THE

TRANSACTIONS

OF

THE LINNEAN SOCIETY

OF

LONDON.

SECOND SERIES.—VOLUME X.

ZOOLOGY.

LONDON:

PRINTED BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET:

SOLD AT THE SOCIETY'S APARTMENTS, BURLINGTON-HOUSE, PICCADILLY, W. 1,

AND BY LONGMANS, GREEN, AND CO., PATERNOSTER-ROW.

1904–1922.

BISCAYAN PLANKTON.

Part XIII.—THE SIPHONOPHORA.

By Henry B. Bigelow, *Museum of Comparative Zoology, Cambridge, Mass.*

(*Communicated by* G. Herbert Fowler, *Ph.D., F.L.S.*)

(Plate 28.)

Read 3rd November, 1910.

List of Species.

Except for a single unrecognizable rhizophysid fragment the collection consists exclusively of Calycophoræ. A similar absence of the Physophoræ in the Atlantic during the summer has been noted by Chun (1897 *b*), who has suggested that either the adults or the larvæ must be at considerable depths at this time of the year. The Biscayan collection throws no light on this question, since no larval physophorids were taken, in spite of the considerable number of hauls from comparatively great depths. The scarcity of physophorids is not a phenomenon common to the whole of the North Atlantic during the summer months, for, along the eastern coast of North America, it is during this season chiefly that they are encountered.

On geographical grounds the records are valuable, because very few siphonophores have ever been recorded from the Bay of Biscay, and because several were captured in closing-nets.

The most interesting features of the collection from the systematic standpoint are a new species of *Diphyes*, and a new genus, *Nectopyramis*, probably belonging to the Monophyidæ, but easily distinguished by structural features.

The classification followed in the ensuing pages is that proposed by Chun (1897 *b*), and since adopted by Lens and Van Riemsdijk (1908). For a very different scheme, see K. C. Schneider (1898). All the species here listed, with the single exception of

Nectopyramis thetis, are contained in the 'Albatross' Eastern Pacific Expedition; and in my report on that collection, now in press, they are more fully described and figured, and questions of synonymy and classification are discussed in greater detail than the scope of the present paper allows.

In conclusion, I may say that the excellent condition of the specimens, upon which Dr. Fowler is to be congratulated, have made their study much easier than is usually the case with preserved Siphonophores.

CALYCOPHORÆ.

MONOPHYIDÆ, Claus, 1874.

SPHÆRONECTINÆ (Huxley, 1859), Haeckel, 1888.

NECTOPYRAMIS, gen. nov.

A single nectophore, apparently a monophyid, differs in so many important features from all known Calycophoræ that it has been made the type of a new genus. *Nectopyramis* is also represented in the 'Albatross' collection by a considerable series. When I first examined the specimen I thought, from the appendages, that it might prove to be the polygastric state of the eudoxid described by Chun (1888, 1897 *b*), Bedot (1904), and Lens and Van Riemsdijk (1908) as *Ceratocymba*. But the bract, though in some respects suggesting that form, differs so much from it in the structure of its somatocyst as to forbid the union. And I may forestall my account of the 'Albatross' collection by adding that it shows strong evidence connecting *Ceratocymba* with *Abyla leuckartii*, a union the possibility of which has already been suggested by K. C. Schneider (1898).

So far as we can judge from the single available example, *Nectopyramis* may be defined as *Monophyidæ with rounded nectophore, with the somatocyst represented by a series of divergent canals: the cormidia are without special nectophores.*

NECTOPYRAMIS THETIS, sp. nov. (Pl. 28. figs. 1–4.)

Occurrence: 300 to 0 fathoms. 36 *k*. 1 specimen in excellent condition.

Nectophore.—The nectophore, which is 11 mm. in greatest length, is of a pyramidal form, so characteristic that it makes the animal noticeable at the first glance. It may be described as bounded by four equilateral triangles, with somewhat concave margins; but these triangles are hardly comparable to the facets of the cymbonectids or diphyids, because they join each other by gradual curves, instead of being separated by sharp ridges. In this regard, then, the general form is intermediate between that of such forms as *Sphæronectes* and *Halopyramis*. The gelatinous substance of the nectophore is stiff, but almost perfectly transparent.

The nectosac lies in one of the triangular faces, near its dorsal angles. It is comparatively small, shallow, and saucer-shaped, and its subumbrellar surface, though torn, is sufficiently well preserved in places to show that its musculature, like that of *Hippopodius*, is so weak that it cannot serve as a very effective swimming-organ. The hydrœcium is large, deep, and laterally compressed. It is situated immediately above the nectosac. Its opening lies along the line of junction between two of the facets, and

extends from end to end of the nectophore. The relationship of nectosac to hydrœcium, and the form of the latter, can best be seen in the accompanying photographs (figs. 1, 2).

The typical somatocyst of other monophyids is here represented by a series of canals, which form not the least interesting feature of the nectophore, and suggest the condition in *Stephanophyes superba*, Chun (1891). The arrangement of the canals is as follows:—from the point on the inner surface of the hydrœcium where the stem is attached, a canal runs on either side over the inner lateral surface of the hydrœcium, to terminate blindly before reaching its ventral margin. Each of these canals, at a point nearly opposite the dorsal margin of the nectosac, gives off a branch which runs in a direct line to the dorso-lateral angle of the nectophore. The ascending branch, corresponding in location to the ascending branch of the somatocyst of *Rosacea* and *Praya*, is so much injured that it is impossible to tell how far it extended normally. In the specimen it can be traced about halfway to the apex of the hydrœcium. The descending branch, after giving off the trunks to the lateral walls of the hydrœcial cavity, follows the dorsal margin of the hydrœcium, as in the Prayinæ; but instead of connecting with the nectosac by a single canal, as is usually the case, it sends no less than four to that structure. These canals, clearly seen in the photographs, are a pair of laterals, arising together, a dorsal and a ventral each arising separately, opposite the dorsal or ventral margin of the nectosac, as the case may be. The canals do not join the nectosac at its apex, but about at its mid-level. But in spite of their unusual arrangement, they no doubt correspond to the radial subumbral canals of more typical forms. In its further extension the descending branch of the somatocyst reaches nearly to the ventro-basal angle of the nectophore.

Stem and Appendages.—The stem is very much contracted, but when detached from the nectophore the following features could be determined. There are no buds for reserve bells, nor could I distinguish any structure suggesting that a second bell had been attached, but had been lost. The evidence of a single example, so contracted as is this one, is perhaps insufficient to make it certain that the species is a monophyid. But so far as it goes it is positive, and unless other specimens are found with posterior nectophores, or with the buds for such structures, no course is open except to refer *Nectopyramis* to the Monophyidæ. Besides a considerable number of very young appendages and buds, there is one group in which siphon, tentacle, two gonophores, and bract are well developed.

The bract is very characteristic. In general form it is saucer-shaped, or scale-like, bluntly pointed at the superior, transversely truncate at the inferior end. Though flat, there are three dorsal ridges, a single descending and two ascending, and near the centre, where the latter arise, there are two triangular prominences. The canal system of the bract consists of a single descending, and two diverging lateral branches, each of which gives off a short, nearly vertical branch running up into one of the dorsal prominences.

It thus resembles even to minor details the canal system of the bract of *Praya cymbiformis*, so often described and figured, and, though less closely, that of *Rosacea plicata*.

One of the gonophores is already of comparatively large size, and has a well-marked hydrœcial groove, limited by broad wings, but open as yet throughout its length. Except for these wings, the surface of the gonophore shows neither ridges nor distinct facets, nor are there any basal teeth. But the absence of such structures at this early stage does not necessarily imply that they are not developed later.

The spadix is extremely small—indeed, it is nothing more than a minute knob projecting downward into the bell cavity; at this early stage its sex could not be determined.

In addition to this gonophore there are two younger ones in the single cormidium preserved; both are very young, but one has a well-developed manubrium on which ova, already of considerable size, can be distinguished. In this cormidium there is no special nectophore; but it can only be settled on more extensive material whether such organs are developed later or not.

The siphon, which is relatively large and has a well-marked basigaster, presents no feature of special interest.

The basal part alone of the tentacle is still intact, and the numerous tentillæ which are attached to it are all immature. So far as their present state shows, they are of the type characteristic of *Sphæronectes* and other monophyids.

Assuming that *Nectopyramis* is a monophyid, it does not fit in very well with either of the two subdivisions of that group usually recognized, for although, so far as the form of the nectophore is concerned, it agrees well enough with the Sphæronectinæ, it differs from that subfamily, and from the Cymbonectinæ as well, in the structure of the somatocyst. In this respect the only close parallel among Calycophoræ is afforded by certain Diphyidæ, e. g. *Stephanophyes*, Chun. But the absence of any trace of a posterior nectophore forbids classing it in that family. To make further speculation as to its affinities of any real value, large series must be examined, to determine especially whether more than one nectophore is ever present.

