoliths are yet formed; (en) endodermic core. × 250.

Fig. 5. Cunoctantha octonaria; fully formed median otocyst, containing one large otolith (ol); (op) otoporpa; (n) nematocyst. × 250.

Fig. 6. Cunoctantha tenella, sp. nov. Margin of one lappet, with three otocysts (oc), all well-developed; (en) endodermic core of tentacle; (en.r) endodermic root of tentacle; (n.p) nematocyst pad at base of tentacle; (op) otoporpa. × 30.

Fig. 7. Cunoctantha tenella. Otocyst. × 250.

Fig. 8. Cunina globosa; otocyst (oc), and otoporpa (op). The shape of the latter is characteristic; (n) nematocyst. × 250.

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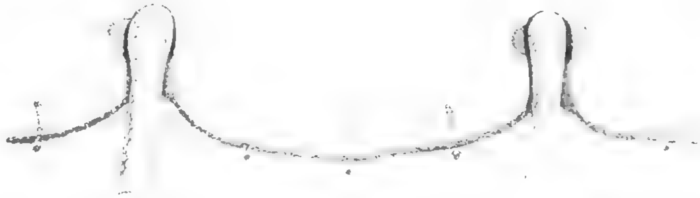

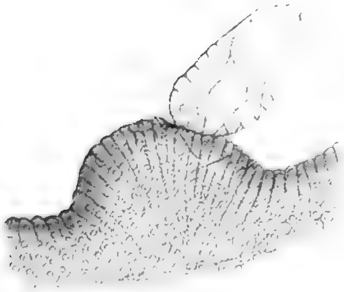

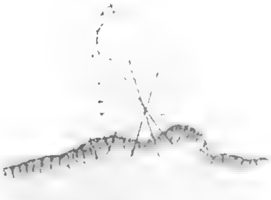

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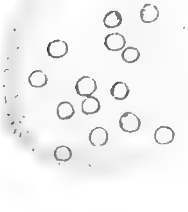


PLATE **18.**

Plate 18.

All figures are of Pegantha martagon.

Fig. 1. Side view of mature specimen 20 mm. in diameter.

Fig. 2. Oral view of same individual.

Fig. 3. Portion of bell margin, with otocysts (otc) and otoporpae (op). × 20.

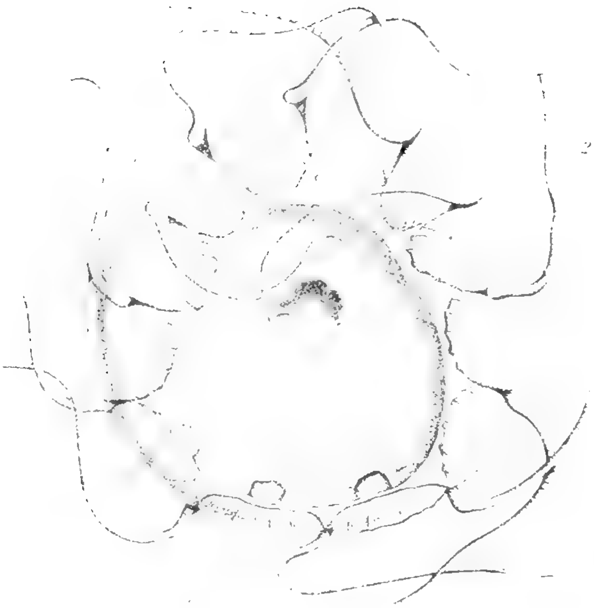
Fig. 4. Two marginal lappets of a small specimen, 5 mm. in diameter, showing one sma tentacle more recently formed than the other two; (v) velum.

Fig 5. Oral view of portion of lower gastric wall of a young specimen, 12 mm. in diamete, showing an early stage in the growth of the gonads (go), which are still sim globular swellings; (c.per) peronial canal.

Fig. 6. Four adjacent gonads (go) of a mature specimen, showing slight seconda lobing; (c.per) peronial canal. × 6.

Fig. 7. Otocyst and otoporpa; (ol) otolith; (ec) ectoderm, and (en) endoderm of otocys; (op) otoporpa, bounded by cap-like cells; (n) nematocyst. From a specim stained in borax-carmine. Bristles were seen in life, but are destroyed preservation. × 300.

Fig. 8. Somewhat diagrammatic cross-section through marginal zone in radius of a gona, to show the gelatinous genital prominence (g.pn) which supports the centr region of each gonad (go); (c.c) circular canal. From a dissection.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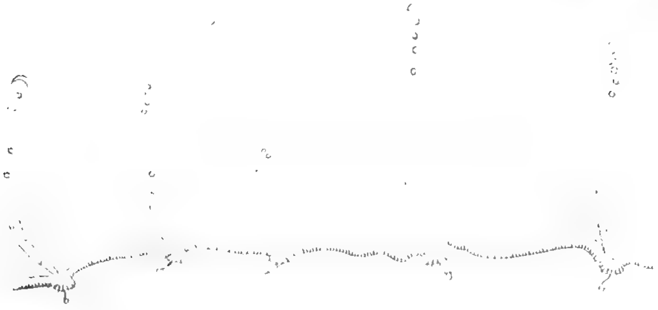


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PLATE **19**.

Plate 19.

Pegantha smaragdina, sp. nov.

Fig. 1. Rudimentary tentacle, connected with otoporpa (per) replacing an otocyst on the bell margin; (en) endodermic core of tentacle. × 300.

Fig. 2. Oral view of a segment of the disc of the type specimen showing conformation of the gonads, and canal system. × 2.

Fig. 3. Otocyst containing five otoliths (ol), and otoporpa (per). × 300. (n) nematocyst.

Fig. 4. Optical section of tentacle to show core of chordate endoderm cells (en); (ec) ectoderm. × 15.

Fig. 5. Aboral (outer) view of three marginal lappets of the smaller specimen, showing parasitic larvae, in polyp and medusa stages, lying in the gastric cavity and in the peripheral canal system of the parent-host. × 6.

Fig. 6. Dissection of bell showing endodermic tentacle root (en.r); gonad (go); perona (per); (t) tentacle.

Fig. 7. Radial section in plane of a gonad in the mature specimen, to show the gelatinous genital prominence (g.pr) which supports the gonad (go); (c.c) lumen of circular canal; (v) velum. From a dissection. × 8.

Fig. 8. Otocyst in optical section; (ol) otolith; (ec) ectoderm; (en) endodermic core. × 300.

Fig. 9. Radial section of the immature specimen. There is neither genital prominence nor gonad; (g) mesogloea; (c.c) circular canal; (v) velum. × 8.


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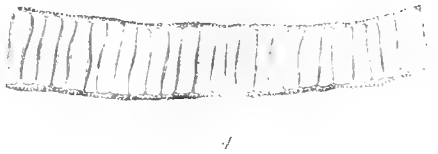
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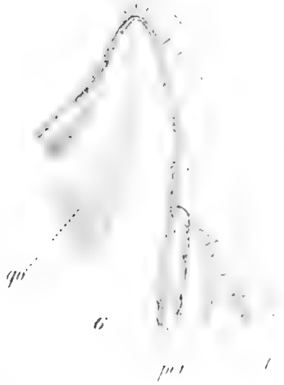
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PLATE 20.

PLATE 20.

Pegantha triloba.

Fig. 1. Radial section through the margin of a specimen 11 mm. in diameter, before appearance of gonads, in the plane of an otocyst; (v) velum; (nr.r) nerve ring; (ot) otocyst, (s.lam) stutzlamella; (op) otoporpa; (n) nematocyst; (en.lam) endodermic vascular lamella. The endoderm lining of the circular canal is much thickened on its oral face.

Fig. 2. Surface views of three adjacent gonads of adult, showing the three main lobes of which each is composed; in each the lateral lobes are secondarily subdivided. × 8.

Fig. 3. Surface view of otocyst and base of otoporpa (op); (ol) otolith; (en) endodermic core of the sense organ; (n) nematocyst. The bristles were observed on a fresh specimen; they are destroyed by preservation. × 300.

Pegantha laevis, sp. nov.

Fig. 4. Aboral view of portion of lappet-zone of a specimen in which the gonads have not yet appeared, showing two large tentacles, and a third small one of more recent formation. × 6.

Fig. 5. Surface (oral) view of three adjacent gonads (go) of mature individual; (c.c) circular canal; (per) peronia; (v) velum. × 8.

Fig. 6. Otocyst (oc) and otoporpa (op); (ol) otolith; (n) nematocyst. × 300.


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PLATE 21.

Plate 21.

Solmissus incisa.

Fig. 1. Oral view of small specimen, 10 mm. in diameter. There are only one or t otocysts per lappet. Only a few of the tentacles are shown in their ent length.

Fig. 2. Same specimen; a rudimentary tentacle; (per) peronia.

Fig. 3. Same specimen; a young tentacle further advanced; the peronia (per) is mu longer.

Fig. 4. Solmissus marshalli, otocyst, surface view, with bristles. From life. × 300.

Fig. 5. Solmissus incisa; optical section of otocyst, from a specimen stained in bora carmine; (ot) otolith. The bristles have all been destroyed by preservation. × 3

Solmissus marshalli.

Fig. 6. One marginal lappet with thirteen otocysts (oc); (per) peronium.

Fig. 7. Oral view of two adjacent gastric pockets of a female, showing gonads (go). T gastric wall is torn over the central region of each pocket. From life.

Fig. 8. Radial section through margin in radius of an otocyst, to show the absence of endodermic strand which might represent the ring canal; (g) mesogloea; (c otocyst; (nr.r) nerve ring; (s.l) stutzlamella. The musculature of the o side of the velum is indicated. × 150.


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PLATE 22.

PLATE 22.

Stages in the development of the parasitic generation of **Pegantha smaragdina**, sp. nov

All figures magnified 1600 diameters.

Specimens fixed in formol; stained in Delafield's haematoxylin.

Figs. 1–6. Amoeboid cells from the mesogloea, near the aboral gastric wall, close to th margin of the gastric cavity.

Fig. 5. An amoeboid cell in process of amitotic division.

Fig. 6. Amoeboid cell in contact with the endoderm (en).

Fig. 7. Mitosis in endoderm cell.

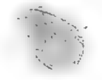
Figs. 8, 9. Mitosis in amoeboid cells; metaphase.

Figs. 10, 11. Two amoeboid cells in contact. This is the phenomenon which led Metschnikoff to believe that one cell might engulf another.

Fig. 12. Youngest undoubted stage in development of the larva. The embryo consist of two cells, one, the nurse (n.ce), enclosing the other.

Fig. 13. A slightly later stage. The nucleus of the nurse cell (n.n) has divided amitotically. The inner cell, the future embryo, is in the metaphase of mitosis.

