Memoirs of the Museum of Comparative Zoology
AT HARVARD COLLEGE.
Vol. XXXV. No. 1.

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

VIII.

THE HYDROIDS.

By SAMUEL F. CLARKE.

WITH FIFTEEN PLATES.

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CAMBRIDGE, U. S. A.:
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February, 1907.

EASTERN TROPICAL PACIFIC.

The following Publications of the Museum contain Reports on the Dredging Operations in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross," during 1904 and 1905, Lieut.-Commander L. M. Garrett, U. S. N., Commanding.

I. Alexander Agassiz. Three Letters to the Hon. George M. Bowers on the Cruise in the Eastern Pacific, of the U. S. Fish Commission Steamer "Albatross." Bull. M. C. Z., XLVI. No. 4. April, 1905. 22 pp.

II. Harriet Richardson. Description of a new genus of Isopods, typical of a peculiar family. Bull. M. C. Z., XLVI. No. 6. July, 1905. 4 pp. 1 Plate.

III. C. A. Kofoid. Craspedotella, a new genus of the Cystoflagellata, an example of convergence. Bull. M. C. Z., Vol. XLVI. No. 9. September, 1905. 5 pp. 1 Plate.

IV. W. E. Ritter. Octacnemus. Bull. M. C. Z., Vol. XLVI. No. 13. January, 1906. 22 pp. 3 Plates.

V. Alexander Agassiz. General Report of the Expedition. Mem. M. C. Z., Vol. XXXIII. January, 1906. 90 pp. 96 Plates.

VI. T. W. Vaughan. Madreporaria. Bull. M. C. Z., Vol. L. No. 3. August, 1906. 14 pp. 10 Plates.

VII. C. R. Eastman. Sharks' Teeth and Cetacean Bones. Bull. M. C. Z., Vol. L. No. 4. November, 1906. 26 pp. 4 Plates.

VIII. S. F. Clarke. The Hydroids. Mem. M. C. Z., Vol. XXXV. No. 1. February, 1907. 18 pp. 15 Plates.

IX. C. A. Kofoid. New Species of Dinoflagellates. Bull. M. C. Z., Vol. L. No. 6. February, 1907. 48 pp. 18 Plates.

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THE HYDROIDS.

INTRODUCTION.

The collection of Hydroids made by Mr. Agassiz in the Eastern Pacific in 1904–1905 is a small one of twelve species, and some of these are represented by single specimens. All of them are from the tropics, four are from the shores of Perico Island in the Gulf of Panama, three are from stations near the Galapagos Islands, two are from stations off Aguja and Callao, Peru, and one, *Obelia striata*, was also collected in the open Pacific almost directly on the equator, some 1500 miles west of South America. Their names, localities, and bathymetrical distribution are shown in the accompanying table : —

	Station No.	Latitude.	Longitude W.	Depth.
Pennaria pacifica, sp. nov. . .	Perico Id.			
Campanularia obliqua, sp. nov. .	Perico Id.			
Obelia striata, sp. nov. . . .	4742	N. 0° 3.4′	117° 15.8′	Trawl 2320 "
Obelia striata, sp. nov. . . .	4657	S. 7 12.5	84 9.0	Tow 300 "
Obelia sp.	Perico Id.			
Campanulina denticulata, sp. nov.	4672	S. 13 11.6	78 18.3	2845 "
Lafoea gracillima	4642	S. 1 30.5	89 35.0	300 "
Thuiaria tubuliformis	Perico Id.			
Sertularella tropica	4647	S. 4 33	87 42.5	2005 "
Zygophylax chazaliei	4642	S. 1 30.5	89 35.0	300 "
Cladocarpus distomus, sp. nov. .	4630	N. 6 52.0	81 42.5	556 "
Plumularia helleri	4621	N. 6 36.0	81 44.0	581 "
Plumularia helleri	4622	N. 6 31.0	81 44.0	581 "
Aglaophenia struthionides . .	4643	S. 1 28.7	89 48.5	100 "

The most surprising fact about this collection is that from the 116 stations occupied on this expedition the hydroids are so small in amount and the species so few. From the shores of Perico Island, near the anchorage of the "Albatross," in the Bay of Panama, there are four species, and the remaining seven are from eight of the stations after leaving Panama. That leaves 112 stations showing no hydroid life. Of the eleven species, *Lafoea gracillima* is the most widely known, but it has hitherto been reported from northern waters only ; Marktanner-Turneretscher 79° 5.4′ N.

Br., 61° 23.6′ W. L. Dr. Kepes; Yellow Sea, Dr. Swoboda; North Atlantic, Bonnevie; Coast of Maine, Verrill; Alaska, Clarke.

It is interesting to find that two of the species, *Thuiaria tubuliformis* and *Zygophylax chazaliei*, were known hitherto from the Atlantic side of the Isthmus of Panama only. In 1888 Mr. Alexander Agassiz discussed the resemblances of these two marine faunas, as shown especially by the results of his deep-sea dredgings, in his volumes on "Three Cruises of the Blake," page 157: "In fact, the deep-sea fauna of the Caribbean and of the Gulf of Mexico is far more closely related to that of the Pacific than to that of the Atlantic. Before the cretaceous period the Gulf of Mexico and the Caribbean were undoubtedly in freer communication with the Pacific than with the Atlantic Ocean; so that, notwithstanding the presence of a number of Atlantic types, the characteristic genera were common to the Pacific."

The label in the bottle with *Campanulina denticulata* records a depth of 2845 fathoms, something unusual, but not unequalled, for hydroids. Allman gives records of 2900 fathoms in the Pacific for *Stylactis vermicola*, and for *Monocaulis imperator*, collected by the "Challenger."