Cymbonectinæ, Haeckel, 1888.

Muggiæa, Busch, 1851.

Muggiæa kochii (Will), Chun.

Diphyes kochii, Will, 1844, p. 77, Taf. 2. fig. 22; Busch, 1851, p. 46, Taf. 4. figs. 3–5.
Muggiæa pyramidalis, Busch, 1851, p. 48, Taf. 4. fig. 6.
Muggiæa kochii, Chun, 1882, p. 679, Taf. 16. figs. 1–7; 1892, p. 89; K. C. Schneider, 1898, p. 88.

For a complete synonymy of this species and its eudoxid, the *Ersæa pyramidalis* of Will, see Chun, 1892, p. 89.

Occurrences: 50 to 0 fathoms.	25 *g*.	10	anterior nectophores.
100 to 0 fathoms.	30 *g*, 35 *b*, 36 *b*, 36 *e*.	11	„ „
150 to 0 fathoms.	36 *f*.	3	„ „
200 to 0 fathoms.	36 *g*.	4	„ „
250 to 0 fathoms.	36 *h*.	2	„ „

All about 12 mm. long.

These nectophores, none of which are in very good condition, agree, on the whole, so

well with Chun's (1882) description and figures of *Muggiæa kochii* that I have no doubt that they belong to that species; the more so since in none of them was any trace of a posterior nectophore, or of a bud for such a structure, to be seen.

As Will (1844), Busch (1851), and Chun (1882) have all observed, the nectophore is pyramidal, with five prominent ridges, but with nothing more pronounced in the way of basal teeth than a slightly prominent dorsal ridge. One feature not mentioned by earlier students is that the lateral ridges invariably end a short distance above the basal margin. But since this fact is often masked by the incurving of the bell-margin, and can be seen in contracted material only by flattening out this region, it may well have been overlooked. In expanded specimens, particularly those in which the musculature of the subumbrella is torn away; the course and termination of the ridges is easily followed.

The somatocyst is cylindrical and reaches from one-third to one-half the height of the nectosac. Its general form is one of the readiest field-marks to separate this species from *Diphyes fowleri*, which resembles it in general appearance; its shortness, together with the shallowness of the hydrœcium, which lies almost wholly below the level of the opening of the nectosac, serve to distinguish *M. kochii* from *M. atlantica* (Cunningham, 1892).

To Chun's account I can further add that the dorsal wall of the hydrœcium below the level of the bell-opening is divided longitudinally into two nearly symmetrical wings, as in many Diphyopsinæ.

In every specimen, all but the youngest appendages were wanting. *M. kochii* has already been recorded from the Atlantic (Chun, 1888), as well as from the Mediterranean. But there is, so far as I know, no definite record of its occurrence so far north as the Bay of Biscay.

DIPHYIDÆ, Eschscholtz, 1829.

PRAYINÆ, Kölliker, 1853.

ROSACEA, Quoy et Gaimard, 1827.

ROSACEA PLICATA, Quoy et Gaimard.

Rosacea plicata, Quoy et Gaimard, 1827, p. 177, pl. 4 B. fig. 4; K. C. Schneider, 1898, p. 78.
Rosacea ceutensis (partim), Blainville, 1834, p. 140, pl. 6. fig. 8.
Praya diphyes, Kölliker, 1853 *a*, p. 33, Tab. 9; 1853 *b*, p. 306; Vogt, 1854, p. 99, pls. 16, 17; Bedot, 1882, p. 122; non Lesson, 1843, p. 144.
Diphyes bragæ, Vogt, 1851 *b*, p. 140.
Rhizophysa filiformis, Delle Chiaje, 1842, p. 135, pl. 149. fig. 3; Vogt, 1851 *b*, p. 522.
Praya filiformis, Keferstein und Ehlers, 1861, p. 20.
Lilyopsis diphyes, Chun, 1885, p. 280; 1897 *b*, p. 102; Haeckel, 1888, p. 150.
? *Rosacea ceutensis*, Quoy et Gaimard, 1827, p. 176, pl. 4 *b*. figs. 2, 3.

This species, so fully described and well figured by Vogt (1854) and by Kölliker (1853 *a*), is usually known as *Lilyopsis diphyes* (Vogt), Chun, but, as K. C. Schneider (1898) has pointed out, there is good reason to believe that it is identical with the *Rosacea plicata* found by Quoy and Gaimard in the Straits of Gibraltar. It is true that

their figure, which is of the superior nectophore only, leaves much to be desired, but, as Leuckart long ago observed, the species which they studied was undoubtedly a Prayid; while the presence of a globular swelling at the extremity of the somatocyst points strongly to its identity with the *P. diphyes* of Vogt and Kölliker, rather than with any other species of the subfamily. Nor is there anything in the original figure or description to forbid the union of the two. It is, of course, most desirable to identify the older and usually very insufficient figures and descriptions of Siphonophores with the species actually known to-day, and it seems that in the present case this can be done safely.

The name *Praya diphyes* was first used by Lesson (1843) [the quotation by Vogt of Blainville, 1834, for this name is an error] for the *Diphyes prayensis* of Quoy and Gaimard, a species founded for a single detached nectophore. It was regarded by Vogt as identical with the species he studied. But Quoy and Gaimard's figures (1834, pl. 5. figs. 37, 38), so far as they go, agree better with *P. cymbiformis*.

Occurrences: 250 to 0 fathoms.	36 *h*, 36 *i*.	6 superior,	5 inferior nectophores.			
300 to 0 fathoms.	36 *k*.	6	„	2	„	„
350 to 0 fathoms.	36 *l*.	3	„	3	„	„
1250 to 0 fathoms.	27 *a*.	1	„			
300 to 200 fathoms.	21 *c*, 26 *f*.	2	„	1	„	„

The superior nectophores range from 12 mm. to 21 mm. in length, and from 9 mm. to 17 mm. in breadth; the inferior ones from 12 mm. to 22 mm. and from 7 to 15 mm. respectively.

When the collection reached my hands all the nectophores here listed were separate. The older [inferior] and younger [superior] ones, however, are not only easily identified, but from their sizes can often be associated with each other in pairs. In all the specimens the greater part of the corm and appendages are broken off, but in one I was able to find a well-preserved special nectophore, in addition to many crowded gonophores, siphons, tentacles, and the remnants of bracts. This discovery, of course, makes its generic identification certain.

The specimens are identified with *R. plicata* (rather than with *R. medusa*, Metschnikoff 1870=*R. diphyes*, Graeffe, 1860=*R. rosea*, Chun, 1885), because of the absence of tentacular rudiments on the margin of the special nectophore. Diagnostic also is the comparatively small size of the nectosac, the short oval form of the nectophores, and the presence of well-marked hydrœcial furrows. In *R. medusa*, as clearly shown in the figures by Metschnikoff (1870) and Bedot (1895), the chief nectophores are triangular, the nectosacs relatively very large. A single colony of *R. medusa*, from the Pacific, which I have examined, agrees with these figures, in the almost total suppression of the hydrœcium. The two nectophores are merely slightly concave ventrally and closely apposed to each other.

Comparison between the Biscayan specimens and excellently preserved material of *Praya cymbiformis*, Delle Chiaje (=*P. maxima*, Gegenbaur), from both the Mediterranean and the Pacific, shows differences in the forms of the younger (superior) of the two chief nectophores, sufficient for identification, even if the stem be lacking.

In *R. plicata* the nectophore is short and broad, and the hydrœcium, which is very deep, occupies only about one-third of the ventral surface. In *P. cymbiformis*, however, as is clearly shown in Gegenbaur's (1854) excellent figures, the nectophore is proportionately longer, and the hydrœcium extends for its whole length, in the form of a groove. When specimens of the two species are placed side by side, these differences, which (though, of course, of minor importance) prove to be constant, are at once apparent. [Compare also the figures of *R. plicata* (=*P. diphyes*) by Kölliker, 1853 *a*, with those of *P. cymbiformis* (=*P. maxima*) by Gegenbaur, 1854.]

The terminal dilatation of the somatocyst in *R. plicata*, lately mentioned as a specific character by K. C. Schneider (1898), also proves to be constant. Although the contraction of preserved material may obscure it, it is more or less prominent in all the Biscayan specimens, and was observed and figured by Kölliker and by Vogt, as well as by Quoy and Gaimard, but it has never been recorded, nor have I observed it, in *P. cymbiformis*.

The appendages are too fragmentary to enable me to add to the earlier descriptions of these structures noted above. In its form, the single special nectophore which was still preserved agrees clearly with Vogt's figures.

The inferior (older) nectophores are proportionately somewhat shorter and broader than those of *P. cymbiformis*. The difference is so slight, however, that the two might be easily confused in the absence of their respective superior nectophores. The form of the hydrœcium in *R. plicata* is well shown in Vogt's figure (1854, pl. 16. fig. 3).

