

BULLETIN

OF THE

Harvard University,
MUSEUM OF COMPARATIVE ZOOLOGY

AT

HARVARD COLLEGE, IN CAMBRIDGE.

VOL. LXII.

CAMBRIDGE, MASS., U. S. A.

1918-1919.

Bulletin of the Museum of Comparative Zoölogy

AT HARVARD COLLEGE.

VOL. LXII. No. 8.

SOME MEDUSAE AND SIPHONOPHORAE FROM THE
WESTERN ATLANTIC.

BY HENRY B. BIGELOW.

WITH EIGHT PLATES.

CAMBRIDGE, MASS., U. S. A.:

PRINTED FOR THE MUSEUM.

DECEMBER, 1918.

No. 8.—*Some Medusae and Siphonophorae from the Western Atlantic.*

BY HENRY B. BIGELOW.

CONTENTS.

	PAGE.
Introduction	365
List of species	366
Anthomedusae	367
Leptomedusae	383
Trachomedusae	387
Narcomedusae	390
Scyphomedusae	399
Siphonophorae	402
Geographical distribution	428
Table of stations	435
Bibliography	436
Explanation of plates	

INTRODUCTION.

THE Medusae and Siphonophorae described here were collected by the United States Coast Survey Steamer BACHE, January to March, 1914, and by the United States Fisheries Schooner GRAMPUS, off Chesapeake Bay, in August, 1916.

The itinerary of the cruise of the BACHE has been published (1917a); but for convenience, the stations at which Medusae or Siphonophorae were taken are listed (p. 435).

The collections were made, and the material preserved, by Mr. W. W. Welsh, of the Bureau of Fisheries, who, in spite of stormy weather, handled this fragile material successfully.

The synonymies of the better known species are, as a rule, omitted, full references to the earlier literature on the Medusae having been given by Mayer (1910); on the Siphonophorae by me (1911b).

LIST OF SPECIES.

	PAGE.
Anthomedusae.	
Cytaeis tetrastyla Eschscholtz	367
Bougainvillea niobe Mayer	368
Stomotoca pterophylla Haeckel	372
Pandea conica (Quoy and Gaimard)	373
Eutiara mayeri, gen. and sp. nov.	374
Calycopsis papillata, sp. nov.	378
Heterotia anonyma Maas	382
Leptomedusae.	
Cyclocanna welshi, gen. and sp. nov.	383
Laodicea cruciata (Forskål)	387
Aequorea aequorea (Forskål)	387
Trachomedusae.	
Aglaura hemistoma Péron and Lesueur	387
Aglantha digitale (Fabricius)	388
Rhopalonema velatum Gegenbaur	388
Liriope tetraphylla (Chamisso and Eysenhardt)	389
Liriope seutigera McCrady	389
Liriope species ?	390
Geryonia proboscidalis (Forskål)	390
Narcomedusae.	
Cunina peregrina Bigelow	393
Pegantha clara R. P. Bigelow ?	397
Pegantha dactyletra Maas ?	398
Solmundella bitentaculata (Quoy and Gaimard)	399
Scyphomedusae.	
Charybdea marsupialis var. xaymachana Conant	399
Charybdea alata Reynaud	400
Periphylla hyacinthina Steenstrup	401
Nausithoë punctata Kölliker	401
Linuche unguieulata (Schwartz)	401
Siphonophorae.	
Muggiae spiralis (Bigelow)	402
Cuboides vitreus Quoy and Gaimard	403
Amphicaryon acaule Chun	403
Hippopodius hippopus (Forskål)	404
Vogtia pentacantha Kölliker	406
Vogtia glabra, sp. nov.	407
Abyla trigona Quoy and Gaimard	408
Abyla leuckartii Huxley	409

Abyla dentata, sp. nov.	409
Abylopsis tetragona (Otto)	411
Abylopsis eschscholtzii (Huxley)	411
Bassia bassensis (Quoy and Gaimard)	411
Ceratocymba sagittata (Quoy and Gaimard)	411
Galeolaria quadridentata Quoy and Gaimard	417
Galeolaria monoica (Chun)	418
Galeolaria australis Quoy and Gaimard	419
Diphyes appendiculata Eschscholtz	420
Diphyes fowleri Bigelow	422
Diphyopsis dispar (Chamisso and Eysenhardt)	422
Diphyopsis mitra (Huxley)	423
Diphyopsis bojani (Eschscholtz)	424
Chuniphyes multidentata Lens and Van Riemsdijk	425
Agalma okeni Eschscholtz	426
Stephanomia rubra (Vogt)	426
Rhizophysa filiformis (Forskål)	427
Velella velella (Linné)	428

ANTHOMEDUSAE.

CYTAEIDAE L. Agassiz.

CYTAEIS TETRASTYLA Eschscholtz.

Cytaeis tetrastyla Eschscholtz 1829, p. 104, taf. 8, fig. 2. (For synonymy see Hartlaub, 1911, p. 139; Vanhöffen, 1911, p. 204).

Station

10,176	50-0 meters	1	spec.	3 mm.	high
10,200	surface	2	"	4 mm.	" both
10,200	100-0 meters	1	"	3 mm.	"
10,208	100-0 "	1	"	4 mm	"

These specimens support Vanhöffen's (1911) contention that a single species of *Cytaeis* inhabits all three great oceans, for I can find nothing to separate them from the series collected by the ALBATROSS in the eastern Pacific (Bigelow, 1909a, p. 190, "*C. vulgaris*"), with which they agree, not only in general structure, and in the pigmentation of the cores of the tentacles, but in the presence of Medusa buds on the walls of the manubrium.

BOUGAINVILLEIDAE Gegenbaur.

BOUGAINVILLEA NIOBE Mayer.

Bougainvillea niobe Mayer, 1894, p. 236, pl. 1, fig. 2; 1900, p. 42; 1904, p. 11, pl. 2, fig. 14-14c; 1910, p. 166, pl. 18, fig. 1-3.

This species was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,172, 10,173, 10,176, 10,178, 10,180, 10,186, 10,188, 10,192, 10,195, 10,196, 10,197, 10,200, 10,203, 10,206, 10,208, 10,209, 10,211, in hauls with open nets at various depths from the surface down to 1,000-0 meters; a total of about 80 specimens.

Perhaps no Medusae stand more in need of critical revision than do the members of this genus, for not only are many of the species closely related to one another, but actual observation has proven that some, at least, are merely environmental races of others (Mayer, 1910, p. 159); and in all probability some of the more simply organized "species" are merely the young of the larger and anatomically more complex ones. As Mayer points out (1910, p. 159), the "confusion which prevails at present can not be dissipated until the hydroids of all or most of the species are discovered."

The species recognized by Mayer (1910), and by Hartlaub (1911) in his very useful account of the Bougainvilleas of northern waters, may be divided, for convenience into two groups, those with many (8 or 9) marginal tentacles per bundle, and in which the oral tentacles branch dichotomously five or more times, and those in which either marginal tentacles, or dichotomous branchings of the oral tentacles, or both, are few. The first group includes *B. macloviana*, *B. principis*, *B. fulva*, *B. brittanica*, *B. superciliaris*, *B. nordgardii*, *B. bougainvillei*, and *B. niobe*. Without attempting to settle the relationships of these species to one another, I may point out that *B. niobe* is easily separated from *B. macloviana* by the absence of peduncle, and structure of gonads, which are strictly limited to the manubrium; from *B. superciliaris* and *B. bougainvillei* (which are probably identical) by the absence of a peduncle; from *B. principis* by fewer marginal tentacles, and especially by the smaller, narrower, marginal tentacular pads; from *B. nordgardii* by larger size and presence of ocelli. *Bougainvillea niobe*, *B. brittanica*, and *B. fulva* are closely allied, anatomically, to one another: in all three the bell is high, thick walled, without peduncle, attaining a height of 10-12 mm.; the manubrium short, with broad cruciform basis; there are upwards of 8 marginal tentacles per bundle;

the oral tentacles branch 5–7 times; the gonads are adradial; axial ocelli are present. But the number of marginal tentacles per bundle is greater in *B. brittanica* (16–30) than in *B. niobe* (8–15); and the length of the basal trunk of the oral tentacles (proximal to the first dichotomous branching) is much longer in the former than in the latter.

After actual comparison of specimens, I have not been able to find any constant anatomical differences, other than such as are obviously due to preservation or contraction or to different stages in development, to separate *B. niobe* from *B. fulva*, and should not hesitate to unite them, were it not for the occurrence of Medusa buds on the walls of the manubrium in *B. niobe*, a phenomenon separating it not only from *B. fulva*, but from all known species of Bougainvillea. And so many specimens of *B. fulva* have now been studied, over a range extending across the whole breadth of the Pacific (Maas, 1905, Bigelow, 1909a), and the Indian Ocean (Browne, 1916), that this type of asexual reproduction can hardly have been overlooked in them; whereas it is as frequent in *B. niobe* (Mayer, 1910), as it is in *Rathkea blumenbachii* (Bigelow, 1909c; 1913; Hartlaub, 1911). Nor is this the only Bougainvillea characterized by a peculiar reproductive cycle, *B. superciliaris* carrying the planulae, resulting from its sexual reproduction, in the walls of the manubrium.

An excellent account of the budding phase of *B. niobe* has been given by Mayer (1910); and the present series affords an account of the sexual phase, not previously recorded.

Budding takes place in medium sized specimens, about 5–8 mm. in diameter, a stage in which, as Mayer observed, there are about 8–10 marginal tentacles in each of the four groups, while the oral tentacles branch 4–6 times. Budding specimens compose about one half the present series; and there are almost as many larger specimens (8–10 mm. high) with gonads. The sexual organs are adradial, just as in *B. fulva* (Maas, 1906a, fig. 10c), and *B. brittanica* (Hartlaub, 1911); but the specimens are so contracted that I can not say whether they are entirely discontinuous in the inter-, as they certainly are in the per-radius, or whether they are occasionally joined, interradially, at the upper end of the manubrium, as is the case in *B. brittanica*. In the largest specimens there are 12–15 marginal tentacles in each bundle, and the oral tentacles branch 7 or 8 times in several. But these organs are so contracted, or intertwined, that in most cases it is impossible to disentangle them.

Most of the large specimens are so strongly contracted that the bell-

opening is entirely closed over by the gelatinous substance of the exumbrella, just as Maas (1905, pl. 1, fig. 8) has figured, and Browne (1916) described it, for contracted *B. fulva*. And this violent contraction likewise results in 4 longitudinal radial furrows in the exumbrella, not present in life (Mayer, 1910). In the few medium sized specimens which are not contracted, the outline of the bell is much as Mayer has figured it.

PANDEIDAE Haeckel.

(*Sens. em.* Bigelow, 1909a; *Tiaridae* Haeckel, 1879; Hartlaub, 1913 (*partim*)).

I have already maintained (1913, p. 12) that the name *Tiaridae* must be abandoned since *Tiara*, the generic name, is preoccupied for a mollusc. And though Hartlaub (1913, p. 240) thinks such a change unnecessary, it is in accord with the International code of zoölogical nomenclature, Art. 15. Hartlaub has recently (1913) given a thorough revision of the family. But while I am in full accord with most of his conclusions, it seems to me wiser to retain the *Bythiotiariidae* as a separate family rather than to include them as a "gruppe" (calyceopsiden) of the Pandeidae, because the structure of tentacle base and margin, in the various calyceopsids, is very different from that of the typical pandeids ("gruppe neoturriden" of Hartlaub).

STOMOTOCa L. Agassiz, 1862.

(*Sensu* Bigelow, 1909a; Hartlaub, 1913; Vanhöffen, 1913a).

Pandeidae with 2 large, opposed, perradial tentacles and many rudimentary tentacles; with the manubrium situated on a gelatinous peduncle.

Mayer (1910) enlarges this genus to include all pandeids with 2 large and many rudimentary tentacles, whether or not a peduncle is present. But this organ is so commonly of generic importance among Medusae, that there seems no reason to deny it that value here.

The three described species, included in this genus as limited here, *S. atra* A. Agassiz, *S. pterophylla* Haeckel, and *S. divisa* Maas, are so closely allied that I have already suggested the unity of the last two, (1909a), while Vanhöffen (1913a) unequivocally unites them all under the oldest name, *S. atra*; though Mayer (1910) retains all three. No previous student, however, has actually compared specimens from the

three type-localities: an opportunity afforded by the Eastern Pacific collection (1909a), the present specimens, and by a series of *S. atra*, including A. Agassiz's original specimens, and others collected off Vancouver Island, in 1906.

The BACHE specimens, listed below, confirm my earlier conclusion (1909a, p. 202) that none of the characters used by Maas (1897) to separate *S. divisa* from *S. pterophylla*, *i. e.* presence of an apical projection, swollen tentacular bases, and a coronal furrow, can be relied on. The first two occur equally in *S. pterophylla*, as indeed Mayer (1910) points out, while it is only in occasional specimens from the type-locality of *S. divisa* that the coronal furrow occurs (Bigelow, 1909a, p. 202); this feature was lacking in most of the ALBATROSS examples, and in all recorded by Vanhöffen (1913a, p. 14) from Callao, Peru.

Mayer's figures of *S. pterophylla* (1910, pl. 29, fig. 3-14) suggest that its gonads, and lip, are less complex than those of its Pacific relative. But actual comparison of specimens shows that no sharp line can be drawn between the two in this respect, for the primary sexual folds of Atlantic specimens, 10-12 mm. high, being often bi- or tri-fid with occasional pinnate sublobes (Mayer, 1910, pl. 29, fig. 3, 4), agree with those of Pacific specimens of a corresponding size, though less complex than those of larger Pacific specimens, (Bigelow, 1909a, pl. 43, fig. 6). And this is also true of the crenulations of the lip. In the number of primary sexual folds, too, (7-9), the two agree. And the number of rudimentary tentacles per quadrant (16-21) is about the same in the BACHE as in the Pacific specimens of 20-25 mm. In short, the large *S. pterophylla* agree very closely with $\frac{2}{3}$ grown *S. divisa* in all these characters. And further growth, on the part of *S. pterophylla*, would no doubt lead to what may be called the *S. divisa* stage.

According to Mayer, color separates the two species. And it is certainly true that in all specimens of *S. pterophylla* studied in life (Mayer, 1910, Bigelow, 1917) the stomach and tentacular bulbs were deep brown, whereas in the Pacific specimens I have seen alive (1909a), the gonads were orange to brownish red, tentacular bulbs pale yellow. But color is proverbially inconstant among Medusae. In short, *S. divisa* and *S. pterophylla* belong to one species, of which they represent at most two color-phases.

According to Vanhöffen (1913a) this is likewise true of *S. atra*, and he explains the simplicity of the gonads and of the lip in A. Agassiz's (1865) figures as evidence of immaturity merely. This assumption is not unreasonable, for it is never possible to postulate how far com-

plication of structure may progress with growth, in a Medusa the life-history of which is unknown. But the large size of Agassiz's specimens (20–25 mm. high) argues against it. And the specimens of *S. atra* which I have myself studied (1909a) suggest that the simplicity of gonads and lip is permanent, for in all of them, irrespective of size (6–14 mm. high), the sexual folds are simple, or at most bifid, with no trace of the pinnation so characteristic of *S. pterophylla*. And the margin of the lip is perfectly simple, without crenulations, or folds of any sort. In short, they agree perfectly, in these respects, with the still larger specimens described by A. Agassiz (1865).

Thus the evidence at hand points to the existence of two species of *Stomotoca*, *atra* and *pterophylla*, closely allied to each other it is true, but sufficiently separated by the simplicity of lip and gonads in the former, contrasted with their complexity in the latter.

STOMOTOCa PTEROPHYLLA Haeckel.

Stomotoca pterophylla Haeckel, 1879, p. 52, taf. 4, fig. 10; Mayer, 1910, p. 113, pl. 29, fig. 3–5, pl. 30, fig. 7; Bigelow, 1917, p. 306.

Stomotoca divisa Maas, 1897, p. 11, taf. 1, fig. 1–9; Bigelow, 1909a, p. 203, pl. 7, fig. 9; pl. 43, fig. 6–7.

Stomotoca atra (partim) Vanhöffen, 1913a, p. 14; (*non Stomotoca atra* A. Agassiz, 1865; Mayer, 1910; Hartlaub, 1913).

Station						
10,200	surface	2 spec.	11	mm. in diameter		
10,202	"	1 "	10	"	"	"
10,202	450–0 meters	1 "	9	"	"	"
10,203	surface	1 "	14	"	"	"
10,205	"	1 "	9	"	"	"
10,211	"	1 "	12	"	"	"

These specimens agree so closely, in general appearance, with earlier descriptions (Bigelow, 1909a; Mayer, 1910), that no further account, beyond what has been given above, is needed.

PANDEA Lesson, 1843.

Hartlaub (1913), in his recent revision of the Pandidae admits to this genus only one species, *P. conica*, of the five grouped there by Mayer (1910), adding thereto *P. rubra* Bigelow (1913). This reduction results partly from the fact that at least one of Mayer's Pandea-

is an Aglantha, and one a Sarsia; partly from the limitation of the genus to pandeids in which the gonads form a net-work, which excludes *P. violacea* Mayer. I too, formerly classed the latter as a Pandea (1909a) in describing specimens from the west coast of Mexico, defining Pandea as "Tiaridae with horseshoe-shaped gonads" (1909a, p. 205). But as Hartlaub (1913) and Vanhöffen (1911) have pointed out, the gonads of the type-species, *conica*, form a net-work; a type of sexual development shared by the mesoplanktonic *Pandea rubra* recently described (Bigelow, 1913, p. 14). And inasmuch as the structure of the gonad has proved to be a very useful taxonomic character, in fact the only trustworthy one, among the polytentacular pandeids, it is wisest to follow Hartlaub in his limitation of the genus, referring the *Pandea violacea* of Mayer (1910) and Bigelow (1909a) in which the gonads are smooth, to the new genus *Merga*, established by Hartlaub (1913, p. 249) expressly for it. To *Merga* likewise belongs the *Pandea sp.* of Lo Bianco (1903), for though Hartlaub (1913, p. 250) thought it deserved a separate genus, *Mergintha*, the only character separating it from *Merga*, its folded lip, is not of more than specific value. This leaves *P. conica* Quoy and Gaimard, and *P. rubra*, Bigelow as the sole representatives of Pandea. *Pandea rubra* is separable from *P. conica* by its large size, deep red pigmentation, extremely complex gonad-net, and by the absence of the exumbral nettle ribs so characteristic of *P. conica*.

PANDEA CONICA (Quoy and Gaimard).

Dianea conica Quoy & Gaimard, 1827, p. 182, pl. 6A; fig. 3, 4. (For synonymy, see Mayer, 1910, p. 118; Hartlaub, 1913, p. 338).

Station 10,171, 75-0 meters, 1 contracted specimen, 9 mm. high by 9 mm. broad.

This specimen is undoubtedly a Pandea; and in its main features resembles *P. conica* so far as can be seen in its present imperfect and distorted state. But it is with some hesitation that I refer it to that species, because of the minor differences enumerated below. A larger series might show that it represents a new, though allied, species.

In its general form; in the net-like structure of its gonads; in the presence of well-developed "mesenteries" involving all but the oral end of the gastric wall; in the smooth walled radial canals; the occurrence of exumbral nettle-ribs, one to each tentacle; the structure of the tentacular bulbs; the presence of abaxial ocelli; and in pigmentation,

it agrees with the descriptions of *P. conica* by Haeckel, (1879), Mayer (1910), and Hartlaub (1913). But the manubrium, filling the upper half of the bell-cavity, is larger than figured by them for *P. conica*, or than in two excellent Mediterranean specimens of that species with which I have compared it. And there are more tentacles, *i. e.*, 34, instead of 24 or less, as seems to be the rule in *P. conica* from the Mediterranean. The apical gelatinous thickening, so characteristic of *P. conica*, is apparently wanting here; though owing to the condition of the specimen, this apparent difference can not be relied on. And, for the same reason, it is best to place no dependence on the apparent limitation of the nettle-ribs to the lower $\frac{1}{3}$ of the exumbrella surface, the latter being much damaged.

Preserved in formalin, manubrium and tentacular bulbs are pale ochre-yellow, ocelli yellowish brown.

EUTIARA, gen. nov.

This genus is proposed for an interesting new pandeid which is allied, in its general structure, to Leuckartiara and Neoturris, but which has well-developed centripetal canals. It may be defined as Pandidae with blind centripetal canals alternating with the radial canals; with well-developed mesenteries; complex gonads fundamentally of the "Neoturris" type.

EUTIARA MAYERI, sp. nov.

Plate 1, fig. 1-5; Plate 3, fig. 6.

Station 10,161, 100-0 meters, 1 specimen, 18 mm. high by 14 mm. broad. TYPE.

Fortunately the single example is in fair condition anatomically, though somewhat crumpled. The bell is dome shaped, thin walled as in Leuckartiara and Neoturris, its cavity deep; and there is no trace of any apical gelatinous thickening, the cavity of the manubrium being domed, corresponding to the outline of the bell, the bell-wall as thin at the apex as elsewhere (Plate 1, fig. 1). In this it resembles adults of Neoturris (Hartlaub, 1913, p. 331). A striking character of this Medusa is the presence of 8 radial exumbral ribs, one opposite each tentacle, extending from the tentacle-base, with which it is continuous, up over the exumbrella. At first sight they suggest the

nematocyst ribs of Pandea, or of Browne's (1916) *Leuckartiara gardineri*. But cross-sections prove that in reality they are canals, with well-developed entodermal layer, not solid ectodermal thickenings. Presumably their lumens connect with those of the tentacles to which they correspond. To my surprise no nematocysts were to be found in them, either on sections, or on surface examination with the microscope. But unfortunately, the histological condition of the specimen was poor, most of the ectoderm being destroyed along these canals, though persisting on the exumbrella flanking it; hence it is best to lay no stress on the absence of nematocysts. Nothing to correspond to these canals has ever been described for any pandeid; but it is possible that the exumbral bands of *Leuckartiara gardineri* are likewise canals in reality. And since, so far as I know, the microscopical structure of the exumbral ribs of Pandea has not been studied, they too, may be hollow. Exumbral canals of this type, though certainly unusual, are fundamentally nothing more than extreme prolongations of the tentacular bulbs, which, in most pandeids, clasp the exumbrella more or less. Browne (1916) surmises that the exumbral bands of *Leuckartiara gardineri* are brilliantly colored in life: after preservation, however, they are colorless in our specimen of Eutiara. The canals opposite the radial tentacles extend upward almost to the apex of the bell, the interradials only to about its mid-level, (Plate 1, fig. 1); their unequal lengths suggesting that they, like the two series of tentacles, radial and interradial, are developed successively.