Pennaria pacifica, sp. nov.

Plate 1.

Troposome: — Hydrocaulus 20 to 35 mm. high, simple, black near the base, becoming horn color at the distal ends, divided by nodes into rather short internodes without annulations in the distal portion, with one, rarely two, in the basal part; pinnae arranged alternately, one from each node, originating below the internode, divided by nodes like the stem and with two or three annulations at the base; peduncles borne on the upper sides of the pinnae, one proximally to each node, tapering but slightly to the base, where there are two or three annulations. Hydranths with twelve to fourteen filiform tentacles, and when fully developed having about sixteen capitate tentacles, somewhat irregularly arranged.

Gonosome: — Not present.

Habitat: — Perico Island.

These specimens resemble *P. symmetrica*, but a careful comparison of the specimens of both species shows constant differences in the character and number of the annulations and in the shape of the peduncles, which makes it easy to recognize each kind. In *P. symmetrica* the annulations are more

numerous, three to seven usually, on each internode of the stem, sometimes nine, not in the form of simple rings, but saucer-shaped (see Pl. 2, fig. *3*), five to seven at the base of each pinna, and the same number at the base of each peduncle. The annular base of the peduncle is the narrowest part and is much compressed, making one of its transverse diameters much greater than the other. The hydranths are not very well preserved in either lot of specimens, and I discover no marked differences in those of equal size like the ones in terminal positions on the main stem and pinnae. As the stem and pinnae elongate, a new hydranth is formed just below the terminal, and as the terminal hydranth is the largest on the pinna, the largest and oldest is always next to the youngest and smallest, however many there may be on the pinna.

It is possible that when we have more material with the gonosomes of both these species, and we know their complete life histories, we can unite the two.

I have had an opportunity to study the original specimens of *Pennaria gibbosa* L. Agassiz from Key West. In studying *P. symmetrica* for description I considered it distinct from *P. gibbosa*, because of the gibbous shape of the hydranth, and the very slender, tapering, completely annulated character of the peduncle showing no compression at the base, in the description of *gibbosa*. In comparing the specimens of the two I find that the peduncles are alike in both and the hydranths of one are as gibbous as those of the the other (see Pl. 2, figs. *2* and *4*). The filiform tentacles are somewhat longer in *symmetrica* than in *gibbosa*, but that is a feature of slight value. *Pennaria symmetrica* Clarke becomes a synonym of *Pennaria gibbosa* Agassiz.

A fact of some importance in valuing the characters of the species of Pennaria is found in the changes produced by somewhat different environment even in localities close together. In examining specimens of *Pennaria tiarella* from Woods Hole, Mass., I was impressed with the differences between the specimens from the piles of the wharf and those growing on the long, slender, ribbon-like leaves of eelgrass (Zostera) near-by. Those from the eelgrass have stems much smaller at the base than at the distal ends, the latter often being twice the diameter of the basal part. (See Pl. 3, figs. *3*, *4*). In the specimens from the wharf the base of the stem is but slightly smaller than the distal end; the difference is obvious in one, while in the other it would not be seen without careful observation (see Pl 3, figs. *1*, *2*). The basal third or two thirds of the stem, in the specimens

from the Zostera, are black; the remainder is horn color. The stem in the wharf specimens is horn color throughout. The filiform tentacles in the Zostera specimens are longer than those of the wharf specimens. The swollen distal ends of the capitate tentacles are often larger than those of the wharf specimens. I find that Professor Hargitt[1] in 1900 called attention to certain differences in these two forms of *P. tiarella* at Woods Hole. He says that the form upon the eelgrass "matures with much greater rapidity and has apparently a much briefer period of activity, hardly covering more than about four or five weeks. It is further distinguished by a higher coloration of the colonies and of the medusae. Again, the medusae free themselves with much greater frequency and ease, and swim much more actively. The ova of the two forms likewise show the same difference of coloration, those of the [eelgrass] being a brighter orange and much more conspicuous, while those of the [wharf] are of a creamy white, with the slightest tint of dull pink."

From an examination of the capitate tentacles of many hydranths of *P. tiarella* I find no exception to a regular arrangement in verticils in the younger state, but in the fully developed hydranths with a larger number of capitate tentacles there appears an irregular arrangement, especially in the proximal region nearest to the filiform tentacles. (See Pl. **4**.)

Hargitt has pointed out that Allman founded the genus Halocordyle on the untenable basis of a verticillate arrangement of the tentacles, separating *P. tiarella* on that ground from *P. gibbosa*, in which they are described as irregularly arranged. In addition to what I have said above in regard to the arrangement of the capitate tentacles in the young and old hydranths, I would call attention to Pl. **2** fig. *5*, a camera lucida drawing from the type specimen of *P. gibbosa* which shows the distal capitate tentacles arranged in two verticils. Comparing this with the figures of *P. tiarella*, it seems probable that in both the distal capitate tentacles are the first to appear, the more distal row first of all, and that later a more or less irregular arrangement of the complete number obtains. These observations re-enforce the view expressed by Hargitt that the "intergradations in all degrees in species from different regions and from the same region" leave no basis for the genus Halocordyle.

[1] American Naturalist, **34**, p. 387.

Campanularia (?) obliqua, sp. nov.

Plate 5, Figs. *1–4*.

Trophosome : — Hydrothecae with a full outline tapering but little toward the base, with a diaphragm on which rests the body of the hydranth ; the margin has ten prominent teeth which do not point directly upward, but obliquely ; the peduncles are annulated at the base and immediately below the hydrotheca, and in one of the specimens there are a few annulations about the middle of the peduncle. The hydrorhiza consists of simple creeping tubes.

