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Siphonophorae.

By

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With 83 figures in the text.

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INTRODUCTION.

The siphonophores described in the following pages were collected on the cruises of the "Thor", 1908—1909, and 1910, in the Atlantic between the English Channel and the Straits of Gibraltar, and during the intensive campaigns of towing throughout the Mediterranean. The locations of the stations are shown in Figure 1.

The collection does not contain any novelties, nor was it likely that any would be encountered, for the siphonophore-fauna has been more intensively examined in these regions than in any other part of the sea. And the condition of such of the long-stemmed physophores as were collected bears out the experience of previous expeditions, that special precautions must be taken, if these extremely fragile animals are to be brought back in good enough condition for positive identification. But the collection adds to previous knowledge of the morphology of several of the Calycophorae, and it is especially instructive from the distributional standpoint (p. 68), for it affords the first general survey of the abundance, and of the regularity of occurrence, of the common species of siphonophores over the Mediterranean basins as a whole, most of the earlier investigations having been carried out either close to the shore, as at Naples and Villefranche, or in tributary waters, e. g., Aegean Sea and Adriatic Sea. In fact, it affords the first basis for detailed regional and seasonal study for the siphonophores, of any sea-area of comparable extent. And this also applies to vertical distribution (p. 69). It is likewise the largest collection of siphonophores that had been made up to that time, numbering upwards of 95,000 colonies or loose nectophores.

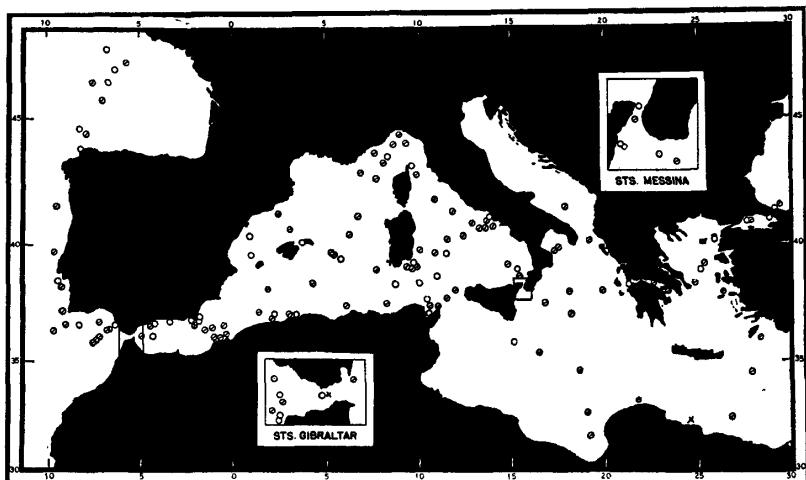


Fig. 1. Positions of "Thor" towing stations, 1908—1909, and 1910. O = stations where tows were made with 65 meters of wire out or less; ◎ = stations where tows were also made with 300 meters of wire out or more; X = stations where tows were made with 300 meters of wire out, or more, but not shallower.

PART I. SYSTEMATIC. TERMINOLOGY.

Much confusion has been introduced into siphonophore literature, by the use, by different authors, of different terminologies in their descriptions. These disagreements have come in part from the custom of using the terms "ventral", "dorsal", "anterior" and "posterior", borrowed from the terminology of bilater-

ally symmetrical animals, to describe the structures of animals that are not bilateral. And confusion has been added, by the adjustment of terminology by different students, to express their views as to homologies, mode of development, etc., within the group.

This last viewpoint has most recently been upheld by MOSER (1925, p. 21). Since, however, the primary purpose of descriptive terminology is to add precision to written accounts, and especially to make comparable the accounts by different authors, it seems to us preferable to use it in a strictly descriptive way, without any implication whatever as to our opinions regarding phylogeny or the mechanics of development.

TOTTON (1932, p. 318) has recently argued that "since all the nectophores of polygastric stages of Calycophorae appear to be homologous structures, it is as well to use the same terms throughout for comparable parts". He therefore followed the old custom of using the term "dorsal" for the abaxial, "ventral" for the axial side of all nectophores, whether superior or inferior¹. And this procedure is adopted here, as in earlier papers (BIGELOW 1911b, 1913, 1918, 1931).

The question which side of a calycophorid nectophore is to be named "right", which side "left", depends on whether the oral (basal) end of the bell is to be regarded as anterior from the standpoint of orientation, as by TOTTON (1932), or whether the aboral (apical) end is to be so named, as by many authors (CHUN, 1885—1913; BIGELOW, 1911b, 1918; and MOSER, 1925 among others). The latter course is followed here.

This same terminology is employed for bracts or free eudoxids, in this case the apical or anterior end (determining which face is "left", which "right") being that which was uppermost — (i. e. nearest to the nectophores of the colony) while the bract was still attached to the stem (MOSER, 1925, Fig. 5).

CALYCOPHORAE Leuckart 1854.

Different interpretations of the phylogenetic relationships of such of the calycophorids as develop only a single definitive nectophore, in relation to those which develop two or more nectophores (i. e., whether the former are primitive or derivative), lead to essentially different subdivisions of the group.

An earlier discussion (BIGELOW 1911b) led to the conclusion that they are primitive, *Sphaeronectes* being ancestral to the Hippopodiidae, and that available evidence on the whole favors a similar relationship for *Muggiaeae* to the typical Diphyidae, for *Nectopyramis* to the Prayidae, for *Enneagonum* (*Cuboides* auct.) to the Abylididae: BIGELOW (1911b) therefore, followed CHUN (1897) in referring all monophyid calycophores to a single family, Sphaeronectidae. MOSER (1925), who next revised the Calycophorae, also regarded *Sphaeronectes* and *Muggiaeae* as primitive forms because of their monophyid character. But she considered *Enneagonum* as derived by loss of the second nectophore from the Abylididae, though with some reservation. Most recently, TOTTON (1932, p. 328) has argued that there are no sufficient grounds for assuming "that monophyism was ancestral," (i. e. that *Muggiaeae*- and *Enneagonum*-like forms gave rise to diphyids and abyliids respectively).

So far as *Sphaeronectes* is concerned, no evidence has come to hand to controvert the seemingly ancestral character. Quite apart from its possession of only a single nectophore, and whether or not its single definitive nectophore be actually homologous with the larval bell of the Hippopodiidae, as one of us has earlier argued², nevertheless it shows little sign of progressive specialization. This reasoning, however, does not apply to *Enneagonum*, for while the latter seems certainly allied to the Abylinae, its single definitive bell is not only homologous with the latter in all essentials, as TOTTON has shown, but is more complex in architecture than is the corresponding bell of any member of that group. Whether or not its monophyism be more

¹ MOSER (1925), who regards the inferior nectophore of a diphyid or of a prayid as homologous with a sterile gonophore, names its abaxial side "ventral", its axial, "dorsal", i. e., she reverses the terminology she uses for the superior nectophores.

² MOSER (1925, p. 75) concludes that it is not, on the ground that it is situated on the dorsal side of the stem.

primitive than the diphyism of the Abylinae (i. e., whether or not it is an abylid with the second bell aborted), it is clearly more closely allied to the Abylinae than it is to the primitive *Sphaeronectes*.

The arguments adduced by TOTTON (1932) similarly favor removing *Muggiaeae* from family-unity with *Sphaeronectes*. Not only do they strengthen the view, long held, that this genus is closely allied to the Diphyinae, but he has also shown that the several species of *Muggiaeae*, are more closely allied to various other Diphyinae, than they are to one another.

TOTTON (1932, p. 328) therefore discards "as a single natural group an association of all the monophyid species", and definitely unites *Enneagonum* with the Abylinae, *Muggiaeae* with the Diphyinae, and *Nectopyramis* with the Prayidae. In the light of present knowledge, this scheme is a decided advance over the older schemes followed by CHUN (1897), by MOSER (1925) and by BIGELOW (1911b), hence is adopted here, as it already has been by LELoup (1933, 1934, 1935).

PRAYIDAE Kölliker 1853.

NECTOPYRAMIDINAE Bigelow 1911.

NECTOPYRAMIS Bigelow 1911.

NECTOPYRAMIS THETIS Bigelow 1911.

Figs. 2—5.

Nectopyramis thetis, Bigelow, 1911a, p. 338, Pl. 28, Fig. 1—4; 1911b, p. 346; Moser, 1925, p. 115; Leloup, 1932^a, p. 1, Fig. 1—5; 1933, p. 10, Pl. 1, Fig. 11—15.

Material.

St. 76. 47°01' N., 5°48' W. 10. III. 1909.
Y. 1600 m w. 1 eudox.

St. 91. 35°53' N., 7°26' W. 18. VI. 1910.
Y. 1600 m w. 1 nectoph.

Colony. The one nectophore (Fig. 2), though much crumpled and twisted, is in good enough condition to show that it agrees in all essential respects with the two examples of the polygastric generation which have been taken previously. Its general form is similarly pyramidal. And while its apical and its two dorso-lateral angles are somewhat more pronounced and acute than in the type specimen, this difference probably represents nothing more than a difference in the degree of contraction which the respective specimens underwent in preservation. Especially close is the agreement in the canalization, each of the specimens so far seen having shown the arrangement shown in dorsal view in Fig. 2, in which the somatocyst system consists of one ascending branch, extending to the apical angle of the bell, and one descending, which gives off a lateral branch to each side, shortly below its point of origin. For lateral views, and also an earlier dorsal view see BIGELOW, 1911a, Pl. 28, Figs. 1—2, LELoup, 1933, Fig. 11. Each of these lateral trunks then divides dichotomously, one of the resultant branches curving around the hydrocial wall, nearly to the ventral margin of the latter, the other running out through the gelatinous substance to the lateral corner of the bell. Beyond its point of subdivision, the main descending trunk continues basally, along the dorsal face of the hydrocium, giving off, first, the dorsal subumbrial canal, then after a considerable interval, the two lateral subumbrales, then (again after some interval) the ventral

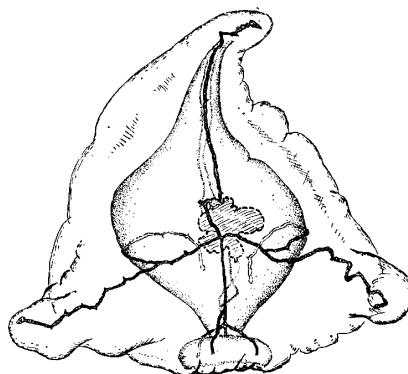


Fig. 2. *Nectopyramis thetis*; dorsal view of nectophore, 7 mm. high; "Thor" St. 91.

subumbrial. Beyond the latter point of subdivision it still continues for some distance. Sundry small variations exist among the three recorded specimens, in the degree of jaggedness of the margins of the canals, and in the small undulations or angles along the courses of the latter.

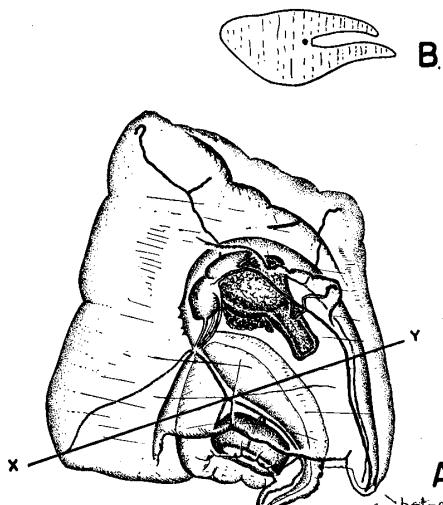


Fig. 3. *Nectopyramis thetis*; eudoxid, 9 mm high, "Thor" St. 76. A. Lateral view. B. Cross section of nectophore along the line XY in A.

Fig. 12). In the "Thor" specimen (Fig. 3), it is laterally much compressed, irregularly pentagonal, with five rounded angles corresponding to the terminations of the descending, ascending, and transverse canals, and to the postero-dorsal margin of the hydroecium¹. Furthermore, the bract is spirally twisted (Fig. 4) so that the hydroecial opening is diverted somewhat to the left (Fig. 3) and is distinctly asymmetrical (Fig. 4) with the angle corresponding to the left-hand transverse canal lying at a level considerably below (basal) that of the right-hand side.

Were such differences as these to be found in the case of definitive nectophores, the latter would unhesitatingly be referred to different species. But in bracts, such divergences might represent successive stages in growth, during the period after their detachment, or they might very well result from different degrees of compression by neighboring bracts while still attached to the stem, or from different contraction phases. Since all of the specimens, LELOUP's and the "Thor" alike, have been more or less distorted by preservation, the latter appears to be the correct explanation in the present case. This is the more likely since LELOUP's original specimen corresponds to the "Thor" example in that the gelatinous wall of the bract is much thinner on the posterior side than on the anterior, whereas in his most recent figure (1933, Pl. 1, Fig. 12), these two walls are more nearly equal in thickness.

The present specimen agrees so closely in all other essential characters with LELOUP's (1933, p. 12) detailed account, that brief further mention will suffice here. Its most characteristic feature, and one in which this eudoxid differs from all others so far described, is that the pedicular plate, from which the siphon, tentacle, gonophores and the somatic canal system arise, is expanded into a bilobed vesicle (Figs. 3, 4, 5), named by LELOUP (1933, p. 13), a "formation spéciale". Some distance basad, from the latter, but connected with it by 3 short canals, the special nectophore is attached to the wall of the hydroecium (Fig. 3). The characteristic and complex interrelationship of the somatic canals

Unfortunately, the present example adds nothing to our previously meagre knowledge of the appendages, for only the base of the stem, with fragments of young siphons, is present. The type specimen showed gonophores and young bracts, while LELOUP (1932, 1933) has described free eudoxids probably belonging to this species.

Eudoxid of *N. thetis*(?). LELOUP (1932a) was the first to describe an eudoxid, referable to *N. thetis* because its canal system resembled that of a bract of the latter figured by BIGELOW (1911a, Pl. 28, Fig. 3—4) from the "Research" collection, and because it had a special nectophore similar, in general conformation, to the stem groups of the latter. The Monaco collection contained 6 more specimens (LELOUP, 1933), which being in better condition, allowed him to amplify his original account. And the "Thor" series yields still another, which agrees with LELOUP's account in all its essential features, though differing slightly in the shape of the bract and of the special nectophore.

In LELOUP's specimens, the bract was definitely triangular with rounded margins (LELOUP, 1932a, Fig. 1—2; 1933, Pl. 1,

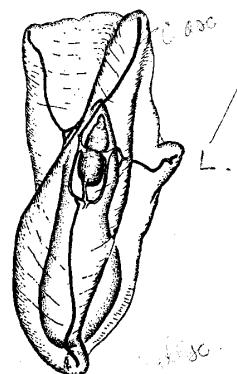


Fig. 4. *Nectopyramis thetis*; Antero-dorsal view of bract of specimen illustrated in Fig. 3.

¹ Orientation deduced from young bract earlier figured (Bigelow, 1911a).

is essentially as recorded by LELoup. From the point of attachment of the special nectophore, one branch runs directly to the antero-dorsal angle of the bract, while three branches (a median and 2 laterals) run toward its apex. The median member of this group shortly dilates to form the capacious vesicle, just mentioned, which in LELoup's specimen was triangular, but which is rounded and equatorially constricted in the "Thor" example. Unfortunately, its apical segment is damaged and therefore its outlines as shown in Figures 3—5 are necessarily somewhat idealized. The two lateral members of the ascending trio of canals apparently coalesce with this dilation as shown in Fig. 4¹. In LELoup's specimens, these points of coalescence form the lateral angles of the triangular structure, but in the "Thor" specimen the points of union lie just below the level of the circumferential constriction.

From the points of union, on either side, a canal runs out, along the hydroecial wall, to the postero-dorsal angle of the bract. The left hand member of this pair gives off one transverse branch running to the gelatinous prominence on that side of the bract. The other member of the pair gives off two such branches, one of which follows a corresponding course, while the other (again branching en route) extends out to the apical corner (Fig. 3—5).

Special nectophore. The canal system, well described by LELoup, agrees closely to that of the corresponding nectophore in *Archisoma*, in that the main trunk extends from the point of pedicular attachment obliquely along the hydroecial face of the nectophore to its ventro-basal angle. En route, it gives off 4 separate trunks, running, respectively, to the dorsal, ventral, and lateral faces of the nectosac (Fig. 5).

The general form of the nectophore, like the one shown by LELoup (1933, Pl. 1, Fig. 12), is rounded-triangular, much compressed laterally, with its ventro-basal angle somewhat extended. The deep hydroecial groove along the ventral face is enclosed by two broad, but separate wings of which the right hand is considerably the wider (Fig. 3).

LELOUP's example bore both ♂ and ♀ gonophores, but the only trace of future sex-bells in the present specimen is one small bud (Fig. 5). The much contracted siphon presents nothing remarkable, and such tentilla as are still intact are very young.

AMPHICARYONINAE Chun 1888.

AMPHICARYON Chun 1888.

AMPHICARYON ACAULE Chun 1888.

Amphicaryon acaule, Chun, 1888, p. 1162; Bigelow, 1911b, p. 195, Pl. 4, Figs. 1—8; 1918, p. 403; 1919, p. 332; 1931, p. 530; Moser, 1925, p. 399; Browne, 1926, p. 60; Totton, 1932, p. 330; Leloup, 1933, p. 9.

Material.

St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 300 m w. 1 col.
St. 91. 35°55' N., 7°26' W. 18. VI. 1910.
Y. 1600 m w. 1 col.

St. 96. 35°48' N., 5°58' W. 23. VI. 1910.
Y. 65 m w. 9 sup. nectoph., 6 inf. nectoph.
St. 282. 38°12' N., 15°37' E. 8. III. 1911.
S. 40 m w. 1 col.

These rather fragmentary specimens throw no light on the interesting question, whether the small degenerate nectophore of *Amphicaryon* is the older (superior) member of the pair (BIGELOW, 1911b, p. 196), or whether it is the younger (inferior), as MOSER (1925) argues²; nor do they add to the knowledge of the cormidia.

¹ LELoup so describes them, and so far as can be seen from surface views, this is the case in the present example.

² This latter view is tentatively accepted by TOTTEN (1932, p. 330).

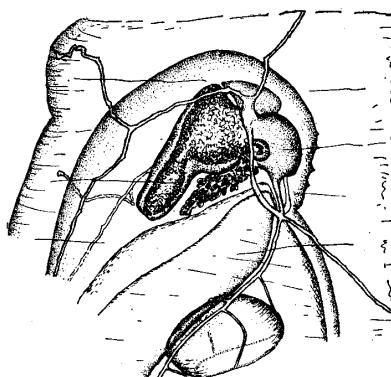


Fig. 5. *Nectopyramis thetis*; more enlarged view of siphon and canal system of specimen illustrated in Fig. 3, from the opposite side.

The series (all more or less damaged) add cumulative evidence, that the stem is here reduced to a plate-like structure, which is not extensible, and to which the individual groups of cormidia are attached close together. More detailed knowledge in this respect must await the study of living specimens. One of the specimens does, however, show several, of the tentilla which have not been described previously. These closely resemble HAECKEL's (1888b, Pl. 28, Fig. 8) illustration of the tentilla of *Mitrophyes peltifera*.

PRAYINAE Haeckel 1888.

If we omit such of the older names as were based on descriptions, and illustrations, so inadequate that it is not possible to refer them to actual animals, all the representatives of this group so far described probably fall in seven species, at most, which may be grouped as follows:—

A. Four species, in which the subumbrial canals as well as the somatocyst are simple. To this group belong the great majority of the accounts of Prayinae that have yet appeared. Owing to the extreme fragility of the bells in question, and to the fact that the species closely resemble one another in general appearance, many of the published accounts (particularly the earlier ones) are, however, so inadequate that it is impossible to be certain to which species they actually belonged. And as no recent student has had the opportunity critically to compare all four of the supposed species, it is not surprising that there has been great confusion in the nomenclature; and that the specific delimitations still await a satisfactory analysis, though MOSER (1925, p. 371), LELOUP (1934, p. 9) and BIGELOW (1911b, 1931) have already attempted somewhat to unravel the tangle. Obviously it would be most desirable to connect all of the older accounts (prior to 1850) with actual species, for as long as any one of them remains as a *nomen nudum*, it may be resurrected at any time, with consequences the more disturbing, the longer the event be postponed.

B. Two species in which both somatic and subumbrial canals are branched. The first described, *Diphyes dubia* Quoy & Gaimard (1834), is the type of BLAINVILLE's (1834) genus *Praya*, as pointed out elsewhere (BIGELOW, 1931, p. 529¹). A second species of this group was described by BIGELOW (1911b, p. 206, Pl. 1, Fig. 7, 8; Pl. 3, Fig. 1—7) as *Nectodroma reticulata*, but must be referred to *Praya*.

C. One species has been described with branched subumbrial, but simple somatocyst canals, *Rosacea intermedia*, Leloup (1934, p. 11, Fig. 4).

Group A. As far as we have been able to learn, the first report of any prayid was the illustration, by DELLE CHIAJE (1822, Pl. 76, Fig. 1; republished in 1842, Pl. 33, Fig. 1) of his *Physalia cymbiformis*, which was next reported by QUOY & GAIMARD, (1834, p. 106, Pl. 5, Fig. 37, 38) as *Diphyes prayensis*. This species has subsequently been re-described and re-figured by many authors (see synonymy, p. 10, *Rosacea cymbiformis*). It is, in fact, the best known member of its family, hence it is a happy circumstance that QUOY & GAIMARD's illustrations of it were so diagnostic, that no serious doubt can be raised as to their identity, for they show the long hydroecium, long somatocyst and long nectophore with short nectosac.

Unfortunately this does not apply to the prayids next described, the *Rosacea ceutensis* and *R. plicata* of QUOY & GAIMARD (1827, p. 176, Pl. 4B, Fig. 2, 3 and p. 177, Pl. 4B, Fig. 4). The first of these has, by common consent, been relegated to the "doubtful" category, because no prayid bell has since been seen corresponding to it. And MOSER (1925, p. 373) disposes similarly of *plicata*. True, the figures of the latter are sketchy. They fail, for instance, to give any indication of the outlines of the hydrocial furrow, which has since proved to be specifically diagnostic in this subfamily. However, they do agree in two minor characters with the form later described by KÖLLIKER (1853) and by VOGT (1854) as *Praya diphyses*, and which subsequent investigations have proven a well-defined species (p. 11), namely, in the form of the nectophore, and of the apical termination of the somatocyst. TOTTEN (1932, p. 329), LELOUP (1933, p. 8; 1934, p. 11), and BIGELOW (1911b, p. 201; 1913, p. 64) have followed SCHNEIDER (1898, p. 79) in referring *diphyses* to the

Praya diphyses of Schneider
"Praya diphyses" of Schneider
identical with Bigelow's "R.
plicata"

a wrong genus *P. diphyses* not congruic
N. Moser

synonymy of *plicata*. This course not only has the advantage of definitely establishing one of the oldest siphonophore names, but also of establishing the status of the old genus *Rosacea*, of which *plicata* has repeatedly been selected (by implication) as the type. *Plicata*, like *cymbiformis*, has now been examined so often that the most diagnostic specific features of its nectophores seem sufficiently established (p. 11). MOSER (1923, p. 40; 1925, p. 506), it is true, believes that superior bells of the type here named *plicata* are merely persistent larval bells of *cymbiformis*. But the fact that in the latter, as pictured by her (1923, Pl. 1, Fig. 1, 3), the somatocyst lacks a descending branch and the subumbrial canals are direct, forbids this possibility. The third species of this group, now generally recognized, is the *Praya medusa* of METSCHNIKOFF (1870, p. 925, Pl. 1). This species had already been described, ten years earlier as *P. diphyses* by GRAEFFE (1860, p. 11, Pl. 1, Fig. 1—3), he not realizing that it was specifically distinct from KÖLLIKER's species of that name (= *plicata*, see above). *Medusa* has subsequently been re-figured twice (BEDOT, 1896, p. 369, Pl. 12, Fig. 1, *Lilyopsis rosacea*; FEWKES, 1880, Pl. 3, Fig. 2, *Praya* sp.?). MOSER (1925, p. 506) also gives a recent description (as *Lilyopsis diphyses*). And the "Albatross" Eastern Pacific collection contained one fragmentary colony (BIGELOW, 1911b, p. 203). But it has so seldom been seen that its specific limits still remain somewhat doubtful. MOSER, finally (1925, p. 379, Pl. 27, Fig. 1—5), has described a fourth member of this group as *Praya tuberculata*.

Group B. The first member of this group, to appear in literature, was the *Diphyes dubia* of QUOY & GAIMARD (1834, p. 104, Pl. 5, Fig. 34—36). This was not seen again until MOSER (1925, p. 381) and BIGELOW (1911b, p. 204, Pl. 3, Fig. 8, 9) found it, in collections from the Eastern Pacific. The "Arcturus" also obtained it in 1925 between the Galapagos Islands and the American coast (BIGELOW, 1931, p. 531). Having so long dropped out of sight, it is fortunate that the original pictures of *dubia* were so good that there can be no doubt of their identity. The "Albatross" collection also yielded a second, and new member of this group, in which the subumbrial canals form an anastomosing network (*Nectodroma reticulata*, BIGELOW, 1911b, p. 206, Pl. 1, Fig. 7, 8, Pl. 3, Fig. 1—7). *Reticulata* has subsequently been reported from the Eastern Sea between Japan and China, and from California (BIGELOW, 1913, p. 65; 1931, p. 532; BIGELOW and LESLIE, 1930, p. 551).

Group C. The only known member of Group C is *Rosacea (Prayoides) intermedia*, recently described by LELoup (1934, p. 11, Fig. 4).

Much confusion has existed, as to how many genera the members of these groups represent, and as to what names should be used for the genera, the tendency having been toward a reduction of these. In revising the group in 1911, BIGELOW recognized three; *Praya* with simple subumbrial canals and somatocyst, and lacking special nectophores in the stem-groups, *Rosacea* separated from it only by the possession of special nectophores, and a new genus (*Nectodroma*) for species with branching canals and somatocyst. MOSER (1925), the next reviser, united the first two, not considering the presence or absence of special nectophores a differential character of more than specific significance. This union is followed in the present paper. She also pointed out, that to accord with the rules of nomenclature, it would be necessary to transfer the name *Praya* to the species with branched canals, and to find some other name for those with simple canals, though to avoid confusion, she did not do so. And shortly after, this change was made by BIGELOW (1931, p. 530). Most recently of all, LELoup's (1934, p. 11) discovery of a new species (*intermedia*) bridging the gap between prayids with branched, and those with simple canals and somatocyst, in that it has branched subumbrial canals combined with a simple somatocyst, has prompted him to unite all known Prayinae in one genus, *Rosacea*¹.

Pending further information concerning *intermedia*, it seems to us wiser to retain the generic name *Praya* for species with branched subumbrial canals, to emphasize the fact that two categories of species exist.

¹ *Rosacea* dates from 1827; *Praya* from 1834: see above.

The Danish Oceanographical Expedition. II. H. 2.

ROSACEA Quoy and Gaimard 1827.

ROSACEA CYMBIFORMIS, Delle Chiaje 1822.

Figs. 6—8.

Physalia cymbiformis, Delle Chiaje, 1822, Pl. 76, Fig. 1.*Rosacea cymbiformis* Schneider, 1898, p. 79.For further synonymy, see *Praya cymbiformis*, Bigelow, 1911 b, p. 200; Moser, 1925, p. 374; *Rosacea cymbiformis*, Leloup, 1933, p. 8.

Material.

St. 69. 36°13' N., 9°44' W. 28. II. 1909.
 Y. 300 m w. 2 nectoph.

St. 71. 39°35' N., 9°45' W. 4. III. 1909.
 Y. 600 m w. 2 nectoph.

St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
 Y. 300 m w. 4 nectoph.

St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
 Y. 65 m w. 4 nectoph.

St. 112. 36°56' N., 2°15' E. 27. VI. 1910.
 Y. 300 m w. 10 nectoph.

St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
 Y. 300 m w. 1 nectoph.

St. 183. 37°52' N., 23°09' E. 16. VIII. 1910.
 Y. 300 m w. 30 nectoph. (fragm.).

St. 217. 38°01' N., 1°48' E. 1. IX. 1910.
 Y. 300 m w. 1 nectoph.

St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
 Y. 300 m w. 1 nectoph.

St. 232. 36°28' N., 9°06' W. 9. IX. 1910.
 Y. 1000 m w. 2 nectoph.

St. 233. 36°49' N., 9°15' W. 10. IX. 1910.
 Y. 25 m w. 38 nectoph.

The nectophores of *R. cymbiformis* are so fragile that when found among gatherings of plankton they are usually in a very fragmentary condition, and the "Thor" series is no exception to this rule. Fortunately, however, the most distinctive morphological character of the species is usually recognizable in fragmentary

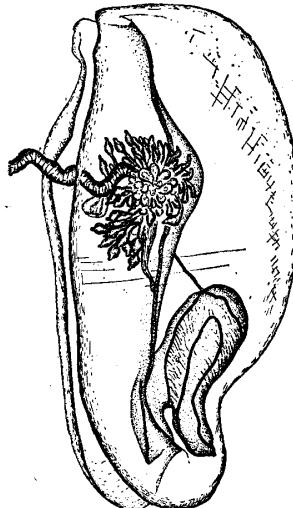


Fig. 6. *Rosacea cymbiformis*; lateral view of nectophore of 30 mm. from "Atlantis" St. 1735.

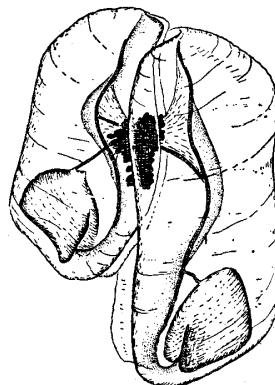


Fig. 7. *Rosacea cymbiformis*; pair of nectophores, 31 mm. and 23 mm., still connected, from Naples Zoological Station (Mus. Comp. Zool. Cat. No. 898).

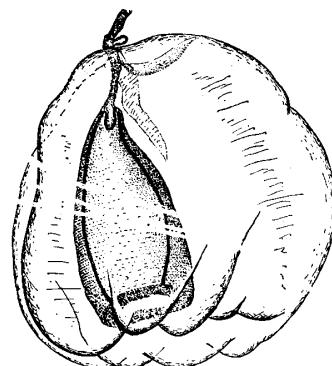


Fig. 8. *Rosacea cymbiformis*; gonophore, about 1.9 mm. high from a specimen from "Atlantis" St. 1735, X 27.

nectophores, namely, that the hydroecial groove extends past the nectosac, right to the base of the bell, as does the descending branch of the somatocyst also. Bells of *R. cymbiformis* (Figs. 6—8) strongly contrast in this respect, with those of *R. plicata* (p. 11) and it is on this basis that the bells listed above have been identified. In all of them, the whole stem has been lost, so that they add nothing morphologically, to previous accounts.

ROSACEA PLICATA Quoy and Gaimard 1827. *Praya plicata* Quoy et Gaimard 1827. *Rosacea plicata* Quoy and Gaimard 1827. *Rosacea plicata* Quoy and Gaimard 1827. *Rosacea plicata* Quoy and Gaimard 1827.

Figs. 9—14.

Rosacea plicata, Quoy and Gaimard, 1827, p. 177, Pl. 4B, Fig. 4. For synonymy, see *Rosacea plicata*, Bigelow, 1911b, p. 201; Leloup, 1933, p. 8; and *Praya diphyes*, Moser, 1925, p. 377.

Material.

St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 600 m w. 9 loose nectoph.; 5—21 mm. high.

St. 234. 38°10' N., 9°20' W. 10. IX. 1910.
Y. 1000 m w. 4 nectoph.

Specific identification of these bells rests on the great depth and shortness of the hydroecial furrow, and on the shortness of the descending branch of the somatocyst, which terminates above the aboral level of the nectosac. In these features they agree closely with specimens already described from the Bay of

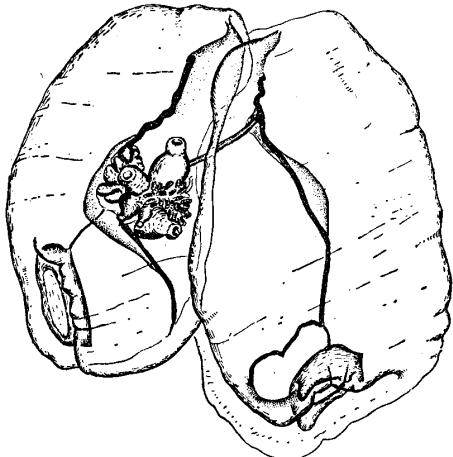


Fig. 9. *Rosacea plicata*; pair of nectophores, 16 mm. and 13 mm., still connected, from Bering Sea, "Albatross" St. 4767¹.

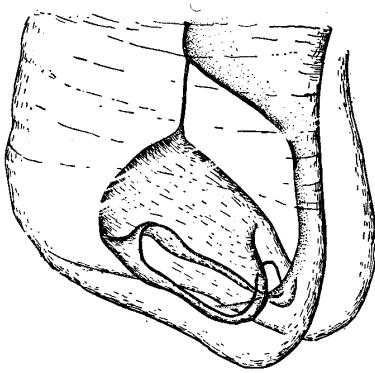


Fig. 10. *Rosacea plicata*; lateral view of basal portion of loose inferior nectophore, 20 mm. long, from Bering Sea, "Albatross" St. 4763.

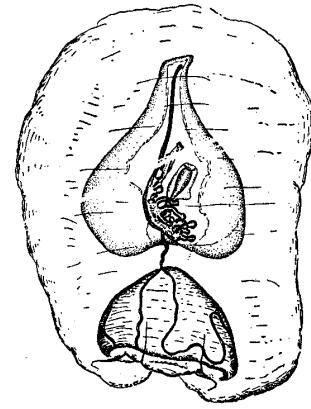


Fig. 11. *Rosacea plicata*; dorsal view of nectophore, 21 mm. long, from "Thor" St. 69.

Biscay (BIGELOW, 1911a, p. 341); from the Eastern Tropical and Northeastern Pacific (BIGELOW 1911b, p. 201; 1913, p. 64); and differ markedly from the nectophores of *R. cymbiformis* (p. 10, Fig. 6—8).

One of us has previously commented on the fact that the inferior (older) nectophore of the pair, in *plicata*, so closely resembles that of *cymbiformis*, that "the two might be easily confused in the absence of their respective superior nectophores" (BIGELOW 1911a, p. 343), or are actually indistinguishable (BIGELOW 1913, p. 65). It seems, however, that the location of the point of attachment of the pedicular canal is diagnostic for the inferior (older) nectophore, for in a specimen from Bering Sea¹ (Fig. 9) this is situated relatively much closer to the apex of the bell, (i. e. relatively farther away from the point of origin of the canal that runs to the nectosac) than it is in two excellent specimens of *cymbiformis* from Naples (Fig. 7), in another of that species from the Eastern Tropical Pacific (BIGELOW, 1911b, Pl. 2, Fig. 1) or than it is shown by HAECKEL (1888b, Pl. 31, Fig. 6). In the superior (younger) nectophores, however, the attachment of the pedicular canal is only slightly above the origin of the subumbra.

Conclusive evidence would be welcome, as to whether *R. plicata* actually does develop a permanently sterile swimming bell in each of the cormidia, as do certain of the diphyids, or whether the structures so

¹ This is one of the specimens reported earlier by BIGELOW (1913, p. 64). The relative positions of the 2 bells were found to be reversed (i. e. the apex end of the smaller bell lay opposed to the basal part of the larger). Before the illustration (Fig. 9) was drawn they were twisted back into what almost certainly seems to have been their natural relationship.

interpreted by KÖLLIKER¹ (1853a) and by VOGT (1854) were in reality gonophores that had lost the spadix, such as KEFERSTEIN & EHLERS (1861, Pl. 5, Fig. 10) observed and illustrated.

As elsewhere pointed out (BIGELOW, 1911a, p. 342, 1913, p. 65), one specimen in the "Research" collection bore what appeared to be a typical sterile nectophore, in addition to gonophores. And the contracted base of the stem in one "Thor" specimen (Fig. 11) bears a similar small empty bell, in addition to young siphons and buds. But that such structures are simply gonophores which have lost the spadix is made highly probable by the fact that a ♂ gonophore, in one of the "Research" series, from which the spadix was accidentally detached while we were drawing figures 12 and 14, thereafter had precisely the same appearance as the apparently sterile bell in the "Thor" specimen (Fig. 11). We might call attention, in particular to the fact that the spadix came out "clean", so that the bell after losing it shows no apparent sign that it had previously contained one.

Present indications, then, are that the so-called "special swimming bells" of *R. plicata* are actually the old gonophores, from which the spadix has become detached after the discharge of the sex products, and that these empty bells continue attached to the stem for some time thereafter, serving as swimming organs. But the question cannot be considered as settled until some student has opportunity to examine a specimen with a considerable length of stem intact, with several groups of appendages.

The sterile (or empty) bell in the "Thor" specimen (Fig. 11) is laterally flattened. But judging from its present appearance this is at least partly due to general flattening in preservation. The larger of the two gonophores in the "Research" specimen, shown in Fig. 14, is distinctly ovate, its gelatinous wall thickened along the side which, in side view, shows an apical expansion. And VOGT (1852, Pl. 14, Fig. 3; 1854, Pl. 17, Fig. 1) shows

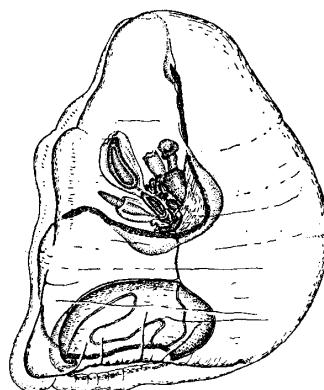


Fig. 12. *Rosacea plicata*; lateral view of nectophore, 18 mm. long, collected in the Bay of Biscay by H. M. S. "Research" (Mus. Comp. Zool. Cat. No. 804).

"Research" specimen, shown in Fig. 14, is distinctly ovate, its gelatinous wall thickened along the side which, in side view, shows an apical expansion. And VOGT (1852, Pl. 14, Fig. 3; 1854, Pl. 17, Fig. 1) shows

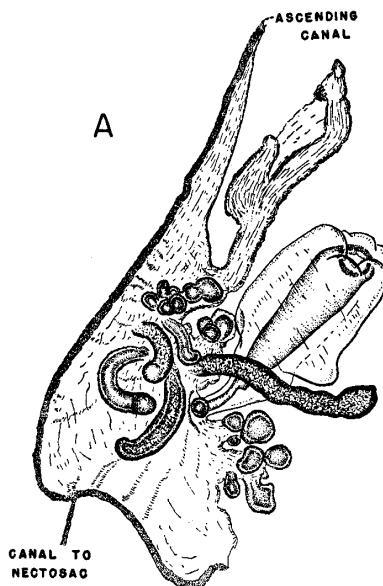


Fig. 13. *Rosacea plicata*; A. Appendages of specimen from "Thor" St. 69, same view as Fig. 11. $\times 25$. B. Apex of somatocyst from another specimen. $\times 25$.

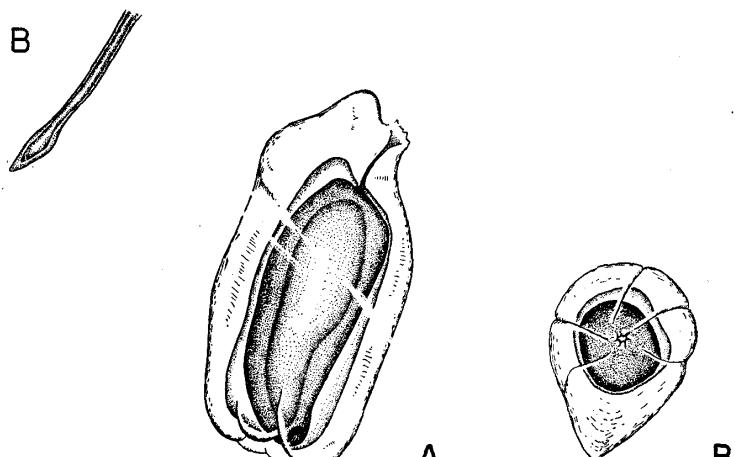


Fig. 14. *Rosacea plicata*; ♂ gonophore, 4 mm. high, with spadix detached, from specimen shown in Fig. 12. A. Lateral view; B. Oral view.

¹ BIGELOW's (1913, p. 64) statement that nothing of the sort was shown by KÖLLIKER was incorrect, for he described and figured a "kleine Schwimmglocke" (KÖLLIKER 1853a, p. 36, Pl. 9, Fig. 2).

a still more pronounced wing-like asymmetrical expansion. But KÖLLIKER (1853 a, Pl. 9, Fig. 2) does not show this asymmetry, and KEFERSTEIN & EHLERS (1861, p. 22) expressly remark that the sex bells have no angles, as is the case in *R. cymbiformis* (Fig. 8). Probably the correct interpretation for these different accounts is that the sex bells may either be circular in cross-section, or more or less flattened and more or less asymmetrical, depending on the degree to which they are crowded by neighboring siphons, or bells, during their period of most active growth.

Another feature in which previous accounts have varied is the conformation of the extremity of the somatocyst, whether or not it is dilated. The present series confirms our earlier (BIGELOW 1913) explanation that this is not of taxonomic significance, but represents either different contraction phases, or individual variation.

PRAYINAE genus?

Material.

St. 29. 40°47' N., 12°55' E. 20. I. 1909. Y. 1650 m w. 1 nectoph.	St. 74. 44°21' N., 7°55' W. 8. III. 1909. Y. 600 m w. 2 nectoph.
St. 46. 37°17' N., 6°00' E. 7. II. 1909. Y. 300 m w. 1 nectoph.	St. 99. 36°02' N., 5°16' W. 23. VI. 1910. Y. 300 m w. 1 nectoph.
St. 51. 36°27' N., 0°37' W. 18. II. 1909. Y. 300 m w. Fragments.	St. 107. 36°18' N., 1°14' W. 25. VI. 1910. Y. 2000 m w. Fragments.
St. 69. 36°13' N., 9°44' W. 28. II. 1909. Y. 300 m w. Nectoph. C. 3000 m w. Bracts.	St. 113. 36°53' N., 3°09' E. 28. VI. 1910. Y. 300 m w. Fragments.
	St. 232. 36°28' N., 9°06' W. 9. IX. 1910. Y. 300 m w. Fragments.

Bells listed above are so fragmentary that it is not possible to identify them.

The bracts from Station 69 are, however, in tolerably good condition. Their general conformation, and arrangement of canals, suggest that they are Prayinae. But they cannot be referred to any species.

HIPPOPODIIDAE Kölliker 1853.

Although the character (form of the nectophores) on which generic separation in this family has usually been based, has been shown by MOSER (1925) to be too trivial for more than specific significance, one of us has elsewhere argued (BIGELOW, 1931, p. 536) that differences in the structure of the tentilla demand the retention of *Vogtia* as distinct from *Hippopodius*. On this basis, the two known genera of Hippopodiidae, may be defined as follows:—

- | | |
|---|--------------------|
| Cnidoband "sac-like" from the beginning..... | <i>Hippopodius</i> |
| Cnidoband at first spirally coiled, though with the coil finally coming to lie in one plane, thus secondarily
assuming a sac-like outline..... | <i>Vogtia</i> |

Vogtia, as above defined, includes all three of the angular-belled hippopodids, the spiral coiling of the cnidoband having been described for *V. serrata* by MOSER (1925)¹, for *V. pentacantha* by KEFERSTEIN and EHLERS (1861, p. 24, Pl. 3, Fig. 13—16), for *V. spinosa* by BIGELOW (1911b, Pl. 15, Fig. 6, 7), and for the rounded-belled form, *V. glabra* by BIGELOW (1918, p. 408, Pl. 4, Fig. 6, 7).

Admittedly, this scheme has a practical drawback. Should loose bells of some new hippopodid be taken, it would be impossible to refer them to their correct genus in the absence of the tentilla.

HIPPOPODIUS Quoy and Gaimard 1827.

As limited above *Hippopodius* includes only one known species.

¹ MOSER (1925, p. 422, Pl. 27, Fig. 6) mentions "korkzieherartig aufgerollten Nesselknöpfen" and also indicates them on her illustration of the colony.

HIPPOPODIUS HIPPOPUS Forskål 1776.

Fig. 15—19.

Gleba Hippopus, Forskål, 1776, p. 14, Pl. 43, Fig. E. For synonymy, see Bigelow, 1911 b, p. 208; 1931, p. 536; Moser, 1925, p. 409 (*Hippopodius luteus*); Leloup, 1933, p. 15.

Material.

St. 10. 37°21' N., 16°45' E. 15. XII. 1908.	St. 57. 36°40' N., 3°30' W. 20. II. 1909.
Y. 25 m w. 50 nectoph.	Y. 25 m w. 4 nectoph.
Y. 65 m w. 62 nectoph.	Y. 200 m w. 13 nectoph.
Y. 300 m w. 7 nectoph.	St. 58. 36°36' N., 4°24' W. 20. II. 1909.
Y. 600 m w. 8 nectoph.	Y. 65 m w. 1 nectoph.
St. 11. 36°57' N., 18°16' E. 16. XII. 1908.	St. 59. 36°02' N., 4°24' W. 20. II. 1909.
Y. 25 m w. 108 nectoph.	Y. 25 m w. 1 nectoph.
Y. 300 m w. 5 nectoph.	Y. 500 m w. 1 nectoph.
St. 20. 37°48' N., 15°49' E. 5. I. 1909.	St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 25 m w. 5 nectoph.	Y. 65 m w. 3 nectoph.
St. 24. 40°14' N., 12°23' E. 16. I. 1909.	Y. 300 m w. 33 nectoph.
Y. 65 m w. 1 nectoph.	Y. 600 m w. 5 nectoph.
Y. 300 m w. 3 nectoph.	St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 600 m w. 4 nectoph.	Y. 25 m w. 2 nectoph.
St. 25. 40°34' N., 13°24' E. 17. I. 1909.	Y. 300 m w. 17 nectoph.
Y. 65 m wire. 20 nectoph.	St. 74. 44°21' N., 7°55' W. 9. III. 1909.
St. 26. 40°40' N., 13°59' E. 19. I. 1909.	Y. 600 m w. 1 nectoph.
Y. 300 m w. 68 nectoph.	St. 89. 36°28' N., 8°22' W. 18. VI. 1910.
St. 28. 40°53' N., 13°43' E. 19. I. 1909.	Y. 300 m w. 9 nectoph.
Y. 25 m wire. 1 nectoph.	Y. 1000 m w. 1 nectoph.
St. 29. 40°47' N., 12°55' E. 20. I. 1909.	St. 91. 35°53' N., 7°26' W. 18. VI. 1910.
Y. 200 m w. 27 nectoph.	Y. 1600 m w. 12 nectoph.
St. 30. 41°15' N., 11°55' E. 21. I. 1909.	St. 95. 37°57' N., 6°00' W. 23. VI. 1910.
Y. 65 m w. 7 nectoph.	Y. 65 m w. 1 nectoph.
Y. 300 m w. 1 nectoph.	Y. 300 m w. 14 nectoph.
St. 31. 41°44' N., 10°52' E. 21. I. 1909.	St. 96. 35°48' N., 5°58' W. 23. VI. 1910.
Y. 65 m w. 9 nectoph.	Y. 65 m w. 5 nectoph.
Y. 200 m w. 4 nectoph.	St. 99. 36°02' N., 5°16' W. 23. VI. 1910.
Y. 600 m w. 1 nectoph.	Y. 65 m wire. 3 nectoph.
St. 33. 43°04' N., 9°35' E. 22. I. 1909.	Y. 300 m w. 9 nectoph.
Y. 65 m w. 4 nectoph.	St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
St. 34. 43°27' N., 8°16' E. 23. I. 1909.	Y. 300 m w. 5 nectoph.
Y. 65 m w. Nectoph.	Y. 1200 m w. 5 nectoph.
St. 35. 43°36' N., 7°36' E. 28. I. 1909.	St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
Y. 300 m w. 43 nectoph.	Y. 2000 m w. 1 nectoph.
Y. 1000 m w. 11 nectoph.	St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
C. 2500 m w. 5 nectoph.	Y. 300 m w. 6 nectoph.
St. 36. 42°49' N., 6°54' E. 30. I. 1909.	St. 113. 36°53' N., 3°09' E. 28. VI. 1910.
Y. 65 m w. 21 nectoph.	Y. 300 m w. 2 nectoph.
Y. 300 m w. 8 nectoph.	St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
St. 38. 40°45' N., 9°50' E. 31. I. 1909.	Y. 25 m w. 3 nectoph.
Y. 65 m w. 7 nectoph.	Y. 65 m w. 5 nectoph.
St. 39. 39°41' N., 10°02' E. 1. II. 1909.	St. 116. 39°27' N., 5°26' E. 29. VI. 1910.
Y. 25 m w. 19 nectoph.	Y. 25 m w. 11 nectoph.
Y. 65 m w. 14 nectoph.	St. 123. 44°14' N., 8°55' E. 2. VII. 1910.
Y. 300 m w. 1 nectoph.	Y. 65 m w. 4 nectoph.
St. 40. 39°10' N., 9°40' E. 1. II. 1909.	Y. 300 m w. 5 nectoph.
Y. 65 m w. 19 nectoph.	St. 124. 44°20' N., 9°05' E. 3. VII. 1910.
St. 42. 38°58' N., 9°37' E. 2. II. 1909.	Y. 65 m w. 5 nectoph.
Y. 300 m w. 25 nectoph.	St. 125. 43°54' N., 9°13' E. 9. VII. 1910.
St. 43. 38°14' N., 8°42' E. 3. II. 1909.	Y. 25 m w. 1 nectoph.
Y. 65 m w. 37 nectoph.	St. 130. 39°35' N., 11°20' E. 13. VII. 1910.
St. 46. 37°17' N., 6°00' E. 7. II. 1909.	Y. 25 m w. 1 nectophore.
Y. 600 m w. 14 nectoph.	St. 131. 38°36' N., 11°00' E. 13. VII. 1910.
St. 47. 36°55' N., 3°12' E. 8. II. 1909.	Y. 25 m w. 1 nectoph.
Y. 65 m w. 10 nectoph.	Y. 300 m w. 10 nectoph.
Y. 300 m w. 22 nectoph.	St. 132. 38°57' N., 9°47' E. 14. VII. 1910.
St. 50. 37°02' N., 1°17' E. 16. II. 1909.	Y. 25 m w. Nectoph.
Y. 25 m w. 14 nectoph.	Y. 300 m w. 8 nectoph.
Y. 1600 m w. 1 nectoph.	St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
St. 51. 36°27' N., 0°37' W. 18. II. 1909.	Y. 25 m w. 2 nectoph.
Y. 300 m w. 16 nectoph.	Y. 300 m w. 7 nectoph.
St. 55. 36°46' N., 2°18' W. 19. II. 1909.	St. 134. 37°37' N., 10°17' E. 15. VII. 1910.
Y. 65 m w. 90 nectoph.	Y. 25 m w. 17 nectoph.

- | | |
|---|--|
| <p>St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
Y. 250 m w. 4 nectoph.</p> <p>St. 138. 37°37' N., 11°25' E. 19. VII. 1910.
Y. 1000 m w. 2 nectoph.</p> <p>St. 139. 37°57' N., 11°54' E. 20. VII. 1910.
Y. 300 m w. 7 nectoph.</p> <p>Y. 800 m w. 1 nectoph.</p> <p>St. 143. 35°18' N., 16°25' E. 22. VII. 1910.
Y. 25 m w. 7 nectoph.</p> <p>Y. 1000 m w. 1 nectoph.</p> <p>St. 144. 34°31' N., 18°40' E. 23. VII. 1910.
Y. 300 m w. 14 nectoph.</p> <p>St. 145. 32°38' N., 19°02' E. 25. VII. 1910.
Y. 25 m w. 7 nectoph.</p> <p>Y. 300 m w. 5 nectoph.</p> <p>St. 147. 31°35' N., 19°02' E. 25. VII. 1910.
Y. 25 m w. 3 nectoph.</p> <p>Y. 300 m w. 10 nectoph.</p> <p>St. 154. 32°10' N., 24°46' E. 29. VII. 1910.
Y. 300 m w. 7 nectoph.</p> <p>St. 156. 32°16' N., 26°03' E. 30. VII. 1910.
Y. 25 m w. 11 nectoph.</p> <p>Y. 1000 m w. 12 nectoph.</p> <p>St. 158. 34°23' N., 27°57' E. 31. VII. 1910.
Y. 300 m w. 24 nectoph.</p> <p>St. 160. 35°59' N., 28°14' E. 1. VIII. 1910.
Y. 1000 m w. 7 nectoph.</p> <p>Y. 4000 m w. 9 nectoph.</p> <p>St. 163. 37°52' N., 26°22' E. 2. VIII. 1910.
Y. 200 m w. 20 \pm nectoph.</p> <p>St. 182. 38°18' N., 24°48' E. 14. VIII. 1910.
Y. 600 m w. 9 nectoph.</p> <p>St. 183. 37°52' N., 23°09' E. 16. VIII. 1910.
Y. 65 m w. 6 nectoph.</p> <p>St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
Y. 65 m w. 1 nectoph.</p> <p>Y. 300 m w. 1 nectoph.</p> <p>St. 187. 37°54' N., 18°02' E. 18. VIII. 1910.
Y. 25 m w. 2 nectoph.</p> <p>Y. 300 m w. 6 nectoph.</p> <p>Y. 1000 m w. 4 nectoph.</p> <p>St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.
Y. 25 m w. 1 nectoph.</p> <p>St. 190. 37°51' N., 15°19' E. 19. VIII. 1910.
Y. 25 m w. 6 nectophores.</p> <p>St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
Y. 25 m w. 3 nectoph.</p> <p>Y. 600 m w. 1 nectoph.</p> <p>St. 193. 38°15' N., 15°39' E. 21. VIII. 1910.
Y. 10 m w. 4 nectoph.</p> <p>St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
Y. 10 m w. 6 nectoph.</p> <p>Y. 25 m w. 11 nectoph.</p> <p>Y. 1200 m w. 2 nectoph.</p> <p>St. 195. 39°02' N., 14°55' E. 21. VIII. 1910.
Y. 25 m w. 13 nectoph.</p> | <p>St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
Y. 25 m w. 10 nectoph.</p> <p>Y. 300 m w. 2 nectoph.</p> <p>St. 200. 39°18' N., 10°11' E. 26. VIII. 1910.
Y. 25 m w. 7 nectoph.</p> <p>St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
Y. 65 m w. 3 nectoph.</p> <p>St. 205. 39°16' N., 5°52' E. 27. VIII. 1910.
Y. 25 m w. 16 nectoph.</p> <p>St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
Y. 25 m w. 2 nectoph.</p> <p>Y. 300 m w. 9 nectoph.</p> <p>Y. 1000 m w. 5 nectoph.</p> <p>Y. 2000 m w. 15 nectoph.</p> <p>St. 209. 40°34' N., 3°03' E. 29. VIII. 1910.
C. 150 m w. 3 nectophores.</p> <p>St. 210. 41°10' N., 2°23' E. 30. VIII. 1910.
Y. 25 m w. 2 nectoph.</p> <p>Y. 600 m w. 12 nectoph.</p> <p>St. 215. 39°14' N., 0°52' E. 31. VIII. 1910.
Y. 25 m w. 7 nectoph.</p> <p>St. 216. 38°31' N., 1°24' E. 1. IX. 1910.
Y. 25 m wire. 11 nectoph.</p> <p>St. 218. 36°54' N., 2°57' E. 2. IX. 1910.
Y. 25 m w. 61 nectoph.</p> <p>St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
Y. 25 m w. 3 nectoph.</p> <p>St. 228. 36°02' N., 5°06' W. 7. IX. 1910.
Y. 300 m w. 4 nectoph.</p> <p>St. 232. 36°28' N., 9°06' W. 9. IX. 1910.
Y. 25 m w. 1 nectophore.</p> <p>St. 233. 36°49' N., 9°15' W. 10. IX. 1910.
Y. 25 m w. 3 nectoph.</p> <p>St. 276. 36°30' N., 19°20' E. 4. IV. 1911.
S. 132 m w. 51 nectoph.</p> <p>St. 277. 33°20' N., 27°30' E. 6. IV. 1911.
S. 132 m wire. 250 \pm nectoph.</p> <p>St. 279. 38°11.5 N., 15°36.5' E. 23. II. 1911.
S. 30 m w. 4 nectoph.</p> <p>St. 281. 38°15' N., 15°37.5' E. 1. III. 1911.
S. 30 m w. 1 nectoph.</p> <p>St. 282. 38°12' N., 15°37' E. 8. III. 1911.
S. 40 m w. 7 nectoph.</p> <p>St. 283. 38°12' N., 15°37.5' E. 12. III. 1911.
S. 40 m w. 7 nectoph.</p> <p>St. 296. 32°10' N., 29°50' E. 25. VI. 1911.
S. 28 m w. 1 nectoph.</p> <p>St. 297. 33°10' N., 25°03' E. 25. VI. 1911.
S. 28 m w. 190 \pm nectoph.</p> <p>St. 298. 34°20' N., 21°10' E. 26. VI. 1911.
S. 38 m w. 61 nectoph.</p> <p>St. 339. 40°30' N., 3°10' E. 20. VIII. 1911.
S. 28 m wire. Nectoph.</p> <p>St. 340. 35°50' N., 21°30' E. 26. VIII. 1911.
S. 28 m w. 3 nectoph.</p> <p>St. 341. 34°00' N., 26°20' E. 27. VIII. 1911.
S. 28 m w. 14 nectoph.</p> |
|---|--|

The many descriptions of the general morphology of *Hippopodius hippocampus*, and of its development, have paid little attention to the conformation of the nectophores, no doubt because there seemed to be no danger of confusing this species with any other known siphonophore. The recent discovery, however, of another hippopodid (*Vogtia glabra*, p. 17), the bells of which are likewise rounded, not angular, makes it desirable to illustrate those of *H. hippocampus* here, especially as the identification of this species is often based on captures of loose bells in the tow-net.

The most distinctive feature, apart from the oft-quoted horse-shoe-like form, is the presence of four rounded dorsal knobs, arranged along an arc, close to, and paralleling the oral margin, on its apical side (Figs. 15, 16). These four knobs were first shown by VOGL (1854, Pl. 15, Fig. 2), and more recently by LENS and VAN RIEMSDIJK (1908, Pl. 9, Fig. 80); BROWNE (1926, p. 61); MOSER (1925, p. 410) and TOTTEN (1932, p. 330).

So far, no variation in their number has been observed. The full number of knobs is discernable from the time the bell assumes its definitive form (Fig. 15). They are in fact much more prominent in small bells than in the large ones (cf. Fig. 15 with Fig. 18). In *Vogtia glabra*, on the contrary, the bells bear only two

prominences and TOTTON (1932, p. 331) states that these two were to be seen in a *V. glabra* bell only 4 mm. long, but beginning to assume its definitive shape. Considerable variation is, however, to be seen among preserved specimens of *H. hippocampus*, in the conformation of the basal part of the bell, especially in the relative spread between the basal corners. This is due probably to contraction, or perhaps in part to varying degrees of compression by the adjacent bells in the colony. For example, the basal angles of the medium sized bells of one colony¹ are drawn closely together (Fig. 16), whereas in a smaller bell they are spread wide apart (Fig. 15), while in two larger bells, presumably from the same colony (13 and 14 mm.

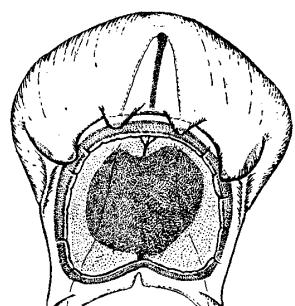


Fig. 15. *Hippopodius hippocampus*; Dorsal view of the second nectophore, 8 mm. in length, from a colony from "Bache" St. 10180, in the Western Atlantic.

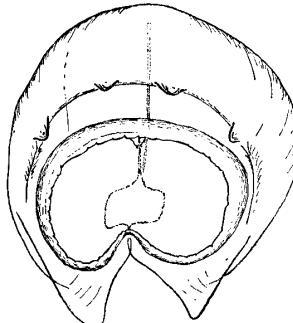


Fig. 16. *Hippopodius hippocampus*; dorsal view of one of the medium sized nectophores, 10.5 mm. in length, from the same colony as the nectophore illustrated in Fig. 15.

long) the basal outline is much as illustrated in Fig. 17—18. The nectophore 19 mm. wide, illustrated in Fig. 17—19, is the largest yet definitely recorded. Previous authors have commented on such other diagnostic features as the shoalness of the nectosac and the opalescence and rigidity of the bell as a whole.

We may add, since it has not previously been emphasized, that in *H. hippocampus*, as in the various species of *Vogtia*, the ventral sinus decreases greatly in relative size with the growth of the nectophore. In none of

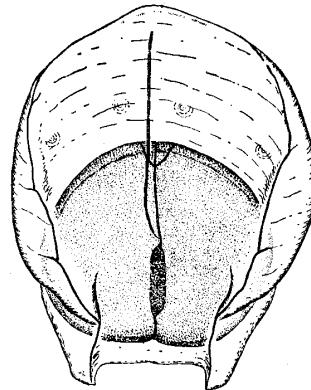


Fig. 17. *Hippopodius hippocampus*; ventral view of seventh nectophore, 19 mm. long, from a colony from the Western Atlantic, "Arcturus" St. 18.