Manubrium. The manubrium is large, hanging slightly below the mid-level of the bell-cavity, its spacious cavity domed above, as already noted, the mouth wide open, the lip apparently crenulated, but too much torn for accurate description. The so-called "mesenteries," which are in reality nothing but the expanded bases of the radial canals, are well developed, the lines of union between canal and manubrium extending over practically the whole length of the latter, from lip to apex, the four slit-like openings of the canals almost completely subdividing the walls of the manubrium along the perradii (Plate 1, fig. 2). The general structure of these "mesenteries" is already well known for *Leuckartiara* (Hartlaub, 1913); what is interesting here is the high degree to which they are developed.

Gonads. The sexual folds (Plate 1, fig. 2) are reducible to the Neoturris type (Maas, 1904b; Bigelow, 1909a; Hartlaub, 1913), there being two series of adradial folds in each quadrant of the gastric wall, which are not confluent at their interradial end as in *Leuckartiara*, but independent of one another (the distinction between these two

gonad types has recently been discussed in detail by Hartlaub, 1913). In Eutiara, as in *Neoturris*, the four broad interradial zones, although bare of folds, except near the upper end of the manubrium where the two series in each quadrant approach each other, bear sexual products in irregular pockets. And though these are much fewer, 2 or 3 in each quadrant, than in *Neoturris*, it is possible that they may increase in number with the continued growth of the Medusa; especially since the thinness of the gastric wall, even in the region of the sexual folds, shows that the specimen is immature.

Canal-system. The radial canals are very broad; next the ring-canals their margins are simply more or less wavy: but above $\frac{1}{3}$ of the bell-height their margins bear numerous long diverticula (Plate 1, fig. 1), some of them simple, others dendritically branched, with short, blunt terminal lobes, which are largest at, and slightly above, the lower edge of the slit-like gastric openings of the canals. The margin of the ring-canals, itself as broad and flat as the radials, is smooth except for 1-3 very small triangular spurs per quadrant. The four interradial centripetal canals, mentioned above as the most characteristic feature of the genus, are as broad as the radials, and reach to about $\frac{1}{3}$ of the bell-height, where they end blindly (Plate 1, fig. 1). Their margins are wavy, with a few short, blunt, lateral, and terminal diverticula at their upper ends, corresponding, in size, to the small diverticula from the radial canals at the same level. And one of them bears two short, pointed spurs, at its junction with the ring-canals, similar in outline to the spurs of the latter.

Tentacles. There is a large tentacle opposite every canal, radial, or centripetal, *i. e.*, eight in all; the basal bulbs are large, triangular, laterally compressed; they clasp the exumbrella (Plate 1, fig. 3) and their outer corners are continuous with the exumbral bands already described. Such of the tentacular filaments as I was able to disentangle are about three times as long as the bell is high: their tips are all destroyed. There are no tentacular ostia on the basal bulbs, such as occur in *Neoturris fontata* (Bigelow, 1909a, p. 209). The margin between the tentacles bears a series of small rounded, rudimentary tentacular bulbs, without filaments, none of which show any signs of later developing into tentacles; their number per octant is 8, 6, 5, 9, 7, 7, 9, 8, a total of 59. In their permanently rudimentary condition Eutiara agrees with *Leuckartiara gardineri* Browne (1916).

Ocelli. No ocelli, or pigment-clusters, are to be seen on the bases of the eight large tentacles. But most of the rudimentary knobs bear abaxial pigment-spots near their tips (Plate 1, fig. 4): and the few

which lack them may have lost them through damage in capture or preservation.

Color. After preservation in formalin, manubrium, large tentacular bulbs, and the pigment-spots, or ocelli, on the rudimentary tentacular bulbs, are yellowish brown.

BYTHOTIARIDAE Maas.

CALYCOPSIS Fewkes, 1882.

(*Sibogita* Maas, 1905).

The species described below bridges the gap between *Calycopsis* and *Sibogita*. According to Vanhöffen (1911, p. 214) these two genera are separated by the fact that in *Sibogita* the centripetal canals unite with the radials, or with each other, whereas in *Calycopsis* they are either permanently blind, or join the cruciform base of the manubrium; a view accepted, though with reserve, by Hartlaub (1913), and tacitly, by me in an earlier paper (1913). But it is obvious that this difference is a minor one, centripetal canals joining radials, or manubrium, according to their location on the subumbrella. And as some of the centripetal canals in one of the specimens described below join the former, some the latter, some of its quadrants would belong to one genus, others to the other, were both to be recognized.

Eight "species" of *Calycopsis*, as here defined, have been described from the deep-sea expeditions of recent years: *C. typa* Fewkes (incl. *C. nauarchus* Bigelow, 1909b); *C. geometrica* Maas (1905); *C. simulans* Bigelow (1909a); *C. borchgrevinki* Browne (1910); *C. chuni* and *C. bigelowi* Vanhöffen (1911); *C. nematophora* Bigelow (1913); *C. valdiviae* Hartlaub (1913): the relationships, of most of these, I have discussed elsewhere (1913, p. 21). *Calycopsis typa*, *C. simulans*, *C. chuni*, and *C. borchgrevinki* are closely allied to one another structurally; being separated only by such minor characters as relative number of canals and tentacles; presence or absence of an apical depression; and regularity of the sexual folds. And it is possible that the last may be a young stage of one of the others (1913, p. 22). *Calycopsis geometrica* is, however, sharply marked off from the others by the union of the centripetal canals with the radials, instead of with the manubrium; *C. nematophora* by its labial nemocyst knobs, and by the structure of its gonads; *C. valdiviae*, founded by Hartlaub for the specimens recorded by Vanhöffen (1911, 1912) as *C. typa*, by the fact that the

radial canals, in their union with the manubrium, show no trace of the enlargements, or so called "mesenteries" characteristic of other species of *Calycopsis* (Hartlaub, 1913, p. 347). And it is further characterized by the prickly, or warty, nature of the marginal lobes of the exumbrella between the tentacles (Vanhöffen, 1912b, p. 364). The series of *Calycopsis* in the present collection has similar exumbrella sculpture, in the form of rows of high, conical, gelatinous prominences, on the marginal lobes. And as nothing comparable occurs in any *Calycopsis* which I have seen, either in life or after preservation (1909a, 1909b, 1913, 1917), or is recorded, except for *C. valdiviae*, it separates the new species, *C. papillata*, from all members of the genus, except the latter. It is sufficiently distinguished from *C. valdiviae* by the presence of well-developed "mesenteries"; by the small number of centripetal canals, and especially by the fact that some of the latter join the manubrium, some the radials (p. 377); in fact, this character alone would separate it from all specimens of the genus yet described. But it is by no means impossible that a similar type of canal-union may take place in other species, though it has not actually been observed. *Calycopsis papillata* is further distinguished from its relatives as follows:—from *C. nematophora*, by the smooth lip; by equal numbers of tentacles and canals; from *C. borchgrevinki*, *C. bigelowi*, and *C. chuni*, by equal numbers of canals and tentacles; from *C. typa*, by much smaller manubrium, narrow sexual folds, and small number of canals and tentacles; from *C. geometrica*, by small number of tentacles and canals.

CALYCOPSIS PAPILLATA, sp. nov.

Plate 2, fig. 1-7; Plate 3, fig. 1.

Station

10,206, 75-0 meters, 1 spec. 27 mm. high by 26 mm. broad. TYPE.
10,196, surface 2 " respectively, 18 mm. broad by 18 mm.
high, and 11 mm. by 11 mm.

All are in good condition.

In all these specimens the bell is dome shaped, the gelatinous substance thick and notably rigid, with the deep bell-cavity characteristic of this genus (Plate 3, fig. 1). The type, and the 18 mm. specimen, are both somewhat flattened laterally, but inasmuch as the compression is interradial in the former, radial in the latter, while the small specimen is not flattened at all, the flattening is apparently no more signifi-

cant in this species than it is in *C. typa*, or in *C. nematophora* (1909b, 1913), where it is either a temporary contraction phase, or the result of preservation. In all three specimens the apex of the bell is rounded, with no trace of the funnel-shaped apical depression, so characteristic of *C. typa* (Bigelow, 1909b, fig. 1).

It is characteristic of *Calycopsis* that the tentacular roots lie in furrows of the exumbrella. And these are much deeper in *C. papillata* (Plate 2, fig. 2) than in any other specimens of the genus which I have studied (1909b, fig. 1; 1909a, pl. 43, fig. 2; 1913, pl. 3, fig. 1), the gelatinous substance between every two tentacles forming a well-marked lobe, or ridge, which projects downward below the margin in a manner better illustrated by Plate 2, fig. 2, 3 than verbally. And it is the distal extremities of these ridges, below the level of the bell-margin, that bear the gelatinous papillae which are one distinctive feature of the species. These are conical in outline, rigid in substance, situated in 1-3 irregular rows on each marginal lobe, the number, in four successive lobes of the type-specimen, being 9, 11, 6, 7. In the 18 mm. specimen, they are equally unmistakable, though fewer in number (4-6 per marginal lobe), and the lobes themselves smaller. In the smallest specimen most of the lobes bear at least one papilla, though two are smooth. And even thus early the lobes themselves are as large as the corresponding structures in adults of other species of *Calycopsis*.

Manubrium. The manubrium is much smaller in *C. papillata* than in Atlantic specimens of *C. typa* (Bigelow, 1909b, fig. 1); or in *C. nematophora* (Bigelow, 1913, pl. 2, fig. 8), being only about 5 mm. long in the type, in which it is slightly contracted, contrasted with a length of 13-15 mm. in *C. typa* of corresponding size. It is 4 and 2 mm. long, respectively, in the two smaller specimens. And as it is correspondingly narrow, it gives the Medusa an aspect very different from that of *C. typa* (incl. *C. navarchus*).

In the type-specimen the lip is irregularly folded; in the two smaller ones circular; and in all three its margin is smooth, without any trace of the labial nematocyst knobs which characterize *C. nematophora*. The gonads (Plate 2, fig. 4) much resemble those of *C. typa*, there being two rows of narrow, regular genital folds in each interradius, alternating with smooth zones in the perradii where no sexual tissue is developed. But the irregular sexual lobes seen in *C. typa* do not occur in our specimens of *C. papillata*, nor is there any trace of the irregular net-work which characterizes the mid-line of each interradius in *C. nematophora*. The genital folds are nearly as well developed, with

14–16 rows in each series, in the medium sized specimen as in the type, in which many large eggs are clearly visible (Plate 2, fig. 4), and equally regular, and precise in their arrangement, though it is impossible to determine the sex from surface views. In the smallest specimen the gonads are represented by double rows, each of 14–15 small, oval thickenings in each interradius of the flask-shaped manubrium.

Canal-system. As pointed out (p. 377) the canal-system of this species shows that no sharp line can be drawn between *Calycopsis* and *Sibogita*. In the smallest specimen, besides the four radial canals, there are eight centripetals, all ending blindly at about $\frac{3}{4}$ of the bell-height (Plate 2, fig. 7), and varying only slightly in length. And the same number of canals is to be seen in the medium sized specimen. But corresponding to the increase in bell-height from 11 to 18 mm. (Plate 2, fig. 5), the centripetal canals are proportionally longer, reaching nearly to the apex of the bell-cavity, though all of them are still blind. In the type-specimen, as already noted, two of the centripetal canals are still blind; but of the remaining six, three have joined the cruciform base of the manubrium; two join radial canals close to their bases, and one joins a radial canal at a considerable distance from the manubrium (Plate 2, fig. 1). Likewise, there are four very short centripetal canals alternating with the large ones, such as I have described for *C. typa* (1909b, p. 207, fig. 6, 7); and one of the latter has a transverse branch nearly reaching the canal next adjacent, suggesting such a union as occasionally takes place in *C. nematophora* (1913, p. 24, pl. 2, fig. 8). In *C. papillata* as in *C. typa* and *C. nematophora*, the four radial canals dilate just below their union with the manubrium, to form the so-called "mesenteries" on the taxonomic value of which Hartlaub (1913) has laid stress. But no trace is to be seen of subumbrial muscle-bands such as flank the canals in *C. nematophora*.

Tentacles. There are twelve tentacles in every specimen; a tentacle opposite every canal in the two smaller ones. In the type there is a tentacle opposite each radial and each large centripetal canal, but none opposite the small centripetals. Structurally the tentacles are of the usual calycopsisid type, the bases turned outward against the exumbrella, so that they appear to arise some distance above the margin, then bending sharply downward. In the smallest specimen several of the tentacles bear spherical terminal knobs, such as characterize *C. nematophora*. But, as, unfortunately, the tips of all the tentacles of the two larger specimens have been destroyed, it is doubtful whether

the knobs are permanently spherical, or whether, with growth, they assume the oval outline seen in *C. typa*.

Color. In the two larger specimens (preserved in formalin), the manubrium is pale reddish yellow. But experience has shown that this gives little idea of its color in life.

The localities of capture, Straits of Florida and N. E. Providence Channel, add a link to the chain of evidence that *Calycopsis* is a neritic form, though probably the hydroid stage of most of its members is passed in deep water. Were this not so, we might expect to find *Calycopsis* generally distributed over the high seas, like most holoplanktonic coelenterates, for the range of the genus extends from the Arctic to the Antarctic, and to all three great oceans. But most of the records so far obtained suggest just the contrary, being near land. Thus *C. typa* (*sens. str.*; p. 277) is only known along the continental shelf between Cape Cod and Chesapeake Bay; *C. nematophora* from the Sea of Okhotsk and Bering Sea; *C. borchgrevinki* from the shores of the Antarctic continent; *C. geometrica* from Malaysia; *C. simulans* between the Galapagos Islands and Central America; *C. bigelowi* from the Gulf of Aden; *C. chuni* from the Gulf of Aden and the neighborhood of Cape Gardafui. *Calycopsis valdiriae* alone, has been taken far from any coast-line, *i. e.* off Liberia ($0^{\circ} 12' N.$; $16^{\circ} 39' W.$), and in the Indian Ocean off Bourbon; its other captures are from the Alguhlas current off South Africa, and near the Cape Verde Islands (Vanhöffen, 1911, 1912a, "*S. typa*").

HETEROTIARA Maas, 1905.

The two known species of *Heterotiara*, *H. anonyma* Maas (1905), large (15–25 mm. high) but with only 12 tentacles at most, and *H. minor* Vanhöffen, small (10 mm. high), but with 20 or more tentacles, have been so fully discussed by Vanhöffen (1911), by Hartlaub (1913) and by me (1913) that no comment would be needed here had not Browne (1916) recently suggested that the specimens from off the coast of Peru referred by me (1909a) to *H. anonyma* really did not belong to *Heterotiara* at all but to some other genus. This supposition is based on the absence in these Peruvian specimens, of the terminal tentacular knobs which have since proved to be characteristic both of *H. anonyma* and *H. minor*. But since their tentacles were obviously imperfect, and they agree otherwise with several excellent specimens from the north-western Pacific and Bering Sea (1913, p. 25) and with the present

series, I am convinced that they were *H. anonyma*, the apparent absence of terminal tentacular knobs being merely an evidence of mutilation.

HETEROTIARA ANONYMA Maas.

Heterotiara anonyma Maas, 1905, p. 19, pl. 3, fig. 19-21; Bigelow, 1909a, p. 216, pl. 41, fig. 12, 13; 1913, p. 25; Vanhoffen, 1911, p. 211, pl. 22, fig. 3, 4; Hartlaub, 1913, p. 350.

The collection contains the following series:—

Station	Depth meters	Height mm.	Diameter mm.	Tentacles
10,208	100-0	11	7.5	9
10,200	surface	9	6	11
10,205	100-0	9	7	11
10,205	100-0	9	7	10, + 5 knobs
10,205	100-0	7	5	7, + 1 small
10,205	100-0	7	?	8
10,200	75-0	13	9	11

Also two much contracted specimens from Station 10,200, 75-0 meters, and one from Station 10,203, 75-0 meters.

These specimens add nothing of importance to my earlier (1913) account, except for the presence of young tentacles in two of them; something never before observed in this species (1913, p. 26). Did all these young tentacles develop, a total of fifteen would result for one of the BACHE specimens; but the maximum number of fully developed tentacles so far counted in any *H. anonyma* is twelve.

In the BACHE, as in the northwest Pacific specimens, the surface of the high arched bell is smooth, with no trace of the four interradial folds noted by Maas (1905). And as these do not appear in any specimen recorded since the species was first described, they were probably a contraction-phenomenon.

All tentacles that are intact bear spherical terminal knobs. In all the present series the manubrium is so strongly contracted that no account of the gonads is possible.

The most interesting feature about this series is its Atlantic origin, all previous records for the genus being from the Pacific Ocean, the Indian Ocean, or seas tributary to them.

LEPTOMEDUSAE.

MELICERTIDAE Mayer.

(Sensu em.)

CYCLOCANNA, gen. nov.

This new genus is proposed for a new leptomedusid, without otocysts or other marginal sense-organs, but with two kinds of tentacles, large and small, and in which the radial canals perform a peculiar S-like curve, in their course from manubrium to margin.

That this new Medusa belongs to the Leptomedusae is sufficiently established by the location of the gonads on the radial canals (distinguishing it from the Anthomedusae), and by its hollow tentacles, which separate it from all Trachomedusae except the aberrant freshwater Limnocnida. But its family relationship must remain more or less doubtful until it is definitely known whether the absence of otocysts (p. 385) is normal, or accidental. Under the former supposition, which is the more probable (p. 386), it must fall nearest the simply organized Leptomedusae recently grouped by Mayer (1910) under Thaumantias,¹ being separated from the Laodiceidae (Browne, 1907) by the absence of cordyli; from Melicertum by the number of canals; and from the various other genera in which neither otocysts nor cordyli are present, the Polyorchinae and Berenicinae of Mayer (1910), by its simple canals.

According to Mayer's (1910) scheme Cyclocanna would then fall in the subfamily Melicertinae of his Thaumantidae. But there is a serious objection to his system, in the fact that, being based wholly on the simplicity, or style of branching, of the radial canals, it groups together genera with, and genera without marginal cordyli, organs which, as Browne (1907) has pointed out, are probably more significant, phylogenetically, than is the precise character of the radial canals.

Since the location of Cyclocanna in this general section of the Leptomedusae depends on a character (absence of otocysts) yet to be definitely established, it is useless to discuss the matter here, further than to point out that if it actually lacks otocysts, it, together with the

¹ Poche (1914, p. 73) points out that the name can not be used in this sense because the type-species *T. hemispherica* Eschscholtz 1829 was undoubtedly a Phialidium (Browne, 1896, p. 482; Mayer, 1910, p. 198).

"Thaumantias" of Mayer, and Melicertum, form a natural family, distinguished from all other Leptomedusae by having neither otocysts nor cordyli, and by the simple radial canals. The name Meliceridae is available for it, though in a narrower sense than Mayer (1910, p. 197, "Melicerinae") has used it.

Should Cyclocanna prove to have otocysts, it would fall, without difficulty, into the Eucopidae. In any case, it is easily separable from all known Leptomedusae by the peculiar course of the radial canals. The depth and method of its capture, as well as dark pigmentation of its manubrium, suggests that it belongs to the ever growing list of Medusae whose habitat is the intermediate depths, not at the surface.

CYCLOCANNA WELSHI, sp. nov.

Plate 3, fig. 2-5.

GRAMPUS Station 10,385, 37° 28' N. Lat., 74° 25' W. Long., August 13, 1916, 140-0 meters, 2 specimens, 68 mm. (TYPE), and 49 mm. in diameter.

This Medusa is so peculiar in appearance, owing to its canals, and deeply pigmented manubrium, that it can not be confused with any other species.

In both specimens the bell is of the typical leptomedusan form, saucer shaped, with shallow cavity, the gelatinous substance moderately thick near the center, diminishing toward the margin. Both exumbrella and subumbrella surfaces are smooth (Plate 3, fig. 2).

The course of the radial canals affords the most distinctive feature of the genus. These arise from the apex of the manubrium in the usual manner, and are not branched; but instead of running direct to the margin, as is the common rule among Medusae with simple canals, they follow a peculiar S-curve, bending sharply to the left, *i. e.*, anti-clockwise, at about the mid-breadth of the bell, thence running roughly parallel to the margin, almost to the line of the neighboring perradii, where they once more turn toward the margin (Plate 3, fig. 2). In the type-specimen the outer angle of each canal is close to the inner angle of its next neighbor; but apparently this extreme condition is not attained till maturity, for in the smaller specimen the junction of the radial canals with the circular canal takes place, roughly, in the interradii, though the canals are looped on the same plan as in the type.

Both radial and circular canals are narrow and smooth walled, as in most Leptomedusae.

Gonads. The gonads occupy the major portion of the radial canals, leaving only their proximal and distal ends bare. Each consists of a single, broad, thin lamella, a simple dilation of the canal, thrown into a complicated series of alternating transverse folds (Plate 3, fig. 3).

The type is a sexually mature female, large eggs being plainly visible. The other specimen is apparently a male, and its gonads are smaller and simpler, corresponding to its smaller size.

Manubrium. The manubrium is voluminous, hanging to, or perhaps below, the opening of the bell, somewhat cruciform in cross-section, the radial canals traceable to the center over its aboral surface. It is squarish in outline, without any clear morphological division into basic, gastric, and labial portions. In both specimens it is more or less twisted, and longitudinally wrinkled and folded in the interradii. But since these folds follow no definite plan, but vary from quadrant to quadrant, they may safely be classed as contraction phenomena. Along the perradii the walls of the manubrium are smooth (Plate 3, fig. 3). The mouth is wide-open, as broad, in both specimens as the greatest diameter of the manubrium, and surrounded by a simple lip. But although the latter has no distinct lobes, or radial prolongations, its margin bears a series of small folds, and crenulations (Plate 3, fig. 3).