Gonosome : — Not known.

Habitat : — On a sertularian from Perico Island.

This is a small creeping form with peduncles from 1 mm. to 1½ mm. in height. In the annulation of the peduncles, the shape and number of teeth, this species is like *C. gravieri* Billard.[1] It is distinguishable from the latter by the obliqueness of the teeth in *obliqua* and the crests of the teeth in *gravieri*.

This species is represented in the collection by a few specimens only, and the main reason for recognizing them as a species, aside from the marked peculiarity of the obliqueness of the teeth, is the hope that by calling attention to them they may be watched for in any future collections from the region of Perico Island.

Obelia striata, sp. nov.

Plates 6 and 7.

Trophosome : — Hydrocaulus rising from a creeping stolon, simple, clustered, eight to ten annulations at the base, seldom and very sparingly branched, annulated with numerous (12 to 16) rings immediately above the origin of each hydrotheca ; five to eight annulations at the base of each hydrotheca. Hydrothecae pedunculate, alternately arranged, deeply campanulate, very hyaline, tapering to the base ; a well-marked diaphragm defines a basal cavity ; the margin has a crenated edge forming about fourteen to sixteen teeth which have well-developed crests projecting inward ; the distal part is deeply fluted, producing a series of longitudinal striations that are about one third the length of the hydrothecae.

[1] Bulletin Muséum d'histoire naturelle, 1904, n° 7, p. 480.

Gonosome : — The gonothecae occur both on the hydrorhiza and on the hydrocaulus. They are sessile, or nearly so, nearly cylindrical in the distal half, tapering to the base, strongly curved, having a terminal opening in the centre of a diaphragm-like membrane. A somewhat unusual type of a young medusa with four main tentacles was found in one of the gonothecae (see Pl. 6, fig. *7*).

Habitat : — Serial Number of Haul, 4742. Latitude, North, 0°.3.4′. Longitude, 117°. 15.8′ West. Trawl, 2320 fms.

As this colony was attached to a pteropod shell still containing its maker, it was probably taken in the tow.

This is a beautiful form, and because of its perfect freedom from other animals and plants and from all dirt, it is an especially favorable and enjoyable object for study. The most marked feature is the deep fluting of the distal portion of the hydrothecae, which is well shown in Pl. 7, fig. *4*. Something of a transverse constriction occurs in some of the hydrothecae, always a little below the transverse median line ; it appears in some of the hydrothecae on each of several hydrocauli, as represented on Pl. 6. The size of the hydrothecae varies much, a few very small ones, the peduncles of which arise from the hydrorhiza, being only one half the length of the largest.

A second colony of what is apparently this same species was taken in the tow net in a surface haul at the locality recorded under serial number 4657, Latitude, South, 7°–12.5′. Longitude, West, 84° 9′. Tow at 300 fms. This colony is also attached to an inhabited shell (see Pl. 7, fig. *5*). It will be seen that the differences of the number of annulations and the curvature of the gonothecae are far too slight to be of specific value.

Obelia (?) sp.

Plate 5, Figs. *5–7*.

Trophosome : — Stems simple, unbranched, rising from a simple creeping stolon, with four to six annulations at the base and the same number immediately above the origin of each peduncle. The hydrothecae occur alternately on opposite sides of the stem, borne on short, stout peduncles of four to six annulations ; their length is about two and a half times their greatest breadth, they taper gradually to the base, the diaphragm is well marked, the rim bears about sixteen pointed teeth arranged in pairs, the space be-

tween each pair being cut a trifle deeper than the space between the two teeth of each pair, and a striation beginning at the centre of each of the deeper indentations of the rim is continued proximally for a third or a half of the length of the hydrotheca.

Gonosome : — Unknown.

Habitat : — Perico Island.

The method of reproduction being unknown, makes it impossible to determine the generic relations of this species, and because there are only a very few specimens, and they so small as to suggest the possibility of their being young colonies, I do not believe in giving it a specific name. There are, so far as I know, three other species which have hydrothecae of a similar shape, with the same arrangement of the teeth in pairs, and the same striations. They are *Campanularia* (?) *spinulosa* Bale[1]; *Obelia bidentata* Clarke[2]; and *O. bicuspidata* Clarke.[2] *C. spinulosa* is like these specimens from Perico Island also in being a small form "about half an inch high" and in having the marginal teeth crested, but much more prominently so than in the Perico specimens. The stem in *C spinulosa* exhibits the rudiments of a compound or polysiphonic structure, there is more annulation of the stem, the peduncles are longer and more slender, the hydrothecae are shorter in proportion to their greatest width, and the teeth are shorter than in the specimens from Perico Island. The number of the teeth in *C. spinulosa* is from 20 to 24; in the Perico form, 16 to 18.

The figure of this Perico form compares very closely with that of *O. bidentata* Clarke, but the latter has a compound stem, attains a height of 150 mm., and is much branched. Our specimens may be young specimens of *O. bidentata*, but without more material and a knowledge of the gonosome that point cannot be determined. Bale makes the same suggestion in regard to his *C.* (?) *spinulosa*. Thornely[3] has described a hydroid *Gonothyrea longicyatha*, from New Britain Island, which also has the teeth in pairs on a castellated rim; the striations, however, are wanting. The stem becomes compound by the development of stolons from the bases of the peduncles, and they grow downward as they do in Bale's *C.* (?) *spinulosa*. Three of these campanulate forms with castellated rims and paired teeth are from the Pacific Ocean, — Perico Island, New Britain Island, and Australia, — and

[1] Proceedings Linnean Soc. New South Wales, June 27, 1888, p. 756.