The entire absence of this species from any of the surface hauls, the comparatively great depths of the hauls in which it was taken, and the positive evidence of its capture in one closing-net haul between 300 and 200 fathoms, show that at least in the Bay of Biscay, at the time of the expedition of the 'Research,' it was a member of the mesoplankton, not of the epiplankton. But, inasmuch as it has been recorded previously from the surface on many occasions, its presence at a lower level cannot be regarded as indicating an invariable habitat.

Diphyopsinæ, Haeckel, 1888.

Diphyes, Cuvier, 1830.

Diphyes subtilis, Chun.

Ersæa elongata, Will, 1844, p. 82, Tab. 2. figs. 30, 31.
Monophyes irregularis (partim), Chun, 1885, p. 271, Taf. 2. fig. 3 (non Claus, 1874).
Monophyes gracilis (partim), Chun, 1885, p. 271, Taf. 2. fig. 5 (non Claus, 1874).
Diphyes subtilis, Chun, 1886, p. 449 ; 1897 *b*, p. 103 ; Lens & Van Riemsdijk, 1908, p. 47.
Monophyes diptera, Haeckel, 1888, p. 129.
Diphyes elongata, K. C. Schneider, 1898, p. 85 (non Hyndman, 1841, p. 165).

Occurrences : 25 to 0 fathoms ; 31 *a*. 1 anterior nectophore.
75 to 0 fathoms ; 32 *g*. 1 anterior nectophore.
100 to 0 fathoms ; 24 *d*, 32 *d*, 32 *p*, 35 *b*, 36 *b*. 17 anterior nectophores ; all about 5 mm. long.

The earliest name, *elongata*, cannot be used, since it was preoccupied by Hyndman for another *Diphyes*.

This species, thanks to the peculiar form of its somatocyst, with long thread-like stalk and spherical terminal dilatation, is one of the most easily recognized members of the genus. Lens and Van Riemsdijk (1908) found that the form of this organ and the rounded apex of the anterior nectophore were constant in a large series from Naples, and the 18 specimens from the Bay of Biscay are perfectly typical so far as both characters are concerned. To Chun's accounts I need only add that, in spite of a shallowness of the hydrœcium, so extreme that we may almost speak of its cavity as entirely suppressed, its dorsal wall below the level of the opening of the nectosac is divided so as to form a right and left wing, much as in *D. fowleri* and in *Muggiæa kochii*. This region is not clearly shown in Chun's figure. All of the specimens were more or less distorted; in most of them the subumbrellar musculature is destroyed and the entire stem with its appendages torn off. No inferior nectophores could be identified, nor could I find any of its eudoxids.

Diphyes subtilis is one of the most common Siphonophores in the Mediterranean, where it is an epiplanktonic form of regular occurrence. So far as I am aware, it has been recorded in the Atlantic only from the Canary Islands, where Chun (1888) found it only occasionally. It is not present in the extensive West Indian collections which I have examined. The present captures, all in open nets, are too few to warrant speculation as to its bathymetric range further than to note, as rather surprising in view of its previously known habitat, its absence from all the surface hauls. They show, however, that it is not so exclusively a subtropical form as has been supposed, for it was taken in temperatures somewhere between 52° (100 fathoms) and 66° F. (surface).

Diphyes appendiculata, Eschscholtz.

Diphyes appendiculata, Eschscholtz, 1829, p. 138, Taf. 12. fig. 7; Huxley, 1858, p. 34, pl. 1. fig. 2; K. C. Schneider, 1898, p. 85.
Diphyes bipartita, Costa, 1836, 'Genere Diphya," p. 4, Tav. 4; Chun, 1897 *b*, p. 24.
Diphyes elongata, Hyndman, 1841, p. 165, figs. 1–4.
Diphyes acuminata, Leuckart, 1853, p. 61, Taf. 3. figs. 11–20.
Diphyes sieboldii, Kölliker, 1853 *a*, p. 36, Tab. 11. figs. 1–8.
Diphyes gracilis, Gegenbaur, 1854 *a*, p. 309, Taf. 16. figs. 5–7.
? *Diphyes pusilla*, McCrady, 1857, p. 174.

In this list only the more important references are given.

I follow Huxley and K. C. Schneider in uniting in one species the Atlantic *D. bipartita* and the Pacific *D. appendiculata*, because my examination of large series from both, as well as from the Indian Ocean (Bigelow, 1904), has failed to reveal a single character to separate them.

This species and its eudoxid are so well known that I need only mention here that the collection shows that the presence of only three ridges at the apex of the anterior nectophore is constant, and that the fourth ridge, which arises some distance below the apex, invariably becomes the left lateral.

D. appendiculata is the most abundant siphonophore in the collection. Its occurrences were as follows :—

Depth in fathoms.	Number of hauls.	Anterior Nectophores.	Posterior Nectophores.	Eudoxid.
0	15	9	5	257
25	5	34	7	22
50	9	38	18	57
75	6	13	7	24
100	10	96	55	89
200–100	4	8	8	
300–200	1	1		
500–400	1	3	4	5
500–250	1	3		
		205	104	454

Fortunately the anterior and posterior nectophores are all in such good condition as to be recognized readily. But many of the eudoxids are very much battered. Only those which could be identified certainly are listed above; there are a considerable number in addition which may belong to this same species.

D. appendiculata has long been known to be a widely distributed form, not only belonging to the epiplankton, but living at very considerable depths (1300 metres, Chun, 1887; 1000 metres, Bedot, 1904). Indeed, it is perhaps the most nearly universal of all siphonophores. The captures show that its eudoxid is commonest on the surface, but that in the Bay of Biscay the polygastric generation, on the contrary, is most abundant in the zone between 100 and 25 fathoms. The scarcity of the adult on the surface is surprising, in view of the fact that it has been so commonly taken there in other localities, both tropical and temperate. Below 100 fathoms both adult and eudoxid are rare; but the excellent condition of the specimens of both forms, which were taken in the closing-net between 500 and 400 fathoms, indicates that they were alive at that depth, and not merely corpses on their way to the bottom.

Its vertical range in the region now under consideration parallels that of *Aglantha* among the Medusæ (Browne, 1906, p. 174), a genus most common between 100 and 50 fathoms, though occurring in lesser numbers at much greater depths.

D. appendiculata, like *Nausithoe punctata* among Scyphomedusæ, passes through a wide range of temperature in its distribution, both vertical and horizontal. The evidence of the present collection would suggest, for the polygastric generation, an optimum of 50°–60° F. But it occurs commonly on the surface in the tropical regions of all three great oceans, in temperatures of from 70°–78°. The most northerly record which can

safely be attributed to this species is that by the Plankton Expedition (Chun, 1897 *b*) of an eudoxid in the closing-net, 800–1000 metres, 60° 2′ N., 22° 7′ W., at a temperature of 42·8° F. (11·6° C.). Römer (1902, p. 176), it is true, records anterior nectophores from Spitzbergen. But since he says that these specimens had "Zahnartigen Vorsprönge an den untere Schirmrande," *i.e.* basal teeth, they cannot have belonged to *D. appendiculata*.

On the surface the polygastric state of this species is known from as far north as the northern coast of Ireland.

Diphyes fowleri, sp. nov. (Pl. 28. fig. 5.)

Occurrences: Surface.	21 *e*.	4	anterior nectophores.
50 to 0 fathoms.	36 *d*, 26 *c*.	4	,, ,,
75 to 0 fathoms.	33 *h*.	7	,, ,,
100 to 0 fathoms.	21 *h*, 24 *b*, 24 *d*, 24 *e*, 30 *g*, 30 *h*, 32 *d*, 35 *b*, 35 *x*, 36 *b*, 36 *e*.	39	,, ,,
250 to 0 fathoms.	36 *h*.	1	,, ,,
300 to 0 fathoms.	36 *k*.	4	,, ,,

The specimens all measured about 11 mm. in length.

I have likewise been able to study 6 anterior nectophores of this species from the West Indies, and it is represented in the 'Albatross' Eastern Pacific collection by 8. Comparison of Atlantic with Pacific specimens has revealed no differences sufficient to justify their separation.

In its general form *D. fowleri* resembles the *Diphyes subtiloides* of Lens and Van Riemsdijk (1908) so closely that only a slight difference in the structure of the hydrœcium and the shape of the somatocyst distinguish it from the latter.

Anterior Nectophore.—The diagnostic characters are as follows: there are constantly five ridges at the apex, and these, which are not prominent, run to the base without branching. In the best-preserved specimens the general form is high and narrow, but the more battered individuals are often proportionately much broader. This difference is probably to be correlated with contraction or expansion of the nectosac. There are no baso-lateral teeth, and the dorsal tooth is represented merely by a slight prominence of the dorso-basal angle. The nectosac reaches almost to the apex, and the canals follow the usual course.