Marginal organs. There are four large radial tentacles with much swollen bases (Plate 3, fig. 2). And though all but the bases of these have been destroyed in all cases, enough remains to show that they are hollow. Between these the margin bears a considerable number of very small papilliform tentacles, without filaments (Plate 3, fig. 4). And fortunately many of them are in such good condition that I can safely assert that their present rudimentary condition is normal, not the result of mutilation. They, too, are hollow, as is clearly visible, when torn or broken. They are of various sizes, the presence of several very small ones in the type showing that interpolation of new ones takes place right up to maturity. But the larger ones are extremely uniform in length, and there is nothing to suggest that they ever develop into large tentacles.

In the only quadrant wholly intact (type) there are twenty-three small tentacles, suggesting a total of 80–90. In the smaller specimen there are about twenty in one quadrant.

A careful search with the compound microscope has failed to reveal any otocysts, and as portions of the margins of both specimens are

in good condition, it is probably safe to say that such organs are lacking. But otocysts are so easily destroyed that the possibility that they were present but have been lost, must be recognized. This is not true of the solid marginal clubs, or cordyli, characteristic of the Laodiceidae, which are equally wanting in Cyclocanna. I should emphasize the fact that the small marginal organs of this genus are true, hollow tentacles, though they somewhat resemble cordyli in general appearance. There are no true ocelli.

Color. The pigmentation of Cyclocanna is extremely characteristic and striking, the interradial walls of the manubrium, except for lip and immediate basal portion, being very dark gray, almost black, and extremely opaque, the result of great numbers of minute black pigment-granules crowded together in the ectoderm (Plate 3, fig. 2, 3). These granules occur along the perradii as well, but in such small numbers as to be hardly appreciable there, the result being that the perradii are extremely conspicuous, as white bands on the dark manubrium. The lip too, and the immediate base of the manubrium are likewise colorless, though opaque, at least in the preserved state. And this is also true of the inner, endodermal gastric wall. Black pigment-granules likewise occur in such numbers in the ectoderm of the oral sides of the small tentacles that these organs, are dark gray, often nearly black, in oral view. And though the pigmentation is not sharply defined, the granules spreading in small numbers out over the neighboring parts of the marginal thickenings from the tentacles (Plate 3, fig. 5), they are confined to the immediate neighborhood of the latter, the intervals between the tentacles, as well as the neighboring velum, being colorless. Black pigment is likewise present on the oral side of the bases of the large radial tentacles, but these are in such poor condition that its extent is doubtful. Pigmentation is confined to the oral, (axial), surfaces of the marginal organs, the aboral, (abaxial), surfaces being colorless. The gonads of both specimens are still salmon-pink after two months in formalin.

LAODICEIDAE L. Agassiz.

(Sensu Brown, 1907).

LAODICEA Lesson, 1843.

(Sensu em. Browne, 1907; Bigelow 1909a).

LAODICEA CRUCIATA (Forskål).

Medusa cruciata Forskål, 1775, p. 110; 1776, taf. 33, fig. 8.*Laodicea cruciata* L. Agassiz, 1862, p. 350.

(For synonymy, see Mayer, 1910, p. 201).

As Mayer points out, the identity of the *Medusa cruciata* Forskål with *Laodicea cruciata* L. Agassiz and later authors (= *Thaumantias mediterranea* Gengenbaur 1856, and *Thaumantias undulata* Forbes and Goodsir 1853), is doubtful. But at least there is nothing in Forskål's figure to forbid it, and it will tend toward stability of nomenclature to use *L. cruciata*, referring it, however, to Forskål, not to L. Agassiz.

The BACHE collection contains a single specimen of this common and well-known species, which adds nothing to previous accounts.

Station 10,206, surface, 1 specimen.

EUCOPIDAE Gegenbaur.

AEQUOREA AEQUOREA (Forskål).

Medusa aequorea Forskål, 1775, p. 110; 1776, pl. 32.

(For synonymy, see Mayer, 1910, p. 325, and Bigelow, 1913, p. 38).

Station 10,161, surface, 1 very fragmentary specimen, 60 mm. in diameter.

This specimen, undoubtedly an *Aequorea*, apparently belongs here, but is too imperfect to add anything to previous accounts.

TRACHOMEDUSAE.

TRACHYNEMIDAE Gegenbaur.

AGLAURA HEMISTOMA Péron and Lesueur.

Aglaura hemistoma Peron & Lesueur, 1809, p. 351.

(For synonymy, see Bigelow, 1909a, p. 119, and Browne, 1916, p. 196).

Station

10,161 surface, 7 specimens.

10,166 100-0 meters, 2 specimens.

These few specimens add nothing to previous accounts. The most interesting fact is that this species, found in such abundance by most expeditions to warm seas, should have been so rare in the region traversed by the BACHE.

AGLANTHA Haeckel, 1879.

Vanhöffen (1913) has recently united this genus with Aglaura: but though the two are close allies, and each contains at most but one or two species, the difference in the location of the gonads (at the extremity of the peduncle in Aglaura, on the subumbrella near the base of the peduncle in Aglantha), seems sufficiently important to warrant the retention of Aglantha. The impossibility of distinguishing two species in this genus, based on the number of otocysts, has now been fully demonstrated by Vanhöffen (1912a), by Mayer (1910), and by my own studies on a large series of specimens of all sizes from northern waters, both Atlantic and Pacific (1909c; 1913). All belong to *A. digitale*.

AGLANTHA DIGITALE (Fabricius).

Medusa digitale Fabricius, 1780, p. 366.

(For synonymy, see Mayer, 1910, p. 402).

Station

10,157 18-0 meters, 5 fragmentary specimens all about 10 mm. high.
10,158 600-0 meters, 1 fragmentary specimen, 10 mm. high.

None of the specimens are in good enough condition to show the otocysts, but all have gonads, in spite of their small size. They are interesting chiefly for the record of occurrence.

RHOPALONEMA VELATUM Gegenbaur.

Rhopalonema velatum Gegenbaur, 1856, p. 251, pl. 9, p. 1-5.

(For synonymy, see Bigelow, 1909a, p. 129).

This species was taken at Stations 10,161, 10,162, 10,166, 10,169, 10,171, 10,173, 10,176, 10,178, 10,180, 10,182, 10,188, 10,192, 10,195, 10,196, 10,200, 10,202, 10,203, 10,206, 10,208, 10,209, 10,211, 10,212, in hauls varying from the surface to 1,000-0 meters.

Most of the specimens are fragmentary, having lost tentacles and otocysts. But the length, at least, of the gonads can usually be traced, even when the organs themselves are destroyed. And this, together with the number (8) of canals, the characteristic outline and especially

the apical thickening, or top-knot, which is intact in all, serve to identify them as *R. relatum*. Vanhöffen (1902) and I (1909a) have already given reasons for the belief that this is likewise true of all Rhopalomedusae, except the recently discovered *R. funerarium* of the mid-depths. Browne (1916), on the contrary, believes that the specimens described by him (1906) from the Bay of Biscay, as *R. coeruleum*, represent a separate species, a view, based on the length of the gonads, which occupy the middle $\frac{1}{3}$ of the radial canals, the specimens agreeing in all other respects with *R. relatum*. But this difference does not seem sufficient to separate them from *R. relatum* for there is considerable variation in the length of the gonads in the latter, the condition described by Browne falling well within the extremes.

GERYONIDAE Eschscholtz.

LIRIOPE Lesson, 1843.

The few imperfect specimens listed below do not add anything to my previous discussions of the genus (1909a, 1913). The shape of the gonads is now generally accepted as the most important character in Liriope (Vanhöffen, 1902, Maas, 1905, 1909, Bigelow, 1909a, Browne, 1916); and the form with primarily triangular gonads is usually designated as *L. tetraphylla*. The various races with oval gonads are in such urgent need of revision, that I (1909a, p. 115) have hesitated to identify such specimens; Browne (1916) does likewise.

LIRIOPE TETRAPHYLLA (Chamisso and Eysenhardt).

Geryonia tetraphylla Chamisso & Eysenhard, 1821, p. 357, pl. 27, fig. 2.

(For synonymy, see Bigelow, 1909a, p. 112; 1913, p. 55).

Station

10,200	75-0 meters	1 specimen	8 mm. in diameter
10,207	100-0	"	10 mm. "

Both specimens are fragmentary; but their gonads are already triangular, though small.

LIRIOPE SCUTIGERA McCrady?

Liriope scutigera McCrady, 1857, p. 106.

(For synonymy, see Mayer, 1910, p. 421).

Five small fragmentary specimens of Liriope, 6-10 mm. in diameter, and obviously immature, with small oval gonads, were taken at Sta-

tions 10,202, 10,203, 10,211, 10,212. They are provisionally identified as *L. scutigera*, because their gonads agree with that form (McCrady, 1857, Brooks, 1886).

LIRIOPE species?

Four Liriope in which the gonads were entirely destroyed were taken at Stations 10,203 and 10,209. Their condition is so poor that it is idle to attempt to identify them.

GERYONIA PROBOSCIDALIS (Forskål).

Medusa proboscidalis Forskål, 1775, p. 108; 1776, pl. 36, fig. 1..
(For synonymy, see Bigelow, 1909a, p. 116).

This well-known species occurred twice, at Station 10,206, where fragments of a large specimen were taken in a haul from 100 meters, and at Station 10,200, surface, 3 specimens so young that the gonads have not appeared.

NARCOMEDUSAE.

The classification of the Narcomedusae has been the subject of much discussion. And while all recent authors agree that Haeckel's (1879) system is unnatural, the revisions proposed by Maas (1904a, 1904b) and adopted, in its essentials by Mayer (1910) and by me (1909a, 1913) differs fundamentally from Vanhöffen's scheme (1908a, 1912a). The characters which have been used to separate, first, families, then genera in this group, are, the presence or absence of gastric pockets, the location of the gastric pockets, radial or inter-radial, and the presence or absence of a peripheral canal-system. To Maas, and to me, the gastric pockets seem the more important, while Vanhöffen chooses the canal-system, these two systems resulting in widely divergent alignments of genera, and even species. I have already (1909a, p. 48), given reasons for considering the state of the gastric pockets the more significant character, phylogenetically, of the two: they are, in brief that canals may, or may not, be present, in genera obviously closely allied, if not directly related in phylogeny (*e. g.*, *Aegina*, *Solmundella*, and *Aeginopsis*), and even in different species of a genus (*e. g.*, in *Cunina*): that different genera may exhibit gradations in the degree of development of the canals, and that at least two Narcomedusae (*Cunina proboscidea*, and *Pegantha clara*) have

two generations, one with, the other apparently without canals. Which of two characters is the more important in classification is necessarily more or less a matter of opinion: and this is especially true of a group so imperfectly known as the Narcomedusae. What is most needed now is not so much a continued discussion of family relationships, as an attempt to fill in the gaps in our knowledge of the actual genera and species concerned. When these are sufficiently described, and the parentage of the various young Narcomedusae, on which so many species-names have been based, has been determined, a sound phylogenetic classification will follow automatically.

Our knowledge of certain species, and groups of species, of Narcomedusae, already fulfills this requirement; consequently, they are universally recognized, though called, perhaps, by different names, and differently located in classification, by different authors. There are, to begin with, several species with interradial gastric pockets, and with otoporvae,¹ which fall into four genera according as they have two developed and two suppressed tentacles (*Solmundella*); four developed tentacles (*Aegina*); four developed and four suppressed tentacles (*Aeginopsis*); or eight developed tentacles (*Aeginura* of Maas and Bigelow, *Cunoctona* of Vanhöffen). And while these four genera are grouped in one family by Maas (1904b) by Mayer (1910), and by me (1909a), in two families by Vanhöffen (1908a), they are universally recognized, with the limits outlined above.

Equally well defined is a species-group without gastric pockets, but with very conspicuous peripheral canals (at least in one generation), and with otoporvae. These are all located in the Solmaridae by Mayer (1910, one genus *Pegantha*) and by me (p. 394, two genera, *Polycolpa* and *Pegantha*): Vanhöffen (1908a) gives them the dignity of a separate family, *Peganthidae*, with three genera.

It is in the cases of the various Narcomedusae with perradial gastric pockets; and of those with neither pockets nor peripheral canals, that we find the greatest confusion and disagreement. Species with perradial gastric pockets may or may not have a peripheral canal-system, or otoporvae. According to the scheme here followed they form, together, the Cuninidae, with three genera, *Cunoctantha* and *Cunina* with otoporvae, *Solmissus* without otoporvae. The first two are so closely allied (differing only in the number of tentacles) that they may finally be united. But until an intergradation is actually observed, it is wisest to retain both.

¹ Ectodermic ridges running over the exumbrella, from the otocysts, bearing nematocysts and perhaps with a sensory function.

CUNINIDAE.

CUNINA Eschscholtz.

(*Sensu* Maas (1904a, 1904b); Bigelow (1909a); Mayer (1910)).

Narcomedusae with perradial gastric pockets; with otoporvae; with nine or more tentacles and marginal lappets; with or without peripheral canal-system.

Vanhöffen (1908a) does not recognize this genus, including most of its species in his Aeginidae; an arrangement which I have already criticised (1909a, p. 49), on the ground that it results in the combination of species with per- and with inter-radial gastric pockets. No less than nineteen "species" have, at one time or another, been referred to Cunina, but it is certain that few of them are valid. Mayer (1910) recognizes seven, but one of these, *C. mucilaginosa*, was so vaguely figured and described (Chamisso and Eysenhardt 1821, taf. 30) that it must always remain doubtful whether the original specimens possessed, or lacked, peripheral canals and otoporvae. And one, *C. prolifera*, may prove to be a solmarid, either a Polycolpa or a Pegantha, it being doubtful whether it has any true gastric pockets (Mayer, 1910, p. 480; Vanhöffen, 1908a, p. 65).

Among the five species remaining in Mayer's list, *C. proboscidea* Metchnikoff, is conspicuous for its gelatinous peduncle and long proboscis, and for the fact that its canal-system is degenerate, short lengths of the canals alone being open, as demonstrated by Mayer (1910, p. 476) from serial sections. It is historic because of its remarkable method of reproduction (Metchnikoff, 1886, Woltereck, 1905, Stschelkanowzeff, 1906).

In *C. lativentris* Gegenbaur, likewise, there is a low gelatinous proboscis, as shown in Gegenbaur's figure (1856, taf. 10, fig. 2), a fact I have myself been able to substantiate on two specimens from Naples. But the peronial canal-system is well developed. Vanhöffen it is true says (1908a, p. 66), that *C. lativentris* has no peripheral canals; quoting Metchnikoff (1878) as his authority. But the Hertwigs not only describe well-developed peronial and ring-canals for this species, but illustrate them both on cross-sections and surface views of the margin (1878, p. 15, taf. 1, fig. 1, 2; taf. 10, fig. 4). And inasmuch as they are equally visible on one of the Mediterranean specimens just mentioned, which agrees in general outline, low proboscis, number of tentacles (12), and outlines of gastric pockets, with Gegenbaur's

figures, it may be definitely stated that *C. lativentris* has a canal-system.

The Pacific Cunina recently described by me (1909a), as *C. globosa* Eschscholtz, likewise has unmistakable canals; and further resembles *C. lativentris* in its short oval otoporae (as I have been able to establish by actual comparison), and in lacking nematocyst pads under the bases of the tentacles. But it has no peduncle, and its gastric pockets are square, instead of widening distally, as is characteristic of *C. lativentris*. Eschscholtz's figure (1829, taf. 9, fig. 3) of *C. globosa* is so general that it will always be open to question whether my Pacific specimens actually belong to that species. But it shows the same general outline, and number of tentacles, while he observed about the same number of otocysts (3) per lappet, though without recognizing their nature. And since there is nothing to forbid my reference of the ALBATROSS specimens to *C. globosa*, it will stabilize the nomenclature of the genus to accept it. The type-species is *Cunina globosa*.

Cunina duplicata Maas (1893), so closely resembles *C. lativentris* in general form, in its well-developed peripheral canals, and its short otoporae, that it may finally prove to belong to that species, from which it differs only in the greater number (16) of tentacles. But only one specimen of *C. duplicata* has been seen.

C. peregrina Bigelow (1909a) is separated from all other species, except *C. proboscidea*, by the absence of peripheral canals: from *C. proboscidea* by the absence of peduncle, by its long tentacles, and by more numerous otocysts (4-8 per lappet). It is the only Cunina represented in the BACHE collection.

CUNINA PEREGRINA Bigelow.

Cunina peregrina Bigelow, 1909a, p. 59, pl. 1, fig. 6; pl. 15, fig. 1, 2, pl. 28, fig. 1-7, pl. 45, fig. 8; Maas, 1909, p. 37, taf. 3, fig. 19; Mayer, 1910, p. 481.

Station

10,195	100-0 meters	1 spec.	9 mm. diameter	10 tentacles
10,208	surface	1 "	9 "	10 "
10,208	"	1 "	7 "	11 "
10,208	"	1 "	6 "	13 "

The ALBATROSS specimens from the eastern Pacific (Bigelow, 1909a) ranged from 3-14 mm. in diameter, the number of tentacles from 8-12. The Japanese specimens recorded by Maas (1909) likewise had 8-12

tentacles. The BACHE specimens add nothing, except by way of verification to the earlier accounts. The most characteristic features, which by themselves are sufficient to separate *C. peregrina* from all other species, are the absence of peripheral canals and of peduncle; minor features of diagnostic value are the square marginal lappets, the squarish outline and comparatively great length of the gastric pockets, the large nematocyst pads beneath the bases of the tentacles, and the large number of otocysts (5–8 per lappet).

The BACHE captures are of interest geographically (p. 431), all previous records for *C. peregrina* being from the Pacific.

SOLMARIDAE Haeckel.

(*Sensu*. Maas, 1904b; Bigelow, 1909a; Mayer, 1910).

Narcomedusae without gastric pockets.

PEGANTHA Haeckel, 1879.

Solmaridae with peripheral canal-system (at least in one generation), and with otoporpae; with gonads localized at the edge of the stomach, as numerous as, and in the radii of, the marginal lappets.

As here defined, Pegantha corresponds to the genera Pegantha + Polyxenia + Polycolpa of Vanhöffen (1908a, 1912a, 1912b). According to him these three genera can be separated by the number of tentacles, Pegantha having 8–13, Polyxenia 16–18, Polycolpa 24–30. But specimens of *Pegantha triloba* having recently been found with fourteen and fifteen tentacles (Vanhöffen 1912a, 1912b), there is no longer any justification for separating Polyxenia from Pegantha, at least on this ground. And the supposed gap, in tentacle-number, between Polyxenia and Polycolpa proves to be equally non-existent, for *Pegantha laevis* Bigelow with 19–22 tentacles when mature (1909a, p. 97) is exactly intermediate between them. The number of tentacles is, at most, only a specific character here; and even so, must be used with caution, being variable in every peganthid yet described.

But it does not follow that all Solmaridae with peripheral canals and otoporpae should be united in one genus, for they fall into two groups, according as the sexual products are localized in pockets at the margin of the stomach, as numerous as, and in the radii of, the marginal lappets (Pegantha), or form a continuous ring in the lower gastric wall, as Haeckel describes them for his genus Polycolpa. And a typical Polycolpa, *i. e.*, solmarid with ring-like gonad, and with

canals and otoporphae, has recently been recorded from the Indian Ocean by Browne (1916) as "Solmaris sp.?"

In short, the Solmaridae fall naturally into three genera, Solmaris with ring-gonad, and neither canals nor otoporphae, Pegantha and Polycolpa limited as above, though Mayer (1910), uses the genus Pegantha to include all solmarids with localized interradial gonads, irrespective of the presence or absence of peripheral canals or otoporphae.

In no genus of Medusae is the delimitation of the various species more difficult than in Pegantha, owing to the unsatisfactory nature of most of the older descriptions and figures; and to the paucity and poor condition of available specimens. And it is so homogeneous that for specific characters we must turn to such minor features as the form of the gonads, the number of otocysts, exumbrella sculpture, and number of tentacles with due regard to its variability.

On this basis Vanhöffen (1908a, p. 67) reduces the eighteen species listed by Haeckel (1879) to ten, while Mayer (1910) recognizes eleven. But when the various Peganthas are better known, a much more drastic revision will probably be necessary. This it would be idle for me to attempt, without larger series of specimens than are at hand. But it may be of service to outline briefly the present state of our knowledge.

One species of Pegantha, and one only, *P. triloba* Haeckel, has been taken often enough, and studied sufficiently (1909a, Vanhöffen, 1908a, 1912a, 1912b) to make its specific features, and their variability, well known.

It is characterized by well-marked exumbrella sculpture; by long ovate marginal lappets, tripartite gonads, with occasional bipartite and quadripartite variations, 9–16 tentacles, and 18–20 otocysts per lappet. *P. biloba* Haeckel, with bipartite, and *P. sieboldi* and *P. quadriloba* Haeckel with quadripartite gonads, are probably identical with it (Bigelow 1909a); and the Pegantha described by Vanhöffen (1908a) as *Polyxenia cyanogramma* Quoy and Gaimard, certainly is, as Mayer (1910) has already pointed out. *Pegantha pantheon* Haeckel (1881) resembles *P. triloba* in general form and sculpture, and is separable from it only by having eighteen instead of sixteen, or fewer, tentacles, a distinction which may be merely an evidence of extreme variation. Vanhöffen (1908a, p. 67) it is true, credits it with "Funf-Teiligen Gonaden." But Haeckel's figures of the gonad show merely a much wrinkled sac, as might be expected of alcoholic material.

Pegantha martagon Haeckel has likewise been redescribed recently

(Bigelow, 1909a, p. 83). It, like *P. triloba*, has comparatively few tentacles (9–13) and a high-arched bell; but it is separated from that species by the limitation of the exumbrella-sculpture to the marginal lappets, and especially by the structure of the gonads, which are simple in the young, and though more or less lobed and irregular in the adult (Bigelow, 1904, pl. 18, fig. 6), never definitely subdivided, or trifid, as they are in *P. triloba*. The Medusa from the Maldivian Islands which I described (1902) as *P. simplex*, is *P. martagon*. *Pegantha zonaria* Haeckel is apparently close to, if not identical with it, as may also be the *Pegasia dodecagona* of Péron and Lesueur (1809), redescribed by Haeckel (1879). And this is likewise true of the *Medusa mollicina* Forskål (1775), redescribed by Haeckel (1879), as *Polyxenia mollicina*. But these early descriptions are so unsatisfactory that it is doubtful whether they can ever be definitely connected with any actual Medusa.