Fig. 14. Still later stage. The embryo is in the two-cell stage. The nurse cell in thi specimen has only one nucleus.



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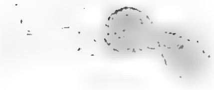

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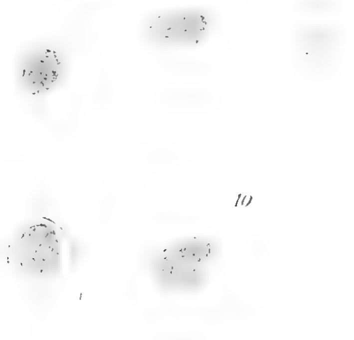

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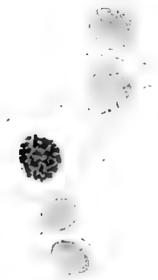

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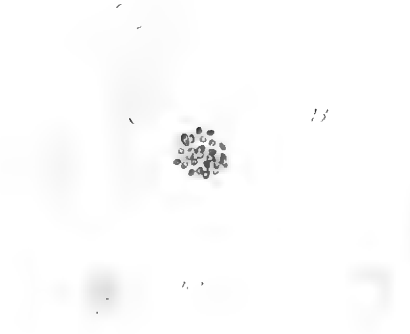

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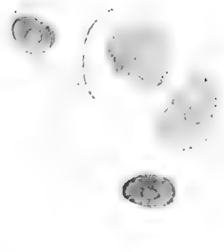


PLATE 23.

Plate 23.

Stages in the development of the parasitic generation in Pegantha smaragdina, sp. nov. All figures from sections. Figs. 1–7 × 1600; Figs. 8–11 × 900.

Fig. 1. Two-celled stage; nurse nucleus (n.n) in process of amitotic division.

Fig. 2. Four-celled stage; nurse cell contains two nuclei.

Fig. 3. A later stage with about twelve blastomeres. The cytoplasm of the nurse encloses large vacules and it has two nuclei (n.n).

Fig. 4. Slightly later stage, with about sixteen blastomeres. The nurse nuclei (n.n) are flattened and cap-like.

Fig. 5. Section through morula stage, lying close to endoderm of parent host. One of the blastomeres is in process of mitosis. No differentiation into ectoderm and endoderm is yet visible. The cytoplasm of the nurse is now thin; (n.n) nurse nucleus.

Fig. 6. Morula stage, surface view. The nurse nucleus (n.n) covers the embryo like a cap.

Fig. 7. Section through slightly later stage. The embryo is now in close contact with the endoderm of the parent (en). The central cells of the morula, the future endoderm, are now divided from the peripheral layer by a thin, but deep staining layer, probably the earliest manifestation of the mesogloea. The cytoplasm of the nurse is now exceedingly thin.

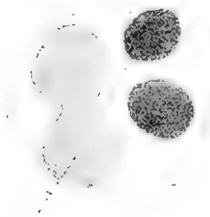
Figs. 8–11 are of larvae lying free in the gastric cavity of the parent host.

Fig. 8. Longitudinal section of earliest stage formed free in the gastric cavity of the parent host. Ectoderm (ec) and endoderm (en) are now clearly distinguishable, but there is as yet no trace of gastric cavity. From a specimen stained in borax-carmine.

Fig. 9. Section through slightly later stage, in which endoderm (en) and ectoderm (ec) are separated by a distinct mesogloea. Ectoderm and endoderm cells now show a difference in size.

Fig. 10. Section through later stage; the ectoderm (ec) and endoderm (en) cells show differentiation, the former being small and cubical, and staining deeply; the latter large, chordate, and staining but slightly; (s.lam) mesogloea.

Fig. 11. Still later stage, in which the differentiation of ectoderm and endoderm cells has progressed even further. The larva is now elongate.



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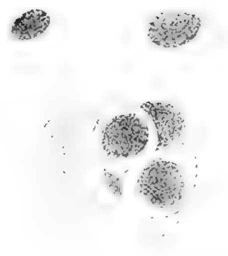

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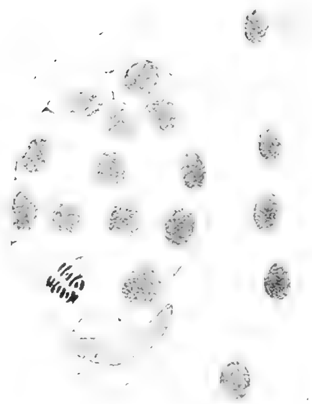

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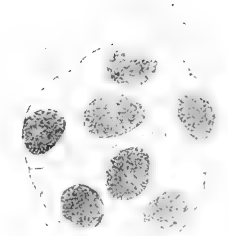

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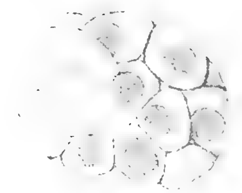

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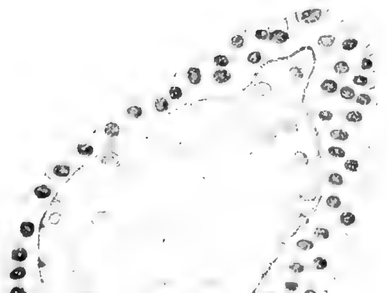

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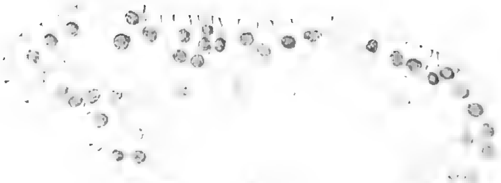

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PLATE 24.

PLATE 24.

Stages in the development of the parasitic generation of Pegantha smaragdina, sp. nov.

Fig. 1. Longitudinal section of a larva, just prior to formation of gastric cavity. × 900.

Fig. 2. Longitudinal section of a larva in which the gastric cavity (g.cav) is formed, but in which the mouth has not yet broken through. The greater bulk of the larva forms the primary tentacle; and the endodermic core (en.r) of a second tentacle can be distinguished. × 900.

Fig. 3. Somewhat diagrammatic longitudinal section of a larva in which the mouth is opened, showing the earliest stage in budding at the aboral pole; (en.r) endodermic core of tentacle. × 300.

Fig. 4. Surface view of the stage represented in figure 1. The main body of the larva is probably the future primary tentacle. × 300.

Fig. 5. Somewhat diagrammatic longitudinal section through a larva with bud constricted off from gastric cavity; (en.r) endodermic core of tentacle; (m) mouth. Reconstructed from three successive serial sections. × 300.

Fig. 6. Diagrammatic longitudinal section through aboral region of a larva with two buds. The distal bud has an open mouth and a rudimentary tentacle; its cavity is entirely constricted off from that of the proximal bud. The cavity of the latter is still connected with the gastric cavity of the parent larva. × 400.

Fig. 7. Medusa stage, radial section through margin in plane of otocyst; (ot) otolith; (g) mesogloea; (s.lam) stutzlamella; (en.lam) vascular endoderm lamella; (n.r) nerve ring; (v) velum. × 500.

Fig. 8. Similar section of a very early stage in the formation of the otocyst (ot). The endodermic core of the otocyst is still continuous with the endodermic lamella (en.lam). × 500.


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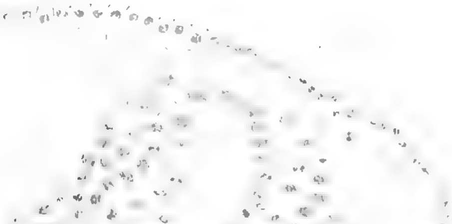

PLATE 25.

Plate 25.

Stages in the development of the parasitic generation of Pegantha smaragdina, sp. nov

The specimens were all taken from the peripheral canal system of the parent-host.

Figs. 1–9. Stages in the development of budding larvae.

Figs. 1, 2. The youngest stages, showing the first appearance of the primary tentacle These larvae are probably the product of budding, because in larvae developed from the egg the primary tentacle is formed earlier. × 150.

Fig. 3. Slightly older stage, with two tentacles. × 150.

Fig. 4. The earliest stage which shows budding. The future bud is represented by a projection of the aboral pole. × 150.

Fig. 5. Slightly later stage. The bud is now partly constricted off. The tentacles are long, and the open mouth is visible at the oral pole. × 150.

Fig. 6. Later stage. Constriction of the bud is now practically complete. × 100.

Figs. 7–9. Larvae showing the formation of two buds before either is constricted off. × 100.

Fig. 7. Earliest stage when this process can be demonstrated; second bud being formed from the aboral pole of the parent larva. × 150.

Fig. 8. The primary bud now has one well developed tentacle, and a second smaller one. × 100.

Fig. 9. The primary bud now has an open mouth and two well-developed tentacles; and it is nearly constricted off from the secondary bud. The latter presents the condition seen in the bud in Fig. 6. It is probable that the latter is the result of such a process. × 100.

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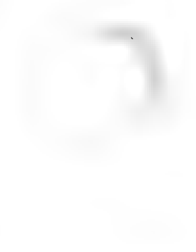

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PLATE 26.

PLATE 26.

Late stages in the development of the parasitic generation of Pegantha smaragdina, sp. nov.

Fig. 1. Early medusa stage with seven tentacles. The bell margin is indicated by a coronal thickening just oral to the tentacles. × 50.

Fig. 2. Aboral view of slightly older medusa, with eight tentacles. The ridge representing the future bell margin is now prominent, and the aboral surface is flattened. × 50.

Fig. 3. Side view of still further advanced stage. The general outline is now flattened. There are nine tentacles of different sizes. × 50.

Fig. 4. Aboral view of an older medusa. The typical medusa outline has been assumed. There are now ten tentacles. Otocysts have been developed (one per marginal lappet) and the marginal lappet zone has increased in width. × 35.

Fig. 5. The oldest stage taken. There are two otocysts in some of the lappets. Peronii are developed. From a specimen stained in borax-carmine. × 35.

Fig. 6. Early stage in the development of an otocyst, in optical section; (ec) ectoderm, (en) endodermic core of future sense organ, the position of which is marked on the exterior by a slight prominence. No otolith is yet formed. × 250.

Fig. 7. Twin otocysts (oc). In only one has the otolith been developed; (en) endodermic core. × 350.

Figs. 8, 9. Two successive stages in the development of otocysts (oc) and otoliths. × 350.

Fig. 10. Tentacle and peronia (pr) of the specimen shown in Fig. 5. × 100.

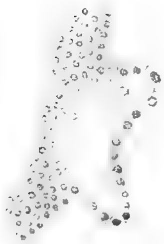

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PLATE **27**.

PLATE 27.

Stages in internal budding in Pegantha laevis, sp. nov.