The hydrœcium is an important character, since it serves to distinguish *D. fowleri* from most other diphyids. It is very short, and lies wholly below the level of the mouth of the nectosac, and is broadly conical. Its form will be more readily understood from the accompanying figure than from a verbal description. In *D. subtiloides*, although the hydrœcium is of similar outline and position according to the figures of Lens and Van Riemsdijk (1908, pl. 7), the dorsal hydrœcial wall below the bell-opening is entire, though slightly concave. But in *D. fowleri*, both from the Atlantic and from the Pacific, the wall is divided as in many diphyids, the division being to one side of the mid-line. In most instances the left-hand flap is the larger, but several of the specimens are too much distorted to show whether or not this is invariably the case.

The somatocyst is spherical or pear-shaped, and, instead of lying nearly in the longitudinal axis of the nectophore, is transverse, a form and position constant in the entire series of 73 specimens, whether Biscayan, West Indian, or Pacific. In *D. subtiloides* the somatocyst, though short, is of the usual fusiform type, merely somewhat narrower near the base, and Lens and Van Riemsdijk found no noticeable variation from this type in 110 specimens.

Stem and Appendages.—The pedicular canal of the nectosac runs almost directly downwards throughout its short course to the apex of the hydrœcium. In only one specimen was an entire group of developed appendages still attached. This consisted of bract, siphon, tentacle, and gonophore. Although the latter was sufficiently developed for identification, there was no trace of any special nectophore, and it is on this evidence that the species is referred to *Diphyes* rather than to *Diphyopsis*.

Inferior Nectophore.—None of the specimens had the second nectophore still attached, but in most of them the remnants of what was apparently the pedicular canal could be detected at the base of the stem, and it is on the strength of these that the species is referred to the Diphyidæ. There are several inferior nectophores in the collection so crumpled and distorted as to be past description or identification. It is possible that some or all of them may belong to *D. fowleri*.

The depths of capture listed above show that, though this form occurs at the surface, it is most abundant between 50 and 100 fathoms, *i. e.* in a temperature of about 52° F.

It seemed to me so unlikely that a North Atlantic species with this habitat, so easily recognized as the present, and so common as it appears to be, should so long have escaped notice, that I was loth to make it the basis for a new specific name. But examination of the literature of both Diphyids and Monophyids seems to leave no other course open.

From the Atlantic forms with baso-lateral teeth—for example, *Diphyopsis dispar*, Cham. & Eys.; *Diphyes steenstrupii*, Gegenbaur; *D. serrata*, Chun; and *Doromasia picta*, Chun,—and from the various Pacific species with this same character, to be discussed in my Report on the 'Albatross' Siphonophores, it is readily distinguished by the entire lack of such structures. The Atlantic Diphyopsinæ previously known, which agree with *Diphyes acuta* in this respect, are *D. appendiculata*, Eschsch. (=*sceboldii*, Gegenbaur, = *bipartita*, Costa); *D. arctica*, Chun; *D. subtilis*, Chun; and *Diphyopsis hispaniana*, Mayer. But from all these, as well as from *Diphyopsis mitra*, Huxley (=*D. diphyoides*, Lens and Van Riemsdijk), and *Diphyes chamissonis*, Huxley, as yet recorded only from the Indo-Pacific region, it is separated by the shortness and position of the hydrœcium, and by the structure of the somatocyst, both of which characters have proved constant. Similarly, in addition to the apparent presence of an inferior nectophore, it is separated from the monophyids *Muggiæa kochii*, Will, and *M. atlantica*, Cunningham.

Among Galeolarinæ, the only species which might perhaps agree with it with regard to the somatocyst is *Galeolaria turgida*, Gegenbaur. But in the latter the structure of the hydrœcium, and particularly the two long dorsal hydrœcial wings, are entirely different from the condition in *D. acuta*. From *G. truncata*, Sars, which somewhat

resembles it in the absence of "wings" and in general appearance, it is separated by the structure of the somatocyst, which, in the latter, is of the ordinary fusiform type and of considerable length. The only species with which it might be confused is *Diphyes subtiloides*, Lens and Van Riemsdijk; but, as noted above, it is easily distinguished from that form by its peculiar somatocyst.

Chuniphyes, Lens and Van Riemsdijk, 1908.

Chuniphyes multidentata, Lens and Van Riemsdijk.

Chuniphyes multidentata, Lens and Van Riemsdijk, 1908, p. 13, pl. 1. figs. 9–11, pl. 2. figs. 12–15.

This very interesting species is represented by 7 anterior and 8 posterior nectophores. The records of its occurrence are:

250 to 0 fathoms.	36 *h*.	1 anterior and 1 posterior nectophore.
300 to 0 fathoms.	36 *k*.	1 anterior nectophore.
1250 to 0 fathoms.	27 *a*.	1 anterior and 1 posterior nectophore.
1500 to 750 fathoms.	30 *a*.	1 anterior and 2 posterior nectophores.
1250 to 1000 fathoms.	27 *b*.	1 posterior nectophore.
2000 to 1000 fathoms.	30 *e*.	3 anterior and 3 posterior nectophores.

The 'Siboga' specimens (1 anterior and 1 posterior nectophore) from which *Chuniphyes* was originally described were so much distorted as to make its general structure seem more unusual than it actually is. In point of fact, it differs in no essential feature from other Diphyids, although the unusual number and arrangement of the ridges and the peculiar form of the hydrœcium and somatocyst justify the retention of *Chuniphyes* as a distinct genus. The pyramidal shape of the nectophores and the form of the hydrœcium strongly suggest that its affinities are with the Diphyopsinæ rather than the Galeolarinæ. Unfortunately, however, neither the 'Siboga,' the 'Albatross,' nor the present specimens afford any information as to the structure of the groups of appendages, and until we know whether they are set free as eudoxids, or remain permanently attached to the stem, it is impossible to settle this point definitely.

Comparison, side by side, between the Biscayan and the 'Albatross' Eastern-Pacific specimens of *Chuniphyes* fails to show any differences sufficient to separate them into two distinct species. And inasmuch as both these series agree with Lens and Van Riemsdijk's description of the 'Siboga' material, so far as the poor condition of the latter allows one to judge, all must be referred to the one species, *C. multidentata*. This form is described and figured in detail in my report on the 'Albatross' Siphonophores, but to make its identification easy, the more diagnostic characters may be repeated here.

The anterior nectophore of *C. multidentata* may be distinguished at first glance by its pyramidal form, by its prominent ridges, and by the peculiar form of its obliquely truncate base. At the sharp-pointed apex there are four ridges: 1 dorsal, 1 ventral, and a lateral on each side. A short distance below the apex the dorsal and the two laterals each branch dichotomously, so that there are seven at the base.

The facets are a triangular dorsal, enclosed by the two branches of the dorsal ridge, and on either side three laterals; the dorso-lateral and the median-lateral being

triangular, the ventro-lateral irregular in outline. Of these, only dorso- and ventro-laterals extend to the apex. The ventral ridge does not branch, and there is no true ventral facet, although Lens and Van Riemsdijk speak of the hydrœcium as such. Each ridge, except the ventral, terminates in a pronounced tooth, and there is in addition a tooth breaking the basal outline of the median lateral facet.

The nectosac extends upward slightly beyond the mid-level of the nectophore, and is rounded apically. In the Biscayan material it is somewhat longer than in the Pacific specimens. But in view of the possibilities of distortion through contraction, and of the fact that all of the specimens are more or less battered, such a slight difference does not justify specific separation. The course of the subumbrellar canals is of the usual type.

The hydrœcium reaches to about the same level as the nectosac, not to the apex as described by Lens and Van Riemsdijk. Along its ventral face it is open for its whole length, and its deepest point is opposite the mid-level of the nectosac.

The somatocyst is of peculiar form, in that shortly above its point of origin it becomes much dilated and then contracts once more to run as a narrow tube nearly to the apex. In the form of this dilatation there is a slight difference between Biscayan and Pacific specimens. In the only one of the latter in which it is intact it is spherical. In four of the Biscayan specimens it projects on either side in a short transverse horn. In one Atlantic specimen, however, the horns are so much smaller as to suggest a transition to the condition in the Pacific material; therefore I consider this divergence of no more importance than the slight difference in the form of the nectosac in the two collections.

The identification of the inferior nectophores listed above, all of which were detached, is made certain by their close resemblance to the corresponding nectophores of two entire colonies in the 'Albatross' collection. Their general form, especially the open hydrœcium, covered only near the apex by two short flaps, the six prominent ridges (only four at apex), and the asymmetry of the basal teeth, of which the right ventral is much the largest, still serve for identification. In both nectophores the unusual prominence and brownish colour of the ridges, already noted by Lens and Van Riemsdijk and very noticeable in the 'Albatross' specimens, form good external field marks for this species.

Chuniphyes has never been taken on the surface; the 'Albatross' records are both from 300–0 fathoms.