All other Peganthas recorded within recent years have sixteen or more tentacles, in connection with a low flat bell, with the exumbrella sculpture much less prominent than that of *P. triloba*. Such are *P. dactyletra* Maas (1893), *P. clara* R. P. Bigelow (1909), *P. smaragdina* H. B. Bigelow (1909a), and the Peganthas described by Vanhöffen (1908a, 1912a, 1912b), as “*Polycolpa forskalii*” Haeckel, and “*Polyxenia cyanostylis*” Eschscholtz.

Pegantha laevis, *P. dactyletra*, and Vanhöffen’s “*P. cyanostylis*” agree so closely with one another in the structure of the gonads, which consist of swellings with papilliform lobes or processes, and in the number of tentacles, that they may prove to be identical. But so unsatisfactory are the accounts of *P. cyanostylis* by Eschscholtz (1829) and by Haeckel (1879) that its identity with any actual Medusa must always remain in doubt.

In *P. smaragdina* and *P. clara* the gonads are simple; and they agree with one another closely in tentacle-number, (21–34), and general form; the only differences between them are the degree of convexity of the subumbral side of the disc, and color, *P. clara* being colorless, whereas in *P. smaragdina*¹ the stomach and canal-system are lemon-yellow. And since neither of these characteristics is apt to be of much significance, judging from other Medusae, Vanhöffen (1913b) is probably correct in uniting them, though final decision must await larger series of each than have yet been studied. The specimens described by Vanhöffen (1908a, 1912b) as *Polycolpa forskalii* Haeckel, may perhaps belong here too, though since the gonads were not present,

¹ The descriptions of *P. smaragdina* H. B. Bigelow (1909a) and of *P. clara* R. P. Bigelow (1909) appeared almost simultaneously.

their identity must remain in doubt. But Haeckel's *Polycolpa forskalii* is generically distinct from Pegantha, as here defined, for in living specimens of that species (Haeckel, 1881, p. 31, pl. 10, fig. 1-8), the gonad forms a ring around the stomach, and does not "send out caecal or pouch-like processes into the separate lobe cavities." Only on the assumption that Haeckel's entire account was an error, which the excellent condition of his material forbids, could it be associated with any Pegantha.

P. magnifica Haeckel resembles the *P. clara*-*P. smaragdina* group in its numerous tentacles (30); but is separated from all other Peganthas by the presence of conical nematocyst knobs on the exumbrella, and by the large number (30-35) of otocysts per marginal lappet.

The following species also apparently belong to Pegantha, as here limited:—*Fovcolia diadema* Lesueur, *Aequorea cyanogramma* Quoy & Gaimard, (both redescribed by Haeckel, 1879), *Polyxenia cyanolina* Haeckel. But the accounts of all three are so unsatisfactory that their tentacle-number alone, 16-20 for all, is established. The gonads are described by Haeckel as simple in *P. diadema*, trifid in *P. cyanogramma*, four parted in *P. cyanolina*; but as he saw alcoholic material only, little weight can be laid on them.

PEGANTHA CLARA R. P. Bigelow?

Pegantha clara R. P. Bigelow, 1909, p. 80.

Pegantha smaragdina H. B. Bigelow, 1909a, p. 90, pl. 14, fig. 1, 2, pl. 19, fig. 1-9, pl. 22-26.

Polycolpa forskalii Vanhöffen, 1908a, p. 56; 1912, p. 32; 1912a, p. 391 (non Haeckel, 1879, 1881).

Station

10,176	50-0 meters	1 spec.	18 mm.	in diam.	21	tent.
10,176	" "	1 "	16 "	" "	20	"
10,211	" "	1 "	12 "	" "	19	"
10,196	surface	1 "	14 "	" "	23	"

These small specimens are referred to *P. clara*, as the young of that species, on the strength of their numerous tentacles, and the limitation of exumbrella sculpture to the lappets, *P. clara* (incl. *P. smaragdina*, and *P. forskalii* Vanhöffen) being the only Pegantha with upwards of eighteen tentacles before the gonads appear, except, perhaps *P. magnifica*, which, however, has exumbral nettle-warts, and a very large

number of otocysts. But as no trace of gonads is yet to be seen on the BACHE specimens, identification can only be provisional.

In the best specimen (the first in the above list) the bell is about 10 mm. high, with thick biconvex central disc, and narrow oval lappets, exumbrella sculpture being limited to the latter. There are four otocysts on most lappets, five on one, with the otoporpae about as long as the lappets. The specimen 14 mm. in diameter has 2-4 otocysts per lappet, that of 12 mm., 2-3 only, each with prominent otoporp.

PEGANTHA DACTYLETRA Maas?

Pegantha dactyletra Maas, 1893, p. 47, taf. 5, fig. 1-8.

?*Pegantha laevis* H. B. Bigelow, 1909a, p. 97, pl. 16, fig. 1, pl. 20, fig. 4-6, pl. 27, fig. 1-7.

?*Polyxenia cyanostylis* Vanhöffen, 1908a, p. 54; 1912, p. 31.

?*Polyxenia cyanostylis* Eschscholtz, 1829, p. 119, taf. 10, fig. 1; Haeckel, 1879, p. 330.

Station

10,200	surface	1	spec.	20	mm.	in diam.	16	tentacles
10,200	"	1	"	27	"	"	16?	"
10,203	"	1	"	31	"	"	16	"

The specimens are in poor condition.

Here again, as in the case of the series referred to *P. clara* (p. 397), immaturity prevents positive identification; but the specimens agree better with *P. dactyletra* than with any other of the genus. Thus they all have the tentacle-number (16), low, rounded bell, smooth biconvex disc, and short, broad, lappets described by Maas (1893); and I need hardly add that a well-developed peripheral canal-system is clearly visible. The number of otocysts per lappet likewise corresponds to that of *P. dactyletra* (5-7) and its close relative (or synonym) *P. lacvis*, (1909a, p. 98); for while there are only from 2-5 per lappet each with its otoporp, in the smallest BACHE specimen, I was able to count eight in one lappet of the largest.¹ In all three specimens the future sexual organs are represented by sixteen small, simple, rounded swellings, at the margin of the stomach in the radii of the marginal lappets, already supported by the gelatinous prominences so characteristic of this genus. This is just what would be expected as the earliest stage in the development of the complex gonad of *P. dactyletra*, in which, when

¹ Both of the larger examples are in such poor condition that most of the otocysts are lost.

adult, each of these primary saccules is supplemented by a number, usually five, of finger-like diverticula. And, this, taken with the other characters first enumerated, seems sufficient to warrant the provisional identification. But the possibility that the present specimens might have developed some other type of gonad, with further growth, must be recognized.

AEGINIDAE Gegenbaur.

(*Sensu* Maas 1904b; Bigelow, 1909a).

SOLMUNDELLA Haeckel, 1879.

(For discussion of this genus see Maas (1905); Browne (1905, 1916); Mayer (1910); Vanhöffen (1908a); and Bigelow (1909a).

SOLMUNDELLA BITENTACULATA (Quoy and Gaimard).

Charybdea bitentaculata Quoy & Gaimard, 1834, p. 295, pl. 25, fig. 4, 5.

(For synonymy, see Bigelow, 1909a, p. 77; Mayer, 1910, p. 455).

Station 10,200, 75-0 meters, 1 specimen about 2 mm. in diameter.

This young specimen is too much contracted to show either the peronii, gonads, or otocysts, consequently it might belong either to the large (*S. bitentaculata*) or small (*S. mediterranea*) variety of the species.

SCYPHOMEDUSAE.

CHARYBDEIDAE Gegenbaur.

CHARYBDEA MARSUPIALIS var. XAYMACHANA Conant.

Charybdea xaymacana Conant, 1897, p. 8, fig. 8.

(For synonymy, see Mayer, 1910, p. 509).

Station 10,188, surface, 1 specimen, 40 mm. high, with large gonads.

Charybdea xaymacana has usually been considered as distinct from *C. marsupialis*, though obviously a close relative of that well-known Medusa (Mayer, 1910, p. 507). But comparison of the present specimen, and one from Jamaica, with examples from Naples, shows

that there is no discontinuity between the West Indian and Mediterranean forms in the characters which have been used to separate them. These are the number of velar canals per octant, *C. marsupialis* having three, occasionally four, *C. xaymachana* described (Conant, 1897, 1898, Mayer, 1910) as having two; and size, *C. marsupialis* being the larger. But the present specimen has three canals in two of the octants, two in each of the other six; and it is of about the same size as *C. marsupialis* as described by Mayer (40 mm. high by 30 mm. broad). It is apparently true, however, that adult Mediterranean specimens are usually larger, and have more velar canals, than West Indian. And for this reason it is wisest to retain the name *xaymachana* for the American variety.

CHARYBDEA ALATA Reynaud.

Charybdea alata Reynaud, 1830, p. 95, pl. 33, fig. 1; Vanhöffen, 1908b, p. 34, fig. 3, 4; Mayer, 1910, p. 510.

The collection contains four young Charybdeas from Stations 10,196, 10,200, 10,208, surface hauls, which are best referred to this species, though positive identification is impossible, because of immaturity.

The most striking feature of these specimens is their large size, for though only the first traces of gonads are visible, they range in height from 42–49 mm.; in diameter from 29–32 mm., with pedalia 20–21 mm. long.

In every case there are three velar canals per octant. Those next the tentacles are invariably branched dichotomously once or twice; of the others (*i. e.*, the two, in each octant, next the rhoparial frenulum), some are simple, some dichotomously branched near their tips; some with small, irregular side branches. This, of course, suggests that at a later stage in development all the canals would be branched; but there is no evidence of future anastomosis. The gonads, though visible in all three specimens, consist merely of narrow, linear bands, hardly 1 mm. broad, obviously a very young stage.

The rhopalia are not in good enough condition to allow a description of the eyes.

These specimens are undoubtedly identical with the somewhat larger examples recorded by Vanhöffen (1908b) as *C. alata*, with which they agree even to minor details; for further discussion see Vanhöffen (1908b) and Mayer (1910).

PERIPHYLLIDAE Haeckel.

PERIPHYLLA HYACINTHINA Steenstrup.

Periphylla hyacinthina, Steenstrup, 1837.

(For synonymy, see Bigelow, 1909a, p. 26; Mayer, 1910, p. 544).

This species has been discussed so fully by Broch (1913) and by me (1909a, 1913) that I need merely record the occurrence of one young specimen, 18 mm. in diameter, with pigment in the "dodecabostrycha" stage, from Station 10,200, 500-0 meters, and 1 specimen, 50 mm. in diameter, from GRAMPUS station 10,352, 40° N. Lat., 68° 44' W. Long.; 500-0 meters.

NAUSITHOIDAE Claus.¹

NAUSITHOE PUNCTATA Kölliker.

Nausithoe punctata Kölliker, 1852, p. 323.

(For synonymy, see Bigelow, 1909a, p. 35; Mayer, 1910, p. 554).

Station				
10,161	100-0 meters	1	specimen	
10,197	200-0	"	1	"
10,206	surface		1	"

These specimens, ranging from 8-10 mm. in diameter, add nothing, except in the way of confirmation, to the various published accounts varying in of this well-known species.

LINUCHE UNGUICULATA (Schwartz).

Medusa unguiculata Schwartz, 1788, p. 195, taf. 6, fig. 1.

(For synonymy, see Linné, 1788, p. 3159; Mayer, 1910, p. 558; Vanhöffen, 1913b, p. 429).

The collection contains ninety-seven specimens, young and adult, from Stations 10,176, 10,200, 10,202, 10,203 and 10,206, in hauls varying in depth from the surface to 500-0 meters.

¹ According to Poche (1914) this name was proposed by Claus, in the 4th edition of his *Grundzuge der zoologie*, 1878, to which I have not had access. But Claus soon abandoned it (1881) in favor of Ephyropsidae, and it seems to have been forgotten. In 1913 I proposed it, as a new name, since Ephyropsidae is not available (1913, p. 55).

Since Vanhöffen (1913b) has demonstrated the unity of *L. unguiculata* and *L. aquila*, all known representatives of Linuche belong to this combined species. The present series adds nothing to the previous accounts.

SIPHONOPHORAE.

SPHAERONECTIDAE Huxley.

(*Sensu* Bigelow, 1911b).

Moser (1912a, p. 528) has revived the name Monophyidae for this family. But although this term is more descriptive than Sphaeronectidae, in its indication of the structural simplicity of the forms in question, the International rules of zoölogical nomenclature forbid its use, Monophyes of Claus (1873) being undoubtedly a synonym of Sphaeronectes Huxley (1859).

MUGGIAEA SPIRALIS (Bigelow).

Diphyes spiralis Bigelow, 1911b, p. 249, pl. 7, fig. 4, pl. 8, fig. 1, 2, pl. 9, fig. 3, pl. 11, fig. 4; 1913, p. 76.

Muggiae spiralis Moser, 1915b, p. 654.

This easily recognized species was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,172, 10,173, 10,176, 10,178, 10,180, 10,182, 10,186, 10,188, 10,212; the captures being both in intermediate hauls and on the surface. The material consists of about 40 nectophores; 2-3 mm. long.

As additional specimens of *M. spiralis* are studied it becomes increasingly certain that it is a monophyid, as Moser (1913a, p. 147, 1915b) maintains, not a diphid, as I formerly supposed. My original location of it in the latter family was due to the presence, in two specimens, of "a very small bud which was apparently the forerunner of a posterior nectophore" (1911b, p. 251). But these buds were probably either very young siphons or gonophores, because neither Moser, nor I, have found an inferior nectophore, or even any bud far enough advanced to be surely identified as such, although a considerable number of specimens in good condition, have now been studied.

Further than this, the present series adds nothing to my earlier description.

CUBOIDES VITREUS Quoy and Gaimard.

Cuboides vitreus Quoy & Gaimard, 1827, p. 19, pl. 2e, fig. 1-3.

(For synonymy, see Bigelow, 1911b, p. 190).

Station 10,198, 75-0 meters, 1 specimen.

PRAYIDAE Kölliker.**AMPHICARYON ACAULE** Chun.

Amphicaryon acaule Chun, 1888, p. 1162; Bigelow, 1911b, p. 195, pl. 4, fig. 1-8; Moser, 1912a, p. 529; 1913a, p. 146.

This species was taken at Stations 10,162, 10,166, 10,169, 10,186, 10,187, 10,195, 10,197, 10,203, 10,210; a total of about 30 specimens, in hauls varying in depth from 600-0 meters to 50-0 meters. It was not taken on the surface, most of the captures being from 100-0 meters.

Unfortunately the specimens are all so fragmentary that they add little, beyond confirmation, to my earlier (1911b) account of this peculiar genus. I may note however, that in none of them does the larger nectophore entirely enclose the smaller scale-like one as Chun (1888) describes it; nor was this the case in any of the ALBATROSS specimens. And the lateral subumbrial canals of the larger nectophore usually bear a series of short lateral diverticula near their upper end, which were not present in the ALBATROSS specimens from the eastern Pacific (1911b).

The extreme reduction of the stem to a disc or plate, mentioned by Chun (1888), is very evident in several of the present specimens, the cormidia being borne on short stalks on either side of the lines of attachment of the two nectophores. In the larger specimens there are 6-9 cormidia, 3-5 on either side.

HIPPOPODIIDAE Kölliker.

Most recent students (Haeckel 1888, Chun 1897b, Bigelow, 1911b) have recognized two genera in this family, Hippopodius with rounded, Vogtia with angular nectophores. Schneider (1898) and Moser (1911-1915) have united them, thinking this character too trivial to be given generic importance. But the study of a new hippopodid in the BACHE collection has convinced me that neither of these schemes

is correct, Vogtia and Hippopodius being actually separable, not by the form of the gonophores, but by a much more important character, structure of the tentilla. In Hippopodius, as has long been known, these organs, when adult, consist of a large, sac-like cnidosac (Plate 7, fig. 7), with single terminal filament. And this state is attained by a direct development (Plate 7, fig. 6). In Vogtia, it is true, the adult tentillum (Plate 4, fig. 7; 1911b, Plate 15, fig. 7) resembles that of Hippopodius superficially. But in its development it passes through a spirally coiled stage (Plate 4, fig. 6), closely resembling the tentilla of certain agalmids. And the apparent cnidosac of the adult tentillum of Vogtia is in reality the spiral cnidoband of the younger tentillum, shortened and flattened into one plane; *i. e.*, a secondary, not a primary development. The difference between young tentilla of the two genera is very striking.

The new hippodid described (p. 407) has tentilla of the "Vogtia" type, though its nectophores are rounded, like Hippopodius. And as the structure of the tentillum is undoubtedly far more important in phylogeny, and hence classification, than the mere details of outline of the nectophores, it follows that the latter can no longer be used as a generic character in this connection.

HIPPOPODIUS HIPPOPUS (Forskål).

Plate 7, fig. 6, 7.

Gleba hippopus Forskål, 1775, p. 14; 1776, pl. 43, fig. E.

(For synonymy, see Bigelow, 1911b, p. 208).

This well-known siphonophore was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,172, 10,173, 10,176, 10,178, 10,180, 10,182, 10,184, 10,186, 10,187, 10,188, 10,192, 10,194, 10,195, 10,197, 10,198, 10,200, 10,202, 10,203, 10,207, 10,208, 10,209, 10,210, 10,211. Some of the captures were made on the surface, most of them, however, in open-net hauls from 100 fathoms, or more. Thus it was almost universal in the warm waters traversed by the BACHE, failing to appear at only 8 out of 37 tow-net stations. But it did not occur in the cool coastal water off Chesapeake Bay (Stations 10,157–10,160).

Hippopodius hippopus has so often been recorded, and is so well known, that no account is needed here, further than to point out that none of the spherical larvae, or primary bells, of this species, so characteristic and easily recognized (Chun, 1897a), were detected in the BACHE collections, though they outnumbered the adults in the

RESEARCH collections from the Bay of Biscay (1911a). Most of the BACHE specimens are fragmentary, but their bells, though dissociated, are sufficiently preserved for their characteristic outlines to identify them at a glance.

VOGTIA Kölliker, 1853.

How many species are represented by the representatives of this genus previously described, is still an open question. I formerly recognized two only, *V. pentacantha* Kölliker and *V. spinosa* Kefferstein and Ehlers. But Moser (1913a, 1915a, 1915b) believes that the specimens from Bering Sea described by me (1913) were in reality a new species, which she has christened *V. serrata*. And she has not only studied specimens of this form, from the collections of the GAUSS but compared them with *V. pentacantha* from the Mediterranean. Unfortunately her preliminary papers give no description of her specimens of *V. serrata*; nor does she state how she would distinguish it from *V. pentacantha*. But from the fact that she refers my Bering Sea (1913) series to it, I can only assume that she applies this name to Vogtias in which neither the facets nor the angles of old nectophores are spinous. In *V. spinosa* both facets and angles bear prominent tubercles or spines (Kefferstein and Ehlers, 1861, Haeckel, 1888b, Bigelow, 1911b, p. 211, pl. 15, fig. 9, 10), whereas in the Mediterranean *V. pentacantha* as described both by Kölliker (1853) and by Kefferstein and Ehlers (1861), and in the Biscayan specimen recorded by me (1911a), the angles are spinous or tuberculate, the facets smooth. As Moser (1913a) points out, *V. pentacantha* is intermediate between *V. spinosa* and *V. serrata*. And such extremes as *V. spinosa*, on the one hand, and the smooth angled Bering Sea specimens (1913) on the other, would undoubtedly represent two wholly distinct species, were they discontinuous. But this is not the case, for not only is *V. pentacantha* intermediate between the two, with its young nectophores almost exactly paralleling those of *V. spinosa* (p. 406), but the latter is itself variable in the degree of spination of nectophores. So few specimens of the *V. pentacantha* type have been examined critically except by Moser, that final decision may well await the appearance of her detailed account. In the meanwhile all three species may be retained.

All these Vogtias have angular nectophores. But the BACHE collection contains one specimen of a new species (p. 407), with the Vogtia type of tentillum, but with rounded nectophores.

VOGTIA PENTACANTHA Kölliker.

Plate 4, fig. 1.

Vogtia pentacantha Kolliker, 1853, p. 31, tab. 8; Kefferstein & Ehlers, 1861, p. 23, taf. 5, fig. 12-15; Chun, 1897b, p. 35, taf. 1, fig. 11-14; Bigelow, 1911a, p. 351; Moser, 1915b, p. 653.

?Non *Vogtia pentacantha* Bigelow, 1913, p. 66, pl. 5, fig. 7-9, pl. 6, fig. 6.

Station 10,206, 400-0 meters, one much contracted colony with about 13 nectophores still attached.

This example is in excellent condition, except for being contracted.

On the older nectophores (Plate 4, fig. 1) the facets are perfectly smooth, but the angles between them bear varying numbers of conical gelatinous tubercles just as in the specimens collected by the RESEARCH (1911a, p. 351), and by the PLANKTON expedition (Chun, 1897b). Occasionally a tubercle apparently belongs to a facet, not to an angle; but this appearance is the result of contraction. I may further point out, as substantiating Moser's (1913a) statement that *V. pentacantha* is intermediate between *V. spinosa* and *V. serrata*, that not only the sculpture of the nectophores, but the structure of the ventral sinus, is intermediate between the two. As I have already shown (1913), the ventral sinus in *V. spinosa* (adult nectophores) is in the form of two lateral wings, narrowest next the ventral subumbrial canal, whereas in the Bering Sea specimens, identified by me as *V. pentacantha*, but which really belong to *V. serrata* (if that species prove valid), it is reduced, in the old nectophores, to a slight thickening of the ventral canal. In the oldest nectophores of the present specimen we find a condition mid-way between these two extremes, the ventral sinus (Plate 4, fig. 1) being much smaller than in *V. spinosa* nectophores of a corresponding age, but nevertheless extending on either side of the canal as a short wing. Young nectophores of this specimen are spinous on facets as well as angles; in fact are indistinguishable from nectophores of *V. spinosa* of corresponding age, thus corroborating Moser (1913a). In all other respects the specimen so closely resembles *V. spinosa* that no further account is needed, except to point out that the relationship of the nectophores, and the elongated "knospungszone" on which they are borne, is exactly the same as in other members of *Vogtia* (1911b, 1913) and in *Hippopodius* (Chun, 1897a, Bigelow, 1913).