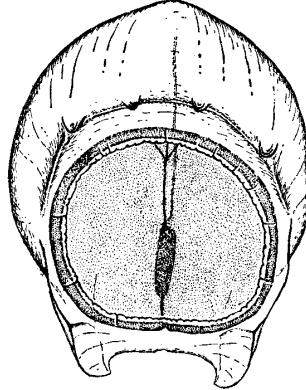


Fig. 18. *Hippopodius hippocampus*; dorsal view of nectophore illustrated in Fig. 17.

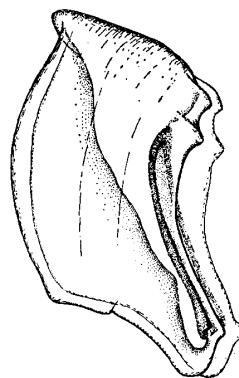


Fig. 19. *Hippopodius hippocampus*; lateral view of nectophore illustrated in Fig. 17 and 18.

the specimens examined, has it been possible to trace the union of the radial subumbrial canals with the ring canal, because of strong contraction or fragmentary condition. Nor has this point been made clear in any of the earlier illustrations or accounts.

The features in which HAECKEL'S (1888b, Pl. 29, Fig. 1, 2, 4) illustrations of his *Polyphyes ungulata* differ from *H. hippocampus* are the pointed, claw-like shape and large size of the four knobs, the sharply angular

¹ Now detached, but two or three of the younger bells are still connected.

bell, and the angular-rhomboid form of the ventral sinus. Bearing in mind the extent to which HAECKEL'S beautiful pictures of siphonophores were idealized, we have no doubt that MOSER (1925, p. 410) was correct in relegating *ungulata* definitely to the synonymy of *hippopus*.

The "Thor" series contains only definitive bells. Probably the absence of larval nectophores is due to the coarseness of the mesh of the nets in which most of the plankton samples were collected.

VOGTIA Kölliker 1853.

According to recent discussions (BIGELOW, 1911b; 1918; MOSER, 1925), the known members of *Voglia*, as defined above, represent four species, the most obviously diagnostic features of their nectophores being as follows:—

1. Bell angular, pentagonal, prismatic in form.
 - a. Facets as well as angles bear conical gelatinous prominences *spinosa*
 - b. Only the angles bear such prominences, the facets being smooth *pentacantha*
 - c. No conical prominences, the angles being merely finely serrate..... *serrata*
2. Bell rounded *glabra*

The nectophores of the three angular-belled species differ so much in general aspect from those of all other known siphonophores that there is no danger of confusing them with any other genus. And if well preserved, the differences between them are so clear (the thorns are extremely arresting to the eye) that specific identification is easy. Unfortunately, however, the sculpturing of the facets and angles often loses definition, and even disappears altogether in loose bells, either from damage in the net, or in the process of disintegration while still afloat in the sea, making specific identification impossible. And the "Thor" collection contains a considerable number of such relics (p. 19).

The nectophores of the rounded-belled species, *glabra*, resemble those of *Hippopodius hippopus* more closely in general appearance, than they do those of the other *Voglia*s. But they are easily separated from *Hippopodius* if in good condition, by the fact they have only two prominences (*Hippopodius* has four) on the dorsal side, that the oral-aboral flattening of the nectosac is not so extreme, and that the apical outline is much more pointed (cf. Fig. 20 and BIGELOW, 1918, Pl. 4, Fig. 2—5 with Figs. 15—19).

VOGTIA GLABRA Bigelow 1918.

Fig. 20.

Voglia glabra, Bigelow, 1918, p. 407, Pl. 4, Fig. 2—7; Totton, 1932, p. 331.
Hippopodius glabrus, Leloup, 1933, p. 17; 1934, p. 6.

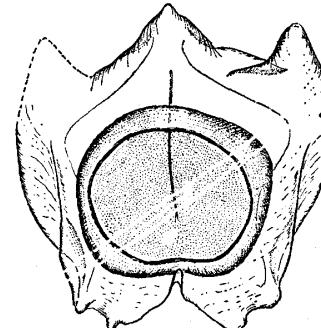


Fig. 20. *Voglia glabra*; dorsal view of nectophore, 11 mm. in length from "Thor" St. 91.

Material.

St. 69. 36°13' N., 9°44' W. 28. II. 1909.

Y. 65 m w. 3 nectoph.

Y. 300 m w. 40 nectoph.

St. 71. 39°35' N., 9°45' W. 4. III. 1909.

Y. 1600 m w. 1 nectoph.

St. 91. 35°53' N., 7°26' W. 18. VI. 1910.

1600 m w. 10 nectoph., 3 still connected (or 1 col.?).

St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.

Y. 1200 m w. 3 nectoph.

This list includes all hippopodid bells which are rounded in outline and show only two prominences on the dorsal side.

The catches all consist of loose bells in poor condition, except that from Station 91. The latter apparently represents one colony, the 3 younger nectophores of which are still connected. In these, the dorso-lateral knobs are considerably more prominent than in the type specimen of the species (cf. Fig. 20 with BIGELOW,

1918, Pl. 4, Fig. 2—5). But it is probable that this apparent difference represents different phases of contraction in preservation, for the older "Thor" bells, up to 14 mm. long, agree with the original account of nectophores of corresponding sizes.

VOGTIA PENTACANTHA Kölliker 1853.

Vogtia pentacantha, Kölliker, 1853, p. 31, Pl. 8, Fig. 1—8. For synonymy, see Moser, 1925, p. 416 (*Hippopodius pentacanthus*); Bigelow, 1918, p. 406, Pl. 4, Fig. 1; Browne, 1926, p. 61.

Material.

St. 29. 40°47' N., 12°55' E. 20. I. 1909. Y. 1650 m w. 6 nectoph.	St. 145. 32°38' N., 19°02' E. 25. VII. 1910. Y. 300 m wire. 1 nectoph.
St. 66. 36°16' N., 6°52' W. 25. II. 1909. Y. 1200 m w. 8 nectoph.	St. 147. 31°35' N., 19°02' E. 25. VII. 1910. Y. 1000 m w. 8 nectoph.
St. 122. 43°50' N., 8°34' E. 2. VII. 1910. Y. 1200 m w. 14 nectoph.	St. 194. 38°33' N., 15°29' E. 21. VIII. 1910. Y. 1200 m w. 2 nectoph.
St. 129. 40°05' N., 11°31' E. 12. VII. 1910. Y. 1000 m w. 3 nectoph.	St. 206. 39°32' N., 5°15' E. 28. VIII. 1910. Y. 2000 m w. 9 nectoph.

Questionable identification.

St. 31. 41°44' N., 10°52' E. 21. I. 1909. Y. 1400 m w. 49 nectoph.	St. 199. 39°32' N., 10°49' E. 25. VIII. 1910. Y. 1000 m w. 56 nectophores.
St. 91. 35°53' N., 7°26' W. 18. VI. 1910. Y. 1600 m w. 19 nectoph.	St. 206. 39°32' N., 5°15' E. 28. VIII. 1910. Y. 1000 m wire. 5 nectoph.
St. 129. 40°05' N., 11°31' E. 12. VII. 1910. Y. 1000 m w. 35 nectoph.	St. 210. 41°10' N., 2°23' E. 30. VIII. 1910. Y. 600 m w. 4 nectoph.
St. 147. 31°35' N., 19°02' E. 25. VII. 1910. Y. 1000 m w. 26 nectoph.	St. 281. 38°13' N., 15°36' E. 1. III. 1911. S. 40 m w. 2 nectoph.
St. 160. 35°59' N., 28°14' E. 1. VIII. 1910. Y. 1000 m w. 11 nectoph.	St. 282. 38°12' N., 15°37' E. 8. III. 1911. S. 40 m w. 12 nectoph.
St. 194. 38°33' N., 15°29' E. 21. VIII. 1910. Y. 1200 m wire. 24 nectoph.	

The foregoing list includes all the pentagonal hippocodid nectophores, on which the presence of thorns could be detected on the angles, but not on the facets. No doubt the list of doubtful Vogtias (p. 19) also includes some *pentacantha*.

In view of the large numbers of bells taken at some of the stations, the fact that they are all detached bears witness to the rough treatment that siphonophores receive when caught in large nets of rough texture, among the mass of other plankton.

VOGTIA SPINOSA Keferstein and Ehlers 1861.

Vogtia spinosa, Keferstein and Ehlers, 1861, p. 24, Pl. 5, Fig. 16; Haeckel, 1888b, p. 364; Bigelow, 1911b, p. 210, Pl. 15, Fig. 5—12; 1931, p. 537; Leloup, 1933, p. 19.

Vogtia köllikeri, Haeckel, 1888b, p. 182, Pl. 29, Fig. 9—14.

Hippopodius spinosus, Moser, 1925, p. 419.

Material.

St. 63. 35°50' N., 6°03' W. 22. II. 1909. Y. 600 m w. 1 nectoph.	St. 89. 36°28' N., 8°22' W. 18. VII. 1910. Y. 1000 m w. 15 nectoph.
St. 65. 35°53' N., 7°25' W. 24. II. 1909. Y. 600 m w. 12 nectoph.	St. 106. 36°33' N., 2°00' W. 25. VI. 1910. Y. 1200 m w. 1 nectoph.
St. 66. 36°16' N., 6°52' W. 25. II. 1909. Y. 600 m w. 30 nectoph.	St. 115. 38°17' N., 4°11' E. 28. VI. 1910. Y. 2000 m w. 2 nectoph.
St. 68. 36°39' N., 7°21' W. 27. II. 1909. Y. 800 m w. 30 nectoph.	St. 138. 37°37' N., 11°25' E. 19. VII. 1910. Y. 1000 m w. 10 nectoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909. Y. 600 m w. 22 nectoph.	St. 139. 37°57' N., 11°54' E. 20. VII. 1910. Y. 800 m w. 25 nectoph.
St. 71. 39°35' N., 9°45' W. 4. III. 1909. Y. 600 m w. 8 nectoph.	St. 144. 34°31' N., 18°40' E. 23. VII. 1910. Y. 2000 m w. 3 nectoph. with bits of stem.
Y. 1600 m w. 17 nectoph.	St. 189. 37°44' N., 15°58' E. 19. VIII. 1910. Y. 1000 m w. 1 nectoph.
St. 81. 41°32' N., 9°32' W. 15. VI. 1910. Y. 500 m w. 7 nectoph.	

St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
Y. 1200 m w. 1 nectoph.
St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
Y. 2000 m w. 2 nectoph.

St. 234. 38°10' N. 9°20' W. 10. IX. 1910.
Y. 1000 m w. 3 nectoph.
St. 242. 46°19' N., 6°48' W. 16. IX. 1910.
C. 4350 m w. 6 nectoph.

Questionable identification.

St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.
Y. 1000 m w. 1 nectoph.

St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
Y. 1200 m w. 1 nectoph.

These loose nectophores, few of which are in good condition, add nothing to previous accounts based on much better preserved material. The identification is based on the presence of thorns on facets as well as on the angles of the bell (p. 17).

VOGTIA SERRATA Moser 1913, 1925.

Hippopodius serratus, Moser, 1915, p. 212; 1915b, p. 653; 1925, p. 420, Pl. 27, Fig. 6—8, Pl. 28, Fig. 4—9.

Vogtia pentacantha, Moser, 1912, p. 329; Bigelow, 1913, p. 66, Pl. 5, Fig. 7—9, Pl. 6, Fig. 6.

Vogtia serrata, Moser, 1913, p. 149; Bigelow, 1918, p. 405; 1931, p. 538; Leloup, 1933, p. 18.

Non *V. pentacantha*, Kölleker, 1853, p. 31.

Material.

St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 1600 m w. 10 nectoph.

St. 242. 46°19' N., 6°48' W. 16. IX. 1910.
C. 4350 m w. 13 nectoph.

This list includes all pentagonal hippopodid nectophores, which show [no] trace of [thorns] either on the facets or on the angles. In most cases some trace of denticulation is to be seen along the angles. But this is soon lost when the bells have undergone any appreciable degree of deterioration. They add nothing to previous accounts (see especially MOSER, 1925; BIGELOW, 1913).

VOGTIA PENTACANTHA or VOGTIA SPINOSA.

Material.

St. 187. 37°54' N., 18°02' E. 18. VIII. 1910.
Y. 1000 m w. 43 nectoph.
St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
Y. 600 m w. 14 nectoph.

St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
Y. 1200 m w. 12 nectoph.

VOGTIA sp.?

Material.

St. 10. 37°21' N., 16°45' E. 15. XII. 1908.
Y. 600 m w. 36 nectoph.
St. 12. 39°34' N., 17°17' E. 19. XII. 1908.
Y. 1000 m w. 3 nectoph. (fragmentary).
St. 24. 40°14' N., 12°23' E. 16. I. 1909.
Y. 600 m w. 19 nectoph.
St. 29. 40°47' N., 12°55' E. 20. I. 1909.
Y. 600 m w. 2 nectoph.
St. 34. 43°27' N., 8°16' E. 23. I. 1909.
Y. 25 m w. 2 nectoph.
St. 35. 43°36' N., 7°36' E. 28. I. 1909.
Y. 1600 m w. 3 nectoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 65 m w. 4 nectoph.
St. 71. 39°35' N., 9°45' W. 4. III. 1909.
Y. 600 m w. 6 nectoph.
Y. 1600 m w. 3 nectoph.
St. 75. 45°37' N., 7°03' W. 9. III. 1909.
Y. 600 m w. 2 nectoph.
St. 115. 38°17' N., 4°11' W. 28. VI. 1910.
Y. 300 m w. 2 nectoph.

St. 143. 35°18' N., 16°25' E. 22. VII. 1910.
Y. 1000 m w. 4 nectoph.
St. 144. 34°31' N., 18°40' E. 23. VII. 1910.
Y. 2000 m w. 5 nectoph.
C. 4000 m w. 3 nectoph.
St. 160. 35°59' N., 28°14' E. 1. VIII. 1910.
C. 4000 m w. 3 nectoph.
St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
Y. 1200 m w. 6 nectoph.
St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.
Y. 1000 m w. 17 nectoph.
St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
Y. 300 m w. 4 nectoph.
Y. 600 m w. 4 nectoph.
St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
Y. 1200 m w. 23 nectoph.
St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
Y. 1000 m w. 2 nectoph.
St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
Y. 1000 m w. 29 nectoph.

St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
Y. 1000 m w. 6 nectoph.
St. 209. 40°34' N., 3°03' E. 29. VIII. 1910.
Y. 25 m w. 5 nectoph.

St. 210. 41°10' N., 2°23' E. 30. VIII. 1910.
Y. 600 m w. 4 nectoph.
St. 232. 36°28' N., 9°06' W. 9. IX. 1910.
Y. 300 m w. 3 nectoph.

HIPPOPODIIDAE genus?

Hippopodid bells, too fragmentary for identification, even as to genus, were taken as follows:—

Material.

St. 13. 39°43' N., 17°30' E. 19. XII. 1908.
Y. 1000 m w. 50 nectoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 600 m w. 19 nectoph.
C. 3000 m w. 1 nectoph.

St. 74. 44°21' N., 7°55' W. 8. III. 1909.
Y. 600 m w. 7 nectoph.
St. 129. 40°05' N., 11°31' E. 12. VII. 1910.
Y. 25 m w. 1 nectoph.
St. 134. 37°37' N., 10°17' E. 15. VII. 1910.
Y. 25 m w. 1 nectoph.

DIPHYIDAE Quoy and Gaimard 1827.

ABYLINAE L. Agassiz 1862.

The collection contains large series of the three members of this subfamily that are at once the best known, and that have most frequently been reported from different expeditions, but none of the other Abylinae are represented at all.

ENNEAGONUM Quoy and Gaimard 1827.

ENNEAGONUM HYALINUM Quoy and Gaimard 1827.

Figs. 21—25.

Enneagonum hyalinum, Quoy and Gaimard, 1827, p. 18, Pl. 2D, Fig. 1—6.

Cuboides vitreus, Quoy and Gaimard, 1827, p. 19, Pl. 2E, Fig. 1—3. For synonymy, see Bigelow, 1911b, p. 190 (*Cuboides vitreus*); Moser, 1925, p. 404 (*Cuboides vitreus*); Totton, 1932, p. 335; Leloup, 1933, p. 23.

Material.

St. 46. 37°17' N. 6°00' E. 7. II. 1909.
Y. 600 m w. 6 nectoph.; 8 eudox.
St. 47. 36°55' N., 3°12' E. 8. II. 1909.
Y. 300 m w. 2 nectoph.; 1 eudox.
St. 50. 37°02' N., 1°17' E. 17. II. 1909.
Y. 600 m w. 148 nectoph.; 78 eudox.; 7 gonoph.; 29 eudox.
or nectoph. (fragm.).
Y. 1600 m w. 25 nectoph.; 9 eudox.; 21 bracts.
St. 51. 36°27' N., 0°37' W. 17. II. 1909.
Y. 300 m w. 33 nectoph.; 34 eudox.
St. 53. 36°13' N., 1°28' W. 18. II. 1909.
C. 2600 m w. 7 eudox.
St. 55. 36°46' N., 2°18' W. 19. II. 1909.
Y. 65 m w. 3 bracts.
St. 57. 36°40' N., 3°30' W. 20. II. 1909.
Y. 25 m w. 39 nectoph.; 221 eudox.; 12 gonoph.
Y. 200 m w. 13 nectoph.; 13 eudox.; 14 bracts; 1 gonoph.
St. 58. 36°36' N., 4°24' W. 20. II. 1909.
Y. 65 m w. 2 nectoph.; 32 eudox.; 13 bracts.
Y. 100 m w. 4 nectoph.; 6 eudox.; 2 gonoph.
St. 59. 36°02' N., 4°24' W. 21. II. 1909.
Y. 25 m w. 6 nectoph.; 28 eudox.; 2 gonoph.
Y. 100 m w. 196 nectoph.; 305 eudox.; 45 gonoph.
Y. 500 m w. 130 nectoph.; 126 eudox.; 11 gonoph.
Y. 1200 m w. 131 nectoph.; 108 eudox.; 19 gonoph.; 14 nectoph.
or eudox. (fragm.).
St. 61. 35°57' N., 5°35' W. 21. II. 1909.
Y. 600 m w. 12 eudox.; 18 bracts.
St. 62. 35°45' N., 5°59' W. 21. II. 1909.
Y. 25 m w. 3 bracts.

St. 63. 35°50' N., 6°03' W. 22. II. 1909.
Y. 25 m w. 2 eudox.
Y. 600 m w. 20 nectoph.; 21 eudox.; gonoph.
St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 65 m w. 1 nectoph.; 2 eudox.
Y. 300 m w. 12 nectoph.; 28 eudox.; 8 gonoph.
Y. 600 m w. 4 nectoph.; 8 eudox.
St. 66. 36°16' N., 6°52' W. 25. II. 1909.
Y. 65 m w. 1 nectoph.; 2 eudox.
Y. 300 m w. 8 nectoph.; 5 eudox.
Y. 600 m w. 45 nectoph.; 63 eudox.
Y. 1200 m w. 9 nectoph.; 3 eudox.
St. 68. 36°39' N., 7°21' W. 27. II. 1909.
Y. 800 m w. 9 nectoph.; 11 eudox.; 3 gonoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 300 m w. 9 nectoph.; 24 eudox.; 11 gonoph.
St. 70. 39°06' N., 9°47' W. 4. III. 1909.
Y. 65 m w. 1 nectoph.; 2 eudox.
St. 71. 39°35' N., 9°45' W. 4. III. 1909.
Y. 300 m w. 5 nectoph.; 1 eudox.
Y. 600 m w. 1 nectoph.
St. 87. 37°03' N., 9°15' W. 17. VI. 1910.
Y. 300 m w. 1 nectoph.
St. 89. 36°28' N., 8°22' W. 18. VI. 1910.
Y. 300 m w. 1 eudox.
St. 91. 35°53' N., 7°26' W. 18. VI. 1910.
Y. 1600 m w. 1 nectoph.; 3 eudox.
St. 94. 36°06' N., 6°02' W. 23. VI. 1910.
Y. 65 m w. 1 nectoph.

- St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
 Y. 25 m w. 1 nectoph. (?) (fragm.).
 Y. 65 m w. 3 nectoph.; 1 eudox.
 Y. 300 m w. 6 nectoph.; 3 eudox.; 5 bracts.
 St. 96. 35°48' N., 5°58' W. 23. VI. 1910.
 Y. 65 m w. 1 nectoph.
 St. 98. 35°57' N., 5°35' W. 23. VI. 1910.
 Y. 65 m w. 4 nectoph.; 2 eudox.
 St. 99. 36°02' N., 5°16' W. 23. VI. 1910.
 Y. 65 m w. 51 nectoph.; 51 eudox.; 28 gonoph.
 Y. 300 m w. 66 nectoph.; 204 eudox.; 98 gonoph.
 St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
 Y. 300 m w. 6 nectoph.; 26 eudox.; 2 gonoph.
 Y. 1200 m w. 67 nectoph.; 144 eudox.; 15 gonoph.
 St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
 Y. 65 m w. 4 nectoph.
 Y. 300 m w. 27 nectoph.; 65 eudox.; gonoph.
 Y. 200 m w. 24 nectoph.; 74 eudox.; 16 gonoph.
 St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
 Y. 65 m w. 4 eudox.
 Y. 300 m w. 3 nectoph.; 20 eudox.; 4 gonoph.

- St. 112. 36°56' N., 2°15' E. 27. VI. 1910.
 Y. 300 m w. 117 nectoph.; 93 eudox.; 15 gonoph.
 St. 113. 36°53' N., 3°09' E. 28. VI. 1910.
 Y. 300 m w. 4 nectoph.; 4 eudox.; 4 fragm.
 St. 118. 41°00' N., 6°43' E. 30. VI. 1910.
 Y. 300 m w. 1 nectoph.
 St. 204. 38°52' N., 7°43' E.
 Y. 1000 m w. 2 nectoph.
 St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
 Y. 1000 m w. 2 nectoph.
 St. 222. 35°53' N., 0°57' W. 4. IX. 1910.
 Y. 300 m w. 36 nectoph.; 50 eudox.; 8 gonoph.; 24 nectoph.
 or eudox. (?) (fragm.).
 St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
 Y. 300 m w. 3 eudox.
 St. 228. 36°02' N., 5°06' W. 7. IX. 1910.
 Y. 25 m w. 12 nectoph.; 37 eudox.; 3 gonoph.
 St. 229. 35°51' N., 5°58' W. 8. IX. 1910.
 Y. 300 m w. 2 nectoph.
 St. 232. 36°28' N., 9°06' W. 9. IX. 1910.
 Y. 1000 m w. 1 nectoph.

The history of this species illustrates the degree to which the nomenclature of siphonophores has been confused by uncertainty as to the actual identity of species described from the early exploring expeditions: uncertainty in this case, as to whether or not, QUOY and GAIMARD's pictures of *Enneagonum* represented the form subsequently described by HUXLEY (1859) as *Abyla vogtii*, by HAECKEL (1888 b) as *Cymba crystallus* and by CHUN (1892) as *Halopyramis adamantina*.

In the most recent discussion of this subject, TOTTEN (1932) pointed out that the original figures of *Enneagonum*, though distorted, correspond in all essential features with the nectophores of these latter. Consequently he re-introduced this name, and his lead is followed by LELoup (1933, 1934); also here in the hope that the name *Enneagonum* may now have found its final resting place. It has long been fully established that this is the parent of the eudoxid first described by QUOY and GAIMARD (1827) as *Cuboides vitreus*, synonyms of which are *Cuboides crystallus* HAECKEL, and *Cuboides adamantina*, CHUN¹.

Colony. This is one of the best-characterized of Caly-cophorae, its polygastric generation being made easily recognizable by the pyramidal form and nine prominent angles of the nectophore, the eudoxid by its cubical bract.

The "Thor" specimens are all more or less damaged, especially the gelatinous angles of the nectophores. But comparison with several excellent examples from the Philippines, and with others from the Eastern Tropical Pacific fails to show anything to separate the Atlantic from the Pacific form. All agree very closely with CHUN's (1892) detailed description and pictures, which still remain the best and most complete account of the species.

In all the specimens of the polygastric generation that we have seen, Atlantic and Mediterranean as well as Pacific, the angles of the nectophore are produced into definite points (Fig. 21—23), much as they are figured by HAECKEL (1888 b) and by CHUN (1892), with the connecting ridges and intervening facets definitely (often deeply) concave, so that the bell has a somewhat stellate appearance. TOTTEN's recent illustration (1932, Fig. 16) shows the angles as much less prominent, the ridges as more nearly straight, and the

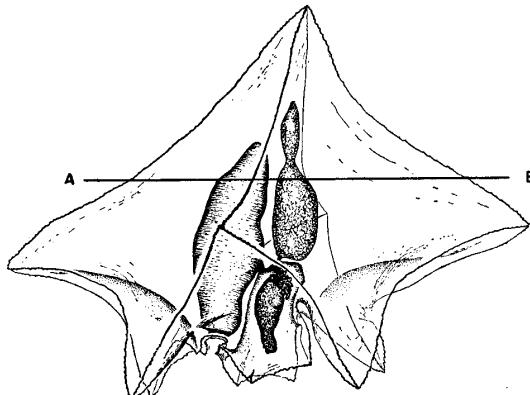


Fig. 21. *Enneagonum hyalinum*; general view of a colony, 13.5 mm. high, from the Philippines, "Albatross" St. 5500.

¹ The selection of *Enneagonum* as the generic name, rather than *Cuboides*, is based on page-priority, *Enneagonum hyalinum* appearing on page 18, Quoy & Gaimard 1827; *Cuboides vitreus* on page 19. For further discussion see BIGELOW, 1911b, p. 189; TOTTEN, 1932, p. 336.

hydroecial region as relatively larger. As it was drawn from a small specimen (about 8 mm. high), these may be juvenile characters. But the fact that one specimen from the Eastern Tropical Pacific, only about 6 mm. high, is strongly stellate, with points relatively about as long as in the large specimen illustrated in Figure 21

shows that adult conformation may be attained in this respect at a very small size. Specimens in poor condition show a tendency for the points to lose prominence, the facets to lose concavity, and ridges to lose sharpness, apparently due to swelling of their gelatinous substance in preservation.

TOTTON's figure also shows a short transverse ridge at the apex, and this is present in one Philippine specimen. In the latter, the dorsal and right lateral ridges rise together, as do the ventral and the left lateral, with the transverse ridge connecting the points of origin of these two pairs (Fig. 23). In TOTTON's spec-

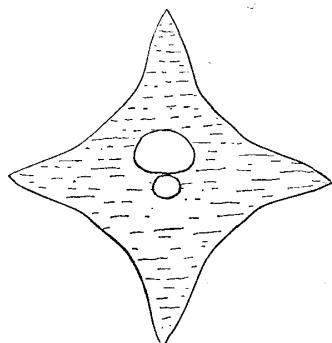


Fig. 22. *Enneagonum hyalinum*; optic section of specimen about 13 mm. high from the Philippines, "Albatross" St. 5500, at the level marked AB in Fig. 21.

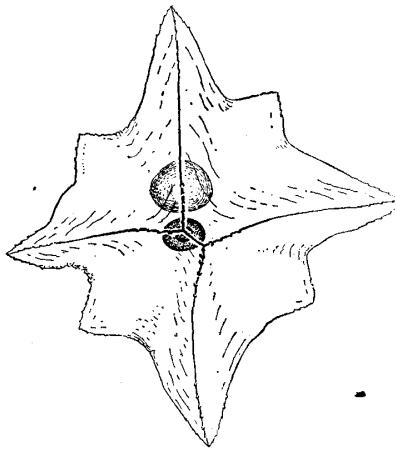


Fig. 23. *Enneagonum hyalinum*; apical view of another nectophore from the Philippines, "Albatross" St. 5500.

imen it was the dorsal and left lateral, the ventral and right lateral that were paired. But it seems that such variations are unusual, for in all other good specimens examined, the four descending ridges arise at one point, at the sharply pointed apex (Fig. 21).

As no recent account of the basal part of the bell has appeared, it is worth mention that CHUN's (1892) description of the oral margin of the nectosac as having two prominent lateral teeth only (besides the ventral

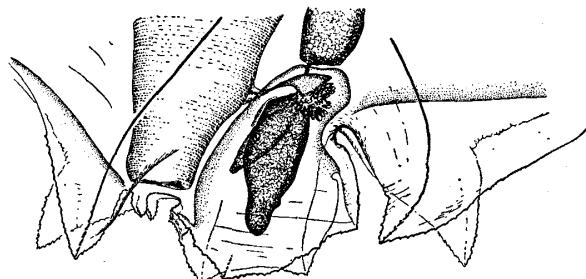


Fig. 24. *Enneagonum hyalinum*; lateral view of basal portion of the nectophore shown in Fig. 21.

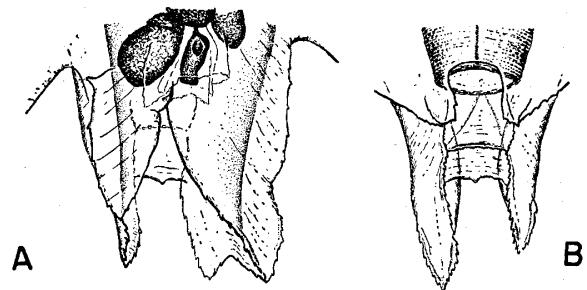


Fig. 25. *Enneagonum hyalinum*; A. Ventral view of nectophore from "Thor" St. 99; B. Dorsal view of the same specimen. $\times 8.5$.

lamella) was correct. The additional dorsal tooth with which HAECKEL (1888b) credited it, is non-existent. CHUN (1892), and latterly LELOUP (1934), have commented on the very characteristic asymmetry of the basal margin of the hydroecium (overlooked by HAECKEL), the two sides of which differ in outline in a way easier illustrated (Fig. 25) than described. In every specimen so far examined, it has been the left-hand side that has borne the more prominent angles.

It is also worth noting, since not previously clearly stated¹, that the dorsal hydroecial wall, below the level of the opening of the nectosac, is divided, by a transverse denticulate ridge, into two distinct facets,

¹ This is indicated, however, in CHUN's figure (1892, Pl. 12, Fig. 1).

lying at an angle of approximately 90° one with the other, (Figs. 24, 25), so that the hydroecial cavity here forms a re-entrant pocket.

In the better preserved specimens that we have seen, the hydroecium is not only laterally flattened, as CHUN long ago remarked, but its two basal lips are closely pressed together. In more flaccid specimens, however, they are spread apart (CHUN, 1892, Pl. 12, Fig. 1); no doubt this is the case in life, else there would be no passage for the stem.

The somatocyst is axial, as CHUN observed, the nectosac eccentric toward the dorsal side, when the nectophore is viewed from the apex (Fig. 22). The nectophores of the "Thor" series range from 7 mm. to 15 mm. in height: 14 mm. was the greatest height previously recorded (BROWNE, 1926, p. 60).

Eudoxid. The eudoxids being well known, and perhaps the most easily recognized of all calyco-phore eudoxids (beautifully figured by CHUN, 1892), the rather fragmentary specimens collected by the "Thor" call for no special comment. For a recent discussion of the homologies between the bracts of various Abylinae, with respect to ridges and facets, see TOTTON (1932, p. 337).

ABYLOPSIS Chun 1888.

ABYLOPSIS TETRAGONA Otto 1823.

Pyramis tetragona, Otto, 1823, p. 306, Pl. 42, Figs. 2a—2e. For synonymy, see Bigelow, 1911b, p. 224; 1931, p. 544; Browne, 1926, p. 63; Leloup, 1933, p. 21; Moser, 1925, p. 320 (*Abylopsis pentagona*).

Material.

- | | |
|--|---|
| <p>St. 10. $37^{\circ}21' N.$, $16^{\circ}45' E.$ 15. XII. 1908.
 Y. 25 m w. 5 col.; 1 sup. nectoph.; 6 inf. nectoph.; 8 eudox.;
 8 gonoph.
 Y. 65 m w. 1 col.
 Y. 600 m w. 3 col.; 9 sup. nectoph.; 8 inf. nectoph.; 5 eudox.;
 3 gonoph.</p> <p>St. 11. $36^{\circ}57' N.$, $18^{\circ}16' E.$ 16. XII. 1908.
 Y. 25 m w. 7 col.; 15 sup. nectoph.; 8 inf. nectoph.; 18 eudox.;
 9 gonoph.
 Y. 1000 m w. 4 inf. nectoph.</p> <p>St. 13. $39^{\circ}43' N.$, $17^{\circ}30' E.$ 19. XII. 1908.
 Y. 15 m w. 9 col.; 14 inf. nectoph.
 Y. 1000 m w. 1 col.; 1 gonoph.</p> <p>St. 15. $40^{\circ}04' N.$, $19^{\circ}06' E.$ 22. XII. 1908.
 Y. 25 m w. 2 col.; 4 sup. nectoph.; 12 inf. nectoph.
 Y. 1200 m w. 1 col.; 11 inf. nectoph.</p> <p>St. 20. $37^{\circ}48' N.$, $15^{\circ}49' E.$ 5. I. 1909.
 Y. 25 m w. 3 col.; 2 sup. nectoph.; 3 inf. nectoph.</p> <p>St. 21. $37^{\circ}51' N.$, $15^{\circ}21' E.$ 5. I. 1909.
 Y. 10 m w. 2 inf. nectoph.</p> <p>St. 22. $38^{\circ}50' N.$, $15^{\circ}18' E.$ 7. I. 1909.
 Y. 200 m w. 4 col.; 16 inf. nectoph.</p> <p>St. 23. $40^{\circ}34' N.$, $13^{\circ}24' E.$ 15. I. 1909.
 Y. 25 m w. 13 col.; 9 inf. nectoph.</p> <p>St. 24. $40^{\circ}14' N.$, $12^{\circ}23' E.$ 16. I. 1909.
 Y. 25 m w. 37 col.; 3 sup. nectoph.; 39 inf. nectoph.
 Y. 65 m w. 20 col.; 7 sup. nectoph.; 44 inf. nectoph.; 2 eudox.;
 2 gonoph.
 Y. 300 m w. 3 col.
 Y. 600 m w. 3 col.; 4 sup. nectoph.; 8 inf. nectoph.</p> <p>St. 26. $40^{\circ}40' N.$, $13^{\circ}59' E.$ 18. I. 1909.
 Y. 150 m w. 1 sup. nectoph.; 23 inf. nectoph.
 Y. 300 m w. 4 col.; 4 sup. nectoph.; 6 inf. nectoph.; 3 eudox.</p> <p>St. 27. $40^{\circ}58' N.$, $13^{\circ}49' E.$ 19. I. 1909.
 Y. 25 m w. 1 col.; 2 inf. nectoph.</p> <p>St. 28. $40^{\circ}53' N.$, $13^{\circ}43' E.$ 19. I. 1909.
 Y. 25 m w. 5 col.; 5 inf. nectoph.</p> <p>St. 29. $40^{\circ}47' N.$, $12^{\circ}55' E.$ 20. I. 1909.
 Y. 200 m w. 12 col.; 2 sup. nectoph.; 16 inf. nectoph.; 4 eudox.
 Y. 600 m w. 9 col.; 4 sup. nectoph.; 11 inf. nectoph.
 Y. 1650 m w. 3 col.; 1 inf. nectoph.</p> | <p>St. 30. $41^{\circ}15' N.$, $11^{\circ}55' E.$ 21. I. 1909.
 Y. 65 m w. 3 col.; 1 inf.</p> <p>St. 31. $41^{\circ}44' N.$, $10^{\circ}52' E.$ 21. I. 1909.
 Y. 65 m w. 16 col.; 4 sup. nectoph.; 34 inf. nectoph.; 1 eudox.
 Y. 200 m w. 4 sup. nectoph.
 Y. 600 m w. 14 sup. nectoph.; 1 inf. nectoph.
 Y. 1400 m w. 1 col.; 2 sup. nectoph.</p> <p>St. 34. $43^{\circ}27' N.$, $8^{\circ}16' E.$ 23. I. 1909.
 Y. 25 m w. 1 inf. nectoph.
 Y. 200 m w. 1 col.; 1 sup. nectoph.; 4 inf. nectoph.; 1 eudox.</p> <p>St. 35. $43^{\circ}36' N.$, $7^{\circ}36' E.$ 28. I. 1909.
 Y. 200 m w. 3 col.; 39 inf. nectoph.
 Y. 300 m w. 10 col.; 6 sup. nectoph.; 10 inf. nectoph.
 S. 700 m w. 6 col.; 4 inf. nectoph.
 S. 1000 m w. 3 sup. nectoph.; 3 inf. nectoph.
 Y. 1600 m w. 3 col.; 3 sup. nectoph.; 6 inf. nectoph.; 5 eudox.;
 1 gonoph.
 C. 2500 m w. 1 sup. nectoph.; 3 inf. nectoph.</p> <p>St. 36. $42^{\circ}49' N.$, $6^{\circ}54' E.$ 30. I. 1909.
 Y. 300 m w. 3 inf. nectoph.; 2 eudox.</p> <p>St. 38. $40^{\circ}45' N.$, $9^{\circ}50' E.$ 31. I. 1909.
 Y. 25 m w. 2 inf. nectoph.
 Y. 65 m w. 1 col.; 3 inf. nectoph.
 Y. 150 m w. 1 inf. nectoph.</p> <p>St. 39. $39^{\circ}41' N.$, $10^{\circ}02' E.$ 1. II. 1909.
 Y. 25 m w. 9 sup. nectoph.; 23 inf. nectoph.; 5 eudox.; 4 gonoph.
 Y. 65 m w. 1 eudox.
 Y. 300 m w. 1 inf. nectoph.</p> <p>St. 40. $39^{\circ}10' N.$, $9^{\circ}40' E.$ 1. II. 1909.
 Y. 65 m w. 6 col.; 12 inf. nectoph.; 12 eudox.; 2 gonoph.</p> <p>St. 42. $38^{\circ}58' N.$, $9^{\circ}37' E.$ 2. II. 1909.
 Y. 300 m w. 5 col.; 2 inf. nectoph.</p> <p>St. 43. $38^{\circ}14' N.$, $8^{\circ}42' E.$ 3. II. 1909.
 Y. 65 m w. 8 col.; 2 sup. nectoph.; 6 inf. nectoph.; 3 eudox.;
 5 gonoph.</p> <p>St. 46. $37^{\circ}17' N.$, $6^{\circ}00' E.$ 7. II. 1909.
 Y. 65 m w. 38 col.; 3 sup. nectoph.; 25 inf. nectoph.; 1 eudox.;
 1 gonoph.
 Y. 300 m w. 12 col.; 1 sup. nectoph.; 9 inf. nectoph.
 Y. 600 m w. 99 col.; 79 sup. nectoph.; 233 inf. nectoph.; 12
 eudox.; 7 gonoph.</p> |
|--|---|

- St. 47. 36°55' N., 3°12' E. 8. II. 1909.
 Y. 65 m w. 5 col.; 3 sup. nectoph.; 6 inf. nectoph.; 18 eudox.; 3 gonoph.
 Y. 300 m w. 34 col.; 52 sup. nectoph.; 72 inf. nectoph.; 19 eudox.; 13 gonoph.
- St. 50. 37°02' N., 1°17' E. 17. II. 1909.
 Y. 25 m w. 32 col.; 24 sup. nectoph.; 137 inf. nectoph.; 50 eudox.; 36 gonoph.
 Y. 65 m w. 87 col.; 35 sup. nectoph.; 120 inf. nectoph.; 26 eudox.; 29 gonoph.
 Y. 300 m w. 20 col.; 5 sup. nectoph.; 12 inf. nectoph.; 12 eudox.; 4 gonoph.
 Y. 600 m w. 8 col.; 5 sup. nectoph.; 20 inf. nectoph.; 1 eudox.
 Y. 1600 m w. 13 col.; 1 sup. nectoph.; 9 inf. nectoph.; 2 eudox.
- St. 51. 36°27' N., 0°37' W. 18. II. 1909.
 Y. 300 m w. 26 col.; 8 sup. nectoph.; 23 inf. nectoph.; 20 eudox.; 4 gonoph.
- St. 52. 35°55' N., 1°02' W. 18. II. 1909.
 Y. 300 m w. 1 inf. nectoph.; 2 eudox.; 2 gonoph.
- St. 53. 36°13' N., 1°28' W. 18. II. 1909.
 C. 2600 m w. 9 col.; 4 inf. nectoph.
- St. 55. 36°46' N., 2°18' W. 19. II. 1909.
 Y. 25 m w. 5 inf. nectoph.
 Y. 65 m w. 7 inf. nectoph.; 4 eudox.; 2 gonoph.
- St. 57. 36°40' N., 3°30' W. 20. II. 1909.
 Y. 25 m w. 2 col.; 1 sup. nectoph.; 1 inf. nectoph.
 Y. 200 m w. 1 col.; 5 inf. nectoph.
- St. 58. 36°36' N., 4°24' W. 20. II. 1909.
 Y. 65 m w. 1 col.; 1 sup. nectoph.; 5 inf. nectoph.
 Y. 100 m w. 2 col.
- St. 59. 36°02' N., 4°24' W. 21. II. 1909.
 Y. 25 m w. 100 col.; 50 sup. nectoph.; 135 inf. nectoph.
 Y. 100 m w. 26 col.; 16 sup. nectoph.; 40 inf. nectoph.
 Y. 500 m w. 198 col.; 48 sup. nectoph.; 146 inf. nectoph.
 Y. 1200 m w. 128 col.; 131 sup. nectoph.; 148 inf. nectoph.
- St. 61. 35°57' N., 5°35' W. 21. II. 1909.
 Y. 600 m w. 57 col.; 29 sup. nectoph.; 44 inf. nectoph.
- St. 63. 35°50' N., 6°03' W. 22. II. 1909.
 Y. 25 m w. 1 col.
 Y. 600 m w. 1 col.; 6 inf. nectoph.
- St. 66. 36°16' N., 6°52' W. 25. II. 1909.
 Y. 300 m w. 1 inf. nectoph.
 Y. 600 m w. 4 sup. nectoph.; 4 inf. nectoph.
- St. 69. 36°13' N., 9°44' W. 28. II. 1909.
 Y. 25 m w. 1 inf. nectoph.? (fragm.).
 Y. 600 m w. 8 sup. nectoph.; 1 inf. nectoph.; 18 eudox.; 5 gonoph.
- St. 71. 39°35' N., 9°45' W. 4. III. 1909.
 Y. 300 m w. 1 inf. nectoph.
- St. 74. 44°21' N., 7°55' W. 9. III. 1909.
 Y. 600 m w. 1 inf. nectoph.
- St. 94. 36°06' N., 6°02' W. 23. VI. 1910.
 Y. 65 m w. 1 inf. nectoph.
- St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
 Y. 25 m w. 7 sup. nectoph.; 8 inf. nectoph.; 5 eudox.
 Y. 65 m w. 5 col.; 3 sup. nectoph.; 2 inf. nectoph.; 37 eudox.
 Y. 300 m w. 1 col.; 4 sup. nectoph.; 4 inf. nectoph.
- St. 98. 35°57' N. 5°35' W. 23. VI. 1910.
 Y. 65 m w. 12 col.; 39 sup. nectoph.; 40 inf. nectoph.; 48 eudox.
- St. 99. 36°02' N., 5°16' W. 23. VI. 1910.
 Y. 65 m w. 2 col.; 6 sup. nectoph.; 6 inf. nectoph.; 12 eudox.
 Y. 300 m w. 56 col.; 48 inf. nectoph.; 43 eudox.
- St. 104. 36°37' N., 2°04' W. 24. VI. 1910.
 Y. 65 m w. 4 col.; 5 sup. nectoph.; 5 inf. nectoph.; 6 eudox.
- St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
 Y. 300 m w. 92 sup. nectoph.; 94 inf. nectoph.; 75 eudox.; 20 gonoph.
 Y. 1200 m w. 35 col.; 42 sup. nectoph.; 59 inf. nectoph.; 9 eudox.
- St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
 Y. 65 m w. 3 col.; 49 sup. nectoph.; 36 inf. nectoph.; 308 eudox.; 196 gonoph.
 Y. 300 m w. 20 sup. nectoph.; 17 inf. nectoph.; 71 eudox.; gonoph.
- Y. 2000 m w. 126 col.; 76 sup. nectoph.; 128 inf. nectoph.; 17 eudox.
- St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
 Y. 25 m w. 2 eudox.
 Y. 65 m w. 1 col.; 32 sup. nectoph.; 5 inf. nectoph.; 185 eudox.; 74 gonoph.
 Y. 300 m w. 17 col.; 27 sup. nectoph.; 38 inf. nectoph.; 22 eudox.; 2 gonoph.
- St. 112. 36°56' N., 2°15' E. 26. VI. 1910.
 Y. 25 m w. 61 sup. nectoph.; 43 eudox.; 14 gonoph.
 Y. 65 m w. 2 col.; 443 sup. nectoph.; 16 inf. nectoph.; 556 eudox.; 160 gonoph.
 Y. 300 m w. 10 col.; 23 sup. nectoph.; 31 inf. nectoph.; 40 eudox.
- St. 113. 36°53' N., 3°09' E. 28. VI. 1910.
 Y. 300 m w. 101 col.; 76 sup. nectoph.; 104 inf. nectoph.; 20 eudox.
- St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
 Y. 25 m w. 164 sup. nectoph.; 1 inf. nectoph.; 181 eudox.; 46 gonoph.
 Y. 65 m w. 6 col.; 158 sup. nectoph.; 3 inf. nectoph.; 164 eudox.; 20 gonoph.
 Y. 300 m w. 75 col.; 90 sup. nectoph.; 127 inf. nectoph.; 13 eudox.; 1 gonoph.
 Y. 2000 m w. 47 sup. nectoph.; 26 inf. nectoph.; 32 eudox.; 6 gonoph.
- St. 116. 39°27' N., 5°26' E. 29. VI. 1910.
 Y. 25 m w. 3 col.; 412 sup. nectoph.; 19 inf. nectoph.; 273 eudox.; 125 gonoph.
 Y. 65 m w. 1 col.; 38 sup. nectoph.; 1 inf. nectoph.; 19 eudox.; 17 gonoph.
 Y. 300 m w. 22 col.; 58 sup. nectoph.; 39 inf. nectoph.; 14 eudox.
- St. 118. 41°00' N., 6°43' E. 30. VI. 1910.
 Y. 25 m w. 40 sup. nectoph.; 19 inf. nectoph.; 35 eudox.; 25 gonoph.
 Y. 65 m w. 15 col.; 11 sup. nectoph.; 34 inf. nectoph.; 4 eudox.
 Y. 300 m w. 59 sup. nectoph.; 77 inf. nectoph.; 17 eudox.; 2 + gonoph.
- St. 120. 42°31' N., 7°41' E. 1. VII. 1910.
 Y. 300 m w. 7 sup. nectoph.; 7 inf. nectoph.; 3 eudox.; gonoph.
- St. 121. 43°08' N., 8°05' E. 2. VII. 1910.
 Y. 25 m w. 1 sup. nectoph.; 7 eudox.; 3 gonoph.
- St. 122. 43°50' N., 8°34' E. 2. VII. 1910.
 Y. 600 m w. 1 inf. nectoph.; 3 eudox.; 1 gonoph.
 Y. 1200 m w. 14 sup. nectoph.; 18 inf. nectoph.; 3 eudox.
- St. 123. 44°14' N., 8°55' E. 3. VII. 1910.
 Y. 25 m w. 2 sup. nectoph.; 6 eudox.
 Y. 65 m w. 10 col.; 125 sup. nectoph.; 5 inf. nectoph.; 743 eudox.; 339 gonoph.
 Y. 300 m w. 12 sup. nectoph.; 14 inf. nectoph.; 7 eudox.; gonoph.
 Y. 300 m w. 12 sup. nectoph.; 14 inf. nectoph.; 7 eudox.; gonoph.
- St. 125. 43°54' N., 9°13' E. 9. VII. 1910.
 Y. 25 m w. 2 sup. nectoph.; 2 inf. nectoph.; 11 eudox.; 5 gonoph.
 Y. 300 m w. 48 sup. nectoph.; 51 inf. nectoph.; 3 eudox.
- St. 126. 42°43' N., 9°50' E. 10. VII. 1910.
 Y. 300 m w. 1 col.; 1 sup. nectoph.; 1 inf. nectoph.
- St. 129. 40°05' N., 11°31' E. 12. VII. 1910.
 Y. 300 m w. 20 sup. nectoph.; 24 inf. nectoph.
 Y. 600 m w. 2 sup. nectoph.; 2 inf. nectoph.
 Y. 1000 m w. 4 col.; 1 sup. nectoph.; 2 inf. nectoph.
 C. 3500 m w. 3 col.; 2 sup. nectoph.; 3 inf. nectoph.
- St. 130. 39°35' N., 11°20' E. 13. VII. 1910.
 Y. 25 m w. 26 sup. nectoph.; 37 eudox.; 5 gonoph.
- St. 131. 38°36' N., 11°00' E. 13. VII. 1910.
 Y. 25 m w. 1 sup. nectoph.; 1 eudox.
 Y. 300 m w. 1 sup. nectoph.
- Y. 1000 m w. 5 col.; 5 sup. nectoph.; 3 inf. nectoph.
- St. 132. 38°57' N., 9°47' E. 14. VII. 1910.
 Y. 25 m w. 4 sup. nectoph.; 1 inf. nectoph.; 5 eudox.; 5 ± gonoph.
- Y. 300 m w. 3 col.; 2 sup. nectoph.; 4 inf. nectoph.
- Y. 600 m w. 1 inf. nectoph.
- St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
 Y. 25 m w. 206 sup. nectoph.; 11 inf. nectoph.; 189 eudox.; 20 gonoph.
- Y. 300 m w. 25 sup. nectoph.; 31 inf. nectoph.; 4 eudox.
- Y. 600 m w. 22 sup. nectoph.; 27 inf. nectoph.; 4 eudox.; 2 gonoph.

- St. 134. 37°37' N., 10°17' E. 15. VII. 1910.
 Y. 25 m w. 521 sup. nectoph.; 174 inf. nectoph.; 107 eudox.;
 40 ± gonoph.
 Y. 300 m wire. 19 col.; 207 sup. nectoph.; 39 inf. nectoph.;
 40 eudox.
- St. 135. 37°17' N., 10°28' E. 15. VII. 1910.
 Y. 25 m w. 2 col.; 15 sup. nectoph.; 3 inf. nectoph.; 7 eudox.;
 2 gonoph.
- St. 136. 37°01' N., 10°31' E. 19. VII. 1910.
 Y. 25 m w. 1 col.; 3 sup. nectoph.; 3 inf. nectoph.
- Y. 100 m w. 1 col.; 3 sup. nectoph.; 2 inf. nectoph.
- St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
 Y. 25 m w. 12 col.; 506 sup. nectoph.; 82 inf. nectoph.; 346
 eudox.; 160 gonoph.
 Y. 250 m w. 109 sup. nectoph.; 45 inf. nectoph.; 34 eudox.;
 15 gonoph.
- St. 138. 37°37' N., 11°25' E. 19. VII. 1910.
 Y. 25 m w. 2 col.; 200 + sup. nectoph.; 3 inf. nectoph.;
 45 + eudox.; 10 gonoph.; 235 fragm.
 Y. 300 m w. 14 col.; 21 sup. nectoph.; 23 inf. nectoph.
- Y. 1000 m w. 96 col.; 111 sup. nectoph.; 127 inf. nectoph.;
 23 eudox.; 6 gonoph.
- St. 139. 37°57' N., 11°54' E. 20. VII. 1910.
 Y. 25 m w. 3 sup. nectoph.; 1 inf. nectoph.; 4 eudox.
 Y. 300 m w. 32 col.; 71 sup. nectoph.; 58 inf. nectoph.; 8
 eudox.; 1 gonoph.
 Y. 800 m w. 15 col.; 14 sup. nectoph.; 16 inf. nectoph.; 4 eudox.
- St. 141. 36°42' N., 13°34' E. 20. VII. 1910.
 Y. 25 m w. 1 inf. nectoph.
- St. 142. 35°44' N., 15°07' E. 22. VII. 1910.
 Y. 25 m w. 1 sup. nectoph.
 Y. 150 m w. 48 sup. nectoph.; 1 inf. nectoph.; 4 eudox.
- St. 143. 35°18' N., 16°25' E. 22. VII. 1910.
 Y. 300 m w. 12 col.; 2 sup. nectoph.; 15 inf. nectoph.
 Y. 1000 m w. 2 col.; 5 sup. nectoph.; 5 inf. nectoph.; 1 eudox.
- St. 144. 34°31' N., 18°40' E. 24. VII. 1910.
 Y. 300 m w. 1 col.
- St. 145. 32°38' N., 19°02' E. 25. VII. 1910.
 Y. 300 m w. 2 col.; 3 sup. nectoph.; 2 inf. nectoph.
- St. 147. 31°35' N., 19°02' E. 25. VII. 1910.
 Y. 25 m w. 1 inf. nectoph.
- St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
 Y. 65 m w. 6 sup. nectoph.; 7 inf. nectoph.; 1 eudox.; 5 gonoph.
 Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.
- Y. 1200 m w. 2 sup. nectoph.; 3 inf. nectoph.
- St. 187. 37°54' N., 18°02' E. 18. VIII. 1910.
 Y. 1000 m w. 2 sup. nectoph.; 3 inf. nectoph.
- St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.
 Y. 100 m w. 1 col.
- St. 190. 37°51' N., 15°19' E. 19. VIII. 1910.
 Y. 25 m w. 4 sup. nectoph.; 8 eudox.
- St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
 Y. 25 m w. 1 sup. nectoph.; 5 eudox.
 Y. 300 m w. 5 col.; 10 sup. nectoph.; 18 inf. nectoph.
 Y. 600 m w. 10 col.; 26 sup. nectoph.; 20 inf. nectoph.
- St. 193. 38°15' N., 15°39' E. 21. VIII. 1910.
 Y. 10 m w. 3 sup. nectoph.; 1 inf. nectoph.; 24 eudox.; 3 gonoph.
- St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
 Y. 10 m w. 1 sup. nectoph.; 4 eudox.
 Y. 25 m w. 10 sup. nectoph.; 1 inf. nectoph.; 41 eudox.; 10
 gonoph.
 Y. 1200 m w. 4 col.; 1 sup. nectoph.; 4 eudox.
- St. 195. 39°02' N., 14°55' E. 21. VIII. 1910.
 Y. 25 m w. 6 sup. nectoph.; 16 eudox.; 2 gonoph.
 Y. 300 m w. 1 sup. nectoph.; 1 inf. nectoph.
- St. 197. 40°34' N., 13°36' E. 24. VIII. 1910.
 Y. 300 m w. 3 col.; 5 sup. nectoph.; 3 inf. nectoph.
- St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
 Y. 25 m w. 1 col.
 Y. 300 m w. 5 sup. nectoph.; 6 inf. nectoph.; 2 eudox.
 Y. 1000 m w. 3 col.; 3 sup. nectoph.; 2 inf. nectoph.
- St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
 Y. 25 m w. 1 col.; 4 sup. nectoph.; 4 inf. nectoph.
 Y. 65 m w. 1 col.; 5 sup. nectoph.; 3 inf. nectoph.; 9 eudox.
 Y. 300 m w. 61 col.; 46 sup. nectoph.; 72 inf. nectoph.; 1 eudox.
 Y. 1000 m w. 38 col.; 21 sup. nectoph.; 21 inf. nectoph.; 5 eudox.
- St. 205. 39°16' N., 5°52' E. 27. VIII. 1910.
 Y. 25 m w. 223 sup. nectoph.; 206 inf. nectoph.; 22 eudox.
- St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
 Y. 25 m w. 8 col.; 22 sup. nectoph.; 45 inf. nectoph.; 8 eudox.;
 3 gonoph.
 Y. 300 m w. 40 col.; 75 sup. nectoph.; 107 inf. nectoph.; 21
 eudox.; 5 gonoph.
- Y. 1000 m w. 36 col.; 79 sup. nectoph.; 105 inf. nectoph.;
 29 eudox.; 1 gonoph.
- Y. 2000 m w. 148 sup. nectoph.; 142 inf. nectoph.; 22 eudox.;
 10 gonoph.
- St. 207. 39°58' N., 3°41' E. 28. VIII. 1910.
 Y. 25 m w. 2 sup. nectoph.; 1 gonoph.
- Y. 65 m w. 28 sup. nectoph.; 4 inf. nectoph.; 25 eudox.
- St. 208. 40°18' N., 3°20' E. 29. VIII. 1910.
 Y. 25 m w. 6 sup. nectoph.
- St. 209. 40°34' N., 3°03' E. 29. VIII. 1910.
 C. 0–35 m w. 3 sup. nectoph.
 C. 150 m w. 1 col.; 41 sup. nectoph.; 8 inf. nectoph.; 168
 eudox.; 26 gonoph.
- Y. 25 m w. 1 col.; 31 sup. nectoph.; 122 eudox.; 35 gonoph.
 Y. 100 m w. 18 sup. nectoph.; 6 inf. nectoph.; 56 eudox.;
 11 gonoph.
- Y. 300 m w. 9 sup. nectoph.; 12 eudox.; 4 gonoph.
- Y. 2000 m w. 4 col.; 4 sup. nectoph.; 10 eudox.; 3 gonoph.
- St. 210. 41°10' N., 2°23' E. 30. VIII. 1910.
 Y. 25 m w. 1 col.
- Y. 600 m w. 2 col.; 5 sup. nectoph.; 6 inf. nectoph.; 1 eudox.
- St. 215. 39°14' N., 0°52' E. 31. VIII. 1910.
 Y. 25 m w. 5 sup. nectoph.; 2 inf. nectoph.; 5 eudox.
- St. 216. 38°31' N., 1°24' E. 1. IX. 1910.
 Y. 25 m w. 6 sup. nectoph.; 15 inf. nectoph.
- St. 217. 38°01' N., 1°48' E. 1. IX. 1910.
 Y. 300 m w. 13 col.; 9 sup. nectoph.; 13 inf. nectoph.; 2
 eudox.
- St. 218. 36°54' N., 2°57' E. 2. IX. 1910.
 Y. 25 m w. 18 sup. nectoph.; 18 inf. nectoph.; 2 eudox.; 4
 gonoph.
- St. 220. 36°25' N., 0°42' E. 4. IX. 1910.
 Y. 25 m w. 17 col.; 6 sup. nectoph.; 23 inf. nectoph.; 1 eudox.
- St. 221. 35°44' N., 0°53' W. 4. IX. 1910.
 Y. 25 m w. 7 col.; 1292 sup. nectoph.; 98 inf. nectoph.; 5926
 eudox.; 2769 gonoph.
- St. 222. 35°53' N., 0°57' W. 4. IX. 1910.
 Y. 300 m w. 34 col.; 58 sup. nectoph.; 72 inf. nectoph.; 13
 eudox.; 11 gonoph.
- St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
 Y. 25 m w. 7 sup. nectoph.; 1 eudox.; 1 gonoph.
- Y. 300 m w. 73 col.; 30 sup. nectoph.; 76 inf. nectoph.
- St. 225. 36°35' N., 3°00' W. 6. IX. 1910.
 Y. 25 m w. 41 sup. nectoph.; 316 eudox.; 96 gonoph.
- St. 228. 36°02' N., 5°06' W. 7. IX. 1910.
 Y. 25 m w. 12 col.; 6 sup. nectoph.; 13 inf. nectoph.; 2
 eudox.
- Y. 800 m w. 206 col.; 169 sup. nectoph.; 234 inf. nectoph.;
 24 eudox.; 7 gonoph.
- St. 229. 35°51' N., 5°58' W. 8. IX. 1910.
 Y. 300 m w. 1 inf. nectoph.
- St. 245. 47°14' N., 6°02' W. 17. IX. 1910.
 Y. 250 m w. 1 eudox.
- St. 278. 38°11.5' N., 15°37.5' E. 22. II. 1911.
 S. 15 m w. 1 col.; 1 sup. nectoph.; 7 eudox.; 1 gonoph.
- St. 279. 38°11.5' N., 15°36.5' E. 23. II. 1911.
 S. 30 m w. 1 col.; 6 eudox.
- St. 280. 38°11' N., 15°36.5' E. 25. II. 1911.
 S. 15 m w. 1 sup. nectoph.; 5 eudox.; 7 gonoph.
- St. 281. 38°15' N., 15°37.5' E. 1. III. 1911.
 S. 10 m w. 1 sup. nectoph.; 1 inf. nectoph.
- S. 30 m w. 1 col.; 1 sup. nectoph.; 1 inf. nectoph.; 1 eudox.
- S. 40 m w. 2 col.; 7 eudox.; 4 gonoph.
- St. 282. 38°12' N., 15°37' E. 8. III. 1911.
 S. 40 m w. 1 col.; 4 sup. nectoph.; 3 inf. nectoph.; 17 eudox.;
 5 gonoph.
- St. 283. 38°12' N., 15°37' E. 12. III. 1911.
 S. 40 m w. 6 sup. nectoph.; 2 inf. nectoph.; 5 eudox.; 2
 gonoph.

The reasons that necessitate reviving OTTO's name *tetragona*, for this species, are stated elsewhere (BIGELOW, 1911b, p. 224; 1931, p. 545).

Most of the "Thor" specimens are more or less battered. There is, however, no danger of confusing the inferior nectophores of *A. tetragona* with those of any other species. The conformation of the bract of the free eudoxid is equally distinctive, for the relative sizes of the apico-lateral and baso-lateral facets differ widely from those of *A. eschscholtzii*, the only other abyliid in which the bracteal somatocyst is of similar form¹. For discussions of the criteria by which superior nectophores are distinguishable from those of *A. eschscholtzii*, which they closely resemble in general appearance, see BROWNE, 1926, p. 64; BIGELOW, 1931, p. 547; TOTTEN 1932, p. 335.