Fig. 1. Surface (aboral) view of a portion of peronial and ring canal showing budding. × 35.

Fig. 2. A budding ridge or stolon dissected out. Surface view. × 200.

Fig. 3. Cross section of ring canal in plane of a stolon; (g) mesogloea; (c.c) lumen of the circular canal; (s.lam) stutzlamella; (ec) ectoderm; (en) endoderm; (v) velum. × 250.

Fig. 4. Section through a stolon, more enlarged, (ec) ectoderm of canal; (en) endoderm; (s.lam) stutzlamella. × 350.

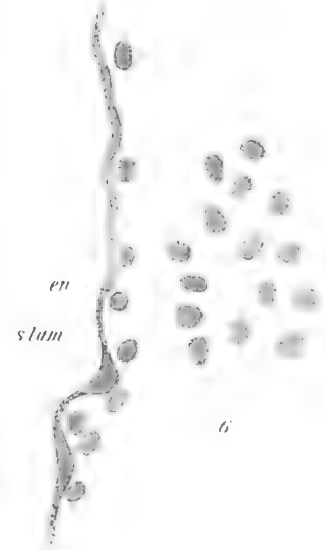
Fig. 5. Section through bud formed directly from endoderm (en) of canal. The ectoderm is not shown; (s.lam) stutzlamella. × 500.

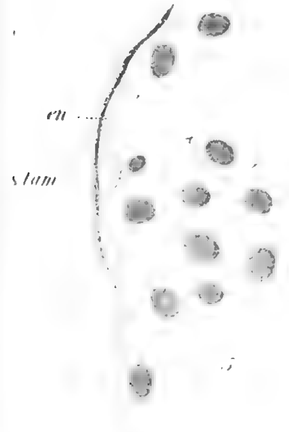
Fig. 6. An older bud, in morula stage, lying free in the lumen of the canal. The ectoderm of the canal is not shown. Lettering as above. × 500.

Fig. 7. Same stage in surface view.

Cunina species (?)

Fig. 8. Budding stolon taken from the gastric cavity of a Solmundella bitentaculata. × 100.





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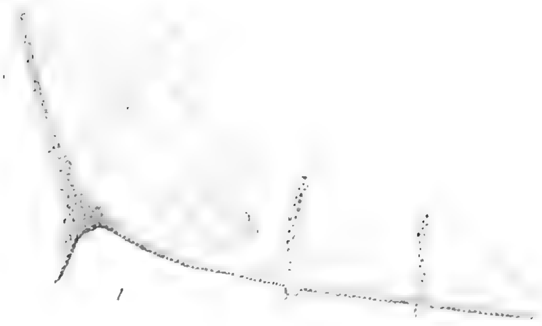

PLATE 28.

Plate 28.

Cunina peregrina, sp. nov., stages in internal budding.

Fig. 1. Surface view of two adjacent gastric pockets, showing endodermal thickenings and budding. × 10.

Fig. 2. Surface view of one corner of a gastric pocket, showing active formation of endodermal ridges, or proliferating stolons, and buds. × 100.

Fig. 3. Surface view of one such stolon. × 300.

Fig. 4. Radial section through a gastric pocket, in the plane of the tentacle, showing the location of the stolons near the margin of the pocket, and their relation to the gonad (go); (g) mesogloea; (t) tentacle; (n.p) nematocyst pad; (v) velum; (s.lam) stutzlamella; (ec) ectoderm; (g.cav) cavity of the gastric pocket. × 100.

Figs. 5–7. Three successive stages in the constriction of the bud, b^2, from the budding stolon, b^1, showing the endodermic nature of the latter. In Fig. 5, the bud is but slightly constricted, in Fig. 6 it is almost separated, and in Fig. 7 it lies free in the cavity of the gastric pocket, though close to the stolon (b^1); (ec) ectoderm; (en) endoderm; (s.lam) stutzlamella. × 350.

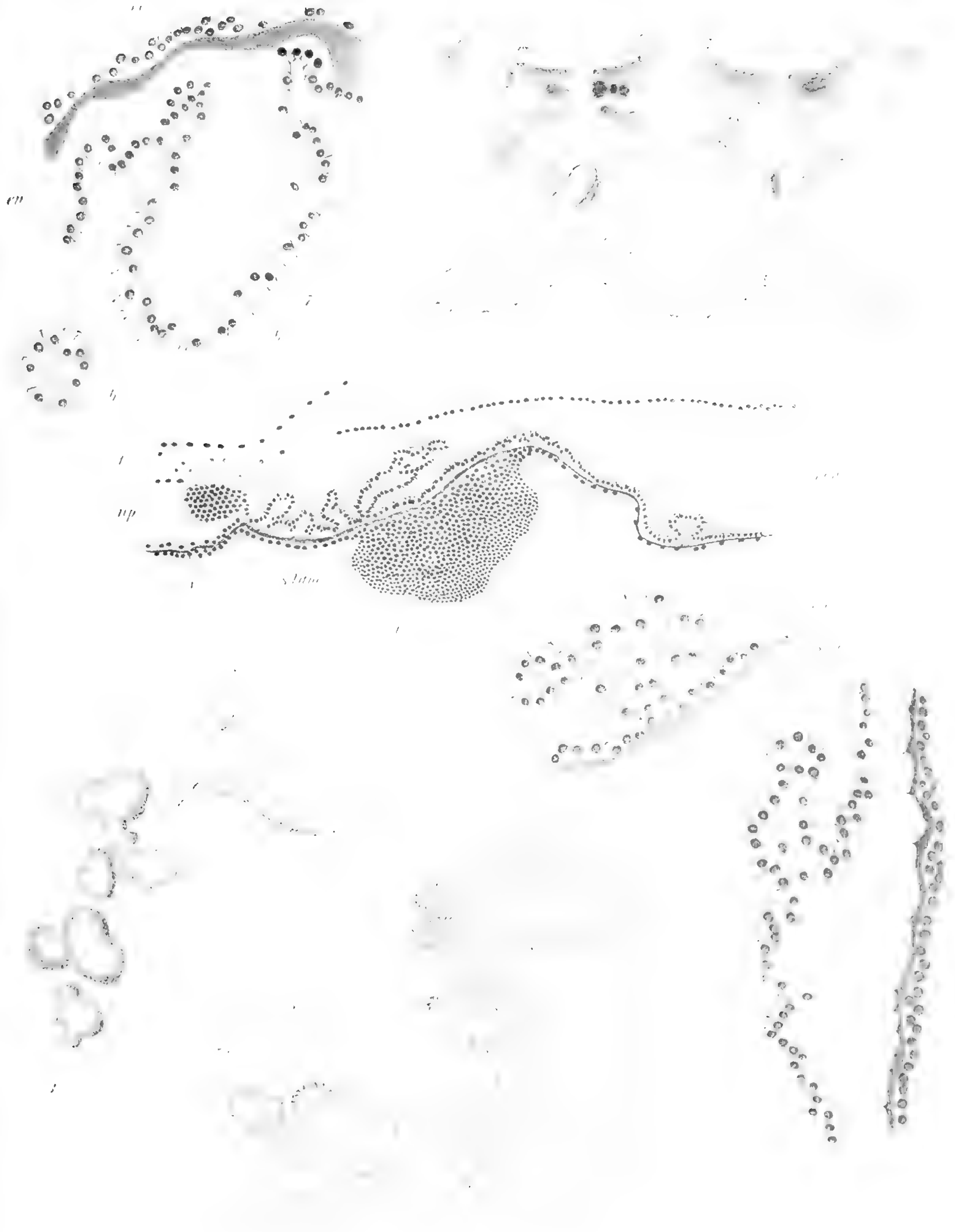
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PLATE 29.

Plate 29.

Tetrorchis erythrogaster, gen. nov., sp. nov.

Fig. 1. Side view of the type specimen: the color of the manubrium is taken from a sketch from life made on board the "Albatross." × 4.

Fig. 2. Side view of margin of bell, with large radial tentacle opposite the fertile radial canal; (go) gonad; (en.r) endodermic root of radial tentacle; (c.c) circular canal; (v) velum. × 16.

Fig. 3. Base of one of the small tentacles, with rounded endodermic root (en.r). × 100.

Aglantha digitale, var. intermedia, var. nov.

Fig. 4. Side view of mature specimen, 14 mm. in diameter, showing the form of the gonads and bell, and the muscular condition of the subumbrella.

Fig. 5. Oral view of the same specimen, showing the stumps of eighty-eight tentacles.

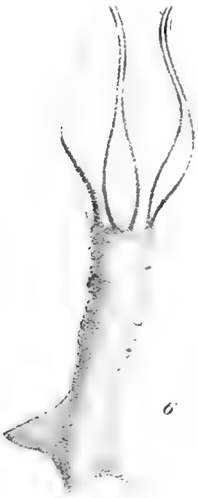
Fig. 6. Peduncle, showing the course of the radial canals, and manubrium with the mouth widely open, showing the absence of separate lips. × 10.

Fig. 7. Peduncle and manubrium, with mouth closed. The ridges thus formed suggest the presence of four long lips. × 10.

Fig. 8. Manubrium with lip region everted, showing the endodermic pigmentation of the lining of the gastric cavity. From a sketch from life. × 10.

Fig. 9. The youngest specimen taken, 2.5 mm. high. There is as yet no peduncle, and no trace of gonads.

Fig. 10. A somewhat older specimen, 5 mm. high, in which the peduncle is developed. Minute globular swellings on the radial canals near the apex of the bell cavity represent the earliest visible stage in the development of the sexual organs.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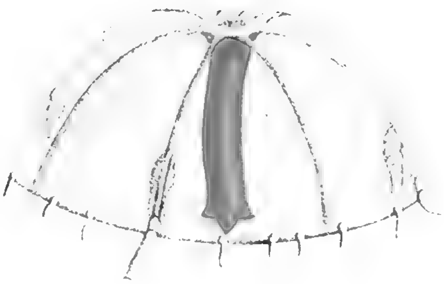
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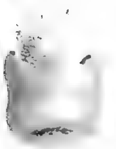
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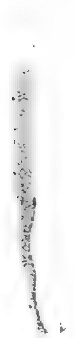
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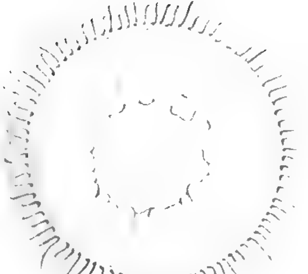
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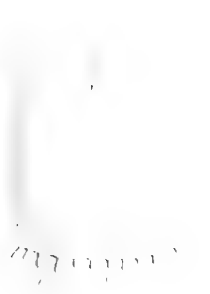
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PLATE 30.