[2] Transactions Connecticut Acad. Sci., 3, July, 1875, p. 58.

[3] A. Willey's Zoölogical Results, Part 4, Dec., 1899, p. 454.

they are all of small size. The other two are from the Atlantic, Long Island Sound, and are both large species, 75 to 150 mm. in height. It will be interesting to see, when their gonosomes are known, if they are generically related. The gonothecae have been seen in the *G. longicyatha* only, where one of them bore an imperfect external capsule. They are all shallow-water specimens, apparently, although no exact depth is given for *C.* (?) *spinulosa* at Port Jackson.

Campanulina denticulata, sp. nov.

Plate 8.

Trophosome: — The hydrocaulus arises from a simple stolon, is unbranched, nearly colorless, monosiphonic, and has a few annulations, two to four, at its base. Hydrothecae arise alternately on the hydrocaulus, pedunculated, two to five annulations at the base of the peduncle; a diaphragm partly separates the proximal part of the cavity, and this varies much in size, in some instances being one third the length of the hydrotheca, sometimes deeply campulate, sometimes tapering slightly to the distal end, always markedly so to the proximal end, the margin cut into large castellated teeth, ten to twelve in number, an operculum of converging segments equal in number with the teeth, and arising inside the teeth.

Gonosome: — Gonotheca irregularly cylindrical, very long, tapering slightly at the base, full width at the distal end, external opening terminal, not full width and at one side, borne on a peduncle of two annulations arising from the hydrocaulus.

Habitat: — From serial No. 4672, Latitude, South, 13° 11.6′, Longitude, West, 78° 18.3′. Depth 2845 fms. Tanner net tow at 400 fms.

A very delicate form 10 to 15 mm. high.

In general appearance these specimens have the look of a Campanulina with pointed hypothecae (see Pl. 8, fig. 2), but with a higher power some of them are seen to be campanulate. Some of the hydrothecae have the structure shown in Pl. 8, figs. 6 and 6*b*. This seems to be due to two successive enlargements of the hydrothecae, starting in each instance from within the teeth, in which case the original operculum must have been dropped off or else have had its segments united to form the addition and to leave the succeeding set of teeth at the new rim. The various sets of teeth persisting form an unusual ornamentation, tiara-like in its plan. I have found one

hydrotheca in the specimens in which, even when stained, I can find no trace of teeth, only an operculum, which adds to the difficulty of deciding the generic relations of this peculiar form with both teeth and operculum. As the gonophores are unknown there is far too little basis for creating even a provisional genus for these peculiar hydrothecae.

It is interesting to find a species which combines the general shape of the hydrothecae of the Campanulinidae with the campanulate forms of the Campanularidae; and the operculum combined with teeth is a new combination. Teeth may have sometimes developed into opercula, but this would seem to be a case where the operculum originates at the same place of growth activity as the teeth. In those hydrothecae with the triple rows of teeth the two additions to the length of the hydrothecae may have come about through the growing together of the proximal parts of the segments of the opercula, or, as would seem more probable, by a new cylindrical growth having a toothed rim, after either of which processes there would have been the growth of a new operculum. The latter method would be, with the exception of the formation of the teeth, like the secondary growths seen in *Calycella syringa*, as shown by Nutting[1] and by Levinsen. Figure 17 of Levinsen[2] forms an especially interesting comparison, as in that the segments of the original operculum are retained.

Lafoea gracillima Alder.

One small specimen of this delicate species was brought up by the "Tangles" from Station 4642, five miles southeast from Hood Island, Galapagos Archipelago; depth, 300 fms.; bottom, broken shells and Globigerinae.

This species, so far as I am aware, has been found hitherto only in northern waters: North Atlantic, Bonnevie[3]; Alaska, Clarke[4]; Yellow Sea, Marktanner-Turneretscher[5]; Coast of Maine, Verrill.[6] Its occurence at Station 4642 brings it about two degrees south of the equator.

[1] Bulletin U. S. Fish Comm., 1899, p. 354.

[2] Om Fornyelsen af Ernaeringsindividerne hos Hydroiderne. Saertryk af Vidensk. Meddel. fra den naturhist. Forening i Kjobenhavn. 1892.

[3] The Norwegian North Atlantic Expedition, Zoölogy, Hydroida, Christiania, 1899, p. 65.

[4] Scientific Results Exploration of Alaska, W. H. Dall, Smithsonian Institution, Washington, 1876, p. 12.

[5] Annalen des K. K. Naturhistorischen Hofmuseums, **5**, s. 217.

[6] Amer. Journ. Sci., April, 1874, **7**, p. 413.

Thuiaria tubuliformis Marktanner-Turneretscher.

Plate 9.

There are about 20 colonies attached to pieces of a bivalve shell from Perico Island. The specimens are from 25 to 40 mm. in height, and several have gonangia. The internodes are described as "bearing a branch and two hydrothecae on one side and a single hydrotheca on the other." Some of the internodes in these specimens bear a branch and three hydrothecae on one side and two on the other. The tendency of the hydrothecae to arrange themselves in groups, mentioned by Nutting,[1] and especially so toward the distal ends of the branches, is quite pronounced. The localities for this species hitherto reported are all from the Atlantic side of the continent, — Brazil, Florida, and the Bahama Banks. This is yet another instance of the same marine invertebrate occurring on both sides of the Isthmus of Panama.

Sertularella tropica Hartlaub.