BASSIA L. Agassiz 1862.

BASSIA BASSENSIS Quoy and Gaimard 1834.

Diphyes bassensis, Quoy & Gaimard, 1834, p. 91, Pl. 4, Figs. 18—20.

For synonymy, see Bigelow, 1911b, p. 229; Moser, 1925, p. 347; Leloup, 1933, p. 24.

Material.

St. 7. 37°00' N., 9°07' W. 4. XII. 1908. Y. 65 m w. 2 inf. nectoph.	St. 91. 35°53' N., 7°26' W. 18. VI. 1910. Y. 300 m w. 69 sup. nectoph.; 66 eudox.; 159 bracts; 30 gonoph. (fragm.).
St. 10. 37°21' N., 16°45' E. 15. XII. 1908. Y. 25 m w. 2 col.; 11 sup. nectoph.; 2 inf. nectoph.; 28 eudox.; 2 gonoph.	Y. 1600 m w. 1 col.; 7 sup. nectoph.; 4 inf. nectoph.; 16 eudox.; 15 gonoph.
Y. 65 m w. 1 sup. nectoph.; 1 eudox.	St. 92. 36°18' N., 6°50' W. 19. VI. 1910. Y. 65 m w. 286 ± sup. nectoph.; 337 ± inf. nectoph.; 270 ± eudox.; 5 gonoph. ²
Y. 600 m w. 5 sup. nectoph.; 3 eudox.	St. 93. 36°17' N., 6°17' W. 22. VI. 1910. Y. 50 m w. 3 sup. nectoph.; 5 inf. nectoph.; 4 eudox.; 4 bracts.
St. 11. 36°57' N., 18°16' E. 16. XII. 1908. Y. 25 m w. 15 sup. nectoph.; 8 inf. nectoph.; 21 eudox.	St. 94. 36°06' N., 6°02' W. 23. VI. 1910. Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.
St. 38. 40°45' N., 9°50' E. 31. I. 1909. Y. 150 m w. 1 inf. nectoph.	St. 95. 35°57' N., 6°00' W. 23. VI. 1910. Y. 25 m w. 808 sup. nectoph.; 379 inf. nectoph.; 457 eudox.; 220 gonoph.
St. 43. 38°14' N., 8°42' E. 3. II. 1909. Y. 65 m w. 1 bract.	Y. 65 m w. 810 sup. nectoph.; 431 inf. nectoph.; 1202 eudox.; 184 gonoph.
St. 47. 36°55' N., 8°12' E. 8. II. 1909. Y. 65 m w. 1 bract.	Y. 300 m w. 3 sup. nectoph.; 5 inf. nectoph.; 3 eudox.; 8 bracts; 1 gonoph.
St. 63. 35°50' N., 6°03' W. 21. II. 1909. Y. 25 m w. 6 inf. nectoph.; 1 eudox.	St. 96. 35°48' N., 5°58' W. 23. VI. 1910. Y. 65 m w. 4 sup. nectoph.; 4 inf. nectoph.; 5 bracts.
St. 65. 35°53' N., 7°26' W. 24. II. 1909. Y. 25 m w. 3 sup. nectoph.; 4 inf. nectoph.	St. 98. 35°57' N., 5°35' W. 23. VI. 1910. Y. 65 m w. 860 sup. nectoph.; 625 inf. nectoph.; 1194 eudox.; 214 gonoph.; (100 fragm.).
Y. 65 m w. 3 sup. nectoph.; 17 inf. nectoph.; 14 eudox.; 4 gonoph.	St. 99. 36°02' N., 5°16' W. 23. VI. 1910. Y. 65 m w. 5 eudox.
Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.; 3 eudox.	St. 106. 36°33' N., 2°00' W. 24. VI. 1910. Y. 300 m w. 1 eudox.
Y. 600 m w. 1 inf. nectoph.	St. 108. 36°03' N., 0°27' W. 25. VI. 1910. Y. 25 m w. 1 bract.
St. 66. 36°16' N., 6°52' W. 25. II. 1909. Y. 25 m w. 1 inf. nectoph.	Y. 65 m w. 1 eudox.
Y. 300 m w. 1 sup. nectoph.	St. 112. 36°56' N., 2°15' E. 26. VI. 1910. Y. 25 m w. 1 eudox.
St. 68. 36°39' N., 7°21' W. 27. II. 1909. Y. 800 m w. 1 inf. nectoph.; 1 gonoph.	Y. 65 m w. 1 sup. nectoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909. Y. 25 m w. 2 sup. nectoph.; 21 eudox.; 2 gonoph.; 10 fragm.	St. 123. 44°14' N., 8°55' E. 2. VII. 1910. Y. 25 m w. 1 eudox.
Y. 65 m w. 1 col.; 25 sup. nectoph.; 9 inf. nectoph.; 177 eudox.; 36 gonoph.	St. 134. 37°37' N., 10°17' E. 15. VII. 1910. Y. 25 m w. 3 sup. nectoph.; 1 inf. nectoph.; 1 eudox.
Y. 300 m w. 24 sup. nectoph.; 21 inf. nectoph.; 181 eudox.; 43 gonoph.	Y. 300 m w. 1 bract.
Y. 600 m w. 1 col.; 3 sup. nectoph.; 2 inf. nectoph.; 23 eudox.; 4 gonoph.; 6 fragm.	St. 136. 37°01' N., 10°31' E. 19. VII. 1910. Y. 25 m w. 1 inf. nectoph.
C. 3000 m w. 1 inf. nectoph.; 1 gonoph.	St. 137. 37°17' N., 10°56' E. 19. VII. 1910. Y. 25 m w. 4 sup. nectoph.; 4 inf. nectoph.
St. 70. 39°06' N., 9°47' W. 4. III. 1909. Y. 65 m w. 1 inf. nectoph.; 2 gonoph.	Y. 250 m w. 1 sup. nectoph.; 2 inf. nectoph.
St. 71. 39°35' N., 9°45' W. 4. III. 1909. Y. 300 m w. 1 sup. nectoph.; 6 inf. nectoph.; 15 eudox.	St. 138. 37°37' N., 11°25' E. 19. VII. 1910. Y. 25 m w. 2 sup. nectoph.? (fragm.).
St. 87. 37°03' N., 9°15' W. 17. VI. 1910. Y. 300 m w. 1 eudox.	Y. 300 m w. 1 inf. nectoph.
St. 89. 36°28' N., 8°22' W. 18. VI. 1910. Y. 300 m w. 12 sup. nectoph.; 2 inf. nectoph.; 25 eudox.; 30 gonoph.	Y. 1000 m w. 1 sup. nectoph.; 2 eudox.
Y. 1000 m w. 55 sup. nectoph.; 10 inf. nectoph.; 50 eudox.; 30 gonoph.	

¹ For diagrams of bracts of Abylid eudoxids, see TOTTEN, 1932, Fig. 17.

² Catches estimated after actually counting 0.19 and 0.29 of the tows at St. 92 (65 m wire) and St. 233 (25 m wire), respectively.

- St. 142. $35^{\circ}44' N.$, $15^{\circ}07' E.$ 22. VII. 1910.
Y. 25 m w. 2 sup. nectoph.; 2 inf. nectoph.
- St. 143. $35^{\circ}18' N.$, $16^{\circ}25' E.$ 23. VII. 1910.
Y. 1000 m w. 1 sup. nectoph.
- St. 144. $34^{\circ}31' N.$, $18^{\circ}40' E.$ 24. VII. 1910.
Y. 25 m w. 4 sup. nectoph.; 1 inf. nectoph.; 2 bracts.
- St. 145. $32^{\circ}38' N.$, $19^{\circ}02' E.$ 25. VII. 1910.
Y. 25 m w. 1 sup. nectoph.
- St. 147. $31^{\circ}35' N.$, $19^{\circ}02' E.$ 25. VII. 1910.
Y. 300 m w. 1 col.; 5 sup. nectoph.; 3 bracts.
- St. 152. $33^{\circ}11' N.$, $21^{\circ}44' E.$ 27. VII. 1910.
Y. 25 m w. 2 inf. nectoph.; 1 bract.
- St. 156. $32^{\circ}16' N.$, $26^{\circ}03' E.$ 29. VII. 1910.
Y. 1000 m w. 2 sup. nectoph.; 1 inf. nectoph.
- St. 158. $34^{\circ}23' N.$, $27^{\circ}57' E.$ 31. VII. 1910.
Y. 300 m w. 1 sup. nectoph.; 2 bracts.
- St. 160. $35^{\circ}59' N.$, $28^{\circ}14' E.$ 1. VIII. 1910.
Y. 25 m w. 87 sup. nectoph.; 11 inf. nectoph.; 15 eudox.; 61 bracts.
- St. 161. $36^{\circ}12' N.$, $27^{\circ}16' E.$ 2. VIII. 1910.
Y. 25 m w. 2 sup. nectoph.; 2 inf. nectoph.; 1 bract.
- St. 163. $37^{\circ}52' N.$, $26^{\circ}22' E.$ 2. VIII. 1910.
Y. 25 m w. 37 col.; 527 sup. nectoph.; 134 inf. nectoph.; 114 eudox.; 473 bracts; 89 gonoph.
- St. 179. $40^{\circ}02' N.$, $25^{\circ}55' E.$ 13. VIII. 1910.
Y. 65 m w. 11 bracts.
- St. 181. $38^{\circ}49' N.$, $25^{\circ}09' E.$ 13. VIII. 1910.
Y. 65 m w. 2 col.; 12 sup. nectoph.; 11 inf. nectoph.
- St. 182. $38^{\circ}13' N.$, $24^{\circ}48' E.$ 14. VIII. 1910.
Y. 65 m w. 2 sup. nectoph.; 3 inf. nectoph.; 2 bracts.
- St. 183. $37^{\circ}52' N.$, $23^{\circ}09' E.$ 16. VIII. 1910.
Y. 600 m w. 2 inf. nectoph.; 3 bracts.
- St. 208. $40^{\circ}18' N.$, $3^{\circ}20' E.$ 29. VIII. 1910.
Y. 25 m w. 1 gonoph.
- St. 217. $38^{\circ}01' N.$, $1^{\circ}48' E.$ 1. IX. 1910.
Y. 300 m w. 1 eudox. (fragm.).
- St. 221. $35^{\circ}44' N.$, $0^{\circ}53' W.$ 4. IX. 1910.
Y. 25 m w. 1 inf. nectoph.
- St. 229. $35^{\circ}51' N.$, $5^{\circ}58' W.$ 8. IX. 1910.
Y. 25 m w. 3 inf. nectoph.; 1 bract.
- St. 231. $35^{\circ}56' N.$, $7^{\circ}16' W.$ 8. IX. 1910.
Y. 25 m w. 33 col.; 402 sup. nectoph.; 764 inf. nectoph.; 948 eudox.; 121 bracts; 304 gonoph.; 103 fragm.
- St. 232. $36^{\circ}28' N.$, $9^{\circ}06' W.$ 9. IX. 1910.
Y. 25 m w. 1 col.; 17 sup. nectoph.; 15 inf. nectoph.; 30 eudox.; 1 gonoph.
- St. 233. $36^{\circ}49' N.$, $9^{\circ}15' W.$ 10. IX. 1910.
Y. 25 m w. $61 \pm$ col.; $7562 \pm$ sup. nectoph.; $7262 \pm$ inf. nectoph.; 4207 \pm eudox.; 2623 \pm gonoph¹.
- St. 234. $38^{\circ}10' N.$, $9^{\circ}20' W.$ 10. IX. 1910.
Y. 25 m w. 1 inf. nectoph.?
- St. 296. $32^{\circ}10' N.$, $29^{\circ}50' E.$ 25. VI. 1911.
S. 28 m w. 1 inf. nectoph.
- St. 341. $34^{\circ}00' N.$, $26^{\circ}20' E.$ 27. VIII. 1911.
S. 28 m w. 1 sup. nectoph.; 1 inf. nectoph.

Distinctive morphological characters of the superior nectophore, which resembles that of *Abylopsis* in the general arrangement of facets and ridges, are that the base of the hydroecium is not prolonged, as it is in the latter, and that the somatocyst lacks any trace of an apical diverticulum. The inferior nectophore stands alone, among the Abylinae, in that the wings of the hydroecium are fused to form a tube along the upper two thirds of the length of the bell, instead of remaining separate. MOSER (1925, p. 351) seems to have been the first specifically to emphasize (though many previous observers must have seen) the most striking feature of the nectophores and bracts of *Bassia*; namely, that the angles appear as white bands when seen on a black background, and as opaque-grayish or brownish ridges by transmitted light. So noticeable is this, that it is easy to detect even the most battered specimens at a glance. The fact that the basal angle of the right hydroecial wing of the inferior nectophore is prolonged as a prominent tooth seems also first to have been mentioned and pictured by her (MOSER, 1925, p. 351, Pl. 22, Fig. 3, 7). This is also shown in TOTTON's (1932, Fig. 18) drawing. HAECKEL's otherwise beautiful illustrations fail to show the notable asymmetry, in this respect, between the hydroecial wings.

Superior nectophores of this species are more resistant than the inferior ones, and many of the superiors in the "Thor" series are in good condition. But the inferiors are much battered, for which reason, they do not solve the question whether the suppressed ridge is the right lateral, as one of us has stated (BIGELOW, 1911b, p. 230), or the median dorsal, as TOTTON (1932, p. 339) believes.

MOSER (1925), who gave the first detailed account of the radial subumbrial canals of the inferior nectophore, describes them as grouped in two pairs, a dorsal, and a ventral, corresponding in radial location, to the four basal angles of the bell. TOTTON (1932, Fig. 18) shows them as similarly paired. But while MOSER states that the members of the ventral pair draw close together as they approach the ring canal, TOTTON shows them as continuing well apart, to their junction with the latter. Such of the inferior bells, in the "Thor" collection as are in good enough condition to show this feature, agree with MOSER's account in this respect. The great majority are too fragmentary to show the critical parts of all four of the canals clearly. In our ex-

¹ Catches estimated after actually counting 0.19 and 0.29 of the tows at St. 92 (65 m wire) and St. 233 (25 m wire), respectively.

perience, as in BROWNE's (1926, p. 65) routine preservation with formalin usually so softens and wrinkles the gelatinous substance of inferior bells of *Bassia* that the courses of the ridges and outlines of the basal angles and teeth are much distorted. This also applies to the bracts. Superior nectophores, on the other hand, preserve very well.

CERATOCYMBINAE Moser 1925.

CERATOCYMBA Chun 1888.

CERATOCYMBA SAGITTATA Quoy and Gaimard 1827.

Cymba sagittata, Quoy and Gaimard, 1827, p. 16, Pl. 2c, Fig. 1—9 (free Eudoxid).

Diphyabyla hubrechti, Lens and Van Riemsdijk, 1908, p. 36, Pl. 6, Fig. 47; Bigelow, 1911 b, p. 231, Pl. 12, Fig. 7.

For synonymy, see Bigelow, 1918, p. 411; Moser, 1925, p. 269.

Subsequent references are, *Ceratocymba sagittata*, Totton, 1925, p. 446; Browne, 1926, p. 65; Bigelow, 1931, p. 548; Leloup, 1933, p. 19; 1934, p. 54.

Material.

St. 62. 35°45' N., 5°59' W. 21. II. 1909. Y. 25 m w. 1 sup. nectoph.	St. 91. 35°53' N., 7°26' W. 18. VI. 1910. Y. 300 m w. 3 sup. nectoph.; 14 eudox.; 27 gonoph.
St. 64. 36°32' N., 6°26' W. 22. II. 1909. Y. 25 m w. 1 eudox.	St. 94. 36°06' N., 6°02' W. 23. VI. 1910. Y. 65 m w. 1 eudox.
St. 65. 35°53' N., 7°26' W. 24. II. 1909. Y. 600 m w. 1 sup. nectoph.; 3 inf. nectoph.	St. 95. 35°57' N., 6°00' W. 23. VI. 1910. Y. 300 m w. 1 bract; 1 gonoph.
Y. 1600 m w. 1 sup. nectoph.	St. 96. 35°48' N., 5°58' W. 23. VI. 1910. Y. 65 m w. 4 bracts; 5 gonoph.
St. 66. 36°16' N., 6°52' W. 25. II. 1909. Y. 25 m w. 1 sup. nectoph.	St. 98. 35°57' N., 5°35' W. 23. VI. 1910. Y. 65 m w. 2 sup. nectoph.
Y. 65 m w. 1 sup. nectoph.	St. 99. 36°02' N., 5°16' W. 23. VI. 1910. Y. 300 m w. 1 eudox.; 1 gonoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909. Y. 25 m w. 2 sup. nectoph.; 1 eudox.; 2 gonoph.	St. 232. 36°28' N., 9°06' W. 9. IX. 1910. Y. 300 m w. 1 bract.
Y. 600 m w. 1 sup. nectoph.; 1 inf. nectoph.; 1 eudox.	Y. 1000 m w. 3 sup. nectoph.; 1 inf. nectoph.
St. 71. 39°35' N., 9°45' W. 4. III. 1909. Y. 300 m w. 1 inf. nectoph.	
St. 89. 36°28' N., 8°22' W. 18. VI. 1910. Y. 65 m w. 1 eudox.	
Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.; 4 eudox.; 1 bract; 5 gonoph.	
Y. 1000 m w. 2 gonoph.	

The superior nectophores, made recognizable at a glance, among abylids, by their high-pyramidal outline, have been pictured by LENS and VAN RIEMSDIJK (1908), by MOSER (1925), and by BIGELOW (1911 b, Pl. 12, Fig. 7). The largest superior nectophore in the "Thor" series is 29 mm. long. Up to the present, no complete colonies have been seen, with both bells still connected; nor are there any in the "Thor" collection. But the inferiors described and figured by BIGELOW (1918, p. 413, Pl. 7, Fig. 1) and by MOSER (1925, p. 275, Pl. 15, Figs. 1, 4, Pl. 16, Fig. 1) seem almost certainly to belong to this species, not only because taken side by side with the superior bells, but also because of their large size, of their strongly diagnostic characters (see below), and of their resemblance to the gonophores of this species. Like the inferior bells of *Abyla trigona*, they are triangular in cross section above the midlevel. In *Ceratocymba*, however, as in *Abyla leuckartii*, it is the upper part of the dorsal ridge which is suppressed, whereas it is the upper part of the right lateral in *trigona*. *Ceratocymba* is, however, sharply separated from *A. leuckartii* by the fact that the right ventro-basal corner of the inferior bell of the former is prolonged into a tooth that is much longer than either the dorsal or the lateral teeth, whereas the left ventro-basal corner is but little more than rectangular. The asymmetry is, in fact, much more pronounced in this respect, in *Ceratocymba* than in any other abylid so far known¹. Altogether, the "Thor" series contains 8 inferiors, of this type, ranging in length up to 33 mm.

¹ The inferior nectophores of all known abylids have been described, except that of *A. haekeli*, the superior bell of which so closely resembles that of *A. trigona* that the parallelism will probably be found to extend to the inferior as well.

Superior and inferior bells of this species are so large, so resistant, and so easily recognized, that the foregoing list no doubt includes all that were taken. It is, therefore, interesting that there are more than twice as many superiors as inferiors, the numbers being equal in only one haul. This suggests that the bells are easily separated, and that after separation — perhaps by waves — the inferiors soon perish, as might, indeed, be expected. On the other hand, the superiors often continue attached to the stem, and hence are enabled to survive. The stems, in one superior nectophore in the "Bache" collection, bore one cormidium with a male gonophore far enough advanced to show its definitive characters (BIGELOW, 1918, Pl. 6, Fig. 1, 2). And it is on the basis of this that the free eudoxids with gonophores attached, and loose gonophores are identified as this species. The gonophores show the same type of asymmetry as the inferior nectophores, but the two sexes are mirror images, one of the other in this respect, it being the right basoventral tooth that is prolonged in the male, the left hand in the female as MOSER (1912a) first pointed out. For illustrations of the gonophores, see BIGELOW, 1918, Pl. 6, Fig. 2, 3; Pl. 7, Fig. 2, 3; MOSER, 1925, Pl. 16, Fig. 3, 5.

The identity of the loose bracts listed above seems equally assured, both by the fact that they were taken together with *sagittata* gonophores and that the collection did not contain any examples (nectophores or eudoxids) of *Abyla leuckartii*, which is the only known species with which they could be confused.

According to MOSER (1913a; 1925, p. 289), the bracts of *C. sagittata* and *A. leuckartii* are in fact so much alike that they are indistinguishable when detached. But, as elsewhere pointed out (BIGELOW, 1918, p. 414, Pl. 5, Fig. 5; 1931, p. 549), the left lateral ridge of the bract of *C. sagittata* (identity proven by the gonophore), fails to reach the left apical ridge, whereas it reached the latter in the only *A. leuckartii*, of proven identity¹, seen by us. And as this is also true of all of the eudoxids listed above (except for a few that are too damaged to show the ridge at all), and likewise for such of the loose bracts as are in good condition, it seems that it is a reliable specific criterion. This also applies to the contour of the apical facet of the bract which is deeply concave and triangular in all the "Thor" specimens, as it was the "Bache" series (BIGELOW, 1918, p. 414, Pl. 5, Fig. 5). This contrasts so strongly with the flat or slightly convex and quadrangular apical facet of the bract of *A. leuckartii* as to make identification possible for specimens the condition of which does not allow detection of the point of termination of the left lateral ridge.

GALETTINAE Stechow 1921.

TOTTON (1932, p. 340) followed by LELLOUP (1933, p. 25) has shown what one of us (BIGELOW, 1931) had overlooked, that abandonment of *Galeolaria* as the generic name for siphonophores because preoccupied for a worm as STECHOW (1921) pointed out, necessitates the resurrection of *Sulculeolaria*, Blainville (1834) with *S. quadrivalvis* Blainville (1834) as the type. Whether *Galetta*, proposed by STECHOW (1921) to replace *Galeolaria* as a siphonophore-name, becomes a synonym of *Sulculeolaria*, depends on whether absence of basal teeth in its type species (*G. australis*, Quoy and Gaimard 1834) contrasted with their presence in *Sulculeolaria quadrivalvis*, is sufficient difference for generic separation. Totton recognizes both genera, *Sulculeolaria* for toothed Galettinae, *Galetta* for the toothless species. And this course is followed here, as by LELLOUP (1933, 1934).

SULCULEOLARIA Blainville 1830².

Recent studies by BROWNE (1926, p. 66), by TOTTON (1932, p. 340), and by BIGELOW (1918, p. 415; 1931, p. 549) indicate that the three named forms referable to *Sulculeolaria* as now limited, *quadrivalvis* Blainville, *quadridentata* Quoy & Gaimard and *monoica* Chun, represent as many good species, the first

¹ Identified by the gonophore.

² For the history of this generic name see TOTTON (1932, p. 340). MOSER (1925, p. 135) dates it from "Lesueur, Manuscript, 1807". But manuscript names have no standing, by the International Rules of Zoological Nomenclature.

S. quadrivalvis having only two, the second four basal teeth in the superior nectophore, and the third three teeth (1 dorsal, 2 dorso-lateral) besides a projecting lappet on each side. MOSER (1925, p. 142) on the other hand does not consider the dentition a reliable specific character in this group, on the ground that "Abweichungen in der Bildung der Mundzähne sind häufig". She therefore united all the early references to the quadridentate as well as to the bidentate form¹, under the synonymy of *quadrivalvis*. LELOUP (1932, p. 5) also definitely unites *quadridentata* with *quadrivalvis*, and MOSER (1925, p. 142, 145) even suggests that *monoica* may on this same ground prove to be only a variety of *quadrivalvis*, though she still retains it in her system, as a distinct species.

The early history of *quadrivalvis* and of *quadridentata* is summarized elsewhere (BIGELOW, 1931, p. 550). The existence of the two alternate forms, bidentate and quadridentate, was not clearly recognized until 1918, when QUOY and GAIMARD's old name *quadridentata*, was revived for the latter (BIGELOW, 1918, p. 417, Pl. 8, Fig. 1). Since that time, BROWNE (1926), LELOUP (1933, p. 26) and BIGELOW (1931, Fig. 201) have not only had specimens with large lateral teeth, as well as the two dorsals (as had MOSER, also), but have likewise found among specimens with only two large teeth (the dorsal), occasional examples with projecting baso-lateral angles, or incipient teeth (TOTTON, 1932, Fig. 19A; LELOUP, 1932, Fig. 1A; BIGELOW, 1931, Fig. 197). But these have been greatly outnumbered, among primarily bidentate specimens, by those in which the latero-basal margin is not so interrupted (TOTTON, 1932, Fig. 19C; LELOUP, 1932, Fig. 1B; BIGELOW, 1931, Fig. 195, 196). TOTTON's and BIGELOW's series combined (a total of 47 specimens) were distributed as follows:— 33 with baso-lateral angles uninterrupted (typical *quadrivalvis*); 2, with slightly projecting baso-lateral eminences; 12, with rudimentary triangular lateral teeth; much smaller, however, than the 2 dorsal teeth as previously illustrated (TOTTON, 1932, Fig. 19A; BIGELOW, 1931, Fig. 197). In none of these, however, nor in the specimen illustrated by LELOUP, did the lateral teeth approach those of the typically quadridentate form in size. The gap between the latter, and the extreme variants of the bidentate form has not yet been bridged by actual observation. Neither does the "Thor" series add any evidence in that direction, for while all are more or less damaged, it has been possible to classify all the superior nectophores of *Sulculeolaria* either as definitely quadridentate, or as bidentate.

On the other hand, no criterion has yet been found to separate the inferior nectophores of the two forms. And this is admittedly a strong argument for uniting them specifically, because it is decidedly exceptional for species of Calycophorae which differ in the conformation of the superior nectophore, to show no differences in the inferior.

It was formerly believed that the colonies of *Sulculeolaria* were unisexual as early described by GEGENBAUR (1853, p. 108), VOGT (1854, p. 112) and WEISMANN (1883, p. 199). NEPPI's (1921) discovery of a specimen in which the most distal gonophore was a male, but the more proximal gonophores were female, suggests, on the contrary, that *Sulculeolaria* actually is monoecious, with gonophores of one sex developing first, the other sex afterward. Unfortunately, none of the specimens we have seen throw any light on the point. And it does not necessarily follow that, if one specimen be protandrous, the sexual succession may not be the reverse, in others. The possibility that the alternate states of the superior nectophore — bidentate and quadridentate — may be a sexual character, not a specific one, must therefore be considered. VOGT (1854, p. 112) remarks, it is true, that the nectophores of the two sexes are alike, but his account of the base of the superior nectophore is not satisfactory. GEGENBAUR does not comment on this point, nor has any more recent author. And while WEISMANN (1883) states that the 10 colonies he obtained at Naples were all of one sex (female), he gives no account of the nectophores.

The only specimens we have seen, with stems still intact, are two *quadridentata* from Naples, both of which bear a continuous series of female gonophores, and one lot (three) of bidentate specimens, from the Eastern Tropical Pacific. When dipped up from the surface (BIGELOW, 1911b, p. 237), the latter had the stems attached, and were so preserved. But their stems became detached in transit. On examination it proved

¹ MOSER seems not to have seen the re-description of *quadridentata* from the "Bache" collection (BIGELOW, 1918, p. 417).

(BIGELOW, 1911b, Pl. 5, Fig. 6, 7) that both sexes were represented among the three, a fact verified on re-examination. But as the stems are not only detached, but fragmented, it is impossible to determine whether there were two male and one female specimen, or vice versa. However this may be, observation thus makes it certain that the bidentate form occurs in both sexes. Hence it may be assumed that this applies equally to the quadridentate, though it happens that the only colonies of the latter of which the sex has been definitely determined, chanced to be females.

This evidence does not, of course, forbid the possibility that the quadridentate form is a sport that appears more often in female than in male colonies. But as there is no evidence of this (it seems at the best unlikely), it seems wisest to retain two species, at least for the time being. In this way the alternate or joint regional occurrence of the two will be emphasized instead of obscured, and the need for more critical examination of the question will be kept to the fore.

Superior nectophores of *Sulculeolaria* are therefore listed here, under the two species. All inferiors taken in the tows are listed as belonging to "*S. quadridentata* or *quadrivalvis*".

Reasons for regarding *monoica*, also, as a good species are given elsewhere (BIGELOW, 1931, p. 559). It is separated from the *quadrivalvis-quadridentata* group, not only by the dentition of the superior nectophore, but also by the fact that the inferior nectophore has three dorsal teeth, projecting lateral angles, and an undivided ventral wing, whereas the *quadrivalvis-quadridentata* group have 4 teeth (2 dorsal, and a lateral on each side) and a divided wing in the inferior nectophore.

Recent records of *monoica* are by BROWNE (1926, p. 69) and by TOTTON (1932, p. 342), who have commented on the dentition; also by LELoup (1932, p. 3; 1933, p. 25) and by BIGELOW (1931, p. 558).

SULCULEOLARIA QUADRIDENTATA Quoy and Gaimard 1834.

Galeolaria quadridentata, Quoy and Gaimard, 1834, p. 45, Pl. 5, Figs. 32, 33.

Positive references to this species are:—

Diphyes quadrivalvis, Keferstein and Ehlers, 1861, p. 18, Pl. 5, Fig. 26 E.

Galeolaria aurantiaca, Lochman, 1914, p. 262, Pl. 7, Fig. 1—3.

Galeolaria quadridentata, Bigelow, 1918, p. 417, Pl. 8, Figs. 1—2; Browne, 1926, p. 67.

Galeolaria quadrivalvis (partim), Moser, 1925, p. 139; Leloup, 1932, p. 4.

Galettea quadridentata, Bigelow, 1931, p. 556, Text-figs. 201—203.

Sulculeolaria quadridentata, Totton, 1932, p. 340.

Sulculeolaria quadrivalvis (partim), Leloup, 1933, p. 26.

Material.

- | | |
|---|---|
| St. 63. 35°50' N., 6°03' W. 22. II. 1909.
Y. 25 m w. 1 sup. nectoph. | St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
Y. 25 m w. 4 sup. nectoph. |
| St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 65 m w. 2 sup. nectoph. | St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
Y. 25 m w. 16 sup. nectoph. |
| St. 66. 36°16' N., 6°52' W. 25. II. 1909.
Y. 300 m w. 1 sup. nectoph. | St. 138. 37°37' N., 11°25' E. 19. VII. 1910.
Y. 25 m w. 1 sup. nectoph. |
| St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 25 m w. 2 sup. nectoph. | St. 144. 34°31' N., 18°40' E. 23. VII. 1910.
Y. 25 m w. 3 sup. nectoph. |
| Y. 600 m w. 2 sup. nectoph. | St. 145. 32°38' N., 19°02' E. 25. VII. 1910.
Y. 25 m w. 3 sup. nectoph. |
| St. 86. 37°22' N., 9°15' W. 17. VI. 1910.
P. Surface. 2 sup. nectoph. | St. 156. 32°16' N., 26°03' E. 30. VII. 1910.
Y. 25 m w. 1 sup. nectoph. |
| St. 112. 36°56' N., 2°15' E. 27. VI. 1910.
Y. 25 m w. 1 sup. nectoph. | St. 182. 38°13' N., 24°48' E. 14. VIII. 1910.
Y. 65 m w. 1 sup. nectoph. |
| St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
Y. 25 m w. 1 sup. nectoph. | St. 183. 37°52' N., 23°09' E. 16. VIII. 1910.
Y. 65 m w. 3 sup. nectoph. |
| Y. 65 m w. 1 sup. nectoph. | St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
Y. 10 m w. 1 sup. nectoph. |
| St. 130. 39°35' N., 11°20' E. 13. VII. 1910.
Y. 25 m w. 37 sup. nectoph. | |
| St. 131. 38°36' N., 11°00' E. 13. VII. 1909.
Y. 25 m w. 1 sup. nectoph. | |

St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.
 Y. 25 m w. 1 sup. nectoph.
 Y. 1000 m w. 1 sup. nectoph.
 St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
 Y. 25 m w. 5 sup. nectoph.
 Y. 600 m w. 1 sup. nectoph.
 St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
 Y. 10 m w. 2 sup. nectoph.
 Y. 25 m w. 1 sup. nectoph.
 St. 196. 39°59' N., 14°31' E. 22. VIII. 1910.
 Y. 25 m w. 13 sup. nectoph.
 St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
 Y. 25 m w. 3 sup. nectoph.
 Y. 300 m w. 1 sup. nectoph.
 Y. 1000 m w. 2 sup. nectoph.
 St. 202. 38°59' N., 9°25' E. 26. VIII. 1910.
 Y. 300 m w. 3 sup. nectoph.

St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
 Y. 25 m w. 8 sup. nectoph.
 Y. 65 m w. 4 sup. nectoph.
 Y. 300 m w. 1 sup. nectoph.
 Y. 1000 m w. 1 sup. nectoph.
 St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
 Y. 1000 m w. 1 sup. nectoph.
 Y. 2000 m w. 1 sup. nectoph.
 St. 208. 40°18' N., 3°20' E. 29. VIII. 1910.
 Y. 25 m w. 2 sup. nectoph.
 St. 209. 40°34' N., 3°03' E. 29. VIII. 1910.
 Y. 25 m w. 6 sup. nectoph.
 C. 150 m w. 1 sup. nectoph.
 St. 215. 39°14' N., 0°52' E. 31. VIII. 1910.
 Y. 25 m w. 1 sup. nectoph.
 St. 216. 38°31' N., 1°24' E. 1. IX. 1910.
 Y. 25 m w. 3 sup. nectoph.

This list includes all the superior nectophores of *Sulculeolaria* which have large latero-basal teeth. Since recent collections have yielded fewer superior nectophores of *quadridentata* than *quadrivalvis* (the "Arcturus" series contained only 2 of the former to 32 of the latter), it is interesting that the relative proportions of the two in the "Thor" collection are reversed.

In every case, all but the basal attachment of the stem has been lost, hence the material adds nothing to the earlier accounts of reserve buds or of stem groups (BIGELOW, 1931, p. 556), which agree in every respect with those of *S. quadrivalvis*, so far as can be seen from a comparison of excellent specimens of the latter both from the Pacific and from the Atlantic (BIGELOW, 1911 b, Pl. 5, Figs. 5—7; 1931, p. 553, Figs. 198—200) with *quadridentata* from Naples (BIGELOW, 1931, p. 556, Figs. 201—203).

SULCULEOLARIA QUADRIVALVIS Blainville 1830.

Sulculeolaria quadrivalvis, Blainville, 1830, p. 126; 1834, p. 138, Pl. 6, Fig. 6.

References, prior to 1918, which certainly apply to *S. quadrivalvis* as distinguished from *quadridentata* are:—

Diphyes quadrivalvis, Gegenbaur, 1853 a, p. 315, 449, Pl. 16, Figs. 8—11.

Galeolaria filiformis, Leuckart, 1854, p. 280, Pl. 11, Figs. 14—17.

Galeolaria aurantiaca, Vogt, 1854, p. 110, Pl. 18—20.

The following notices published since the rediscovery of *S. quadridentata* (Bigelow, 1918) also refer wholly or in part to *quadrivalvis*.

Galeolaria quadrivalvis, Bigelow, 1919, p. 336; Moser, 1925, p. 139 (partim); Browne, 1926, p. 66; Leloup, 1932, p. 4 (partim).

Galettea quadrivalvis, Bigelow, 1931, p. 549.

Sulculeolaria quadrivalvis, Totton, 1932, p. 341; Leloup, 1933, p. 26 (partim).

For many other references, which may apply to either or to both species, see the bibliography given by MOSER (1925, p. 139).

Material:

St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
 Y. 25 m w. 1 sup. nectoph.
 St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
 Y. 25 m w. 1 sup. nectoph.

St. 207. 39°58' N., 3°41' E. 28. VIII. 1910.
 Y. 65 m w. 1 sup. nectoph.

These few bells are all more or less fragmentary, but all show the bidentate conformation (p. 30). As the stems have been lost, they add nothing to earlier accounts of the reserve bells or stem groups (for a recent discussion and illustrations of the reserve bells, of the mode of attachment of the siphons to the stem and of the conformation of the gonophores, see BIGELOW, 1931, p. 553).

Inferior Nectophores of
SULCULEOLARIA QUADRIVALVIS and QUADRIDENTATA.

Material.

St. 63. 35°50' N., 6°03' W. 22. II. 1909. Y. 25 m w. 1 inf. nectoph.	St. 189. 37°44' N., 15°58' E. 19. VIII. 1910. Y. 300 m w. 2 inf. nectoph.
St. 65. 35°53' N., 7°26' W. 24. II. 1909. Y. 65 m w. 3 inf. nectoph.	Y. 1000 m w. 1 inf. nectoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909. Y. 25 m w. 1 inf. nectoph.	St. 192. 38°07' N., 15°35' E. 20. VIII. 1910. Y. 25 m w. 10 inf. nectoph.
Y. 600 m w. 1 inf. nectoph.	St. 194. 38°33' N., 15°29' E. 21. VIII. 1910. Y. 10 m w. 2 inf. nectoph.
St. 86. 37°22' N., 9°15' W. 17. VI. 1910. P. Surface. 2 inf. nectoph.	Y. 25 m w. 2 inf. nectoph.
St. 106. 36°33' N., 2°00' W. 25. VI. 1910. Y. 300 m w. 1 inf. nectoph.	St. 196. 39°59' N., 14°31' E. 22. VIII. 1910. Y. 25 m w. 6 inf. nectoph.
St. 112. 36°56' N., 2°15' W. 27. VI. 1910. Y. 25 m w. 1 inf. nectoph.	St. 199. 39°32' N., 10°49' E. 25. VIII. 1910. Y. 25 m w. 3 inf. nectoph.
St. 115. 38°17' N., 4°11' E. 28. VI. 1910. Y. 65 m w. 1 inf. nectoph.	Y. 300 m w. 1 inf. nectoph.
St. 130. 39°35' N., 11°20' E. 13. VII. 1910. Y. 25 m w. 60 inf. nectoph.	Y. 1000 m w. 2 inf. nectoph.
St. 131. 38°36' N., 11°00' E. 13. VII. 1910. Y. 25 m w. 2 inf. nectoph.	St. 202. 38°59' N., 9°25' E. 26. VIII. 1910. Y. 300 m w. 3 inf. nectoph.
St. 133. 38°18' N., 9°56' E. 14. VII. 1910. Y. 300 m w. 1 inf. nectoph.	St. 204. 38°52' N., 7°43' E. 27. VIII. 1910. Y. 25 m w. 6 inf. nectoph.
St. 134. 37°37' N., 10°17' E. 15. VII. 1910. Y. 25 m w. 3 inf. nectoph.	Y. 65 m w. 7 inf. nectoph.
St. 137. 37°17' N., 10°56' E. 19. VII. 1910. Y. 25 m w. 17 inf. nectoph.	Y. 300 m w. 1 inf. nectoph.
Y. 250 m w. 6 inf. nectoph.	St. 206. 39°32' N., 5°15' E. 28. VIII. 1910. Y. 1000 m w. 2 inf. nectoph.
St. 141. 36°42' N., 13°34' E. 20. VII. 1910. Y. 25 m w. 1 inf. nectoph.	Y. 2000 m w. 1 inf. nectoph.
St. 144. 34°31' N., 18°40' E. 23. VII. 1910. Y. 25 m w. 4 inf. nectoph.	St. 207. 39°58' N., 3°41' E. 28. VIII. 1910. Y. 65 m w. 1 inf. nectoph.
St. 145. 32°38' N., 19°02' E. 25. VII. 1910. Y. 25 m w. 3 inf. nectoph.	St. 208. 40°18' N., 3°20' E. 29. VIII. 1910. Y. 25 m w. 2 inf. nectoph.
St. 156. 32°16' N., 26°03' E. 30. VII. 1910. Y. 25 m w. 1 inf. nectoph.	St. 209. 40°34' N., 3°03' E. 29. VIII. 1910. Y. 25 m w. 5 inf. nectoph.
St. 183. 37°52' N., 23°09' E. 16. VIII. 1910. Y. 300 m w. 2 inf. nectoph.	C. 150 m w. 3 inf. nectoph.
St. 186. 37°57' N., 19°51' E. 17. VIII. 1910. Y. 10 m w. 3 inf. nectoph.	St. 215. 39°14' N., 0°52' E. 31. VIII. 1910. Y. 25 m w. 2 inf. nectoph.
	St. 216. 38°31' N., 1°24' E. 1. IX. 1910. Y. 25 m w. 2 inf. nectoph.
	St. 223. 36°13' N., 1°28' E. 5. IX. 1910. Y. 25 m w. 2 inf. nectoph.
	St. 277. 33°20' N., 27°30' E. 6. IV. 1911. P. 132 m w. 2 inf. nectoph.

In the above list are included all the inferior nectophores belonging either to *S. quadridentata* or to *S. quadrivalvis*, since they were all detached from their superior nectophores and, hence, were indistinguishable.

GALETTA Stechow 1921.

It is still doubtful how many species are represented by the known members of this genus, the chief difficulty being that no recent student has had specimens certainly identifiable as the species first described by GEGENBAUR (1854), as *Diphyes turgida*. GEGENBAUR, and also SARS (1857) described this as lacking a somatocyst, and GEGENBAUR's (1854, p. 443) characterization of the basal lamella of the superior nectophore as "abgerundete" suggests that the wing is undivided. For any diphid actually to lack a somatocyst would be so exceptional, that several authors — most recently CANDEIAS (1929, p. 273) and LELoup (1933, p. 27) — have suggested that this organ may have been overlooked by GEGENBAUR. TOTTON (1932, p. 345) has, in fact, referred Australian specimens with "very small somatocysts" to *turgida*, but without stating whether their basal lamellae were divided or undivided, or describing the canalization. It is also pertinent that both CANDEIAS (1929, p. 272) and LELoup have recently reported specimens of *G. australis* (i. e., with divided basal lamellae) with minute somatocysts. LELoup (1933, p. 27), in particular, speaks of a specimen which had a "somato-cyste minusculé qui forme à peine une boursouflure dans le canal gastrovasculaire". Several of the *australis* we have seen also have extremely minute somatocysts. But while specimens not in the best of condition often show no trace of the latter, a somatocyst has been detectable, even if minute, in every good example that we have seen.

Quite apart from the question of the presence or absence of the somatocyst, GEGENBAUR's (1854) *turgida*, would stand alone among the known Galettes if the basal lamella of the superior nectophore actually was not divided.

Lack of critical information as to the growth stages, as to the limits of variation in the length of the somatocyst, as to the outlines of the hydroecial sector of the base of the superior nectophore, and as to the regularity with which a commissural canal is present, similarly complicate our decision as to whether the Galettes with a divided basal wing in the superior nectophore all fall within the old species *G. australis*, or whether *G. chuni* LENS and VAN RIEMSDIJK, and *G. meteori* LELOUP are recognizable species.

According to the original description, *chuni* is characterized by lacking commissural canals in the superior nectophore¹, as well by its very large somatocyst. And MOSER (1925, p. 150) has subsequently reported as *G. chuni* a considerable series, showing similarly simple canalization and large somatocysts. Recently, TOTTON (1932, p. 342) has recorded small superior bells from Australia, with long somatocysts, and lacking commissural canals, as *chuni*. However, among thirteen superior nectophores with large somatocysts reported by BROWNE under this name, eight showed "a *Diphyes* type of canal system and three the normal *Galeolaria* type" (BROWNE, 1926, p. 70). This, with the evidence given below (p. 36), points to such a wide variability in the presence or absence of the commissural canal, that this character cannot safely be used as specific; leaving only the very long somatocyst as diagnostic of *chuni*. And as the contrast so far reported in this respect between it and *australis* is wide, it seems that earlier reference of *chuni* to the synonymy of *australis* (BIGELOW, 1911b) was premature, though its status certainly requires further investigation.

G. meteori LELOUP (1934) resembles *australis* in the shortness of the somatocyst, but differs from it in the depth of the hydroecial indentation of the base, in the fact that this involves the ventral margin of the bell for a considerable distance above the level of the mouth of the nectosac (only the superior bell is known), and in the narrowness of the basal sector between the opening of the nectosac and the ventral margin. But as the largest of LELOUP's series was only 4 mm. long, it may perhaps prove to be the young of *australis*. At any rate, its status needs farther investigation.

As the matter now stands, the superior bells of *Galetta* may be grouped as follows:—

Basal wing divided:

Somatocyst not reaching more than $\frac{1}{3}$ the length of the nectosac, and often minute: possibly even absent in some specimens

 Baso-ventral sector broad; no definite hydroecial indentation *australis*

 Baso-ventral sector very narrow; a well marked hydroecial furrow *meteori* (perhaps a growth stage of *australis*)

 Somatocyst reaching well above mid-level of nectosac *chuni*

Basal wing undivided; no somatocyst *turgida* (status somewhat doubtful)

It is not yet possible to state precise criteria for specifically identifying the inferior nectophores of the several species of *Galetta*. The case is, in fact, worse than for the superior bells. In all of them (except for *meteori*, the lower bell of which is not yet known) the ventral wing is undivided. But considerable variation has been recorded from a simply rounded to a definitely notched basal contour, among inferior bells taken side by side with superiors both of *chuni* and of *australis*. To judge from MOSER's (1925, Pl. 3, Fig. 4) and TOTTON's (1932, p. 343, Fig. 20, B, D) drawings, the hydroecial wings of *chuni* do not show the sudden increase in breadth toward the superior end of the bell which is characteristic of *australis* (BIGELOW 1911b, Pl. 5, Fig. 9; Pl. 6, Fig. 3). MOSER (1925, p. 154) likewise describes the ventral lamella as very short. But her own figures (Pl. 3, Fig. 3, 4) show little difference in this respect between *australis* and *chuni*, while TOTTON found it fully as long in the latter as it is in *australis*. And GEGENBAUR's (1854) illustration of the lower bell of *G. turgida* is not detailed enough for critical comparison.

The better preserved examples of *australis* among those we have seen — Atlantic as well as Pacific —

¹ LENS and VAN RIEMSDIJK's illustration (Pl. 9, Fig. 79) shows commissural canals, however.

show at least some trace of the lateral wings. The basal contour-line of the undivided ventral wing when intact, shows a more or less pronounced duplex curve (BIGELOW, 1911 b, Pl. 5, Fig. 9), which may prove to be diagnostic, as the wing is simply notched or even rounded in *chuni* according to TOTTEN's (1932, Fig. 20) and Moser's (1925, Pl. 3, Fig. 4) drawings. Unfortunately, the ventral wing is so easily damaged that its normal contour is traceable only in unusually well preserved specimens¹.

GALETTA AUSTRALIS Quoy and Gaimard 1834.

Fig. 26.

Galeolaria australis, Quoy and Gaimard, 1834, p. 43, Pl. 5, Figs. 30—31.

For synonymy, see Moser, 1925, p. 145.

More recent references which can be positively referred to this species (p. 34) are:—

Galeolaria australis, Bigelow, 1918, p. 419; Browne, 1926, p. 67 (partim); Candeias, 1929, p. 273, text-figs. 2—6; Leloup, 1932, p. 6.

Galeetta australis, Bigelow, 1931, p. 559, text-figs. 204—207; Leloup, 1933, p. 26; 1934, p. 15.

Material. *1917 Spec. coll. Genoa* *646 of C. australis*

- | | |
|--|--|
| St. 10. 37°21' N., 16°45' E. 15. XII. 1908.
Y. 65 m w. 6 sup. nectoph.; 3 inf. nectoph. | St. 130. 39°35' N., 11°20' E. 13. VII. 1910.
Y. 25 m w. 18 sup. nectoph.; 41 inf. nectoph. |
| St. 11. 36°57' N., 18°16' E. 16. XII. 1908.
Y. 25 m w. 21 sup. nectoph.; 30 inf. nectoph. | St. 132. 38°57' N., 9°47' E. 14. VII. 1910.
Y. 25 m w. 13 sup. nectoph.; 21 inf. nectoph. |
| St. 24. 40°14' N., 12°23' E. 16. I. 1909.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph. | Y. 300 m w. 1 inf. nectoph. |
| St. 36. 42°49' N., 6°54' E. 30. I. 1909.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph. | St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
Y. 25 m w. 6 sup. nectoph.; 4 inf. nectoph. |
| St. 39. 39°41' N., 10°02' E. 1. II. 1909.
Y. 65 m w. 1 inf. nectoph. | St. 134. 37°37' N., 10°17' E. 15. VII. 1910.
Y. 25 m w. 1 sup. nectoph.; 4 inf. nectoph. |
| St. 46. 37°17' N., 6°00' E. 7. II. 1909.
Y. 65 m w. 1 inf. nectoph. | Y. 300 m w. 2 inf. nectoph. |
| St. 47. 36°55' N., 3°12' E. 10. II. 1909.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph. | St. 138. 37°37' N., 11°25' E. 19. VII. 1910.
Y. 25 m w. 67 sup. nectoph.; 85 inf. nectoph. |
| St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph. | St. 139. 37°57' N., 11°54' E. 20. VII. 1910.
Y. 800 m w. 1 sup. nectoph.; 1 inf. nectoph. |
| St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 65 m w. 1 sup. nectophore; 1 inf. nectoph. | St. 143. 35°18' N., 16°25' E. 23. VII. 1910.
Y. 1000 m w. 1 inf. nectoph. |
| St. 70. 35°53' N., 7°26' W. 18. VI. 1910.
Y. 1600 m w. 2 sup. nectoph.; 2 inf. nectoph. | St. 147. 31°35' N., 19°02' E. 25. VII. 1910.
Y. 300 m w. 2 inf. nectoph. |
| St. 91. 35°53' N., 7°26' W. 18. VI. 1910.
Y. 1600 m w. 2 sup. nectoph.; 2 inf. nectoph. | St. 152. 33°11' N., 21°44' E. 27. VII. 1910.
Y. 25 m w. 2 sup. nectoph.; 5 inf. nectoph. |
| St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
Y. 25 m w. 1 inf. nectoph. | St. 182. 38°13' N., 24°48' E. 14. VIII. 1910.
Y. 65 m w. 1 inf. nectoph. |
| St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
Y. 300 m w. 1 inf. nectoph. | St. 183. 37°52' N., 23°09' E. 16. VIII. 1910.
Y. 65 m w. 3 sup. nectoph.; 6 inf. nectoph. |
| St. 115. 38°17' N., 4°11' W. 29. VI. 1910.
Y. 25 m w. 8 sup. nectoph.; 10 inf. nectoph. | St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
Y. 65 m w. 1 sup. nectoph.; 4 inf. nectoph. |
| Y. 65 m w. 7 inf. nectoph. | Y. 300 m w. 2 sup. nectoph.; 2 inf. nectoph. |
| Y. 2000 m w. 3 sup. nectoph.; 2 inf. nectoph. | Y. 1200 m w. 2 sup. nectoph.; 1 inf. nectoph. |
| St. 116. 39°27' N., 5°26' W. 30. VI. 1910.
Y. 25 m w. 4 sup. nectoph.; 4 inf. nectoph. | St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.
Y. 300 m w. 2 sup. nectoph.; 2 inf. nectoph. |
| Y. 65 m w. 3 sup. nectoph.; 3 inf. nectoph. | Y. 1000 m w. 5 sup. nectoph.; 2 inf. nectoph. |
| Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph. | St. 190. 37°51' N., 15°19' E. 19. VIII. 1910.
Y. 25 m w. 13 sup. nectoph.; 10 inf. nectoph. |
| St. 118. 41°00' N., 6°43' E. 30. VI. 1910.
Y. 25 m w. 1 sup. nectoph. | St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph. |
| Y. 65 m w. 2 sup. nectoph.; 2 inf. nectoph. | St. 193. 38°15' N., 15°39' E. 21. VIII. 1910.
Y. 10 m w. 6 sup. nectoph.; 8 inf. nectoph. |
| Y. 300 m w. 6 sup. nectoph.; 9 inf. nectoph. | St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
Y. 25 m w. 11 sup. nectoph.; 8 inf. nectoph. |
| St. 123. 44°14' N., 8°55' E. 3. VII. 1910.
Y. 25 m w. 2 inf. nectoph. | St. 195. 39°02' N., 14°55' E. 21. VIII. 1910.
Y. 300 m w. 1 sup. nectoph. |
| St. 129. 40°05' N., 11°31' E. 12. VII. 1910.
Y. 25 m w. 9 sup. nectoph.; 18 inf. nectoph. | St. 197. 40°34' N., 13°36' E. 24. VIII. 1910.
Y. 25 m w. 3 sup. nectoph.; 2 inf. nectoph. |
| Y. 300 m w. 1 inf. nectoph. | St. 199. 39°32' N., 10°49' E. 25 VIII. 1910.
Y. 25 m w. 7 sup. nectoph.; 16 inf. nectoph. |
| Y. 600 m w. 1 inf. nectoph. | St. 200. 39°18' N., 10°11' E. 26 VIII. 1910.
Y. 25 m w. 5 inf. nectoph. |

¹ As already pointed out (BIGELOW, 1931, p. 559) MOSER's (1925, p. 148) statement that BIGELOW had illustrated the basal wing of the inferior nectophore of *australis* as divided, was based on misreading of the legend. Actually the figure in question (BIGELOW, 1911 b, Pl. 6, Fig. 2) was of the superior nectophore. The other figures (Pl. 5, Fig. 9, Pl. 6, Fig. 3) plainly show the undivided wing of the inferior bell.

St. 205. 39°16' N., 5°52' E. 27. VIII. 1910.
 Y. 25 m w. 48 sup. nectoph.; 71 inf. nectoph.
 St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
 Y. 25 m w. 55 sup. nectoph.; 34 inf. nectoph.
 Y. 300 m w. 6 sup. nectoph.; 2 inf. nectoph.
 Y. 1000 m w. 3 sup. nectoph.; 1 inf. nectoph.
 Y. 2000 m w. 7 sup. nectoph.; 11 inf. nectoph.
 St. 217. 38°01' N., 1°48' E. 1. IX. 1910.
 Y. 300 m w. 1 inf. nectoph.
 St. 275. 39°05' N., 14°50' E. 3. IV. 1911.
 S. 94 m w. 1 sup. nectoph.

St. 276. 36°30' N., 19°20' E. 4. IV. 1911.
 S. 132 m w. 78 sup. nectoph.; 49 inf. nectoph.
 St. 277. 33°20' N., 27°30' E. 6. IV. 1911.
 S. 132 m w. 10 sup. nectoph.; 11 inf. nectoph.
 St. 296. 32°10' N., 29°50' E. 25. VI. 1911.
 S. 28 m w. 2 sup. nectoph.; 2 inf. nectoph.
 St. 297. 33°10' N., 25°03' E. 25. VI. 1911.
 S. 28 m w. 61 sup. nectoph.; 96 inf. nectoph.
 St. 298. 34°20' N., 21°10' E. 26. VI. 1911.
 S. 38 m w. 3 sup. nectoph.; 20 inf. nectoph.

This list includes all the superior nectophores of Galettinae which lack any trace of teeth, and in which the ventral wing is divided. In all of the better preserved examples a very small somatocyst is visible (Fig. 26A, B, D, E), though all trace of this organ has been lost in many of the poorly preserved examples

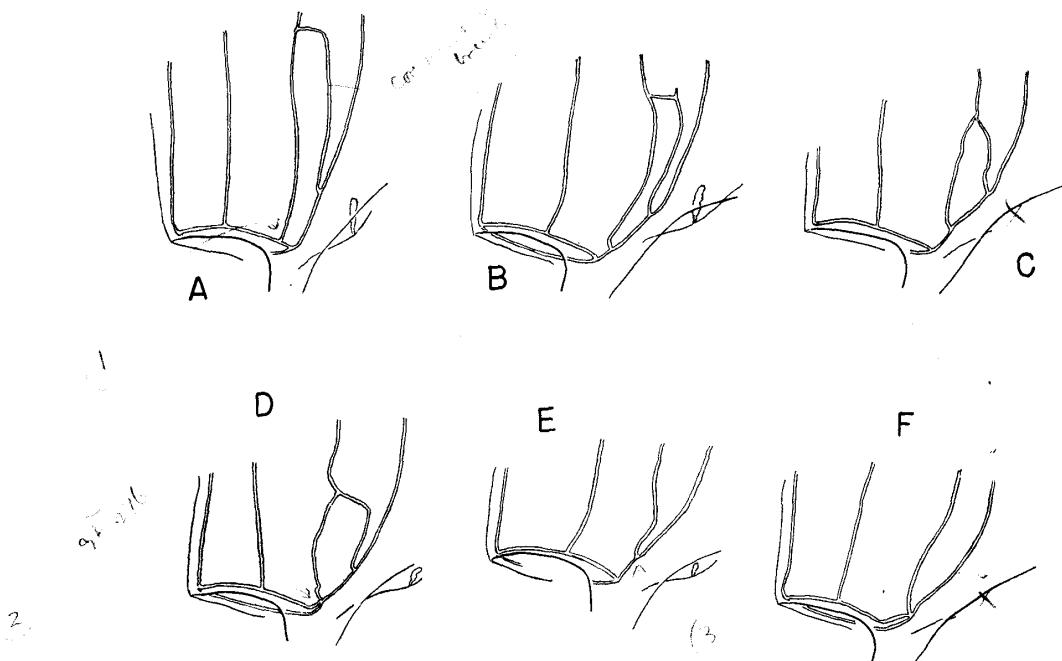


Fig. 26. *Galetta australis*; lateral views of the basal portions of six superior nectophores illustrating the variations in the lateral and commissural canals. A. Specimen with nectosac 14.5 mm. long from "Thor" St. 65; B—F Specimens with nectosacs 8—9 mm. long, from "Thor" St. 276. In specimens G and F, the somatocyst was too damaged for illustration.

(the latter are in the majority). But as none of the better specimens have a long somatocyst, there is no reason to suppose that *chuni* is represented among the fragmentary specimens either, for it is likely that a somatocyst as large as that of *chuni* would be visible until disintegration had reached an advanced stage, as is the case in *Sulculeolaria*.

All of the specimens also show the broad baso-ventral sector characteristic of *australis*. Since the canalization of the superior nectophore, i. e., whether with or without commissural trunks connecting the ascending lateral loop with the ventral, has been used as a specific character (see above, p. 34), it is worth record that very wide variation may occur in this respect, among specimens of roughly equal size and agreeing in the smallness of the somatocyst, as CANDEIAS (1929) has already recorded. Seven specimens from one haul, at Station 276, for example, illustrate five distinguishable types (Fig. 26); three with and two without commissures. Furthermore, the ventral side of the lateral loop may arise either from the ring canal some little distance from the ventral, or jointly with the latter from the ring canal, or from the ventral canal some distance above the ring canal. And the commissural link, when present, may either depart from

the lateral canal at an acute angle as is usual in *Sulculeolaria*, or at (roughly) a right angle. The point of junction also varies considerably in its height above the ring canal. Small subsidiary trunks have likewise been recorded, in one case forming a secondary union between the commissural and lateral canals (CANDEIAS, 1929, p. 274, Fig. 4).

None of the specimens retain more than a basal fragment of the stem. For recent illustrations of the mode of association of the nectophores and of the stem groups see BIGELOW, 1931, Figs. 204—207.

The inferior nectophores of the Galettinae listed above as *australis* include all those which lack teeth and have an undivided basal wing. The only species with which they might be confused are *chuni* and *turgida* (if the latter actually exists). But as these are not included among the superior nectophores, there is no reason to suppose they are among the inferiors, either.

GALETTINAE genus?

The "Thor" also took the following specimens of Galettinae, so poorly preserved that it was impossible to identify them, even as to genus.

Material.

St. 76. 47°01' N., 5°48' W. 10. III. 1909. Y. 1600 m w. 4 nectoph.	St. 156. 32°16' N., 26°03' E. 30. VII. 1910. Y. 1000 m w. 1 sup. nectoph.
St. 116. 39°27' N., 5°26' E. 29. VI. 1910. Y. 25 m w. 1 inf. nectoph.	St. 160. 35°59' N., 28°14' E. 1. VIII. 1910. Y. 4000 m w. 1 sup. nectoph.
St. 132. 38°57' N., 9°47' E. 14. VII. 1910. Y. 25 m w. 1 sup. nectoph.	St. 178. 40°16' N., 26°32' E. 12. VIII. 1910. Y. 65 m w. 1 inf. nectoph.

DIPHYINAE Moser 1925.

The taxonomic arrangement within the Diphyinae has been in a state of flux during the past few years. This has been due in part to crystallization of opinion to the effect that the presence or absence of sterile swimming bells in the stem groups is not a proper generic character in this group (see discussions by BIGELOW, 1931, p. 539; MOSER, 1925, p. 131), and in part to the nomenclatural changes recently found necessary to accord with the accepted rules. TOTTON (1932) has also proposed that the old, broadly inclusive genus *Diphyes* be subdivided, to accord with the fact that its members fall into several categories of closely related species. In addition, there have been differences of opinion as to the proper location of the several species which (being monophyid) would fit in the older definition of the genus *Muggiaeae* (see discussion, p. 38).