PLATE 30.

Gossea brachymera, sp. nov.

All figures except Fig. 3 are from photographs.

Fig. 1. General side view, from preserved type. × 10.

Fig. 2. Oral view of the same specimen. × 10.

Fig. 3. Diagrammatic drawing of one quadrant of the bell margin, showing arrangement of marginal organs; (t.ra) radial tentacle; (t^1 and t^2) primary and secondary tentacle of each tentacle group; (c.ra) radial canal; (c.c) circular canal; (n.p) nematocyst pad. × 20.

Fig. 4. Photograph of a similar quadrant; ($t.ra^1$ and $t.ra^2$) primary and secondary members of radial tentacle group. The interradial tentacle group is likewise composed of two members. The adradial tentacles are simple; (go) gonad; (c.ra) radial canal. × 30.

Fig. 5. Base of interradial tentacle, showing position of otocyst (otc). × 60.

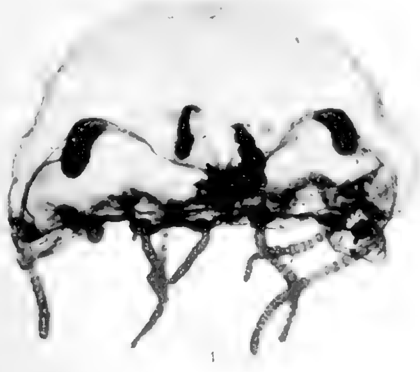
Fig. 6. Two radial, and an interradial tentacle, showing nematocyst rings, and absence of sucking pads. × 60.

Fig. 7. Interradial tentacle group; oral view, showing the primary and secondary members, t^1 and t^2. × 60.

Fig. 8. Side view of the same, showing especially the spur-like form of the secondary tentacle (t^2), and the form of the nematocyst pad (n.p). × 60.

Fig. 9. Aboral view of same.

Fig. 10. An adradial tentacle still more enlarged; its solid endodermic core (en) is clearly visible. × 90.



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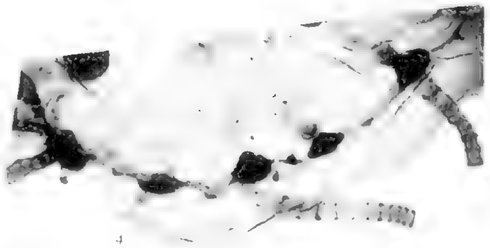

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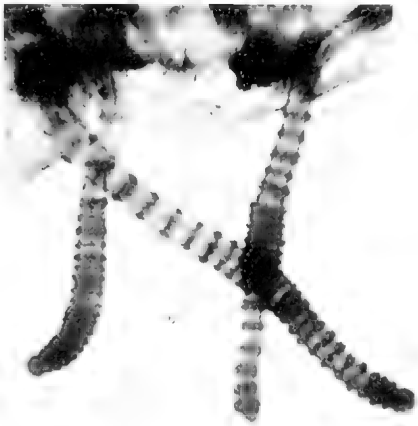

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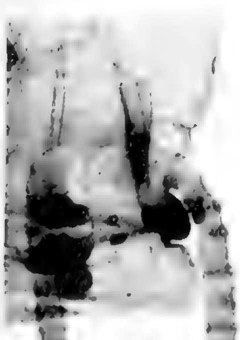

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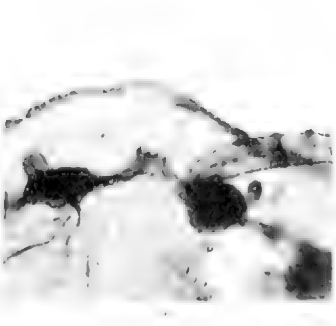

PLATE 31.

Plate 31.

Olindias singularis.

Fig. 1. General view. × 2.

Fig. 2. Aboral view of the same specimen, showing the blind centripetal canals.

Fig. 3. Side view of a portion of the margin, showing the position of the otocysts (oc) at the bases of the primary (exumbrella) tentacles (t.ex). × 8.

Fig. 4. A portion of the bell margin; (t.ex) primary tentacles; (tv) secondary (velar) tentacles; (t.b) tentacular bulbs. At the base of each primary tentacle there are either one or two otocysts. × 6.

Fig. 5. A portion of the same, more enlarged.

Fig. 6. Manubrium, showing the complexly folded lips. × 4.

Fig. 7. Tip of a secondary (velar) tentacle, with terminal nematocyst knob.

Fig. 8. Tip of a primary tentacle; (s) sucking disc.

Fig. 9. A portion of a secondary tentacle, to show arrangement and extent of nematocyst bands.

Fig. 10. Base of a primary tentacle with two otocysts; (oc) otocyst; (ot) otolith; (t) tentacle. In one otocyst there is one; in the other, there are two otoliths. × 25.

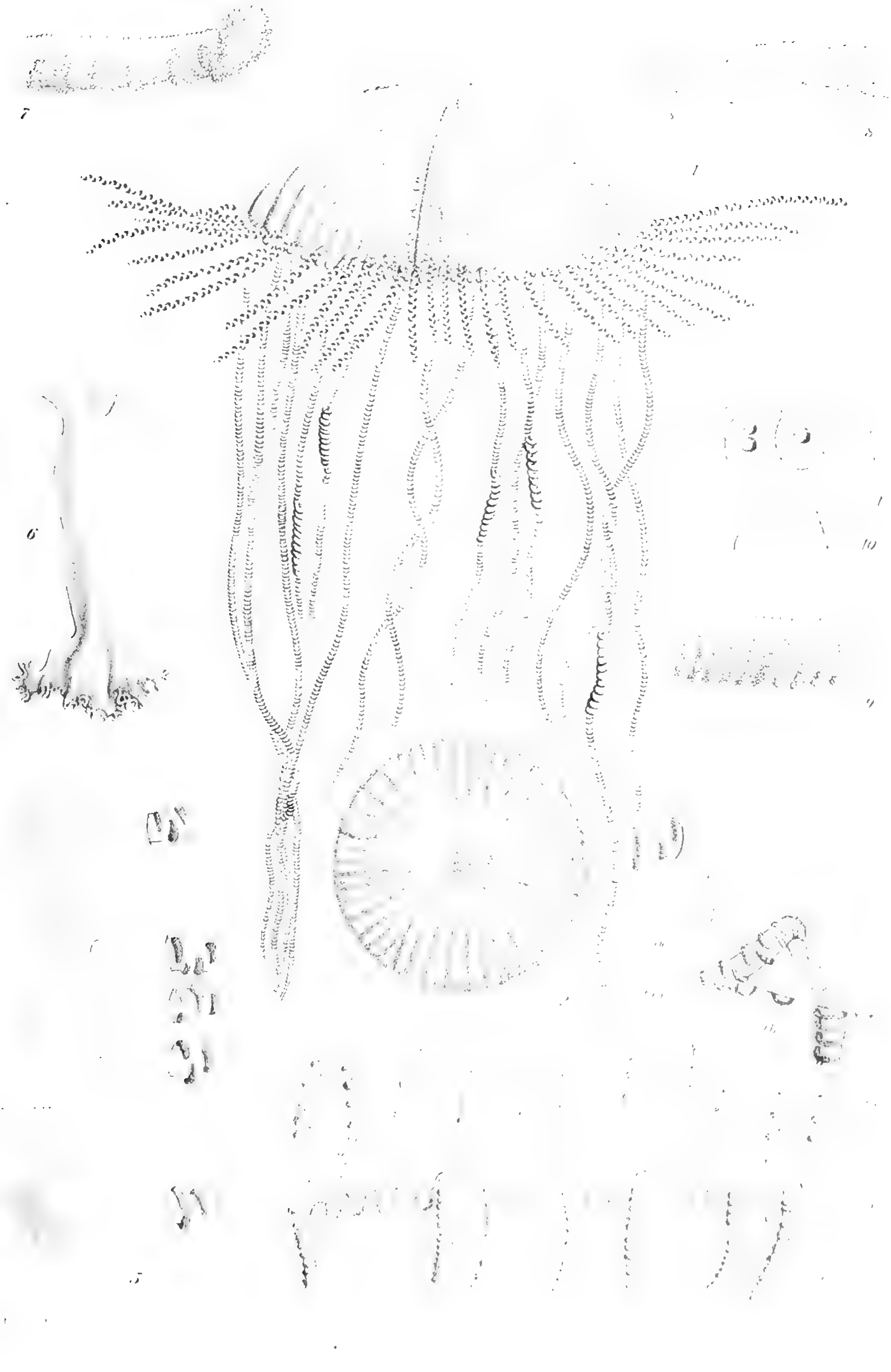
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PLATE 32.

PLATE 32.

All figures from unretouched photographs of preserved specimens.

Gonionemus suvaensis.

Fig. 1. A little more than one quadrant of the bell margin, with tentacles and otocysts. Only three of the latter are visible. × 20.

Fig. 2. Dissection of bell margin, showing endodermal roots of tentacles. × 40.

Fig. 3. Portion of tentacle, showing sucking disc. From a specimen stained in borax-carmine. × 75.

Fig. 4. Side view of manubrium. × 20.

Fig. 5. Gonad by transmitted light; from a specimen cleared in glycerine. × 35.

Fig. 6. Portion of margin showing bases of two tentacles, and otocyst containing one otolith. × 75.

Fig. 7. Abnormal individual, 7 mm. in diameter, with only one radial canal and one gonad.

Olindias singularis.

Fig. 8. Abnormal individual, with nine gonads and two distinct gastric cavities. × 2.

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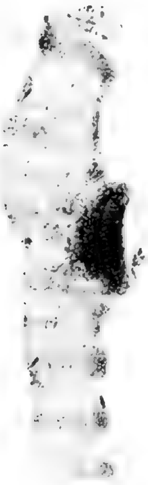

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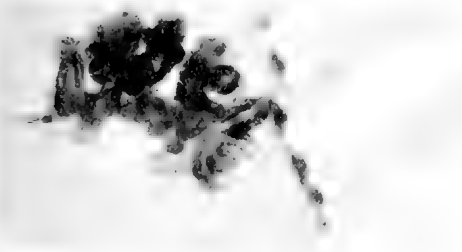

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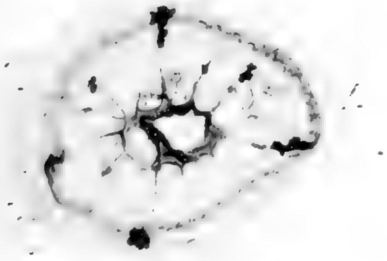

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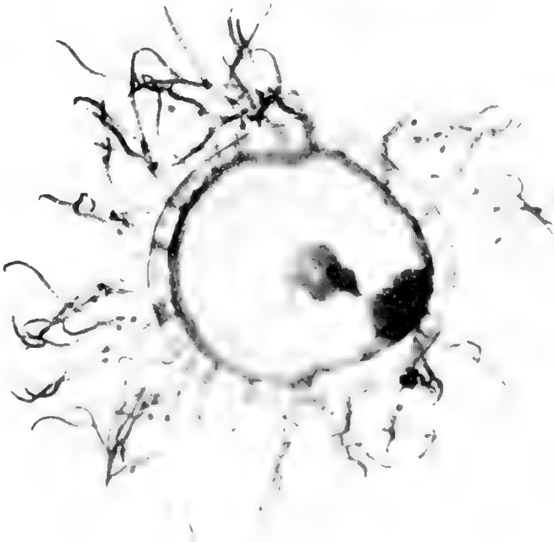

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Plate 33.