Plate 10, Figs. *1–3, 3 b.*

A few small, fragmentary specimens attached to a chitinous worm tube came from Station 4647, Latitude, South; 4° 33′, Longitude, West, 87° 42.5′.

Depth, 2005 fms. Trawl, open net tow to surface from 800 fms.

In Nutting's table of the bathymetrical distribution of the Sertularidae, the greatest depth recorded is 1168 fms., and it is interesting to note that it is a record of this species, and in the Eastern Pacific not far from the Equator. As the worm tube to which this specimen is attached is uninhabited, it may have been floating and have been picked up by the tow net on its way up from the 800 fm. line.

This species was first named *Sertularia variabilis* by myself in 1894, an unfortunate christening, as that specific name was preoccupied. Hartlaub renamed it *tropica* in 1900, and changed it into the genus Sertularella. These two genera are not distinct enough to warrant a further complication of the synonymy by calling this again Sertularia. The determination of genera in the Hydroida is perhaps peculiarly unsatisfactory, inasmuch as there is oftentimes only the perisarc from which the description is written, and in some cases only that of the trophosome. The recognition of genera being largely a matter of convenience, and as the fuller knowledge shows us ever more

[1] Special Bulletin, Smithsonian Institution, 1904, Part 2, p. 70.

and closer relationships, fewer distinct groups, the scientific attitude would seem to look toward the reduction of the number of genera and species, and to limiting the number of new names as much as possible.

Zygophylax chazaliei Versluys

Plates 11–13.

Perisiphonia chazaliei Versluys.[1]

Two specimens were taken on the "Tangles" at a depth of 300 fms., five miles from the southeast end of Hood Island, Galapagos Archipelago, from a bottom of broken shells and Globigerinae, in Latitude 1° 30.5′ South, Longitude 89° 35′ West. They are about 40 mm. in height, of a light yellow horn color, and agree very well with the careful description and figures of Versluys.

Both colonies were broken off short at the bases of the main stems, making it impossible to determine the exact connection of the axial and peripheral tubes with the tubes of the hydrorhiza. The basal portion of the axial tube, when separated from the peripheral tubes, shows a number of peripheral tubes originating from it; all of them are continued upward, some of them branching (Pl. **13**, fig. *1*). As the thickness of the main stem is determined by the number of peripheral tubes, and as the size is greatest at the base, there must be many peripheral tubes arising from the hydrorhiza; and as the main stem decreases in size distally, few, if any, of the peripheral tubes from the base reach the top. As pointed out by Versluys, the peripheral tubes of the main stem send branches to the pinnae (see Pl. **11**, fig. *5*, and Pl. **13**, fig. *2*). The two peripheral tubes between which the hydrothecae project have membranous outgrowths on the portions of their opposed surfaces which lie between the hydrothecae, forming something like a collar around each hydrotheca (Pl. **13**, fig. *6*).

In some cases there is an internal ring of the perisarc formed close below the hydrotheca (Pl. **11**, fig. *4*).

The number of axial tubes at the base of the main stem is about 30, something like 12 of these showing on one half the surface when viewed as an opaque object. This number agrees well with that given by Versluys "près de son sommet," where, in these specimens, the number is much less.

[1] Mémoires Société Zoologique France, **12**, p. 29, 1899.

Versluys's statement is, "Ainsi, sur une coupe transversale d'un tronc principal assez près de son sommet, je compte trente ou trente-et-un tubes périphériques, entourant le tube axial d'une couche triple." The size of the pinnules and the number and arrangement of their peripheral tubules is like that given by Versluys.

In the short uncovered, distal portions of the axial tube the hydrothecae are attached to the stem in their basal part for nearly half their entire length. After a brief soaking in caustic potash they are partly separated (Pl. **11**, fig. *3*), while after boiling in caustic potash they become entirely free (Pl. **11**, fig. *4*; Pl. **12**). Pictet and Bedot have already called attention to this fact. It is also to be noted that after this treatment the hydrothecae of the main stem appear somewhat pedunculated, while those of the pinnae do not (Pl. **12**; Pl. **13**, fig. *1*).

The two localities for this species are off the Galapagos Islands in the Pacific, and off the Testigos Islands some fifty miles north of Venezuela in the Caribbean Sea. This is another of those interesting cases where the same marine form is found on both the Atlantic and Pacific sides of the Isthmus of Panama to which Mr. Alexander Agassiz first called attention in 1888.

Kirkpatrick in 1890 wrote, "It would appear, then, that Perisiphonia is synonymous with Zygophylax." I agree with him, and with Jäderholm, that the slight difference of the continuation of the peripheral tubes quite or not quite to the distal ends of the stem and branches is not a sufficient basis for generic distinction, and therefore the species described as Perisiphonia must be classified as of the genus Zygophylax. This genus now comprises these seven species:—

Zygophylax profunda Quelch, 1885, Cape Verde Islands	500 fathoms
Zygophylax (Perisiphonia) pectinata Allman, 1888, New Zealand	700 "
Zygophylax (Perisiphonia) pectinata Pictet and Bedot 1900, Gulf of Gascogny	300 metres
Zygophylax (Perisiphonia) pectinata Pictet and Bedot, 1900, Azores	318 "
Zygophylax pectinata, Jäderholm, 1903, Eastern Atlantic (about 500 miles west of Gibraltar)	162 fathoms
Zygophylax operculata Jäderholm, 1903, Patagonia, Cape Valentyn	150 "
Zygophylax (Perisiphonia) filicula Allman, 1888, Azores	450 "
Zygophylax (Perisiphonia) filicula Allman, 1888, Australia	150 "
Zygophylax tizardensis Kirkpatrick, 1890, China Sea	35 "
Zygophylax chazaliei Versluys, 1899, Testigos Island	80 metres
Zygophylax chazaliei Clarke, 1907, Hood Island	300 fathoms
Zygophylax biarmata Billard, 1905, Bay of Biscay	not given

Two of the seven species (*profunda* and *operculata*) have the irregularly branched habit of the species of Lafoea, the form of the colony of *biarmata* is not given, and the other four have the rigid regular habit of *pectinata* and *filicula*.