VOGTIA GLABRA, sp. nov.

Plate 4, fig. 2-7.

Station 10,202, 450-0 meters, one specimen with 3 nectophores; also 4 loose nectophores; in good condition. TYPE.

In its general organization, this new species agrees exactly with other species of *Voglia* (1911b, 1913), and with *Hippopodius hippocampus*, particularly in the relationship of the elongated "knospungzone" which bears the nectophores to the siphosome, of which Chun (1897a, 1913) and Richter (1907) have given excellent accounts. But the nectophores are strikingly characteristic. The youngest nectophore (aside from a very small bud), already 7 mm. long, is elongate in outline (Plate 4, fig. 2, 3), its apex prolonged into a triangular process, and there are two principal dorsal prominences, one on either side, about mid-way between the nectosac and the apex, which, though trivial in their nature, prove to be an important specific character.

In ventral view (Plate 4, fig. 3), it is seen that there is a deep hydrocial groove, running the whole length of the nectophore, and partially enclosed by its lateral flaps, particularly near the apex. At this early stage the ventral sinus is large.

The next older nectophore (Plate 4, fig. 4) already 17 mm. long, is relatively shorter and broader, and its outline more rounded. But the apical point, and the two dorsolateral prominences are as evident as at the earlier stage. And there is no trace of the four dorsal prominences which bound the margin of the nectosac in *H. hippocampus*, unless the dorsolateral prominences can be said to represent them. Corresponding to the general alteration in the shape of the nectophore, which takes place with growth, the hydrocial groove is shallower, and broader, its enclosing flaps lower; and the ventral sinus has decreased in relative size.

The large nectophores (27-30 mm. broad) are nearly circular in outline (Plate 4, fig. 5), with very broad, shallow hydroecium. But the two dorsolateral, and the apical, prominences are as evident as before.

The rounded outlines of the nectophore separate *V. glabra* at a glance from the other members of *Voglia*. And though it resembles *Hippopodius hippocampus* superficially in this respect, the bells of the two species differ characteristically in detail. Thus, in the latter, the apex of the bell is rounded, not pointed, even in nectophores only 3-4 mm. long, while the dorsolateral prominences of *Voglia glabra* are

replaced, in *Hippopodius hippocampus* by a series of four knobs, close to, and often overhanging, the dorsal margin of the nectosac, as has so often been described.

Tentilla. The adult tentilla of *V. glabra* (Plate 4, fig. 7) very closely resemble those of *V. spinosa* (1911b, plate 15, fig. 7), consisting of the same coiled cnidoband, lying nearly in a single plane so as to simulate the cnidosac of Hippopodius, and of a single terminal filament, though the large spindle-shaped cnidoblasts are fewer in number. And, as in *V. spinosa*, the tentillum, in its development, passes through a stage in which the cnidoband is spirally coiled (Plate 4, fig. 6), the final state being apparently attained by a loosening of the spiral, and its contraction into one plane.

Siphons and gonophores. These organs so closely resemble those of *V. spinosa* (1911b, p. 212) that no account is necessary here further than to point out that like that species, each cormidium bears both ♂ and ♀ gonophores.

DIPHYIDAE Eschscholtz.

I have discussed elsewhere (1911b) the three subfamilies, Abylinae, Galeolarinae, and Diphyopsinae, into which this family has usually been divided and believe that the limits previously given them still stand; but with the addition of a fourth, Clausophyinae (Bigelow, 1913, p. 70), for the reception of Clausophyes. Moser (1913a, p. 148), it is true, has recently given a new definition to the Galeolarinae, expanding it to include "alle Diphyes-Ähnlichen formen...., bei deren Oberglocke das Hydroecium rudimentar ist, und tiefer als der mund legt, während es bei der unterglocke sehr primitiv ist." But the nature of the cormidia, whether detached as free-living eudoxids (Diphyopsinae), or permanently connected with the stem (Galeolarinae), seems to me a much more fundamental matter than the precise outlines of the hydroecium. And at any rate, the former is an absolute, the latter only a gradual difference, for there is no sharp line between species with deep, and those with shallow, or suppressed hydroecium.

ABYLA TRIGONA Quoy and Gaimard.

Abyla trigona Quoy & Gaimard, 1827, p. 14, pl. 2B, fig. 1-8.

(For synonymy, see Bigelow, 1911b, p. 221).

This well-known species was taken at Stations 10,163, 10,166, 10,171, 10,178, 10,186, 10,192, 10,194, 10,207, and 10,211, in both

surface and intermediate hauls. The material consists of two entire specimens and fifteen superior nectophores, and two eudoxoids.

ABYLA LEUCKARTII Huxley.

Abyla leuckartii Huxley, 1859, p. 49, pl. 3, fig. 2; Agassiz & Mayer, 1902, p. 165 (*partim*); Lens & Van Riemsdijk, 1908, p. 34, pl. 5, fig. 42–46; Bigelow, 1911b, p. 216, pl. 13, fig. 5–8, pl. 15, fig. 3, 4; Moser, 1913a, p. 149.
Enneagonum leuckartii Schneider, 1898, p. 93.

Station 10,194, 100– meters, one superior nectophore, 6 mm. long. The identity of this specimen rests on actual comparison with specimens from the West Indies, and from the Pacific (1911b).

ABYLA DENTATA, sp. nov.

Plate 5, fig. 1–4.

Station 10,166, 100–0 meters, one superior nectophore. Extreme length (apical margin to tip of basal tooth), 14 mm. TYPE.

Station 10,171, 75–0 meters, one superior nectophore, badly distorted.

These large nectophores evidently belong to the *A. trigona-leuckartii* group, *i. e.*, are true Abyla, in the restricted sense (1911b, p. 213). But they differ so much from all described species in the arrangement of ridges and facets, as to necessitate a new species. Like *A. leuckartii*, the nectophore is pentagonal in side view, its upper portion rectangular (Plate 5, fig. 1); but it is much thicker than that species, a fact which gives it a characteristic cubical appearance. The facets are essentially the same as those of *A. leuckartii*, *i. e.*, apical, dorsal, ventral, dorso-lateral, and ventrolateral. The most diagnostic feature of this new species is the dorsal facet of its superior nectophore. In all other Abylas, *i. e.* *A. leuckartii*, *A. trigona*, and *A. haeckeli*, this is rectangular. But in *A. dentata* it is essentially triangular (Plate 5, fig. 3), its apex apical, its base deeply emarginate, with its lateral margins strongly bowed, and very prominently toothed in the lower $\frac{2}{3}$ of their length.

The ventral facet (Plate 5, fig. 2) at first sight suggests *A. trigona* (1911a, pl. 13, fig. 4), being similarly pointed basally, and emarginate laterally near its upper end, while lacking the transverse ridge which subdivides it in *A. haeckeli*. But instead of being limited apically by a distinct apicoventral ridge, as is the case in *A. leuckartii*, *A. trigona*, and *A. haeckeli*, it is continuous here with the apical ridge,

one merely curving into the other. The lateral margins of the ventral, like the dorsal facet, are strongly toothed along their lower halves.

The dorsolateral facet resembles *A. trigona*, the lateral ridge extending to the basal tooth of the hydroecium, instead of terminating some distance above it, as is the case in *A. leuckartii*. But the ventro-lateral facet is single, as in the latter, instead of being subdivided by a transverse ridge, as it is in both *A. trigona* and *A. haekeli*. And corresponding to the continuity of ventral and apical facets, its ventral margin is rounded, instead of angular. Its basal margin is strongly toothed as is also the lateral ridge. The apical facet (Plate 5, fig. 4), is essentially pentagonal, but it has only three distinct angles, dorsal, and two lateral, there being no ventral angles, owing to the continuity of apical with ventral facet. This outline, particularly the fact that the apical facet is pointed at its dorsal end, is characteristic, for in both *A. trigona*, *A. haekeli*, and *A. leuckartii* it is hexagonal, its dorsal end bounded by a transverse margin instead of an angle, owing to the different shape of the dorsal facet.

As illustrated by the apical view (Plate 5, fig. 4), all the facets are deeply concave, a fact which gives the nectophore a very characteristic appearance.

The hydroecium (Plate 5, fig. 1), though of the ordinary abylid type, is shallower than in other members of *Abyla* (*sensu strictu*) occupying only about two thirds of the length of the nectophore. But the nectosac extends almost the whole length of the nectophore, the pedicular canal joining it a considerable distance below its apex; and consequently its dorsoradial canal follows a diphyid rather than an abylid, course, just as in *Ceratocymba* (1911b, p. 232).

The somato cyst is oval, much as in *A. leuckartii*, except that its pedicular canal joins it some distance below its apex.

No account of the appendages is possible, only a few much contracted young siphons, with their tentilla, being visible, and the inferior nectophore is lost.

The features just mentioned, of which the triangular dorsal facet, the continuity of ventral and apical facets and the dorsal angle of the latter, are most diagnostic, suffice to separate *Abyla dentata* from all abyliids yet described. But it is not certain that the BACHE specimen is the first which has been studied, for Moser (1913a, p. 149) mentions as close allies of the *A. trigona*-*A. leuckartii* group, two new abyliids (as yet unnamed) from the collections of the German South Polar Expedition, one or other of which may prove to be identical with *A. dentata*, when described.

ABYLOPSIS TETRAGONA (Otto).

Pyramis tetragona Otto, 1823, p. 306, taf. 42, fig. 2a-2c.

(For synonymy see Bigelow, 1911b, p. 224).

This well-known species was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,173, 10,176, 10,178, 10,180, 10,182, 10,186, 10,192, 10,196, 10,197, 10,200, 10,202, 10,203, 10,208, 10,209, 10,211, 10,212; both in surface and intermediate hauls, about 200 specimens. The free eudoxid was taken at Stations 10,161, 10,169, 10,192. The specimens, all more or less damaged, agree so well with previous descriptions that no account of them is necessary.

ABYLOPSIS ESCHSCHOLTZII (Huxley).

Aglaismoides eschscholtzii Huxley, 1859, p. 60, pl. 4, fig. 2.

(For synonymy, see Bigelow, 1911b, p. 226).

The polygastric generation was taken at Stations 10,161, 10,163, 10,169, 10,171, 10,176, 10,178, 10,186, 10,188, 10,192, 10,197, 10,207, 10,212, about 75 specimens; the free eudoxid at Stations 10,161, 10,169, 10,171, 10,188, 10,192.

BASSIA BASSENSIS (Quoy and Gaimard).

Diphyes bassensis Quoy & Gaimard, 1834, p. 91, pl. 7, fig. 18-20.

(For synonymy, see Bigelow, 1911b, p. 229).

The polygastric generation of *Bassia bassensis*, or its free eudoxid, was taken at Stations 10,161, 10,162, 10,163, 10,169, 10,176, 10,178, 10,180, 10,182, 10,188, 10,192, 10,208, 10,210, and 10,212, about 50 specimens of each. The records are both from surface and from intermediate hauls.

There is no difficulty in recognizing such characteristic nectophores as those of this species, though the material is in poor condition.

CERATOCYMBIA SAGITTATA (Quoy and Gaimard).

Plate 5, fig. 5; Plate 6, fig. 1-3; Plate 7, fig. 1-5.

The free eudoxid has been described as: —

Cymba sagittata Quoy & Gaimard, 1827, p. 16, pl. 2e; fig. 1-9; Eschscholtz, 1829, p. 134; Lesson, 1843, p. 454.

Diphyes cymba Quoy & Gaimard, 1834, p. 95, pl. 5, fig. 12-17.
Nacella sagittata Blainville, 1830, p. 120; 1834, p. 131, pl. 4, fig. 2.
Ceratocymba spectabilis Chun, 1888, p. 1160.
Ceratocymba sagittata Chun, 1897, p. 33; Bedot, 1904, p. 1, pl. 1, fig. 1; Moser, 1911, p. 431; 1912a, p. 538, fig. 22; 1913a, p. 149.

The synonymy of the polygastric generation is:—

Diphyabyla hubrechti Lens & Van Riemsdijk, 1908, p. 36, pl. 6, fig. 47; Bigelow, 1911b, p. 231, pl. 12, fig. 7; Moser, 1911, p. 431; 1913a, p. 149.

The polygastric generation was taken as follows:—

Station

10,161	surface	3	superior	nectophores
10,162	150-0 meters	1	"	" and 2 inferior nectophores
10,176	50-0	1	"	" and 1 inferior nectophore
10,180	75-0	1	"	" and 1 inferior nectophore
10,182	75-0	1	"	" and 1 inferior nectophore
10,182	1000-0	1	"	"
10,184	50-0	1	"	" and 2 inferior nectophores
10,186	25-0	3	"	" and 1 inferior nectophore
10,194	100-0	1	"	"
10,203	150-0	1	"	"
10,212	500-0	1	"	"

The free eudoxid was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,173, 10,178, 10,180, 10,182, 10,184, 10,186, 10,187, 10,188, 10,194, 10,195, 10,198, 10,203, 10,208, 10,211; a total of about 140 specimens.

Since Moser (1912a, 1913a), whom I can corroborate here, has found that *Ceratocymba sagittata* is the free eudoxid of *Diphyabyla hubrechti*,¹ the former (older) name must, of course, be employed. The superior nectophores range, in length, from 9 to 31 mm.; the inferior nectophores from 20 to 40 mm.

Superior nectophores of this species have already been figured, and described in detail by Lens and Van Riemsdijk (1908) for a large, by me (1911b) for a small specimen. The present series connects these two extremes, showing that the slight differences in outline, between the two, are merely indications of different stages in growth.

¹ Moser (1913a, p. 149) states that I have believed *C. sagittata* to be the eudoxid of *Abyla leuckartii*; but this was an error on her part, it being *C. asymetrica* Lens and Van Riemsdijk which I so identified (1911b, p. 219); and probably correctly, as pointed out below (p. 414).

Most striking of these is that the pointed apex of the nectophore above the level of the somatocyst is longer in the adult than in the young; the nectosac being correspondingly longer, the somatocyst proportionately smaller, the triangular hydroecium proportionately broader at its mouth. But the same characteristic arrangement of ridges and facets is to be seen at all stages in growth. And this is likewise true of the basal teeth of both nectosac and hydroecium. In the young specimen listed here, and in the still smaller ALBATROSS example the apex of the nectophore is bent ventrally, above the level of the somatocyst. But since it bends dorsally, though at about the same level in all the large specimens, both SIBOGA (Lens and Van Riemsdijk, 1908) and BACHE, it is a question whether this bending is normal, or the result of contraction or preservation.

Inferior nectophore. The inferior nectophore of Ceratocymba has not previously been described, though it is figured by Moser (1912b, fig. 23). The inferior nectophores listed above (p. 412) occurred side by side with the anterior ones, and, from this fact, from their large size (20-45 mm. long) and resemblance to the gonophores of *Diphyabyla*, and from Moser's (1912b) figure, probably belonged to it. The general outline with its long, narrow nectosac, is better shown (Plate 7, fig. 1), than verbally. Its most diagnostic feature is its curious asymmetry, not sufficiently illustrated by Moser. The hydroecium is open, ventrally, from end to end, enclosed, however, by two broad flaps. Of these, the right hand one terminates in a very long basal tooth (Plate 7, fig. 1) whereas the left hand one has no basal tooth but merely makes a right-angle with the short dorso-basal wall of the hydroecium. The latter, as well as the basal parts of the hydroecial flaps, bears a series of prominent, hook-like serrations. The mouth of the nectosac is armed with two very prominent triangular teeth, right and left lateral; and a very much smaller dorsal tooth. Besides the flaps, the nectophore has two ridges, so prominent as to be better described, perhaps, as wings, at first sight apparently a dorsal and a left lateral. But the former is in reality the right lateral, for it terminates in the right lateral basal tooth. The dorsal ridge is almost entirely suppressed, except close to its base, being traceable for most of its course only as a faint line. The nectophore is thus triangular in cross-section, like that of *Abyla trigona*. But the resemblance between the two is purely superficial, for in *A. trigona* it is the right lateral ridge, not the dorsal, which is suppressed. Above the level of the nectosac the apex of the bell is prolonged in a narrow triangle.

The subumbrial canals (Plate 7, fig. 1), are of the usual abylid type,

i. e.; do not parallel those of *A. tetragona* (Bigelow, 1911b). In all cases the stem is much contracted, or broken off; as a rule only very young siphons and tracts being visible. But in one specimen from Station 10,180 a group of appendages, or "eudoxid," so far advanced as to be nearly ready to assume its independent sexual existence, is still intact. In its main features (Plate 6, fig. 1), this eudoxid closely resembles the corresponding phase of *Abyla leuckartii* (Bigelow, 1911b, pl. 13, fig. 8), the somatocysts of the two agreeing even to the recurved tip of its descending branch. And the bract is similarly asymmetrical, consisting of three facets, dorsal, and two laterals, of which the left hand is much the smallest (the apical region is still open, for the passage of the stem). But in *Ceratocymba* the margins of the bract, and its left lateral ridge, are very strongly toothed, whereas in the slightly younger specimen of *A. leuckartii* they were smooth, or only minutely denticulate.

The chief interest of this eudoxid is its corroboration of Moser's (1911, 1912a, 1913a) statement that the free-swimming sexual phase of "Diphyabyla," like that of *Abyla leuckartii* (Bigelow, 1911b), is a "*Ceratocymba*." Two species of "*Ceratocymba*" are known, *C. sagittata* Quoy and Gaimard, well described by Chun (1888, 1897b) and by Bedot (1904), which according to Moser is the eudoxid of Diphyabyla, and *C. asymmetrica* Lens and Van Riemsdijk, the latter the eudoxid of *Abyla leuckartii* (Bigelow, 1911b, p. 219).¹

According to Moser (1913a), their bracts are exactly alike. But, though both are essentially similar, with the same peculiar asymmetry, my experience has been that they are readily separated by characteristic, if minor, features. Most important of these is the fact that whereas the left lateral (the asymmetrical) ridge of the latter invariably joins the left apical ridge, and the apical facet is correspondingly quadrilateral in outline (Bigelow, 1911b, pl. 15, fig. 4), in *C. sagittata* the lateral ridge never reaches the apical ridge, and the apical facet is triangular (Plate 5, fig. 5). Furthermore, while the apical facet of the eudoxid of *Abyla leuckartii* is flat, or even slightly convex, in *Ceratocymba sagittata* it is deeply concave, with prominent lateral angles or horns. This concavity is greatest in small specimens, but it characterizes the largest also, though to a less and varying degree (Chun, 1888). Finally, as a general rule at least, the somatocyst is relatively smaller in the latter than in the former. The gonophores

¹ Following Lens and Van Riemsdijk (1908), I formerly (1911b) referred the *C. sagittata* Bedot (1904) to *C. asymmetrica*. But actual examination of the two forms shows that there is no connection between them; *C. sagittata* being identified at a glance by its characteristic gonophores, as described below (p. 415).

of the two "Ceratocymbas" are even more diagnostic (Moser, 1913a), that of the eudoxid of *Abyla leuckartii* (*C. asymmetrica*) having the two basoventral teeth short, and roughly equal in length (Plate 6, fig. 4, Lens and Van Riemsdijk, 1908), whereas in *Ceratocymba sagittata* one of these teeth is very long, the other very short (Plate 7, fig. 2, 3) as observed by Chun (1888) and Bedot (1904). One of the most interesting features of *Ceratocymba asymmetrica*, is that the ♀ and ♂ gonophores are not alike (Moser, 1912a) the right basoventral tooth being prolonged in the male, the left hand one in the female (Plate 7, fig. 2-5); and the asymmetry of the hydroecial walls being similarly reversed, the left-hand one largest in the ♂, the right hand in the female. Furthermore, the asymmetry of these ridges is much more pronounced in the male than in the female.

So far as its bract is concerned the eudoxid here described might equally well develop into either "Ceratocymba." But its gonophore (Plate 6, fig. 2) unmistakably connects it with *C. sagittata*, thus corroborating Moser; for even at this early stage the right basoventral tooth is longest, the left hydroecial wall broadest (in the ♂): while the basodorsal tooth is of the spur-like outline characteristic of *C. sagittata*. And the characteristic asymmetry, with prominent wing-like left-lateral ridge, smaller right-lateral ridge, and suppressed dorsal ridge, is already well developed.

In slightly older gonophores, from the free eudoxid, the disparity in length between the two basoventral teeth is greater. And with further growth the difference increases, until it is very marked (Plate 7, figs. 2, 3; Moser, 1912b, fig. 23), while an equally striking change takes place, with growth, in the hydroecium, its broad enclosing flaps dwindling, until in examples upwards of 30 mm. long, the hydroecium is wide open (Plate 7, fig. 4, 5).

Moser (1912a) has already noted the similarity between the inferior nectophore, and the ♂ gonophore of the free eudoxid, in *Ceratocymba sagittata*. This I need merely corroborate, pointing out that in both it is the right hand basoventral tooth which is prolonged, and that in both the left-lateral ridge is far more prominent than the right hand one, with the dorsal ridge practically suppressed.

GALEOLARIA Blainville, 1834.

Diphyidae, with rounded nectophores, of about the same size; the groups of appendages are permanently attached to the stem.

This definition excludes the *D. truncata* Sars, referred to Galeolaria by Moser (1913b, 1915a, 1915b). Recent researches have shown that

specific differences, consisting chiefly of the number and arrangement of basal wings and teeth, are particularly clear cut in this genus. And though the value of these characters has only recently been appreciated, it has usually been possible to connect the actual specimens at hand with the older accounts and figures.