As recent authors agree with regard to the first of these matters, no further discussion is required here. And TOTTON's subdivision of the old genus *Diphyes* (including *Diphyopsis* auct.) seems a decided advance, as recognizing the fact that the species falling in each category, are more closely allied to one another, by a combination of characters, than they are to the members of the other categories. According to TOTTON's scheme, *Diphyes* (genotype, *D. dispar* Chamisso and Eysenhardt 1821) is limited to species in which the superior nectophore has large oral teeth, a deep hydroecium, and an undivided basal plate. The remaining Diphyinae he distributes among HUXLEY'S (1859) old genus, *Eudoxoides* (genotype, *D. mitra* Huxley 1859), and two new genera, *Chelophyes* (genotype, *D. appendiculata* Eschscholtz 1829) and *Lensia* (genotype, *D. subtiloides* Lens and Van Riemsdijk 1908).

These new genera TOTTON defines as follows:—

Chelophyes:— "Baso-dorsal and lateral teeth absent from both nectophores. Posterior nectophore retained, its basal lamella with two strong teeth." (TOTTON, 1932, p. 354).

Lensia:— "Small diphyid Calycophorae, with pentagonal anterior and smaller fragile posterior nectophores. The anterior nectophore has a very shallow hydroecium, a short and divided mouth-plate and no dorsal or lateral teeth. Its radial canals have no commissures, and its somatocyst is short or of medium length." (TOTTON, 1932, p. 363).

The nectophores of *Eodoxoides*, according to TOTTON (1932, p. 346) are marked by "the peculiar lancet-shaped wings of the mouth-plate", and by "the shallow hydroecium with truncated apex".

By these definitions, *Lensia* and *Chelophyses* are confined to species with two bells, but the definitions for *Diphyes* and for *Eodoxoides* are broad enough to admit species with only a single bell. According to TOTTON, each of these last two genera does actually include at least one such monophyid form, *chamissonis* in the case of *Diphyes*, *spiralis* in the case of *Eodoxoides*. However, there is no place in his scheme, as it stands, for the two monophyid species that have been commonly known as *Muggiaeae kochii* and *Muggiaeae atlantica*. Quite apart from the number of bells, the absence of basal teeth and the fact that the basal wing is split would bar them from *Diphyes* as limited by him, the square or rounded corners of the basal wing from *Eodoxoides*, the deep hydroecium from *Lensia*, while the fact that there is a well developed dorsal ridge, running from base to apex of the superior nectophore, marks them off from the two species referred by TOTTON to *Chelophyses* in which the dorsal ridge terminates only a short distance above the base¹.

If the old genus *Muggiaeae* be included among the Diphyninae, as now seems rational (p. 5), obviously some place must be found for its members in the generic subdivision of the sub-family. It is also highly desirable, from the practical standpoint of easy identification, that the primary generic characters be based as far as possible on homologous structures of the superior nectophore, for it is by these that Diphyninae are usually represented in collections. And it is obvious that when characters exhibited by the nectophore, can be correlated with characters of the bract, the presumption that we are dealing with a natural group is strengthened. It is equally obvious that whatever be one's viewpoint as to the phylogenetic relationship between monophyid and diphysid species, the use of the presence or absence of a second nectophore as a generic character, is extremely confusing, because this structure is so often lost, leaving no trace. Furthermore, there is no way of proving (and may never be!) whether some of them are ancestral and others regressive, or whether all of them are the latter. The decision in such a case will always be largely subjective.

With the foregoing considerations in mind, it now seems wise to cut the Gordian knot by discarding the number of nectophores altogether, as a generic character among Diphyninae. Fortunately, this course does not involve any serious disturbance of nomenclature, since the two old species of *Muggiaeae*, *kochii* and *atlantica*, are more closely related one to the other, by structural characters, than is either of them to any other species.

The following generic definitions are therefore proposed, based primarily on the superior nectophore.

1. *Diphyes*, (genotype, *Diphyes dispar*, Chamisso and Eysenhardt 1821):—
Superior nectophore pentagonal in cross section with long dorsal ridge; basal wing divided or not, its outer angles not produced; oral opening armed with teeth; an inferior nectophore occurs in some species, but not in others (*chamissonis*).
2. *Eodoxoides*, (genotype, *Diphyes mitra* Huxley 1859):—
Superior nectophore pentagonal in cross section with long dorsal ridge; basal wing divided, its outer angles produced as lancet-shaped wings; oral margin without prominent teeth.
3. *Chelophyses*, (genotype, *Diphyes appendiculata* Eschscholtz 1829):—
Superior nectophore quadrangular in cross section, dorsal ridge short, extending only a little distance upward from the base; basal wing divided, its outer angles not greatly produced; oral margin without prominent teeth. The two species so far known have two nectophores.
4. *Lensia*, (genotype, *Diphyes subtiloides* Lens and Van Riemsdijk 1908):—
Superior nectophore pentagonal or polygonal in cross section, basal wing divided, its outer corners not produced; oral opening without large teeth; hydroecium very shallow, reaching hardly, if at all, above the oral level of the nectosac. So far as known all species have inferior nectophores.

¹ Although this, with the resultant quadrangular form of the bell, is an outstanding feature of these two species, TOTTON does not include it in his generic characterization of *Chelophyses*.

5. *Muggiaeae*, (genotype, *Muggiaeae kochii* Will 1844):—

Superior nectophore pentagonal in cross section with long dorsal ridge; hydroecium deep; basal wing divided, its outer corners not produced; no oral teeth. The known species are monophyid.

The superior nectophores of the various Diphyinae are so sharply defined, by characters readily seen and subject to but little variation, that various keys of them can easily be arranged, for purposes of identification. One was offered in an earlier paper (BIGELOW, 1911b, p. 246). To take account of additional species since described, of the inclusion of the two species of *Muggiaeae*, and of recent knowledge as to the relationship of other species, a new key is presented below, showing generic groupings, as well as specific distinctions.

1. Oral opening with prominent teeth (genus *Diphyes*) 2
Oral opening without prominent teeth..... 5
2. Oral opening with a pair of lateral teeth only..... *D. antarctica*
Oral opening with one large dorsal, as well as a pair of lateral teeth..... 3
3. Left lateral ridge strongly twisted, apex only bluntly pointed..... *D. chamissonis*
Left lateral ridge not strongly twisted, apex narrowly acute..... 4
4. Dorsal side of basal wing bears a denticulate median crest; nectosac tubular at apex..... *D. bojani*
Basal wing without median crest; nectosac fusiform at apex..... *D. dispar*
5. Mid-sector of bell quadrangular, with dorsal ridge extending only a short distance above base
(genus *Chelophyses*)..... 6
Mid-sector of bell pentagonal, or polygonal, with dorsal ridge extending nearly or quite to apex 7
6. Right lateral facet much narrower than left; somatocyst twisted to right..... *C. contorta*
Facets symmetrical except close to apex; somatocyst in mid-line..... *C. appendiculata*
7. Outer angles of divided basal plate much produced, as lanceolate wings (genus *Eudoxoides*)... 8
Outer angles of divided basal plate square-cut, or rounded 9
8. Bell strongly twisted, spirally..... *E. spiralis*
Bell not spirally twisted..... *E. mitra*
9. Hydroecial cavity extends well above oral level of nectosac (genus *Muggiaeae*)..... 10
Hydroecial cavity does not extend appreciably above oral level of nectosac, (genus *Lensia*).... 11
10. Somatocyst extends nearly or quite to level of apex of nectosac, latero-basal outline of hydroecium
nearly transverse to main axis of bell..... *M. atlantica*
Somatocyst extends little, if any, above mid-level of nectosac; latero-basal outline of hydroecium,
strongly oblique to main axis of bell *M. kochii*
11. See key to *Lensia*, p. 47.

MUGGIAEA Busch 1851.

MUGGIAEA ATLANTICA Cunningham 1892.

Muggiaeae atlantica, Cunningham, 1892, p. 214.

For synonymy, see Bigelow, 1911b, p. 187; Moser, 1925, p. 106.

Material.

St. 46. 37°17' N., 6°00' E. 7. II. 1909.

Y. 65 m w. 11 nectoph.

St. 47. 36°55' N., 3°12' E. 10. II. 1909.

Y. 65 m w. 3 nectoph.

Y. 300 m w. 4 nectoph.

St. 50. 37°02' N., 1°17' E. 17. II. 1909.

Y. 25 m w. 17 nectoph.

Y. 65 m w. 1 nectoph.

Y. 300 m w. 1 nectoph.

Y. 600 m w. 2 nectoph.

Y. 1600 m w. 2 nectoph.

St. 51. 36°27' N., 0°37' W. 17. II. 1909.
 Y. 300 m w. 2 nectoph.
 St. 57. 36°40' N., 3°30' W. 20. II. 1909.
 Y. 25 m w. 1 nectoph.
 St. 59. 36°02' N., 4°24' W. 21. II. 1909.
 Y. 25 m w. 10 nectoph.
 Y. 100 m w. 11 nectoph.
 Y. 1200 m w. 1 nectoph.
 St. 63. 35°50' N., 6°03' W. 22. II. 1909.
 Y. 600 m w. 3 nectoph.
 St. 65. 35°53' N., 7°26' W. 24. II. 1909.
 Y. 1600 m w. 1 nectoph.
 St. 71. 39°35' N., 9°45' W. 4. III. 1909.
 Y. 300 m w. 1 nectoph.
 St. 84. 39°22' N., 9°23' W. 16. VI. 1910.
 Y. 45 m w. 77 nectoph.
 St. 85. 38°22' N., 9°28' W. 17. VI. 1910.
 4 nectoph.
 St. 93. 36°17' N., 6°17' W. 22. VI. 1910.
 Y. 50 m w. 178 nectoph.
 St. 94. 36°06' N., 6°02' W. 23. VI. 1910.
 Y. 65 m w. 500? nectoph.
 St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
 Y. 25 m w. 16 nectoph.
 Y. 300 m w. 23 nectoph.
 St. 96. 35°48' N., 5°58' W. 23. VI. 1910.
 Y. 65 m w. 18 nectoph.
 St. 98. 35°57' N., 5°35' W. 23. VI. 1910.
 Y. 65 m w. 702 nectoph.

St. 99. 36°02' N., 5°16' W. 23. VI. 1910.
 Y. 65 m w. 50 nectoph.
 Y. 300 m w. 36 nectoph.
 St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
 Y. 300 m w. 5 nectoph.
 Y. 1200 m w. 1 nectoph.
 St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
 Y. 65 m w. 93 nectoph.
 Y. 300 m w. 21 nectoph.
 Y. 2000 m w. 33 nectoph.
 St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
 Y. 65 m w. 137 nectoph.
 Y. 300 m w. 5 nectoph.
 St. 112. 36°56' N., 2°15' E. 26. VI. 1910.
 Y. 300 m w. 3 nectoph.
 St. 113. 36°53' N., 3°09' E. 28. VI. 1910.
 Y. 300 m w. 5 nectoph.
 St. 122. 43°50' N., 8°34' E. 2. VII. 1910.
 Y. 600 m w. 2 nectoph.
 St. 147. 31°35' N., 19°02' E. 25. VII. 1910.
 Y. 300 m w. 146 nectoph.
 St. 152. 34°23' N., 27°57' E. 31. VII. 1910.
 Y. 25 m w. 1 nectoph.
 St. 221. 35°44' N., 0°53' W. 4. IX. 1910.
 Y. 25 m w. 146 nectoph.
 St. 225. 36°35' N., 3°00' W. 6. IX. 1910.
 Y. 25 m w. 14 nectoph.

This species has been so fully described, first by CUNNINGHAM, more recently by MOSER (1925, p. 106, Pl. 1, Fig. 5) and by BIGELOW (1911b, p. 187, Pl. 7, Fig. 1; Pl. 9, Figs. 7, 8), that we need merely summarize here, the diagnostic differences between it and *M. kochii*, the latter being the only species with which *atlantica* might be confused. The most striking difference is in the length of the somatocyst, which reaches, or surpasses the apex of the nectosac in *atlantica*, but hardly reaches to the mid-level of the nectosac in *kochii*. The relative depths of the hydroecium differ similarly, that of *atlantica* reaching about one quarter to one third the way up the nectosac in large specimens, but that of *kochii* only about one fifth the way. As noted above (p. 39), the latero-basal margin of the hydroecium is also much more strongly oblique to the main axis of the bell in *kochii* than in *atlantica*. On the other hand the two species agree, not only in the generic characters stated on p. 39, but in the narrowness of the somatocyst, and in its close apposition to the ventral wall of the nectosac, as well as in the conical outline of the hydroecial cavity as seen in side view. The maximum length so far recorded is 8 mm. for *atlantica*, 7 mm. for *kochii*¹.

DIPHYES Cuvier 1817.

DIPHYES DISPAR Chamisso and Eysenhardt 1821.

Diphyes dispar, Chamisso and Eysenhardt, 1821, p. 365, Pl. 33, Fig. 4.

For synonymy, see Bigelow, 1911b, p. 257 (*Diphyopsis dispar*); Moser, 1925, p. 170; Leloup, 1933, p. 29.

Material.

St. 65. 35°53' N., 7°26' W. 24. II. 1909.
 Y. 65 m w. 1 inf. nectoph.
 St. 66. 36°16' N., 6°52' W. 25. II. 1909.
 Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph.

St. 69. 36°13' N., 9°44' W. 28. II. 1909.
 Y. 65 m w. 1 sup. nectoph.
 Y. 300 m w. 2 sup. nectoph.; 3 inf. nectoph.
 St. 205. 39°16' N., 5°52' E. 27. VIII. 1910.
 Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.

These few nectophores add nothing to the several excellent and detailed accounts of this species that have previously appeared; see especially HAECKEL, 1888b, p. 153, Pl. 33, 34, (*D. compressa*); and MOSER, 1925, p. 170, Pl. 5—7, Pl. 8, Figs. 1, 2.

¹ For excellent description of *kochii*, and an account of its chequered history, see MOSER, 1925.

CHELOPHYES Totton 1932.

CHELOPHYES APPENDICULATA Eschscholtz 1829.

Diphyes appendiculata, Eschscholtz, 1829, p. 138, Pl. 12, Fig. 7.For synonymy, see Bigelow, 1911b, p. 248 (*Diphyes appendiculata*); Moser, 1925, p. 231 (*Diphyes sieboldii*); Leloup, 1933, p. 31.

Material.

- | | |
|--|--|
| St. 10. 37°21' N., 16°45' E. 15. XII. 1908.
Y. 25 m w. 14 sup. nectoph.; 1 inf. nectoph.
Y. 65 m w. 2 sup. nectoph.
Y. 600 m w. 617 sup. nectoph.; 208 inf. nectoph. | St. 39. 39°41' N., 10°02' E. 1. II. 1909.
Y. 25 m w. 116 sup. nectoph.; 25 inf. nectoph.
Y. 65 m w. 60 sup. nectoph.; 5 inf. nectoph.
Y. 300 m w. 36 sup. nectoph.; 9 inf. nectoph. |
| St. 11. 36°57' N., 18°16' E. 16. XII. 1908.
Y. 25 m w. 101 sup. nectoph.; 4 inf. nectoph.
Y. 300 m w. 10 sup. nectoph.
Y. 1000 m w. 33 sup. nectoph.; 3 inf. nectoph. | St. 40. 39°10' N., 9°40' E. 1. II. 1909.
Y. 65 m w. 54 sup. nectoph.; 2 inf. nectoph. |
| St. 12. 39°34' N., 17°17' E. 19. XII. 1908.
Y. 300 m w. 27 sup. nectoph.; 1 inf. nectoph.
Y. 1000 m w. 253 sup. nectoph.; 59 inf. nectoph. | St. 42. 38°58' N., 9°37' E. 2. II. 1909.
Y. 300 m w. 24 sup. nectoph.; 6 inf. nectoph. |
| St. 13. 39°43' N., 17°30' E. 19. XII. 1908.
Y. 15 m w. 2 sup. nectoph.
Y. 1000 m w. 1511 sup. nectoph.; 548 inf. nectoph. | St. 43. 38°14' N., 8°42' E. 3. II. 1909.
Y. 65 m w. 123 sup. nectoph.; 20 inf. nectoph. |
| St. 14. 41°24' N., 17°45' E. 21. XII. 1908.
Y. 1000 m w. 53 sup. nectoph.; 1 inf. nectoph. | St. 46. 37°17' N., 6°00' E. 7. II. 1909.
Y. 65 m w. 11 sup. nectoph.
Y. 300 m w. 5 sup. nectoph. |
| St. 15. 40°04' N., 19°06' E. 22. XII. 1908.
Y. 25 m w. 7 sup. nectoph.
Y. 1400 m w. 13 sup. nectoph.; 1 inf. nectoph. | Y. 600 m w. 24 sup. nectoph.; 2 inf. nectoph. |
| St. 20. 37°48' N., 15°49' E. 5. I. 1909.
Y. 25 m w. 2 sup. nectoph. | St. 47. 36°55' N., 3°12' E. 10. II. 1909.
Y. 65 m w. 89 sup. nectoph.; 9 inf. nectoph. |
| St. 22. 38°50' N., 15°18' E. 7. I. 1909.
Y. 200 m w. 2 sup. nectoph. | Y. 300 m w. 54 sup. nectoph.; 7 inf. nectoph. |
| St. 24. 40°14' N., 12°23' E. 16. I. 1909.
Y. 25 m w. 16 sup. nectoph.; 1 inf. nectoph.
Y. 65 m w. 26 sup. nectoph.; 1 inf. nectoph.
Y. 300 m w. 3 sup. nectoph. | St. 50. 37°02' N., 1°17' E. 17. II. 1909.
Y. 45 m w. 121 sup. nectoph.; 48 inf. nectoph.
Y. 65 m w. 27 sup. nectoph.; 2 inf. nectoph. |
| St. 27. 40°58' N., 13°49' E. 19. I. 1909.
Y. 25 m w. 2 sup. nectoph. | Y. 300 m w. 2 sup. nectoph. |
| St. 29. 40°47' N., 12°55' E. 20. I. 1909.
Y. 200 m w. 21 sup. nectoph.; 2 inf. nectoph.
Y. 600 m w. 23 sup. nectoph. | Y. 600 m w. 4 sup. nectoph.; 1 inf. nectoph.
Y. 1600 m w. 1 col.; 1 sup. nectoph. |
| St. 30. 41°15' N., 11°55' E. 21. I. 1909.
Y. 65 m w. 56 sup. nectoph.; 3 inf. nectoph.
Y. 300 m w. 30 sup. nectoph.; 5 inf. nectoph. | St. 51. 36°27' N., 0°37' W. 18. II. 1909.
Y. 300 m w. 4 sup. nectoph. |
| St. 31. 41°44' N., 10°52' E. 21. I. 1909.
Y. 65 m w. 77 sup. nectoph.; 14 inf. nectoph.
Y. 200 m w. 44 sup. nectoph.; 23 inf. nectoph. | St. 52. 35°55' N., 1°02' W. 18. II. 1909.
Y. 300 m w. 1 col.; 4 sup. nectoph. |
| St. 33. 43°04' N., 9°35' E. 22. I. 1909.
Y. 65 m w. 12 sup. nectoph.; 2 inf. nectoph. | St. 53. 36°13' N., 1°28' W. 18. II. 1909.
C. 2600 m w. 4 sup. nectoph. |
| St. 34. 43°27' N., 8°16' E. 23. I. 1909.
Y. 25 m w. 61 sup. nectoph.; 44 inf. nectoph. | St. 55. 36°46' N., 2°18' W. 19. II. 1909.
Y. 25 m w. 18 sup. nectoph.; 9 inf. nectoph.
Y. 65 m w. 12 sup. nectoph.; 3 inf. nectoph. |
| St. 35. 43°36' N., 7°36' E. 29. I. 1909.
Y. 200 m w. 3 sup. nectoph.
Y. 300 m w. 110 sup. nectoph.; 25 inf. nectoph. | St. 57. 36°40' N., 3°30' W. 20. II. 1909.
Y. 25 m w. 4 sup. nectoph.
Y. 200 m w. 4 sup. nectoph. |
| S. 700 m w. 52 sup. nectophores; 43 inf. nectoph.
Y. 1000 m w. 379 sup. nectoph.; 265 inf. nectoph. | St. 58. 36°26' N., 4°24' W. 20. II. 1909.
Y. 65 m w. 2 sup. nectoph. |
| Y. 1600 m w. 108 sup. nectoph.; 62 inf. nectoph.
C. 2500 m w. 72 sup. nectoph.; 30 inf. nectoph. | Y. 100 m w. 6 sup. nectoph.; 4 inf. nectoph. |
| St. 36. 42°49' N., 6°54' E. 30. I. 1909.
Y. 65 m w. 99 sup. nectoph.; 102 inf. nectoph. | St. 59. 36°02' N., 4°24' W. 21. II. 1909.
Y. 25 m w. 65 sup. nectoph.; 2 inf. nectoph. |
| Y. 300 m w. 262 sup. nectoph.; 137 inf. nectoph. | Y. 100 m w. 5 sup. nectoph.; 1 inf. nectoph. |
| St. 38. 40°45' N., 9°50' E. 31. I. 1909.
Y. 25 m w. 29 sup. nectoph.; 4 inf. nectoph. | Y. 500 m w. 2 sup. nectoph. |
| Y. 65 m w. 41 sup. nectoph.; 1 inf. nectoph. | Y. 1200 m w. 5 sup. nectoph. |
| Y. 150 m w. 42 sup. nectoph.; 5 inf. nectoph. | St. 61. 35°57' N., 5°35' W. 21. II. 1909.
Y. 600 m w. 3 sup. nectoph. |
| The Danish Oceanographical Expedition. II. H. 2. | St. 62. 35°45' N., 5°59' W. 21. II. 1909.
Y. 25 m w. 80 sup. nectoph.; 20 inf. nectoph. |
| | St. 63. 35°50' N., 6°03' W. 22. II. 1909.
Y. 25 m w. 63 sup. nectoph.; 9 inf. nectoph. |
| | Y. 600 m w. 57 sup. nectoph.; 11 inf. nectoph. |
| | St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 25 m w. 14 sup. nectoph. |
| | Y. 65 m w. 388 sup. nectoph.; 18 inf. nectoph. |
| | Y. 300 m w. 328 sup. nectoph.; 48 inf. nectoph. |
| | Y. 600 m w. 170 sup. nectoph.; 26 inf. nectoph. |
| | Y. 1600 m w. 33 sup. nectoph.; 3 inf. nectoph. |
| | St. 66. 36°16' N., 6°52' W. 25. II. 1909.
Y. 25 m w. 1 sup. nectoph. |
| | Y. 65 m w. 90 sup. nectoph.; 23 inf. nectoph. |
| | Y. 300 m w. 175 sup. nectoph.; 50 inf. nectoph. |
| | Y. 600 m w. 17 sup. nectoph.; 4 inf. nectoph. |
| | Y. 1200 m w. 25 sup. nectoph.; 2 inf. nectoph. |
| | St. 68. 36°39' N., 7° 21' W. 27. II. 1909.
Y. 800 m w. 41 sup. nectoph.; 18 inf. nectoph. |

- St. 69. 36°13' N., 9°44' W. 28. II. 1909.
 Y. 25 m w. 55 sup. nectoph.; 37 inf. nectoph.
 Y. 65 m w. 4 col.; 122 sup. nectoph.; 188 inf. nectoph.
 Y. 300 m w. 218 sup. nectoph.; 132 inf. nectoph.
 Y. 600 m w. 1 col.; 72 sup. nectoph.; 66 inf. nectoph.
 C. 3000 m w. 41 sup. nectoph.; 20 inf. nectoph.
- St. 70. 39°06' N., 9°47' W. 4. III. 1909.
 Y. 65 m w. 61 sup. nectoph.; 29 inf. nectoph.
- St. 71. 39°35' N., 9°45' W. 4. III. 1909.
 Y. 300 m w. 96 sup. nectoph.; 66 inf. nectoph.
 Y. 600 m w. 8 sup. nectoph.; 4 inf. nectoph.
 Y. 1600 m w. 1 inf. nectoph.
- St. 74. 44°21' N., 7°55' W. 8. III. 1909.
 Y. 300 m w. 12 sup. nectoph.; 8 inf. nectoph.
- St. 75. 45°37' N., 7°03' W. 9. III. 1909.
 Y. 300 m w. 2 sup. nectoph.; 2 inf. nectoph.
 Y. 600 m w. 2 sup. nectoph.
 C. 4300 m w. 4 sup. nectoph.; 1 inf. nectoph.
- St. 76. 47°01' N., 5°48' W. 10. III. 1909.
 Y. 600 m w. 1 sup. nectoph.
 Y. 1600 m w. 1 sup. nectoph.
- St. 80. 46°17' N., 7°31' W. 13. VI. 1910.
 Y. 25 m w. 1 sup. nectoph.
- St. 81. 41°32' N., 9°32' W. 15. VI. 1910.
 Y. 300 m w. 2 sup. nectoph.
 Y. 500 m w. 3 sup. nectoph.; 3 inf. nectoph.
- St. 85. 38°22' N., 9°28' W. 17. VI. 1910.
 Y. 65 m w. 2 sup. nectoph.
- St. 86. 37°22' N., 9°15' W. 17. VI. 1910.
 P. Surface. 36 sup. nectoph.; 18 inf. nectoph.
- St. 87. 37°03' N., 9°15' W. 17. VI. 1910.
 Y. 65 m w. 18 sup. nectoph.; 13 inf. nectoph.
 Y. 300 m w. 187 sup. nectoph.; 135 inf. nectoph.
- St. 89. 36°28' N., 8°22' W. 18. VI. 1910.
 Y. 65 m w. 33 col.; 1185 sup. nectoph.; 678 inf. nectoph.
 Y. 300 m w. 156 sup. nectoph.; 50 inf. nectoph.
 Y. 1000 m w. 345 sup. nectoph.; 109 inf. nectoph.
- St. 91. 35°53' N., 7°26' W. 18. VI. 1910.
 Y. 300 m w. 2 col.; 980 sup. nectoph.; 657 inf. nectoph.
 Y. 1600 m w. 153 sup. nectoph.; 79 inf. nectoph.
- St. 92. 36°16' N., 6°50' W. 19. VI. 1910.
 Y. 65 m w. 5585 ± sup. nectoph.; 4945 ± inf. nectoph.¹
- St. 94. 36°06' N., 6°02' W. 23. VI. 1910.
 Y. 65 m w. 1 col.; 4 sup. nectoph.; 4 inf. nectoph.
- St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
 Y. 25 m w. 59 sup. nectoph.; 51 inf. nectoph.
 Y. 65 m w. 2 col.; 37 sup. nectoph.; 19 inf. nectoph.
 Y. 300 m w. 8 sup. nectoph.; 8 inf. nectoph.
- St. 96. 35°48' N., 5°58' W. 23. VI. 1910.
 Y. 65 m w. 1 col.; 30 sup. nectoph.; 28 inf. nectoph.
- St. 98. 35°57' N., 5°35' W. 23. VI. 1910.
 Y. 65 m w. 34 sup. nectoph.; 30 inf. nectoph.
- St. 99. 36°02' N., 5°16' W. 23. VI. 1910.
 Y. 65 m w. 5 sup. nectoph.; 1 inf. nectoph.
 Y. 300 m w. 205 sup. nectoph.; 130 inf. nectoph.
- St. 104. 36°37' N., 2°04' W. 24. VI. 1910.
 Y. 65 m w. 3 col.; 23 sup. nectoph.; 5 inf. nectoph.
- St. 105. 36°43' N., 2°08' W. 24. VI. 1910.
 Y. 40 m w. 2 sup. nectoph.
- St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
 Y. 300 m w. 3 sup. nectoph.; 4 inf. nectoph.
 Y. 1200 m w. 2 col.; 14 sup. nectoph.; 3 inf. nectoph.
- St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
 Y. 65 m w. 1 col.; 29 sup. nectoph.; 18 inf. nectoph.
 Y. 300 m w. 21 sup. nectoph.; 6 inf. nectoph.
 Y. 2000 m w. 1 col.; 4 sup. nectoph.; 2 inf. nectoph.
- St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
 Y. 25 m w. 7 sup. nectoph.; 7 inf. nectoph.
 Y. 65 m w. 1 sup. nectoph.
 Y. 300 m w. 3 sup. nectoph.; 2 inf. nectoph.
- St. 112. 36°56' N., 2°15' E. 27. VI. 1910.
 Y. 25 m w. 8 col.; 699 sup. nectoph.; 110 inf. nectoph.
 Y. 65 m w. 82 sup. nectoph.; 16 inf. nectoph.
 Y. 300 m w. 2 col.; 21 sup. nectoph.; 1 inf. nectoph.
- St. 113. 36°53' N., 3°09' E. 28. VI. 1910.
 Y. 300 m w. 3 col.; 16 sup. nectoph.; 7 inf. nectoph.
- St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
 Y. 25 m w. 24 col.; 491 sup. nectoph.; 277 inf. nectoph.
 Y. 65 m w. 31 col.; 378 sup. nectoph.; 292 inf. nectoph.
 Y. 300 m w. 36 sup. nectoph.; 11 inf. nectoph.
 Y. 2000 m w. 61 sup. nectoph.; 43 inf. nectoph.
- St. 116. 39°27' N., 5°26' E. 29. VI. 1910.
 Y. 25 m w. 24 col.; 577 sup. nectoph.; 225 inf. nectoph.
 Y. 65 m w. 2 col.; 97 sup. nectoph.; 53 inf. nectoph.
 Y. 300 m w. 2 col.; 109 sup. nectoph.; 55 inf. nectoph.
- St. 118. 41°00' N., 6°43' E. 30. VI. 1910.
 Y. 25 m w. 265 sup. nectoph.; 168 inf. nectoph.
 Y. 65 m w. 3 col.; 86 sup. nectoph.; 40 inf. nectoph.
 Y. 300 m w. 136 sup. nectoph.; 76 inf. nectoph.
- St. 120. 42°31' N., 7°41' E. 1. VII. 1910.
 Y. 300 m w. 86 sup. nectoph.; 60 inf. nectoph.
- St. 121. 43°08' N., 8°05' E. 2. VII. 1910.
 Y. 25 m w. 3 col.; 215 sup. nectoph.; 35 inf. nectoph.
- St. 122. 43°50' N., 8°34' E. 2. VII. 1910.
 Y. 600 m w. 201 sup. nectoph.; 145 inf. nectoph.
 Y. 1200 m w. 34 sup. nectoph.; 21 inf. nectoph.
- St. 123. 44°14' N., 8°55' E. 3. VII. 1910.
 Y. 10 m w. 646 sup. nectoph.; 9 inf. nectoph.
 Y. 25 m w. 6 col.; 1064 sup. nectoph.; 100 inf. nectoph.
 Y. 65 m w. 21 col.; 3324 sup. nectoph.; 721 inf. nectoph.
 Y. 300 m w. 242 sup. nectoph.; 93 inf. nectoph.
- St. 124. 44°20' N., 9°05' E. 3. VII. 1910.
 Y. 65 m w. 415 sup. nectoph.; 51 inf. nectoph.
- St. 125. 43°54' N., 9°13' E. 9. VII. 1910.
 Y. 25 m w. 309 sup. nectoph.; 106 inf. nectoph.
 Y. 300 m w. 32 sup. nectoph.; 21 inf. nectoph.
- St. 126. 42°43' N., 9°50' E. 10. VII. 1910.
 Y. 25 m w. 418 sup. nectoph.; 49 inf. nectoph.
 Y. 300 m w. 2 col.; 116 sup. nectoph.; 31 inf. nectoph.
- St. 129. 40°05' N., 11°31' E. 12. VII. 1910.
 Y. 25 m w. 1280 sup. nectoph.; 75 inf. nectoph.
 Y. 300 m w. 82 sup. nectoph.; 23 inf. nectoph.
 Y. 600 m w. 77 sup. nectoph.; 35 inf. nectoph.
 Y. 1000 m w. 2 col.; 66 sup. nectoph.; 23 inf. nectoph.
 C. 3500 m w. 48 sup. nectoph.; 25 inf. nectoph.
- St. 130. 39°35' N., 11°20' E. 13. VII. 1910.
 Y. 25 m w. 6 col.; 944 sup. nectoph.; 731 inf. nectoph.
- St. 131. 38°36' N., 11°00' E. 13. VII. 1910.
 Y. 25 m w. 4 col.; 84 sup. nectoph.; 8 inf. nectoph.
 Y. 300 m w. 17 sup. nectoph.; 2 inf. nectoph.
 Y. 1000 m w. 25 sup. nectoph.; 7 inf. nectoph.
- St. 132. 38°57' N., 9°47' E. 14. VI. 1910.
 Y. 25 m w. 273 sup. nectoph.; 188 inf. nectoph.
 Y. 300 m w. 17 col.; 357 sup. nectoph.; 253 inf. nectoph.
 Y. 600 m w. 6 col.; 638 sup. nectoph.; 530 inf. nectoph.
- St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
 Y. 25 m w. 342 sup. nectoph.; 183 inf. nectoph.
 Y. 300 m w. 36 sup. nectoph.; 12 inf. nectoph.
 Y. 600 m w. 37 sup. nectoph.; 17 inf. nectoph.
- St. 134. 37°37' N., 10°17' E. 15. VII. 1910.
 Y. 25 m w. 117 sup. nectoph.; 38 inf. nectoph.
 Y. 300 m w. 12 col.; 75 sup. nectoph.; 79 inf. nectoph.
- St. 135. 37°17' N., 10°28' E. 15. VII. 1910.
 Y. 25 m w. 4 sup. nectoph.; 2 inf. nectoph.
- St. 136. 37°01' N., 10°31' E. 19. VII. 1910.
 Y. 25 m w. 24 sup. nectoph.; 13 inf. nectoph.
 Y. 100 m w. 3 sup. nectoph.; 1 inf. nectoph.
- St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
 Y. 25 m w. 12 col.; 268 sup. nectoph.; 115 inf. nectoph.
 Y. 250 m w. 91 sup. nectoph.; 59 inf. nectoph.
- St. 138. 37°37' N., 11°25' E. 19. VII. 1910.
 Y. 25 m w. 2 col.; 520 sup. nectoph.; 277 inf. nectoph.
 Y. 300 m w. 2 col.; 42 sup. nectoph.; 21 inf. nectoph.
 Y. 1000 m w. 86 sup. nectoph.; 36 inf. nectoph.
- St. 139. 37°57' N., 11°54' E. 20. VII. 1910.
 Y. 25 m w. 5 sup. nectoph.; 7 inf. nectoph.
 Y. 300 m w. 4 sup. nectoph.; 2 inf. nectoph.
 Y. 800 m w. 1 inf. nectoph.
- St. 141. 36°42' N., 13°34' E. 20. VII. 1910.
 Y. 25 m w. 3 col.; 198 sup. nectoph.; 98 inf. nectoph.

¹ See note ¹ on p. 44.

- St. 142. 35°44' N., 15°07' E. 22. VII. 1910.
 Y. 25 m w. 2 col.; 679 sup. nectoph.; 56 inf. nectoph.
 Y. 150 m w. 43 sup. nectoph.; 1 inf. nectoph.
- St. 143. 35°18' N., 16°25' E. 22. VII. 1910.
 Y. 25 m w. 1 col.; 110 sup. nectoph.; 45 inf. nectoph.
 Y. 300 m w. 1 col.; 79 sup. nectoph.; 18 inf. nectoph.
 Y. 1000 m w. 1 col.; 57 sup. nectoph.; 12 inf. nectoph.
- St. 144. 34°31' N., 18°40' E. 23. VII. 1910.
 Y. 25 m w. 1 col.; 82 sup. nectoph.; 69 inf. nectoph.
 Y. 300 m w. 10 sup. nectoph.; 5 inf. nectoph.
 Y. 2000 m w. 5 sup. nectoph.; 2 inf. nectophores.
 C. 4000 m w. 3 sup. nectoph.; 2 inf. nectoph.
- St. 145. 32°38' N., 19°02' E. 25. VII. 1910.
 Y. 25 m w. 110 sup. nectoph.; 28 inf. nectoph.
 Y. 300 m w. 1 col.; 22 sup. nectoph.; 9 inf. nectoph.
- St. 147. 31°35' N., 19°02' E. 25. VII. 1910.
 Y. 25 m w. 21 sup. nectoph.; 2 inf. nectoph.
 Y. 300 m w. 11 sup. nectoph.
 Y. 1000 m w. 6 sup. nectoph.
- St. 152. 33°11' N., 21° 44'E. 27. VII. 1910.
 Y. 25 m w. 39 sup. nectoph.; 34 inf. nectoph.
 Y. 300 m w. 15 sup. nectoph.; 8 inf. nectoph.
 Y. 1000 m w. 8 sup. nectoph.; 2 inf. nectoph.
- St. 154. 32°10' N., 24°46' E. 29. VII. 1910.
 Y. 300 m w. 1 sup. nectoph.; 1 inf. nectoph.
- St. 156. 32°16' N., 26°03' E. 29. VII. 1910.
 Y. 25 m w. 2 col.; 211 sup. nectoph.; 94 inf. nectoph.
 Y. 600 m w. 4 sup. nectoph.; 2 inf. nectoph.
 Y. 1000 m w. 13 sup. nectoph.; 6 inf. nectoph.
- St. 158. 34°23' N., 27°57' E. 31. VII. 1910.
 Y. 300 m w. 1 col.; 12 sup. nectoph.; 3 inf. nectoph.
- St. 160. 35°59' N., 28°14' E. 1. VIII. 1910.
 Y. 25 m w. 3 col.; 569 sup. nectoph.; 69 inf. nectoph.
 Y. 300 m w. 8 sup. nectoph.; 3 inf. nectoph.
 Y. 1000 m w. 2 col.; 23 sup. nectoph.; 8 inf. nectoph.
 Y. 4000 m w. 6 sup. nectoph.; 1 inf. necotph.
- St. 161. 36°12' N., 27°16' E. 2. VIII. 1910.
 Y. 25 m w. 13 sup. nectoph.; 5 inf. nectoph.
- St. 163. 37°52' N., 26°22' E. 2. VIII. 1910.
 Y. 25 m w. 8 sup. nectoph.
- St. 179. 40°02' N., 25°55' E. 13. VIII. 1910.
 Y. 65 m w. 2 sup. nectoph.
- St. 181. 38°49' N., 25°09' E. 13. VIII. 1910.
 Y. 65 m w. 10 sup. nectoph.
 Y. 300 m w. 1 col.; 15 sup. nectoph.; 2 inf. nectoph.
- St. 182. 38°18' N., 24°48' E. 14. VIII. 1910.
 Y. 10 m w. 3 col.; 73 sup. nectoph.; 2 inf. nectoph.
 Y. 65 m w. 5 col.; 78 sup. nectoph.; 4 inf. nectoph.
 Y. 600 m w. 2 col.; 48 sup. nectoph.; 4 inf. nectoph.
- St. 183. 37°52' N., 23°09' E. 16. VIII. 1910.
 Y. 65 m w. 4 col.; 912 sup. nectoph.; 219 inf. nectoph.
 Y. 300 m w. 9 col.; 373 sup. nectoph.; 76 inf. nectoph.
- St. 185. 38°12' N., 21°17' E. 17. VIII. 1910.
 Y. 25 m w. 43 sup. nectoph.; 6 inf. nectoph.
- St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
 Y. 10 m w. 32 sup. nectoph.; 18 inf. nectoph.
 Y. 65 m w. 323 sup. nectoph.; 123 inf. nectoph.
 Y. 300 m w. 2 col.; 163 sup. nectoph.; 85 inf. nectoph.
 Y. 1200 m w. 213 sup. nectoph.; 95 inf. nectoph.
- St. 187. 37°54' N., 18°02' E. 18. VIII. 1910.
 Y. 25 m w. 5 sup. nectoph.
 Y. 300 m w. 18 sup. nectoph.
 Y. 1000 m w. 29 sup. nectoph.; 12 inf. nectoph.
- St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.
 Y. 25 m w. 16 sup. nectoph.; 1 inf. nectoph.
 Y. 300 m w. 2 col.; 78 sup. nectoph.; 9 inf. nectoph.
 Y. 1000 m w. 1 col.; 85 sup. nectoph.; 30 inf. nectoph.
- St. 190. 37°51' N., 15°19' E. 19. VIII. 1910.
 Y. 25 m w. 243 sup. nectoph.; 66 inf. nectophores.
- St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
 Y. 25 m w. 11 col.; 1779 sup. nectoph.; 144 inf. nectoph.
 Y. 300 m w. 3 col.; 36 sup. nectoph.; 5 inf. nectoph.
 Y. 600 m w. 1 col.; 82 sup. nectoph.; 16 inf. nectoph.
- St. 193. 38°15' N., 15°39' E. 21. VIII. 1910.
 Y. 19 m w. 2 col.; 870 sup. nectoph.; 163 inf. nectoph.
- St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
 Y. 10 m w. 2 col.; 370 sup. nectoph.; 2 inf. nectoph.
 Y. 25 m w. 4 col.; 1095 sup. nectoph.; 51 inf. nectoph.
 Y. 1200 m w. 3 col.; 80 sup. nectoph.; 29 inf. nectoph.
- St. 195. 39°02' N., 14°55' E. 21. VIII. 1910.
 Y. 25 m w. 3 col.; 81 sup. nectoph.; 3 inf. nectoph.
 Y. 300 m w. 124 sup. nectoph.; 80 inf. nectoph.
- St. 196. 39°59' N., 14°31' E. 22. VIII. 1910.
 Y. 25 m w. 4 col.; 338 sup. nectoph.; 103 inf. nectoph.
- St. 197. 40°34' N., 13°36' E. 24. VIII. 1910.
 Y. 25 m w. 19 sup. nectoph.; 5 inf. nectoph.
 Y. 300 m w. 2 col.; 53 sup. nectoph.; 18 inf. nectoph.
- St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
 Y. 25 m w. 1 col.; 32 sup. nectoph.; 4 inf. nectoph.
 Y. 300 m w. 239 sup. nectoph.; 171 inf. nectoph.
 Y. 1000 m w. 2 col.; 86 sup. nectoph.; 39 inf. nectoph.
- St. 200. 39°18' N., 10°11' E. 26. VIII. 1910.
 Y. 25 m w. 7 col.; 1043 sup. nectoph.; 36 inf. nectoph.
- St. 202. 38°59' N., 9°25' E. 26. VIII. 1910.
 Y. 300 m w. 1 col.; 80 sup. nectoph.; 41 inf. nectoph.
- St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
 Y. 25 m w. 10 col.; 436 sup. nectoph.; 19 inf. nectoph.
 Y. 65 m w. 4 col.; 758 sup. nectoph.; 371 inf. nectoph.
 Y. 300 m w. 1 col.; 63 sup. nectoph.; 30 inf. nectoph.
 Y. 1000 m w. 1 col.; 68 sup. nectoph.; 25 inf. nectoph.
- St. 205. 39°16' N., 5°52' E. 27. VIII. 1910.
 Y. 25 m w. 205 sup. nectoph.; 11 inf. nectoph.
- St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
 Y. 25 m w. 113 sup. nectoph.; 40 inf. nectoph.
 Y. 300 m w. 3 col.; 47 sup. nectophores; 36 inf. nectoph.
 Y. 1000 m w. 5 col.; 113 sup. nectoph.; 51 inf. nectoph.
 Y. 2000 m w. 138 sup. nectophores; 64 inf. nectoph.
- St. 207. 39°58' N., 3°41' E. 28. VIII. 1910.
 Y. 25 m w. 4 col.; 992 sup. nectoph.; 62 inf. nectoph.
 Y. 65 m w. 2 col.; 30 sup. nectoph.; 3 inf. nectoph.
 Y. 100 m w. 2 col.; 81 sup. nectoph.; 46 inf. nectoph.
- St. 208. 40°18' N., 3°20' E. 29. VIII. 1910.
 Y. 25 m w. 8 col.; 620 sup. nectoph.; 357 inf. nectoph.
- St. 209. 40°34' N., 3°03' E. 29. VIII. 1910.
 N. 0—35 m. 14 sup. nectoph.; 4 inf. nectoph.
 N. 35—75 m. 7 sup. nectoph.
 C. 150 m w. 1 col.; 338 sup. nectoph.; 76 inf. nectoph.
 Y. 25 m w. 88 sup. nectoph.; 6 inf. nectoph.
 Y. 100 m w. 2 col.; 326 sup. nectoph.; 43 inf. nectoph.
 Y. 300 m w. 6 col.; 233 sup. nectoph.; 141 inf. nectoph.
 Y. 2000 m w. 1 col.; 102 sup. nectoph.; 36 inf. nectoph.
- St. 210. 41°10' N., 2°23' E. 30. VIII. 1910.
 Y. 25 m w. 1 col.; 99 sup. nectoph.; 9 inf. nectoph.
 Y. 600 m w. 69 sup. nectoph.; 22 inf. nectoph.
- St. 213. 40°14' N., 0°54' E. 31. VIII. 1910.
 Y. 25 m w. 5 sup. nectoph.
 Y. 95 m w. 65 sup. necrophores; 33 inf. nectoph.
- St. 215. 39°14' N., 0°52' E. 31. VIII. 1910.
 Y. 25 m w. 300 sup. nectoph.; 135 inf. nectoph.
- St. 216. 38°31' N., 1°24' E. 1. IX. 1910.
 Y. 25 m w. 1 col.; 272 sup. nectoph.; 29 inf. nectoph.
- St. 217. 38°01' N., 1°48' E. 1. IX. 1910.
 Y. 300 m w. 17 sup. nectoph.; 12 inf. nectoph.
- St. 218. 36°54' N., 2°57' E. 2. IX. 1910.
 Y. 25 m w. 65 sup. nectoph.; 37 inf. nectoph.
- St. 220. 36°25' N., 0°42' E. 4. IX. 1910.
 Y. 25 m w. 7 col.; 231 sup. nectoph.; 202 inf. nectoph.
- St. 221. 35°44' N., 0°53' W. 4. IX. 1910.
 Y. 25 m w. 3 sup. nectoph.; 1 inf. nectoph.
- St. 222. 35°53' N., 0°57' W. 4. IX. 1910.
 Y. 300 m w. 1 sup. nectoph.; 1 inf. nectoph.
- St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
 Y. 25 m w. 2 col.; 224 sup. nectoph.; 143 inf. nectoph.
- St. 225. 36°35' N., 3°00' W. 6. IX. 1910.
 Y. 25 m w. 5 sup. nectoph.; 2 inf. nectoph.
- St. 229. 35°51' N., 5°58' W. 8. IX. 1910.
 Y. 45 m w. 9 sup. nectoph.; 1 inf. nectoph.
 Y. 300 m w. 3 sup. nectoph.; 2 inf. nectoph.

- St. 231. 35°56' N., 7°16' W. 9. IX. 1910.
 Y. 25 m w. 91 sup. nectoph.; 28 inf. nectoph.
 St. 232. 36°29' N., 9°06' W. 9. IX. 1910.
 Y. 25 m w. 393 sup. nectoph.; 24 inf. nectoph.
 Y. 300 m w. 4 col.; 173 sup. nectoph.; 6 inf. nectoph.
 Y. 1000 m w. 131 sup. nectoph.; 5 inf. nectoph.
 St. 233. 36°49' N., 9°15' W. 10. IX. 1910.
 Y. 25 m w. 353 sup. nectoph.; 171 inf. nectoph.¹
 St. 234. 38°10' N., 9°20' W. 10. IX. 1910.
 Y. 25 m w. 1 col.; 147 sup. nectoph.; 67 inf. nectoph.
 Y. 1000 m w. 37 sup. nectoph.; 20 inf. nectoph.
 St. 275. 39°05' N., 14°50'. E. 3. IV. 1911.
 S. 94 m w. 10 sup. nectoph.; 6 inf. nectoph.
 St. 276. 38°30' N., 19°20' E. 4. IV. 1911.
 S. 132 m w. 157 sup. nectoph.; 16 inf. nectoph.
 St. 277. 33°20' N., 27°30' E. 6. IV. 1911.
 S. 132 m w. 185 sup. nectoph.; 8 inf. nectoph.
 St. 278. 38°11.5' N., 15°37.5' E. 22. II. 1911.
 S. 15 m w. 123 sup. nectoph.; 25 inf. nectoph.
 St. 279. 38°11.5' N., 15°36.5' E. 23. II. 1911.
 S. 30 m w. 92 sup. nectoph.; 30 inf. nectoph.
 St. 280. 38°11' N., 15°36.5' E. 25. II. 1911.
 S. 15 m w. 79 sup. nectoph.; 21 inf. nectoph.

- St. 281. 38°15' N., 15°37.5' E. 1. III. 1911.
 S. 10 m w. 19 sup. nectoph.; 3 inf. nectoph.
 S. 30 m w. 39 sup. nectoph.; 15 inf. nectoph.
 S. 40 m w. 69 sup. nectoph.; 14 inf. nectoph.
 St. 282. 38°12' N., 15°37' E. 8. III. 1911.
 S. 40 m w. 222 sup. nectoph.; 48 inf. nectoph.
 St. 283. 38°12' N., 15°37' E. 12. III. 1911.
 S. 40 m w. 90 sup. nectoph.; 34 inf. nectoph.
 St. 296. 32°10' N., 29°50' E. 25. VI. 1911.
 S. 28 m w. 9 sup. nectoph.; 5 inf. nectoph.
 St. 297. 33°10' N., 25°03' E. 25. VI. 1911.
 S. 28 m w. 7 sup. nectoph.; 2 inf. nectoph.
 St. 298. 34°20' N., 21°10' E. 26. VI. 1911.
 S. 38 m w. 4 sup. nectoph.; 1 inf. nectoph.
 St. 339. 40°30' N., 3°10' E. 20. VIII. 1911.
 S. 28 m w. 25 sup.. nectoph.
 St. 340. 35°50' N., 21°30' E. 26. VIII. 1911.
 S. 28 m w. 1 sup. nectoph.
 St. 341. 34°00' N., 26°20' E. 27. VIII. 1911.
 S. 28 m w. 3 col.; 106 sup. nectoph.
 S. 108 m w. 8 sup. nectoph.

Most recent authors agree in the choice of ESCHSCHOLTZ's (1829) old name *appendiculata* for this well known species. MOSER (1911, 1913 a, 1925) on the contrary, considers ESCHSCHOLTZ's (1829) account of his *appendiculata* unrecognizable, hence discards that name in favor of *sieboldii* KÖLLIKER, the identity of which is certain. Reasons are given elsewhere (BIGELOW, 1918, p. 420) for concluding that identification of ESCHSCHOLTZ's old species is no more doubtful than it is for "most of the early descriptions of Siphonophorae and Medusae", in fact, ESCHSCHOLTZ's figure (1829, Pl. 12, Fig. 7) agrees very well with the form subsequently described by COSTA (1836) as *bipartita*², by LEUCKART (1853) as *Diphyes acuminata* and by KÖLLIKER (1853) as *Diphyes sieboldii*.

In short, we see no reason to alter the earlier view that "when the probability that identification of an old name is correct, is as strong as in the present case, it should be used, until some actual reason to the contrary is adduced" (BIGELOW, 1918, p. 421).

In deciding what degree of completeness or accuracy, one should expect from the older descriptions, it is perhaps pertinent that one of the most diagnostic features of *C. appendiculata*, namely that the left lateral ridge arises some distance below the apex, was generally overlooked until 1911.

The present series is chiefly interesting (from the taxonomic standpoint) as cumulative evidence of the constancy of several minor characters, which have already been shown to be diagnostic of the species; namely the origin of the left ridge considerably below the apex; the twisting of the apical extremity of the right lateral ridge; the suppression of all but the basal sector of the dorsal ridge; and the truncate outlines of the hydroecium. So far, no significant variant has been recorded in any these respects.

EUDOXOIDES Huxley 1859.

This generic name was proposed by HUXLEY (1859) for an eudoxid, which (as now seems certain) belonged to his *Diphyes mitra* (BROWNE, 1926, p. 74; TOTTON, 1932, p. 346, 358).

EUDOXOIDES SPIRALIS Bigelow 1911.

- Diphyes spiralis*, Bigelow, 1911 b, p. 249, Pl. 7, Fig. 4, Pl. 8, Fig. 1, 2, Pl. 9, Fig. 3, Pl. 11, Fig. 4; 1913, p. 76.
Muggiae spiralis, Moser, 1925, p. 108, Pl. 1, Fig. 6—11; Browne, 1926, p. 59.
Eudoxoides spiralis, Totton, 1932, p. 360; Leloup, 1933, p. 34; 1934, p. 25.

¹ The catches were estimated after counting 0.19 and 0.29 of the actual catches from St. 92 (65 m wire) and St. 233 (25 m wire), respectively.

² The *Salpa (bipartita) lanceolata bipartita* of BORY DE ST. VINCENT (1804) was *Diphyes dispar*.

Material.

- St. 10. $37^{\circ}21'$ N., $16^{\circ}45'$ E. 15. XII. 1908.
 Y. 25 m w. 2 nectoph.; 1 eudox.
 Y. 65 m w. nectoph.
 Y. 600 m w. 18 nectoph.
 St. 11. $36^{\circ}57'$ N., $18^{\circ}16'$ E. 16. XII. 1908.
 Y. 25 m w. 234 nectoph.
 St. 13. $39^{\circ}43'$ N., $17^{\circ}30'$ E. 19. XII. 1908.
 Y. 1000 m w. 1 eudox.?
 St. 26. $40^{\circ}40'$ N., $13^{\circ}59'$ E. 18. I. 1909.
 Y. 300 m w. 1 nectoph.
 St. 29. $40^{\circ}47'$ N., $12^{\circ}55'$ E. 20. I. 1909.
 Y. 200 m w. 1 nectoph.
 St. 39. $39^{\circ}41'$ N., $10^{\circ}02'$ E. 1. II. 1909.
 Y. 25 m w. 7 nectoph.; 3 gonoph.
 St. 40. $39^{\circ}10'$ N., $9^{\circ}40'$ E. 1. II. 1909.
 Y. 65 m w. 20 nectoph.; 3 bracts; 3 gonoph.
 St. 42. $38^{\circ}58'$ N., $9^{\circ}37'$ E. 2. II. 1909.
 Y. 300 m w. 1 nectoph.
 St. 43. $38^{\circ}14'$ N., $8^{\circ}42'$ E. 3. II. 1909.
 Y. 65 m w. 18 nectoph.; 4 eudox.; 6 bracts; 16 gonoph.
 St. 46. $37^{\circ}17'$ N., $6^{\circ}00'$ E. 7. II. 1909.
 Y. 65 m w. 11 nectoph.; 1 eudox.; 9 bracts; 8 gonoph.
 Y. 300 m w. 2 nectoph.
 Y. 600 m w. 46 nectoph.; 51 eudox.; 45 gonoph.
 St. 47. $36^{\circ}55'$ N., $3^{\circ}12'$ E. 10. II. 1909.
 Y. 65 m w. 62 nectoph.; 6 eudox.; 36 bracts; 64 gonoph.
 Y. 300 m w. 35 nectoph.; 9 eudox.; 10 bracts; 19 gonoph.
 St. 50. $37^{\circ}02'$ N., $1^{\circ}17'$ E. 17. II. 1909.
 Y. 25 m w. 121 nectoph.; 86 eudox.; 101 gonoph.
 Y. 65 m w. 52 nectoph.; 24 eudox.; 25 gonoph.
 Y. 300 m w. 19 nectoph.; 9 eudox.; 3 gonoph.
 Y. 600 m w. 9 nectoph.
 Y. 1600 m w. 7 nectoph.; 2 eudox.; 7 gonoph.
 St. 51. $36^{\circ}27'$ N., $0^{\circ}37'$ W. 18. II. 1909.
 Y. 300 m w. 12 nectoph.; 1 eudox.; 2 gonoph.
 St. 55. $36^{\circ}46'$ N., $2^{\circ}18'$ W. 19. II. 1909.
 Y. 25 m w. 2 nectoph.; 1 bract.
 Y. 65 m. w. 4 nectoph.
 St. 57. $36^{\circ}40'$ N., $3^{\circ}30'$ W. 20. II. 1909.
 Y. 200 m w. 2 nectoph.
 St. 58. $36^{\circ}36'$ N., $4^{\circ}24'$ W. 20. II. 1909.
 Y. 65 m w. 1 nectoph.; 1 gonoph.
 St. 59. $36^{\circ}02'$ N., $4^{\circ}24'$ W. 21. II. 1909.
 Y. 25 m w. 5 nectoph.; 3 gonoph.
 Y. 100 m w. 1 nectoph.
 Y. 500 m w. 1 nectoph.
 Y. 1200 m w. 2 nectoph.
 St. 65. $35^{\circ}53'$ N., $7^{\circ}26'$ W. 24. II. 1909.
 Y. 65 m w. 2 nectoph.
 Y. 1600 m w. 1 nectoph.
 St. 69. $36^{\circ}13'$ N., $9^{\circ}44'$ W. 28. II. 1909.
 Y. 65 m w. 1 nectoph.
 St. 88. $36^{\circ}28'$ N., $8^{\circ}22'$ W. 18. VI. 1910.
 Y. 65 m w. 5 nectoph.
 Y. 1000 m w. 10 nectoph.; 1 eudox.
 St. 91. $35^{\circ}53'$ N., $7^{\circ}26'$ W. 18. VI. 1910.
 Y. 300 m w. 64 nectoph.
 Y. 1600 m w. 3 nectoph.
 St. 95. $35^{\circ}57'$ N., $6^{\circ}00'$ W. 23. VI. 1910.
 Y. 65 m w. 140 nectoph.
 St. 99. $36^{\circ}02'$ N., $5^{\circ}16'$ W. 23. VI. 1910.
 Y. 300 m w. 1 nectoph.
 St. 106. $36^{\circ}33'$ N., $2^{\circ}00'$ W. 25. VI. 1910.
 Y. 65 m w. 94 nectoph.
 Y. 300 m w. 1 nectoph.; 1 eudox.
 Y. 1200 m w. 2 nectoph.
 St. 107. $36^{\circ}18'$ N., $1^{\circ}14'$ W. 25. VI. 1910.
 Y. 65 m w. 12 nectoph.; 1 bract.
 Y. 300 m w. 3 nectoph.
 Y. 2000 m w. 4 nectoph.
 St. 108. $36^{\circ}03'$ N., $0^{\circ}27'$ W. 25. VI. 1910.
 Y. 65 m w. 4 nectoph.
 St. 112. $35^{\circ}56'$ N., $2^{\circ}15'$ E. 27. VI. 1910.
 Y. 25 m w. 74 nectoph.; 1 eudox.; 3 gonoph.
- Y. 65 m w. 117 nectoph.; 43 eudox.; 29 bracts; 137 gonoph.
 Y. 300 m w. 10 nectoph.; 1 gonoph.
 St. 113. $36^{\circ}53'$ N., $3^{\circ}09'$ E. 28. VI. 1910.
 Y. 300 m w. 1 nectoph.
 St. 115. $38^{\circ}17'$ N., $4^{\circ}11'$ E. 28. VI. 1910.
 Y. 25 m w. 18 nectoph.
 Y. 65 m w. 88 nectoph.; 1 eudox.; 1 gonoph.
 Y. 300 m w. 15 nectoph.
 Y. 2000 m w. 21 nectoph.
 St. 116. $39^{\circ}27'$ N., $5^{\circ}26'$ E. 29. VI. 1910.
 Y. 25 m w. 90 nectoph.; 1 eudox.; 6 gonoph.
 Y. 65 m w. 5 nectoph.
 Y. 300 m w. 7 nectoph.
 St. 118. $41^{\circ}00'$ N., $6^{\circ}43'$ E. 30. VI. 1910.
 Y. 25 m w. 18 nectoph.
 Y. 65 m w. 18 nectoph.
 Y. 300 m w. 12 nectoph.
 St. 120. $42^{\circ}31'$ N., $7^{\circ}41'$ E. 1. VII. 1910.
 Y. 300 m w. 2 nectoph.
 St. 122. $43^{\circ}50'$ N., $8^{\circ}34'$ E. 2. VII. 1910.
 Y. 1200 m w. 1 nectoph.
 St. 123. $44^{\circ}14'$ N., $8^{\circ}55'$ E. 3. VII. 1910.
 Y. 10 m w. 4 nectoph.
 Y. 25 m w. 10 nectoph.
 Y. 65 m w. 108 nectoph.; 2 eudox.; 1 gonoph.
 Y. 300 m w. 7 nectoph.; 1 bract.
 St. 124. $44^{\circ}20'$ N., $9^{\circ}05'$ E. 3. VII. 1910.
 Y. 65 m w. 10 nectoph.
 St. 126. $42^{\circ}43'$ N., $9^{\circ}50'$ E. 10. VII. 1910.
 Y. 25 m w. 2 nectoph.
 St. 129. $40^{\circ}05'$ N., $11^{\circ}31'$ E. 12. VII. 1910.
 Y. 25 m w. 2 nectoph.
 Y. 600 m w. 1 nectoph.
 Y. 1000 m w. 1 nectoph.
 C. 3500 m w. 1 nectoph.
 St. 130. $39^{\circ}35'$ N., $11^{\circ}20'$ E. 13. VII. 1910.
 Y. 25 m w. 4 nectoph.
 St. 131. $38^{\circ}36'$ N., $11^{\circ}00'$ E. 13. VII. 1910.
 Y. 1000 m w. 2 nectoph.
 St. 132. $38^{\circ}57'$ N., $9^{\circ}47'$ E. 14. VII. 1910.
 Y. 25 m w. 1 nectoph.
 St. 133. $38^{\circ}18'$ N., $9^{\circ}59'$ E. 14. VII. 1910.
 Y. 600 m w. 5 nectoph.
 St. 134. $37^{\circ}37'$ N., $10^{\circ}17'$ E. 15. VII. 1910.
 Y. 25 m w. 11 nectoph.
 Y. 300 m w. 6 nectoph.
 St. 137. $37^{\circ}17'$ N., $10^{\circ}56'$ E. 19. VII. 1910.
 Y. 25 m w. 78 nectoph.; 3 gonoph.
 Y. 250 m w. 9 nectoph.
 St. 138. $37^{\circ}37'$ N., $11^{\circ}25'$ E. 19. VII. 1910.
 Y. 25 m w. 185 nectoph.; 2 eudox.; 12 gonoph.
 Y. 300 m w. 7 nectoph.
 Y. 1000 m w. 12 nectoph.
 St. 139. $37^{\circ}57'$ N., $11^{\circ}54'$ E. 20. VII. 1910.
 Y. 25 m w. 9 nectoph.
 St. 141. $36^{\circ}42'$ N., $13^{\circ}34'$ E. 20. VII. 1910.
 Y. 25 m w. 3 nectoph.
 St. 142. $35^{\circ}44'$ N., $15^{\circ}07'$ E. 22. VII. 1910.
 Y. 25 m w. 99 nectoph.
 St. 143. $35^{\circ}18'$ N., $16^{\circ}25'$ E. 22. VII. 1910.
 Y. 300 m w. 5 nectoph.
 Y. 1000 m w. 8 nectoph.
 St. 144. $34^{\circ}31'$ N., $18^{\circ}40'$ E. 23. VII. 1910.
 Y. 25 m w. 1 nectoph.
 Y. 300 m w. 7 nectoph.
 St. 145. $32^{\circ}38'$ N., $19^{\circ}02'$ E. 25. VII. 1910.
 Y. 25 m w. 2 nectoph.
 Y. 300 m w. 215 nectoph.
 St. 147. $31^{\circ}35'$ N., $19^{\circ}02'$ E. 25. VII. 1910.
 Y. 1000 m w. 22 nectoph.
 St. 152. $33^{\circ}11'$ N., $21^{\circ}44'$ E. 27. VII. 1910.
 Y. 25 m w. 7 nectoph.
 Y. 300 m w. 90 nectoph.
 Y. 1000 m w. 12 nectoph.