The gonosome has been found in only one of these species, *pectinata*, by Pictet and Bedot, and there is some doubt as to the character of the structures found, as, in addition to certain gonophore-like bodies, there is a Coppinia cluster on the same stem. This is most beautifully figured by M. Bedot on Plate 5,[1] and he suggests of the gonophore-like bodies, "il est possible qu'ils représentent les gonothèques d'un des sexes et la coppinie les gonothèques de l'autre."

Some of the species are closely similar, and with more material and a knowledge of the gonosomes in all of them there may be some rearrangement needed. They have a wide distribution in the Atlantic and Pacific oceans and are deep-water forms, from 35 to 500 fms.

Cladocarpus distomus, sp. nov.

Plate 14.

Trophosome: — Stem compound at the base, the hydrotheca-bearing tube on the surface simple in about the distal third, 50 mm. in height, but imperfect, the top being broken off, bearing, near the base, one branch which is compound in its basal half, simple in its distal half; also eight widely separated alternate pinnae composed of a single tube, with the stem processes of three other more proximal ones which had been broken off, one pinna on the branch, and processes of four others; pinnae divided by transverse nodes into long internodes, each of which bears one hydrotheca. Hydrothecae long, tapering to the base with an outer margin, which in side view is slightly S-shaped, intrathecal ridge absent, margin with one prominent pointed tooth and the remainder slightly uneven. Nematophores large, the supra-calycine tubular, extending well above the hydrothecae, with a transverse slit-like terminal orifice, and a circular lateral opening on the inner side near the top; the two mesial nematophores are one below the node, and one below the hydrotheca, the free end of the latter not reaching to the base of the hydrotheca; they are stout, broad, with a wide transverse slit-

[1] Pictet and Bedot, Résultats des Campagnes Sci. du Prince de Monaco, Fasc. 13, 1900.

like opening in every respect like those of the pinna-bearing tube on which there are 12 to 14 nematophores between each two adjoining pinnae.

Gonosome: — Not present.

Habitat: — Station 4630. Latitude N., 6° 52′. Longitude W., 81° 42.5′. Depth, 556 fms.

There are 6 tubes showing in surface view of the base of the main stem, hence there must be at least 12 in it, and these apparently all come from the hydrorhiza. The hydrotheca-bearing tube disappears at the base under some of the simple tubes.

This species is nearest to *C. dolicotheca* Allman and *C. flexuosus* Nutting, but differs from them both in the compound character of the main stem, the nodal joints of the pinnae, and in the structure and the arrangement of the nematophores. Neither are there any "imperfect septa (septal ridges)" in the parts of the stem at the backs of the hydrothecae.

Plumularia helleri Hincks.

Plate 15.

Two colonies of this delicate Plumularian attached to a large spicule of a siliceous sponge were collected in the Gulf of Panama; one at Station No. 4621; Lat. N. 6° 36′, Long. W. 81° 44′, depth 581 fms.; and the other at Station No. 4622, Lat. N. 6° 31′, Long. W. 81° 44′, depth 581 fms.

A slight difference in the two specimens is noticed in the position of the hydrothecae on the internodes: in the specimen from Station 4621 the inner part of the rim of the hydrotheca is on a level with the node; in the other specimen the rim is below the node.

Aglaophenia struthionides Murray

Plate 10, figs. *4–6*.

A single stem of this beautiful species, with several corbulae, is from Station 4643. Depth, 100 fms.; bottom, broken shells and Globigerinae. Locality about 4½ miles southwest by south from the west end of Hood Island, Galapagos Archipelago.

In several collections I have had from the Pacific Coast of the United States, this has been the most abundant species. This extends the range of Puget Sound to San Diego, southward to the Galapagos. It was described by Murray in 1860 as *Plumularia struthionides*, and by Clarke in 1876 as *Aglaophenia struthionides*.

EXPLANATION OF PLATES.

When not otherwise specified, drawings are by S. F. Clarke.

PLATE 1.

Plate 1.

Pennaria pacifica, page 6.

Figures 1 and 2 by J. H. Emerton.

Fig. 1. A hydranth from which the filiform tentacles have been cut away, bringing more clearly to view the somewhat irregular arrangement of the capitate tentacles in the adult hydranth.

Fig. 2. A perfect hydranth of the same.

Fig. 3. A hydranth, camera sketch. × 40.

Fig. 4. A colony, natural size.

Fig. 5. Part of a pinna with a peduncle. × 116.

Fig. 6. The distal part of a main stem. × 20.

FIGURES 1 AND 2 BY J. H. EMERTON.

HEL. TYPE CO., BOSTON.

PLATE 2.

Plate 2.

Pennaria gibbosa, page 7.

Fig. 1. Part of a pinna with peduncles. × 60.

Fig. 2. Hydranths. × 40.

The above are from the type specimens of L. Agassiz, which are not in a good state of preservation.

Fig. 3. Part of a pinna with peduncles. × 60.

Fig. 4. Hydranths with some of the tentacles not drawn, to show the outline of the bodies of the hydranths. × 40.

The last two figures are from specimens from Bahia Honda originally described as *P. symmetrica* Clarke.