PLATE 33.

Fig. 1. Halitrephes maasi, gen. nov., sp. nov. Tentacle base, showing endodermic roo (en.r). × 20.

Fig. 2. Halitrephes maasi, tentacle, showing differentiation into proximal and dista regions. × 5.

Fig. 3. Halitrephes maasi. Somewhat diagrammatic section through bell margin t illustrate relation of endodermal root of the tentacle (en.r) to circular cana (c.c); (v) velum; (g) mesoglœa.

Fig. 4. Halitrephes maasi, oral view of type. The position of the gonads is indicated by the shaded areas at the bases of certain of the radial canals. Slightly more than natural size.

Fig. 5. Halitrephes maasi. Proximal portion of tentacle in optical section, to show its core of chordate endodermic cells; (en) endoderm core.

Fig. 6. Homeonema alba, otocyst. From a photograph. × 250.

Fig. 7. Halitrephes maasi. Tip of tentacle, closely crowded with nematocysts. × 30.

Fig. 8. Halicreas papillosum, otocyst; (en) endodermic core. From a photograph. × 250.

Fig. 9. Halicreas papillosum. Segment of distal portion of tentacle with the ectoderm partly stripped off, showing the endodermic core.

Fig. 10. Halitrephes maasi, otocyst. × 150.

Fig. 11. Homoeonema alba; one octant of bell margin; (en.r) endodermic root of the large radial tentacles (t.ra) of which only the stumps persist; (otc) otocyst. There are stumps of fourteen interradial tentacles. From a photograph. × 15.


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PLATE 34.

PLATE 34.

All figures from unretouched photographs of preserved specimens.

Halicreas papillosum.

Fig. 1. Oral view of about one-half the disc of an adult specimen, showing position of the gonads (go), radial canals, and exumbral papillae (p.ra). × 2.

Fig. 2. Portion of bell margin, with marginal organs, particularly to illustrate the difference in size between radial (t.ra), and adradial (ta.ra) tentacles; (c.ra) radial canal; (otc) otocyst. × 10.

Fig. 3. Oral view of an exumbral papilla (p.ra), showing its secondary projections; (c.ra) radial canal. × 5.

Fig. 4. Homoeonema species (?); one octant of bell margin with marginal organs; (t.r) radial tentacle; (t.ira) interradial tentacle; (otc) otocyst. × 20.

Fig. 5. Halicreas papillosum, distal portion of tentacle; (en) chordate cells of endodermic core. × 40.

Fig. 6. Oral view of Homoeonema species (?) × 5.

Tentacles of Halicreasidae.

Fig. 7. Homoeonema species (?); tip of tentacle thickly clothed with nematocysts. × 40.

Fig. 8. Halicreas papillosum; transition region between proximal and distal portions. × 40.

Fig. 9. Homoeonema alba, tentacle tip. × 40.

Fig. 10. Halicreas papillosum, tentacle tip. × 40.

Fig. 11. Halicreas papillosum, entire tentacle, showing differentiation into stout proximal, and slender spine-like distal portions. × 20.

Amphogona apsteini.

Fig. 12. Transverse section through two adjacent gonads; both female and containing large ova; (en) endoderm. × about 50.

Fig. 13. Otocyst. (Cf. Fig. 10, Pl. 45.) × about 100.

Fig. 14. Margin, showing tentacle stumps, radial canals (c.ra), and spherical gonads (go). × about 50.

Fig. 15. Manubrium and peduncle; (c.ra) radial canal. × 20.


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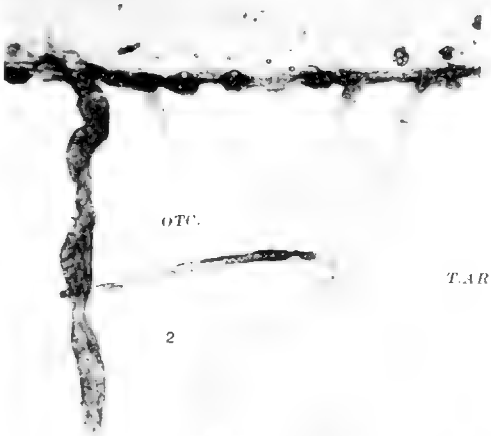
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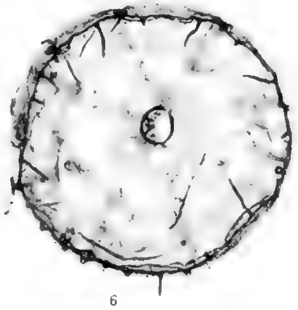
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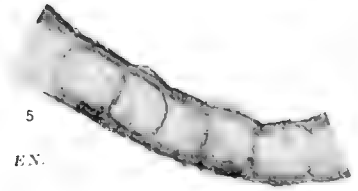
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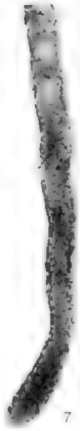
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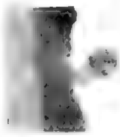
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PLATE 35.

PLATE 35.

All figures are from unretouched photographs of preserved specimens.

Fig. 1. Eutima levuka. Quadrant of bell margin, with marginal organs; (c.ra) radial canal; (t.ra) radial tentacle; (otc) otocyst. × about 20.

Fig. 2. Eutima levuka. Tentacle base showing lateral cirri (ci); (c.c) circular canal. × 30.

Aequorea coerulescens.

Fig. 3. Portion of bell margin showing radial canals (c.ra); gonads (go), and the very numerous and densely crowded tentacles; (g) gelatinous substance. × 6.

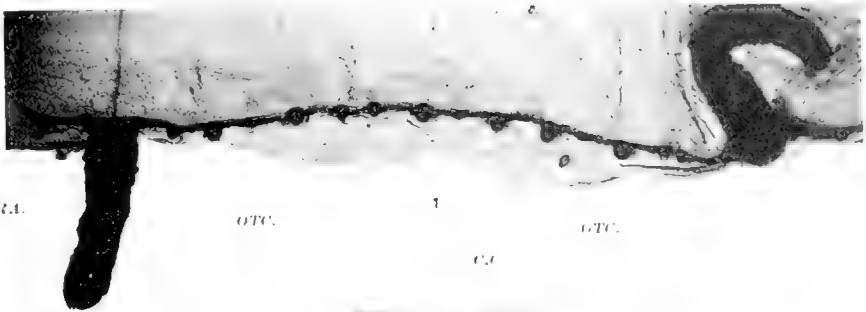
Fig. 4. A segment of the gastric wall, showing conformation of the lips, and the bases of radial canals (c.ra) of various sizes. × 6.

Fig. 5. Portion of bell margin more enlarged, to show a twin otocyst (otc).

Fig. 6. Oral view of tentacle bases; (v) velum; (p. ex) excretory papilla. × 30.

Fig. 7. Side view of tentacle base; (p. ex) excretory papillae. × 35.

Fig. 8. Aboral view of tentacle bases; (c.ra) radial canal; (c.c) circular canal; (v) velum. × 30.



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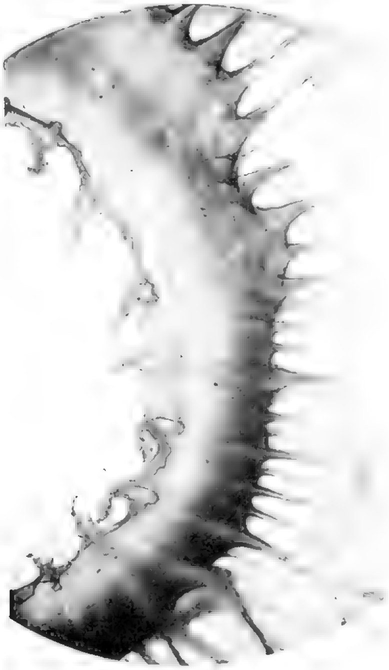

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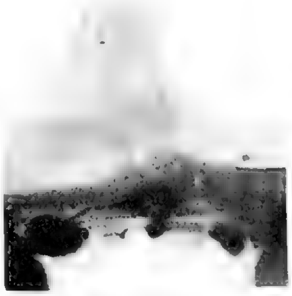

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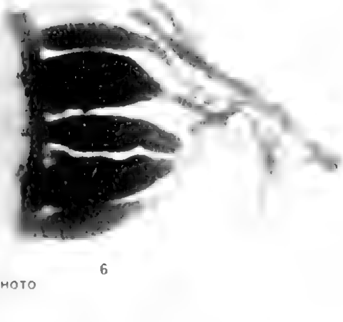

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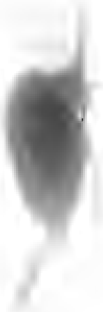

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PLATE 36.

PLATE 36.

Eirene viridula.

Fig. 1. Side view of medusa, from life. × 5.

Fig. 2. Portion of margin, with otocyst containing four otoliths, and marginal cirrus; (en) solid endodermic core of cirrus; (n) nematocyst. × about 150.

Fig. 3. Aboral view of base of manubrium showing form of lips, and basal portion of radial canals. × 15.

Fig. 4. Portion of bell margin with marginal organs, tentacles, tentacular knobs, cirri, and otocysts (otc). × 15.

Aequorea macrodactylum.

Fig. 5. Tentacle base, aboral view, (go) gonad. From a photograph. × 30.

Fig. 6. Bell margin showing tentacles, tentacular knobs, and otocysts (otc), and the extremities of the radial canals. × 10.

Fig. 7. Tentacle base seen from within; (go) gonad. From a photograph. × 30.

Fig. 8. Tentacle base, side view; (ex.p) excretory papilla. From a photograph. × 30.

Fig. 9. General oral view of medusa, showing condition of the gastric wall often seen in life. × 3.

Fig. 10. Otocyst, containing two otoliths (otl). × about 200.


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Plate **37**.