St. 154. 32°10' N., 26°46' E. 29. VII. 1910. Y. 300 m w. 1 nectoph.	St. 202. 38°59' N., 9°25' E. 26. VIII. 1910. Y. 300 m w. 1 nectoph.
St. 156. 32°16' N., 26°03' E. 30. VII. 1910. Y. 600 m w. 2 nectoph. Y. 1000 m w. 7 nectoph.	St. 204. 38°52' N., 7°43' E. 27. VIII. 1910. Y. 25 m w. 3 nectoph. Y. 65 m w. 7 nectoph.; 1 gonoph. Y. 300 m w. 1 nectoph. Y. 1000 m w. 7 nectoph.
St. 158. 34°23' N., 27°57' E. 31. VII. 1910. Y. 300 m w. 7 nectoph.	St. 205. 39°16' N., 5°52' E. 27. VIII. 1910. Y. 25 m w. 4 nectoph.
St. 160. 35°59' N., 28°14' E. 1. VIII. 1910. Y. 25 m w. 3 nectoph. Y. 300 m w. 3 nectoph. Y. 1000 m w. 1 nectoph. C. 4000 m w. 1 nectoph.	St. 206. 39°32' N., 5°15' E. 28. VIII. 1910. Y. 300 m w. 18 nectoph.; 1 gonoph. Y. 2000 m w. 21 nectoph.; 2 gonoph.
St. 163. 37°52' N., 26°22' E. 2. VIII. 1910. Y. 25 m w. 3 nectoph. Y. 200 m w. 25 nectoph.	St. 207. 39°58' N., 3°41' E. 28. VIII. 1910. Y. 25 m w. 6 nectoph. Y. 65 m w. 2 nectoph.
St. 179. 40°02' N., 25°55' E. 13. VIII. 1910. Y. 65 m w. 12 nectoph.	St. 208. 40°18' N., 3°20' E. 29. VIII. 1910. Y. 25 m w. 3 nectoph.
St. 181. 38°49' N., 25°09' E. 13. VIII. 1910. Y. 65 m w. 3 nectoph.	St. 209. 40°34' N., 3°03' E. 29. VIII. 1910. C. 35-0 m w. 1 nectoph. C. 150 m w. 4 nectoph.; 1 gonoph.
St. 182. 38°13' N., 24°48' E. 14. VIII. 1910. Y. 10 m w. 2 nectoph. Y. 65 m w. 9 nectoph. Y. 600 m w. 11 nectoph.	Y. 25 m w. 2 nectoph. Y. 100 m w. 1 nectoph. Y. 2000 m w. 1 nectoph.
St. 183. 37°52' N., 23°09' E. 16. VIII. 1910. Y. 65 m w. 26 nectoph. Y. 300 m w. 2 nectoph.	St. 218. 36°54' N., 2°57' E. 2. IX. 1910. Y. 25 m w. 4 nectoph.
St. 186. 37°57' N., 19°51' E. 17. VIII. 1910. Y. 65 m w. 9 nectoph.; 1 gonoph. Y. 300 m w. 2 nectoph.	St. 221. 35°44' N., 0°53' W. 4. IX. 1910. Y. 25 m w. 32 nectoph.; 4 gonoph.
St. 187. 37°54' N., 18°02' E. 18. VIII. 1910. Y. 300 m w. 2 nectoph.	St. 223. 36°13' N., 1°28' W. 5. IX. 1910. Y. 25 m w. 2 nectoph.
St. 189. 37°44' N., 15°58' E. 19. VIII. 1910. Y. 300 m w. 4 nectoph. Y. 1000 m w. 5 nectoph.	St. 225. 36°35' N., 3°00' W. 6. IX. 1910. Y. 300 m w. 1 nectoph.; 1 eudox.; 1 bract; 2 gonoph.
St. 190. 37°51' N., 15°19' E. 19. VIII. 1910. Y. 25 m w. 60 nectoph.; 1 bract; 6 gonoph.	St. 232. 36°28' N., 9°06' W. 9. IX. 1910. Y. 25 m w. 17 nectoph. Y. 300 m w. 3 nectoph.
St. 192. 38°07' N., 15°33' E. 20. VIII. 1910. Y. 25 m w. 6 nectoph.; 2 gonoph.	St. 278. 38°11.5' N., 15°37.5' E. 22. II. 1911. S. 15 m w. 79 nectoph.; 3 eudox.; 4 bracts; 6 gonoph.
St. 193. 38°15' N., 15°39' E. 21. VIII. 1910. Y. 10 m w. 54 nectoph.; 2 eudox.; 5 gonoph.	St. 279. 38°11.5' N., 15°36.5' E. 23. II. 1911. S. 30 m w. 30 nectoph.; 4 eudox.; 5 bracts; 10 gonoph.
St. 194. 38°33' N., 15°29' E. 21. VIII. 1910. Y. 25 m w. 1 nectoph. Y. 1200 m w. 10 nectoph.	St. 280. 38°11' N., 15°36.5' E. 25. II. 1911. S. 15 m w. 23 nectoph.; 3 eudox.; 6 bracts; 5 gonoph.
St. 195. 39°02' N., 14°55' E. 21. VIII. 1910. Y. 300 m w. 3 nectoph.	St. 281. 38°15' N., 15°37.5' E. 1. III. 1911. S. 10 m w. 11 nectoph. S. 30 m w. 1 nectoph.
St. 197. 40°34' N., 13°36' E. 24. VIII. 1910. Y. 300 m w. 1 nectoph.	St. 282. 38°12' N., 15°37' E. 8. III. 1911. S. 40 m w. 191 nectoph.; 5 eudox.; 18 bracts; 43 gonoph.
St. 199. 39°32' N., 10°49' E. 25. VIII. 1910. Y. 300 m w. 15 nectoph. Y. 1000 m w. 5 nectoph.	St. 283. 38°12' N., 15°37.5' E. 12. III. 1911. S. 40 m w. 52 nectoph.; 1 eudox.; 2 bracts; 9 gonoph.
	St. 297. 33°10' N., 25°03' E. 25. VI. 1911. S. 28 m w. 3 nectoph.
	St. 298. 34°20' N., 21°10' E. 26. VI. 1911. S. 38 m w. 1 nectoph.

The first account of this species (BIGELOW, 1911b, p. 251) referred it to *Diphyes*, because "in two specimens the stem bore a very small bud which was apparently the forerunner of a posterior nectophore". This interpretation seems, however, to have been in error, for neither MOSER, BROWNE, TOTTEN nor LELLOUP found either inferior nectophores, or buds for the latter in any of the superior nectophores that they have examined. And as they are equally lacking in the "Thor" series, MOSER (1925, p. 109) was no doubt correct in concluding that *spiralis* is monophyid.

The spirally twisted nectophores, and gonophores, are so striking to the eye as to make this the most easily recognized of all Diphyniae. The present specimens add nothing to the detailed accounts that have previously appeared of the nectophore (BIGELOW, 1911b; MOSER, 1925) or of the eudoxid (MOSER, 1925; BROWNE, 1926; TOTTEN, 1932).

LENSIA Totton 1932.

This genus was proposed by TOTTEN (1932, p. 363) for certain small diphydids, which agree in the following combination of characters:— Superior nectophore pentagonal, without baso-lateral or baso-dorsal

teeth; with a very shallow hydroecium; with a short divided mouth-plate; without commissures from the radial canals; inferior nectophore (where known), small and fragile. Besides the type species (*Diphyes subtiloides* Lens and Van Riemsdijk 1908), TOTTON referred the following to *Lensia*:— *Diphyes subtilis* Chun 1886; *D. fowleri* Bigelow 1911; *D. truncata* Sars 1846¹; *Galeolaria campanella* Moser 1925; *G. multicristata* Moser 1925 (incl. *D. bigelowi* Browne 1926). LELOUP in 1933 also referred to it a new species, *L. grimaldii*, which, however, he later (1934) considered a variety of *L. multicristata*.

Although the characters separating these species are for the most part such as might be classed as "minor", yet they are so clear-cut that specific diagnosis is not only remarkably precise, but easy for well preserved material. One species, *campanella*, is set apart by the spiral twisting of the superior nectophore. This is not represented in the "Thor" collection but has been studied by TOTTON (1932) as well as by its discoverer. A second species, *multicristata*, or perhaps pair of species (incl. *grimaldii*), is delimited by the large number of longitudinal ridges (7 or more) and by deep concavity of the basal margin of the ventral facet. The remaining species resemble each other closely in general appearance, but are separable by details of conformation, as summarized in the following key.

Superior nectophore.

- | | |
|--|---|
| 1. Spirally twisted | <i>campanella</i> |
| Not spirally twisted | 2 |
| 2. Apex rounded, somatocyst with a thread-like stalk much longer than its globular terminal portion, <i>subtilis</i> | |
| Apex pointed; somatocyst either without stalk, or if stalked, stalk is much shorter than terminal portion, . . . | 3 |
| 3. With 7 or more longitudinal ridges | <i>multicristata</i> incl. <i>grimaldii</i> |
| With 5 ridges only | 4 |
| 4. Somatocyst globular, lying wholly below the level of the opening of the nectosac | <i>fowleri</i> |
| Somatocyst ovate or fusiform, extending apically beyond the level of the opening of the nectosac | 5 |
| 5. Dorso-basal angle somewhat produced, latero-basal margin of hydroecial portion only slightly oblique to general longitudinal axis of bell (Fig. 47) | <i>conoidea</i> |
| Dorso-basal angle not produced, latero-basal margin of hydroecial portion strongly oblique to longitudinal axis of bell (Fig. 47) | <i>subtiloides</i> |

TOTTON (1932, p. 370) has also given brief accounts of certain superior nectophores, resembling *conoidea* in general, but apparently differing from that species in minor features. However, as they were not in good enough condition for critical study, nothing further can be said about them.

Inferior nectophore. Among the 5 species, inferior bells of which have been described, *conoidea*² is set apart by the considerable length and bifid outline of the basal wing (p. 52, Fig. 34). The inferior bells of *campanella*, *multicristata*, *subtilis*, and *subtiloides* agree in the shortness of the basal wing and in the fact that its outline is entire. Judging from the illustrations so far published (see also p. 58), it seems that the inferior bell of *multicristata*³ is identifiable by the fact that the lateral ridges terminate some distance above the oral margin, as is also the case in the superior nectophore. In *campanella*⁴, the lateral ridges are lacking. In *subtilis*⁵ and *subtiloides*⁶ lateral ridges are present, but in *subtiloides* the apical outline of the nectosac is transversely truncate (as it is also in *campanella* and *conoidea*), whereas it is narrowly rounded in *subtilis* (cf. TOTTON, 1932, Fig. 34B, with Fig. 32B).

¹ As pointed out on page 49, this name was preoccupied, and the name *L. conoidea* Keferstein and Ehlers 1860 must be substituted.

² Inferior nectophore observed attached to the superior (SARS, 1846).

³ Buds were present among the "Thor" series (p. 58).

⁴ Loose lower bell, probably *campanella*, described by MOSER (1925, p. 154, Taf. 4, fig. 2) and figured by TOTTON (1932, Fig. 35B).

⁵ Inferior nectophore repeatedly observed still connected with the superior bell (LENS and VAN RIEMSDIJK, 1908, p. 47; MOSER, 1925, p. 164; TOTTON, 1932, Fig. 34).

⁶ Bud for the inferior nectophores seen by LENS and VAN RIEMSDIJK (1908, p. 48), and loose inferior bells, no doubt of this parentage, recorded by TOTTON (1932, p. 364).

The only species of *Lensia*, in which the cormidia and free eudoxids have been seen, are *conoidea* (SARS 1846; TOTTON, 1932, p. 367) and *subtiloides* (TOTTON, p. 366, Fig. 33). The "Thor" collection adds nothing in this respect.

LENSIA CONOIDEA Keferstein and Ehlers 1860.

Figs. 27—35, 47.

Diphyes truncata, Sars, 1846, p. 41—45, Pl. 7, Fig. 1—15; Bigelow, 1913, p. 73—75, Textfig. 2, Pl. 6, Fig. 3—5. (non *Diphyes truncata* Quoy and Gaimard, 1834, p. 97, Pl. 5, Fig. 21—23).

Diphyes conoidea, Keferstein and Ehlers, 1860, p. 260; 1861, p. 16, Pl. 5, Fig. 6—7.

Galeolaria truncata, Moser, 1925, p. 154, Pl. 3, Fig. 7—8, Pl. 4, Fig. 3—4.

Lensia truncata, Totton, 1932, p. 340; Leloup, 1933, p. 36; 1934, p. 42.

Material.

- | | |
|---|--|
| St. 30. 41°15' N., 11°55' E. 21. I. 1909.
Y. 300 m w. 11 sup. nectoph.; 19 inf. nectoph. | St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 600 m w. 8 sup. nectoph. |
| St. 31. 41°44' N., 10°52' E. 21. I. 1909.
Y. 65 m w. 38 sup. nectoph.; 40 inf. nectoph.
Y. 200 m w. 132 sup. nectoph.; 91 inf. nectoph. | St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 25 m w. 5 sup. nectoph.; 1 inf. nectoph.
Y. 65 m w. 10 sup. nectoph.; 3 inf. nectoph. |
| Y. 600 m w. 103 sup. nectoph.; 47 inf. nectoph.
Y. 1400 m w. 82 sup. nectoph.; 49 inf. nectoph. | Y. 300 m w. 195 sup. nectoph.; 5 inf. nectoph.
Y. 600 m w. 56 sup. nectoph.; 1 inf. nectoph. |
| St. 33. 43°04' N., 9°35' E. 22. I. 1909.
Y. 65 m w. 1 sup. nectoph. | St. 71. 39°35' N., 9°45' W. 4. III. 1909.
Y. 300 m w. 317 sup. nectoph.; 190 inf. nectoph. |
| St. 34. 43°27' N., 8°16' E. 23. I. 1909.
Y. 25 m w. 2 sup. nectoph.; 2 inf. nectoph.
Y. 65 m w. 1 sup. nectoph.; 1 inf. nectoph. | Y. 600 m w. 3 sup. nectoph.
Y. 1600 m w. 7 sup. nectoph. |
| Y. 200 m w. 2 sup. nectoph. | St. 74. 44°21' N., 7°55' W. 9. III. 1909.
Y. 300 m w. 239 sup. nectoph.; 107 inf. nectoph. |
| St. 35. 43°36' N., 7°36' E. 29. I. 1909.
Y. 300 m w. 2 sup. nectoph. | Y. 600 m w. 43 sup. nectoph.; 4 inf. nectoph. |
| Y. 700 m w. 9 sup. nectoph.; 2 inf. nectoph. | St. 75. 45°37' N., 7°03' W. 9. III. 1909.
Y. 300 m w. 227 sup. nectoph.; 149 inf. nectoph. |
| S. 1000 m w. 7 sup. nectoph.; 5 inf. nectoph. | Y. 600 m w. 50 sup. nectoph.; 10 inf. nectoph. |
| Y. 1600 m w. 6 + sup. nectoph.; 6 + inf. nectoph. | C. 4300 m w. 1 sup. nectoph.; 1 inf. nectoph. |
| C. 2500 m w. 8 sup. nectoph.; 2 inf. nectoph. | St. 76. 47°01' N., 5°48' W. 10. III. 1909.
Y. 600 m w. 39 sup. nectoph.; 18 inf. nectoph. |
| St. 36. 42°49' N., 6°54' E. 30. I. 1909.
Y. 300 m w. 92 sup. nectoph.; 74 inf. nectoph. | Y. 1600 m w. 11 sup. nectoph. |
| St. 38. 40°45' N., 9°50' E. 31. I. 1909.
Y. 65 m w. 1 sup. nectoph. | St. 79. 47°30' N., 6°43' W. 13. VI. 1910.
Y. 65 m w. 6 sup. nectoph.; 3 inf. nectoph. |
| St. 39. 39°41' N., 10°02' E. 1. II. 1909.
Y. 25 m w. 8 sup. nectoph.; 4 inf. nectoph. | St. 80. 46°17' N., 7°31' W. 13. VI. 1910.
Y. 25 m w. 1 sup. nectoph. |
| Y. 300 m w. 1 sup. nectoph. | Y. 300 m w. 21 sup. nectoph.; 15 inf. nectoph. |
| St. 40. 39°10' N., 9°40' E. 1. II. 1909.
Y. 65 m w. 6 sup. nectoph.; 1 inf. nectoph. | St. 89. 36°28' N., 8°22' W. 18. VI. 1910.
Y. 1000 m w. 130 sup. nectoph.; 1 inf. nectoph. |
| St. 42. 38°58' N., 9°37' E. 2. II. 1909.
Y. 300 m w. 1 sup. nectoph. | St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
Y. 25 m w. 1 sup. nectoph. |
| St. 43. 38°14' N., 8°42' E. 3. II. 1909.
Y. 65 m w. 5 sup. nectoph.; 1 inf. nectoph. | Y. 300 m w. 14 sup. nectoph. |
| St. 46. 37°17' N., 6°00' E. 7. II. 1909.
Y. 65 m w. 6 sup. nectoph. | St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
Y. 300 m w. 1 sup. nectoph. |
| Y. 300 m w. 1 sup. nectoph. | Y. 1200 m w. 60 sup. nectoph. |
| Y. 600 m w. 4 sup. nectoph. | St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
Y. 65 m w. 1 sup. nectoph. |
| St. 47. 36°55' N., 3°12' E. 10. II. 1909.
Y. 300 m w. 1 sup. nectoph. | Y. 300 m w. 2 sup. nectoph. |
| St. 50. 37°02' N., 1°17' E. 17. II. 1909.
Y. 25 m w. 1 sup. nectoph. | Y. 2000 m w. 12 sup. nectoph. |
| Y. 65 m w. 2 sup. nectoph. | St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
Y. 300 m w. 4 sup. nectoph. |
| Y. 600 m w. 1 sup. nectoph. | Y. 2000 m w. 115 sup. nectoph.; 23 inf. nectoph. |
| Y. 1600 m w. 3 sup. nectoph. | St. 116. 39°27' N., 5°26' E. 30. VI. 1910.
Y. 300 m w. 10 sup. nectoph. |
| St. 51. 36°27' N., 0°37' W. 18. II. 1909.
Y. 300 m w. 3 sup. nectoph. | St. 118. 41°00' N., 6°43' E. 1. VII. 1910.
Y. 300 m w. 7 sup. nectoph. |
| St. 57. 36°40' N., 3°30' W. 20. II. 1909.
Y. 200 m w. 5 sup. nectoph. | St. 120. 42°31' N., 7°41' E. 1. VII. 1910.
Y. 300 m w. 10 sup. nectoph. |
| St. 58. 36°36' N., 4°24' W. 20. II. 1909.
Y. 65 m w. 1 sup. nectoph. | St. 122. 43°50' N., 8°34' E. 2. VII. 1910.
Y. 600 m w. 52 sup. nectoph.; 16 inf. nectoph. |
| Y. 100 m w. 5 sup. nectoph. | Y. 1200 m w. 397 sup. nectoph.; 121 inf. nectoph. |
| St. 59. 36°02' N., 4°24' W. 21. II. 1909.
Y. 100 m w. 9 sup. nectoph. | St. 123. 44°14' N., 8°55' E. 3. VII. 1910.
Y. 300 m w. 8 sup. nectoph.; 1 inf. nectoph. |
| Y. 500 m w. 2 sup. nectoph. | |
| Y. 1200 m w. 15 sup. nectoph. | St. 125. 43°54' N., 9°13' E. 9. VII. 1910.
Y. 300 m w. 13 sup. nectoph.; 1 inf. nectoph. |
| St. 61. 35°57' N., 5°35' W. 21. II. 1909.
Y. 600 m w. 3 sup. nectoph. | St. 126. 42°43' N., 9°50' E. 10. VII. 1910.
Y. 25 m w. 1 sup. nectoph. |

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|---|---|
| <p>St. 129. 40°05' N., 11°31' E. 12. VII. 1910.
Y. 1000 m w. 1 sup. nectoph.; 1 inf. nectoph.</p> <p>St. 132. 38°57' N., 9°47' E. 14. VII. 1910.
Y. 300 m w. 1 + sup. nectop.</p> <p>St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
Y. 300 m w. 14 sup. nectoph.; 1 inf. nectoph.</p> <p>St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
Y. 250 m w. 7 sup. nectoph.; 6 inf. nectoph.</p> <p>St. 138. 37°37' N., 11°25' E. 19. VII. 1910.
Y. 1000 m w. 4 sup. nectoph.</p> <p>St. 139. 37°57' N., 11°54' E. 20. VII. 1910.
Y. 800 m w. 2 sup. nectoph.</p> <p>St. 156. 32°16' N., 26°03' E. 30. VII. 1910.
Y. 600 m w. 10 sup. nectoph.</p> <p>Y. 1000 m w. 1 sup. nectoph.</p> <p>St. 160. 36°59' N., 28°14' E. 1. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.</p> <p>St. 163. 37°52' N., 26°22' E. 3. VIII. 1910.
Y. 25 m w. 1 sup. nectoph.; 1 inf. nectoph.</p> <p>St. 174. 40°54' N., 28°63' E. 11. VII. 1910.
Y. 65 m w. 15 sup. nectoph.</p> <p>St. 175. 40°48' N., 27°59' E. 11. VII. 1910.
Y. 100 m w. 445 sup. nectoph.; 62 inf. nectoph.</p> <p>Y. 400 m w. 210 sup. nectoph.; 66 inf. nectoph.</p> <p>Y. 1200 m w. 187 sup. nectoph.; 105 inf. nectoph.</p> <p>St. 181. 38°49' N., 25°09' E. 13. VIII. 1910.
Y. 65 m w. 1 sup. nectoph.</p> <p>St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
Y. 1200 m w. 1 sup. nectoph.</p> | <p>St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
Y. 10 m w. 3 sup. nectoph.; 9 inf. nectoph.</p> <p>Y. 1200 m w. 62 sup. nectoph.</p> <p>St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
Y. 300 m w. 3 sup. nectoph.</p> <p>St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
Y. 300 m w. 24 sup. nectoph.; 14 inf. nectoph.</p> <p>St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
Y. 300 m w. 4 sup. nectoph.; 1 + inf. nectoph.</p> <p>Y. 1000 m w. 6 sup. nectoph.</p> <p>Y. 2000 m w. 104 sup. nectoph.; 53 inf. nectoph.</p> <p>St. 209. 40°34' N., 3°03' E. 29. VIII. 1910.
Y. 2000 m w. 104 sup. nectoph.; 21 inf. nectoph.</p> <p>St. 217. 38°01' N., 1°48' E. 1. IX. 1910.
Y. 300 m w. 1 sup. nectoph.</p> <p>St. 222. 35°53' N., 0°57' W. 4. IX. 1910.
Y. 300 m w. 2 sup. nectoph.</p> <p>St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
Y. 300 m w. 3 sup. nectoph.; 1 inf. nectoph.</p> <p>St. 228. 36°02' N., 5°06' W. 7. IX. 1910.
Y. 300 m w. 2 sup. nectoph.</p> <p>St. 229. 35°51' N., 5°58' W. 8. IX. 1910.
Y. 300 m w. 14 sup. nectoph.</p> <p>St. 242. 46°19' N., 6°48' W. 16. IX. 1910.
C. 4350 m w. 1 sup. nectoph.</p> <p>St. 245. 47°14' N., 6°02' W. 17. IX. 1910.
Y. 250 m w. 1 sup. nectoph.</p> |
|---|---|

Identification doubtful:—

- St. 210. 41°10' N., 2°23' E. 30. VIII. 1910.
Y. 600 m w. 1 sup. nectoph.

In recent discussions of this diphyid, the fact seems to have been overlooked that twelve years before SARS described his *Diphyes truncata*, QUOY and GAIMARD had used this same name for the bell of quite a different siphonophore¹. For this reason (to comply with the International Rules of Zoological Nomenclature), the specific name *truncata* cannot be used for SARS's species. Fortunately, however, there is no need of a new name in this case, for in 1860, KEFERSTEIN and EHLERS redescribed and, in 1861, excellently figured (apparently without knowledge of SARS's account) a Mediterranean diphyid as *D. conoidea*, which was undoubtedly identical with SARS's Norwegian *truncata*. Consequently, *conoidea* must be substituted for *truncata* as the specific name for SARS's species, and *truncata* be reserved pending the time (if ever) when some actual siphonophore is found with which QUOY and GAIMARD's account and pictures can be identified with reasonable probability.

Successive studies of recent collections have shown that *conoidea* is one of the most easily recognizable of diphyids, for its distinctive characters are precise, the mature bells grow to a considerable size (maximum recorded length, 28 mm. for the superior nectophore, 17 mm. for the inferior nectophore), and the gelatinous substance is so firm and the subumbrial musculature so strong that the number and location of the ridges, with the outlines of the facets and of the basal parts of the bells are easy to trace even on poorly preserved material. The most distinctive characters of the species were, in fact, stated and figured so adequately both by SARS and by KEFERSTEIN and EHLERS, that there is little room for amplification, except as regards variations in the length and the form of the somatocyst, in the depth of the hydroecial cavity (if any), and in the precise basal outline of the superior nectophore.

These apparently minor characters call for discussion, because it is their constancy which shows the closely allied forms, *L. fowleri* and *L. subtiloides*, to be specifically distinct, as BROWNE (1926) and TOTTEN (1932) have recently shown, and not mere variants of *conoidea*.

Superior Nectophore. In the general form of the bell, the number of ridges (5 from apex to base

¹ QUOY and GAIMARD's *D. truncata* was apparently the superior nectophore of some abylid, not of a diphyid. But it has not been possible to identify it with any known species.

Fig. 27—29), in the outlines of the 5 facets, in the absence of basal teeth, and in the transversely truncate outlines of the base with the point of origin of the somatocyst and of the stem lying below the level of the opening of the nectosac (or at least no higher than the latter), no variations appear in the Atlantic and Pacific specimens we have examined, other than such as are obviously results of differences in rigidity, or of contraction in preservation. Median grooves often seen in the dorso-lateral and ventro-lateral facets (Fig. 29, 33), may simply be contraction phenomena, for they do not appear in SARS's illustration; and the various minor grooves in the basal portion (Fig. 27) certainly are. It is interesting, in passing, that the ventral facet never (in our experience) shows any such contractions, probably because of the thickness of jelly which separates it from the musculature. The shape and flatness of this facet (Fig. 28), and the rectangular outline of base (Fig. 29) are the readiest field marks to the species.

Considerable variation appears in the length and the outline of the somatocyst (Fig. 30), and in the presence or absence of a definite hydroecial cavity or indentation of the base (Fig. 31, 32). In the "Thor" series the somatocyst ranges in length from about 40% of the total length of the bell to about 50%. In MOSER's figure (1925, Pl. 3, Fig. 7), it is about 33%, in SARS's (1846, Pl. 7, Fig. 1—2) about 45%, in KEFERSTEIN and EHLLER's (1861, Pl. 5, Fig. 6)

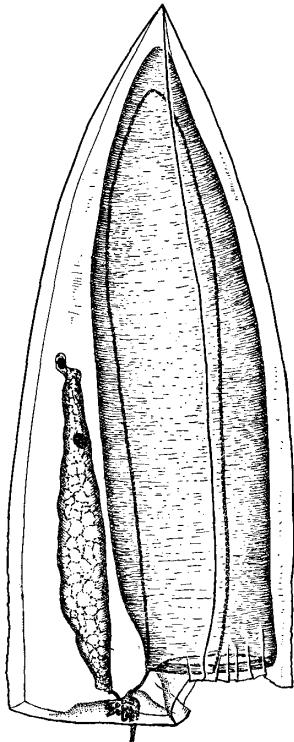


Fig. 27. *Lensia conoidea*; lateral view of superior nectophore, 14.5 mm. long, from "Thor" St. 36.

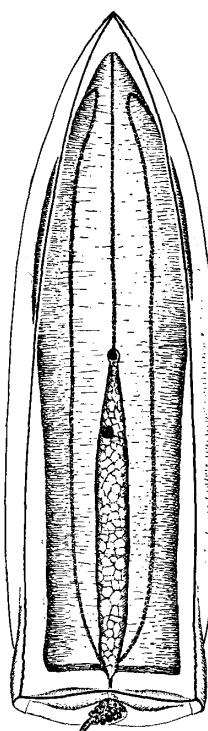


Fig. 28. *Lensia conoidea*; ventral view of specimen illustrated in Fig. 27.

only about 25%. Among specimens of large size from Bering Sea (BIGELOW, 1913, p. 75, Fig. 2), it ranged from 23% to slightly less than 50% of the total length. Its maximum length may thus be set at about 50%, it is minimum at about half as much. It varies, also, from a breadth so great as to occupy most of the space between the ventral face of the nectosac and the ventral surface of the bell, to a fusiform outline (Fig. 30). But in all cases, so far recorded, its main axis has been parallel to the main axis of the bell, or nearly so, and the stalk-portion of the somatocyst has occupied only a very minor part of the total length of that organ (Fig. 30).

According to MOSER (1925), the type of somatocyst occurring in *L. fowleri* Bigelow, in which this organ is still shorter, and with its main axis transverse to that of the nectophore, falls within the varietal range of *conoidea*, consequently she refers *fowleri* to the synonymy of the latter species. But while *conoidea* closely resembles *fowleri* in general outlines, TOTTEN (p. 370) has already pointed out other differences. And this, as discussed on page 55, applies equally to *L. subtiloides* Lens and Van Riemsdijk, which MOSER (1925) and BIGELOW (1913, p. 73) also united with *conoidea*.

The range of variation in the conformation of the ventro-basal part of the superior nectophore (presence or absence of the hydroecial furrow, and the depth of the latter if present), also proves to be considerable, in preserved material. BROWNE (1926, p. 78) has already pointed out that

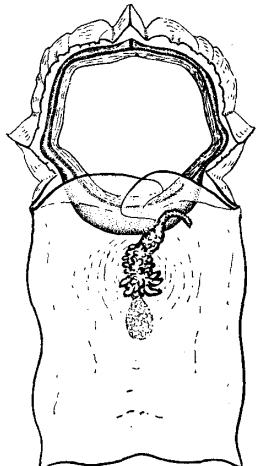


Fig. 29. *Lensia conoidea*; basal view of superior nectophore about 14 mm. long, "Thor" St. 36.

the "Albatross" specimens from Bering Sea, showed a well marked hydroecium, whereas others from the Faroes and Irish waters did not. Because of this difference, he concluded that the North Pacific form was not identical with the North Atlantic. It proves, however, that both extremes are represented in each ocean. On the one hand, the base of the bell may be square-cut, without any definite indentation, and with the point of connection between the stiel-canal and the stem (well below the level of the opening of the nectosac) lying at about the level of the ventro-lateral margins of the bell (Fig. 31). In specimens of this type, represented not only in the "Thor" collection¹, but also among the "Albatross" series from Bering Sea, the basal boundary of the ventral facet may either be entire, following a nearly straight line, without a definite median groove (Fig. 28), or its angular boundary may be interrupted in the median line (Fig. 31 B).

On the other hand, other specimens (Atlantic as well as Pacific) show a distinct hydroecial groove, varying from very shallow (the usual state, Fig. 27) to so deep that the junction of the stiel-canal with the stem lies little, if any, below the level of the opening of the nectosac (BIGELOW, 1913, Textfig. 2, p. 74). The extreme case so far seen is illustrated by a specimen from Bering Sea (Fig. 32), in which the hydroecial indentation is expanded in the form of two subsidiary hollows, which rise above the level of the nectosac,

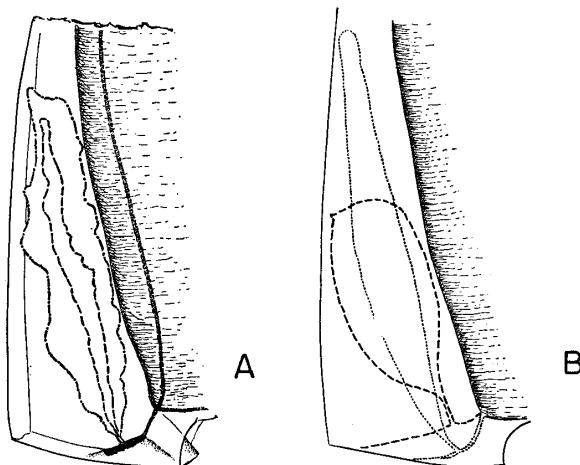


Fig. 30. *Lensia conoidea*; lateral view (diagrammatic) of ventro-basal portion of superior nectophores, to illustrate variations in the size of the somatocyst. A. Two specimens from "Thor" St. 36, each about 15 mm. long. B. Specimens 22 mm. long (with long somatocyst equal to 48% of total length) and 19 mm. (with short somatocyst equal to 26% of total length) from Bering Sea, "Albatross" St. 4759.

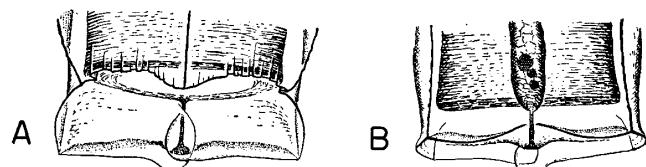


Fig. 31. *Lensia conoidea*; A. Dorsal view of basal part of superior nectophore, 14.6 mm. long; "Thor" St. 36. B. Ventral view of the same. C. Lateral view of the same.

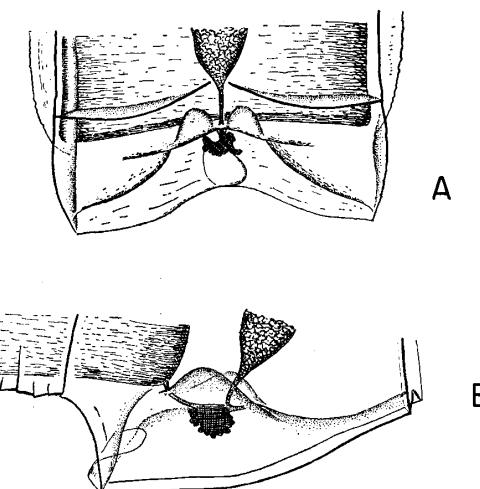


Fig. 32. *Lensia conoidea*; hydroecial portion of superior nectophore 20 mm. long, from Bering Sea, "Albatross" St. 4775. A. Ventral view. B. Lateral view.

enclosing the basal part of the somatocyst between them. Furthermore, the basal boundary of the ventral facet of specimens with definite hydroecial indentations is usually interrupted in the median line by a shallow,

¹⁾ This is the type shown by SARS (1846, Pl. 7, Fig. 1—2) and by KEFERSTEIN and EHLERS (1861, Pl. 5, Fig. 6—7).

groove-like extension, ventrad, of the hydroecium (Fig. 32B) though occasionally it is continuous. Without examination of living material it is impossible to state how far these variations of the hydroecial region represent different states of relaxation and contraction. At any rate they are not specific, because there is no discontinuity between the extremes.

The fact that these several variants have now been found to occur, both among the Atlantic specimens, of the *conoidea* type that we have examined, and among the North Pacific, confirms the earlier view (BIGELOW, 1913) that no specific distribution can be drawn between the two.

In the preserved state, the two wings into which the dorsal face of the basal sector is split, below the level of the nectosac, show considerable variation in outline — but much of this is obviously due to contraction in the preservative. In most of the better-preserved specimens, the condition approximates that shown in Figures 29 and 31. In most cases, at least, the right wing overlaps (is dorsad to) the left wing. But one specimen showed the reverse condition. But the condition of the material prevents critical examination of this point. In most cases, the basal parts of the dorsal and ventral ridges are slightly denticulate or wavy, the remainder of their courses smooth. But there is considerable variation in the respect.

Inferior Nectophore. The inferior nectophore has been redescribed and figured both by MOSER (1925, p. 161, Pl. 3, Fig. 8) and by BIGELOW (1913, p. 75, Pl. 6, Fig. 3). But examination of the considerable series from "Thor" Station 36, and comparison with SARS's (1846, Pl. 7, Fig. 3) original illustrations, shows that neither of the two recent accounts is adequate, for while MOSER's does not correctly state the outline of the ventral lamella, BIGELOW's was not correct as regards the course of the apical sector of the lateral subumbrial canals. The conditions exhibited by a representative from Station 36 are therefore illustrated in

Fig. 34.¹

Unfortunately, the inferior nectophores, of the "Thor" series have all become detached from the superior bells, either in the net, or in the process of preservation. However, the facts that they were taken in the same hauls with roughly equal numbers of superior *conoidea* nectophores, and (more significant) that in all essentials they very closely resemble SARS's (1846, Pl. 7) original illustrations of inferior bells connected with the superiors, establishes their specific identity.

As SARS observed, the squarely truncate outline of the apex is distinctive (Fig. 34, 35). The bell is pentagonal in cross section, with one well marked dorsal, two lateral, and two ventral ridges. His figure, from life, shows the dorso-lateral and ventro-lateral facets as only slightly concave. And a well expanded specimen from Bering Sea (Fig. 35), shows this same condition, which is no doubt the normal one. But it is likely that the bells can, when swimming, assume the contraction-phase shown by the "Thor" specimens from Station 36, in which the facets are deeply grooved between the ridges. With the ventral wings narrowing toward the apex toward the base, the hydroecial groove (open from end to end) is much deeper apically than basally.

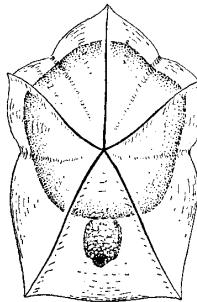


Fig. 33. *Lensia conoidea*; apical view of superior nectophore illustrated in Fig. 27.

point. In most cases, the basal parts of the dorsal and ventral ridges are slightly denticulate or wavy, the remainder of their courses smooth. But there is considerable variation in the respect.

Inferior Nectophore. The inferior nectophore has been redescribed and figured both by MOSER (1925, p. 161, Pl. 3, Fig. 8) and by BIGELOW (1913, p. 75, Pl. 6, Fig. 3). But examination of the considerable series from "Thor" Station 36, and comparison with SARS's (1846, Pl. 7, Fig. 3) original illustrations, shows that neither of the two recent accounts is adequate, for while MOSER's does not correctly state the outline of the ventral lamella, BIGELOW's was not correct as regards the course of the apical sector of the lateral subumbrial canals. The conditions exhibited by a representative from Station 36 are therefore illustrated in

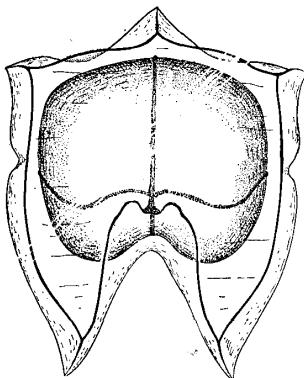


Fig. 35. *Lensia conoidea*; apical view of inferior nectophore, 5.5 mm. broad (dorso-ventrally) from Bering Sea, "Albatross" St. 4760.

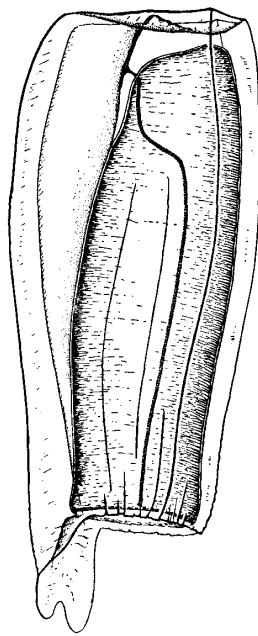


Fig. 34. *Lensia conoidea*; lateral view of inferior nectophore, 18 mm. long from "Thor" St. 36.

¹ We are in doubt as to the meaning of TORRON'S (1932, p. 367) statement that the inferior nectophore of this species exhibits a "diverticulum in the nectocalyx anterior to the entry of the pedicular canal".

The present series (or such of them as are in good enough condition) show the lateral subumbrial canals (Fig. 34) as following the sinuous course (first running toward the base, then swinging dorsad, to turn again toward the base near the mid-line of the nectosac) described by SARS (1846), by KEFERSTEIN and EHLERS (1861) and recently by MOSER (1925, p. 161, Pl. 3, Fig. 8). The earlier illustration (BIGELOW, 1913, Pl. 6, Fig. 3) of a Bering Sea specimen was erroneous in this respect.

On the other hand, the basal wing was correctly shown there as indented in the mid-line, with the right side somewhat longer than the left (Fig. 34), as, indeed, SARS long ago pictured it. We have seen no variant in this respect, other than such small differences in precise outline as naturally results from contraction, and from the distortion of preserved specimens. MOSER's (1925, p. 155) statement that the basal wing is a "halbrunde Lamelle ohne Mediantteilung" is not correct for this species — in fact her own illustration (Pl. 3, Fig. 8) does show a shallow indentation of the wing, in the median line.

LENSIA FOWLERI Bigelow 1911.

Figs. 36—39, 47.

Diphyes fowleri, Bigelow, 1911a, p. 346, Pl. 28, Fig. 5; 1911b, p. 255, Pl. 8, Fig. 4, Pl. 9, Fig. 5.

For recent bibliography, see Leloup, 1934, p. 41.

Material.

- | | |
|--|--|
| St. 3. 47°45' N., 5°28' W. 30. XI. 1908.
Y. 65 m w. 1 sup. nectoph. | St. 89. 36°28' N., 8°22' W. 16. VI. 1910.
Y. 1000 m w. 1 sup. nectoph. |
| St. 10. 37°21' N., 16°45' E. 15. XII. 1908.
Y. 600 m w. 2 sup. nectoph. | St. 91. 35°53' N., 7°26' W. 18. VI. 1910.
Y. 1600 m w. 1 sup. nectoph. |
| St. 11. 36°57' N., 18°16' E. 16. XII. 1908.
Y. 300 m w. 5 sup. nectoph. | St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
Y. 300 m w. 2 sup. nectoph. |
| St. 12. 39°34' N., 17°17' E. 19. XII. 1908.
Y. 300 m w. 13 sup. nectoph. | St. 96. 35°48' N., 5°58' W. 23. VI. 1910.
Y. 65 m w. 1 sup. nectoph. |
| Y. 1000 m w. 6 sup. nectoph. | St. 106. 36°33' N., 2°00' W. 25. VI. 1910.
Y. 300 m w. 1 sup. nectoph. |
| St. 13. 39°43' N., 17°30' E. 19. XII. 1908.
Y. 1000 m w. 15 sup. nectoph. | St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
Y. 300 m w. 4 sup. nectoph. |
| St. 26. 40°40' N., 13°59' E. 18. I. 1908.
Y. 300 m w. 9 sup. nectoph. | St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
Y. 65 m w. 1 sup. nectoph. |
| St. 30. 41°15' N., 11°55' E. 21. I. 1909.
Y. 300 m w. 2 sup. nectoph. | St. 112. 36°56' N., 2°15' E. 27. VI. 1910.
Y. 300 m w. 25 sup. nectoph. |
| St. 31. 41°44' N., 10°52' E. 21. I. 1909.
Y. 600 m w. 11 sup. nectoph. | St. 113. 36°53' N., 3°09' E. 28. VI. 1910.
Y. 300 m w. 6 sup. nectoph. |
| St. 35. 43°36' N., 7°36' E. 28. I. 1909.
Y. 1000 m w. 4 sup. nectoph. | St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
Y. 300 m w. 29 sup. nectoph. |
| St. 36. 42°49' N., 6°54' E. 30. I. 1909.
Y. 65 m w. 1 sup. nectoph. | Y. 2000 m w. 13 sup. nectoph. |
| Y. 300 m w. 3 sup. nectoph. | St. 116. 39°27' N., 5°26' E. 29. VI. 1910.
Y. 300 m w. 14 sup. nectoph. |
| St. 39. 39°41' N., 10°02' E. 1. II. 1909.
Y. 300 m w. 6 sup. nectoph. | St. 118. 41°00' N., 6°43' E. 30. VI. 1910.
Y. 65 m w. 1 sup. nectoph. |
| St. 46. 37°17' N., 6°00' E. 7. II. 1909.
Y. 600 m w. 8 sup. nectoph. | Y. 300 m w. 147 sup. nectoph. |
| St. 47. 36°55' N., 3°12' E. 10. II. 1909.
Y. 300 m w. 6 sup. nectoph. | St. 120. 42°31' N., 7°41' E. 1. VII. 1910.
Y. 300 m w. 5 sup. nectoph. |
| St. 50. 37°02' N., 1°17' E. 17. II. 1909.
Y. 65 m w. 1 sup. nectoph. | St. 121. 43°08' N., 8°05' E. 2. VII. 1910.
Y. 25 m w. 1 sup. nectoph. |
| Y. 300 m w. 2 sup. nectoph. | St. 122. 43°50' N., 8°34' E. 2. VII. 1910.
Y. 600 m w. 5 sup. nectoph. |
| St. 51. 36°27' N., 0°37' W. 18. II. 1909.
Y. 300 m w. 5 sup. nectoph. | Y. 1200 m w. 2 sup. nectoph. |
| St. 57. 36°40' N., 3°30' W. 20. II. 1909.
Y. 200 m w. 5 sup. nectoph. | St. 123. 44°14' N., 8°55' E. 3. VII. 1910.
Y. 300 m w. 1 sup. nectoph. |
| St. 58. 36°36' N. 4°24' W. 20. II. 1909.
Y. 100 m w. 6 sup. nectoph. | St. 125. 43°54' N., 9°13' E. 9. VII. 1910.
Y. 300 m w. 30 sup. nectoph. |
| St. 59. 36°02' N., 4°24' W. 21. II. 1909.
Y. 100 m w. 3 sup. nectoph. | St. 126. 42°43' N., 9°50' E. 10. VII. 1910.
Y. 300 m w. 8 sup. nectoph. |
| St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 600 m w. 3 sup. nectoph. | St. 129. 40°05' N., 11°31' E. 12. VII. 1910.
Y. 300 m w. 2 sup. nectoph. |
| Y. 1600 m w. 1 sup. nectoph. | Y. 600 m w. 2 sup. nectoph. |
| St. 66. 36°16' N., 6°52' W. 25. II. 1909.
Y. 1200 m w. 1 sup. nectoph. | Y. 1000 m w. 2 sup. nectoph. |
| St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 300 m w. 10 sup. nectoph. | St. 131. 38°36' N., 11°00' E. 13. VII. 1910.
Y. 1000 m w. 2 sup. nectoph. |
| St. 75. 45°37' N., 7°03' W. 9. III. 1909.
C. 4300 m w. 1 sup. nectoph. | St. 132. 38°57' N., 9°47' E. 14. VII. 1910.
Y. 300 m w. 5 sup. nectoph. |
| | Y. 600 m w. 7 sup. nectoph. |

- St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
 Y. 300 m w. 3 sup. nectoph.
 Y. 600 m w. 13 sup. nectoph.
 St. 134. 37°37' N., 10°17' E. 15. VII. 1910.
 Y. 300 m w. 39 sup. nectoph.
 St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
 Y. 250 m w. 5 sup. nectoph.
 St. 138. 37°37' N., 11°25' E. 19. VII. 1910.
 Y. 1000 m w. 10 sup. nectoph.
 St. 139. 37°57' N., 11°54' E. 20. VII. 1910.
 Y. 300 m w. 63 sup. nectoph.
 Y. 800 m w. 4 sup. nectoph.
 St. 143. 35°18' N., 16°25' E. 23. VII. 1910.
 Y. 300 m w. 37 sup. nectoph.
 Y. 1000 m w. 3 sup. nectoph.
 St. 156. 32°16' N., 26°03' E. 30. VII. 1910.
 Y. 600 m w. 1 sup. nectoph.
 St. 160. 35°59' N., 28°14' E. 1. VIII. 1910.
 Y. 300 m w. 2 sup. nectoph.
 Y. 1000 m w. 4 sup. nectoph.
 St. 163. 37°52' N., 26°22' E. 3. VIII. 1910.
 Y. 200 m w. 65 sup. nectoph.
 St. 181. 38°49' N., 25°09' E. 13. VIII. 1910.
 Y. 300 m w. 24 sup. nectoph.
 St. 182. 38°13' N., 24°48' E. 14. VIII. 1910.
 Y. 600 m w. 26 sup. nectoph.
 St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
 Y. 300 m w. 65 sup. nectoph.
 Y. 1200 m w. 17 sup. nectoph.
 St. 187. 37°54' N., 18°02' E. 18. VIII. 1910.
 Y. 300 m w. 14 sup. nectoph.
 Y. 1000 m w. 3 sup. nectoph.
 St. 189. 37°44' N., 15°58' E. 19. VIII. 1910.

- Y. 300 m w. 7 sup. nectoph.
 Y. 1000 m w. 9 sup. nectoph.
 St. 192. 38°07' N., 15°35' E. 20. VIII. 1910.
 Y. 300 m w. 36 sup. nectoph.
 Y. 600 m w. 16 sup. nectoph.
 St. 193. 38°15' N., 15°39' E. 21. VIII. 1910.
 Y. 10 m w. 2 sup. nectoph.
 St. 194. 38°33' N., 15°29' E. 21. VIII. 1910.
 Y. 1200 m w. 11 sup. nectoph.
 St. 195. 39°02' N., 14°55' E. 21. VIII. 1910.
 Y. 300 m w. 34 sup. nectoph.
 St. 197. 40°34' N., 13°36' E. 24. VIII. 1910.
 Y. 300 m w. 12 sup. nectoph.
 St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
 Y. 300 m w. 22 sup. nectoph.
 Y. 1000 m w. 11 sup. nectoph.
 St. 202. 38°59' N., 9°25' E. 26. VIII. 1910.
 Y. 300 m w. 12 sup. nectoph.
 St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
 Y. 300 m w. 127 sup. nectoph.
 Y. 1000 m w. 29 sup. nectoph.
 St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
 Y. 300 m w. 21 sup. nectoph.
 Y. 1000 m w. 3 sup. nectoph.
 Y. 2000 m w. 5 sup. nectoph.
 St. 217. 38°01' N., 1°48' E. 1. IX. 1910
 Y. 300 m w. 14 sup. nectoph.
 St. 222. 35°53' N., 0°57' W. 4. IX. 1910.
 Y. 300 m w. 4 sup. nectoph.
 St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
 Y. 300 m w. 8 sup. nectoph.
 St. 232. 36°28' N., 9°06' W. 9. IX. 1910.
 Y. 300 m w. 17 sup. nectoph.

This species, originally described from the Bay of Biscay, and soon after from the Eastern Tropical Pacific, was relegated by MOSER (1925, p. 154) to the synonymy of *L. conoidea*¹ (see p. 50).

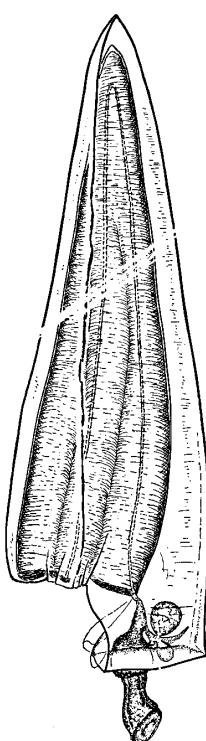


Fig. 36. *Lensia fowleri*; lateral view of superior nectophore, about 4 mm. high, collected by H. M. S. "Research" in the Bay of Biscay (Mus. Comp. Zool. Cat. No. 775).

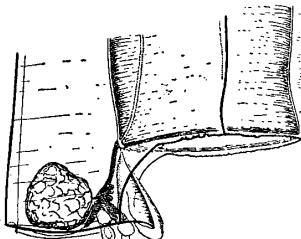


Fig. 37. *Lensia fowleri*; lateral view of basal portion of superior nectophore about 7.6 mm. high, collected by H. M. S. "Research" in the Bay of Biscay (Mus. Comp. Zool. Cat. No. 775).

But BROWNE (1926) and TOTTEN (1932) have recently argued that *fowleri* is in fact a distinct species. And reexamination of specimens from the original series of *fowleri*, now in the collection of the Museum of Comparative Zoölogy confirms this view. The most striking difference between it and *conoidea* (which it closely resembles in general conformation) is in the shape of the somatocyst. This, in *fowleri*, is roughly spherical and lies largely, if not wholly, below the level of the opening of the nectosac (Figs. 36--39). And it is so closely connected with the basal plate that there is no distinguishable stalk. In *conoidea*, on the other hand, the somatocyst is more or less fusiform, reaching well above the opening of the nectosac even in the specimens in which it is shortest (p. 51, Fig. 30), and usually, if not invariably it has a distinguishable stalk. MOSER (1925, p. 156), it is true, thought it impossible to separate the species by the somatocyst, on the ground that in some specimens she examined, its outline could not be classified either as "richtig blasig" or as "eigentlich cylindrisch". Her union of

¹ In the latter MOSER used SARS's name *truncata*.

*fowleri*¹ with *conoidea* seems also to have been influenced by the fact that the two were taken at the same stations. But as just remarked, the difference in the form of the somatocyst lies not only in its precise outline, i. e. whether spherical, egg-shaped, or narrow-fusiform, but still more in its situation. And comparison of a very young *fowleri* (Fig. 36), with a *conoidea* only slightly larger, shows that this difference obtains from an early stage in growth.

Furthermore, TOTTON (1932) has pointed out that the form of the somatocyst is not the only specific difference between *fowleri* and *conoidea*, but that the two can also be distinguished by the fact that in *fowleri* the marginal outline, opposite the dorsal ridge, does not project beyond the general level of the bell opening (Figs. 37, 39, 47), whereas in *conoidea* it does so project (Fig. 27, 47). And though this difference is minor, we have found it invariable within the considerable series of the two species that we have recently studied. TOTTON (1932, p. 370) has likewise noted that the lateral ridges "at their oral ends slope back in a characteristic way towards the mouth plate". The distance from the oral margin to the base of the bell is also usually (if not always) greater in *fowleri* than in *conoidea*. On the other hand another character, noted by TOTTON as distinctive, namely the proximity of the apex of the nectosac to the apex of the bell — is not reliable. In some specimens of *conoidea* (Fig. 27) the former is as close to the latter as in some examples at least of *fowleri*.

Although *fowleri* has now been reported from several collections, and from widely separated localities, its inferior nectophore either remains undescribed, or if it has been seen, it has been confused with that of

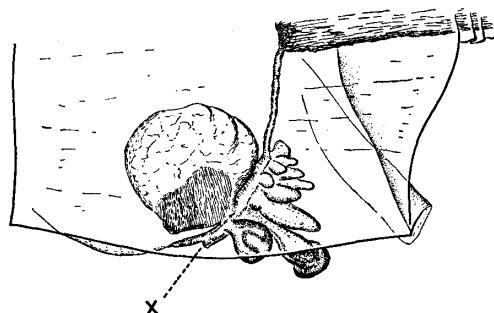


Fig. 38. *Lensia fowleri*; basal portion of large superior nectophore showing reserve bud, collected by H. M. S. "Research" in the Bay of Biscay (Mus. Comp. Cat. No. 775).

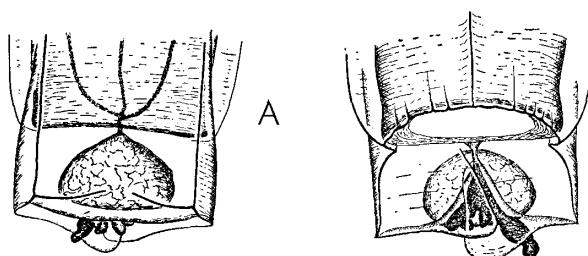


Fig. 39. *Lensia fowleri*; basal portion of superior nectophore, specimen shown in Fig. 37. A. Ventral view. B. Dorsal view.

yet developed, shows what appears to be the bud for the future inferior nectophore, as does another larger one (Fig. 38); and also what is apparently the point of attachment of an inferior bell, now detached (marked X in the illustration). Available evidence thus indicates that reference of this species to *Lensia* is probably correct.

LENSIA MULTICRISTATA Moser 1925.

Figs. 40—44, 47.

Galeolaria multicristata, Moser, 1925, p. 165, Pl. 3, Fig. 9.

Diphyes bigelowi, Browne, 1926, p. 77.

Muggiaeae kochii, (Partim) Bigelow, 1911a, p. 340, 1911b, p. 188, Pl. 12, Fig. 2—4.

Lensia multicristata, Totton, 1932, p. 364; Leloup, 1934, p. 33, Fig. 8.

¹ Also *subtiloides*.

? *Lensia multicristata*, forme *grimaldii*, Leloup, 1934, p. 36, Fig. 9, 10.

? *Lensia grimaldii*, Leloup, 1933, p. 37, Pl. 1, Fig. 1—10.

Non *D. kochii*, Will, 1844, p. 77, Pl. 2, Fig. 22.

Non *M. kochii*, Chun, 1882, p. 679, Pl. 16, Fig. 2.

Material.