The present captures show a range, at the least, from 1000–250 fathoms. Especially instructive are the closing-net records of 1250–1000, 2000–1000, and 1500–750 fathoms, since, of course, they show that the material actually came from these zones. How near this species may have come to the surface cannot, of course, be absolutely determined. But its absence from all hauls from depths of less than 250 fathoms suggests that the latter level is near the upper limit of its distribution. The number of specimens taken is far too small to justify any conclusion as to its relative abundance at different depths.

POLYPHYIDÆ, Chun, 1882.

Hippopodius, Quoy et Gaimard, 1827.

Hippopodius hippopus (Forskål), Schneider.

Gleba hippopus, Forskål, 1776, p. 14, Taf. 43. fig. E.
Gleba excisa, Otto, 1823, p. 309, Taf. 42. fig. 3 *a–d*.
Hippopodius luteus, Quoy et Gaimard, 1827, p. 172, pl. 4 A. figs. 1–12; Chun, 1897 *b*, p. 34.
Hippopodius mediterraneus, Costa, 1836, "genere ippopodio," p. 3, Tav. 2.
Hippopodius neapolitanus, Kölliker, 1853 *a*, p. 28, Taf. 6. figs. 1–5.
Hippopodius gleba, Leuckart, 1854, p. 299, Taf. 12. figs. 1–5.
Hippopodius hippopus, K. C. Schneider, 1898, p. 82.

In this list only the more important references are given. For a more extended bibliography, see Chun (1897 *b*, p. 34).

I am quite willing to admit that, as has often been pointed out, Forskål's two figures, on which his name *Gleba hippopus* is based, are so lacking in detail that it is impossible to reach any altogether satisfactory identification of them. But the probability that they belong to the well-known form so often described as *Hippopodius luteus* is so strong that I believe K. C. Schneider was justified in substituting the name *hippopus* for *luteus*, as a doubtful synonym of which it is listed by Chun (1897 *b*). To do so will no doubt add stability to the nomenclature of the genus, for until *hippopus* is connected with some actual species it will continue to be a source of confusion. Even if *hippopus* be not adopted, *luteus*, used both by Chun (1897 *b*) and by Lens and Van Riemsdijk (1908), cannot be employed, because both these authors list as a synonym Otto's name *excisa*, which antedates *luteus*.

Occurrence: 300 to 0 fathoms. 36 *k*. 6 loose nectophores.

It is surprising that the definitive nectophores of this species so common in the Mediterranean and so often recorded from the warmer parts of the Atlantic, as far north as the British coast (Chun, 1897 *b*), should have been taken only in one haul. The material, moreover, was in very poor condition. In addition to these definitive nectophores, the spherical primary nectophores, so well described by Chun (1897 *a*), were taken as follows:—

75 to 0 fathoms.	34 *c*.	7	specimens.
100 to 0 fathoms.	35 *f*.	1	,,
200 to 0 fathoms.	36 *g*.	2	,,
300 to 0 fathoms.	36 *k*.	5	,,
150 to 50 fathoms.	21 *p*.	1	,,
250 to 150 fathoms.	35 *p*.	1	,,

They are all at the stage at which the bud for the first definitive nectophore is first visible (Chun, 1897 *a*, fig. 6 *a*), and in each the stem bears a single large terminal siphon, with tentacle, and one or two small buds for future siphons. In their spherical form, shallow nectosac, and deep and narrow hydrœcial furrow, they agree very well with Chun's figure; but while he records 7 mm. as the greatest diameter, one of the present series has attained the remarkable size of 10 mm. It is interesting to observe that this

species was not taken in any of the surface hauls. Chun (1887) has already recorded the adult from various depths from the surface to 1200 metres. And according to his observations the larval "primary" nectophores apparently occur on the surface only rarely. But the fact that in the Bay of Biscay they were most numerous between 75 fathoms and the surface shows that there, at least, they were members of the epiplankton. Nor do any of the present records demonstrate its occurrence much below 150 fathoms, between which depth and 250 fathoms a single example was taken in the closing-net.

Vogtia, Kölliker, 1853.

Vogtia pentacantha, Kölliker.

Vogtia pentacantha, Kölliker, 1853 *a*, p. 31, Tab. 8; Keferstein und Ehlers, 1861, p. 23, Taf. 5. figs. 12–15; Chun, 1897 *b*, p. 35, Taf. 1. figs. 11–14.

Hippopodius pentacanthus, Claus, 1863, p. 551, Taf. 47. figs. 23–25; K. C. Schneider, 1898, p. 84.

Occurrence: 350 to 0 fathoms. 36 *l*. A colony with 6 nectophores, but with only the basal remnants of the stem intact.

The chief difference between this species and *V. spinosa*, Keferstein and Ehlers (= *V. köllikeri*, Haeckel), is that in the former the spine-like gelatinous processes characteristic of the genus are restricted to the angles or ridges of the nectophores, whereas in the latter they occur closely crowded over the flat lateral surfaces as well. The evidence afforded by the specimens recorded by Chun from the Plankton expedition, and especially actual comparison between the present example and the large series of typical *spinosa* in the 'Albatross' Eastern Pacific collection, and with the few nectophores described below as probably belonging to that species, points to the validity of this difference as a specific distinction. Furthermore, the shape of the older nectophores in the two species is different, those of *spinosa* being flatter and more regular than they are in *pentacantha*. We must, however, admit that to determine the constancy of these characters will require the examination of a considerable series of *V. pentacantha*. And until this is done, the question whether *pentacantha* and *spinosa* are distinct, or merely represent two phases of one species, must remain without a final answer. The attachment of the nectophores in two alternating rows follows the same plan as in the better-known genus *Hippopodius*, with which the *Vogtia* was confused by Gegenbaur (1860) and Claus (1863). Unfortunately, only the basal end of the stem, with a very few small buds, is still intact. Therefore no description of the appendages is possible.

? Vogtia spinosa, Keferstein and Ehlers.

Vogtia spinosa, Keferstein und Ehlers, 1861, p. 24, pl. 5. fig. 16; Chun, 1897 *b*, p. 103.

Vogtia köllikeri, Haeckel, 1888, p. 182, pl. 29. figs. 9–14.

Occurrences: 200 to 0 fathoms. 36 *g*. 4 detached nectophores.
250 to 150 fathoms. 35 *p*. 8 ,, ,,

These nectophores are all somewhat distorted, and several of them badly flattened and torn. All of them, however, show more or less clearly the spinous processes on the flat

marginal surfaces characteristic of *V. spinosa* and well figured by Haeckel (1888). The similarity between them and the Pacific series of *spinosa* is a further reason for identifying them provisionally as that species. *V. spinosa* has been previously recorded only from off the coast of Brazil (Keferstein and Ehlers) and from the South Atlantic (37° 3′ S., 44° 17′ W., Haeckel).

RHIZOPHYSALIÆ.

A single fragmentary rhizophysid was taken at Station 24*f*′, surface; probably on the wire. But unfortunately it consisted only of three fragments of the stem, without any of the appendages, and therefore cannot be identified, even generically.

BATHYMETRIC DISTRIBUTION.

The number of specimens of each species sent to me from each of the various horizons is given in the accompanying table [in the case of the diphyids only the anterior nectophores are included, to prevent duplication].

Depth in fathoms	0.	25—0.	50—0.	75—0.	100—0.	150—0.	150—50.	150—100.	200—0.	200—100.	250—0.	250—150.	300—0.	300—200.	350—0.	400—300.	500—250.	500—400.	750—500.	1000—750.	1250—0.	1250—1000.	1500—750.	1500—1250.	2000—1000.	2000—1500.
Nectopyramis thetis	..	..	..	..	..	..	..	..	..	..	..	..	1													
Muggiæa kochii	..	..	10	..	11	3	..	..	4	2																
Rosacea plicata	..	..	..	..	..	..	..	..	..	..	6	..	6	2	3	..	..	..	..	..	1					
Diphyes subtilis	..	1	..	1	17																					
„ *appendiculata*	9	34	38	13	96	..	..	..	..	8	..	..	..	1	..	..	3	3								
„ „ eudoxid	257	22	57	24	89	..	..	..	..	..	..	..	..	..	..	..	..	5								
„ *fowleri*	4	..	4	7	39	..	..	..	1	..	..	..	4													
Chuniphyes multidentata	..	..	..	..	..	..	..	..	.	..	1	..	1	..	..	..	..	..	..	..	1	1	1	..	3	
Hippopodius hippopus	..	..	..	..	..	..	..	..	..	..	..	..	1													
„ „ larva	..	..	..	7	1	..	1	..	2	..	..	1	5													
Vogtia pentacantha	..	..	..	..	..	..	..	..	..	..	..	..	1													
„ *spinosa*	..	..	..	..	..	..	..	..	1	..	..	1														
Rhizophysid fragment	1																									

(NOTE.—The smaller Calycophoræ are very delicate; they were peculiarly often caught up in clots of plankton, caused by the branching spines of Phæodarian Radiolaria or by silk threads from the tow-net, from which they could only be released—if at all—in

a hopelessly tattered state. It was therefore impossible satisfactorily to sort out, from the material captured, anything like the total number of specimens present. Consequently the number of specimens from any haul, sent to Mr. Bigelow, can only be taken to indicate the comparative abundance or scarcity of a species in the very roughest and most general way. Some deductions as to their distribution may, nevertheless, fairly be drawn from the number of hauls in which they occurred. For reasons given in earlier papers of this series, we must omit, as unfair for comparison with ordinary nets, the nine hauls made at the surface with silk of 180 meshes per linear inch ; there remain 16 hauls at this horizon for comparison ; for other reasons 35 *c* (75 fathoms) and 35 *d* (100 fathoms) are also omitted. Otherwise the numbers of hauls shown on the general table (p. 358) remain good, since there seems no reason to omit the hauls with a silk at 18 meshes per inch, in the case of these comparatively large forms.—G. H. F.)