Three species, *G. quadrivalvis* (Blainville), *G. australis* Quoy and Gaimard, and *G. monoica* Chun have recently been redescribed in detail (Lens and Van Riemsdijk, 1908, Bigelow, 1911b). Briefly stated their diagnostic features are as follows: —

In *G. quadrivalvis* the superior nectophore has two dorsobasal teeth and two ventrobasal wings, the inferior has four basal teeth (two dorsal, two lateral) and two basoventral wings; and it is further characterized by peculiar constrictions of the inferior nectophore. *Galeolaria australis* has no basal teeth; but the superior nectophore has two, the inferior a single, ventrobasal wing. In *G. monoica* the superior nectophore has one dorsobasal tooth; two laterobasal teeth; two lateral flaps next the latter, and two large ventrobasal wings; while the somatoecyst is very small. Its inferior nectophore has three dorsal teeth, incised at the tip; two lateral triangular angles, and a single large ventrobasal wing.

Aside from *G. chuni* Lens and Van Riemsdijk (1908), which, according to my view is probably *G. australis*, though it is retained by Moser (1913a, p. 148) as a distinct species, all Galeolarias described within recent years can be referred to one, or other, of these three species. But the present collection contains a representative of the genus which, while it resembles *G. quadrivalvis* in its inferior nectophore, differs from all three in the presence of four basal teeth, in the superior nectophore.

This species so closely resembles *G. quadrivalvis* in its general appearance, that it is probable that the two have been confused; indeed the M. C. Z. collection contains two excellent specimens of the "quadridentate" form, received from the Zoölogical station at Naples as *G. quadrivalvis*. For the stability of the nomenclature of the genus it is, of course, desirable to establish to which of these species, with bidentate or with quadridentate superior nectophore, the name *G. quadrivalvis* really belongs. But here, as so often, we are faced by the difficulty that the original account of *G. quadrivalvis* (Blainville, 1834), being taken from the inferior nectophore, applies equally well to either. However, it certainly belongs to one or the other of them. And inasmuch as the quadridentate form is probably the *G. quadridentata* of Quoy and Gaimard (1834), which was

described almost simultaneously, but has since remained problematical, there is every reason to continue to use the name *G. quadrivalvis* for the bidentate species. And there is the more reason for this, since Gegenbaur's (1853) account of *G. quadrivalvis* was probably taken from the bidentate form, though his description of the base of the superior nectophore, crediting it with only *one* dorsal tooth, is not clear. And Vogt's (1854) *G. auriantaca* probably belongs here too, for it is not likely that he would have overlooked the large basal teeth of the superior nectophore, had he been dealing with *G. quadridentata*. But we owe to Leuckart (1854, "*G. filiformis*") the first satisfactory account of basal structure of the bidentate species, for he records both the two dorsal teeth, and the two ventral wings of the superior nectophore. (See Bigelow, 1911b).

GALEOLARIA QUADRIDENTATA Quoy and Gaimard.

Plate 8, fig. 1, 2.

Galeolaria quadridentata Quoy & Gaimard, 1834, p. 45, pl. 5, fig. 32, 33.

Station 10,186, 185-0 meters, 1 superior and 1 inferior nectophore, respectively 12, and 16 mm. long, in good condition.

Station 10,197, 100-0 meters, one superior nectophore, 9 mm. long, in good condition.

Also 2 superior and 2 inferior nectophores, from the Gulf Stream, latitude 38° 33' N., longitude 70° 80' W., GRAMPUS Station 6, 1908; and 2 entire specimens from Naples.

Superior nectophore. The superior nectophore (Plate 8, fig. 1) so closely resembles that of *G. quadrivalvis* in its general form that it might well be confused with it, were it not for its basal teeth, and for the fact that the somatocyst is somewhat shorter, and stouter, than in the specimens of that species which I have seen (1911b, pl. 5, fig. 2). The lateral subumbrial canals arise from the ring-canal, at the point of origin of the ventral canal, as in *G. quadrivalvis* and *G. australis*, instead of from the ventral canal, at some distance above the ring-canal, as is the case in *G. monoica*.

The basal sculpture is the most important specific character of this, as of all other species of *Galeolaria*. As pointed out above (p. 416), the bell-opening is surrounded by four teeth, and two ventral wings or flaps (Plate 8, fig. 2). Of these teeth, two are lateral, two dorsal.

And the indentation between the latter is shallower than that between each dorsal tooth and the lateral tooth which flanks it. As is usual in *Galeolaria*, the teeth are triangular, with rounded, or very slightly dilated, tips; the dorsal teeth deeper than the scale-like lateral teeth. The ventral wings are much shorter than in *G. quadrivalvis*, *G. australis*, or *G. monoica*, squarish in outline, each with a peculiar indentation of its basal margin (Plate 8, fig. 2); and they are entirely separated along the mid-line.

The identity of the inferior nectophore listed above rests not only on the fact that it was taken in the same haul as the superior one just described (they were not attached), but on the fact that it agrees perfectly with the inferior nectophores of two specimens of *G. quadridentata* from Naples. I have not been able to find a single character to separate the inferior nectophore of *G. quadridentata* from that of *G. quadrivalvis*, the former, like the latter, having four basal teeth, and two large basal wings, with secondary flaps on their inner margins; besides even showing the transverse constrictions formerly thought diagnostic of the latter.

The stem with all its appendages, has been lost in both BACHE specimens. In those from Naples (both females), in which it is well preserved, the appendages closely resemble those of *G. quadrivalvis* (1911b, pl. 5, figs. 5-7).

The identification of these specimens as the *G. quadridentata* of Quoy and Gaimard, rests on the presence of the four basal teeth in the superior nectophore, clearly shown in their figure, and described by them as "quatre pointes" (1834, p. 45, pl. 5, fig. 32, 33). The only difference is that the basal wings are shorter in our specimens than in their figure. But this is not sufficient, as against the evidence of the basal teeth, to warrant a new species, which would be necessary were they not referred to *G. quadridentata*, for no other *Galeolaria* so far described has four teeth in the superior nectophore.

GALEOLARIA MONOICA (Chun).

Epibulia monoica Chun, 1888, p. 1157.

(For synonymy and description, see Bigelow, 1911b, p. 239).

This species was taken at Stations 10,161, 10,163, 10,166, 10,169, 10,176, 10,180, 10,186, 10,188, 10,196, 10,198, 10,200, both on the surface and in intermediate hauls. The series consists of about thirty superior and as many inferior nectophores.

These specimens agree, even to such minor details as the relative size of dorsolateral and basolateral teeth, with the Pacific collections which I have studied (1911b, 1913).

Galeolaria monoica is easily identified by the presence of three basal teeth (two large lateral and one narrow dorsal) and two ventral wings in the anterior, three dorsal teeth with incised tips, and an undivided basal wing, in the inferior nectophore.

GALEOLARIA AUSTRALIS Quoy and Gaimard.

Galeolaria australis Quoy & Gaimard, 1834, p. 42, pl. 5, fig. 29–31; Blainville, 1834, p. 129, pl. 6, fig. 6; Lesson, 1843, p. 140; Haeckel, 1888b, p. 151; Bigelow, 1911b, p. 238, pl. 5, fig. 8, 9; pl. 6, fig. 1–3; 1913, p. 69; Moser, 1913a, p. 148, 1915a, p. 205.

Diphyes biloba Sars, 1846, p. 45, taf. 7, fig. 16–21; Schneider, 1898, p. 86.

Galeolaria filiformis Huxley, 1859, p. 38, pl. 3, fig. 5 (*non* Leuckart, 1854).

Diphyes turgida Gegenbaur, 1853, p. 344.

Diphyes sarsi Gegenbaur, 1860, p. 372, taf. 29, fig. 30, 31.

Epibulium turgida Haeckel, 1888a, p. 35.

Galeolaria turgida Haeckel, 1888b, p. 151; Lens & Van Riemsdijk, 1908, p. 57.

Galeolaria biloba Haeckel, 1888b, p. 151; Chun, 1897b, p. 17; Vanhoffen, 1906, p. 16; Römer, 1901, p. 173; Lens & Van Riemsdijk, 1908, p. 59, pl. 9, fig. 75.

Galeolaria australis was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,176, 10,178, 10,186, 10,194, 10,196, 10,197, 10,200, 10,203, 10,207, 10,212; both on the surface, and in intermediate hauls. The material consists of about thirty superior and thirty inferior nectophores, some of them in excellent condition.

The total absence of basal teeth in both nectophores, combined with the presence of two ventrobasal wings in the superior, one in the inferior, nectophore, make this the most easily recognized species of *Galeolaria*.

In my earlier discussion (1911b), I suggested that the Indo-Pacific *G. australis*, and the Atlantic *G. biloba*, Sars, would prove to be identical, hesitating to unite them definitely only for want of material from the Atlantic. According to Moser (1913a) they are identical. And the BACHE specimens listed above corroborate this view, for I have been unable to find any distinction between them and series from the North and South Pacific (1911b, 1913).

DIPHYOPSINAE Haeckel.

(Sensu Bigelow, 1911b).

This subfamily is abundantly represented in the collection, as of course was to be expected. But the series adds very little to our knowledge of the group, consisting chiefly of superior nectophores of a few well-known species. No eudoxids were found in the material submitted to me. The two genera, *Diphyes* and *Diphyopsis*, are retained here, although united by Moser (1912a), because the distinction between the two, presence or absence of special sterile nectophores in the free eudoxid, obviously deserves more importance in classification than the minor differences separating the several species in the two groups.

DIPHYES APPENDICULATA Eschscholtz.

Diphyes appendiculata Eschscholtz, 1829, p. 138, pl. 12, fig. 7.

Diphyes sieboldii Kölliker, 1853, p. 36, taf. 11, fig. 1-8.

?*Diphyes appendiculata* Huxley, 1859, p. 34, pl. 1, fig. 2.

(For synonymy of the polygastric generation, see Bigelow, 1911b, p. 248)

This common *Diphyes* was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,172, 10,173, 10,176, 10,178, 10,180, 10,182, 10,184, 10,186, 10,187, 10,188, 10,194, 10,195, 10,196, 10,197, 10,200, 10,203, 10,207, 10,208, 10,209, 10,211, 10,212 both in surface, and in intermediate hauls at various depths. The material consists of several hundred superior nectophores, a few inferior nectophores and one complete specimen.

Moser (1911, 1913a) maintains that the *D. sieboldii* of Kölliker (1853) and Gegenbaur (1854) is not the *D. appendiculata* of Eschscholtz, with which Huxley (1859), and I (1911a, 1911b, 1913,) have united it. That the wide-spread species which I have recorded under the latter name from the North Atlantic (1911a), the West Indies (1911b), the Eastern Tropical and Northwestern Pacific (1911b, 1913), and which is listed above, from the collections of the BACHE, is identical with *D. sieboldii*, there is no doubt: the question at issue is only whether my identification of it as the still older *D. appendiculata* of Eschscholtz (1829) is correct. Owing to the insufficiency of the original account, this must always remain more or less a matter of opinion: no more so, however, in this case than in that of most of

the early descriptions of Siphonophorae and Medusae. And so far as it goes, Eschscholtz's figure (1829, taf, 12, fig. 7) agrees very well with the specimens here listed, and those I have recorded earlier, particularly in the outlines of the hydroecium, and in the relative proportions of that organ, of the somatocyst and of the nectosac, in the absence of basal teeth, and in the outlines of the inferior nectophore. Eschscholtz's statement (1829, p. 138), that there are "an der Schwimmhohlseite zwei Kanten" points in the same direction, suppression of the dorsal ridge being a very characteristic feature of the species in question. But his description of the opposite side of the nectophore as having three angles, is not clear.

Questions of this sort are the despair of the student of pelagic coelenterates; but when the probability that identification of an old name is correct, is as strong as in the present case, it should be used, until some actual reason to the contrary is adduced.

Whether the Diphyes described by Huxley (1859) as *D. appendiculata* actually belongs here is certainly open to question, for though his figures agree with it in general form, in the very characteristic outline of the hydroecium, and of the inferior nectophore (particularly its closed hydroecium), he represents and describes the dorsal ridge of the superior nectophore as well developed, whereas in all specimens of *D. appendiculata* recently studied it is suppressed, except at the basal end. Time has proved Huxley's figures so accurate in general, that it certainly is not safe to assume him in error in this instance. This much, however, is sure — either he was dealing with *D. appendiculata*, being deceived as to the extent of the dorsal ridge, or with some Diphyes which has never been seen since, and which differs from *D. appendiculata* only in that ridge, and in the origin of the left lateral ridge at the apex, instead of slightly below it.

Although *D. appendiculata* is one of the commonest and most widespread of siphonophores, and has often been described, the confusion which still obtains in the name to be applied to it makes it desirable to summarize its most diagnostic features here, though a detailed account with figures, has been given elsewhere (Bigelow, 1911b), so that there may be no mistake as to what species is meant.

The superior nectophore has no basal teeth. Its hydroecium reaches upward to about $\frac{1}{6}$ of the length of the nectosac, and is of a peculiar and very characteristic conical outline; basally it extends equally far below the level of the mouth of the nectosac; and its basolateral margins are oblique. The somatocyst is long. There are only three ridges at the apex, two ventral, and the right-lateral. The left-

lateral ridge invariably arises some distance below the apex, usually at about the level of the upper end of the nectosac. The dorsal ridge is suppressed except for its basal end.

The hydroecium of the inferior nectophore is closed by the union of its two lateral flaps; there are two basoventral teeth.

Among the many hundreds of specimens, from widely separated localities, which I have examined, I have not found a single variant from any of these characters, and the general outline of the superior nectophore is so characteristic that it identifies *D. appendiculata* at a glance.

DIPHYES FOWLERI Bigelow.

Diphyes fowleri Bigelow, 1911a, p. 346, pl. 28, fig. 5; 1911b, p. 255, pl. 8, fig. 4, pl. 9, fig. 5; 1913, p. 75.

Galeolaria truncata (partim) Moser, 1913b, p. 232.

Stations 10,161, 10,163, 10,169, 10,172, 10,178, 10,187, 10,194, 10,207, 10,208, surface and intermediate hauls; about forty superior nectophores, all more or less damaged.

This species is separable from *D. truncata* only by the oval or globular form, and transverse location, of the somatocyst (1911b, 1913). Moser (1913b, p. 232), has united it with *D. truncata*, but until the evidence upon which she does so is available, *D. fowleri* is retained here as a distinct species, no intermediates between the extremes of somatocyst-form illustrated by *D. fowleri* and *D. truncata*, having been actually recorded. Should such prove to occur *D. fowleri* would become a synonym of *D. truncata*.

DIPHYOPSIS DISPAR (Chamisso and Eysenhardt).

Diphyes dispar Chamisso & Eysenhardt, 1821, p. 365, pl. 33, fig. 4.

To the synonymy given in my former paper (1911b, p. 257), add:—

Doromasia picta Chun, 1888, p. 1154; 1892, p. 8, taf. 8, fig. 3–5, taf. 9, fig. 5–10, taf. 10, fig. 1–7.

Muggiae bojani Schneider, 1898, p. 88.

Diphyopsis picta Mayer, 1900, p. 75.

This well-known diphid was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,172, 10,176, 10,178, 10,180, 10,182, 10,184, 10,186, 10,187, 10,188, 10,192, 10,194, 10,195, 10,196, 10,197,

10,198, 10,200, 10,203, 10,208, 10,209, 10,211, 10,212; both in surface and intermediate hauls. The series consists of about 200 nectophores, mostly superior. Moser's (1912b) figures of successive stages in the development of *D. dispar* prove conclusively that the *Doromasia picta* Chun is merely a young stage of *D. dispar*, as I have already suggested (1911b, 1913).

It was hardly to be expected that these rather fragmentary nectophores would add anything to our knowledge of the morphology of this species. But in as much as the presence of a set of teeth on the dorsal aspect of the dorsal wall of the hydroecium is characteristic of *D. bojani* (p. 425), I may emphasize that this region is perfectly smooth in all specimens of *D. dispar* which I have examined.

DIPHYOPSIS MITRA (Huxley).

Diphyes mitra Huxley, 1859, p. 6, pl. 1, fig. 4.

(For synonymy see Bigelow, 1911b, p. 258).

Diphyopsis mitra proved to be one of the commonest siphonophores in the collection, being taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,172, 10,173, 10,176, 10,178, 10,180, 10,182, 10,186, 10,187, 10,192, 10,194, 10,195, 10,197, 10,200, 10,203, 10,207, 10,208, 10,209, 10,211, 10,212; in both surface and intermediate hauls. The material consists of upwards of 400 superior nectophores, all more or less fragmentary.

It is surprising that a species as well characterized and as common in the warmer parts of the Atlantic as is *D. mitra* should so long have been overlooked there, its first definite record from that ocean being in 1911 (Bigelow, 1911b, p. 259). Since that time, however, it has been found in numbers not only among the West Indies and in the region traversed by the BACHE, but widely distributed over the tropical Atlantic (Moser, 1913a).

Its size and general outlines are such that it has probably been often confused with *D. appendiculata*. Hence though it is in reality one of the most easily recognized members of the group, and has already been described and figured by me in detail (1911b), its diagnostic features are briefly summarized below.

The diagnostic characters of the superior nectophore are its high, symmetrically pyramidal, form, with five ridges running from apex to base; small dorsobasal, but no laterobasal teeth; hydroecium longer below than above the opening of the nectosac, truncate at its apex;

somatocyst short, reaching only to mid-level of nectosac; dorsobasal wall of hydroecium divided into two wings, the left hand one bearing a secondary triangular flap or tooth near its inner margin.

And I have found no variation from these characters in any of the numerous specimens, Atlantic, and Pacific, which I have examined.

The inferior nectophore resembles that of *Diphyes appendiculata*; but is easily distinguished from it by the fact that its hydroecium is open from end to end (1911b, pl. 10, fig. 5).

The location of this species in *Diphyopsis* rather than in *Diphyes* rests on the statement by Lens and Van Riemsdijk (1908, p. 51), that the oldest group of appendages in one of their specimens "showed clearly a bud of a special gonocalyx." But if Moser (1913, p. 147) be correct, this cannot have been the case, for she says that the eudoxid without special nectophores, referred by Lens and Van Riemsdijk and by me to *Diphyes appendiculata*, really belongs to *D. mitra*, which would then be a *Diphyes*. My own studies throw no light on this question, for the specimens of *D. mitra* which I have seen have only young cormidia, or have lost all but the base of the stem. Hence judgment must be suspended until the evidence on which she bases her identification of the eudoxid in question is available.

DIPHYOPSIS BOJANI (Eschscholtz).

Plate 8, fig. 3, 4.

Eudoxia bojani Eschscholtz, 1825, p. 743, taf. 5, fig. 15; 1829, p. 125, taf. 12, fig. 1 (eudoxid); Huxley, 1859, p. 59, pl. 3, fig. 7.

Diphyes steenstrupi Gegenbaur, 1860, p. 369, taf. 29, fig. 27-29; Chun, 1879b, p. 103; Lens & Van Riemsdijk, 1908, p. 44; Bigelow, 1911b, p. 347; Moser, 1911, p. 431.

Cuculus gracilis Haeckel, 1888b, p. 110 (eudoxid).

Ersaea dispar Haeckel, 1888b, p. 361.

Ersaea bojani Chun, 1888a, p. 1154; 1892, p. 108, fig. 7; Lens & Van Riemsdijk, 1908, p. 6, fig. 1-6; Bigelow, 1911b, p. 264, pl. 11, fig. 7, 8 (eudoxid).

Diphyes serrata Chun, 1888, p. 1158; 1897b, p. 26; Lens & Van Riemsdijk, 1908, p. 44; Bigelow, 1911b, p. 347.

Eudoxia serrata Chun, 1888, p. 1159; 1897b, p. 26 (eudoxid).

Doromasia bojani Chun, 1892, p. 108, 110, fig. 8.

Ersaea picta Chun, 1892, p. 98, fig. 6, pl. 11, fig. 8 (eudoxid).

Diphyes indica Lens & Van Riemsdijk, 1908, p. 45, pl. 7, fig. 55, 56.

Diphyes gegenbauri Lens & Van Riemsdijk, 1908, p. 46, pl. 7, fig. 57, pl. 8, fig. 58.

Doromasia pictoides Lens & Van Riemsdijk, 1908, p. 3, pl. 1, fig. 1.

Diphyes bojani Bigelow, 1911b, p. 251, pl. 7, fig. 2, 3, pl. 8, fig. 6, pl. 9, fig. 1, 2, pl. 10, fig. 2, 3, pl. 11, fig. 7, pl. 12, fig. 1; 1917, p. 306; Moser, 1913a, p. 233; 1913b, p. 146.

D. bojani was taken at Stations 10,161, 10,162, 10,163, 10,166, 10,169, 10,171, 10,176, 10,178, 10,180, 10,186, 10,187, 10,188, 10,192, 10,194, 10,197, 10,200, 10,203, 10,207, 10,208, 10,209, 10,210, 10,211, 10,212, both on the surface and in intermediate hauls with open nets, at various depths down to 600 meters. The material consists of upwards of 200 superior nectophores, and a few inferior nectophores.

It is now well established that the Atlantic *D. steenstrupi* Gegenbaur, (*D. serrata* Chun) is identical with the Pacific *D. bojani* Moser, 1911, p. 431; 1913a, p. 146). The use of the name *D. bojani*, instead of *D. steenstrupi*, for this combined species depends on the strong probability that the *Eudoxia bojani* of Eschscholtz is its eudoxid (Moser, 1911, p. 431). But if this is the case, it is a Diphyopsis, not a Diphyes as I formerly supposed, the eudoxid in question having sterile swimming bells as well as gonophores.

The general features of *D. bojani* are well known; the base of the upper nectophore is figured here (Plate 8, fig. 3) in as much as the small teeth on the dorsal wall of the hydroecium are, as noted by Gegenbaur (1860), the most diagnostic difference between *D. bojani* and *D. dispar*. These were overlooked by me in my account of the Eastern Pacific series (1911b).¹

These teeth are situated on a vertical crest, rising from the dorsal surface of the dorsal wall of the hydroecium, near its basal margin (Plate 8, fig. 3, 4), well described by Gegenbaur as a "gezahnelte senkrechte Kante" (1860, p. 40), and they, and the crest which bears them, occur in all the specimens of *D. bojani* which I have examined, Atlantic and Pacific, though they vary in size, and in number, from 2-5.

CHUNIPHYES MULTIDENTATA Lens AND Van Riemsdijk.