PLATE 37.

All figures are from unretouched photographs.

Eirene medusifera, sp. nov.

Fig. 1. One quadrant of bell margin. The positions of the otocysts are indicated by the white arrows; and the otocysts themselves (otc) can be seen on careful examination; (t.ra) radial tentacle. × about 20.

Fig. 2. Base of tentacle flanked by lateral cirri (ci). × 45.

Fig. 3. Rudimentary tentacle, flanked by lateral cirri (ci). × 45.

Fig. 4. Otocyst, containing two otoliths. × about 250.

Fig. 5. Distal portion of radial canal, along which no gonad is yet developed, but which bears medusa buds, b^1, b^2, in various stages of development. × about 50.

Fig. 6. Lateral view of medusa with one side of the bell dissected away so as to show the form of the peduncle (pd), and of the manubrium (mn). × 10.

Fig. 7. Radial canal (c.ra), bearing medusa buds nearly ready to be liberated; (mn) manubrium, and (t) tentacle, of medusa bud. × about 50.

Fig. 8. Oral view of a portion of the bell, showing radial canal with gonad (go) bearing medusa buds. × about 30.

Fig. 9. Phialucium comata, sp. nov., tentacle base and otocyst (otc). × about 30.

Fig. 10. Phialucium comata. Tentacle base showing lateral cirri (ci). × about 30.

Fig. 11. Eutimalphes scintillans, sp. nov. One quadrant of bell margin. The positions of the two otocysts are indicated by the white arrows. The otocysts themselves can be seen on careful examination; (c.ra) radial canal; (t.ra) radial tentacle; (go) gonad; (v) velum. × 10.

Fig. 12. Phialucium comata. Portion of bell margin showing marginal organs. The positions of two otocysts, which are plainly visible, are indicated by white arrows; (t.ra) radial tentacle; (c.ra) radial canal; (go) gonad. × 15.

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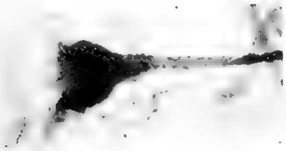

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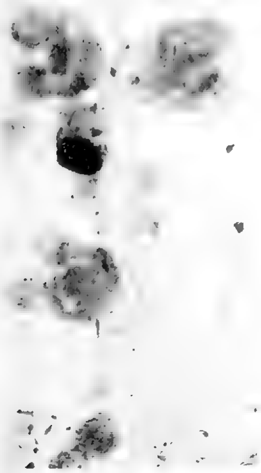

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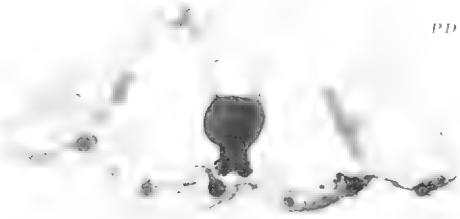

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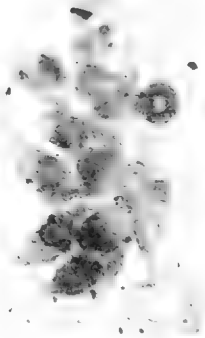

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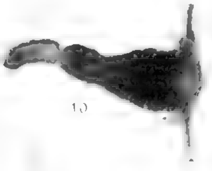

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PLATE 38.

PLATE 38.

Fig. 1. Octocanna polynema; oral view; from preserved specimen; (l) lip; (go) gonad. × 6.

Fig. 2. Octocanna polynema; one quadrant of bell margin; (t.ra) radial tentacle; (t^2) rudimentary tentacular knob; (otc) otocyst; (p.ex) excretory papilla. × about 20.

Fig. 3. Octocanna polynema; otocyst (otc) with otolith (otl). × about 75.

Fig. 4. Phialium duodecimalis; oral view of a preserved specimen. × 30.

Fig. 5. Phialium duodecimalis; one quadrant of bell margin, showing radial tentacles flanked by cirri (ci) and otocysts (otc). × 50.

Fig. 6. Phialidium discoida. Portion of bell margin showing closely crowded tentacles with large basal bulbs and otocysts (otc). × 60.

Fig. 7. Phialidium discoida; otocyst (otc) containing a single otolith. In many instances the otocysts contain several otoliths.

Fig. 8. Ptychogena erythrogonon, sp. nov., cordylus; (en) endodermic core; (ec) ectodermic covering layer. × 75.

Fig. 9. Ptychogena erythrogonon; cirrus with terminal nematocyst cluster. × 75.

Fig. 10. Amphinema australis; one half of bell margin, with two large tentacles, and rudimentary tentacular knobs with ocelli (o). × 20.

Fig. 11. Amphinema australis. Cross-section of bell, through gonads (go) to show interradial position of the latter; (l) lip; (c.ra) radial canal. From a photograph of a dissection. × 30.

Fig. 12. Ectopleura ochracea; side view of preserved specimen. × 50.

Fig. 13. Ectopleura ochracea; aboral view of same specimen to show extent of exumbral nematocyst ridges (nem).


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PLATE 39.

PLATE 39.

Ptychogena erythrogonon, sp. nov.

Fig. 1. Side view of type specimen, from a colored sketch from life.

Fig. 2. Aboral view of manubrium and radial canal in a specimen in which the gonads have not yet developed. The diverticula of the aboral surface of the canal, between which the sexual folds later appear, are already formed. × 5.

Fig. 3. Aboral view of radial canal and gonad (go) of adult specimen, showing the isolated genital folds (go) and the distribution of the pigment. × 5.

Fig. 4. Side view of same. From a preserved specimen. × 5.

Fig. 5. Portion of bell margin of adult, showing marginal organs; (t.ra) radial tentacle; (co) cordylus. × 5.

Fig. 6. Aboral view of a specimen 18 mm. in diameter. The manubrium is relatively much broader than in adult; the tentacles fewer. The radial canals as yet show no diverticulae. From life.

Fig. 7. Aboral view of manubrium of adult, showing widely open mouth, through which is to be seen the junction of the four unpigmented lines which extend along the aboral surfaces of the radial canals. From a preserved specimen. × 4.

Turris fontata, sp. nov.

Fig. 8. Side view of type specimen, from a colored sketch from life. For details of bell margin, see Plate 42. × 2.5.

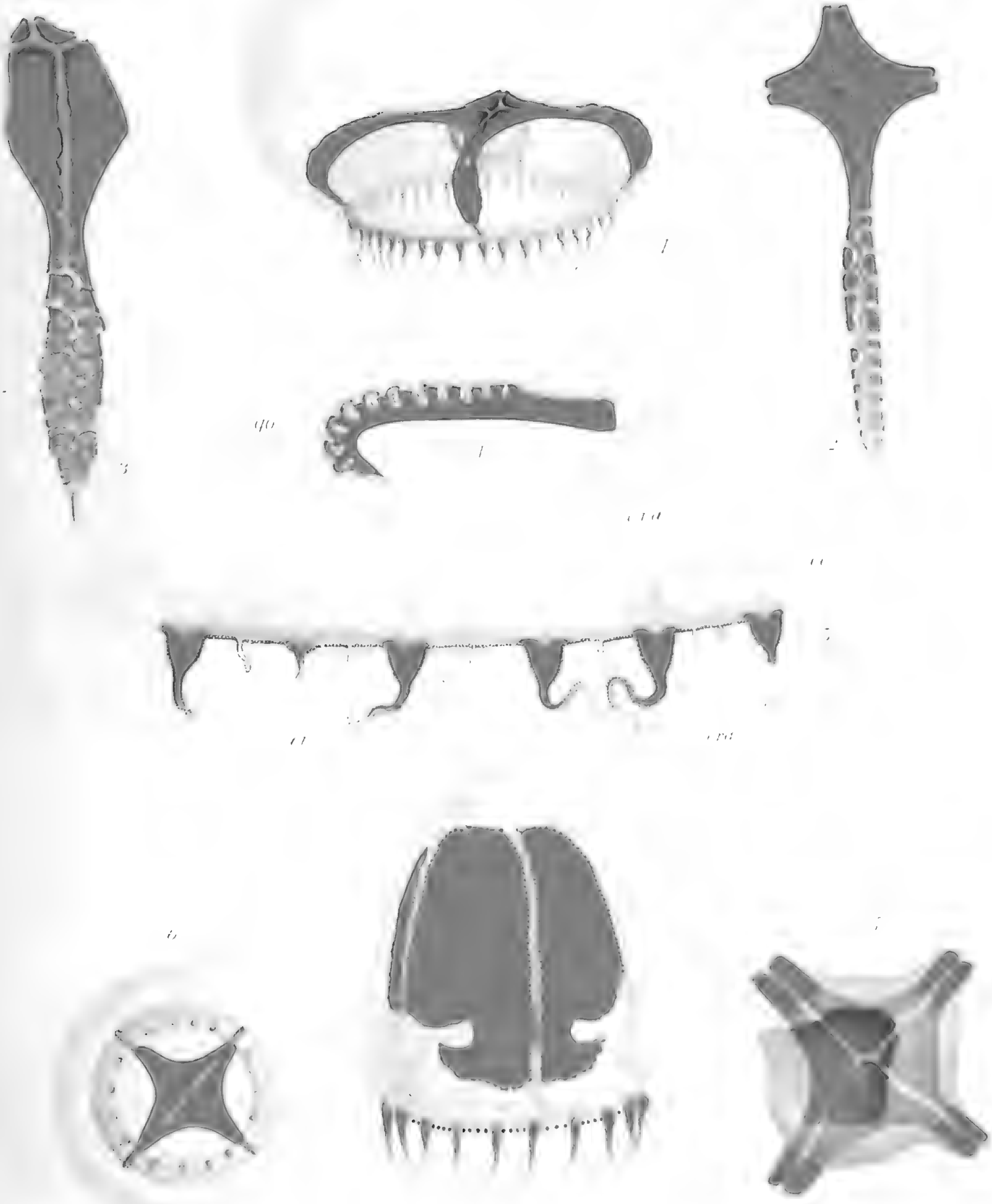

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PLATE 40.

PLATE 40.

All figures from colored sketches made from life on board the "Albatross."

Fig. 1. Sarsia coccometra, sp. nov., type. × 10. For details, see Plate 43.

Fig. 2. Cytaeis vulgaris. × 10. For details, see Plate 43.

Fig. 3. Lymnorea alexandri. × 8.

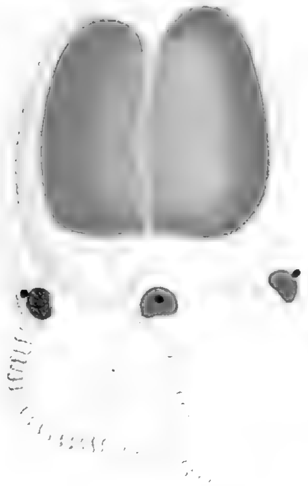
Fig. 4. Lymnorea alexandri, aboral view, showing junction of canals at base of manubrium, and interradial position of gonads.