The only species taken with sufficient regularity to allow its vertical distribution to be worked out in any detail is *Diphyes appendiculata* and its eudoxid.

The polygastric stage occurred between the surface and 200 fathoms

At	0	fathoms	in 18	per cent.	of the total number of comparable hauls.	
25—0	„	25	„	„	„	„
50—0	„	38	„	„	„	„
75—0	„	50	„	„	„	„
100—0	„	42	„	„	„	„

Between 200 and 100 fathoms in 57 per cent. of the total number of comparable hauls.

Below 200 fathoms it was taken in the only closing trawl made between 500 and 250, and in one each of the three closing-nets hauled from 300 to 200 and from 500 to 400 fathoms. It did not occur in any open net from a depth greater than 100 fathoms.

This table shows very clearly that *D. appendiculata* was not common on the surface, and the preceding one, actual numbers of specimens sorted out, emphasizes this fact even more strongly. On the other hand, it is obviously very rare below 200 fathoms, its only record from below that depth being in the three closing-nets, between 200 and 500 fathoms. The tables suggest that it was most abundant between 75 and 100 fathoms. It is true that the largest number of captures in proportion to hauls is from 200–100 fathoms; but since the total number of hauls at that zone was only seven, and the total number of specimens small, it is not so safe to draw inferences from them as from the 100-fathom hauls, of which there were over three times as many. But the excellent condition of the specimens taken at 200–100 fathoms shows that they were actually living at that depth.

That the polygastric stage of *D. appendiculata* occurred in none of the eight open-net hauls from below 100 fathoms is rather remarkable, since in their passage upward the nets must, of course, have passed through the zone where the species was most plentiful. As pointed out above (p. 345) the sporadic occurrence of this form in the closing-net at considerable depth is not surprising in view of the previous records of its capture.

The eudoxid of *D. appendiculata* was taken

At	0	fathoms in	68	per cent. of the total number of comparable hauls.		
25—0	,,	16	,,	,,	,,	,,
50—0	,,	23	,,	,,	,,	,,
75—0	,,	20	,,	,,	,,	,,
100—0	,,	14	,,	,,	,,	,,

and in one haul only at all depths below 100 fathoms.

The eudoxid, then, as already noted, is evidently most abundant at or near the surface, and there is nothing to show that the captures in open nets hauled from 25, 50, 75, or 100 fathoms did not come from near the surface, while the net was on its way upward *. The sporadic occurrence of this form at 400–500 fathoms (one closing-net, five specimens) was unexpected. The material is in excellent condition, with well-developed sexual products, and the fact that it was taken in the same haul with three excellent specimens of the polygastric generation suggests that the species was not only alive, but reproducing itself at that depth.

In general, the table of captures shows a great poverty of Siphonophores at the surface in the region studied, the only records from that zone being *Diphyes appendiculata* and its eudoxid, four specimens of *D. fowleri*, and a Rhizophysid fragment.

The greatest abundance of *Muggiæa kochii*, *Diphyes subtilis*, *D. appendiculata* (Polygastric), and *D. fowleri* was evidently between 100 fathoms and 25 fathoms. Though *Rosacea plicata* was taken only below 200 fathoms, it has previously been recorded from the surface, and I have studied specimens from the Pacific taken at the surface. *Chuniphyes multidentata*, on the other hand, has so far been recorded only from considerable depths (p. 349), and is in all probability a typical representative of the permanent Mesoplankton or Intermediate fauna.

* [I have dealt with this point elsewhere. In cases where the matter can be checked statistically, it is apparent that, down to something like 100 fathoms, the contamination of the sample obtained by hauling horizontally at (say) 50 fathoms for half an hour through something like half a mile of water, by the fauna of the comparatively insignificant distance of the vertical haul to the surface, is negligible.—G. H. F.]

Bibliography.

In the following list only the papers quoted in the foregoing pages are included. For a more extensive bibliography of the Siphonophores see Lens and Van Riemsdijk, 1908, and my forthcoming report on the 'Albatross' collection.

Bedot, Maurice, 1882.—"Sur la faune des Siphonophores du Golfe de Naples." Mitth. Zool. Stat. Neap. vol. iii. pp. 121–123.

——, 1896.—"Les Siphonophores de la Baie d'Amboine." Revue Suisse Zool. t. iii. pp. 367–414, pl. 12.

——, 1904.—"Siphonophores provenant des Campagnes du Yacht 'Princesse-Alice' (1892–1902)." Résultats Camp. Scient. par Albert I., Prince Souverain de Monaco, fasc. xxvii. 27 pp., 4 pls.

Bigelow, Henry B., 1904.—"Medusæ from the Maldive Islands." Bull. Mus. Comp. Zoöl., Harvard vol. xxxix. no. 9, pp. 245–269, 8 pls.

Blainville, Henri Marie Ducrotay de, 1834.—Manuel d'Actinologie ou de Zoophytologie. Paris, 8 and 644 pp., Atlas of 99 pls.

Browne, E. T., 1906.—"The Medusæ." Biscayan Plankton: Part IX. Trans. Linn. Soc. ser. 2, vol. x. part 6, pp. 163–180, pl. 13.

Busch, Wilhelm, 1851.—Beobachtungen über Anatomie und Entwickelung einiger Wirbellosen Seethiere. Berlin, 143 pp., 17 Taf.

Chamisso, Adalbert de, et Eysenhardt, C. G., 1821.—"De Animalibus quibusdam e Classe Vermium Linneana etc., Fasc. 2." Nova Acta Acad. Cæs. Leop. vol. x. pp. 343–374, pls. 24–33.

Chun, Carl, 1882.—"Ueber die cyklische Entwickelung und die Wirwandtschaftsverhältnisse der Siphonophoren." Sitz. k. pr. Akad. Wiss. Berlin, lii. 1882, pp. 677–694 [1155–1172], Taf. 16.

——, 1885.—"Ueber die cyklische Entwicklung der Siphonophoren.—2." Sitz. k. pr. Akad. Wiss. Berlin, xxvi. 1885, pp. 264–280 [511–528], Taf. 2.

——, 1886.—"Ueber Bau und Entwicklung der Siphonophoren.—3." Sitz. k. pr. Akad. Wiss. Berlin, xxxv. 1886, pp. 449–456 [681–688].

——, 1887.—"Die pelagische Thierwelt in grösseren Meerestiefen und ihre Beziehungen zur Oberflächenfauna." Bib. Zool. Bd. i. 66 pp., 5 Taf.

——, 1888.—"Bericht über eine nach den Canarischen Inseln im Winter 1887–88 ausgeführte Reise." Sitz. k. pr. Akad. Wiss. Berlin, xliv. 1888, pp. 1–33 [1141–1173].

——, 1891.—"Die Canarischen Siphonophoren in monographischen Dargestellungen.—1. *Stephanophyes superba*." Abh. Senckenb. naturf. Ges. vol. xvi. Heft 3, 74 pp., 7 Taf.

——, 1892.—"Die Canarischen Siphonophoren.—2. Die Monophyiden." Abh. Senckenb. naturf. Ges. Bd. xviii. pp. 57–144, Taf. 8–12 [6–10].

——, 1897 *a*.—"Ueber den Bau und die morphologische Auffassung der Siphonophoren." Verh. Deutsch. Zool. Ges. Leipzig, Jahresver. 7, pp. 48–111.

——, 1897 *b*.—"Die Siphonophoren der Plankton-Expedition." Ergeb. der Plankton Ex., Bd. ii. K. b. 126 pp., 8 pls.

Claus, Carl, 1863.—"Neue Beobachtungen über die Struktur und Entwicklung der Siphonophoren." Zeit. wiss. Zool. Bd. xii. pp. 536–563, Taf. 46–48.

——, 1874.—"Die Gattung Monophyes, und ihr Abkömmling Diplophysa." Schriften Zool. Inh. Heft i. part 2, pp. 27–33, Taf. 4.