- | | |
|--|--|
| St. 10. 37°21' N., 16°45' E. 15. XII. 1908.
Y. 600 m w. 41 sup. nectoph. | St. 122. 43°50' N., 8°34' E. 2. VII. 1910.
Y. 600 m w. 56 sup. nectoph. |
| St. 13. 39°43' N., 17°30' E. 19. XII. 1908.
Y. 1000 m w. 13 sup. nectoph. | St. 123. 44°14' N., 8°55' E. 3. VII. 1910.
Y. 300 m w. 2 sup. nectoph. |
| St. 35. 43°36' N., 7°36' E. 29. I. 1909.
Y. 1600 m w. 3 + sup. nectoph. | St. 129. 40°05' N., 11°31' E. 12. VII. 1910.
Y. 600 m w. 69 sup. nectoph. |
| St. 46. 37°17' N., 6°00' E. 7. II. 1909.
Y. 1600 m w. 6 sup. nectoph. | Y. 1000 m w. 25 sup. nectoph. |
| St. 47. 36°55' N., 3°12' E. 10. II. 1909.
Y. 300 m w. 1 sup. nectoph. | St. 132. 38°57' N., 9°47' E. 14. VII. 1910.
Y. 600 m w. 24 sup. nectoph. |
| St. 50. 37°02' N., 1°17' E. 17. II. 1909.
Y. 600 m w. 4 sup. nectoph. | St. 133. 38°18' N., 9°59' E. 14. VII. 1910.
Y. 25 m w. 1 sup. nectoph. |
| St. 51. 36°27' N., 0°37' W. 18. II. 1909.
Y. 300 m w. 50 sup. nectoph. | Y. 300 m w. 1 sup. nectoph. |
| St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 600 m w. 17 sup. nectoph. | Y. 600 m w. 229 sup. nectoph. |
| St. 66. 36°16' N., 6°52' W. 25. II. 1909.
Y. 1200 m w. 1 sup. nectoph. | St. 134. 37°37' N., 10°17' E. 15. VII. 1910.
Y. 25 m w. 1 sup. nectoph. |
| St. 68. 36°39' N., 7°21' W. 27. II. 1909.
Y. 800 m w. 4 sup. nectoph. | St. 137. 37°17' N., 10°56' E. 19. VII. 1910.
Y. 250 m w. 67 sup. nectoph. |
| St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 600 m w. 61 + sup. nectoph. | St. 138. 37°37' N., 11°23' E. 19. VII. 1910.
Y. 1000 m w. 70 sup. nectoph. |
| St. 71. 39°35' N., 9°45' W. 4. III. 1909.
Y. 1600 m w. 4 sup. nectoph. | St. 139. 37°57' N., 11°54' E. 20. VII. 1910.
Y. 800 m w. 7 sup. nectoph. |
| St. 74. 44°21' N., 7°55' W. 9. III. 1909.
Y. 600 m w. 1 sup. nectoph. | St. 143. 35°18' N., 16°25' E. 24. VII. 1910.
Y. 1000 m w. 1 sup. nectoph. |
| St. 75. 45°37' N., 7°03' W. 9. III. 1909.
C. 4300 m w. 1 + sup. nectoph. | St. 144. 34°31' N., 18°40' E. 24. VII. 1910.
Y. 2000 m w. 1 sup. nectoph. |
| St. 80. 46°17' N., 7°31' W. 13. VI. 1910.
Y. 300 m w. 1 + sup. nectoph. | St. 147. 31°35' N., 19°02' E. 25. VII. 1910.
Y. 1000 m w. 7 sup. nectoph. |
| St. 87. 37°03' N., 9°15' W. 17. VI. 1910.
Y. 300 m w. 8 sup. nectoph. | St. 160. 35°59' N., 28°14' E. 1. VIII. 1910.
Y. 1000 m w. 53 sup. nectoph. |
| St. 89. 36°28' N., 8°22' W. 18. VI. 1910.
Y. 300 m w. 1 sup. nectoph. | St. 186. 37°57' N., 19°51' E. 17. VIII. 1910.
Y. 1200 m w. 20 sup. nectoph. |
| Y. 1000 m w. 7 sup. nectoph. | St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
Y. 1000 m w. 38 sup. nectoph. |
| St. 91. 35°53' N., 7°26' W. 18. VI. 1910.
Y. 1600 m w. 12 sup. nectoph. | St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
Y. 300 m w. 6 sup. nectoph. |
| St. 95. 35°57' N., 6°00' W. 23. VI. 1910.
Y. 300 m w. 8 sup. nectoph. | Y. 1000 m w. 154 sup. nectoph. |
| St. 107. 36°18' N., 1°14' W. 25. VI. 1910.
Y. 300 m w. 70 sup. nectoph. | St. 206. 39°32' N., 5°15' E. 28. VIII. 1910.
Y. 1000 m w. 56 sup. nectoph. |
| Y. 2000 m w. 4 sup. nectoph. | Y. 2000 m w. 21 sup. nectoph. |
| St. 108. 36°03' N., 0°27' W. 25. VI. 1910.
Y. 300 m w. 1 sup. nectoph. | St. 217. 38°01' N., 1°48' E. 1. IX. 1910.
Y. 300 m w. 143 sup. nectoph. |
| St. 112. 36°56' N., 2°15' E. 27. VI. 1910.
Y. 300 m w. 146 sup. nectoph. | St. 222. 35°53' N., 0°57' W. 4. IX. 1910.
Y. 300 m w. 59 sup. nectoph. |
| St. 113. 36°53' N., 3°09' E. 28. VI. 1910.
Y. 300 m w. 7 sup. nectoph. | St. 223. 36°13' N., 1°28' W. 5. IX. 1910.
Y. 300 m w. 70 sup. nectoph. |
| St. 115. 38°17' N., 4°11' E. 28. VI. 1910.
Y. 300 m w. 3 sup. nectoph. | St. 228. 36°02' N., 5°06' W. 7. IX. 1910.
Y. 300 m w. 1 sup. nectoph. |
| Y. 2000 m w. 11 sup. nectoph. | St. 231. 35°56' N. 7°16' W. 9. IX. 1910.
Y. 25 m w. 1 sup. nectoph. |
| St. 118. 41°00' N., 6°43' E. 30. VI. 1910.
Y. 300 m w. 11 sup. nectoph. | St. 232. 36°28' N., 9°06' W. 9. IX. 1910.
Y. 300 m w. 1 sup. nectoph. |
| St. 120. 42°31' N., 7°41' E. 1. VII. 1910.
Y. 300 m w. 1 sup. nectoph. | Y. 1000 m w. 36 sup. nectoph. |

Identification doubtful:—

- St. 210. 41°10' N., 2°23' E. 30. VIII. 1910.
Y. 600 m w. 4 sup. nectoph.

In 1925, MOSER (1925, p. 165) christened, as *Galeolaria multicristata*, a small diphyid, the superior nectophore of which was characterized by the presence of 7 ridges: a year later Browne (1926, p. 77) described as *Diphyes bigelowi*, a form agreeing with MOSER's account, not only in this most striking feature, but in other less outstanding respects as well.

BROWNE, at the same time pointed out that examination, by him, of specimens from the Bay of Biscay described by BIGELOW (1911 a, p. 340) as *Muggiae kochii*, proved they belonged to the new multicristate species, having 7 ridges, not 5 as stated. And reexamination of one of the three specimens¹ has shown that this applies equally to specimens recorded as "*M. kochii*" from the Eastern Tropical Pacific, (BIGELOW, 1911 b, p. 188, Pl. 12, Fig. 2) for these also have two more ridges than are shown in the illustration.

Specimens of this species of *Lensia*, if in good condition, are easily recognized by the number of ridges, a feature easily seen in apical view but which may be overlooked in side view because of the glassy transparency of most preserved specimens.

LELOUP (1933, 1934) has recently described superior nectophores, otherwise similar, but with still more numerous (10—31) ridges. For the first such example (10 ridges) he (1933, p. 37) founded a new species *grimaldii*. But, from his study of the more extensive series collected by the "Meteor"², he has grouped them all, as a variety, "forme *grimaldii*", of *L. multicristata*, calling the 7-ridged variety "forme *typica*" (LELOUP, 1934, p. 33).

Among the "Thor" collection, all of the superior *multicristata* nectophores that are in good enough condition to show this feature distinctly, have 7 ridges only. Consequently we can add nothing to LELOUP's discussion of the status of specimens that have a greater number.

Aside from the number of ridges in the superior nectophore, distinctive features in the exumbrial sculpture pointed out by BROWNE (1926) are that, on specimens with 7 ridges, only the two ventral ridges, the two laterals, and the dorsal originate at the apex, the supplementary pair (between the ventrals and the laterals) originating at a slightly lower level (Fig. 40, 42). Furthermore, the dorsal and the two ventral ridges alone extend to the basal margin of the bell; the laterals terminate slightly above the margin, the supplemental pair of ridges still higher, in the relative positions shown in Figure 40.

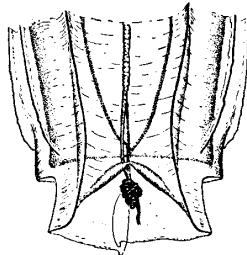


Fig. 41. *Lensia multicristata*; ventral view of basal portion of superior nectophore illustrated in Fig. 40.

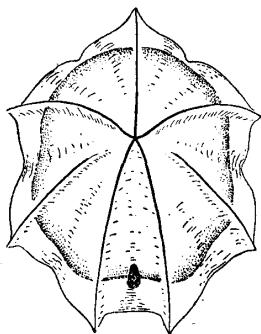


Fig. 42. *Lensia multicristata*; apical view of another superior nectophore, also about 11 mm. long, from "Thor" St. 217.

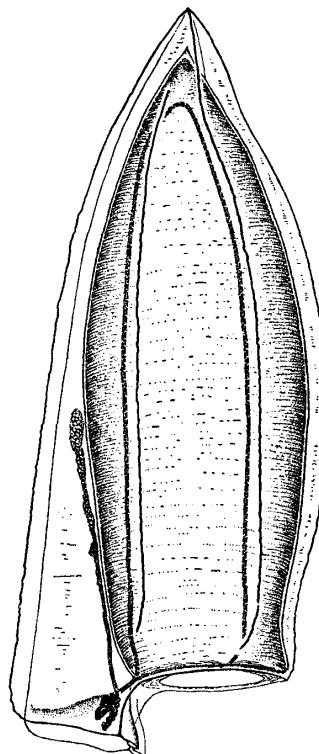


Fig. 40. *Lensia multicristata*; superior nectophore, 11 mm. high, "Thor" St. 217.

Neither is there any trace of marginal teeth opposite any of the ridges. None of the ridges, in any specimen examined, were definitely denticulate, but all were more or less wavy, as illustrated (Fig. 40).

In all specimens so far described, whether by BROWNE, by LELOUP, or by MOSER, or in those examined by us, there is a distinct hydrocial cavity, lying however, entirely below the level of the opening of the nectosac. And the fact that the ventral facet is not only deeply grooved, basally, as described by BROWNE, but that its basal margin is rounded (Fig. 41; see also LELOUP, 1934, Fig. 9A) separates this species at a glance, from *L. conoidea*, and from *L. fowleri*, when seen in ventral view. As in other *Lensias*, as every specimen we have examined (including one from the Eastern Tropical Pacific) has borne a small rounded lobe (already mentioned by MOSER) at

¹ Only one of the 3 specimens (U. S. Nat. Mus. no. 28610) is still in good enough condition to show the feature in question.

² Eleven specimens, distributed as follows: one each with 16, 17, 18, 22, 28, 30 and 31 ridges; two each, with 23 and 24 ridges.

the inner basal angle of each of these 2 wings, this may be taken as a specific character even if a minor one.

BROWNE has already pointed out that the somatocyst shows considerable variation, being either thick and sausage-shaped on a short stalk, or long and slender, on a long thread-like stalk. In most of the better

preserved examples in the "Thor" series (represented by St. 217), the outlines of this organ vary between the extremes shown in Figure 43, i. e. it may be described as slim, fusiform, or linear, usually with a more or less definitely defined and thread-like stalk — never, however, with a definite spherical terminal dilation such as characterizes *Lensia subtilis* (p. 47). In other specimens, less well preserved, it is variously distorted, contracted or even dilated. In most specimens its length equals about 40—45% of the length of the nectophore, from bell-opening to apex. LELOUP (1934, p. 34, p. 35) has pointed out that the "système gastro-vasculaire est simple; les canaux latéraux remontent presque jusqu'au sommet de la subombrelle".

LELOUP (1934, p. 34, Fig. 8, B—D) describes and figures as belonging to this species, a single inferior nectophore, from the "Meteor" collection¹. And the "Thor" series from Station 217 contains (among the 143 superior bells) a single inferior

Fig. 43. *Lensia multicristata*; lateral view of basal parts of two superior nectophores, both about 12 mm. long, "Thor" St. 217, to show variations in the shape of the somatocyst.

which agrees closely with his figures, in general outline, in conformation of the apical portion, in the long open hydroecial furrow, in simplicity of canals, in shortness of the basal wing, and in the fact that the latter is simple, not divided. Unfortunately the "Thor" specimen is not in good enough condition to show the dorsal ridge ("ventral" according to LELOUP's nomenclature) the course of which is diagnostic, according to LELOUP; nor whether it, like LELOUP's specimen, bore a small subsidiary lappet on the hydroecial wing, near the apex. Several of the superior bells also bear large buds, near the base of the stem (Fig. 44): evidently the forerunners of future inferior bells. All but the base of the stem, has, however, been broken off in all cases, consequently the cormidia remain unknown.

LENSIA SUBTILOIDES Lens & Van Riemsdijk 1908. Figs. 45, 46, 47.

Diphyes subtiloides, Lens and Van Riemsdijk, 1908, p. 46, Pl. 7, Figs. 59, 60, 61; Browne, 1926, p. 76.
Lensia subtiloides, Totton 1932, p. 364, Figs. 31, 32, 33.

Material.

St. 80. 46°17' N., 7°31' W. 13. VI. 1910.
Y. 300 m w. 1 sup. nectophore.

MOSER (1925) considered *L. subtiloides* a synonym of *L. conoidea*, as BIGELOW (1913) had, previously. But BROWNE (1926) and TOTTEN (1932) have subsequently shown that it is actually an easily distinguishable species, separated from *conoidea* both by the outline of base and hydroecium, and by the shape of the somatocyst.

¹ Whether or not this bell was still attached to a superior, i. e. whether its specific identity was certain, is not stated.

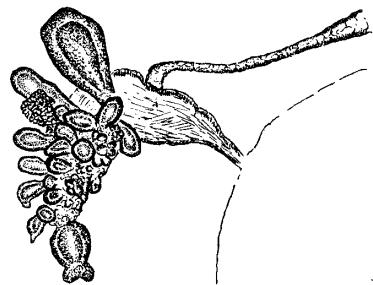
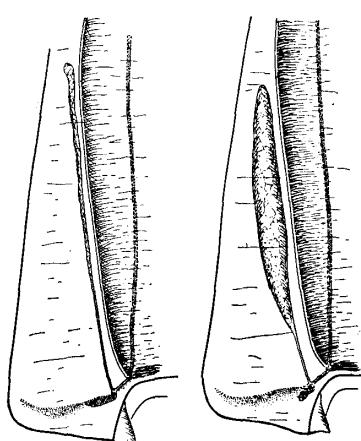


Fig. 44. *Lensia multicristata*; basal portion of stem of superior nectophore bearing a bud for inferior nectophore; "Thor" St. 69, $\times 62.5$.

According to BROWNE (1926), the superior nectophore has no well-marked longitudinal ridges (his specimens were wrinkled by contraction). But TOTTON's (1932, Fig. 31, 32) figures of the superior nectophore clearly show lateral ridges, while also suggesting a dorsal, and the usual pair of ventrals. The one specimen in the "Thor" collection, and two others from the "Dana" expedition, are distinctly pentagonal in cross section as seen in apical view (Fig. 46). But the angles separating the facets are much less prominent than in *L. conoidea*, in *L. fowleri*, or in *L. multicristata*, and it is only along the lower two-thirds of their courses that they are acute enough to be named ridges (Fig. 46). Closer to the apex they are more rounded. But as all of these specimens show more or less damage, by capture and preservation, it is a question whether this weakening of the ridge-like character of the angles toward the apex is a normal feature of the species. Basally, the dorsal and lateral ridges extend to the margin of the bell; but there is no marginal projection opposite either of them (Fig. 45).

Apart from this question of ridges, the most distinctive character of *L. subtiloides*, among those species of *Lensia* which it most resembles, is the obtuseness of the angle, formed by the intersection of the lateral-basal margin of the hydroecial region with the ascending marginal sector which leads to the bell opening (Fig. 45, 47).

In *L. conoidea* this angle is at most not more than 110° . In *multicristata* and *fowleri* it is slightly more than 90° . But in *subtiloides* the angle is about 120° . Furthermore, the hydroecial sector of the latero-basal margin, which is roughly transverse to the general longitudinal axis of the nectophore in *fowleri* and slightly oblique in *multicristata* and *conoidea*, is much more strongly oblique in *subtiloides*. In *subtiloides*, as in *fowleri* and *conoidea*, the ventro-basal corners of the bell are bluntly angular while in *multicristata* they are rounded. The outline of the very shallow — but always existant — hydroecial indentation is also distinctive, as is the fact that the two wings into which the mouth plate is divided are about in equal size, and hang well below the marginal angle.

As TOTTON (1932) has pointed out, the summit of the hydroecium lies at the same level as the mouth of the nectosac. In the very large series from the Great Barrier reef, TOTTON (1932, p. 365) describes the distance from the base of the somatocyst to the mouth plate as about half that between the base of the somatocyst and ventral wall. In one "Dana" example the apical end of the somatocyst lies close to the ventral wall as he described, farther from the ventral wall in another, and in the "Thor" specimen. Poor preservation may be responsible for these differences. In the present example, the form of the somatocyst lies well within the range of variation illustrated by TOTTON (1932, Fig. 31b).

LENS & VAN RIEMSDIJK (1908), in their original description of the species, detected the bud for a future inferior bell in one specimen. Subsequently, BROWNE (1926) found two loose inferior bells presumably of this parentage, and TOTTON (1932, Fig. 32B) has recently given a good illustration of the inferior nectophore.

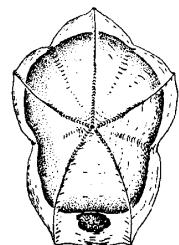


Fig. 46. *Lensia subtiloides*; apical view of superior nectophore, illustrated in Fig. 45.

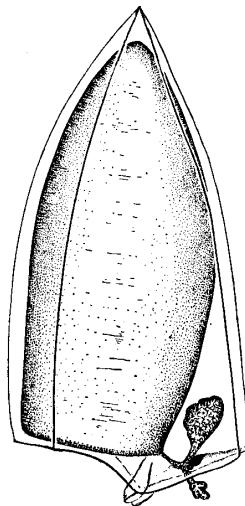


Fig. 45. *Lensia subtiloides*; lateral view of superior nectophore, 6 mm. long, from "Thor" St. 80.

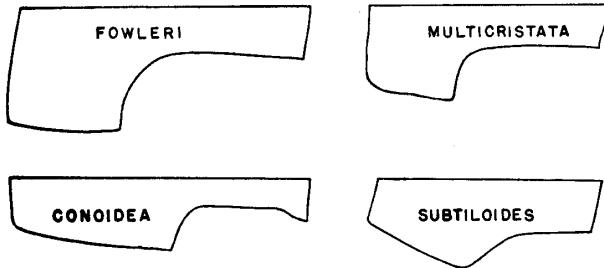


Fig. 47. Outlines of the basal portion of the superior nectophore of 4 species of *Lensia* to show differences in shape.

CHUNIPHYNÆ Moser 1925.

CHUNIPHYES Lens and Van Riemsdijk 1908.

CHUNIPHYES MULTICRISTATA Lens and Van Riemsdijk, 1908.

Fig. 48.

Chuniphyes multidentata, Lens & Van Riemsdijk, 1908, p. 13, Pl. 1, Figs. 9—11, Pl. 2, Figs. 12—15; Bigelow, 1911a, p. 348; 1911b, p. 262, Pl. 8, Fig. 9, Pl. 10, Fig. 7, Pl. 12, Fig. 6; 1918, p. 425; 1919, p. 344; 1931, p. 566; Moser, 1925, p. 357, Pl. 23, Figs. 1—4, Pl. 24, Figs. 1, 2; Leloup, 1932*, p. 26; 1933, p. 39; 1934, p. 44.

Material.

- St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 1600 m w. 5 sup. nectoph.; 4 inf. nectoph.
St. 66. 36°16' N., 6°52' W. 25. II. 1909.
Y. 1200 m w. 13 sup. nectoph.; 17 inf. nectoph.
St. 69. 36°13' N., 9°44' W. 28. II. 1909.
Y. 3000 m w. 15 nectoph. (poorly preserved).
St. 71. 39°35' N., 9°45' W. 4. III. 1909.
Y. 300 m w. 11 sup. nectoph.; 10 inf. nectoph.

- Y. 600 m w. 109 sup. nectoph.; 120 inf. nectoph.
Y. 1600 m w. 10 sup. nectoph.; 16 inf. nectoph.
St. 74. 44°21' N., 7°55' W. 8. III. 1909.
Y. 600 m w. 53 sup. nectoph.; 51 inf. nectoph.
St. 75. 45°37' N., 7°03' W. 9. III. 1909.
C. 4300 m w. 47 sup. nectoph.; 48 inf. nectoph.
St. 76. 47°01' N., 5°48' W. 10. III. 1909.
Y. 25 m w. 1 sup. nectoph.
Y. 1600 m w. 94 sup. nectoph.; 87 inf. nectoph.

The general organization of the nectophores (both inferior and superior) of this interesting bathy-pelagic diphyid is now well known, from the specimens brought in by the "Research" (BIGELOW, 1911a), "Albatross" (BIGELOW, 1911b), "Gauss" (MOSER, 1925) and "Arcturus" (BIGELOW, 1931).

But although a considerable number of examples have been examined, all of them have been more or less distorted or injured in one way or another, either by contraction in preservation, or by pressure in the net. Consequently, none of the illustrations so far published can claim to show the outlines of the living animal in its normal state. For this reason, it is not yet possible to state to what degree the differences that have been described (and that can be seen in any large series) in the relative prominence of the teeth or angles at the basal extremities of the ridges of the superior nectophore, and in the degree of concavity of the several facets, represent individual variations, how far they represent temporary states, from one to another of which the bell may pass in its normal contractions and expansions, or how far they result from the effects of the preservative.

The present series adds still another type of variation (evidently artificial), for the ridges of different bells (both superior and inferior) vary in their degree of prominence, from angles slightly more acute than 90°, to definitely fin-like or blade-like expansions, in which case they are notably tough and stiff. The condition earlier illustrated for one of the Pacific specimens (BIGELOW, 1931, Fig. 209) stands midway between these extremes, as do most of the specimens so far examined.

Differences in interpretation between MOSER's and earlier accounts of the morphology of the basal-hydroecial region in the superior nectophore, are discussed elsewhere (BIGELOW, 1931, p. 566).

No purpose would be served by additional illustrations of the superior nectophore until living examples are studied. But comparison between the considerable "Thor" series and other examples in the collection of the Museum of Comparative Zoölogy, makes it possible to add some detail to earlier accounts of the inferior nectophore. This, as previously described, has three ridges at the apex, one dorsal and two ventro-lateral, each of which divides dichotomously so that there are six ridges over most of the length of the bell, and six basal teeth (Fig. 48). In all the specimens examined, the dorsal ridge divides about 8% of the distance from apex to base, and the two resultant ridges enclose between them a narrow triangular facet. Each ventro-lateral ridge divides at about 25% of the distance apex to base, the lateral member of each pair continuing directly to the base, but the ventral member bending at first abruptly ventrad, then abruptly toward the base. This gives to the hydroecial wing on its respective side, a characteristic outline shown more easily in the illustration (Fig. 48) than verbally, and a corresponding form to the hydroecial groove. The two ventro-basal teeth

are asymmetrical, the right hand (left, according to TOTTON's and MOSER's terminology, see p. 4) much the larger, as previously described. The other teeth are symmetrical. A minor feature, not previously remarked, is that the lateral tooth, on each side, originates some distance above the margin of the nectophore. The two dorsal teeth are smaller than the laterals—but in all the specimens examined they project far enough to deserve to be so named. According to MOSER (1925, p. 360), inferior nectophores, when full-grown, entirely lack denticulation. In this respect, however, inferior bells vary as do superiors (BIGELOW, 1931, p. 569): all that we have examined have shown more or less denticulation of the basal region, in some cases confined chiefly to the teeth and basal margin (Fig. 48), on others extending well up the ridges as well.

Discovery, among the "Thor" series, of one inferior nectophore still attached to the basal part of the stem, with a fragment of the pedicular attachment by which the latter was originally connected to the superior nectophore, allows confirmation of the earlier account (BEGELOW, 1911b) of the union of the two bells. In the case of the inferior, the point of attachment (marked by a projection of the gelatinous substance axially into the hydroecium), lies about one third of the distance between the apex and the level of the apex of the nectosac (Fig. 48) as earlier described (BEGELOW, 1911b, Pl. 8, Fig. 9, Pl. 10, Fig. 7), while the canal, joining the nectosac, is situated a short distance below the apex of the latter. According to MOSER (1925, Pl. 24, Fig. 1), however, the point of pedicular attachment in a young bell was opposite the origin of the stiel canal. It would be interesting to trace the transition from this juvenile condition to the adult.

In all the "Thor" specimens, the gelatinous wall separating hydroecium from nectosac is much thinner than in the only specimen yet seen in which the two bells were still connected (cf. Fig. 48 with BIGELOW, 1911b, Pl. 8, Fig. 9).

MOSER (1925) has already pointed out that the extensions of the somatocyst-system from the point of attachment of the inferior nectophore, to the apex of the bell in the one direction, and basally, along the face of the hydroecium, from the point of origin of the stiel-canal in the other, correspond to the somatocyst-system of the superior nectophore. Unfortunately, none of the specimens we have seen have shown the termination of the descending branch of the somatocyst, nor has it been possible to follow the subumbrial canals throughout their entire course. So far as can be seen, however, they are of the usual diphyid type.

Earlier accounts have mentioned the re-entrant and overlapping flaps borne by the hydroecial wings opposite the apical part of the nectosac, which give to the open groove the potential character of a closed tube. In most of the examples examined, the longitudinal extent of these flaps, and their outlines, have been about

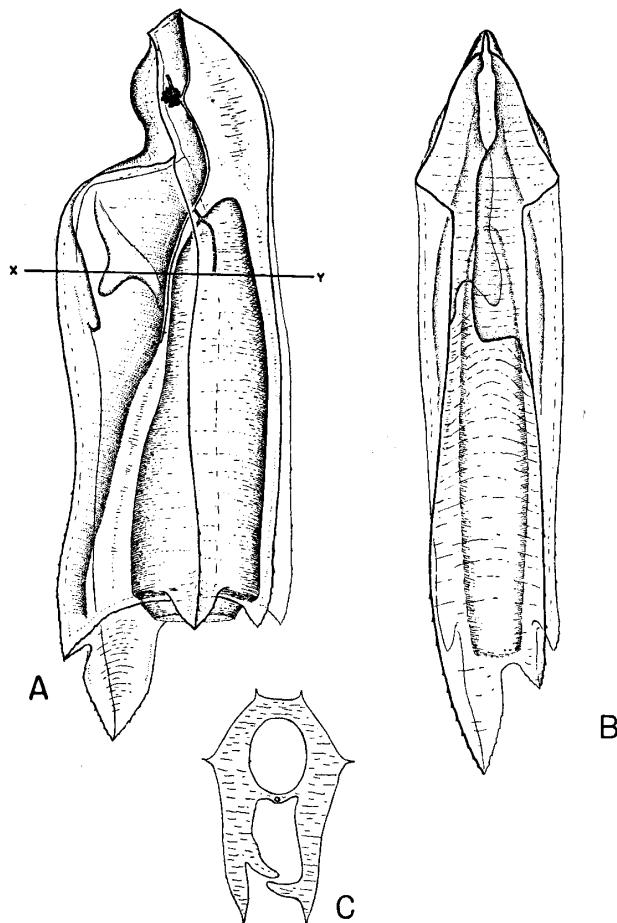


Fig. 48. *Chuniphyes multidentata*; composite drawings of inferior nectophore based chiefly on Bay of Biscay specimens about 30 mm. long, collected by H. M. S. "Research" (Mus. Comp. Zool. Cat. No. 801). A. Lateral view. B. Ventral view. C. Cross section at level XY.

as shown in Figure 48. In all that we have examined, the left-hand flap has been the longer, but MOSER (1925, Pl. 23, Fig. 4) illustrates an example showing the reverse relationship. Usually, too, the left-hand encloses the right-hand. But as the opposite was the case not only in MOSER's figured example, but also in one from the Eastern Pacific Expedition (BIGELOW, 1911b, Pl. 10, Fig. 7), no rule can be laid down — indeed a given specimen might well bring first the one, and then the other flap outside, in its normal contractions and expansions.

All but the basal end of the stem, with young buds for future appendages, has been lost from every specimen yet seen. Consequently the developed appendages remain unknown.

PHYSOPHORAE Eschscholtz 1829.

FORSKALIIDAE Haeckel 1888.

FORSKALIA Kölliker 1853.

FORSKALIA sp.?

Material.

St. 11. 36°57' N., 18°16' E. 16. XII. 1908.
Y. 300 m w. Fragments of 1 col.

While this specimen is strongly contracted and in extremely fragmentary condition, the fact that the two much flattened nectophores that are still attached, still show very long pedicular canals and corresponding narrow triangular extensions of the gelatinous substance, and that one bract (still attached) is also long and narrow, suggests that this is a *Forskalia*.

?FORSKALIA

Material.

St. 89. 36°28' N., 8°22' W. 18. VI. 1910.
Y. 1000 m w. 1 denuded stem.

AGALMIDAE Brandt 1835.

AGALMA Eschscholtz 1825.

AGALMA sp.?

Material.

St. 184. 38°10' N., 22°33' E. 17. VIII. 1910.
Y. 1000 m w. Fragments.

The material consists of fragments of stem, denuded except for the pneumatophore and one gonodendron, and one loose siphon with part of its tentacle, the latter bearing a few tentilla, the oldest of which are far enough advanced to show that they are of the tricornuate type characteristic of *Agalma*.

AGALMIDAE genus?

Material.

Fragments at Stas. 11, 28, 29, 31, 34, 35, 36, 39, 40, 58, 66, 69, 74, 76, 80, 85, 86, 87, 89, 91, 95, 98, 106, 107, 108, 112, 116, 118, 122, 123, 125, 128, 130, 132, 133, 138, 139, 144, 145, 152, 156, 184, 186, 193, 194, 195, 196, 199, 206, 208, 209, 215, 216, 220, 223, 225, 231, 232, 233, 245, 297, 298, 339, 341.

None of these agalmid fragments are in good enough condition for positive identification, even as to the genus. The stems are either entirely denuded (except for the pneumatophore which is intact in most cases), or with parts of tentacles still attached. But none of the latter bear tentilla old enough to show the adult character, whether unicornuate (*Stephanomia*), tricornuate (*Agalma*), or polycornuate (*Lynchnagalma*). And while some of the loose nectophores are still in tolerable condition, knowledge of the limits of variation is not yet precise enough to warrant definite specific identification of these structures alone. In all probability *Agalma elegans* and *Stephanomia bijuga* are represented; very likely *S. rubra* also. But none of the easily recognizable bells or bracts of *A. okeni* were found. The condition of the material would not add, in any case, to what is already known of the morphology of any of these species. And from the geographic side, doubtful identification would be worse than none, for it is possible that other long stemmed physophores are also represented among the catches (e. g. *Apolemia*).

PHYSOPHORIDAE Eschscholtz 1829.

PHYSOPHORA Forskål 1775.

PHYSOPHORA HYDROSTATICICA Forskål 1775.

Fig. 49.

Physophora hydrostatica, Forskål, 1775, p. 119; 1776, Pl. 33, Fig. E.

For synonymy, see Bigelow, 1911b, p. 293.

Material.

St. 43. 38°14' N., 8°42' E. 3. II. 1909.
Y. 65 m w. Stem, palpons.
St. 57. 36°40' N., 3°30' W. 20. II. 1909.
Y. 25 m w. Palpons.
Y. 200 m w. Palpon.
St. 65. 35°53' N., 7°26' W. 24. II. 1909.
Y. 65 m w. Stem; 8 nectoph.
Y. 300 m w. Palpon; 2 nectoph.
Y. 600 m w. Stem; palpons; 2 nectoph.
St. 66. 36°16' N., 6°52' W. 25. II. 1909.
Y. 1200 m w. 2 nectoph.
St. 99. 36°02' N., 5°16' W. 23. VI. 1910.
Y. 65 m w. Stem; palpons; 6 nectoph.
St. 116. 39°27' N., 5°26' E. 29. VI. 1910.
Y. 25 m w. 1 nectoph.

St. 118. 41°00' N., 6°43' E. 30. VI. 1910.
Y. 300 m w. Stem; palpons; nectoph.
St. 132. 38°57' N., 9°47' E. 14. VII. 1910.
Y. 600 m w. 2 nectoph.
St. 195. 39°02' N., 14°55' E. 21. VIII. 1910.
Y. 300 m w. 8 nectoph.
St. 199. 39°32' N., 10°49' E. 25. VIII. 1910.
Y. 300 m w. Stem; palpons.
St. 204. 38°52' N., 7°43' E. 27. VIII. 1910.
Y. 65 m w. Stem, 4 palpons; 4 nectoph.
Y. 300 m w. 7 nectoph.
Y. 1000 m w. Nectoph.
St. 205. 39°16' N., 5°52' E. 27. VII. 1910.
Y. 25 m w. 1 nectoph.
St. 275. 39°05' N., 14°50' E. 3. IV. 1911.
S. 94 m w. Stem; 21 palpons; 13 nectoph.

The specimens were all more or less fragmented. But the palpons, stem, and nectophores of *Physophora* are not only so characteristic in outline, but preserve so satisfactorily, that identification is easy, even when they are scattered loose among other plankton. The combination of a comparatively long and very slender nectosome sector, with a siphosome sector shortened and expanded into a voluminous terminal dilation showing clear evidence of the spiral twisting by which this contour has been developed, and with the points of attachment of each palpon appearing as a distinct polygonal facet, make even a denuded stem recognizable at a glance. No other known siphonophore has a stem of this form except HAECKEL's *Discolabe quadrigata* which agrees with *P. hydrostatica* in all respects ex-

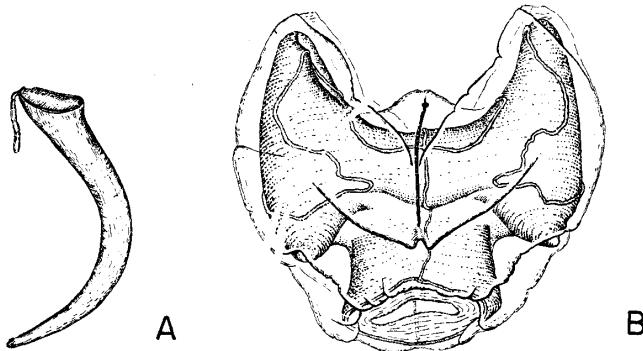


Fig. 49. *Physophora hydrostatica*; A. Palpon, 36 mm. long. B. Nectophore, 14.5 mm. wide, "Thor" St. 275.

cept in the quadriserial arrangement of its nectophores. And since such an arrangement never has been seen since HAECKEL (1888b) reported and pictured it, the status of his supposed species remains doubtful. The large size, stoutness, and oblique basal truncation of the palpons (Fig. 49A) is likewise diagnostic. And details of conformation, especially the sub-angular lateral expansions of the nectosac on the oral side (but not of the gelatinous substance) combined with its deep emargination on the aboral side, make it possible to recognize loose nectophores (Fig. 49B) among other loose physophorid bells, with which they may be mingled in the tow. For accounts of the general morphology of *Physophora*, see especially CLAUS (1860), SARS (1877, p. 32, Pls. 5, 6, Figs. 1—8), and CHUN (1897, p. 39, Pls. 2, 3, Figs. 3—6). For photographs of Pacific *Physophora*, see BIGELOW (1911b, Pl. 16). The present series adds nothing to these earlier accounts, save for confirmation.

ANTHOPHYSIDAE Brandt 1835.

ANTHOPHYSA Brandt 1835.

?ANTHOPHYSA ROSEA Brandt 1835.

Anthophysa rosea, Brandt, 1835, p. 35.

For synonymy, see Bigelow, 1911b, p. 296; 1931, p. 577.

Material.

St. 218. 36°54' N., 2°57' E. 2. IX. 1910.
Y. 300 m w., one fragm. col.

This specimen shows the arrangement of the bracteal lamella characteristic of the genus, and most of the gonodendra are still intact. But it has lost all its bracts, while siphons, palpons, and tentacles, are represented by fragments only. Hence (since it is on these organs that possible specific differences are to be sought) it throws no more light on possible distinction between *Anthophysa* from the Pacific and Atlantic, than did the other Atlantic specimen most recently reported (BIGELOW, 1931, p. 577). We can only say that, so far as gross morphology is concerned, we have found nothing to separate it from the well preserved series of *A. rosea* collected by the Albatross in the Eastern Tropical Pacific (BIGELOW, 1911b, p. 296, Pl. 20, Figs. 7—13, Pl. 21, Figs. 1—5, Pl. 23, Figs. 1—5), which strengthens the presumption that *A. formosa* FEWKES is a synonym of *A. rosea*.

RHIZOPHYSALIAE Chun 1882.

RHIZOPHYSIDAE Brandt 1835.

RHIZOPHYSA Peron and Lesueuer 1807.

It seems sufficiently established (LENS and VAN RIEMSDIJK, 1908; BIGELOW, 1911b) that all representatives of the genus recorded prior to 1925 were referable to two species, *eysenhardtii* GEGENBAUR (1860), in which all the tentilla are simple-filiform, and *filiformis* FORSKÅL (1775), in which most of the tentilla are trifid, but others (less numerous) either dendritic-palmate, or beak-like (GEGENBAUR, 1853a, Pl. 18, Fig. 7—8; FEWKES, 1882, Pl. 6, Fig. 4; LENS and VAN RIEMSDIJK, 1908, p. 101, Pl. 18, Fig. 45).

In 1925, MOSER described two new species of *Rhizophysa*. One of these, her *R. tricornuta* like *R. filiformis*, has "vogelkopfartigen Tentakelknöpfen" (MOSER, 1925, p. 445). According to MOSER, the terminal median beak of her new species corresponds more closely to the terminal ampulla in the young tentillum of *Anthophysa* (BIGELOW, 1911b, Pl. 20, Fig. 8), or of Agalmidae before the cnidoband has become spirally

coiled, than to the terminal median structure in the beak-like tentilla of *R. filiformis*. But comparison of HAECKEL's (1888b, Pl. 24, Fig. 9) figure of the trifid tentillum of *R. filiformis*, and of the "Thor" examples of the latter, with MOSER's (1925, Textfig. 59) illustration of tentilla of *tricornuta* fails to show any essential differences: the terminal structure is, in fact, only slightly more dilated in MOSER's figure than it is shown by HAECKEL, or than in the "Thor" example pictured in Fig. 50. And the lateral filaments show the same indication of incipient subdivision. We are, therefore, inclined to refer *tricornuta* to the synonymy of *filiformis*.

MOSER's *R. megalocystis* is set apart by the possession of palpons ("Tentakel-taster", MOSER, 1925, p. 447) bearing giant nematocyst capsules. As no corresponding structures have ever been described for *Rhizophysa*, it cannot be referred to that genus, but may belong to the genus *Salacia*, in which the polygastric cormidia are described by HAECKEL (1888b, p. 332) as bearing thin spindle shaped tubes, "perhaps palpons which remain permanently mouthless", as well as siphons.

RHIZOPHYSA FILIFORMIS Forskål 1775.

Fig. 50.

Physsophora filiformis Forskål, 1775, p. 120; 1776, Pl. 33, Fig. F.

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

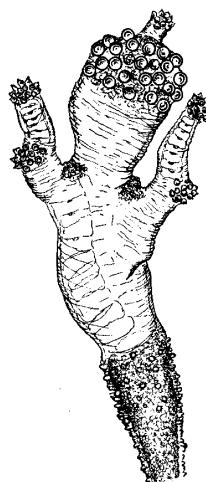
? *Rhizophysa tricornuta*, Moser, 1925, p. 445, Pl. 33, Fig. 2.

Material.

St. 58. 36°36' N., 4°24' W. 20. II. 1909. Y. 65 m w. Part of 1 col.	St. 184. 38°10' N., 22°33' E. 17. VIII. 1910. Y. 65 m w. Part of 1 col.; loose siphons with tentacles.
St. 220. 36°25' N., 0°42' E. 4. IX. 1910. Y. 25 m w. Parts of 2 col.	

St. 223. 36°13' N., 1°28' W. 5. IX. 1910. Y. 2000 m w. Parts of 2 col.	St. 225. 36°35' N., 3°00' W. 6. IX. 1910. Y. 25 m w. Part of 1 col.
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Fig. 50. *Rhizophysa filiformis*; Tentillum, from "Thor" St. 184, $\times 175$.



These specimens all still bear the large pneumatophore with the hypocystic villi plainly visible, some of the siphons, and parts of tentacles still bearing tentilla far enough advanced in development to show the trifid conformation, with expanded median ampulla, that predominates among the tentilla of this species (cf. Fig. 50 with LENS and VAN RIEMSDIJK, 1908, Pl. 18, Fig. 142—144). The palmate and beak like forms that have been described in this species (see above, p. 64) were not to be seen on any of the 'Thor' specimens, but no significance can be given to their apparent absence, as only the basal parts of the tentacles are intact on any of the specimens.

The material is not good enough to add anything to earlier accounts, see especially GEGENBAUR (1853a), HAECKEL (1888b, *Cannophysa murrayana*), and LENS and VAN RIEMSDIJK (1908).

RHIZOPHYSIDAE genus?

Material.

St. 138. 37°37' N., 11°25' E. 19. VII. 1910. Y. 300 m w. Stem.	St. 141. 36°42' N., 13°34' E. 20. VII. 1910.
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The condition of these fragments does not permit identification.

CHONDROPHORAE Chamisso and Eysenhardt 1821.

PORPITIDAE Brandt 1835.

PORPITA Lamarck 1801.

PORPITA UMBELLA O. F. Müller 1776.

Medusa umbella, O. F. Müller, 1776, p. 295, Pl. 9, Fig. 2, 3.

For synonymy, see Bigelow, 1911b, p. 352.

Material.

St. 160. 35°59' N., 28°14' E. 1. VIII. 1910. Y. 25 m w. 1 col., 7.5 mm. in diameter, including limbus.	St. 340. 35°50' N., 21°30' E. 26. VIII. 1911. S. 28 m w. 11 col., about 4—7 mm. in diameter of shell.
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These few, small specimens add nothing to previous accounts of the morphology of *Porpita*. Until someone has the opportunity to compare a well preserved series of Atlantic with Indian Ocean *Porpita*, the former may continue as *umbella*. Should the two prove indistinguishable, as MOSER (1925) believes, the compound species must be called *P. porpita* LINNÉ, which was originally described from the Indian Ocean.

Successive studies (BIGELOW, 1911b, 1931) have yielded cumulative evidence that the *Porpita* of the Pacific or at least of the Eastern side of the latter, probably represent a distinct species, *P. pacifica* LESSON, separated from its Atlantic relative by the facts that the disc is strongly tuberculate, that the tentacular nematocyst-clusters average considerably more numerous, that there are fewer open stigmata, and that the limbar canals are more complex.

VELELLIDAE Brandt 1835.

VELELLA Lamarck 1801.

VELELLA VELELLA Linné 1775.

Fig. 51.

Medusa velella Linné, 1758, p. 660.

For synonymy see Bigelow, 1911b, p. 352, (*Velella velella*), to which must now be added the synonymy for *V. lata* (see Bigelow, 1911b, p. 343).

Material.

St. 204. 38°52' N., 7°43' E. 27. VIII. 1910. Surface. 1 specimen, 31 mm.	St. 217. 38°01' N., 1°48' E. 1. IX. 1910. Surface. 5 specimens, 12—29 mm. in shell length.
St. 206. 39°32' N., 5°15' E. 28. VIII. 1910. Surface. 32 specimens, 11—31 mm.	St. 223. 36°13' N., 1°28' W. 5. IX. 1910. Surface. 2 specimens, 6—11 mm. in greatest diameter.

Recent studies have lead to contradictory conclusions, as to whether the Velellas of the Atlantic and of the Pacific are distinct (BIGELOW, 1911b, p. 342) or are merely varieties of one wide-ranging form. The opportunity further to test this question, offered by the "Thor" series is therefore welcome. In an earlier comparison of Pacific with Atlantic specimens (BIGELOW, 1911b), supposed differences in the form of the crest were not borne out. Unfortunately, it was not possible to make any comparison of the outlines of the limbus which is entire in the Pacific specimens, but which has often been described as irregularly lobed in the Atlantic. But the shells of the Pacific specimens averaged relatively broader than any of the Atlantic specimens, proportional measurements being as follows:—

Atlantic:— Shell length, 11.5—30 mm.; breadth of shell relative to length, extremes, 1:2.7—1:3.1; average, 1:3.0.

Pacific:— Shell length 11—46 mm.; breadth of shell relative to length, extremes, 1:1.9—1:1.2; average, 1:2.1.

And as the shells of Pacific shells also seemed on the whole to be more nearly rectangular with the long sides straighter than those of the Atlantic species, retention of the two species seemed justified.

Measurements of the shells of the "Thor" series give the following results:—

St.	Length mm.	Breadth mm.	Proportion breadth to length	St.	Length mm.	Breadth mm.	Proportion breadth to length
223	3.5	2.0	1 : 1.8	206	18.5	7.0	1 : 2.6
	6.0	3.0	1 : 2.0		18.5	7.0	1 : 2.6
206	8.5	3.0	1 : 2.8		18.5	7.0	1 : 2.6
	12.0	5.0	1 : 2.4		19.5	7.5	1 : 2.6
	13.0	5.0	1 : 2.6		20.0	8.0	1 : 2.5
	14.0	5.5	1 : 2.5		20.5	7.5	1 : 2.7
	14.0	6.0	1 : 2.3		21.0	8.0	1 : 2.6
	14.0	6.0	1 : 2.3		21.5	8.0	1 : 2.7
	16.5	6.5	1 : 2.4		22.0	7.5	1 : 2.9
	16.5	6.5	1 : 2.4		22.0	8.5	1 : 2.6
	17.5	7.0	1 : 2.5		22.5	8.0	1 : 2.8
	18.0	6.5	1 : 2.8		22.5	9.0	1 : 2.5
	18.0	7.0	1 : 2.6		24.0	8.0	1 : 3.0
	18.0	7.0	1 : 2.6		25.0	8.5	1 : 2.9
	18.0	6.5	1 : 2.8	204	24.0	9.0	1 : 2.4
	18.0	7.0	1 : 2.6	217	24.5	10.0	1 : 2.5
	18.5	7.5	1 : 2.5		27.5	10.0	1 : 2.8
	18.5	7.5	1 : 2.5		28.5	10.5	1 : 2.7

The extreme range for specimens with shells more than 8 mm. long is thus from 1:2.3 to 1:3.0 (mean, 1:2.6). As this mean (likewise the extremes) lies almost precisely midway between the means for Atlantic and Pacific series previously measured, no distinction can be longer maintained between the two. And this proves equally true of the outlines of the limbus, for most of the "Thor" series are in good enough condition to show that this is not lobed, but entire, just as it is in Pacific specimens. Lobing seems, therefore, to reflect either temporary contraction or the results of preservation. Of characters previously suggested as perhaps diagnostic, the form of the crest having already been tested and discarded (BIGELOW, 1911b, p. 342), there remains only the form of the shell. And comparison of specimens of approximately equal sizes from the two oceans, shows that this is no more significant than is the proportion of breadth to length, for the earlier view that the shell of Pacific specimens were more rectangular, those of Atlantic more elliptical, can no longer be maintained, there being no significant difference in this respect (Fig. 51).

In short, there is no longer any justification for recognizing a Pacific species of *Velella* as contrasted with an Atlantic, but the two must be united as MOSER (1925) has done under the old name *V. velella* LINNÉ. Presumably this applies to the *Velella* of the Indian Ocean, but the latter still has to be examined critically from this standpoint.

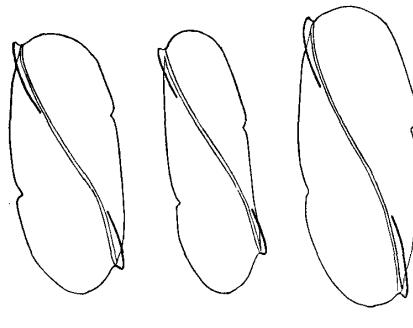


Fig. 51. *Velella velella*; dorsal view of the shells of three specimens showing variations in outline. A. Length, 24.5 mm., "Thor" St. 206. B. Length, 25 mm., "Thor" St. 206. C. Length, 27.5 mm. from Bonin Island (Mus. Comp. Zool. Cat. No. 1566).

PART II. BIOLOGICAL.

INTRODUCTION.

The phases in the biology of siphonophores on which the "Thor" data throw light are, a) distribution, horizontal and vertical; b) fluctuations in abundance from season to season; c) breeding season and depth at which the chief production takes place.

METHODS OF CALCULATION.

Primary data. Most of the catches were made in ordinary horizontal tows with Young Fish Trawls, of the same size (for description, see SCHMIDT, 1912, p. 8). The horizontal portions of the tows varied in duration from 15 to 240 minutes, the majority being of one half hour. In order to make the results comparable, it is necessary, as a first approximation, to reduce all catches to the basis of an equal towing period. For convenience, one hour was selected. In the case of the deeper hauls, the periods occupied in lowering and hauling in the nets, i. e., the oblique or vertical portions of the net's travel must also be taken into account. The station tables (SCHMIDT, 1912) contain no record of these times. But the corresponding linear distance for each tow would, obviously be twice the length of wire payed out. In order to combine this with the horizontal part of the tow, the latter must be translated from the time interval, in which it is stated in the tables (SCHMIDT, 1912), into the corresponding linear distance, the usual speed of the ship, while towing, being stated as two nautical miles per hour (SCHMIDT, 1912, p. 13).

If, for example, 1000 meters of wire were payed out, and the net towed 1 hour, the minimum linear distance would be 2000 meters plus 3700 meters (2 sea miles). Calculations on this basis, contain three unavoidable sources of error; — a) error resulting from variations in the speed of the ship; b) errors resulting from the fact that the travel of the net up and down was no doubt oblique; and c) the error inherent in the tow net method of collection. These errors may have been large for individual tows. But it is not likely that they seriously affect the average results in large numbers of tows. One may assume, to begin with that, with careful navigation, the average speed was close to the standard two knots. And while the second error becomes increasingly serious with increasing depth (nor can any definite estimate of its magnitude be arrived at), it is always in the same direction; i. e., the calculated length of a haul is the minimum in every case. As for the third source of error, general experience with large nets of the fabric actually used on the "Thor" (stramin), makes it likely that reasonably large catches of slow moving animals, too large to pass through the meshes, and distributed at random in the water, made in parallel hauls, would not show an average variation¹ of more than 25% (WINSOR and WALFORD, 1936).

To be on the safe side, it is wise not to credit any significance to variations in unit catches of less than, say, 50—60%.

Except when otherwise stated, it is assumed that the number of calycoaphore colonies represented in any haul equals the number of complete specimens taken, added to the number of superior ectophores or of inferiors, whichever is the more numerous. The number of complete specimens added to the number of loose bracts similarly gives the number of eudoxoids.

Absolute Abundance.

For comparison with animals of other planktonic groups, some expression of absolute abundance is desirable, i. e., the number per unit volume of water, rather than per hour's tow. Exactness cannot be hoped for, in this respect, because of the unknown variations in the speed of the vessel and in the coefficient

¹ Coefficient of variation.

of filtration of the nets. However, assuming 3700 meters as the length of an hours tow, with a net with a rectangular mouth, 2×1.5 meters (SCHMIDT, 1912, p. 8), and assuming furthermore that the straining efficiency of the net be roughly 50% (which is probably too low), the water strained in one hour would be about 5500 cubic meters. And while this estimate may very well be 50%, in error, or even more, as anyone will realize who has had any experience with tow netting, absolute abundances so calculated yield comparative results of considerable interest.

Vertical Distribution.

As all the hauls were made with open nets (the great majority with the Young Fish Trawl) which fish as effectively while being hauled in as while hauled horizontally, and only slightly less effectively while being payed out, it is obvious that part, or (in extreme cases) even the whole of the catch of a deep haul may actually have been taken close to the surface. During the early years of quantitative plankton investigations, various authors emphasized the magnitude of this contribution to the total catches of horizontal hauls with open nets, that may be made by what the net picks up on its way up and down. And it is obvious that if but a single haul were in question, there would be no way whatever of separating this part of the catch from what was made during the horizontal part of the tow. If, however, a number of hauls are made at different levels at a given station and if the area covered by the latter be not too large, differential results often do afford significant information as to vertical distribution (MURRAY and HJORT, 1912). If, for example, one species, or group of species, be caught only in the deep hauls (as is often the case), while the catch of another group is much larger in the shoalest hauls than in the deep, it is clear enough that the latter were (for the most part) living near the surface, but all of the former deep down in the water. All this is so obvious that there is no need to stress the point further.

Information of this sort becomes increasingly reliable, the smaller the vertical intervals between the hauls. This criterion was fulfilled better, perhaps, on the "Thor" cruises than on any previous expedition (at least for zooplanktonic animals so large that horizontal tows are needed for adequate sampling), because tows were made at many levels at many stations, at different times of year; because sizes of nets and duration of tows were accurately recorded; and because the speed of towing was kept approximately uniform (see above).

In evaluating the significance of catches, in terms of vertical distribution, for any given species, the point most definitely established is the upper limit to its regular occurrence — a matter often of great significance in the ecology of the species. Obviously, if it occurs up to the surface, it is caught at that level: if not, it is equally obvious that its upper boundary is near the shoalest depth at which it is caught consistently. From this depth downward, the picture becomes increasingly confused by the contamination of the hauls from successive levels, by individuals of the species picked up by the net on the way down or up. If, for example, an animal has its chief abundance in the 200–600 meter zone, catches in open nets from deeper levels would be significant only if too large to be explained in this way. A correction for this contamination, has therefore, to be subtracted from the total catches, before the latter can be used as illustrative of relative vertical distribution.

If the horizontal distribution of a given species were uniform and random, if it increased in abundance downward in direct proportion to the increase in depth, and if its relative abundance at the shoalest level be known (from the tows at that level), the problem involved in calculating what part of the total catch in the next deeper haul actually came from the horizontal part of the latter might be illustrated in the accompanying diagram (Fig. 52), in which AD represents the upper level at which abundance is known, BC the

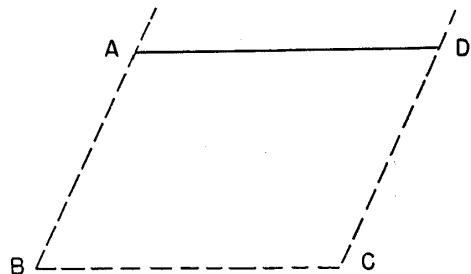


Fig. 52. Schematic representation of relationship between vertical and horizontal parts of hauls, at stations where only two were made shoal and deep.

level of the deeper tow for which the abundance is to be calculated, and the dotted line the course of the net through the water. On the above assumptions, the addition to the catch made during the journeys of the net up and down, will be equal to the average catch per unit length along the paths *AB* and *CD*, multiplied by the length *AB* plus *CD* (or 2 *AB*), this average being equal in turn to one half the sum of the unit catch at the upper level *AD* (known) and at the lower level *BC* (unknown).

The catch made along the paths *AB* plus *CD* may therefore be expressed as:—

$$F = \frac{(E+x)}{2} 2Z = Z(E+x) \quad \checkmark$$

where

F = Total catch along *AB* and *CD*

E = Catch per unit length at the upper level, *AD*

x = Catch per unit length at the lower level, *BC*

Z = Length *AB* or *CD*

L = Length *BC*

T = Total number of organisms along *AB* + *BC* + *CD*

and, the total catch

$$T = F + xL.$$

By substitution

$$T = Z(E+x) + xL$$

$$x = \frac{T - EZ}{Z + L}.$$

When hauls are made at several levels (Fig. 53) at a given station, the calculation becomes cumulative downward, from level to level.

In this case,

$$F_1 = Z(E+x) + Z_1(x+x_1) + Z_2(x_1+x_2). \quad \times$$

and

$$T_1 = F_1 + x_2L$$

where

*Z*₁ = Length *B*₁*B*₂ or *C*₂*C*₁

*Z*₂ = Length *B*₂*B*₃ or *C*₃*C*₂

*F*₁ = Total catch in length *AB*₁*B*₂*B*₃ and *C*₃*C*₂*C*₁*D*

*x*₁ = Catch per unit length along *B*₂*C*₂

*x*₂ = Catch per unit length along *B*₃*C*₃

*T*₁ = Total catch made by the deepest tow along its entire course *AB*₃*C*₃*D*

*L*₁ = Horizontal length of deepest tow, *B*₃*C*₃.

By substitution,

$$T_1 = x_2L_1 + Z(E+x) + Z_1(x+x_1) + Z_2(x_1+x_2)$$

$$x_2 = \frac{T_1 - Z(E+x) - Z_1(x+x_1) - Z_2(x_1)}{L_1 + Z_2}.$$

The calculation for the catches of *Abylopsis tetragona* at St. 206 may serve as an illustration:—

In this case, the actual catches, lengths of wire out, and towing times were:— 25 meters of wire, 15 minutes, 53 colonies and loose inferior nectophores; 300 meters of wire, 15 minutes, 147 colonies and inferior

nectophores; 1000 meters of wire, 45 minutes, 141 colonies and inferior nectophores; 2000 meters of wire, 45 minutes, 148 colonies and inferior nectophores.

The catch per unit length (1 meter) in the 25 meter tow being $\frac{53 \times 4}{3700} = 0.057$ or 212 per hour, (assuming that 1 hour's tow covered a distance of 3700 meters), the catch per meter with 300 meters of wire out was, $x = \frac{147 - 275(0.057)}{925 + 275} = 0.109$ or 403 per hour; the catch per meter with 1000 meters of wire out was

$$x_1 = \frac{141 - 275(0.057 + 0.109) - 700(0.109)}{2775 + 700} = 0.005 = \text{or } 18 \text{ per hour}$$

the catch per meter with 2000 meters of wire out was

$$x_2 = \frac{148 - 275(0.057 + 0.109) - 700(0.109 + 0.005) - 1000(0.005)}{2775 + 1000} = 0.004 = \text{or } 14 \text{ per hour.}$$

The hourly catches, uncorrected, would on the contrary, work out as follows in this case, were it assumed that the entire catch had been made in the horizontal part of each tow, i. e., while the recorded length of wire was out:— 25 meters of wire, 212 specimens per hour; 300 meters of wire out, 588 specimens per hour; 1000 meters of wire, 188 specimens per hour; 2000 meters of wire, 196 specimens per hour. There is therefore good ground for concluding that, in this case, the greater part of the "deep" catches came from the overlying strata, but that an appreciable number were actually living down to the deepest level sampled.

In cases where the catches are large in the shoal hauls, but small at the deep, x_1 , x_2 , etc., often work out as minute quantities, meaning that the whole of the catches made in the deep hauls may very likely have been picked up by the nets in their passage down and up again through the densely populated upper layers. This applies, for example, to the calculation for *Chelophyes appendiculata*, at St. 115, where the catches were:— 25 meters of wire out, 15 minutes, 515 superior nectophores and complete colonies; 65 meters of wire, 15 minutes, 409 superior nectophores and colonies; 300 meters of wire, 30 minutes, 36 superior nectophores and colonies; 2000 meters of wire, 60 minutes, 61 superior nectophores and colonies; The catch per unit length (1 meter) with 25 meters wire being

$$\frac{515 \times 4}{3700} = 0.566, \text{ or } 2060 \text{ per hour}$$

for 65 meters of wire,

$$x = \frac{409 - 40(0.566)}{925 + 40} = 0.390, \text{ or } 1443 \text{ per hour}$$

for 300 meters of wire,

$$x_1 = \frac{36 - 40(0.566 + 0.390) - 235(0.390)}{1850 + 235} = -0.044 \text{ or } 0 \text{ per hour}$$

for 2000 meters of wire,

$$x_2 = \frac{61 - 40(0.566 + 0.390) - 235(0.390 - 0) - 1700(0)}{3700 + 1700} = -0.012 \text{ or } 0 \text{ per hour.}$$

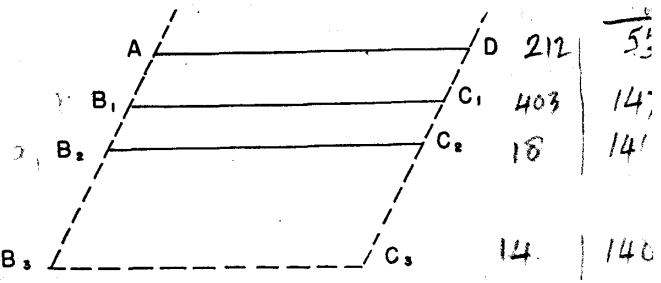


Fig. 53. Schematic representation of relationship between vertical and horizontal parts of tows at stations where tows were made at several levels.

It is obvious that stations where a species is not taken at all, may be omitted from calculations of its relative vertical abundance. This applies equally to stations where towing was done at one level only: in such cases, there is no way of knowing whether the species was more or less plentiful at some other level. Conversely, each tow must be taken into account whether yielding the species or not, at stations where several tows were made, and where any of them took it.

The following example will show how much the calculation for catches at deeper levels is affected by errors (p. 68) in the numerical estimate of the population at the shoaler level. If the catch of *Abylopsis tetragona*, St. 206, at 16 meters of 212 per hour had been 50% less (106), the calculated catch would have been 429 instead of 403 per hour (6% more) at 200 meters, 11 instead of 18 per hour (39% less) at 666 meters, and 13 instead of 14 per hour (6% less) at 1333 meters. If, on the other hand, the catch at 16 meters had been 50% greater (318), the calculated catch would have been 381 instead of 403 at 200 meters (5% less), 14 instead of 18 at 666 meters (22% less), and would have remained about the same (14 per hour) at 1333 meters.

General effects of introducing the correction for contamination from above into the calculations of relative vertical abundance.

The vertical distribution of any animal occupying a fairly wide bathic zone, as plotted directly from catches made in open nets, usually appears as extending downward to the level of the deepest tows (irrespective of whether it actually lives so deep or not), because of the specimens picked up by the nets on their way up and down.

The narrow bands so often shown as extending downward from the polygon of chief abundance, in conventional diagrams of the sort reproduced in Figure 54, are cases in point. Application of the correction for contamination in the vertical portions of the tows, shows with a high degree of probability whether such bands are purely fictitious (resulting from inadequate data), as seems almost certainly to have been true in the case illustrated in Figure 54 A, or whether a sparse population does in fact extend downward for an indefinite distance below the level of major abundance, as in the case illustrated in Figure 54 B. Apart from this, the chief

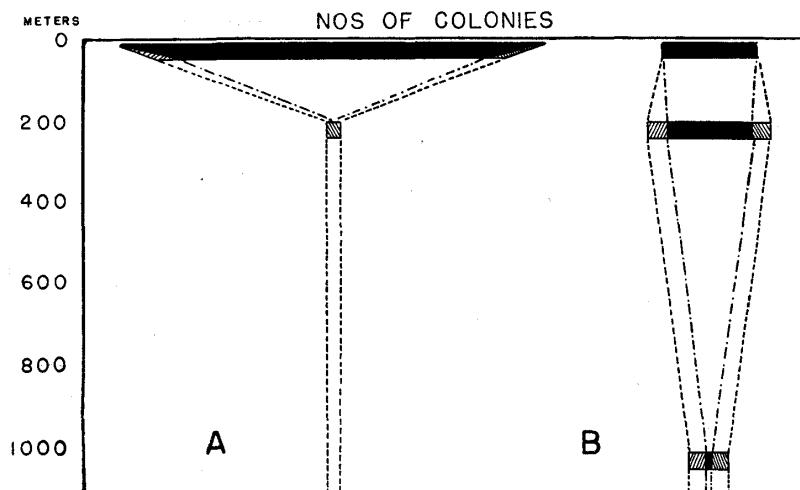


Fig. 54. Illustration of the effect of introducing the correction for contamination into calculations of vertical distribution. A. *Chelophyes appendiculata*, St. 115; B. *Abylopsis tetragona*, St. 206. The outer polygons represent vertical abundance, per hour's towing calculated without correction, the inner polygons, vertical abundance as corrected, the hatched areas being the difference between the two.

alteration that the introduction of the correction effects in the picture of vertical distribution is that it usually subtracts something from the apparent abundance in all but the uppermost stratum of occurrence, a subtraction usually increasing in amount with increasing depth. But if the horizontal parts of the tow, at the several levels combined, considerably exceed the combined vertical parts, the correction is seldom great enough seriously to alter the picture that would result without it, apart from more sharply defining the lower boundary to the occurrence of the species in question.