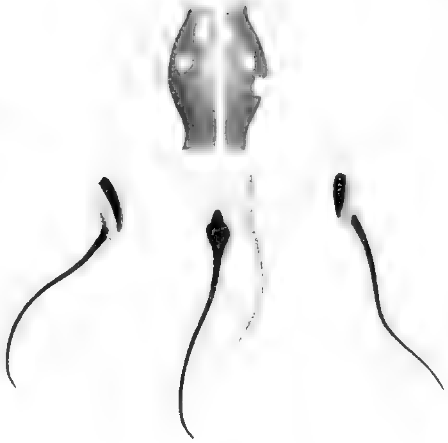
Fig. 5. Cytaeis vulgaris, aboral view of tentacle base, showing endodermic (brown) and ectodermic (yellow) pigmentation.

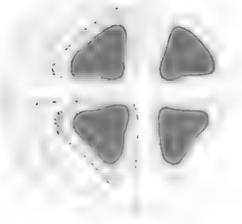
Fig. 6. Amphinema turrida. The outline of the figure is incorrect, in that it fails to show that the two radial tentacular knobs are of larger size than the adradials. See photograph, Fig. 3, Plate 43. × 12.

Fig. 7. Pennaria species (?) × 30.

Fig. 8. Sarsia resplendens, sp. nov., type. × 25.







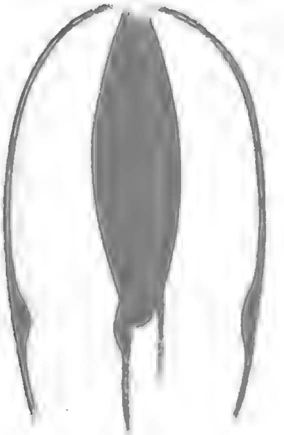


PLATE 41.

Plate 41.

Proboscidactyla ornata, var. stolonifera.

Fig. 1. Side view of preserved specimen, 5 mm. in diameter.

Fig. 2. Oral view of base of manubrium and radial canals (c.ra), in a specimen 3 mm. in diameter, in which the gonads (go) have appeared.

Fig. 3. Oral view of base of manubrium of slightly larger female specimen, showing extension of gonads (go) along radial canals (c.ra).

Fig. 4. Same view of a specimen 5 mm. in diameter, showing extreme extension of gonads (go).

Fig. 5. Base of tentacle showing pigment spot (o); (nem) nematocyst pad; (en) endodermic core of tentacle; (c.ra) radial canal.

Fig. 6. Portion of bell margin; (nem) exumbral nematocyst cluster; (c.ra) radial canal. From a photograph. × about 30.

Fig. 7. Diagram of canal system in a large specimen.

Fig. 8. Sibogita simulans, sp. nov., aboral view of apex of bell of type specimen, showing blind terminations of adradial centripetal canals (c.ara); (c.ra) radial canal; (go) gonad. × 3.

Fig. 9. Sibogita simulans, tip of tentacle with nematocyst knob (nem). × about 15.

Fig. 10. Pandea violacea, one quadrant of bell margin; (t.ra) radial tentacle; (o) ocellus; (c.c) circular canal. × about 25.

Fig. 11. Pandea violacea, side view of preserved specimen, 4 mm. in diameter.

Fig. 12. Heterotiara anonyma, aboral view; (go) gonads; through an error these are represented as *per* instead of *interradial*. × 3.

Fig. 13. Heterotiara anonyma, side view of preserved specimen; gonads are interradial. × 3.


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PLATE 42.

PLATE 42.

Tiara papua.

Fig. 1. A very young individual, 2 mm. in diameter with long apical projection and apical canal (c.ap). From life.

Fig. 2. Side view of a specimen, 5 mm. in diameter, with horseshoe-shaped gonads (go) well developed. The tentacles are all broken short off; (pr.ap) apical projection; (l) lip; (t.ra) radial tentacle; (c.ra) radial canal. From a photograph.

Fig. 3. Quadrant of bell margin of a slightly older specimen, 7 mm. high by 5 mm. in diameter; (o) ocelli; (c.c) circular canal.

Fig. 4. Oral view of the same specimen, showing either one or two tentacles and from two to four rudimentary tentacles between every two radial canals (c.ra); (o) ocellus.

Turris fontata, sp. nov., type.

Fig. 5. Distal portion of radial canal (c.ra), showing lateral glandular diverticula and bell margin; (c.c) circular canal; (t.ra) radial tentacle; (o) ocellus. From a photograph. × 5.

Fig. 6. Portion of bell margin with marginal organs; (t^1) large tentacle; (t^2) immature tentacle; (o) ocellus; (s) exumbral sense pit. × 15.

Fig. 7. Longitudinal section through base of large tentacle, showing tentacular ostium (os) by which its cavity communicates with the exterior; (l.vas) vascular endoderm lamella; (ec) ectoderm; (en) endoderm; (v) velum. × 30.

Fig. 8. Side view of base of tentacle; (g) jelly; (s) exumbral sense pit; (c.c) lumen of circular canal; (v) velum. From a photograph. × 15.

Fig. 9. Side view of margin of bell, and exumbral sense pit (s); (t) base of tentacle. × 100.

Fig. 10. Section through margin of bell and sense pit; (ec) ectodermic lining of sense pit, with bristle cells. × 150.

Fig. 11. Exumbral view of tentacle base, and sense pit (s); (os) tentacular ostium. × 20.

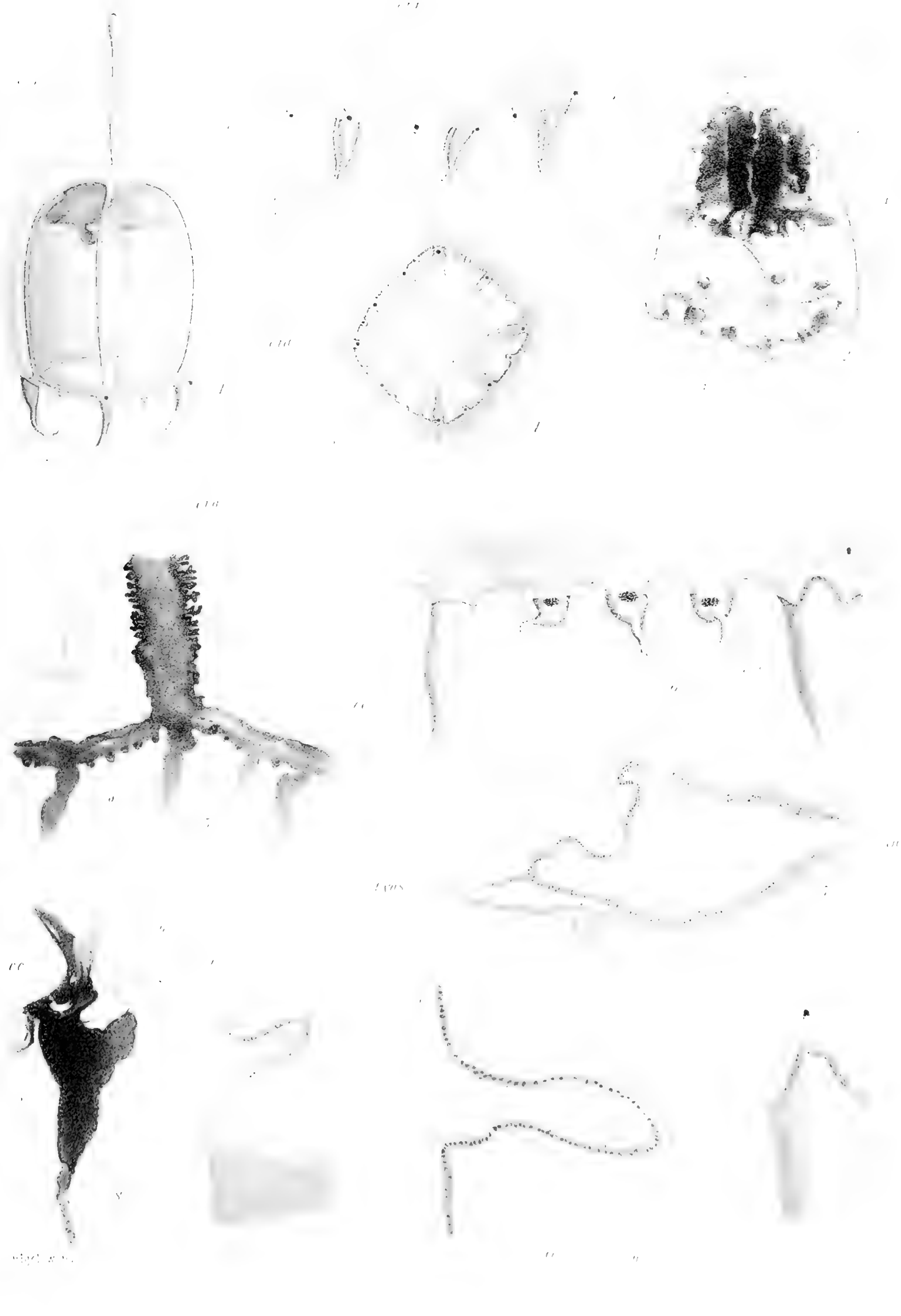

PLATE 43.

PLATE 43.

All figures engraved from photographs.

Fig. 1. Sibogita simulans, sp. nov., type. Apex of bell cavity in side view. The blind termination of one of the adradial canals (c.ara) is clearly visible; (c.ra) radial canal; (go) gonad. × 4.

Fig. 2. Sibogita simulans, portion of bell margin. There is one tentacle opposite every canal; (c.ara) adradial canal; (c.c) circular canal; (t.ra) radial tentacle. × 6.

Fig. 3. Amphinema turrida; one-half of bell margin showing the two well-developed radial tentacles, and a large radial tentacular bulb. There are in addition two or three rudimentary tentacular knobs in each quadrant. In this specimen none of the latter bear filaments, but occasionally they do so; (c.ra) radial canal; (o) ocellus. × 12.

Fig. 4. Cytaeis vulgaris, manubrium with medusa buds (b); (tl) labial tentacle. × about 20.

Fig. 5. Cytaeis vulgaris, lip region; (tl) labial tentacle.

Fig. 6. Stomotoca divisa; manubrium, to show crenulated lips (l) and gonads (go). × 2.

Fig. 7. Stomotoca divisa; one-half of bell margin, showing the two large radial tentacles (t.ra), and numerous rudimentary tentacular knobs; (c.ra) radial canal. × 2.5.