Costa, O. G., 1836.—Fauna del Regno di Napoli &c. Medusari, pp. 1–20, 1–18, 1–14, 1–10, 1–12, 8 pls. (*H. mediterraneus*, Costa, p. 3, pl. 2 [6].)

Cunningham, J. T., 1892.—"On a Species of Siphonophore observed at Plymouth." Journ. Marine Biol. Assoc. Plymouth, n. s. vol. ii. pp. 212–215.

Cuvier, G., 1817.—Le Règne Animal &c. Paris, 4 vols., 15 pls.

Delle Chiaje, S., 1842.—Descrizione e Notomia degli animali invertebrati della Sicilia Citeriore. Naples, tom v. & atlas.

Eschscholtz, J. F., 1829.—System der Aealephen. Berlin, 6+190 pp., 16 Taf.

Forskål, P., 1776.—Icones rerum naturalium quas in itinere orientali depingi curavit Petrus Forskål... edidit Carstem Niebuhr. Hauniæ, 15 pp., 43 pls.

Fowler, G. H., 1904.—"Biscayan Plankton. 1. Methods and Data." Trans. Linn. Soc. ser. 2, Zool. vol. x. pt. i. pp. 1–11.

Gegenbauer, C., 1854 *a*.—"Beiträge zur näheren Kenntniss der Schwimmpolypen (Siphonophoren)." Zeit. wiss. Zool. Bd. v. pp. 285–343, Taf. 16–18.

——, 1854 *b*.—"Ueber Diphyes turgida nebst Bemerkungen über Calycophoriden." Zeit. wiss. Zool. Bd. v. pp. 442–454, Taf. 2, 3.

——, 1860.—"Neue Beiträge zur näheren Kenntniss der Siphonophoren." Nova Acta Acad. Cæs. Leop. vol. xxvii. 94 pp. Taf. 27–33.

Haeckel, E., 1888.—"Siphonophoræ of the 'Challenger.'" Rep. Sci. Results H.M.S. 'Challenger,' Zoology, vol. xxviii. 380 pp., 50 pls.

Huxley, T. H., 1858.—The Oceanic Hydrozoa &c. Ray Soc. London, 141 pp., 12 pls.

Hyndman, G. C., 1841.—"Note on the Occurrence of the Genus *Diphya* on the Coast of Ireland." Ann. Mag. Nat. Hist. ser. 1, vol. vii. pp. 164–166, 4 figs.

Keferstein, W., und Ehlers, E., 1861.—Zoologische Beiträge gesammelt im Winter 1859–1860 in Neapel und Messina.—I. Beobachtungen über die Siphonophoren . . . Leipzig, pp. 1–34, Taf. 1–5.

Kölliker, A., 1853 *a*.—Die Schwimmpolypen oder Siphonophoren von Messina. Leipzig, 96 pp., 12 Taf.

——, 1853 *b*.—"Bericht über einige im Herbste 1852 in Messina angestellte vergleichend anatomische Untersuchungen von Gegenbaur A. Kölliker und A. Müller.—A. Kölliker. Ueber Siphonophoren." Zeit. wiss. Zool. Bd. iv. pp. 306–315.

Lens, A. D., and Van Riemsdijk, Th., 1908.—"The Siphonophora of the 'Siboga' Expedition." Siboga-Expeditie, Uitkom. op Zool. . . . . Gebied, Livr. 38, 130 pp., 24 pls.

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

Leuckart, R., 1853.—Die Siphonophoren. Giessen, 95 pp., 3 pls.

——, 1854.—"Zur nähern Kenntniss der Siphonophoren von Nizza." Arch. f. Naturgesch. Jahrg. 20, Bd. 1, pp. 249–377, Taf. 11–13.

McCrady, J., 1857.—"Gymnophthalmata of Charleston Harbor." Proc. Elliott Soc. vol. i. pp. 103–221, pls. viii.–xii.

Mayer, A. G., 1900.—"Some Medusæ from the Tortugas, Florida." Bull. Mus. Comp. Zoöl., Harvard Coll. vol. xxxvii. no. 2, pp. 13–82, 44 pls.

Metschnikoff, E., 1870.—"Studies on Siphonophores and Medusæ." [Russian.] Bull. Friends Nat. Hist. Moscow, pp. 225–370, 6 pls.

——, 1874.—"Studien über die Entwickelung der Medusen und Siphonophoren." Zeit. wiss. Zool. Bd. xxiv. pp. 15–83, Taf. 2–12.

Otto, A. W., 1823.—"Beschreibung einiger neuer Mollusken und Zoophyten." Nova Acta Acad. Cæs. Leop.-Carol. Bd. xi. pt. 2, pp. 273–314, Taf. 38–42.

Quoy, J. R. C., et Gaimard, P., 1827.—"Observations faites à bord de l'Astrolabe dans le détroit de Gibraltar." Ann. Sci. Nat. t. x. pp. 1–21, 172–193, pls. 1, 2, 4–6. Also 'Oken's Isis,' Bd. xxi.

Quoy, J. R. C., et Gaimard, P., 1834.—'Voyage de découvertes de l'Astrolabe &c. . . . . de M. J. Dumont D'Urville.' Zoologie. Paris, tom. iv. 390 pp., Atlas Zool., tom. ii. Zoophytes, 26 pls.

Romer, F., 1902.—'Die Siphonophoren.' Fauna Arctica, Bd. ii. part 4, pp. 169–184.

Sars, M., 1846.—Fauna littoralis Norwegiæ. Christiania, Heft i. 94 pp., 10 pls.

Schneider, K. C., 1898.—"Mittheilungen über Siphonophoren.—3." Zool. Anz. Bd. xxi. pp. 51–57, 73–95, 114–133, 153–173, 185–200.

Vanhöffen, E., 1906.—"Siphonophoren." Nordisches Plankton, Lief. v. Teil 11, pp. 10–39.

Vogt, C., 1851 *a*.—"Ueber die Siphonophoren." Zeit. wiss. Zool. Bd. iii. pp. 522–525, Taf. 14.

——, 1851 *b*.—Zoologische Briefe, &c. Frankfurt. Vol. i.

——, 1854.—"Recherches sur les Animaux inférieures de la Méditerranée.—1. Sur les Siphonophores de la Mer de Nice." Mém. Inst. Nat. Genèv. vol. i. pp. 1–164, 21 pls.

Will, 1844.—Horæ Tergestinæ . . . . Leipzig. iv & 86 pp., 2 pls.

EXPLANATION OF PLATE 28.

Reference letters.

Br. Bract.
C^1, C^2, C^3, C^4. Bracteal canals.
C.D.R., *C.D.L.* Right and left dorsal somatic canals.
C.A. Ascending somatic canal.
C.H.R., *C.H.L.* Right and left hydrœcial canals.
C.Ra. Radial canal of the nectosac.
H. Hydrœcium.
N.S. Nectosac.
R^1, R^2, R^3. Bracteal ridges.
R.D., *R.V.*, *R.L.* Dorsal, ventral, and lateral ridges.
SO. Somatocyst.

Figs. 1–4. *Nectopyramis thetis*, sp. nov.

Fig. 1. Somewhat oblique lateral view. The heavy dotted line indicates the position of the basal portion of the stem. From a slightly retouched photograph. × 6.

Fig. 2. Dorsal view. From a slightly retouched photograph. × 6.

Fig. 3. Bract, dorsal aspect. From a camera lucida drawing. × 35.

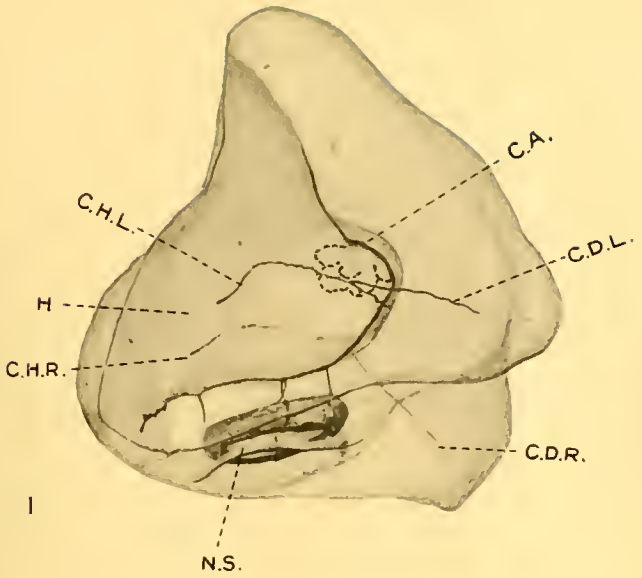
Fig. 4. Bract and gonophores. Slightly oblique lateral view. From a retouched photograph. × about 35.