Depths at which the nets were actually working.

In the station-tables, the hauls are described by the length of wire out, not directly in terms of depth, and it is these lengths which must be used in the calculations of contamination. In picturing vertical distribution, however, it is the depth at which the horizontal parts of the tows were made which is significant. For this, only a rough approximation can be made for the "Thor" hauls, because the wire-angle is not recorded. From experiments with a pressure gauge SCHMIDT (1912, p. 13) concludes that, at the standard speed of 2 sea-miles per hour, the actual depth of the "Thor" hauls was "somewhat greater than half the length of wire out". JESPERSEN (1915, p. 4) from experiments, concludes that the actual depth was "generally about two thirds" of the length of wire actually payed out. The estimate adopted in the present paper of depth equalling $\frac{2}{3}$ of the length of wire out, should therefore be regarded as maximal. The standard depths (so calculated), are 16, 43, 200, 400, 666, 800, 1066 and 1330 meters, the lengths of wire most frequently employed being 25, 65, 300, 600, 1000, 1200, 1600 and 2000 meters.

800 375 750 950 1200
NECTOPYRAMIS THETIS Bigelow (p. 5).
Fig. 55.

Horizontal Distribution.

The localities of capture so far reported for colonies of *Nectopyramis thetis* are, Bay of Biscay (BIGELOW, 1911 a), between the Azores and the Canaries (LELOUP, 1933), and "Thor" St. 91 in the Bay of Cadiz (Fig. 55). The eudoxid has been recorded in the East Temperate Atlantic in August and September (LELOUP, 1932 a; 1933, p. 14), and at "Thor" St. 76 (in March) in the Bay of Biscay.

Vertical Distribution.

All recorded captures, whether of the colonies, or of the eudoxid, have been in open nets, towed at considerable depths, namely; 300—0 fathoms in the Bay of Biscay (colony, BIGELOW, 1911 a); 1000—0 meters, Azores-Canaries (colony, LELOUP, 1933); 1600—0 meters, Bay of Cadiz (colony, "Thor" St. 91); between 1000—0 and 3000—0 meters, Bay of Biscay (eudoxid, LELOUP, 1933).

Evidently this is a bathypelagic species, but available data are not sufficient to show the level of most frequent occurrence.

AMPHICARYON ACAULE Chun (p. 7).

Fig. 55.

Horizontal Distribution.

This siphonophore is now known to be widespread in tropical and sub-tropical belts of all three great oceans (for a list of localities, see TOTTEN, 1932, p. 330). While first described from the Canaries (CHUN, The Danish Oceanographical Expedition. II. H. 2.

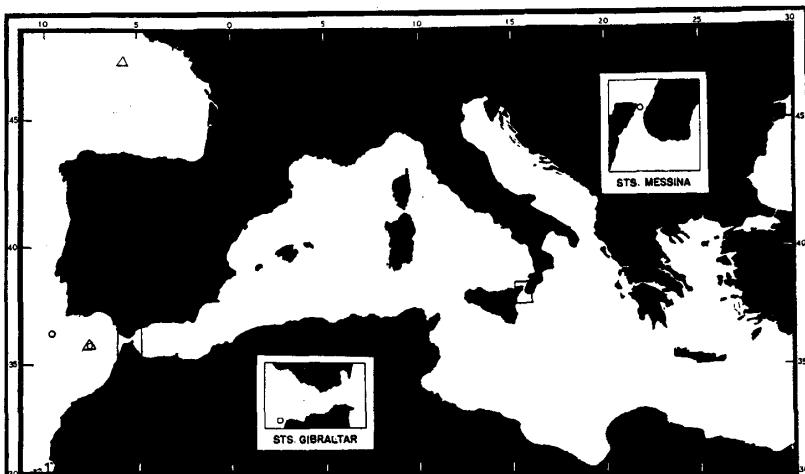


Fig. 55. "Thor" captures of *Nectopyramis thetis* (triangles) and *Amphicaryon acaule* (circles).

1888) it was not taken again in that general region until 1909—1910, when the "Thor" found it outside the Straits of Gibraltar (Sts. 69, 96), and 1913 when the "Hirondelle II" had it in Lat. $38^{\circ}58'$ N., Long. $44^{\circ}55'$ W. (LELOUP, 1933). The capture by the "Thor" of a specimen in the Straits of Messina (St. 282) is the first record for it in the Mediterranean (Fig. 55). Hence, as most of the early observations on siphonophores were made in this region, it must be a rarity there, probably a stray from the Atlantic.

Vertical Distribution.

Previous depth-records from different regions are:—

Western Atlantic, open hauls between 50—0 and 600—0 meters (BIGELOW, 1918);

Central Atlantic, along the track of the "Gauss", vertical hauls, 400—0 to 3000—0 meters (MOSER, 1925);

Eastern Atlantic, between the Canaries and Straits of Gibraltar, 2000—0 meters (LELOUP, 1933);

Indian Ocean, hauls from deeper than 180 meters, once in a closing net at 457—914 meters (BROWNE, 1926);

Off the Great Barrier Reef, Australia, 400—0 meters (TOTTON, 1932);

Eastern Tropical Pacific, open hauls from 550—0 meters (BIGELOW, 1911b).

One of the four "Thor" catches was in a haul at 27 meters (1 colony), one from a 43 meter haul (9 superior nectophores, 6 inferior nectophores), one in a 200 meter haul (1 colony) and one in a 1066 meter haul (1 colony). A wide vertical range is thus established for the species, extending down at least to 450—500 meters and upward to within 40—50 meters of the surface, but apparently never rising actually to the surface. Data are not sufficient to show whether there is any prevailing level of maximum abundance, or how much deeper it may descend beyond the limit to which its presence has actually been proved.

ROSACEA CYMBIFORMIS Delle Chiaje (p. 10).

Fig. 56.

Horizontal Distribution.

Rosacea cymbiformis has been found in all oceans:— in the eastern Atlantic from the tropics northward to the Bay of Biscay (CHUN, 1888; HAECKEL, 1888b; LELOUP, 1933), in the South Atlantic (LELOUP, 1934; LELOUP and HENTSCHEL, 1935, HARDY and GUNTHER, 1935), in the Eastern Tropical Pacific (BIGELOW, 1911b), in the vicinity of the Philippines (BIGELOW, 1919), and in the Indian Ocean (HUXLEY, 1859; BROWNE, 1926). It has been taken more frequently in the Mediterranean than elsewhere, definite locality records there being:—

Nice — LEUCKART (1853, 1854);

Naples — DELLE CHIAJE (1822), KEFERSTEIN and EHLERS (1861), SPAGNOLINI (1868, 1870), SCHMIDT-LEIN (1880), KOROTNEFF (1884), CHUN (1885), SCHNEIDER (1898), Naples Zool. Station, MOSER (1917, 1923, 1925), NEPPI (1921);

Capri — LO BIANCO (1903);

Messina — GEGENBAUR (1854), SARS (1857), MOSER (1917);

Villefranche — FEWKES (1879), LOCHMAN (1914), MOSER (1917, 1925), LELOUP (1935);

Sicily — DELLE CHIAJE (1841);

Trieste — GRAEFFE (1884);

Mentone — PAGENSTECHER (1869).

On the "Thor" cruises, *R. cymbiformis* was taken at 1 station in the eastern basin of the Mediterranean (Gulf of Aegina, St. 183), at 6 stations in the Alboran Sea and the southern part of the Balearic Sea in the western basin, and in the Atlantic at 4 stations off the coast of Portugal and Southern Spain (Fig. 56).

Vertical Distribution.

Although *R. cymbiformis* was never taken in large numbers and only at 11 "Thor" stations, there is some indication that it occurred most often at a depth greater than 50—100 meters, for the captures at 9

of the 11 stations were in tows from 200 meters and deeper while none were taken in the 16 or 43 meter hauls at these same stations. On the other hand the largest catch of all (152 nectophores per hour) was from close to the surface (St. 233, 16 meters), whereas most of the catches in the deeper tows were small, averaging only 20 nectophores per hour (uncorrected); — too few in fact for statistical analysis of vertical distribution.

Earlier depth-records for it have been even more divergent. On the one hand, it has been found floating at the surface so frequently, near Naples, that the local Zoological Station has supplied preserved specimens to many institutions. It has also been recorded in the upper 50 meters, at localities as far apart as the Canaries (HAECKEL 1888b, surface, entire specimen), the Tropical South Atlantic (HAECKEL, 1888b, p. 146, surface), off South Africa (LELOUP and HENTSCHEL, 1935, 0—50 meters), and in the Eastern Tropical Pacific (BIGELOW, 1911b, surface, entire colony). On the other hand, the "Meteor" had it in closing net hauls from 50—100 and 200—400 meters. The "Discovery" took 2 specimens at 250—500 meters and one from 500—750 meters (HARDY and GUNTHER 1935), while the collections made by the Prince of Monaco contain scattering specimens in hauls from 0—1500, 0—2500, and 0—3000 meters; none, however, from surface hauls (LELOUP, 1933, p. 8).

LELOUP and HENTSCHEL (1935, p. 5) conclude that it "Gewässer mässiger Temperatur bevorzugt und deshalb um so bathypelagischer lebt, je mehr sie sich den tropischen Regionen nähert." This may well be the correct explanation for the fact that there is only one surface record for *cymbiformis* within the isothermal belt warmer than 25° C. And the identity of even this one is somewhat uncertain, for it rests on scattered bracts preserved in alcohol (HAECKEL, 1888b, p. 146, "Challenger" St. 352, 10°55' N., 17°46' W.). However, it is not yet possible to state the upper limit of optimum temperature for it, in temperate latitudes where it does rise more regularly to the surface. Its appearances, there, near Naples, being mostly in winter and early spring are in water of 13—15° C. But temperatures as high as about 20° C. are certainly not fatal to it, for the rich catch at "Thor" St. 233, was from a temperature between 17° and 22.5° C.¹.

It may well be that storm waves are an effective bar to the continued existence of so fragile an animal, near the surface, as seems to be the case for the long stemmed physophores.

Breeding Season and Abundance.

According to LO BIANCO (1899), this species breeds off Naples from January to May². HAECKEL also had ripe specimens in February, while LELOUP (1935) reports it as common in winter and in spring at Villefranche. The "Thor" specimens are too few to yield any information as to seasonal fluctuations in abundance.

The largest catch was at the rate of 152 nectophores per hour, or 137 per 5000 cubic meters of water.

¹ Readings at 25 meters at the nearest stations (232, 234) where observations were obtained.

² Examination, at various hands, of specimens supplied by the Naples station has shown that the form listed by LO BIANCO (1899) as *Praya diphyes* VOGT was actually *R. cymbiformis*.

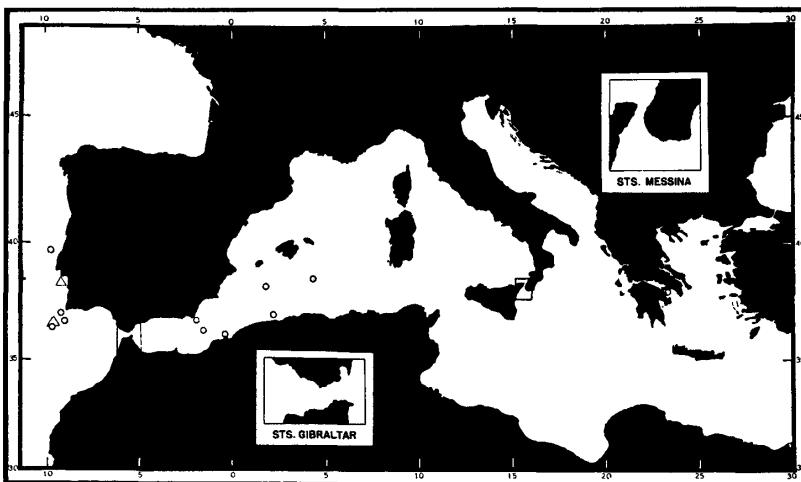


Fig. 56. "Thor" captures of *Rosacea cymbiformis* (circles) and *Rosacea plicata* (triangles).

ROSACEA PLICATA Quoy and Gaimard (p. 11)
Fig. 56.

Horizontal Distribution.

Successive collections have extended the known range of this widespread species, which has now been taken in the open oceans at many localities; in the Temperate North Atlantic including the Bay of Biscay and Gulf of Gascony (CHUN, 1888; BIGELOW, 1911a; LELOUP, 1933), in the South Atlantic and Subantarctic (LELOUP, 1934; LELOUP and HENTSCHEL, 1935; HARDY and GUNTHER, 1935), off the Great Barrier Reef, Australia (TOTTON, 1932, RUSSELL and COLMAN, 1935), in the Malaysian region (LENS and VAN RIEMSDIJK, 1908), and in the Northwestern and Eastern Tropical Pacific (BIGELOW, 1911b; 1913). Originally described from the Straits of Gibraltar (QUOY and GAIMARD, 1827), it has often been listed from the Mediterranean under one or another of its several synonyms (p. 11). But the only Mediterranean records, the specific identity of which is definitely established by diagnostic descriptions or illustrations of specimens taken are:—

Nice — VOGT (1851, 1854);

Messina — KÖLLIKER (1853), KEFERSTEIN and EHLLERS (1861).

And this species has so often been confused with *R. cymbiformis* that it is not wise to base geographic discussion on the older locality records, unless so supported.

The two "Thor" records, respectively 9 and 8 nectophores per hour, were from the Atlantic, near the coasts of Portugal and Spain (Fig. 56).

The fact that the "Thor" did not take it at all in the Mediterranean, in spite of the large amount of towing done there at all depths, shows that it must have been at least very rare there, if present at all, during the winter of 1908—1909 and summer of 1910. Nor do the older records suggest that it is ever as common as its relative *R. cymbiformis*, inside the Straits of Gibraltar.

Vertical Distribution.

Most of the recent captures of this species have been from hauls from considerable depths:— Eastern Pacific, surface, 1 case, 550—0 meters 5 cases (BIGELOW, 1911b); Northwest Pacific, hauls ranging between 366—0 and 2070—0 meters (BIGELOW, 1913); Great Barrier Reef, 80—0 meters (TOTTON, 1932; RUSSELL and COLMAN, 1931); Central and South Atlantic, 2500—0 and 3000—0 meters (LELOUP, 1933); 400—600 meters (LELOUP and HENTSCHEL, 1935); 400—0 and 666—0 meters ("Thor", p. 11); Bay of Biscay, 457—0, 550—0, 640—0, and 350—366 meters (BIGELOW, 1911a). No doubt LELOUP (1933, p. 9) was therefore justified in characterizing it as "mésoplanktonique". Like most other siphonophores of this category, however, it appears at times at the surface: most often perhaps in regions of turbulent circulation like the Straits of Gibraltar (where it was originally found floating at the surface by QUOY and GAIMARD, 1827) and in the Straits of Messina.

Nothing is yet known of its relative abundance at different times of year, or of its breeding season.

HIPPOPODIUS HIPPOPUS Forskål (p. 14).
Fig. 57.

Horizontal Distribution.

Hippopodius hippocampus is well known from all the warmer oceans (see MOSER, 1925 for a summary of its distribution). It was first found in the Mediterranean, and has since been reported there at the following localities:—

Mentone — PAGENSTECHER (1869);

Nice — VERANY (1846), VOGT (1851, 1854), LEUCKART (1853, 1854), MÜNTER (1912);

Straits of Gibraltar — QUOY and GAIMARD (1827);
 Capri — LO BIANCO (1903);
 Naples — OTTO (1823), DELLE CHIAJE (1828), O. G. COSTA (1836), SARS (1857), KEFERSTEIN and EHLERS (1861), SPAGNOLINI (1868, 1870), PAVESI (1869 . . .), DÖNITZ (1871), P. E. MÜLLER (1871), SCHMIDTLEIN (1880), BEDOT (1882), WEISMANN (1883), KOROTNEFF (1884), SCHNEIDER (1898), LO BIANCO (1899), RICHTER (1907), MÜNTER (1912), CHUN (1913), NEPPI (1921), MOSER (1923);
 Villefranche — VOGT (1851), GRAEFFE (1860), METSCHNIKOFF (1874), RICHTER (1907), MÜNTER (1912), MOSER (1923, 1925), LELoup (1935);
 Genoa — VERANY (1846);
 Sicily — DONITZ (1871);
 Messina — KÖLLIKER (1853), GEGENBAUR (1854), SARS (1857), KEFERSTEIN and EHLERS (1861), CLAUS (1863), CIALONA (1901);
 Western Basin — LELoup (1933, 7 stations).

Being already so widely recorded, it was not surprising to find it at 75% of all the "Thor" stations in the Mediterranean (winter and summer) where tows were made at 43 meters or deeper, except in the Sea of Marmora and the Dardanelles region, where it was not encountered at all. In the Atlantic it was taken at 8 stations in the Bay of Cadiz and off Cape St. Vincent and at 1 station in the Bay of Biscay (or 22% of the Atlantic stations) (Fig. 57).

Separation by localities and seasons shows it at 65% of the western basin stations, and 79% of the eastern basin stations in summer. In winter, it was taken at 80% of the 30 stations in the western basin, but only at 2 of the 8 stations in the eastern basin. But with so few stations in this last group, it is doubtful whether such an apparent paucity was anything more than accidental. The chart shows that (with the exception just noted) there was no regional concentration of the stations where the nets failed to take it, or the reverse.

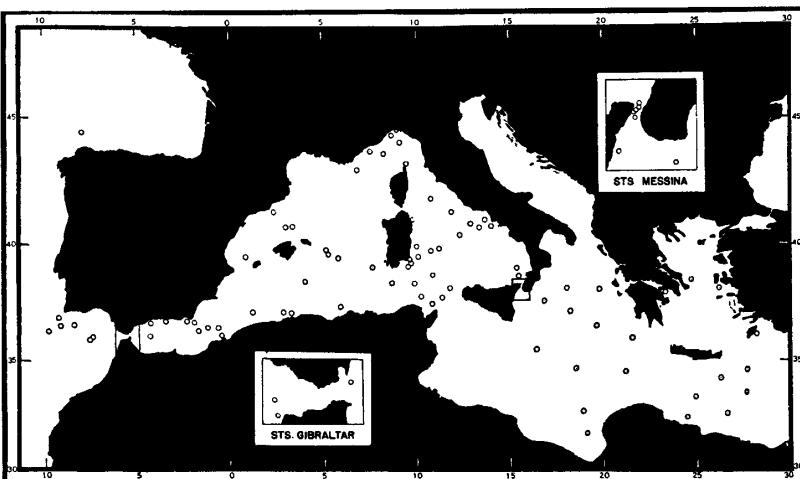


Fig. 57. "Thor" captures of *Hippopodius hippocampus*.

Vertical Distribution.

It has long been known that *H. hippocampus* often appears right up to the surface, wherever it has been taken with any frequency, whether in the Mediterranean, or on the high seas. At Naples, according to CHUN (1887, p. 13) it disappears from the surface at the beginning of summer. But few precise data exist as to its distribution downward, the records of colonies or of adult nectophores (other than those for the surface) having all been from open net hauls, except that one adult bell was taken by the "Meteor" in a closing net between 50 and 100 meters (LELOUP, 1934, p. 5) and that CHUN (1887, p. 13) reports occasional bells, in closing nets, down to 1200 meters.

The "Thor" catches of *Hippopodius* consist for the most part of loose nectophores, which may or may not have been connected when picked up by the net. Hence, — there being no way of knowing how many

colonies may be represented in any given catch — the data do not afford as satisfactory a basis for analysis of vertical distribution, as they do for the diphyids, where the number of colonies is given by the number of superior nectophores.

In a rough way, however, the relative number of loose bells gives at least a rough indication of relative abundance, for it is obvious that a large number of nectophores represents more colonies than does a catch of only 3 or 4, which may all have come from a single colony. And *Hippopodius* bells are so large that one can be certain the samples contain at least the great majority of all that lay in the paths of the nets.¹

At the 26 winter stations where taken in the Mediterranean (western and eastern basins combined) the average number of nectophores caught per hour (uncorrected) in hauls sent to different depths was as follows (Table 1), assuming all the catches to have been taken in the horizontal parts of the tows.

Table 1.

Depth	No. of hauls	Extreme catches per hour	Mean catch per hour
16	14	0—108	14
43	22	0—90	19
200	14	0—300	34
333 + 400	6	0—7	2
666	4	0—5	1
> 800	9	0—3	< 1

Hauls from June up to mid-August, show much this same type of vertical distribution, i. e., one of comparative uniformity down to 200 meters, but few or none at greater depths, as follows (Table 2).

But by August 21—September 7, when the "Thor" returned to the western basin, the catch per hour (uncorrected) was about 4 times as great in the 16 meter hauls (13 hauls, average uncorrected catch per hour, 24; maximum, 122) as in the 200 meter hauls (8 hauls, average uncorrected catch per hour, 6; maximum, 36), suggesting a seasonal alternation, between comparatively uniform distribution down to 200 meters from winter through early summer, and a preponderance in the upper strata in the late summer and early autumn. This, however, throws no light on the presence or absence of *Hippopodius* at the surface at different seasons, our only precise information on this point being CHUN's (1887, p. 13) statement that near Naples, it "mit Beginn des Sommers von der Oberfläche verschwindet".

The Atlantic catches (104 nectophores, from 14 hauls, varying between 16—0 and 1066—0 meters) were too scattered for calculation of relative numbers at different depths. But since 881 of the nectophores were caught in hauls not deeper than 200 meters, it seems that distribution was essentially the same there as in the Mediterranean, i. e. concentrated chiefly in the upper 200 meter stratum.

Breeding Season.

The larvae of this species have been found near Naples by CHUN (1913) in August and September; in the Bay of Biscay in July (BIGELOW, 1911a); at various Atlantic stations between Latitudes 0° and 18° N. in December, March, April, and October, and in the South Atlantic, south to 48° S., in December, May, July, August, and October (LELOUP and HENTSCHEL, 1935), a distribution wide enough to suggest that

¹ The only error, on this score, would be the failure of the nets to filter completely, which is not serious with mesh as large as was used on the "Thor".

Table 2.

Depth	No. of hauls at stations where taken	Extreme catches per hour uncorrected	Mean catch per hour uncorrected
16	20	0—44	9
43	11	0—24	6
200	26	0—48	10
400	5	0—18	4
666	8	0—12	3
800	2	0—5	2
1333	4	0	0

Hippopodius reproduces more or less throughout the year, wherever it is a year-round resident¹. This accords with the fact that the "Thor" tows do not show any great seasonal variation in abundance for the Mediterranean. At most, somewhat larger catches, both mean and maximal, in winter than in summer or in early autumn, may point to somewhat more active multiplication in autumn than at other times of year².

MOSER (1925, p. 413), judging from the depth-distribution of the larvae taken by the "Gauss", and by the "Research" in the Bay of Biscay (BIGELOW, 1911a), concluded that the young stages, like the grown colonies "unterschiedslos Tiefe und Oberfläche bewohnt". The fact that the depth distribution of 10 larvae obtained by the "Meteor" (LELOUP, 1934, p. 5) includes a haul as shoal as 50—0 meters and also a closing net haul as deep as 600—400 meters points similarly to a wide vertical range. Neither do the "Thor" records suggest any tendency for larvae of *Hippopodius* either to rise toward the surface (as do the young of various other siphonophores) or to concentrate at any particular level, the distribution of adults being nearly uniform vertically throughout the depth zone of regular occurrence, i. e., down to about 200 meters.

The fact that the material consists for the most part of loose nectophores prevents any estimate of absolute abundance of colonies. The largest catch was at the rate of 380 nectophores per hour, or 342 per 5000 cubic meters. According to CHUN (1887, p. 13) this is one of the more common siphonophores off Naples.

VOGTIA GLABRA Bigelow (p. 17).

Fig. 58.

Distribution.

This species, originally described from the Straits of Florida (BIGELOW, 1918), has subsequently been taken in the eastern side of the Temperate Atlantic between the Azores, Canaries, and coast of Portugal and Gulf of Gascony, and at one station in the western Mediterranean near Monaco (LELOUP, 1933). It has never been reported from the other oceans, but it is likely eventually to prove as widespread as other members of its genus are known to be. One "Thor" catch (St. 186) shows that its Mediterranean range extends to the eastern basin. The others are from parts of the Atlantic where LELOUP's (1933) records had already revealed its existence. It seems that *V. glabra*, like other Vogtias, is bathypelagic, all the recorded captures having been made in open hauls from 200 meters or deeper (mostly from hauls deeper than 400 meters) except for one "Thor" catch from 43 meters (St. 69) (Fig. 58).

LELOUP's (1933) records cover the months of April, August, and September, the "Thor" records, February, March, June, and August, enough to show that it is to be expected at any time of year. Further than this nothing can yet be said as to relative seasonal abundance, or other phases in its life history.

This is no evidence that this species is ever abundant; the largest "Thor" catch was at the rate of 72 nectophores per 5000 cubic meters of water.

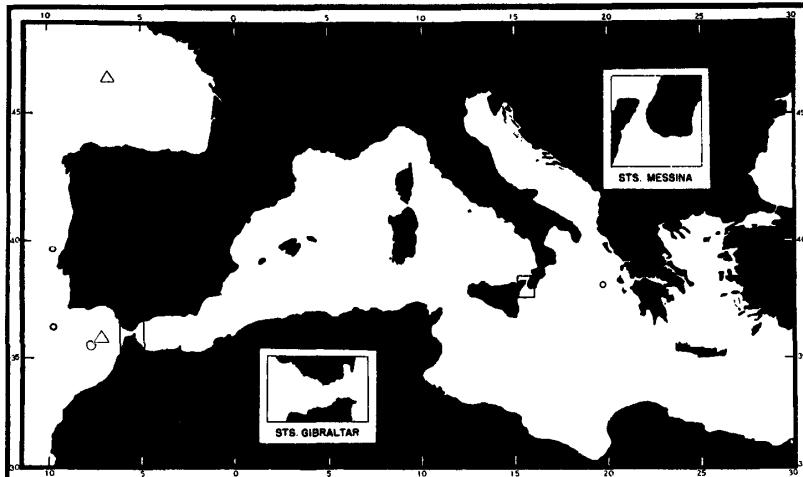


Fig. 58. "Thor" captures of *Vogtia glabra* (circles) and *Vogtia serrata* (triangles).

¹ This would not refer to localities where it may appear in summer only, with the vernal expansions of warm currents.

² LELOUP (1935) records it as common in the plankton at Villefranche during the winter and spring (March—May).

VOGTIA PENTACANTHA Kölliker (p. 18).

Fig. 59.

Horizontal Distribution.

Earlier records of *Vogtia* which can be assigned definitely to *pentacantha* as defined above (p. 18) are confined to the Mediterranean (Naples, Villefranche, and Messina, KÖLLIKER, 1853; GEGENBAUR, 1854; KEFERSTEIN and EHRLERS, 1861; CLAUS, 1863; MOSER, 1923, 1925; LELoup, 1935), the North Equatorial Atlantic current (CHUN, 1897), the Straits of Florida (BIGELOW, 1918), the Bay of Biscay (BIGELOW, 1911 a), and to the Tropical Indian Ocean (BROWNE, 1926). Although the total number of specimens so far seen is very small, this species is evidently widespread, as are the other siphonophores of the mid-depths. The "Thor" records (p. 18) of positive identity (Fig. 59) extend its known range over the western basin of the Mediterranean, and to the southern side of

the eastern basin, showing that it probably occurs generally throughout the Mediterranean, in the deeper strata. And addition of the locality records for nectophores of somewhat doubtful identity would include the Straits of Messina (type locality for the species), likewise the northern side of the eastern basin (St. 160). But there is no evidence so far, that any centers of local abundance ever develop for it within the Mediterranean, for the older accounts were all based on scattering individuals. Thus KEFERSTEIN and EHRLERS (1861) mention a maximum of 4 colonies in

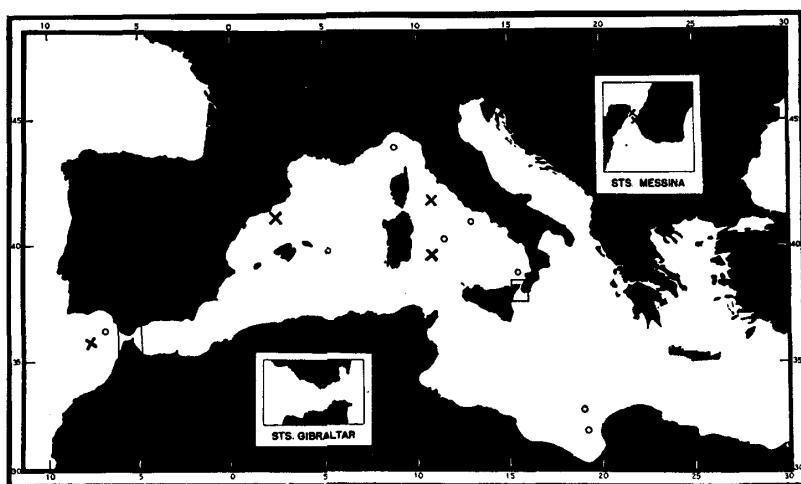


Fig. 59. "Thor" captures of *Vogtia pentacantha*, positive identification marked by circles; less certain identifications by crosses.

one day, while the largest "Thor" catch of 14 loose nectophores (St. 122) could be explained by the fragmentation of not more than two or three colonies. In this its Mediterranean status corresponds to that of *V. spinosa* (p. 82). But lacking evidence of any richer population outside the Straits of Gibraltar, it is as likely that the sparse population inside the Straits is supplied by local production as that it draws from immigration from the Atlantic. The vertical distribution of the species argues in fact, against the latter possibility.

The old records for Messina (September, October, November, December, January, March, and April) cover the part of the year through which KÖLLIKER (1853), GEGENBAUR (1854), KEFERSTEIN and EHRLERS (1861), and CLAUS (1863) carried on their studies there. Addition to the foregoing of the "Thor" catches (1 in January, 2 in March, 1 in June, 6 in July, 7 in August) shows that it is present in the Mediterranean the year round, with no apparent predominance at any particular season.

Vertical Distribution.

Previous depth records for *V. pentacantha* fall into two groups; a) the early records from Messina which were from the surface; and b) all the subsequent captures, which have invariably been in hauls reaching down to 400 meters or deeper. All the positive "Thor" records were also from hauls from 200 meters or deeper; also most of the doubtful records, the only exception being 2 catches in 26 meter tows in the Straits of Messina. This corroborates MOSER's (1925, p. 418) characterization of it as a "Tiefseeform". The only locality where

it has been known to rise close to the surface is the Straits of Messina¹; no doubt it is brought up there by the turbulent currents, as are various other bathypelagic animals. The vertical distribution of the "Thor" catches in the Mediterranean, including the doubtful examples, is as follows, assuming (as in the case of *V. spinosa*, p. 82) that the entire catch was made in the horizontal part of the haul, in each case, i. e. without correction (Table 3).

It is not possible to calculate the probable contamination of the individual hauls, because *V. pentacantha* was caught in only one haul at each of the stations where it was taken. And to base such a correction on average catches for the several depths might not be significant. But the fact that the catches were so small and the records so few in hauls from less than 600 meters, is evidence that the majority of the deeper catches were actually made in the horizontal parts of the tows, or at least near the indicated depths. The tabulation thus affords strong evidence that in summer the greater part of the stock of this species in the Mediterranean lives deeper than 400 meters, but that it is less numerous again below 1000 meters or so. The one Atlantic record was also deep — 8 nectophores for an 800 meter-haul (St. 66).

Table 3.

Depth	No. of hauls at stations where taken	Extreme catches per hour	Nectophores per hour	% of hauls taking the nectophores
16	11	0	0	0
26	7	0—9	1	42
43	5	0	0	0
200	8	0—1	1	12
400	7	0—8	1	14
666	6	0—112	27	83
800	3	4—54	16	100
933	1	49	49	100
1066	3	6—19	12	100
1333	1	12	12	100

Breeding Season and Depth, and Abundance.

Larval bells of this species have not yet been seen. Neither are the recorded captures numerous enough to throw much light on the relative abundance at different seasons. The presence of small numbers in the Mediterranean, winter as well as summer (p. 18), but never, it seems, of large numbers there at any season, suggests that reproduction takes place more or less evenly throughout the year. And the fact that it is only in exceptional localities, e. g., Straits of Messina, that this species ever appears at the surface is evidence that larval stages like the adult life are passed in deep water.

Judging from a maximum catch of 112 nectophores per hour (101 per 5000 cubic meters), this species is somewhat more abundant in the regions covered, than is *V. spinosa* (p. 82).

VOGTIA SERRATA Moser (p. 19).

Fig. 58.

Distribution.

It is probable that this is the most widespread *Vogtia*, for while it was only in 1925 that MOSER pointed out its distinguishing characters as a new species, its range (including older records definitely referable to it) is already known to include the eastern side of the Atlantic generally, from the Gulf of Gascony and between the Azores and Canaries, south to Latitude 53° S. (MOSER, 1925; LELOUP, 1933; HARDY and GUNTHER, 1935), the Subantarctic (MOSER, 1925), Tropical Indian Ocean (Madagascar, MOSER, 1925), Sea of Okhotsk, Northwestern Pacific and the Eastern Tropical Pacific (BIGELOW, 1913, 1931). MOSER's (1925, p. 421) characterization of it as "Kosmopolit im weitesten Sinne des Wortes" was therefore fully justified, for the open oceans. But it is still uncertain whether or not, it occurs in the Mediterranean, for it is not clear whether MOSER's (1925, p. 409) mention of 2 specimens from Monaco refers to this species or to *V. pentacantha*.

¹ LELOUP (1935, p. 6) records it as rising to the surface in the harbor of Villefranche where bathypelagic animals regularly occur (LELOUP 1935, p. 1).

The failure of the "Thor" to take it in the Mediterranean may have been only accidental in view of the fact that it was taken only at two stations in all. One of these in the Bay of Cadiz (St. 65) lies well within the latitudinal limits covered by earlier records. The other (St. 242, Lat. $46^{\circ}19'N.$) extends its known range somewhat farther north (Fig. 58). The depth of the two "Thor" hauls (1066 meters and 2900 meters) is in line with earlier information to the effect that this species usually lives at considerable depths, though occasionally appearing at the surface (MOSER, 1925, p. 421).

VOGTIA SPINOSA Keferstein and Ehlers (p. 18).

Fig. 60.

Horizontal Distribution.

Previous records for this species, the type locality of which is off the coast of Brazil (KEFERSTEIN and EHLERS, 1861), are the Eastern Tropical Pacific (BIGELOW, 1911b; 1931), coast of California (BIGELOW and LESLIE, 1930), South Atlantic (HAECKEL, 1888; MOSER, 1925), and the Eastern North Atlantic, near the Azores, off Spain, and in the Bay of Biscay (BIGELOW, 1911a; LELOUP, 1933). Captures by the "Thor" at 4 stations in the Bay of Cadiz, 3 stations along the coasts of Portugal and Spain, and one station in the Bay of Biscay call for no comment. There was no previous report of it in the Mediterranean. The "Thor" series of loose nectophores (p. 18) shows that actually it is sparsely distributed there, both in the western basin (5 stations) and in

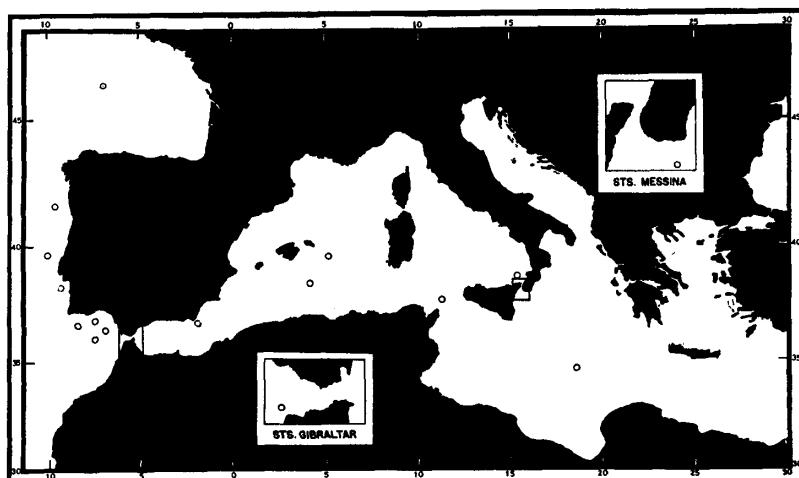


Fig. 60. "Thor" captures of *Vogtia spinosa*.

the eastern basin (2 stations) though not yet found in the tributaries of the latter (Fig. 60). But since the largest catch of nectophores¹ probably did not represent more than 3–5 colonies, there is no evidence of any center of abundance for it, or for a sustained production, within the Mediterranean. This makes it likely that the continued presence there of *spinosa* may be largely dependant on occasional immigration via the Straits of Gibraltar, even though the normally bathypelagic nature of this species suggests that it must be a rare event for any large number to rise to within the sweep of the inflowing current. Its failure to appear in earlier collections from the Mediterranean was no doubt due in part to actual scarcity, but more to the fact that it rarely rises to the upper water layers.

Vertical Distribution.

MOSER (1925, p. 420) has already emphasized the fact that 3 only, of the captures of *spinosa* up to that time, had been from the surface. Those by the "Arcturus" were in open hauls from 250—0, 1274—0, 545—0, and 272—0 meters (BIGELOW, 1931); LELOUP's (1933) records were in open hauls from 1000 and 5000 meters; and the shoalest capture by the "Thor" was in a haul with 500 meters of wire out. Successive

¹ Loose nectophores alone were taken.

proof has thus accumulated that this is a bathypelagic species confined chiefly to depths greater than 300—400 meters.

If it be assumed that the whole of the catch was taken in each case in the horizontal part of the tow (i. e., that none at all were picked up by the net on its way down or up), the mean catch per hour at Atlantic and Mediterranean stations where it occurred, combined, was as follows (Table 4).

Six nectophores were also taken in an hours tow to 3875 meters (4350 m. wire) with a different net. Bearing in mind the strong probability that part of the catches in the deeper hauls were actually made at depths smaller than those listed, above, and that this probability increases with increasing depth, the foregoing suggests somewhat greater abundance (or at least more regular occurrence) between 300 and 500 meters than deeper. The data are not sufficient to show the relative vertical abundance deeper than the 400 meter level, first because neither the number of catches, nor the number of nectophores caught was large enough, secondly, because *spinosa* was caught in one haul only at most of the stations (see list of Material, p. 18). There may have been occasional nectophores down to the greatest depth explored.

Separation of the Atlantic catches from the Mediterranean shows the situation to have been about the same in this respect for the sparser population inside the straits, as for the more abundant stock outside (Table 5).

Table 4.

Depth	No. of hauls	Extreme catches per hour	Nectophores per hour	% of hauls with nectophores
16	15	0	0	0
43	10	0	0	0
200	15	0	0	0
333	1	14	14	100
400	5	1—22	9	100
533	2	10—25	17	100
666	4	6—30	13	100
800	3	1—4	1	66
1066	2	8	4	50
1333	2	2—3	3	100

Table 5.

Depth	Catch of Nectophores (uncorrected) per hour			
	Atlantic		Mediterranean	
	Tows at stations where taken	Catch per hour	Tows at stations where taken	Catch per hour
16	6	0	7	0
43	7	0	3	0
200	7	0	7	0
333	1	14	—	—
400	5	73	—	—
533	1	30	1	25
666	2	18	3	11
800	—	—	2	3
1066	2	17	—	—
1333	—	—	3	7

Seasonal Variation.

V. spinosa was taken in the Atlantic on both the summer and the winter cruises, catches for the two seasons being of the same general order of magnitude. The Mediterranean captures, on the contrary were confined to the summer cruises. But it is not safe to generalize, as to seasonal occurrence, from comparison of summer data for one year with winter data for another, in the case of an animal as sparsely represented as *V. spinosa* was.

An average catch, at the most productive depth of only about 15 nectophores — or perhaps 2—3 colonies — per hour and a maximum of only 50 nectophores per hour, show that *V. spinosa* was one of the less abundant species.

VOGTIA species? (p. 19).

Horizontal Distribution.

Station records for nectophores of *Vogtia* too damaged for specific identification, corroborate the evidence set forth under the several species (p. 79, 80, 81, 82) that the genus is widespread throughout the western basin, and in the neighboring side of the eastern basin, but perhaps not farther east.

Vertical Distribution.

The vertical distribution of the catches (Atlantic and Mediterranean combined) at different levels at the stations where such nectophores were taken, was as follows (Table 6), assuming the whole catch to have been made in the horizontal part of the haul in each case.

Table 6.

Depth	No. hauls	Total nectophores	Total No. of nectophores per hour	% of hauls taking nectophores
16	23	7	1	8
43	12	4	1	8
200	24	9	1	12
400	8	87	11	100
666	10	61	9	60
800	3	41	20	66
1066	4	6	1	50
1333	5	5	1	20
2666	3	6	2	66

This analysis corroborates the evidence for the separate species that *Vogtia*, as a whole, is most numerous and occurs most regularly at considerable depths, only rarely in the upper 200 meters.

ENNEAGONUM HYALINUM Quoy and Gaimard (p. 20).

Fig. 61.

Horizontal Distribution.

Enneagonum hyalinum is widely distributed in warm waters:— Temperate Atlantic

(CHUN, 1888, 1897a; HAECKEL, 1888b); Eastern Tropical Pacific (BIGELOW, 1911b); Philippine waters (BIGELOW, 1919); Malaysian region (LENS and VAN RIEMSDIJK, 1908); Great Barrier Reef of Australia (TOTTON, 1932; RUSSELL and COLMAN, 1935); east of Australia and coast of New Guinea (HUXLEY, 1859); Indian Ocean (BROWNE, 1926).

Though originally described from the Straits of Gibraltar and found by the early investigators in neighboring Atlantic waters, it is only within the last few years that it has been recorded from the Mediterranean proper, the Prince of Monaco (LELOUP, 1933) having taken it at 9 stations, all between the Balearic Islands and the eastern portion of the Alboran Sea. The "Thor" captured it, often in quantity, in the Alboran

Sea and along the northern coast of Africa as far east as the west coast of Sardinia (Fig. 61). In this sector, to the west of Longitude 5° E., and south of Lat. 38°30' N., it was taken at 8 out of 11 "Thor" winter stations where hauls were made at 43 meters or deeper, and at 10 out of 16 such summer stations, the records of capture (71% of the "Thor" stations) being very generally distributed. But it was found at only three stations elsewhere in the western basin, and not at all in the eastern.

Extending the survey to the Atlantic, we find *E. hyalinum*

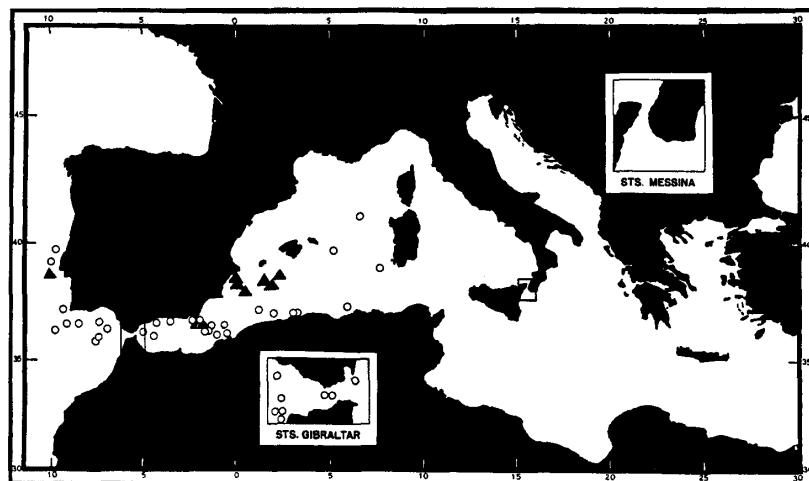


Fig. 61. Captures of *Enneagonum hyalinum* by the "Thor" (circles) and on the cruises of the Prince of Monaco (black triangles, data from LELOUP, 1933).

represented at 8 out of 9 winter stations (where hauls were made at 43 meters or deeper) in the Bay of Cadiz, along the coast of Portugal, and northward to Lat. 39°35' N.; at 7 out of 8 such stations there in June, and at 2 out of 4 stations in September; but not farther north. It was thus as nearly universal in this general region in winter and early summer as in the extreme western part of the Mediterranean, and may

have been equally so in September, when only a few hauls were made. But there was a decided contrast in abundance between catches made outside and inside the Straits, for, whereas the richest catches (corrected) in the Bay of Cadiz or Atlantic were at the rates of only about 17 nectophores per hour in February (St. 63), about 10 per hour in June (St. 95), and about 3 per hour in September, maxima inside the Mediterranean were 241 and 376 per hour for winter (Sts. 50, 59), 204 and 207 per hour in June (Sts. 99, 112), and 70 per hour in September (St. 222).

This picture of a more abundant population just inside the Straits than just outside, combined with the fact that this species is most plentiful at depths of 43 meters and deeper (p. 86), points to the existence at the time of the "Thor"

cruises of a center of production in the western Mediterranean, contributing perhaps to the Bay of Cadiz via the deep outflowing current. Certainly there is no indication of any considerable or continuing immigration in the opposite direction, i. e., inward through the Straits, else we should expect to find *Enneagonum* distributed eastward, and more abundantly, along the axis of the inflowing current in the southern side

of the western basin than on the Spanish side (cf. Fig. 61). However, the lack of any apparent feature in hydrography to explain the rather definite western boundary to its area of occurrence suggests that the presence of this species in the Mediterranean, at all, depends on occasional incursions of specimens caught up in the inflowing upper current. Once within the Straits these appear to find conditions more suitable for reproduction there than outside, as indicated by the fact that much larger numbers of eudoxoids and of detached gonophores were taken at the stations inside the Mediterranean than in the Bay of Cadiz or neighboring stations in the Atlantic as just noted (p. 84), the contrast being shown for the average catches in Table 7.

Table 7.

Depth	No. of cases	Mean no. of eudoxoids outside Mediterranean corrected, per hour	No. of cases	Mean no. of eudoxoids inside Mediterranean corrected, per hour
16	18	2	5	115
43	12	1	7	44
66 + 133 + 200	9	9	7	157
333 + 400 + 533	6	6	2	86

Table 8.

Depth	No. of hauls	No. of colonies per hour		No. of eudoxoids per hour	
		Extreme ¹	Mean	Extreme	Mean
1. Summer and winter combined.					
16	20	0—78	5	0—442	28
43 + 66	26	0—376	24	0—581	37
133 + 200	27	0—207	19	0—318	31
333 + 400 + 533	10	0—241	41	0—126	34
666 + 800	6	0—51	15	0—104	13
1066 + 1333	10	0—1	< 1	0—9	1
2. Winter only.					
16	10	0—78	8	0—442	51
43 + 66	14	0—376	27	0—581	50
133 + 200	10	0—66	12	0—68	15
333 + 400 + 533	10	0—241	41	0—126	34
666 + 800	2	2—36	19	0—7	3
1066 + 1333	2	0	0	0	0
3. June—September only.					
16	10	0—4	1	0	0
43	12	0—204	19	0—204	18
200	17	0—207	26	0—318	41
333 + 400 + 533	—	—	—	—	—
666 + 800	4	0—51	14	0—104	26
1066 + 1333	8	0—1	< 1	0—9	0

¹ In this calculation, 0 includes both cases where none at all were taken, and also the cases where the calculated contamination more than equalled the total catch, as explained on page 69. And this applies to all similar calculations in the following pages.

it on the high seas, do not support the supposition advanced by p. 271) that it is a coastal species.

Its status in the Mediterranean, combined with RUSSELL and COLMAN's (1935, p. 259) report of it in the Lagoon on the Great Barrier Reef at the time of year when salinity is as low as 33‰ or 34‰, shows that *Enneagonum* is able to survive a wide range, in this respect. But the "Thor" data combined with records of

Vertical Distribution.

Catches per hour (corrected) at the 38 stations (both inside and outside the Straits of Gibraltar), where the species was taken, and where deep as well as shoal hauls were made, were as shown in Table 8.

According to this tabulation, colonies were decidedly less abundant in the upper 16 meters than at greater depths, winter as well as summer; this also applied to the eudoxids during the summer and early autumn, when they were not taken at all in the shallowest hauls. But in winter, eudoxids were most numerous in the upper 16—60 meters.

Further evidence as to regularity of occurrence as well as to relative abundance is afforded by the following tabulations a) of the relative frequency with which the hauls at different levels took it or missed it, and b) of the relative frequency with which the maximum catches at stations where the species occurred, were made in hauls from different depths.

Table 9. a) Hauls taking and failing to take *Enneagonum* at stations where it occurred at any level, and where both shoal and deep hauls were made.

Depth	Total number of hauls	% of hauls in which it occurred
16	20	30
43 + 66	26	46
133 + 200	27	77
333 + 400 + 533	10	70
666 + 800	6	83
1066 + 1333	10	20

Table 9. b) Relative frequency with which the maximum catches were made at different levels, at stations where the species occurred at any level and where both shoal and deep hauls were made.

Depth	Total No. of hauls	No. of cases in which maximum catch occurred at this level	% of cases in which the maximum catch occurred at this level
16	20	3	15
43 + 66	26	8	30
133 + 200	27	16	58
333 + 400 + 533	10	5	50
666 + 800	6	3	50
1066 + 1333	10	1	10

Thus, whether judged by the mean catches per hour at the various levels, by the relative frequency with which the largest catches were made at the different levels, or by the frequency with which the species was taken at a given level, the "Thor" data show *E. hyalinum* as increasing in abundance, from near the surface downward.

Atlantic and Mediterranean catches, tabulated separately (below) show maximum abundance at about 100—500 meters, whether outside the straits, or inside. The Atlantic data then suggest an abrupt decrease, with increasing depth, whereas the Mediterranean catches do not show this decline until a depth of 800 meters was reached (Table 10).

Table 10.

Depth	Atlantic				Mediterranean		
	No. cases	Catch per hr. corrected		No. cases	Catch per hr. corrected		
		Nectophores	Eudoxids		Nectophores	Eudoxids	
16	10	2	8	10	9	49	
43 + 66	12	<1	<1	14	44	64	
133 + 200	12	4	7	15	34	51	
333 + 400 + 533	6	6	6	4	96	77	
666 + 800	4	<1	0	3	30	37	
1066 + 1333	3	<1	1	7	0	1	

many other captures of it have been made in open hauls from considerable depths (BIGELOW, 1911b, 1931; MOSER, 1925; LELOUP, 1933); one in a closing net from 1000—1200 meters (CHUN, 1897).

This wide range accords with previous data, for while there are numerous records of its colonies and eudoxids at the surface, or shoaler than 100 meters (QUOY & GAIMARD, 1827; HUXLEY, 1859; HAUCKEL 1888b; CHUN, 1892; BIGELOW, 1911b, 1918; LELOUP 1934),

Seasonal Variations in Abundance.

The seasonal distribution of catches was as follows (Table 12). By these data, *Enneagonum* is about as plentiful in winter as in early summer in the Atlantic, as well as in the Mediterranean, but somewhat less plentiful in early autumn than in June.

Table 11.

Reproduction.

a) Season. The captures of eudoxids at most of the stations where colonies were taken, Atlantic and Mediterranean, whether winter or summer, also at several stations which yielded no colonies, is sufficient proof that the species breeds to some extent throughout the periods of

	Number of stations where taken	Number of colonies per hour corrected		Number of eudoxids per hour corrected	
		Mean	Maximum	Mean	Maximum
Mediterranean					
Winter	10	36	376	69	581
June	7	30	207	50	318
September	5	7	70	13	100
Atlantic					
Winter	8	3	17	3	43
June	7	3	16	2	11
September	2	<1	3	0	0

the year covered by the "Thor" cruises. And as the catches, whether of colonies or eudoxids, were of about the same orders of magnitude in June as in winter, it appears that production continues about equally active through the winter and early summer. But the falling off, in the numbers of colonies and eudoxids between June and September (p. 85) suggests that production slackens during the late summer and early autumn; perhaps it is entirely interrupted during the later autumn.

b) Depth. The vertical distribution of the eudoxids shown by the tabulation on p. 85, is evidence that reproduction takes place at one time or another throughout the whole depth stratum where colonies of the species occur in significant numbers, i. e., from close to the surface down to at least 600—700 meters. The fact that eudoxids were taken as abundantly close up to the surface in winter as at greater depths, but were not taken at all in the shoalest summer hauls, suggests that it is only in the cold season that the upper 20 meters or so serve as a nursery for it in these latitudes.

Maximum abundance.

The richest catches (corrected) were at the rate of 376 colonies, and 581 eudoxids per hour (338 and 522 per 5000 cubic meters respectively).

ABYLOPSIS TETRAGONA Otto (p. 23).

Fig. 62—64.

Horizontal Distribution.

Abylopsis tetragona is common throughout the warmer zones of the oceans (see MOSER, 1925). There are many locality records from the Mediterranean, particularly in the western basin, as follows:—

Straits of Gibraltar — QUOY and GAIMARD (1827), ESCHSCHOLTZ (1829), GEGENBAUR (1860);
 Malaga — BUSCH (1851);
 Western basin — LELoup (1933, 37 stations);
 Villefranche — VOGT (1854), LOCHMAN (1914), LELoup (1935);
 Nice — VERANY (1846), VOGT (1854), LEUCKART (1853, 1854), GRAEFFE (1860);
 Naples — DELLE CHIAJE (1822), OTTO (1823), O. G. COSTA (1836), GEGENBAUR (1854), SARS (1859), KEFERSTEIN and EHLERS (1861), PAVESI (1869 . . .), SPAGNOLINI (1870), P. E. MÜLLER (1871), SCHMIDT-LEIN (1880), BEDOT (1882), KORETNEFF (1884), CHUN (1885), SCHNEIDER (1898), NEPPI (1921);

Capri — LO BIANCO (1903);
 Messina — KÖLLIKER (1853), GEGENBAUR (1854), SARTORIUS (1857), KEFERSTEIN and EHLERS (1861);
 Adriatic — off Ragusa, Lucietta, in the Pomo basin; Southern basin — MOSER (1917);
 Aegean Sea — FORBES (1844).

With this background, it was no surprise to find *A. tetragona* almost universal along the "Thor's" route in the western basin and Straits of Messina, winter as well as summer (77 out of 88 stations, or 87%), also in the neighboring side of the eastern basin as far east as Longitude 19°30' E. (taken at all 6 stations, Figs. 62, 63).

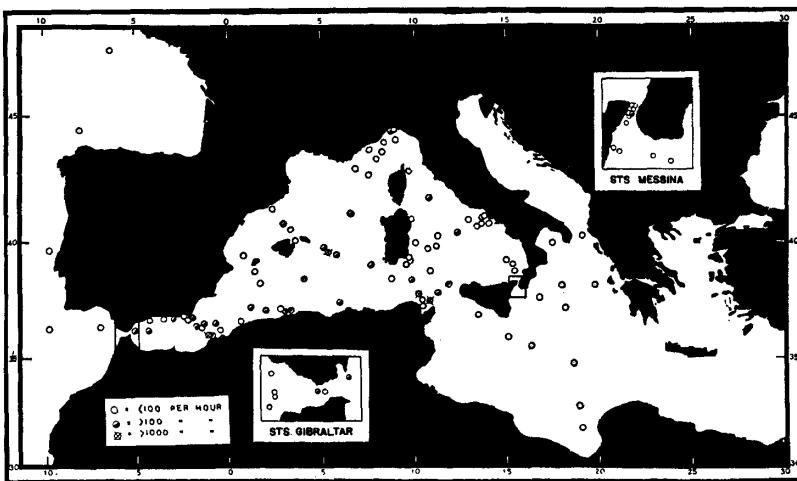


Fig. 62. "Thor" captures of colonies of *Abylopsis tetragona*.

ported a considerably more plentiful stock of *A. tetragona* than the northern, than the eastern half of the Mediterranean, or than the parts of the Atlantic traversed by the "Thor".

Eudoxids, similarly, were taken at stations widely scattered over the western basin, with most of the rich catches in the southern portion (including the Straits of Gibraltar), but at only one station outside the Straits (then only a scattering) and at 6 only in the eastern basin, all in the western part of the latter:— small numbers in each case.

This distribution of colonies and of eudoxids, combined, is good evidence that the population from the Pantellarian Channel westward is maintained by local reproduction independent of immigration from the Atlantic, and that the presence of the species in other parts of the Mediterranean depends largely on dispersal by the current system, from a rich center of production which extends from the Pantellarian Channel westward throughout the southern half of the western basin. But rich production centers may, likewise, develop locally around the northern shores, witness the rich catch of 1443 eudoxids of per hour (corrected) at St. 123, and the early accounts of them at Nice (LEUCKART, 1853), Villefranche (VOGT, 1854), Naples and Messina (GEGENBAUR, 1851; KEFERSTEIN and EHLERS, 1861). Why it is that *A. tetragona* is not carried in significant numbers to the most easterly parts of the Mediterranean is an interesting question to which no obvious answer is to be found in hydrologic conditions.

Vertical Distribution.

An inspection of the list of captures (p. 23) is enough to show that they averaged much larger in the 16 and 43 meter tows than in those from greater depths, i. e., that the species reaches its maximum abundance

¹ In this region there were 6 stations with tows deep enough to have taken it if it had been present in significant numbers.

close to the surface. It has long been clear, however, that the vertical range of the colonies of *A. tetragona* must be wide, for while these have been found in abundance at the surface at many localities in the tropical oceans, as well as in the Mediterranean, they have also been taken so often in deep hauls with open nets as to show that the species must also exist down to very considerable depths. The only previous data allowing calculation of the relative abundance at different levels are the vertical closing net catches by

the "Meteor" expedition (LELOUP and HENTSCHEL, 1935), which show the following distribution with depth, at stations where tows were made at more than one level (Table 12). In the parts of the warm tropical Atlantic traversed by the "Meteor", *A. tetragona* was thus most abundant close to the surface and occurred

with some regularity only down to 100—200 meters, with its lower boundary at perhaps 400—500 meters.

The "Thor" data for the Atlantic, though scanty, suggest a similar concentration close to the surface, the calculated catch of colonies per hour (corrected) being as follows (Table 13), at the stations where the species was taken there.

In the Mediterranean, however, the tabulation (Table 14) shows it as ranging down to a considerably greater depth, and as being perhaps abundant as deep as 300—400 meters as it was near the surface, a regional contrast of the same sort as revealed by the "Thor" data for *Chelophysa appendiculata* (p. 103).

For *A. tetragona*, as for other siphonophores, occasional catches much richer than those at neighboring stations, or than at adjacent levels at the same station, so confuse the picture of vertical distribution that the validity of generalization depends chiefly on the number of data available. For example, the large mean values for the 333 and 400 meter level, for winter, shown in the foregoing table, resulted from very rich catches at two stations, whereas catches at 4 other stations at this level at that season were at the rate of only 0—17 per hour. Similarly, all the winter catches at depths of 666 meters or greater, were 0, except for one at 800 meters of 99 per hour (St. 59); but this one brought the winter average for the deepest hauls up to 14 per hour. And the summer mean for nectophores at this depth would similarly be reduced to 20, by the elimination of one rich catch of 226 per hour at 1333 meters (St. 107). If allowance be made for

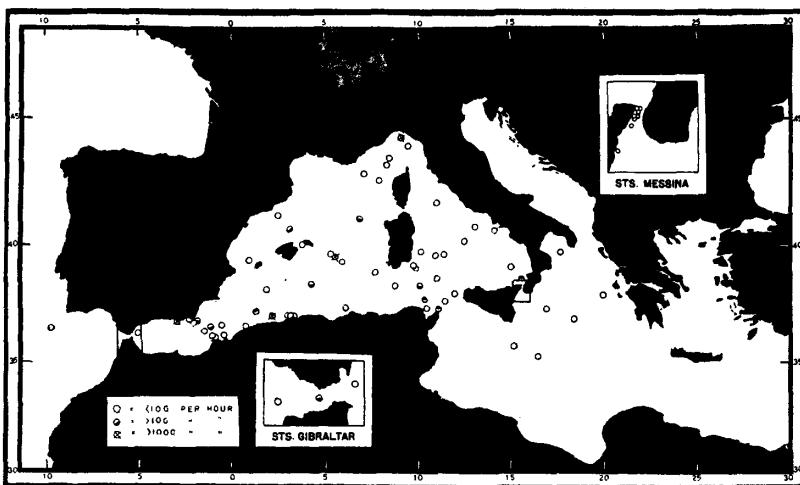


Fig. 63. "Thor" captures of eudoxoids of *Abylopsis tetragona*.

Table 12. "Meteor" catches.