Fig. 5. Showing the arrangement of the capitate tentacles on a hydranth of a small specimen in a small phial labelled Tortugas Id. This phial is in the larger bottle containing the type specimen of L. Agazziz. × 60.

PLATE 3.

Plate 3.

Pennaria tiarella, page 7.

Fig. 1. Base of a stem of a colony growing on a pile of the wharf, Woods Hole, Mass. × 20.

Fig. 2. Top of the same stem. × 20.

Fig. 3. Top of a stem of a colony growing on a blade of eelgrass (Zostera), Woods Hole, Mass. × 20.

Fig. 4. Base of the same colony. × 20.

HELIOTYPE CO., BOSTON

PLATE 4.

Plate 4.

Pennaria tiarella, page 7.

The figures are from camera drawings finished by J. H. Emerton.

Fig. 1. A very young hydranth showing the filiform tentacles and the most distal capitate tentacles appearing first, the capitate in a verticil. × 40.

Fig. 2. A somewhat older hydranth with the second verticil of capitate tentacles showing. × 40.

Fig. 3. A later stage with the capitate tentacles still in verticils. × 40.

Fig. 4. A still older hydranth with the filiform tentacles cut away, showing the capitate tentacles now in an irregular arrangement, especially on the proximal part of the hydranth. × 40.

4

2

3

HELIOTYPE CO., BOSTON.

PLATE 5.

Plate 5.

Campanularia ? obliqua, sp. nov., page 9.

Fig. 1. Natural size, growing on *Thuiaria tubuliformis.*

Figs. 2 and 3. The two specimens enlarged. × 116.

Fig. 4. The same specimen as figure 2. × 60.

Obelia (?) sp., page 10.

Fig. 5. Natural size, on *Thuiaria tubuliformis.*

Fig. 6. An entire colony. × 116.

Fig. 7. The distal end of a hydrotheca.

HELIOTYPE BOSTON.

PLATE 6.

Plate 6.

Obelia striata, page 9.

Fig. 1. A part of a colony; a, young gonothecæ; b, a hydrotheca much less than the usual size; c, a hydrotheca of the normal size and shape; d and e, hydrothecae from the same stem showing a transverse constriction. × 80.

Fig. 2. A part of another stem with normal hydrothecae and a perfect gonotheca. × 80.

Fig. 3. Another hydrotheca from the same stem. × 80.

Fig. 4. Two gonothecae on the hydrorhiza. × 80.

Figs. 5, 5b, 5c. Three hydrothecae from one stem. × 80.

Figs. 6, 6b. Two hydrothecae from still another stem. × 80.

Fig. 7. A gonotheca containing the peculiar gonozoöid. × 116.

Fig. 8. A colony, natural size, attached to a shell.

PLATE 7.

Plate 7.

Obelia striata, page 9.

The figures are from camera drawings finished by J. H. Emerton.

Fig. 1. Basal part of a colony with gonothecae. × 80.

Fig. 2. Distal end of a colony. × 80.

Fig. 3. A piece of the hydrorhiza, with gonothecae. × 80.

Fig. 4. The distal end of a hydrotheca showing the deeply fluted margin more highly magnified.

Fig. 5. A colony growing on a small shell, natural size.

PLATE 8.

Plate 8.

Campanulina denticulata, page 12.

Fig. 1. A single colony, natural size.

Fig. 2. A colony with gonotheca. × 20.

Fig. 3. A hydrotheca with the hydranth partly expanded. × 116.

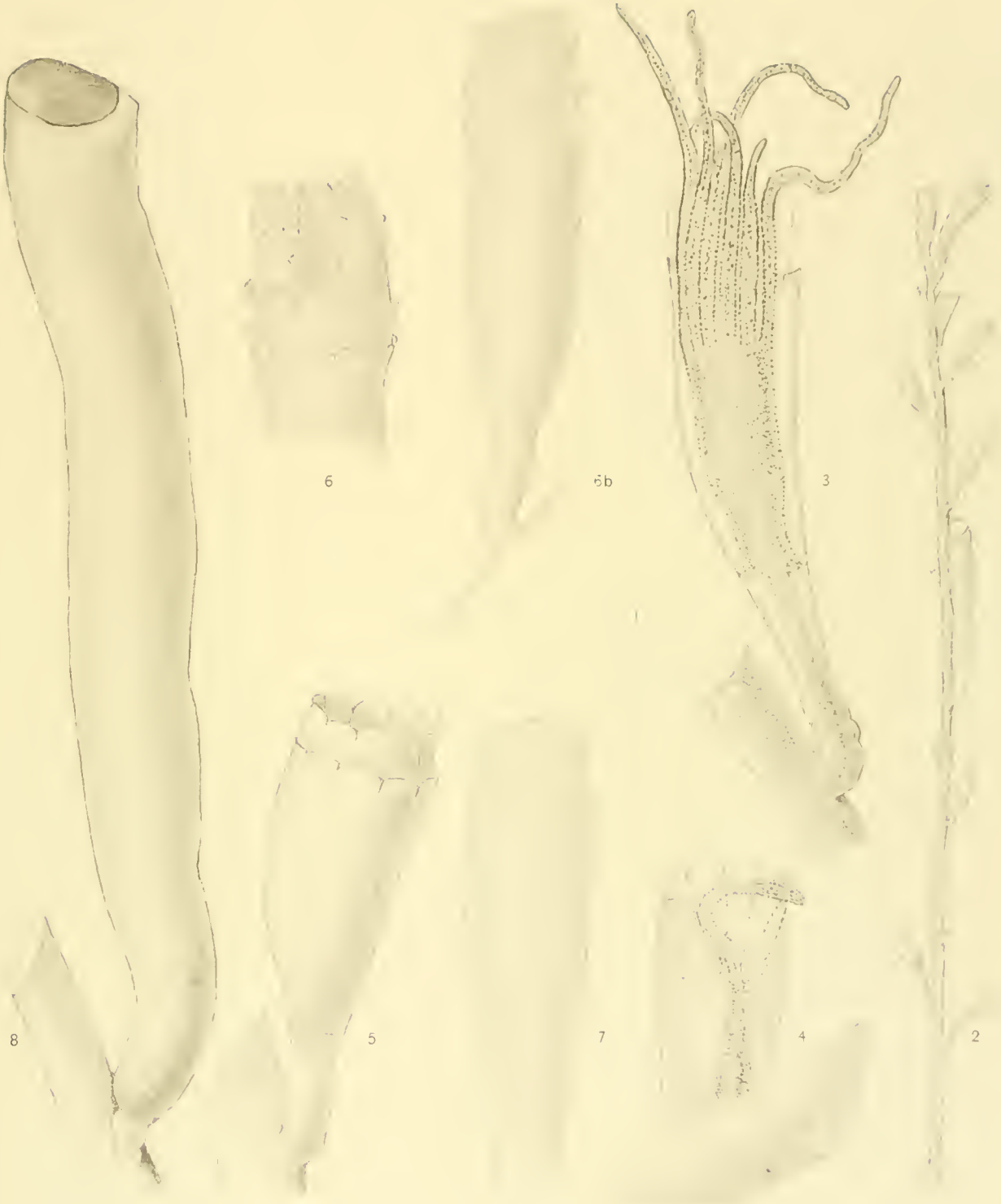
Fig. 4. A hydrotheca with the operculum infolded, and only a frayed remnant of the hydranth left. × 116.