Fig. 5. *Diphyes fowleri*, sp. nov. Lateral view. Based on a camera lucida drawing. × about 10.

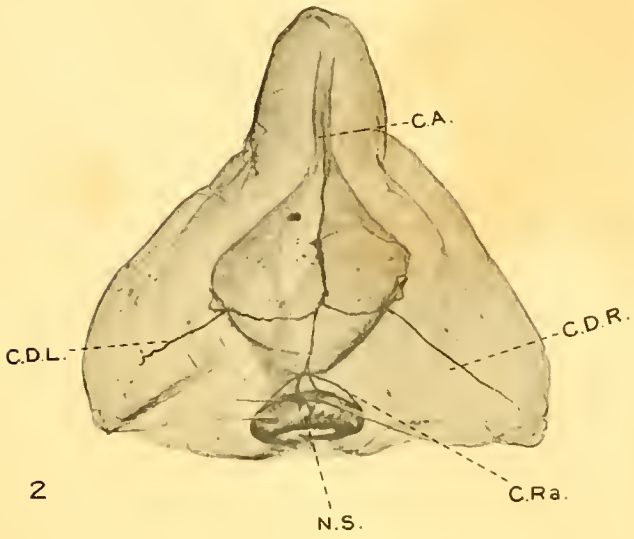
Depth in fathoms.	Haul.	*Muggiæa kochii.*	*Rosacea plicata.*	*Diphyes subtilis.*	*Diphyes appendiculata.*	*Diphyes fowleri.*	*Chuniphyes multidentata.*	*Hippopodius hippopus.*
500—250	29 *a*	..	..	..	+			
1500—750	30 *a*	..	..	..	..	..	+	
2000—1000	30 *e*	..	..	..	..	..	+	
0	21 *e*	..	..	..	+	+		
	21 *i*	..	..	..	+			
	22 *d*	..	..	..	+			
	22 *g*							
	23 *b*	..	..	..	+			
	23 *d*	..	..	..	+			
	23 *e*	..	..	..	+			
	24 *f*							
	24 *g*	..	..	..	+			
	24 *i*	..	..	..	+			
	25 *b*	..	..	..	+			
	25 *h*	..	..	..	+			
	25 *i*	..	..	..	+			
	25 *l*	..	..	..	+			
	30 *c*							
	33 *b*	..	..	..	+			
25—0	26 *a*							
	30 *b*							
	30 *m*							
	31 *a*	..	..	+				
	32 *b*	..	..	..	+			
	32 *e*	..	..	..	+			
	33 *e*	..	..	..	+			
	33 *g*	..	..	..	+			
	34 *a*	..	..	..	+			
	34 *g*							
	35 *w*							
	36 *c*							
50—0	21 *g*	..	..	..	+			
	25 *e*							
	25 *g*	+	..	..	+			
	25 *k*							
	26 *c*	..	..	..	+	+		
	30 *d*	..	..	..	+			
	30 *l*							
	31 *b*	..	..	..	+			
	32 *a*	..	..	..	+			
	32 *h*	..	..	..	+			
	33 *c*							
	33 *f*	..	..	..	+			
	36 *d*	..	..	..	..	+		
75—0	30 *f*	..	..	..	+			
	32 *g*	..	..	+				
	32 *m*	..	..	..	+			
	32 o	..	..	..	+			
	33 *h*	..	..	..	..	+		
	34 *c*	..	..	..	..	..	..	+
	35 *a*	..	..	..	+			
	35 *c*	..	..	..	+			
	35 *e*	..	..	..	+			
	35 *y*							
	36 *a*							
100—0	21 *h*	..	..	..	..	+		
	21 *l*							
	22 *a*							
	24 *b*	..	..	..	..	+		
	24 *d*	..	..	+		*		

Depth in fathoms.	Haul.	*Muggiæa kochii.*	*Rosacea plicata.*	*Diphyes subtilis.*	*Diphyes appendiculata.*	*Diphyes fowleri.*	*Chuniphyes multidentata.*	*Hippopodius hippopus.*
100—0	24 *e*	..	..	..	+	+		
	25 *d*							
	30 *g*	+	..	..	+	+		
	30 *h*	..	..	..	+	+		
	32 *d*	..	..	+	..	+		
	32 *i*	..	..	..	+			
	32 *n*	..	..	..	+			
	32 *p*	..	..	+				
	33 *d*							
	34 *b*							
	34 *d*	..	..	..	+			
	35 *b*	+	..	+	+	+		
	35 *d*	..	..	..	+			
	35 *f*	..	..	..	+	..	..	+
	35 *x*	..	..	..	..	+		
	36 *b*	+	..	+	..	+		
	36 *e*	+	..	..	..	+		
150—0	36 *f*	+						
150—50	21 *p*	..	..	..	..	..	..	+
150—100	21 *n*							
200—0	21 *a*							
	36 *g*	+	..	..	..	..	..	+
200—100	21 *b*	..	..	..	+			
	21 o							
	26 *e*	..	..	..	+			
	34 *h*							
	35 *m*	..	..	..	+			
	35 *n*	..	..	..	+			
	35 *t*							
250—0	36 *h*	+	+	..	..	+	+	
	36 *i*	..	+					
250—150	35 o							
	35 *p*	..	..	..	..	..	..	+
	35 *s*							
300—0	36 *k*	..	+	..	..	+	+	+
300—200	21 *c*	..	+	..	+			
	26 *f*	..	+					
	35 *l*							
350—0	36 *l*	..	+					
400—300	21 *k*							
	32 *l*							
	35 *k*							
500—400	21 *m*							
	35 *h*							
	35 *i*	..	..	..	+			
750—500	22 *b*							
	30 *k*							
	34 *e*							
	34 *f*							
1000—750	23 *a*							
	27 *c*							
	31 *d*							
	32 *f*							
	32 *k*							
1250—1000	24 *a*							
	27 *b*	..	..	..	..	..	+	
	31 *c*							
1500—1250	25 *f*							
	30 *i*							
2000—1500	25 *c*							
	26 *b*							

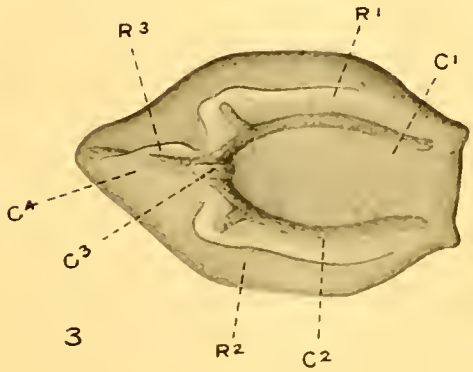
* *Note.*—The first three hauls were made with the mesoplankton trawl.



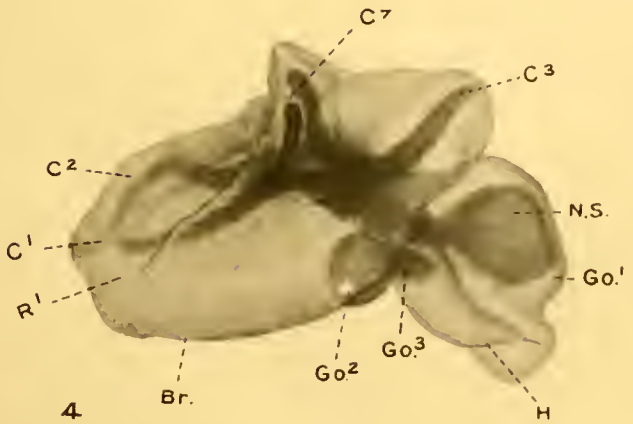
1



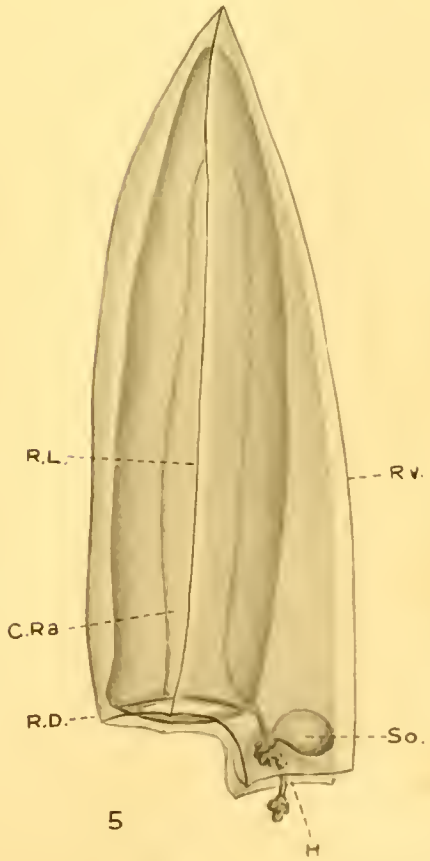
2



3



4



5

Bigelow, del. et Photo

BISCAYAN SIPHONOPHORA.