Fig. 8. Sarsia coccometra, sp. nov., tentacle, showing nematocyst ridges and terminal nematocyst knob; (o) ocellus; (c.ra) radial canal.

Fig. 9. Sarsia coccometra. Manubrium and apex of bell. The interradial ridges labelled (go) are not the gonads, but merely folds of the gastric wall. (See p. 180.)

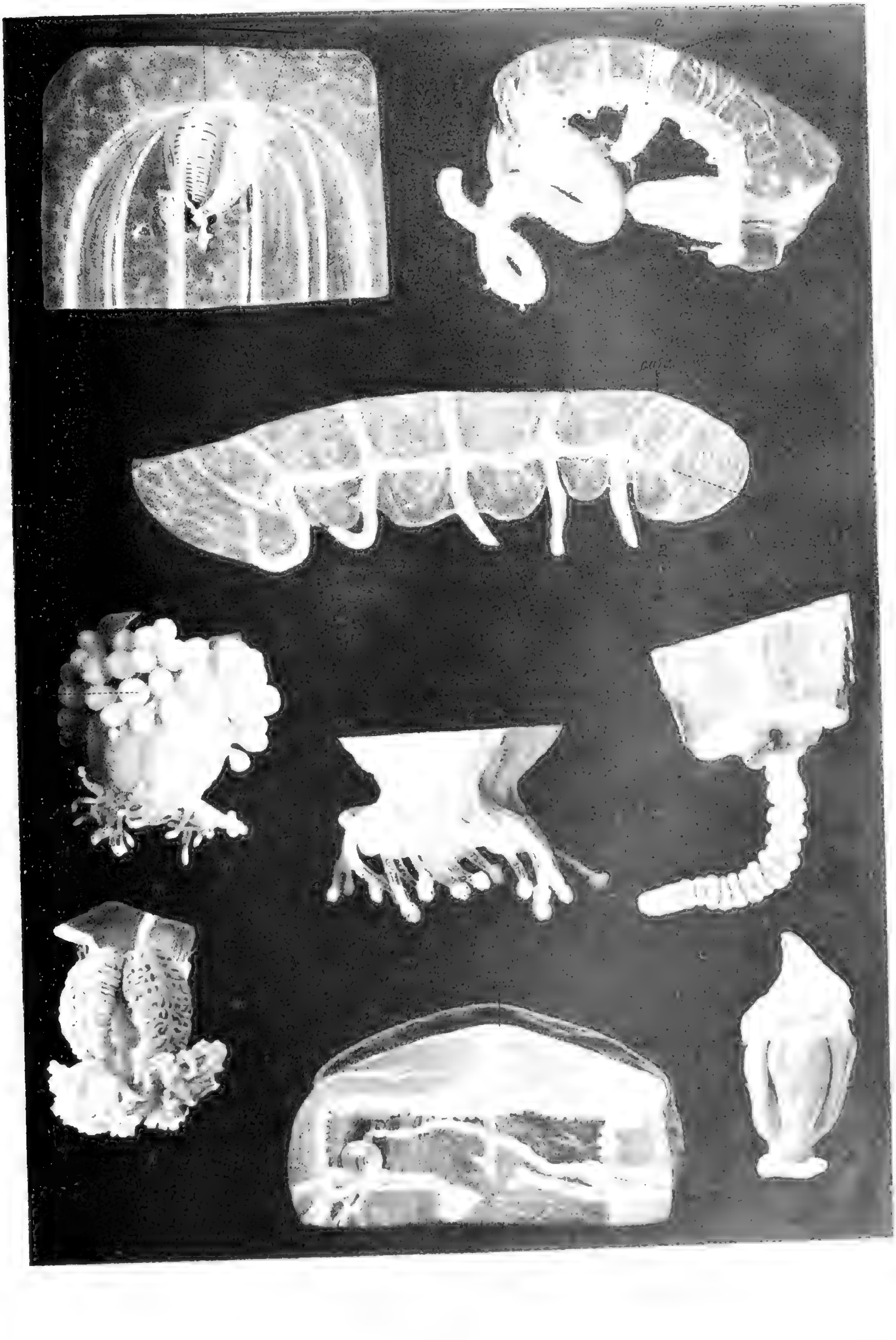

Plate **44**.

Plate **44**.

Fig. 1. Zanclea gemmosa; portion of bell and tentacle (t); (c.ra) radial canal; (nem.r) exumbral nematocyst rib; (nem) stalked tentacular cnidoblast. × about 50.

Fig. 2. Zanclea gemmosa; manubrium with large ova (ov). × 40.

Fig. 3. Amphinema turrida; side view of an immature specimen. The gonads (go) have not yet united with the subumbrella. From a preserved specimen. × 25.

Fig. 4. Amphinema turrida. Cross-section of manubrium near its base. The gonads (go) are continuous in the interradii, but interrupted in the perradii; (c.ra) radial canal; (gas) gastric cavity. From a photograph. × 25.

Fig. 5. Bougainvillea fulva. Diagram of the dichotomous branching of one of the labial tentacles.

Fig. 6. Bougainvillea fulva. Side view of manubrium; lip (l) and labial tentacles (t.l) with terminal nematocyst knobs (nem). From a photograph. × 25.

Fig. 7. Bougainvillea fulva. Cluster of marginal tentacles, containing thirteen members; (o) ocellus. From a photograph. × about 30.

Fig. 8. Purena brownei. Tentacle, showing naked proximal portion, and distal portion clothed with nematocyst ridges. From a photograph. × 25.

Fig. 9. Purena brownei, exumbral view of tentacle base; (o) ocellus. From a photograph. × 35.

Fig. 10. Purena brownei, side view of tentacle base; (o) ocellus; (en) endodermic core of tentacle. From a photograph. × 35.

Fig. 11. Lymnorea alexandri, dissection of margin giving side view of tentacle base, with ocellus (o) on its oral side; (c.c) circular canal; (v) velum; (g) mesogloea.

Fig. 12. Lymnorea alexandri, side view of apex of bell, showing manubrium, interradial gonads (go) and labial tentacles or knobs (t.l); (c.ra) radial canal. From a preserved specimen. × 30.

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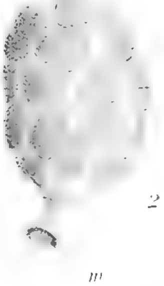
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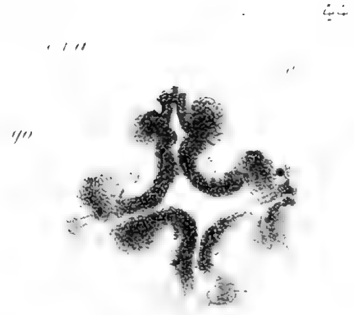
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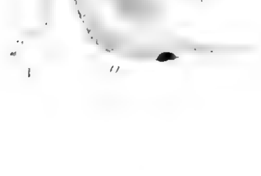
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PLATE 45.

Plate 45.

Fig. 1. Pegantha triloba, exumbral view of a marginal lappet, showing form and extent of otoporpae (otp), and position of otocysts (otc); (v) velum; (per) perona. × 8.

Fig. 2. Pegantha triloba, dissection of gonad, showing the sexual lobes (go) supported by the gelatinous genital prominence (g.pr). × 10.

Fig. 3. Cunina peregrina, sp. nov.(?) Stolon, taken from bell of a Rhopalonema velatum. × 30.

Fig. 4. Young medusa just liberated from above stolon, showing long manubrium (mn), rudimentary tentacles (t), and otocysts (otc). × 50.

Fig. 5. Oral view of somewhat older medusa, from the same stolon, in which there are eight tentacles and well-developed otoporpae; (otc) otocyst; (mn) manubrium. × 60.

Fig. 6. Side view of same medusa, from a photograph, showing otocysts (otc); manubrium (mn); velum (v); tentacles; and outline of gastric cavity.

Fig. 7. Two marginal lappets of same specimen, showing otoporpae (otp), and otocysts (otc). There is no visible indication of a peripheral canal system (v), velum.

Fig. 8. Cunina peregrina, sp. nov., otocyst; (otl) otolith; (otp) otoporpa. × 250.

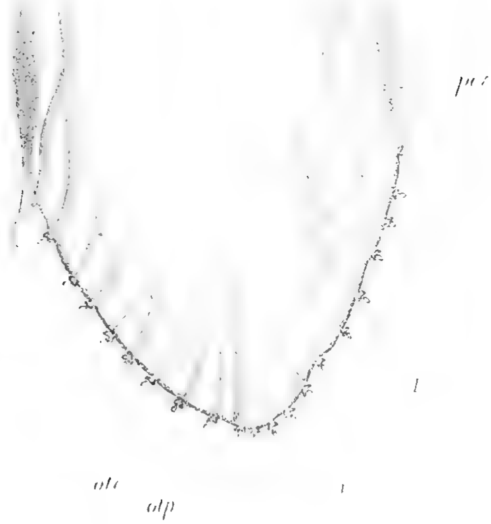
Fig. 9. Crossota brunnea, oral view of apex of bell, showing the long manubrium (mn), gonads (go) hanging from the radial canals (c.ra) into the bell cavity, and the muscular condition of the subumbrella. × 5.

Fig. 10. Amphogona apsteini, otocyst; (en) endodermic core; (otl) otolith. × 100.

Fig. 11. Rhopalonema velatum; one octant of bell margin, showing arrangement of marginal organs; (t.ra) radial tentacle; (otc) otocyst. × about 25.

Fig. 12. Colobonema sericeum; one octant of bell margin, showing the relative sizes of radial (t.ra), adradial, and interradial tentacles, muscular condition of the subumbrella, and extent of the gonads (go). From a photograph. × 4.

Fig. 13. Halitrephes maasi, gen. nov., sp. nov. Portion of the bell margin of type specimen, showing relation of radial canals (c.ra), tentacles, and otocysts (otc).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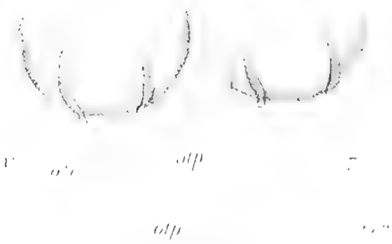
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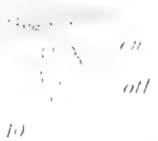
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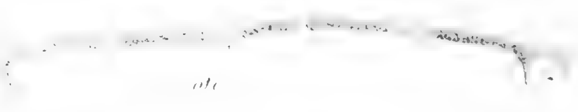
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PLATE 46.

PLATE **46.**

Bathymetric chart of the route.
(For stations occupied see Plates 47 and 48.)