Chuniphyes multidentata Lens & Van Riemsdijk, 1908, p. 13, pl. 1, fig. 9-11, pl. 2, fig. 12-15; Bigelow, 1911a, p. 348; 1911b, p. 262, pl. 8, fig. 9, pl. 10, fig. 7, pl. 12, fig. 6; 1913, p. 73.

Station 10,172, 1800-0 meters, three superior, two inferior nectophores, all about 19 mm. long.

¹ This was called to my attention by Dr. Moser.

The material is so fragmentary that it adds nothing to my earlier discussion of this species. In the one superior nectophore in which the somatocyst is still intact, the median dilation of this organ consists of two short transverse horns, as I have already recorded it for specimens from the Bay of Biscay (1911a), and from the northwestern Pacific (1913).

AGALMIDAE Brandt.

AGALMA OKENI Eschscholtz.

Agalma okeni Eschscholtz, 1825, p. 744, pl. 5, fig. 17.

(For synonymy, see Bigelow, 1911b, p. 277.)

This species was taken at Stations 10,162, 10,163, 10,166, 10,171, 10,176, 10,180, 10,186, 10,188, 10,192, 10,194, 10,195, 10,196, 10,197, 10,198, 10,200, 10,202, 10,203, 10,208, 10,209, 10,211. The material consists of about sixty colonies (or parts of colonies), and a large number of detached nectophores and bracts. I have been able to compare these specimens with series from various parts of the Pacific.

Agalma okeni is perhaps the most easily recognized of all agalmids, owing to its short, stiff stem, large tricornuate involucrate tentilla, thick, prismatic bracts, and flat, firm nectophores. Indeed so diagnostic are the bracts and nectophores, that they are not likely to be confused with any other agalmid, even when found detached in the plankton. As *A. okeni* has recently been described and figured in detail by Haeckel (1888b, "Crystallodes vitreus"), by Lens and Van Riemsdijk (1908), and by me (1911b) no account is needed here, further than to point out that the BACHE collection contains the largest example yet recorded, 115 mm. long after preservation, with nineteen siphons and at least thirty-three nectophores.

STEPHANOMIA RUBRA (Vogt).

Plate 8, fig. 5.

Agalma rubra Vogt, 1852, p. 522; 1854, p. 62, taf. 7-11.

(For synonymy, see Bigelow, 1911b, p. 348).

Station 10,166, 100-0 meters, one very fragmentary specimen, much contracted.

Station 10,206, 400-0 meters, one very fragmentary specimen, much contracted.

Loose bracts, and nectophores, all in poor condition, from Stations 10,161, 10,169, 10,180, 10,194, 10,208, 10,209, 10,211, probably belong to this species also.

The identity of these two specimens rests on the fact that the tentilla (Plate 8, fig. 5) a few of which are intact in each case, have a single terminal filament, and no involucre, for *S. rubra* is the only agalmid with this type of tentillum (1911b), and on actual comparison with two excellent examples of the species from Naples.

Two young bracts, still attached to the specimen from Station 10,166, are of the thin, foliaceous, triangular form typical of that species (Vogt, 1854; Leuckart, 1854; Kolliker, 1853); and two young nectophores (specimen from Station 10,206) are higher and more rounded than the corresponding organs in *Agalma okeni*, in this agreeing with the Naples specimens of *S. rubra*. It is because of their resemblance to the latter, that the nectophores and bracts listed above are referred to *S. rubra*. But though they are easily separated from the corresponding organs of *Agalma okeni*, they so closely resemble *Agalma elegans*, and *Stephanomia bijuga* (1911b), both of which may be expected to occur in the region traversed by the BACHE, that possibly one, or even both, of those species may actually be represented among these loose bells.

The material is so fragmentary, that it adds nothing to the earlier accounts of this species.

RHIZOPHYSIDAE Brandt.

RHIZOPHYSA FILIFORMIS (Forskål).

Physsophora filiformis Forskål, 1775, p. 120; 1776, tab. 33, fig. f.

(For synonymy, see Bigelow, 1911b, p. 319).

Station

10,169	50-0 meters	1	fragmentary specimen
10,188	175-0	"	"
10,205	100-0	"	"

These specimens are fragmentary, and very much twisted. But the presence of trifid tentilla identifies them as *R. filiformis* rather than *R. eysenhardtii*.

VELELLIDAE Brandt.

VELELLA VELELLA (Linné).

Medusa velella Linné, 1758, p. 660.

(For synonymy, see Bigelow, 1911b, p. 353).

The common Velella was taken at Stations 10,163, 10,200, 10,207 a total of about twenty specimens, ranging in length from 5–50 mm.

GEOGRAPHICAL DISTRIBUTION.

Considerable interest naturally attaches to the *first* collection of animals of any group from an oceanic area, even though there be nothing in depth, temperature, salinity, or locality, to presuppose important faunal differences from neighboring regions. The collections obtained by the BACIE are a case in point, for while many pelagic coelenterates are known from the American and West Indian coastal waters, and from the inner margin of the Gulf Stream on the one hand; from Bermuda and the tropical Atlantic on the other, there are practically no previous records of Medusae or Siphonophorae from the oceanic triangle between Cape Hatteras, Bermuda, and the Bahamas. This, as a glance at a chart will show, is a characteristically oceanic region, and as such, general knowledge of the distribution of pelagic animals makes it safe to predict that the characters of its medusan and siphonophore fauna will depend directly on its physical characteristics. Although this part of the oceanic basin is north of the tropics in latitude (27° – 35° N.), its mean annual temperature is upwards of 22° C. on the surface waters, (Schott, 1902, taf. 9), cooling to about 19° – 20° in mid-winter; 18° or higher at 200 meters (1917; Schott, 1902, 1912). And its salinity, 36% or more at all depths down to 500 meters (1917a; Schott, 1902, 1912), is correspondingly high. But this warm salt ocean water contrasts very sharply with the low temperatures and salinities of the coast water on the continental shelf, on the one hand, and on the other with the North Atlantic abyssal water (3.5° – 4° ; about 34.9%), at and below 1,800 meters (1915, 1917).

The Florida, and the Antilles currents both skirt the region in question, the former bringing the water of the Gulf of Mexico, with its denizens, through the Straits of Florida; the latter following the Bahama Bank; beyond which they merge, as the Gulf Stream, to

follow the continental slope northward. As is well known, the main axis of this great current lies close to the slope; while the waters immediately west and southwest of Bermuda, on the contrary, are part of the eddy which occupies the central portions of the North Atlantic (Deutsche seewarte, 1882; Schott, 1902; 1912; Soley, 1911).

On oceanographic grounds the pelagic coelenterate fauna of the Cape Hatteras-Bermuda-Bahamas triangle might be expected to consist of the following elements:—

1. Neritic Medusae, reaching the ocean basin as immigrants from the Bahamas, West Indies, Gulf of Mexico, and American coast on the one hand; from Bermuda, perhaps even from the eastern side of the tropical Atlantic, via the equatorial drift and Antilles current, on the other.

2. The warm water holoplanktonic Medusae and Siphonophorae, which range, undifferentiated, over the entire tropical and subtropical zones of all three great oceans, Atlantic, Indian, and Pacific (1909a, Vanhöffen, 1902).

3. Cosmopolitan holoplanktonic forms; *i. e.*, those whose distribution is independent of temperature.

4. Species at home, not on the surface, but in the low temperatures, and dim light of the intermediate, or even abyssal, depths, most at least, of which, are practically cosmopolitan over the ocean basins.

5. Cold water forms; stragglers from the north.

The neritic, and holoplanktonic categories, it is true, are connected with each other by such Medusae as prolong the interval between fixed (hydroid) stage and fixed stage through the medium of one or more budding phases; nor can hard and fast lines be drawn between any of the groups. But they afford a convenient working classification.

The BACHE collection contains the following typically neritic Medusae; *Stomotoca pterophylla*, *Pandeia conica*, *Laodicea cruciata*, *Aequorea aequorea*, *Nausithoë punctata*, while *Charybdea marsupialis* var. *xaymachana*, *C. alata*, *Linuche unguiculata*, *Calycopsis papillata* and *Eutiara mayeri* probably belong here also. But most of these were taken at only one or two stations each, either in the Gulf Stream close to the Continental Slope (Station 10,161), in the Straits of Florida, or off the Bahama Bank within the sweep of the Antilles current (Station 10,211). And only twice were neritic Medusae taken far from land, a *Pandeia conica* at Station 10,171, a *Charybdea marsupialis* at Station 10,188. The records of previous deep-sea expeditions

have established the rarity of neritic Medusae in the high seas as a general rule (Maas, 1893). But the fact that it is as true of the region west and southwest of Bermuda as of the central Atlantic or Pacific, contrasted with the rich neritic fauna of the Bahamas (Mayer, 1904), the straits of Florida (Mayer, 1900, Vanhöffen, 1913), and even of Bermuda, has a special interest because of the close proximity of the Antilles and Florida currents. These, or the product of them combined, annually transport, perhaps are constantly transporting, many of the West Indian Medusae northward for long distances. And though the extreme northern limit to this migration is unknown, forms which certainly began their journey as far south as Florida, have often been taken in the inner edge of the Gulf Stream off Cape Cod. But since the BACHE records do not reveal any tendency toward dispersal seaward from the land, this migration is apparently confined to a fairly definite track close to the continental slope, at least in winter, which corresponds to the absence of any dominant surface drift either from the continental shelf toward Bermuda, or *vice versa*. But the fact that the neritic Medusae of Bermuda, are, as a whole, practically an impoverished Bahaman fauna, including such unmistakably American species as *Halitiara formosa*, *Eirene pyramidalis*, and *Acquorea floridanus*, is evidence of occasional transfers from the coast eastward across the intervening ocean. Whether, however, this process is going on sporadically today, is by no means certain, for similarity of neritic Medusae does not necessarily mean a present interchange, as witness the conditions on the two sides of Central America (1909a).

The BACHE list includes two species of Anthomedusae made practically holoplanktonic by a budding phase, *i. e.*, *Cytaea tetrastyla* and *Bougainvillea niobe*.

Cytaea is now known to occur very generally, although irregularly, over all warm waters, Mediterranean, Atlantic, Pacific, and Indian (1909a; Vanhöffen, 1911, 1912a), a distribution indicating that the intervals between successive hydroid stages are sufficiently prolonged, by the medium of one or more budding phases, to allow unlimited dispersal in the waters suited to it by temperature. But though *Cytaea* is thus enabled to surmount the barrier which the ocean basins impose to the dispersal of neritic Medusae, it has not attained the uniformity of distribution characteristic of such truly holoplanktonic coelenterates as *Rhopalonema relatum*, *Liriope tetraphylla*, or *Diphyes appendiculata*.

Bougainvillea niobe, previously known only from the Bahamas (Mayer, 1900, 1904, 1910) and from one station in the south Atlantic

(Vanhöffen, 1912, p. 359), occurred, very generally, over the area studied by the BACHE (p. 368), with the sole exception of the cold coast water off Chesapeake Bay, but nowhere in large numbers. And as pointed out (p. 369), the series contains both budding and sexual phases. The area in question is probably chiefly peopled with *Bougainvillea* from the Bahamas, but perhaps from Bermuda also.

The occurrence of *Bougainvillea niobe* in the south Atlantic (25° S.) of course suggests that it ranges as widely in that ocean as does *Cytaeis*. But opposed to this possibility is the fact that it was not found at any of the numerous stations of the PLANKTON or VALDIVIA expeditions in the north and south Atlantic (Maas, 1893, Vanhöffen, 1913b); and that it is not known from the inner edge of the Gulf Stream off New England on the one hand, or from the Canary Islands, or the Mediterranean, on the other. Its absence in the central part of the Atlantic may be a seasonal phenomenon, for while most of its records are for winter or early spring (January to March), plankton hauls on the high seas have been usually taken in summer. And this is made the more likely by its presence in the inner edge of the Gulf Stream off Chesapeake Bay in January (Station, 10,161), contrasted with its absence there and at corresponding localities further north, in summer (1915, 1917b). But its absence in European waters, especially in the Mediterranean, can not be explained on seasonal grounds, nor can the failure of recent deep-sea expeditions to find it in the Pacific or Indian Oceans. I believe the true explanation to be that this fundamentally American species is enabled by its budding phase to spread over the western side of the tropical Atlantic; but that the interval between successive hydroid-stages is not long enough for it to attain a wider dispersal.

The BACHE list includes the following warm water holoplanktonic Medusae:—*Aglaura hemistoma*, *Liriope tetraphylla*, *Geryonia proboscidalis*, *Rhopalonema velatum*, *Cunina peregrina*, *Pegantha clara*, *Pegantha dactyletra*, and *Solmundella bitentaculata*. And all of the siphonophores, except two new species, of whose faunal relationships nothing is known, and the few cosmopolitan forms (p. 434), likewise belong to this category. Most of these Medusae were already known to have very wide range, *Rhopalonema*, *Aglaura*, *Liriope*, *Geryonia*, and *Solmundella* being practically universal throughout the warmer parts of all three great oceans; while *Pegantha clara*, and probably *P. dactyletra*, have been recorded from both the Atlantic and the Pacific. *Cunina peregrina* was previously known from the Pacific only. But as it covers a very wide range there (Bigelow, 1909a, 1913;

Maas, 1909), there is nothing surprising in its occurrence in the tropical Atlantic as well. And the Siphonophorae collected by the BACHE are not only similarly universal, within their temperature limits, in all oceans (1911b; Moser, 1913a, 1913b, 1915), but most of them are already known from the West Indies, the Bahamas, the Tortugas, Bermuda, or the Gulf Stream. The only new siphonophore records for the region in question from the BACHE list are *Vogtia pentacantha*, *Vogtia glabra*, *Abyla dentata*, *Ceratocymba sagittata*, *Galeolaria australis*, Chuniphyes and *Stephanomia rubra*. But all of these, except the two new species, and *Galeolaria quadridentata* for which no locality has ever been given, are already known from some part of the Atlantic. Thus *Vogtia pentacantha* has been recorded from the Bay of Biscay (Bigelow, 1911a), from the central and south Atlantic, and from the Antarctic (Moser, 1913a, p. 146); *Galeolaria monoica* from the Canaries (Chun, 1888); *Galeolaria australis* from Greenland and from the north and south Atlantic (Bigelow, 1911b, "G. biloba"; Moser, 1913a, p. 148), Chuniphyes from the Bay of Biscay (1911a); while *Ceratocymba sagittata* is recorded by Moser (1913a, p. 149) as taken repeatedly by the GAUSS. And though *Stephanomia rubra* has not previously been recorded from the Atlantic, so far as I can learn, it is known from such widely separated localities as the Mediterranean and the Island of Amboina (Bedot, 1896). In short, there is nothing surprising in the capture of any of these holoplanktonic Medusae or Siphonophorae by the BACHE. However, the records have the value of actually filling in a blank on the map, to which their ranges could previously be extended by inference only.

A characteristic example of the holoplanktonic habit, which may serve to illustrate them all in the Atlantic, is afforded by *Rhopalonema relatum*, which has been found all along the routes of the various deep-sea expeditions of recent years, and in the Mediterranean as well (Fig. 1). Its most northern records are from off the Grand Banks on the west, the Bay of Biscay on the east (Browne and Fowler, 1906). And it would not be surprising to find it carried even further north in the warm currents in summer, especially off the European coast as happens with so many other pelagic animals.

Between 30° S., and 40° N. in the Atlantic high seas it is practically universal except in the cool coast water off eastern North America, the only other important gaps in its range being the localities where few, or no, plankton hauls have yet been made. In terms of temperature, the normal limits to its range about coincide with the surface isotherms for 18° C., for the warmer months. And it, or any of the

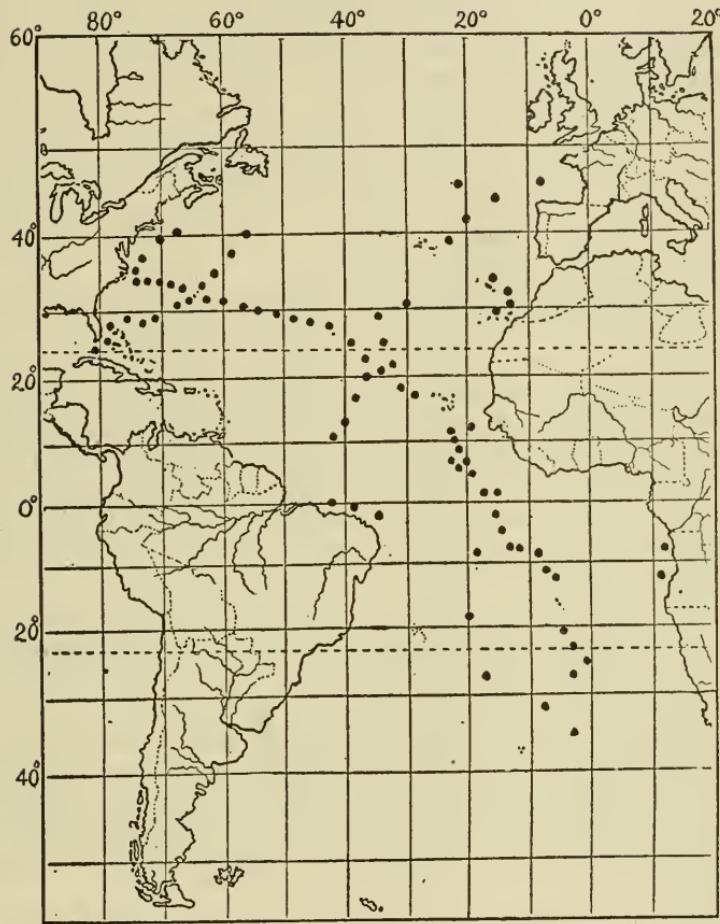


Fig. 1.—Records for *Rhopalonema velatum*.

other warm water holoplanktonic Medusae or Siphonophorae, may be expected anywhere within the isotherms of 20°, except in coastal waters of low salinity.

Off our coasts, north of Chesapeake Bay, the continental slope, *i. e.*, the line of demarcation between Atlantic and coastal water, is roughly the normal western limit to all these holoplanktonic species, though they may sporadically reach the coast. In the coast water the place of the holoplanktonic Medusae is taken by a host of neritic species. But only one siphonophore, *Stephanomia cara*, is anything but accidental there between Chesapeake Bay and Nova Scotia; and even that one species is irregular and sporadic in its occurrence. Probably for siphonophores as a whole the low salinity of the coast water is an effective barrier (1911b).

The holoplanktonic coelenterate fauna proved to be as uniform quantitatively throughout the area traversed by the BACHE (except for the cold coast water), as it is over the tropical oceans as a whole, there being no such contrast between the ocean currents and the more stagnant neighboring water as obtains for the eastern Pacific (Bigelow, 1909a, 1911b). Thus Rhopalonema, Bougainvillea, *Diphyopsis bojani*, Ceratocymba, and *Abylopsis tetragona*, were taken at two thirds or more of the thirty-three tow-net stations, while Hippopodius, *Diphyopsis dispar*, and *Diphyes appendiculata* occurred at nearly every station.

There are no cosmopolitan surface Medusae in the BACHE list; but two examples of this habit are afforded by the siphonophores *Galeolaria australis* and *Vogtia pentacantha*; possibly a third, if *Diphyes fowleri* proves to be a synonym of *D. truncata* (p. 422).

Considering the number of comparatively deep tow-net hauls made by the BACHE surprisingly few deep-sea coelenterates were captured; only one young Periphylla (p. 401) and a small series of *Chuniphyes multidentata* (p. 425). Both of these have already been recorded from the Atlantic (Bigelow, 1911b; Broch, 1913), the former on many occasions.

Stragglers from the north are represented by *Aglantha digitale*, the occurrence of which in the coast water off Chesapeake Bay deserves note, because this is the most southerly record of this species in the Atlantic (Maas, 1906b; Mayer, 1910; Bigelow, 1917b).

TABLE OF STATIONS.

Stations	Lat. N.	Long. W.	Stations	Lat. N.	Long. W.
Off Chesapeake Bay 10,158			10,188 10,192 10,194 10,195	28°51' 28°35' 28°51' 29°	70°08' 73°33' 75°13' 76°23'
Line Chesapeake Bay to Bermuda			N. E. Providence Channel		
10,161 10,162 10,163 10,166 10,169 10,171 10,172 10,173 10,176	35°27' 34°41' 33°22' 32°33' 32°29' 32°27' 32°26' 32°27' 32°30'	73°14' 73°23' 73°37' 72°14' 71°29' 69°55' 69°21' 68°22' 65°48'	10,196	25°27'	77°16'
Off Bermuda			Straits of Florida		
10,178 10,180	32°20' 31°52'	64°21' 65°14'	10,197 10,198 10,200 10,202 10,203 10,205 10,206 10,207	24°18' 23°59' 23°32' 25°34' 25°34' 27°05' 27°17' 27°32'	81°50' 81°50' 81°48' 79°24' 79°42' 79°52' 79°40' 79°21'
Line Bermuda toward Bahamas			North of Bahama Bank		
10,182 10,184 10,186 10,187	30°27' 29°17' 29°15' 28°59'	66°05' 67°07' 68°35' 69°22'	10,208 10,209 10,210 10,211 10,212	27°46' 27°57' 27°59' 28°08' 28°10'	78°46' 78°15' 77°25' 76°48' 76°18'

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EXPLANATION OF THE PLATES.

PLATE 1.

PLATE 1.

EUTIARA MAYERI Bigelow.

- Fig. 1. Side view of type-specimen.
- Fig. 2. Upper portion of bell, with bell-wall spread open, to show the gonads.
- Fig. 3. Portion of margin, showing two large tentacles, small tentacles, and exumbrial ribs.
- Fig. 4. Aboral view of portion of margin, much enlarged, to show two small tentacles, with their pigment.
- Fig. 5. Segment of margin, in side view, showing a small tentacle with its pigment, circular canal, and velum.