Fig. 5. This shows the teeth and operculum in normal position. × 116.

Figs. 6 and 6b show the two hydrothecae that have three rows of teeth and an operculum. × 116.

Fig. 7. The one hydrotheca that has no teeth. × 116.

Fig. 8. The gonotheca. × 116.



HELIOTYPE CO., BOSTON

PLATE 9.

Plate 9.

Thuiaria tubuliformis, page 14.

The figures are from camera drawings finished by J. H. Emerton.

Fig. 1. A colony, natural size.

Fig. 2. Part of a colony. × 60.

Fig. 3. A hydrotheca showing successive additions. × 116.

Figs. 4 and 5. Gonothecae. × 60.

HELIOTYPE CO., BOSTON.

PLATE 10.

Plate 10.

Sertularella tropica, page 14.

Fig. 1. An entire colony. × 12.

Fig. 2. Part of a colony showing origin of branches. × 12.

Figs. 3, 3b. Two hydrothecae enlarged. × 80.

Aglaophenia struthionides, page 18.

Fig. 4. A stem from off Hood Island, natural size.

Fig. 5. An entire colony from Southern California, natural size.

Fig. 6. Part of Fig. 4 enlarged.

FIGURES 1, 2, 3 BY J. H. EMERTON.

HELIOTYPE CO., BOSTON

PLATE 11.

Plate 11.

Zygophylax chazaliei, page 15.

Figures from camera drawings finished by J. H. Emerton.

Fig. 1. A colony, natural size.

Fig. 2. A part of the main stem; a, pinnae. × 60.

Fig. 3. Part of the central tube from the main stem; dissected after maceration in cold KHO. × 60.

Fig. 4. Part of the central tube after maceration in boiling KHO. × 116.

Fig. 5. Showing the mode of branching of the central and of one of the peripheral tubes × 60.


a
a
2
a
4
3

PLATE 12.

Plate 12.

Zygophylax chazaliei, page 15.

Fig. 1. Part of the basal portion of the main stem after maceration in boiling KHO, showing the axial and peripheral tubes. × 60.

HELIOTYPE CO., BOSTON.

PLATE 13.

Plate 13.

Zygophylax chazaliei, page 15.

Fig. 1. Part of the central tube after maceration in boiling KHO. This shows especially well the mode of origin of the peripheral tubules. × 60.

Fig. 2. The branching of a peripheral tube.

Fig. 3. The distal end of one of the pinnae. × 60.

Figs. 4 and 5. Nematothecae. × 300.

Fig. 6. Two adjoining peripheral tubes through which the hydrothecae project. × 60.

HELIOTYPE CO., BOSTON

PLATE 14.

Plate 14

Cladocarpus distomus, page 17.

Figures from camera drawings finished by J. H. Emerton.

Fig. 1. The colony, natural size.

Fig. 2. Part of a pinna seen from the lower side. × 30.

Fig. 3. Part of a pinna in side view. × 30.

Fig. 4. A portion of the upper, simple part of the main stem. × 30.

Fig. 5. A portion of the main stem where it is compound, composed of two tubes. × 30.

Figs. 6 and 7 show the nodal thickenings in the perisarc.

Figs. 8 and 9 show the rim or margin of the hydrothecae. × 116.

Fig. 10. One of the supra-calycine nematothecae with its two openings. × 300.

HELIOTYPE CO., BOSTON

PLATE 15.

Plate 15.

Plumularia helleri, page 18.

Fig. 1. A colony, natural size.
Fig. 2. Part of a colony. × 75.
Fig. 3. The basal portion of a stem. × 60.
Fig. 4. Part of the main stem of a second colony. × 50.
Fig. 5. A pinna from figure 4. × 50.
Fig. 6. An internode enlarged. × 125.

HELIOTYPE C.O., BOSTON.

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