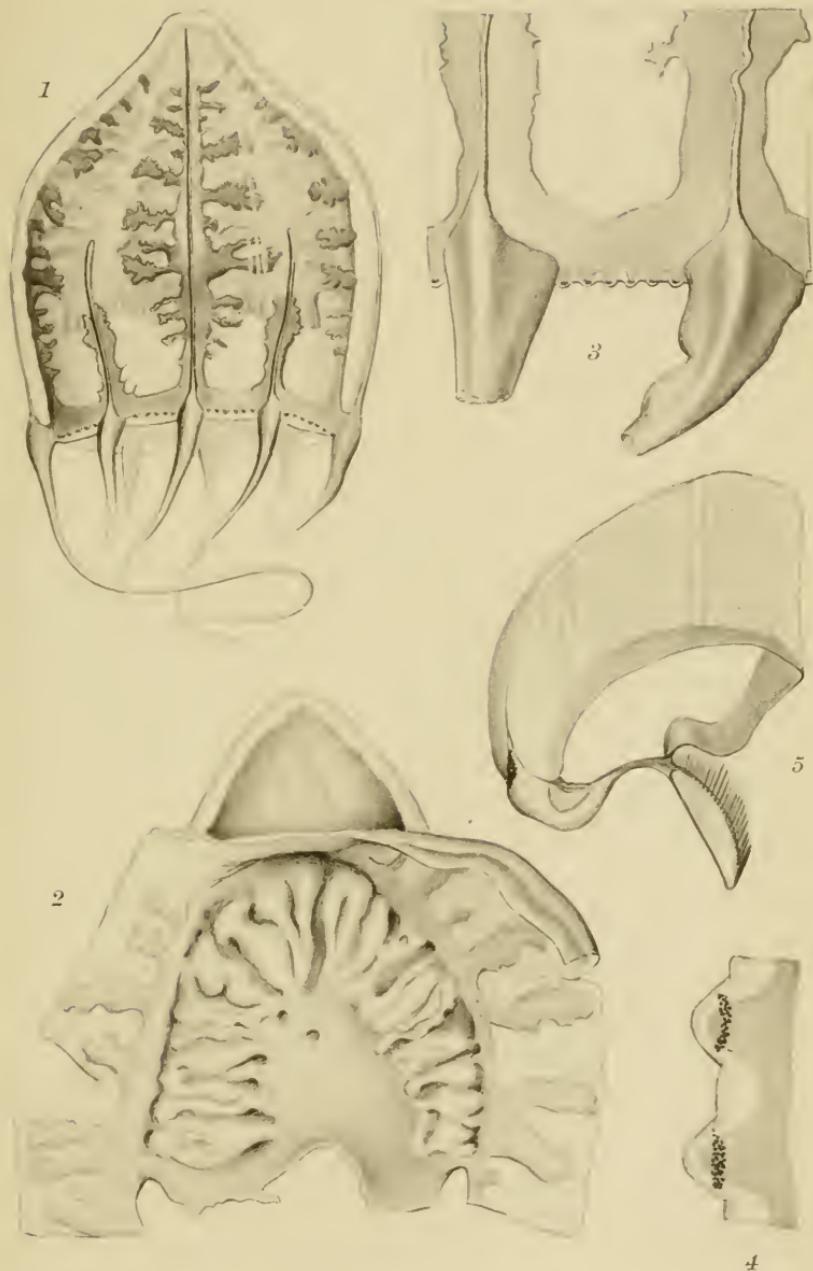
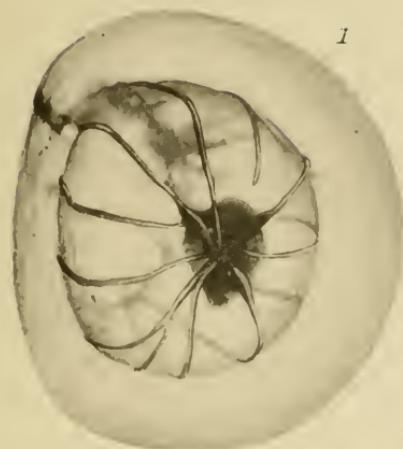


PLATE 2.

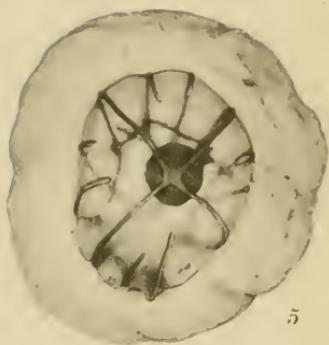
PLATE 2.

CALYCOPSIS PAPILLATA Bigelow. From photographs.

- Fig. 1. Aboral view of type-specimen.
- Fig. 2. Aboral view of portion of margin.
- Fig. 3. Side view of a segment of the margin.
- Fig. 4. Manubrium of type-specimen, to show gonads.
- Fig. 5. Aboral view of specimen 11 mm. high.
- Fig. 6. Side view of specimen 11 mm. high.
- Fig. 7. Aboral view of specimen 18 mm. high.



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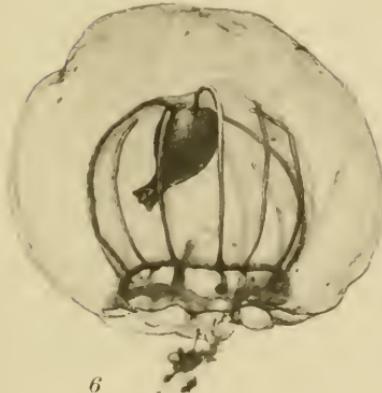
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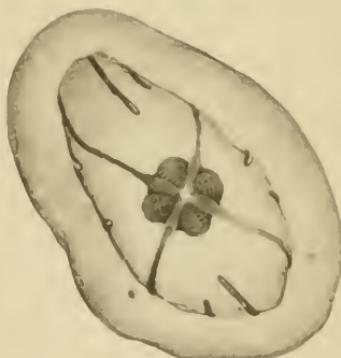
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PLATE 3.

BIGELOW.—*Medusae and Siphonophorae.*

PLATE 3.

CALYOPSIS PAPILLATA Bigelow.

Fig. 1. Side view of type-specimen, with the side of the bell cut away, to show canals and manubrium. From a photograph.

CYCLOCANNA WELSHI Bigelow.

Fig. 2. Aboral view of type-specimen.

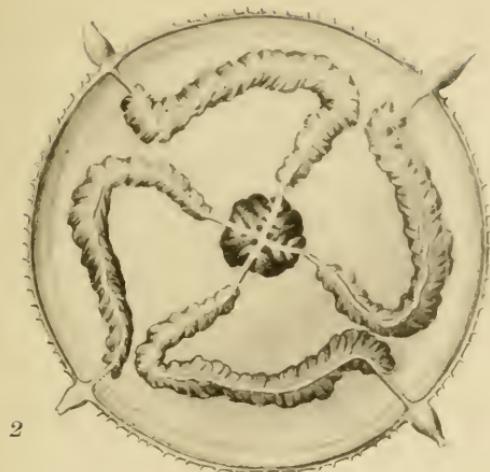
Fig. 3. Side view of manubrium, and basal part of one of the radial canals, with its gonad, of type.

Fig. 4. Aboral view of margin of type, to show large and small tentacles.

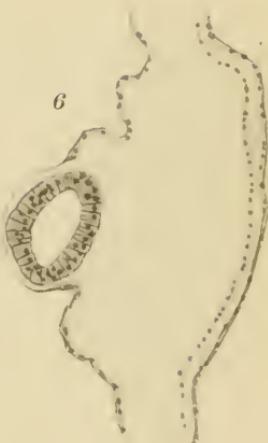
Fig. 5. Aboral view of small tentacle, showing pigmentation.

EUTIARA MAYERI Bigelow.

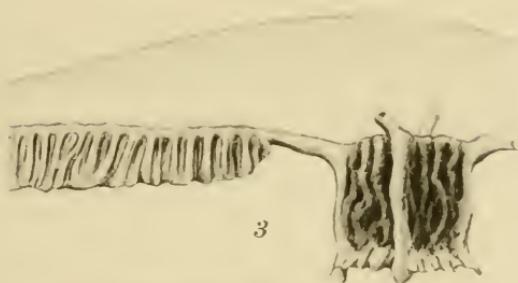
Fig. 6. Section of bell-wall, and one of the hollow exumbral ribs.



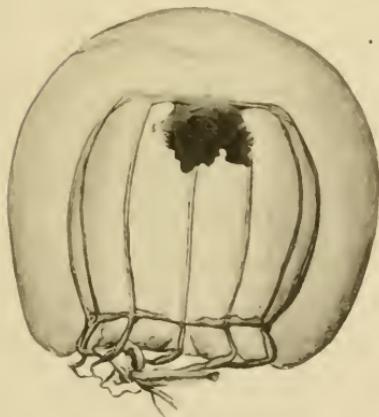
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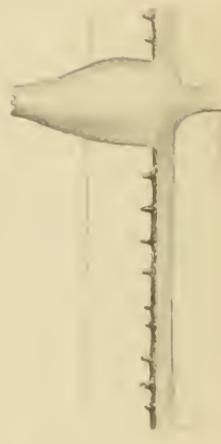
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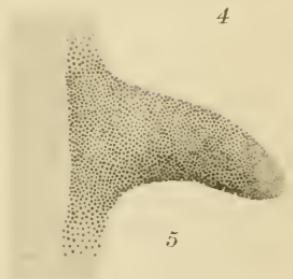
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PLATE 4.

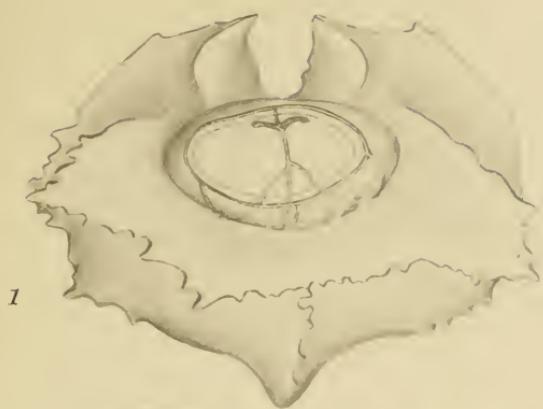
PLATE 4.

VOGTIA PENTACANTHA Kölliker.

Fig. 1. Dorsal view of an adult nectophore.

VOGTIA GLABRA Bigelow.

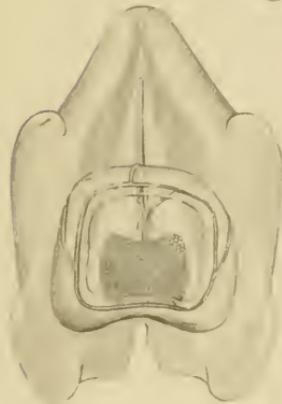
- Fig. 2. Dorsal view of young nectophore, 7 mm. long. Type-specimen.
- Fig. 3. Ventral view of same.
- Fig. 4. Dorsal view of older nectophore, 17 mm. long.
- Fig. 5. Adult nectophore, 30 mm. broad; dorsal view.
- Fig. 6. Young tentillum.
- Fig. 7. Adult tentillum.



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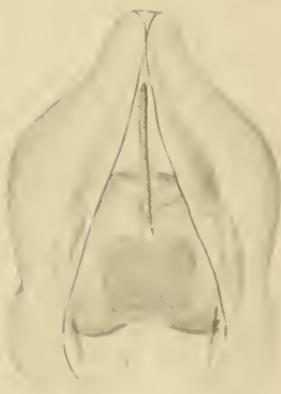
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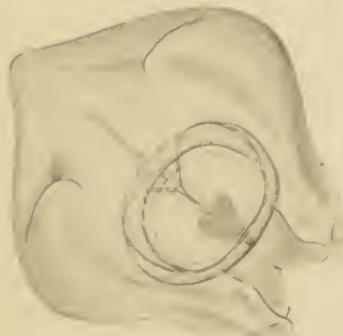
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PLATE 5.

PLATE 5.

ABYLA DENTATA Bigelow.

- Fig. 1. Side view of superior nectophore. Type-specimen.
- Fig. 2. Ventral view of same.
- Fig. 3. Dorsal view of same.
- Fig. 4. Apical view of same.

CERATOCYMBIA SAGITTATA (Quoy & Gaimard).

- Fig. 5. Dorsal view of bract of free eudoxid, 16 mm. long.

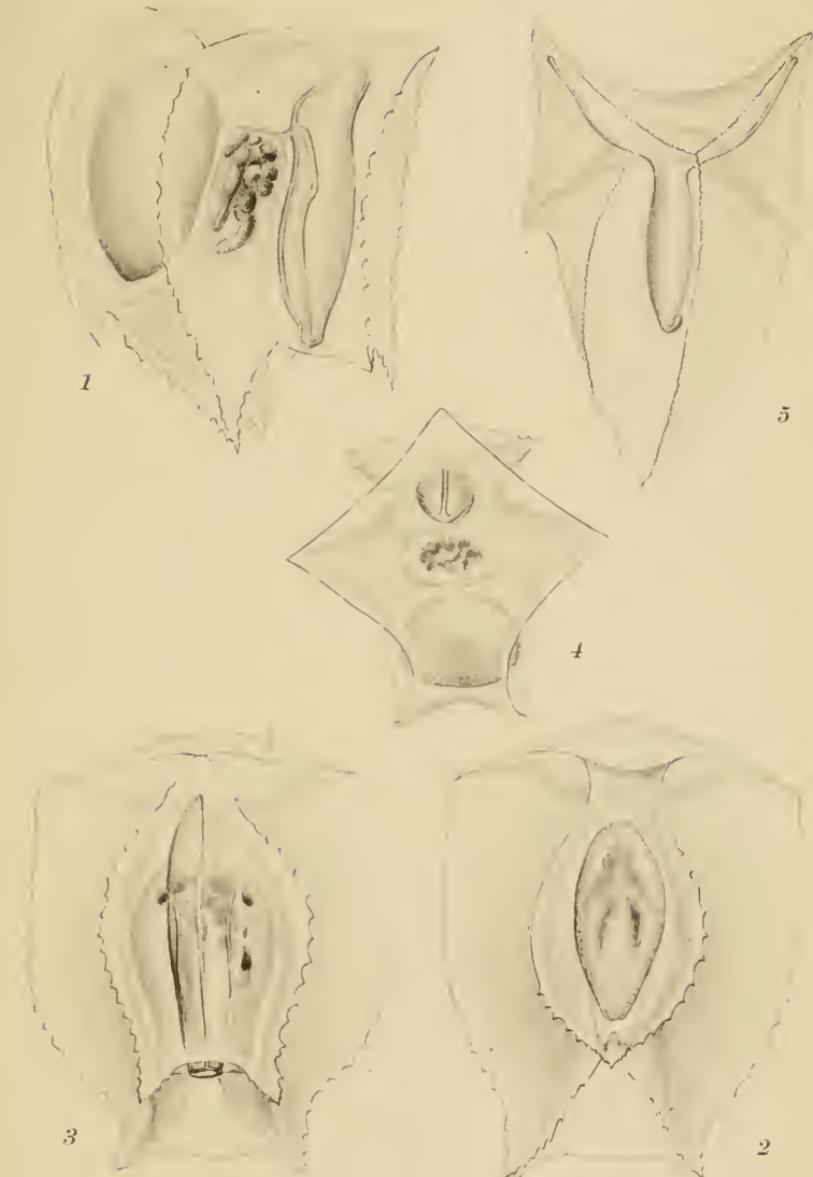


PLATE 6.

PLATE 6.

CERATOCYMBIA SAGITTATA (Quoy & Gaimard).

- Fig. 1. Group of appendages, still attached to the stem (see p. 414).
- Fig. 2. Male gonophore of same, more enlarged, from left side.
- Fig. 3. Female gonophore 30 mm. long, from free eudoxid, seen from right side.

ABYLA LEUCKARTII Huxley.

- Fig. 4. Female gonophore 8 mm. long, from free eudoxid, ALBATROSS Station 4,469, Eastern Pacific.

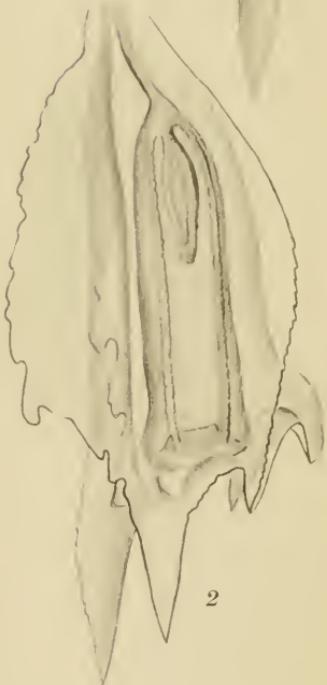
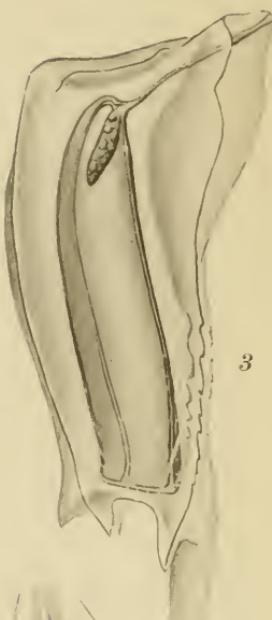
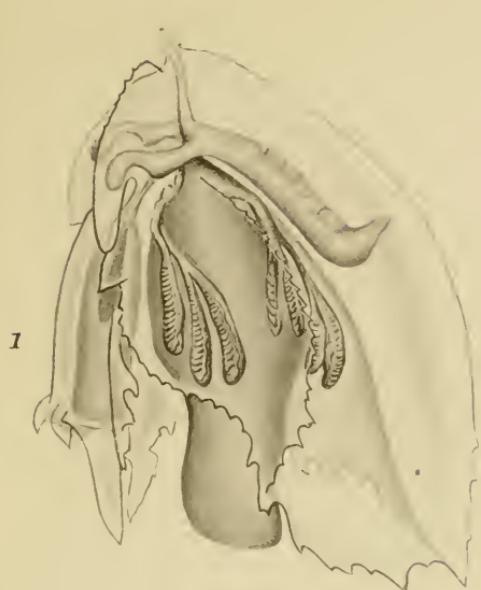


PLATE 7.

PLATE 7.

CERATOCYMBIA SAGITTATA (Quoy & Gaimard).

- Fig. 1. Inferior nectophore, 45 mm. long, seen somewhat obliquely from the left side.
- Fig. 2. Dorsal view of base of female gonophore, 15 mm. long, from free eudoxid.
- Fig. 3. Similar view of male gonophore, 11 mm. long, from free eudoxid.
- Fig. 4. Cross-section of female gonophore 35 mm. long.
- Fig. 5. Cross-section of male gonophore 30 mm. long.

HIPPOPODIUS HIPPOPUS (Forskål).

- Fig. 6. Young tentillum.
- Fig. 7. Adult tentillum.

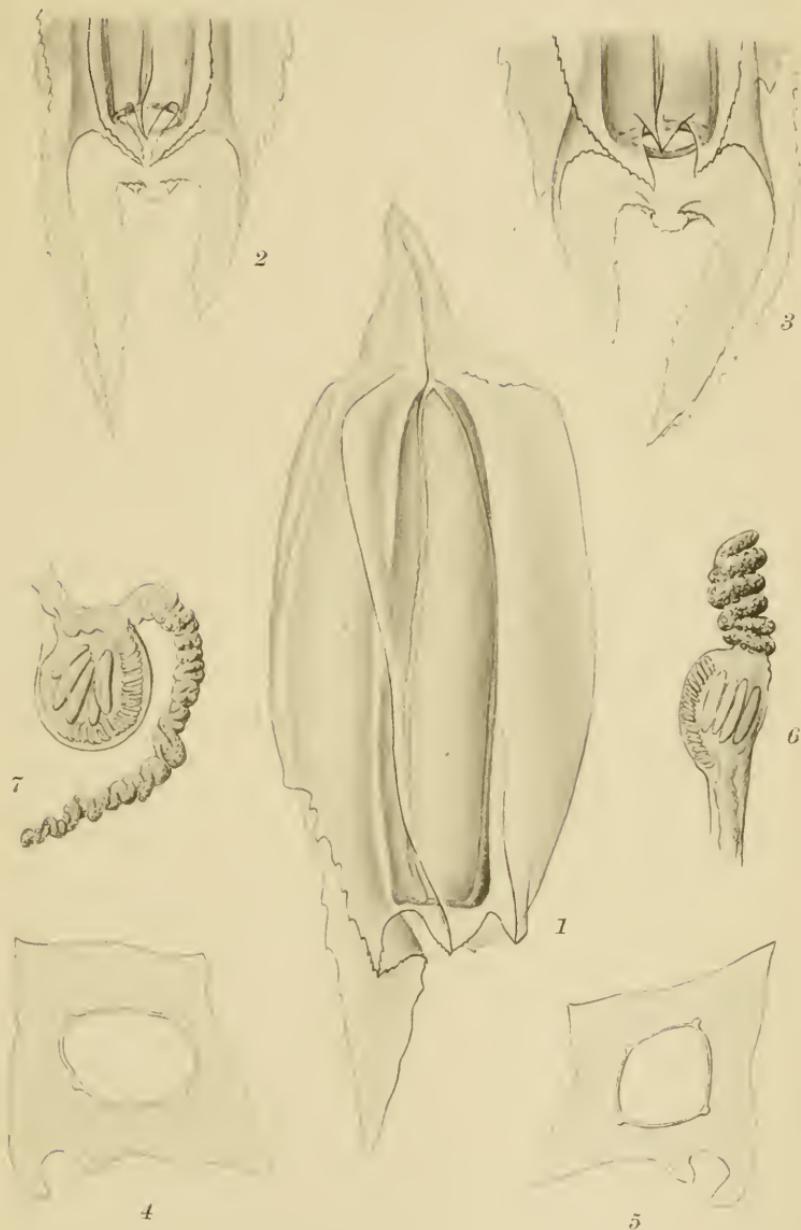


PLATE 8.

PLATE 8.

GALEOLARIA QUADRIDENTATA (Quoy & Gaimard).

- Fig. 1. Side view of superior nectophore, 12 mm. long.
Fig. 2. Basal view of same.

DIPHYOPSIS BOJANI (Eschscholtz).

- Fig. 3. Left lateral view of base of superior nectophore.
Fig. 4. Dorsal view of same.

STEPHANOMIA RUBRA (Vogt).

- Fig. 5. Adult tentillum.