Depth	Meters of towing at stations where taken	Total catches		Mean per 200 meters of towing	
		Colonies & superior nectophores	Eudoxoids and bracts	Colonies & superior nectophores	Eudoxoids and bracts
0—50	400	16	20	8	10
50—100	750	9	9	2.6	2.6
100—200	200	2	2	2.0	2.0
200—400	1200	2	2	0.3	0.3
400—600	600	1	1	0.3	0.0
>600	2000	0	0	0.0	0.0

Table 13.

Depth	No. of tows	Average catch per hour
16	6	6
43	5	3
200	5	1
400	5	2
1066	1	0

Table 14.

Depth	No. of hauls at stations where taken	Colonies per hour corrected			Eudoxids per hour corrected		
		Extremes	Mean	% of hauls taking <i>tetragona</i>	Extremes	Mean	% of hauls taking <i>tetragona</i>
Winter — Western basin.							
16	13	0— 470	80	77	0— 100	10	23
43	14	0— 396	46	50	0— 48	4	36
133 + 200 + 266	19	0— 185	17	60	0— 16	1	27
333 + 400	6	0— 555	171	67	0— 2	1	17
666	3	0	0	0	0	0	0
>666	5	0— 19	19	20	0	0	0
Summer — Western basin.							
16	29	0—1660	202	83	0—1092	149	76
43	10	0—1690	261	90	0—2109	529	90
200	30	0— 740	109	80	0— 133	16	44
400	5	0— 140	50	40	0— 0	0	0
666	8	0— 141	31	50	0— 11	1	25
>666	9	0— 226	36	44	0	0	0

such irregularities, it appears that while the nectophores of this species certainly occur in some numbers down to the deepest levels sampled by the "Thor", they usually averaged more numerous above than below

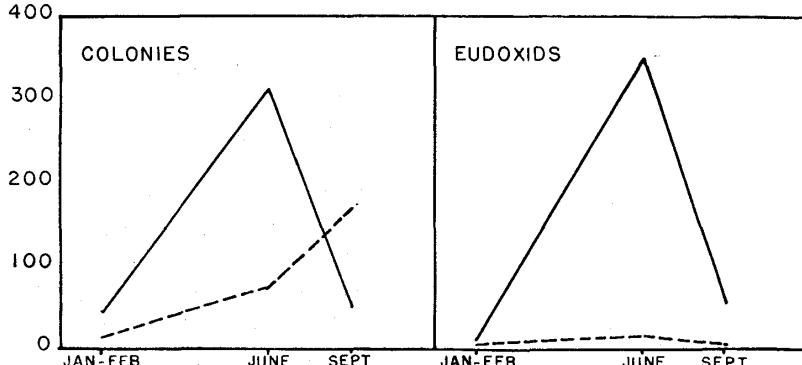


Fig. 64. Seasonal variation in vertical distribution of colonies and eudoxids of *Abylopsis tetragona*. Solid curves, mean catch per hour's towing at 16 and 43 meters combined, broken curves, mean catch per hour at 133, 200, and 266 meters combined, at stations where taken.

and many times as numerous there in summer, as at 200 meters. It is in fact doubtful whether the nets caught any eudoxids deeper than 200 meters at any season.

Segregation of the summer data by months (Table 15, Fig. 64) also shows a decided vertical shift in the center of population of colonies from the upper 50 meters in June to the 200 meter level in August—September, whereas the eudoxids continued most plentiful close to the surface.

This seasonal alteration in the abundance of colonies between the 50—0 and 200 meter levels suggests enrichment of the lower level between June and September by individuals dispersed down from the upper layers by the turbulent movements of the water which must necessarily play a governing role in the vertical distribution of any planktonic animal, unless the specific gravity of the latter differs considerably from that of the water, or unless it be strongly phototropic or rheotropic.

And this is corroborated by the evidence (from the fact that significant numbers of eudoxids occur only in the uppermost stratum) that production for this species is confined almost wholly to the upper 100

400 meters, winter as well as summer, and that in summer they were more than four times more numerous above 200 meters than at greater depths. The relative frequency of distribution as indicated by the percentage of hauls from different levels taking it, corroborates this, being definitely greatest in the upper 400 meters in winter, and in the upper 200 meters in summer.

The eudoxids show a different distribution, being concentrated above 50 meters in winter,

Depth	No. of hauls, stations where taken	June		August—September	
		Catch per hour (corrected)		No. of hauls, stations where taken	Catch per hour (corrected)
		Extremes	Mean		
1. Nectophores.					
16 + 43	25	0—1690	316	14	0—212
200	29	0—329	75	11	0—740
400 + 666	7	0—141	29	8	0—140
> 666	5	0—226	59	4	0—26
2. Eudoxids.					
16 + 43	25	0—2109	353	14	0—488
200	19	0—133	19	11	0—55
400 + 666	7	0	0	8	0—11
> 666	5	0	0	4	0

meters or so; in other words that downward dispersal is almost wholly responsible for the presence of the species at greater depths. The fact that colonies of *A. tetragona* were found in such relatively large numbers down to a depth of 400 meters, thus gives a measure of the high degree of efficiency of this mechanical transport, unless counteracted by some factor inherent in the biology of the animal in question, there being no reason to suppose that this siphonophore reacts directionally to gravity. In the case of *Bassia* (p. 94) for example, it evidently is so counteracted.

Seasonal Variations in Abundance.

1. Colonies. According to the calculations of vertical abundance, tabulated above (p. 90, 91), colonies in the upper 50 meters averaged about five times as abundant in June as in winter, but then declined again by September to about the same numbers as in winter. At 200 meters, however, the increase (though at about the same rate) did not culminate until September or perhaps later. It is not clear from the available data, whether there is any definite seasonal alteration in the deeper levels, because the number of tows was not large enough for the ostensible differences between monthly averages to be significant, when station to station variations in abundance are so great.

2. Eudoxids. Eudoxids in the upper 50 meters were about 50 times as numerous in June as in winter, a rate of increase almost ten times as great as for the colonies. They then decreased by September to about $\frac{1}{6}$ the June strength, though still about 5 times as abundant then as in winter. And some trace of this same fluctuation is apparent as deep as 200 meters (see Tables 15, 16).

Breeding Season and Depth.

The only previous information as to the seasonal occurrence of the eudoxids of *A. tetragona* in the Mediterranean is that the studies on which LEUCKART's (1853), VOGT's (1854), GEGENBAUR's (1854), and KEFERSTEIN and EHLLERS' (1861) accounts were based were all carried out during the colder part of the year between October and May; and that MOSER's (1917) and LELLOUP's (1933) records are for April, May, June, and September.

The capture by the "Thor" of a scattering of eudoxids in January and February is additional evidence that some reproduction does take place in winter. But the fact that the eudoxids were many times as abundant in June (above; LELLOUP's two big catches were in May and September), but then decreased so markedly to September (above) shows that the spring is the chief breeding season.

The very definite concentration of eudoxids and of free gonophores (see list, p. 23) in the upper strata is equally conclusive evidence that reproduction in a significant amount is confined to the upper 100 meters at most, and very likely to the upper 50 meters.

Abundance.

A. tetragona is not only one of the most regularly occurring siphonophores in the Mediterranean as far east on Long. 20° E., but also one of the more abundant in the western basin, the mean (corrected) at the level of maximum abundance at stations where it occurred, being approximately as shown in Table 16.

Table 16.

Western basin	Colonies	Eudoxids
Winter	31 per hour = 1 per 180 cu. meters	5 per hour = 1 per 1100 cu. meters
Late June	255 per hour = 1 per 21 cu. meters	266 per hour = 1 per 20 cu. meters
Late August	220 per hour = 1 per 25 cu. meters	45 per hour = 1 per 152 cu. meters

On the average, it is thus about $\frac{1}{4}$ abundant as *C. appendiculata*. Maximum catches were as shown in Table 17.

Table 17.

Western basin	Colonies	Eudoxids
Winter	470 per hour = 1 per 11 cu. meters	100 per hour = 1 per 55 cu. meters
Late June	1012 per hour = 1 per 5 cu. meters	1486 per hour = 1 per 3.7 cu. meters
Late August	2584 per hour = 1 per 2 cu. meters	23,664 per hour = 1 per 0.2 cu. meters

The Eastern basin stations are omitted from the calculations of absolute abundance, because *tetragona* was taken at so few stations there, and in such varying numbers.

BASSIA BASSENSIS Quoy and Gaimard (p. 26).

Figs. 65, 66.

Horizontal Distribution.

This species has now been taken often enough, and at widely scattered localities, to show that it is generally distributed through the tropical and sub-tropical belts of the oceans, Pacific, Indian, and Atlantic. First described from the Straits of Gibraltar, it has been taken quite regularly outside the latter on the Prince of Monaco's cruises (LELOUP, 1933). But the only previous records for it within the Mediterranean were Alboran Sea (LELOUP, 1933), Villefranche (LELOUP, 1935), Naples, Ragusa, and the Adriatic (MOSER, 1917).

The results of the "Thor" hauls again show it at most of the stations just outside the Straits of Gibraltar. Only an occasional specimen was caught in the western basin (chiefly along the path of the inflowing Atlantic current) winter or summer (Fig. 65). In the eastern basin, however, it was represented by a few specimens at almost every station on

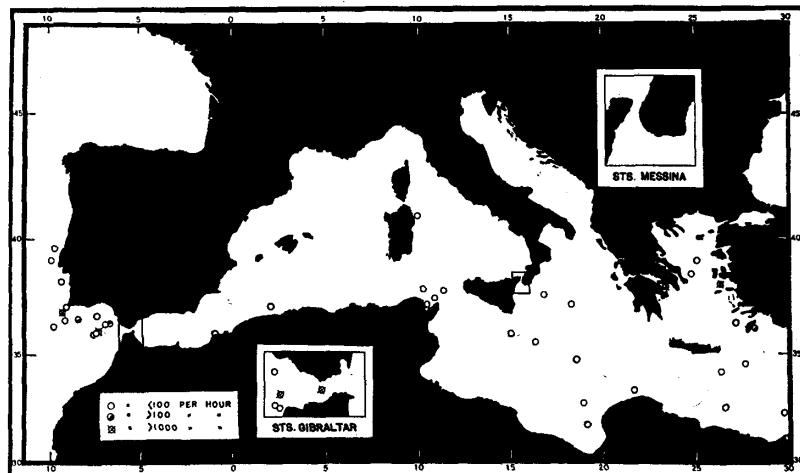


Fig. 65. "Thor" captures of colonies of *Bassia bassensis*.

the summer cruise—including the Aegean Sea—and was taken twice in abundance (north of Nicaria and within the Gulf of Aegina). On the winter cruise it was taken at two stations east of Sicily in the Ionian Sea, though not at the five other stations to the northward in the Adriatic and Gulf of Taranto, or at one in the Gulf of Aegina.

Thus, it appears that while *B. bassensis* is something of a rarity in the western basin and perhaps only an immigrant there via the Straits from the Atlantic (where it is strongly represented), it is so widespread an inhabitant of the eastern basin (at least in summer), occasionally in abundance, as to suggest that the stock there is locally maintained. And this is corroborated by the captures of eudoxids¹ (Fig. 66) which were found in large numbers at 3 stations in the Atlantic (maximum, 16828 per hour, corrected), at one station in the Straits of Gibraltar (4776 per hour corrected), and at two stations in the eastern basin (maximum, 3408 per hour), but of which the maximum catch in any haul in the western basin was only 5 (20 per hour).

The known distribution

of *Bassia*, and (in particular) the fact that "the species is apparently unable to penetrate into the barrier reef lagoon [Great Barrier reef, Australia] during the period of lowered salinity" (RUSSELL and COLMAN, 1935, p. 261) indicate that salinities considerably higher than 35% are most favorable for it.

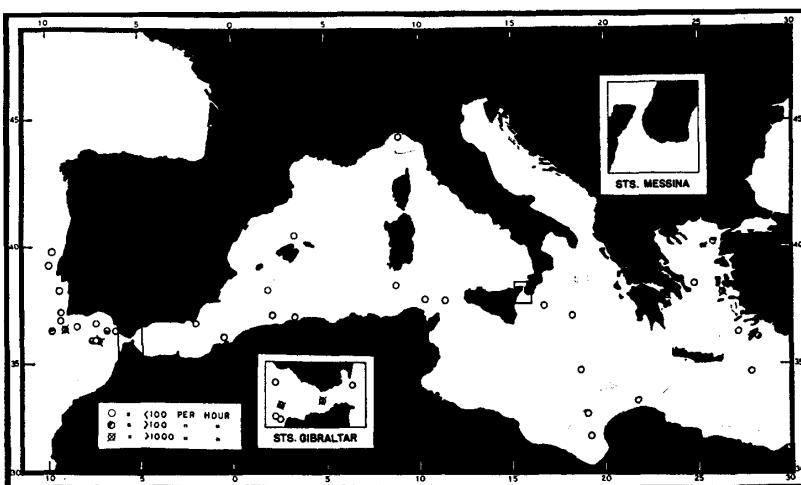


Fig. 66. "Thor" captures of eudoxids of *Bassia bassensis*.

Vertical Distribution.

Table 18. "Meteor" catches, per 200 meters of towing at stations where there were tows at several levels, calculated from LELOUP and HENTSCHEL's (1935) tables.

Depth	Total meters hauled at stations where taken	Total catch ¹		Average catch per ¹ 200 meters of hauling	
		Colonies	Eudoxids	Colonies	Eudoxids
0— 50	850	28	32	6.6	7.6
50— 100	1850	17	23	1.8	2.4
100— 200	400	3	3	1.5	1.5
200— 400	2000	1	3	0.1	0.3
400— 600	2000	2	0	0.2	0
600— 800	1900	0	0	0	0
800—1000	1800	1	0	0.1	0

¹ "Colonies" in this table includes both complete colonies and detached superior necophores; "eudoxids" includes both the complete eudoxids and loose bracts.

nophores. Analysis of the "Meteor" catches in closing nets (Table 18) shows the species as decidedly more regular in its occurrence above 100 meters than below, with only odd examples downward, though one was taken as deep as 800 meters.

The catches per hour (corrected for contamination) at the 5 "Thor" stations in the Mediterranean

It has long been known that *Bassia* frequently appears in abundance at the surface. And while it has also been brought back, repeatedly, in open hauls sent down to great depths, there is no evidence that any significant number have ever been actually taken more than 200 meters or so below the surface. Thus, the 70 odd colonies (or parts of colonies) recorded by BROWNE (1926) from the Indian Ocean were all taken in hauls which did not reach below 180 meters, though many other hauls were also made at greater depths, yielding other siphon-

¹ LELOUP (1935) has subsequently recorded one bract from Villefranche.

(all in the eastern basin) and the 6 "Thor" stations in the Atlantic, where as many as 10 nectophores or eudoxids were taken, and where both shoal and deep hauls were made are as follows (Table 19):—

Table 19.
Mediterranean.

Winter:—	St. 10		St. 11	
	Colonies	Eudoxids	Colonies	Eudoxids
16 meters	13	28	15	21
43 —	1	0	0	0
200 —	—	—	0	0
400 —	3	2	—	—
666 —	—	—	0	0

Summer:—	St. 160		St. 163		St. 183	
	Colonies	Eudoxids	Colonies	Eudoxids	Colonies	Eudoxids
16 meters	174	152	2256	2348	—	—
43 —	—	—	—	—	3604	3408
200 —	0	0	0	0	0	0
400 —	—	—	—	—	—	—
666 —	0	0	0	0	—	—

Atlantic.

Winter:—	St. 65		St. 71		St. 231	
	Colonies	Eudoxids	Colonies	Eudoxids	Colonies	Eudoxids
16 meters	8	0	4	42	0	0
43 —	17	14	48	344	0	0
200 —	0	0	36	274	5	14
400 —	0	0	0	0	0	0
666 —	—	—	—	—	—	—

Summer:—	St. 89		St. 95		St. 231	
	Colonies	Eudoxids	Colonies	Eudoxids	Colonies	Eudoxids
16 meters	—	—	3232	1828	1594	3138
43 —	0	0	1480	2331	—	—
200 —	21	44	0	0	0	0
400 —	—	—	—	—	—	—
666 —	73	56	—	—	—	—
800 —	—	—	—	—	0	0

It is evident from the foregoing that in the Mediterranean, *Bassia* was even more definitely concentrated and (apparently for the most part, confined) to the upper 50 meters than the "Meteor" found it, with most of the stock living close to the surface, whether summer or winter. This was equally the case in the Atlantic, at the summer stations. In winter, however, it seems to have been roughly as abundant down to 200 meters there, as at the surface, though apparently none were living deeper than that.

The only apparent explanation in hydrology for this regional and seasonal difference in the depth of its lower boundary, is that the vertical stability of the upper 200 meters is considerably higher in the Atlantic in summer than in winter and was considerably higher in winter in the Mediterranean than in the Atlantic (Fig. 67) which would tend more to favor dispersal of colonies, downward in the Atlantic in winter than in summer and more in the Atlantic in winter than in the Mediterranean.

Seasonal Changes in Abundance.

No decided seasonal fluctuation in abundance was recorded in the sparse population of the western basin, except perhaps just inside the Straits of Gibraltar, where shallow tows (43 meters) caught 3440 colonies and 4776 nectophores per hour in June (St. 98) but where a 600 meter haul yielded none at all in February (St. 61). In the Atlantic, however, and also in the eastern basin, where the species is both abundant and widespread (p. 93), colonies and eudoxids were much more numerous in summer than in winter, average catches being as follows (Table 20), for the upper 50 meters where the great majority of the stock is concentrated.

Breeding Season and Abundance.

The captures of eudoxids on all the cruises is evidence of a certain amount of reproduction, the year round. But the fact that the eudoxids and colonies were much more abundant in June and later summer than in winter, both in the Atlantic and in the eastern basin (i. e., in regions where any considerable reproduction is indicated at any season) show that *Bassia* breeds the most actively from spring into summer. Some measure of the rate at which additions are made to the population at this time of year is given by the catches, winter as compared with summer. In the eastern basin, the indicated increase was about 67-fold for the colonies and 27-fold for the eudoxids between the February and August cruises (Table 19)¹. In the Atlantic, it was about 457-fold for the colonies, 67-fold for the eudoxids (Table 19). And the fact that the largest catches of all, both of colonies, and of eudoxids, were made in the Atlantic on September 9,

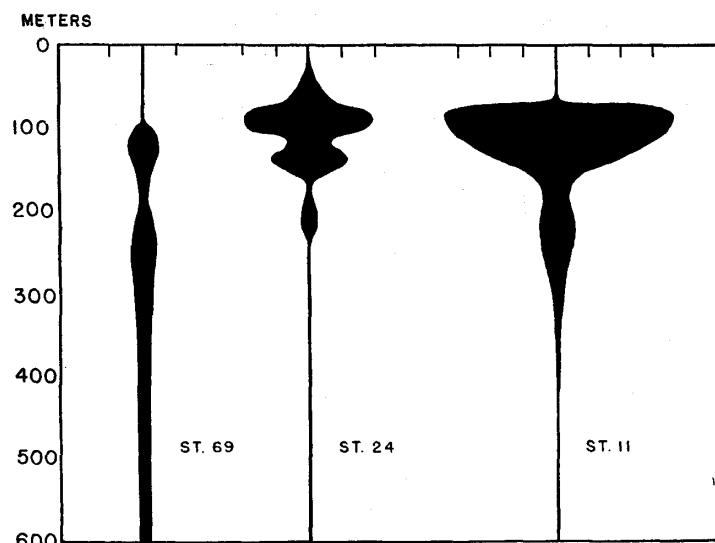


Fig. 67. Relative vertical stability, calculated according to SANDSTRÖM (1919, p. 232) for 25 meter intervals, at winter stations in the Bay of Cadiz (St. 69) in February, and in the western (St. 24), and eastern basins (St. 11), December-January. Each division on the horizontal scale represents 0.1 unit of density [(sp. gr. -1) 1000] at the temperature *in situ*.

Table 20.

	No. of hauls at stations where taken	Extreme catches per hour	Mean No. of colonies per hour	Extreme catches per hour	Mean No. of eudoxids per hour
Atlantic:— Winter.....	10	0— 48	8	0— 344	40
Summer	11	0—30492	3657	0—16828	2704
Eastern basin:— Winter ...	4	0— 15	7	0— 28	17
Summer ..	13	0— 3604	470	0— 3408	457

1910 is an indication that the vernal breeding season does not reach its peak until mid-summer or perhaps even later. Conversely, the corresponding shrinkage in the strength of the population during the autumn gives at least a rough measure of the rate at which the death rate dominates over the replacement rate at that season.

The maximum catch was at the rates of 30492 colonies, and 16828 endoxids, per hour, or 27442 and 153452 per 5000 cubic meters respectively.

¹ Assuming that winter data for 1908—1909 can justly be combined with summer data for 1910.

CERATOCYMBIA SAGITTATA Quoy and Gaimard (p. 28).

Fig. 68.

Horizontal Distribution.

This species has been found in the warm regions of the North and South Atlantic (MOSER, 1925; LELOUP, 1933, 1934; LELOUP and HENTSCHEL, 1935), the Eastern Tropical Pacific (BIGELOW, 1911b), the Indian Ocean (BROWNE, 1926), and the Malayan region (LENS and VAN RIEMSDIJK, 1908). Despite the fact that it was originally described by QUOY and GAIMARD (1827) from the Straits of Gibraltar (the eudoxids) and was taken by the expeditions of the Prince of Monaco at two stations in the Bay of Cadiz, it had never been taken within the Mediterranean before the time of the "Thor" cruises. The latter again had it (one colony) in the Straits of Gibraltar and at 11 stations in the Bay of Cadiz, but at only one station in the Mediterranean (Alboran Sea, 1 eudoxid) (Fig. 68).

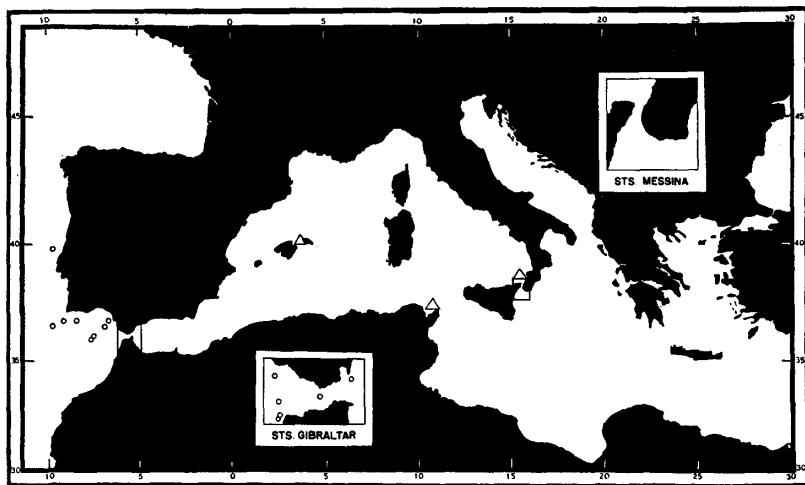


Fig. 68. "Thor" captures of *Ceratocymbia sagittata* (circles) and *Suculeolaria quadrivalvis* (triangles).

As specimens were taken in the bay of Cadiz in hauls as shoal as 43 meters, there is no mechanical barrier to its entrance through the straits. Present indications thus are that this is a warm water species, which, if it drifts within the Mediterranean, shortly perishes there without successful colonization.

Vertical Distribution.

Captures of this species (both nectophores and eudoxids), in hauls from 16 and 43 meters show that at least some were living in the surface waters: this accords with previous data, which include catches both of colonies and of eudoxids, not only right at the surface, but at various depths less than 100 meters (QUOY and GAIMARD, 1827; MOSER, 1925; BIGELOW, 1918). The "Thor" hauls at 200, 400, and 666 meters also yielded a few, but the numbers were in every case so small that no conclusions can be drawn as to the levels in the water at which they were picked up by the nets. And this also applies to the considerable number of open hauls, from shoal depths down to considerable depths, from which it has been reported by other authors. How deep its normal range may extend thus remains doubtful.

Breeding Season and Abundance.

Captures of eudoxids in the Bay of Cadiz in February as well as in June, but in much the larger numbers and with free gonophores in the latter month, shows that while the breeding season of this species is not definitely localized, reproduction is more active in summer than in winter.

The fact that the maximum catches were at the rate of only 6 colonies and 8 eudoxids per hour makes it doubtful whether this species is ever abundant, either in the Mediterranean or in the neighboring parts of the Atlantic.

SULCULEOLARIA QUADRIDENTATA Quoy and Gaimard (p. 31).

Fig. 69.

Horizontal Distribution,

Previous records which can be definitely attributed to *S. quadridentata*, as distinguished from *S. quadrivalvis* (p. 31) though few, have shown it to be widespread in the Eastern Tropical Pacific (BIGELOW, 1911b, 1931), in the region of the Great Barrier Reef, Australia (TOTTON, 1932), in the Indian Ocean (BROWNE, 1926), in the South Atlantic (MOSER, 1925; LELOUP, 1932), in the vicinity of the Canaries and Azores (LELOUP, 1933), and in the western basin of the Mediterranean at Naples and Villefranche (KEFERNSTEIN and EHLERS, 1861; LOCHMAN, 1914; BIGELOW, 1918; LELOUP, 1933).

The "Thor" caught scattering specimens at 30 stations along her route (Fig. 69), winter as well as summer. Those taken on the winter cruise were all outside the Straits of Gibraltar in the Bay of Cadiz. Those on the summer cruise were scattered throughout the Mediterranean, except for the Levant, suggesting possible immigration from the Atlantic.

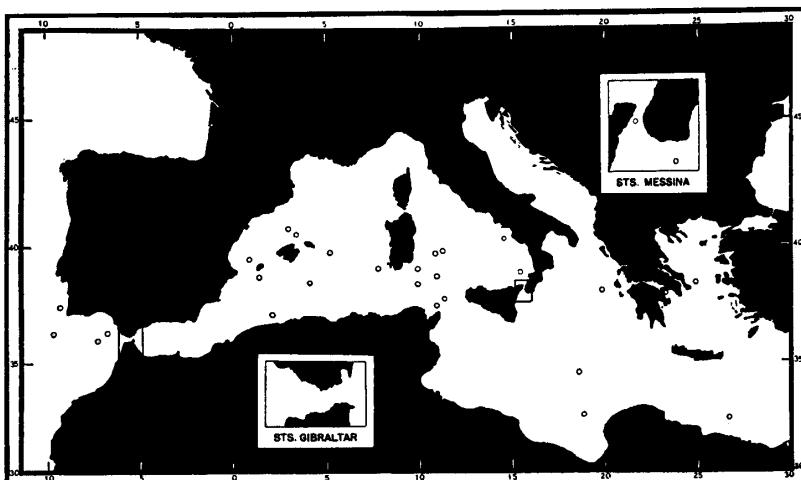


Fig. 69. "Thor" captures of *Sulculeolaria quadridentata*.

Vertical Distribution.

The catches of *quadridentata* were never large enough to permit a detailed analysis of the vertical distribution. But a casual inspection of the list of material suggests that it is a surface form, for 70% of the tows that took it were at 16 and at 43 meters, which accords with previous information. Among the 11 hauls from the layers as deep as 200 meters or deeper which yielded it, all but 3 were at stations where it was also caught in the shoal tows: the specimens may, therefore, have been picked up as the net passed through the upper layers. And while it failed in the shoal tows at 2 stations of this group, the specimens brought up by the deep hauls may also have come from small depths, for the surface population was so sparse that one net may well have missed it and another have picked up an occasional individual. This also applies to the remaining station where no shoal tow was made.

Abundance.

The largest catch was at the rate of 32 superior nectophores per hour (28 per 5000 cubic meters).

SULCULEOLARIA QUADRIVALVIS Blainville (p. 32).

Fig. 68.

Horizontal Distribution.

While there are many published records under this name, particularly in the Mediterranean, it has often been confused with *S. quadridentata*. Records that undoubtedly refer to *quadrivalvis* prove it widespread

in the Eastern Tropical Pacific (BIGELOW, 1911 b, 1931), in the South Pacific (LELOUP, 1932), the Philippines (BIGELOW, 1919), the Malayan region (LENS and VAN RIEMSDIJK, 1908), off the Great Barrier Reef, Australia (TOTTON, 1932; RUSSELL and COLMAN, 1935); and in the Indian Ocean (BROWNE, 1926). There are positive records of it in the Mediterranean at Nice (VOGT, 1854; LEUCKART, 1854) and at Messina (GEGENBAUR, 1854).

The "Thor" only took three specimens, one in the southern part of the Pantellarian Channel (St. 137), 1 northwards from the Straits of Messina in the Tyrrhenian Sea (St. 192), and 1 in the vicinity of the Balearic Islands (St. 207) — all in tows from 43 meters or shoaler (Fig. 68).

GALETTA AUSTRALIS Quoy and Gaimard (p. 35).

Fig. 70.

Horizontal Distribution.

This wide-ranging species is known from many localities in the Indian Ocean (QUOY and GAIMARD, 1833; HUXLEY, 1859; BROWNE, 1926), in the Malayan region (LENS and VAN RIEMSDIJK, 1908), in Philippine waters (BIGELOW, 1919), in the South Pacific (LELOUP, 1932), in the Eastern Tropical Pacific (BIGELOW, 1911 b), in the South Atlantic (MOSER, 1925; LELOUP, 1932, 1934), and in the North Atlantic as far north as the Norwegian coast and Spitzbergen (SARS, 1846; BIGELOW, 1918; CANDEIAS, 1929; LELOUP, 1932, 1934; ROMER, 1902). Previous records in the Mediterranean are:—

Naples — CHUN (1885), SCHNEIDER (1898);

Messina — GEGENBAUR (1854), SARS (1857), KEFERSTEIN and EHLERS (1861);

Adriatic. Southern Deep — MOSER (1917).

Specimens referable to *G. australis* were taken at so many stations along the "Thor's" route (Fig. 70), on all the cruises (as well as at many of the supplementary stations) as to prove it a regular inhabitant both

of the eastern and western basins, as well as of the neighboring parts of the Atlantic, though it was not an abundant member of the siphonophore population anywhere.

Vertical Distribution.

Sixty percent of the "Thor" tows which took *G. australis* were shallow (16 and 43 meters). Fourteen of the 24 hauls from layers as deep as 200 meters that yielded it, were at stations where its presence at small depths was proved by its capture in tows from 16—43 meters. Hence, the

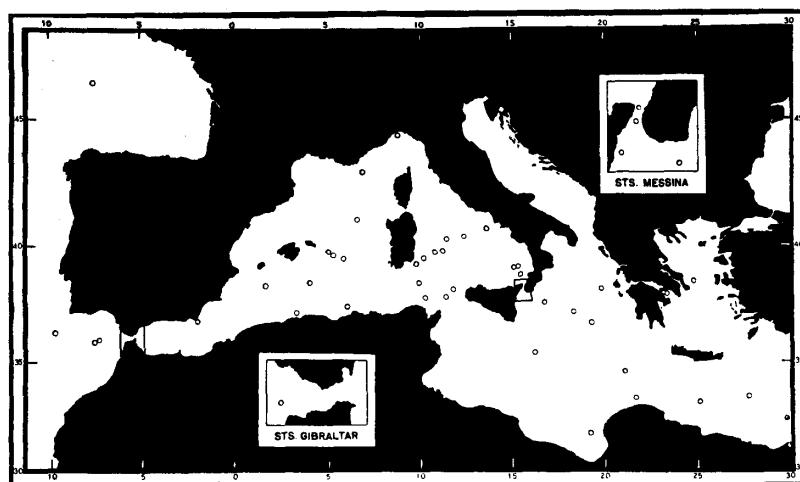


Fig. 70. "Thor" captures of *Galetta australis*.

deep nets may have picked up their catches on the way up or down (bringing the possible percentage of shoal catches up to 83%). And the numbers concerned were so small that this is equally possible for the catches of the remaining 10 deep tows, where corresponding shallow tows may simply have chanced to miss it. The fact that in most cases the deep tows were of longer duration than the shoal makes this the more likely.

Though the catches were not large enough to permit any further analysis, the foregoing is enough to show that *G. australis* may be described as distinctly a surface form in the Mediterranean. This seems to be true of it throughout its range, for wherever it has been taken in any numbers, or with any frequency, so large a proportion of the catches have been at the surface as to make it probable that specimens brought in by deeper hauls — as has often happened — were picked up by the nets at no great depth.

The Atlantic catches — 2 nectophores at 16 meters; 1 at 43 meters; 2 at 200 meters; 2 at 1600 meters — were too scattered and the specimens too few in number to be significant in this respect.

The maximum catch (Mediterranean) was at the rate of 220 superior nectophores per hour (198 per 5000 cubic meters).

MUGGIAEA ATLANTICA Cunningham (p. 39).

Fig. 71.

Horizontal Distribution.

Seen first almost 50 years ago at the Canary Islands by HAECKEL (1888b, p. 137, *Muggiae pyramidalis*), this small diphyid is now known to be common in the general region of the English Channel, Irish Sea, and off the south and west coasts of Ireland (CUNNINGHAM, 1892; BLÈS, 1892; GOUGH 1905; RUSSELL 1934). Recently, it has been caught in the South Atlantic along the west coast of Africa by the "Meteor". It has also been reported from the Pacific off the east coast of Japan (MOSER, 1925), in Monterey Bay (BIGELOW and LESLIE, 1930), and along the route of the "Albatross" in the Eastern Tropical Pacific (BIGELOW, 1911b). Strangely enough, it was not found by the "Research" in the Bay of Biscay (BIGELOW, 1911), or in the material collected by the Prince of Monaco in the vicinity of Gibraltar, or within the Mediterranean (LELOUP, 1933). The "Thor", however, took it at two stations along the coast of Portugal, at several just outside the Straits of Gibraltar in the Bay of Cadiz, in the Straits and in the Alboran Sea, and along the north coast of Africa as far as Tunis — in the swifter part of the inflowing Atlantic current. Aside from these, there are but three records for it in the Mediterranean — one in the eastern part of the Sidra Sea, one South east of Crete, and one (identification doubtful) in the Ligurian Sea (Fig. 71).

In its horizontal distribution, *M. atlantica* stands alone among the siphonophores of the "Thor" expedition, for most of the Mediterranean localities of record are concentrated, not only in the southern side, but within 60 miles of the 200 meter line at farthest. And this was also the case in the Bay of Cadiz. Especially striking was its absence at stations out in the Bay, during the month (June) when large catches were made close in to the coast only a few miles distant (Fig. 71). Since all previous records of it have likewise been near the coast, whether in the English Channel, off Ireland (CUNNINGHAM, 1892; GOUGH, 1905; RUSSELL, 1933), off the west coast of Central and South America (BIGELOW, 1911b), off Japan (BIGELOW, 1913), or off the west and southwest coasts of Africa (LELOUP, 1934).

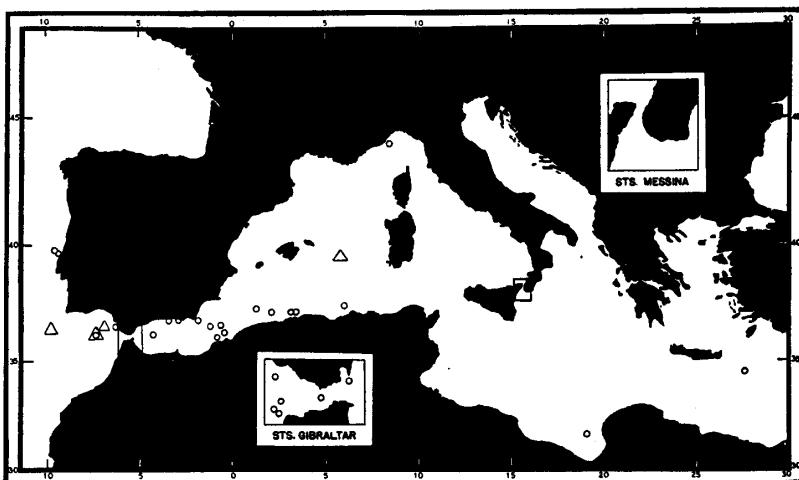


Fig. 71. "Thor" captures of *Muggiae atlantica* (circles) and *Diphyes dispar* (triangles).

it seems that this is definitely a neritic species; a characterization that may also prove to apply to *M. Kochii* (RUSSELL, 1934), to *Diphyes chamissonis*, and to *Lensia subtiloides* (RUSSELL and COLMAN 1935, p. 271).

The frequency of its occurrence in the southern side of the western basin of the Mediterranean, contrasted with the sparseness of occurrence elsewhere, suggests that immigration from rich concentrations in the Bay of Cadiz is an important factor in maintaining the stock within the Mediterranean. The fact that the richest June catches in the Bay of Cadiz were all made within 43 meters of the surface, well within the sweep of the inflowing current (assuming the latter to have been active at the time), is in line with this. So, too, is the improbability that any species at home as far north as the English Channel, should find a habitat definitely more favorable on the southern side of the Mediterranean than in the northern. On the other hand, there is no evidence that the development of a rich population in the Bay of Cadiz in June was either accompanied or followed by any general expansion of its range within the western basin of the Mediterranean. Nor can its capture at two stations in the eastern basin in summer, but not in winter, be safely so interpreted, because the nets may simply have missed it there in the cold season when it was very scarce everywhere. Neither is the numerical occurrence within the Mediterranean suggestive of recent mass immigration from the Atlantic, for one catch in the eastern basin far from the point of entrance was as large as any in the western basin and almost as rich as the June population in the Bay of Cadiz.

It would, in short, be impossible to determine without following the species in the Mediterranean through several years, whether it is in fact a reliable indicator there of Atlantic water, or the relative importance for it of immigration as compared with local centers of reproduction, in maintaining the Mediterranean population.

Vertical Distribution.

The many records of this species, from the vicinity of Plymouth England¹, are from shoal water (BLÈS, 1892; CUNNINGHAM, 1892; GARSTANG, 1894; GOUGH 1905; RUSSELL, 1935). As it was also represented abundantly at the surface, and in open hauls down to 50—0 meters, off Monterey (BEGELow and LESLIE, 1930), and as the deepest positive record for it is only 50—100 meters (LELOUP and HENTSCHEL, 1935) it seems likely that specimens taken in open hauls from 550—0 meters in the Eastern Tropical Pacific (BEGELow, 1911b) were also caught at small depths.

Tabulation of average catches (corrected) at "Thor" stations where the species was taken, and where deep hauls were made as well as shoal, similarly shows unmistakable preponderance in the uppermost stratum sampled (Table 21):—

Table 21.

Depth meters	Atlantic			Mediterranean		
	No. of hauls	Extreme catches per hour corrected	Mean catch per hour corrected	No. of hauls	Extreme catches per hour corrected	Mean catch per hour corrected
16 + 30 + 43 + 66	10	0—356	25	16	0—274	47
200	4	0—37	9	11	0—292	33
333 + 400	3	0—3	1	4	0—2	< 1
800 + 1066 + 1333	2	0—<1	1	7	0—9	1

This also appears from the fact that all catches at the rate of more than 350 per hour were from 43 meters, or shoaler².

Mean catches suggest that the lower limit of its occurrence in significant numbers is considerably

¹ According to CUNNINGHAM (1892) the siphonophore reported from Plymouth by BOURNE (1890) as *M. Kochii* was actually *M. atlantica*. But RUSSELL (1934) has now found that both species occur there.

² St. 93, 33 meters, 356 per hour; St. 94, 43 meters, 1000 per hour; St. 98, 43 meters, 2808 per hour; St. 221, 25 meters, 484 per hour.

closer to the surface in the Atlantic (about 100 meters) than in the Mediterranean (deeper than 200 meters). Actually, this calculated difference results from the fact that a catch at the rate of 292 per hour was made by a 200 meter haul at one Mediterranean station (St. 147), whereas in the Atlantic, 43 meters was the greatest depth where the catch was 200 colonies per hour (St. 94, 1000 per hour, corrected). The differences may thus be merely an evidence of sporadic swarming at one level or another.

Seasonal Variation, Breeding Season and Abundance.

No eudoxids were found. But an increase in the maximum numbers of nectophores per haul, from only 36 per hour in February to upwards of 1000 per hour in June in the Bay of Cadiz, and from 34 per hour in February, to 200—2804 in June, and 584 in September in the western basin of the Mediterranean, points to a wave of reproductive activity in spring and early summer, followed by a rapid death rate in late autumn and early winter. This type of reproductive cycle is common among inshore planktonic animals.

The maximal catch for February was at the rate of about 34 per hour, or 1 specimen per about 160 cubic meters of water, whereas in June (in the Straits) it was at the rate of 2808 per hour, or 1 specimen per 2 cubic meters. At its centers of maximum production, *atlantica* may thus be one of the more abundant siphonophores.

DIPHYES DISPAR Chamisso and Eysenhardt (p. 40).

Fig. 71.

Horizontal Distribution.

D. dispar has often been recorded from the warm zones of all oceans, including the Straits of Gibraltar where it was first described by QUOY and GAIMARD (1827). But the only previous record from the Mediterranean is by VERANY (1846) who mentions it in a list of the fauna of Genoa and Nice, under the name of *Diphyes Bory*. While this name is a synonym of *D. dispar*, it is not certain whether this was actually the diphyid referred to.

The "Thor" took one colony in the center of the Balearic Sea. But as this is only the second Mediterranean record in the literature of this relatively large diphyid, it seems unlikely that it is more than a stray migrant inside the straits. The "Thor" also took it at several stations in the Bay of Cadiz, but it apparently does not extend much to the north of this as it was not found along the coasts of Spain and Portugal nor on the traverse in the offing of the Bay of Biscay (Fig. 71) where the "Research" also failed to find it (BIGELOW, 1911 a).

CHELOPHYES APPENDICULATA Eschscholtz (p. 41).

Fig. 72.

Horizontal Distribution.

C. appendiculata is found in all oceans (see MOSER, 1925). It is also the commonest of all siphonophores; CHUN (1887, p. 12) writes of it, at Naples, that "Kaum ein pelagisches Thier ist gemeiner". It has often been taken in the Mediterranean at the following localities:—

- Mentone — PAGENSTECHER (1869);
- Naples — O. G. COSTA (1836), SPAGNOLINI (1868, 1870), PAVESI (1869 . . .), P. E. MÜLLER (1871), BEDOT (1882), CHUN (1887), SCHNEIDER (1898), NEPPI (1921), MOSER (1923);
- Capri — LO BIANCO (1903);
- Messina — KÖLLIKER (1853), GEGENBAUR (1854), KEFERSTEIN and EHLERS (1861), CIALONA (1901);
- Nice — LEUCKART (1853, 1854), VOGT (1854);
- Villefranche — LOCHMAN (1914), MOSER (1923), LELOUP (1935);

Adriatic, off Skardo-Isto — MOSER (1917, 1 specimen);
Western Basin — LELOUP (1933).

C. appendiculata was generally distributed along the routes of the "Thor" throughout the basins of the Mediterranean, in the Aegean Sea, and even in the landlocked waters of the Gulf of Corinth. But as it failed at all of the stations in the Sea of Marmora, in the Dardenelles, and within the entrance of the Black Sea, it seems reasonably certain that it is not carried inward along this route by the deep indrafts of saline

Mediterranean water, in numbers large enough to maintain a significant population (Fig. 72).

In summer, *appendiculata* was not only generally present everywhere along the "Thor's" route (85% of the stations with appropriate tows) but the rich catches (> 900 nectophores per hour) were widely scattered in both basins, close in to land, as well as out to sea. The whole southern part of the eastern basin seems, however, to have been sparsely populated, for while *appendiculata* was recorded at every station there, the maximum abundance, south of latitude 35°,

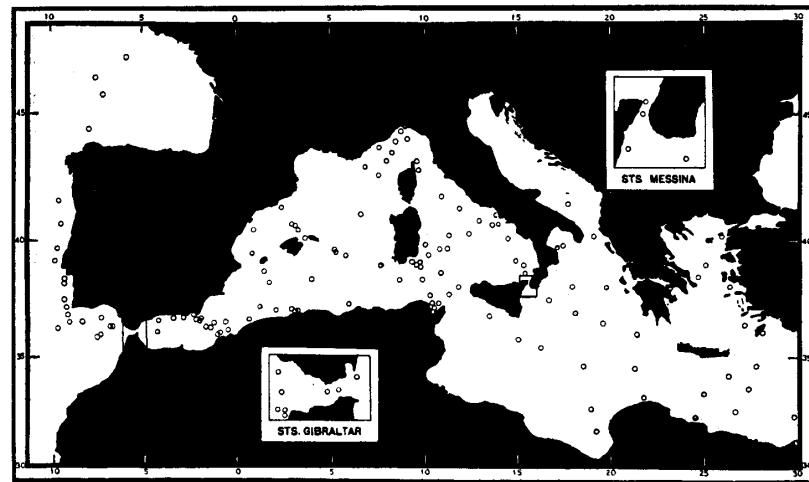


Fig. 72. "Thor" captures of *Chelophysa appendiculata*.

was only 220 nectophores per hour's tow (corrected), contrasted with frequent catches of more than 1000 in the western basin, north to south. *Appendiculata* seems also to be scarce in the Aegean Sea, absent altogether, as just noted from the approaches to the Black Sea.

In winter, while equally widespread (88% of the stations with appropriate tows), it was taken in significantly smaller numbers (p. 41) and with no obvious correlation with locality.

In the case of a species such as this, which is often concentrated near the surface at the season of chief abundance (p. 103), movement inward, through the Straits of Gibraltar, with the upper current may be expected to dominate over movements outward, with the deep outflowing one. And the situation existing at the times of the February and June cruises show that the Bay of Cadiz often supports a population large enough, appreciably to affect the stock just within the Straits, if actually caught up by the inflow, for the average numbers were considerably greater outside the Straits than inside, as follows (Table 22). But in September, such small regional contrast as did exist was the reverse. And in any case, the records of regional occurrence within the Mediterranean set forth above, argue that distribution and local abundance there are not significantly affected by immigration from the Atlantic via the Straits of Gibraltar, but that the stock is self contained, and maintained by local reproduction.

Table 22. Catches per hour (corrected) at 16—43 meters at stations where the species was taken inside and outside the Straits of Gibraltar, in different months.

Month	Average inside	Extreme catches inside	No. St. inside	Average outside	Extreme catches outside	No. St. outside
Feb.	40	4—130	4	230	0— 776	5
June	35	0— 60	4	3272	10—11170	5
Sept.	301	0—904	3	100	18— 182	2

Vertical Distribution.

The hauls in which *C. appendiculata* has been taken in the past, have seldom been of a type to give definite information as to the relative abundance of this species at different depths. Exceptions are the few catches made with closing nets in the Mediterranean by CHUN (1887); in the Atlantic by the Plankton Expedition (CHUN, 1897) and by the Prince of Monaco (BEDOT, 1904), in the Bay of Biscay by the "Research" (BIGELOW, 1911a), and in the North and South Atlantic by the "Meteor" (LELOUP, 1934). These prove that its extreme range extends from the surface down to at least 1000—1300 meters. But the distribution of catches show (especially CHUN's Mediterranean data, and the "Research" data for the Bay of Biscay) that it is much the more abundant between the surface and 200 meters, than deeper. Off Naples, CHUN found it most plentiful at 80—100 meters. Similarly, the "Meteor" catches per 200 meters of towing at stations where the species occurred, and where tows were made at several levels (LELOUP and HENTSCHEL, 1935) averaged about 47 colonies between the surface and 100 metres, but less than 1 at greater depths.

The "Thor" data for the Atlantic again yield the picture of a species much the most abundant in the upper 200 meters, with abrupt decrease in numbers, with increasing depth below that level (Table 23).

In the Mediterranean, however, the concentration in the upper 50 meters was more pronounced on the one hand, but on the other hand the lower level to comparative high abundance lay at least 200 meters deeper (i. e. at 400 meters) than in the Atlantic. And this regional difference, in the relative vertical distribution of this species is largely responsible for the corresponding difference for siphonophores as a whole, shown by the "Thor" catches for the Mediterranean, as contrasted with the Atlantic (p. 137).

Segregation of the Mediterranean catches, by months, shows the following seasonal distribution.

Summer. The relationship of the 200 meter catch (uncorrected) to the 16 meter or 43 meter

Table 23. Average catch at Atlantic stations where *Chelophyses* was taken, and where deep hauls were made as well as shallow.

Depth Meters	No. of tows	Extreme catches per hour (corrected)	Average catch per hour (corrected)
16	16	0—796	196
43	12	0—3872	396
200	17	0—344	138
400	8	0—55	10
666	3	0—37	23
800	2	0	0
1066	4	0	0

Table 24. Average catches of *Chelophyses appendiculata* per hour (corrected) at all Mediterranean stations, where the species was taken.

Depth	Catch	Depth	Catch
16 meters	439	666 meters	10
43 —	800	800 —	3
200 —	150	Deeper than 1300 meters	< 1
400 —	158		

Table 25.

Station	200 meter value	Station	200 meter value
99 ¹	23.3	125 ²	0.07
106 ³	3.0	126 ²	0.20
107 ¹	0.52	129 ²	0.05
108 ¹	0.17	131 ²	0.06
112 ²	1.01	132 ²	0.95
115 ²	0.03	133 ²	0.07
116 ²	0.04	134 ²	0.53
118 ²	0.22	138 ²	0.04
123 ²	0.10	139 ²	0.60

¹ Shoalest tow, 43 meters.² Calculated in relation to the 16 meter tow.³ Catch at 16 meters, 0; at 200 meters, 3.

Table 26.

Station	Depth	No. of specimens actually caught	No. of specimens per hour (uncorrected)	No. of specimens per hour (corrected)
99	43	5	20	20
	200	205	410	315
132	16	273	546	546
	200	374	748	560
	400	644	1288	877

catch, at June stations in the western basin, shows wide variation, considering the shoal catch as unity (Table 25).

This station to station variation, may be further illustrated by the catches (corrected) per hour at stations 99, and 132 (Table 26).

But the foregoing tabulations show that in only about $\frac{1}{5}$ of the cases was the catch of *appendiculata* as large at 200 meters as at 50–100 meters. The mean catches (corrected) per hour, at different levels, for this group of stations combined, similarly shows the population of the western basin as averaging more than ten times as abundant at 16 meters, or at 43 meters, as at 200 meters as follows (Table 27).

Table 27.

Depth in meters	No. of hauls	Colonies per hour (uncorrected)	Colonies per hour (corrected)	Value relative to shoalest stratum
16	4	1382	1220	1.00
43	9	1013	943	.77
200	17	152	112	.09

Table 28.

Station	Value of 400 meter catch referred to 200 meter level (uncorrected)	Same, corrected
129	0.93	0.17
132	1.72	1.57
133	1.00	< 0.01

The one occasion when the 200 meter population was many times the stronger was at a station where the shoal population was decidedly sparse (St. 99, 43 meters, 17 nectophores per hour, corrected). Neither was *appendiculata* ever taken at 200 meters in anything approaching the abundance in which it often occurs near the surface.

Catches, however, averaged at about the same rate (if not corrected) at 400 meters as at 200, at 2 of the 3 stations where tows were made at both levels; much smaller if corrected (Table 28).

And corrected numbers per unit, for deep tows in the western basin, yield the following evidence that measurable numbers may rarely exist even as deep as 800 meters¹, though the deep catches were so small as to suggest that the population at depths greater than 400–500 meters was extremely sparse.

666 meters: St. 129 < 1
St. 131 1
St. 138 < 1

800 meters: St. 106 11
1333 meters: St. 115 < 1

Table 29.

Depth in meters	No. of hauls at stations where taken	Colonies per hour, (uncorrected)	Colonies per hour (corrected)	Value relative to shoalest stratum
16 + 43	12	1169	1164	1.00
200	12	256	36	.03

The following calculations (Table 29) for the summer (July–August) catches in the eastern basin, show the relative vertical distribution to have been essentially the same there, as in the western basin, as indeed, was to be expected.

And while 3 out of 12 available stations showed the 200 meter population from 1–3 times as great as the 16 or 43 meter population, here (as in the western basin) this happened only where the latter was relatively sparse².

Most of the summer catches made in the eastern basin in hauls from deeper than 200 meters were so small that contamination from the shoaler layers may have been entirely responsible³. In only two cases does application of the correction leave any residue:—namely, St. 187 and 189, 19 and 93 per hour respectively

¹ Station 122: No shallow tow, 400 meter tow yielded 201 colonies, 800 meters, 34 colonies, but they may all have been taken near the surface for all that is known to the contrary.

² St. 181, 43 meters, 40 per hour; St. 187, 16 meters, 20 per hour; St. 189, 16 meters, 64 per hour.

³ St. 156, 192, 400 meters; St. 143, 147, 156, 160, 666 meters; St. 186, 800 meters; St. 144, 1333 meters; St. 144, 160, 2666 meters.

at 666 meters. Taken at face value, this suggests that the lower limit to the regular occurrence was somewhat more sharply defined and perhaps somewhat closer to the surface in the eastern basin than in the western.

Autumnal Change. Comparison of the late August—September data with the June data, for the western basin, gives some indication that an alteration in the relative vertical distribution begins during the late summer. Unfortunately, only one late summer station had tows at both 16 and 43 meters. In this one case (St. 204), the deeper of the two (43 meters) yielded 2728 *appendiculata* per hour, contrasted with only 1715 per hour at 16 meters. In one other case (St. 209), the relationship was similar between 16 meters (338 per unit) and 66 meters (987 per unit). So far as these go, they suggest that the zone of maximum abundance may have sunk somewhat since June, i. e. from close to the surface to perhaps the 40—70 meter level. And this is made the more likely by the fact that the disparity between the average populations of the upper 50 meters and of the 200 meter level, which was of the order of 10 to 1 in June (p. 103) was considerably less for the late August—September stations, as evidenced in

Table 30. August—September.

Depth	No. of hauls at stations where taken	Mean no. of colonies per hour uncorrected	Mean no. of colonies per hour corrected	Value relative to shoal tow
16—43	7	1045	819	1.0
200	6	342	275	0.4

Table 30.

Furthermore, the catch (corrected) was the larger in the 200 meter hauls at half of these late season stations as follows (Table 32), but at only about $\frac{1}{5}$ of the June stations.

Table 31.

Station	200 meter value referred to shoal level	Station	200 meter value referred to shoal level
195	0.62	204	0.05
197	1.15	206	0.28
199	4.26	209	1.76 Mean = 1.35

In August—September, however, as in June, this preponderance at 200 meters occurred only at localities where the shoal catch was relatively small (St. 197, 16 meters — 73 per hour (corrected); St. 199, 16 meters — 130 per hour (corrected); St. 209, 16 meters — 338 per hour (corrected)). And there is no evidence that seasonal enrichment of the 200 meter level (if it actually existed), extended any deeper, because the August—September catches in the western basin from greater depths were uniformly insignificant as follows:—

St. 210 — 400 meters.....	Catch per hour (corrected) — 63
- 199 — 666 —	— — — — < 1
- 194 — 800 —	— — — — < 1
- 208 — 1333 —	— — — — < 1
- 209 — 1333 —	— — — — < 1

Winter. In winter, the 200 meter catches in the western basin (whether corrected or uncorrected) averaged about as large as the 43 meter and half as large as the 16 meter catches, instead of only about $\frac{1}{10}$ as large as in early summer. The catch was, in fact, greatest in the 400 meter tow, at two of the four winter stations where hauls were made at that depth as well as shoal. And the fact that *appendiculata* seems to have been most plentiful at 600 meters at one of the five winter stations in the western basin, where it occurred and where deep hauls were made, at 1000 meters at another, suggests that this species may occasionally extend its range much deeper in winter than in summer. This is not a general rule since it seems to have been wholly confined to the uppermost 100 meters at two other winter stations of this group. Details as to the pertinent winter catches just mentioned, are summarized in the following tables 32 and 33.

Table 32. Comparison of 200 meter and 400 meter catches with shoal catches during the winter in the western basin.

Station	Depth	Number per hour (corrected)	Relative value (shoalest tow being unity)	Station	Depth	Number per hour (corrected)	Relative value (shoalest tow being unity)
24	16	32	1.0	31	43	152	1.0
	43	48	1.3		133	70	0.46
	200	0	0.0		400	107	0.7
	400	255	8.2		50	16	240
29	43	0	?		43	47	0.18
	133	19	?		200	0	0.0
	400	19	?		400	0	0.0

Table 33. Comparison of the shoal catches with catches from 600 meters and deeper during the winter in the western basin.

Station	Depth	Number per towing hour (corrected)	Relative value (shoalest being unity)	Station	Depth	Number per towing hour (corrected)	Relative value (shoalest being unity)
35	16	0	?		29	400	19
	66	0	?		1100	22	?
	133	3	?		50	16	240
	200	52	?		43	47	0.18
	466	19	?		200	0	0.0
	666	174	?		400	0	0.0
	43	152	1.0		1066	0	0.0
	133	70	0.46		59	16	129
	400	107	0.7		66	4	0.03
	933	22	0.14		333	0	0.0
29	43	0	?		800	0	0.0
	133	19	?				

This tendency toward a seasonal shift in the center of population to a deeper level in winter than in summer, appears much more clearly in the eastern basin, where the following distribution of catches points to a definite reversal of concentration, from the shoal strata in the warm part of the year (p. 104), to the 400—600 meter zone in the cold (Table 34).

Table 34. Corrected catches per hour in winter, in the eastern basin.

Depth	No. of tows at station where taken	Extreme catches (corrected)	Mean catches (corrected)
16—43	9	0—101	15
200	4	0—22	6
400	1	570	570
666	4	8—1191	393

at 16 meters, 2 per hour at 43 meters and none at all at 200 meters.

How much deeper, in the eastern basin, a significant population may have existed in winter is doubtful. One tow from 800 meters (St. 10) yielded none at all; one from 933 meters (St. 15) brought back 13 (corrected value, 9 per hour).

The foregoing may be summarized as follows:—

If the combination of summer conditions for 1910 with the winter conditions for 1908—1909 illustrates the normal succession, a considerable alteration takes place from season to season in the relative abundance

The great irregularity of distribution forbids a more definite statement. It is, however, interesting, in passing, that the larger of these deep catches rank favorably with the most productive summer catches from the shoal layers, the one from 400 meters (St. 10) being especially interesting because the shoaler tows at this station yielded only 28 per hour (corrected)

of *C. appendiculata* at different depths. In summer and in both basins of the Mediterranean, the species averages much the most abundant near the surface, with mean (corrected) catches only about $\frac{1}{10}$ as great at 200 meters as at 16–43 meters, and about as large at 400 meters as at 200; while measurable numbers may even exist as deep as 800 meters.

Data for the western basin, give slight indication that the zone of maximum abundance may sink between June and September from near the surface to the 40–70 meter level, perhaps with slight relative enrichment as deep as 200 meters. By winter this alteration has progressed in the western basin until the species is nearly or quite as abundant at 200–400 meters as it is in the upper water layers, while in the eastern basin, at this season, it averages most numerous at 400 meters or even deeper, instead of near the surface, as is usually the case in summer. The seasonal difference is even greater for localities where dense aggregations were encountered, the richest unit catch (omitting correction) at 16–43 meters anywhere in the Mediterranean being 242 in winter, whereas 17 (or 27%) of the summer stations yielded more than 1000 per unit, and 5 stations (8%) more than 3000 per hour. Distribution from station to station is, however, extremely irregular. One summer station, for example, yielded upwards of 20 times as many at 200 meters as near the surface, and when the stock in small depths is sparse, the maximum may lie even as deep as 800 meters.

No definite lower boundary to the occurrence of the species is indicated, whether for winter or for summer. But while the stock appears to be very sparse, indeed, below 600 meters in summer, measurable numbers were found to a depth of at least 1600 meters in winter.

It is obvious that an alternation of the sort indicated above, i. e., increase in abundance in the deep water layers, relative to the shoal, might result either from an actual multiplication of the deep living population, or a decrease of the shoal living population.

In the present case it seems certain that seasonal impoverishment of the shoal waters was chiefly responsible, for the average number per hour caught between 50 meters and the surface was about 5–6 times as large in summer as in winter, whether for the western basin alone, or for both basins combined¹. At the same time, some actual enrichment of the deep-living population seems also to occur, for while there is no definite evidence of any significant seasonal alteration one way or the other at the 200 meter level, considerably larger catches were made at and below 600 meters in winter than in summer.

A seasonal alternation of the sort just outlined and in the case of an animal that breeds chiefly in summer (apparently also chiefly near the surface) strongly suggests that the aging individuals tend on the whole to be dispersed progressively downward, both by the eddy-conductivity of the water, and by the fact that their specific gravity is higher than that of water, even if only slightly so. It also indicates that *C. appendiculata* is not effectively phototropic one way or the other.

Seasonal Variations in Abundance.

The mean numbers of *appendiculata* at the stations where it occurred (calculated as explained on p. 68), and at the level of maximum abundance, were approximately:—

Winter	— Western basin	91 per hour	= 1 per	60 cubic meters
—	— Eastern	— 31 —	= 1 -	177 —
—	— Combined	— 80 —	= 1 -	69 —
Summer	— June	— Western basin	1031 per hour	= 1 per 5.3 cubic meters
—	— Sept.	— — —	852 -	= 1 - 6.4 —
—	— Aug.—Sept.	— Eastern basin	310 per hour	= 1 per 17.7 cubic meters
—	— Mid-Sept.	— — —	2025 -	= 1 - 2.2 —
—	— Combined		1046 -	= 1 - 5.3 —

¹ Taking into account only the stations where the species was taken, and where hauls were made both at 16 or 43 meters, and at 200 meters.

The maximal catches were also much larger in summer than in winter as follows:—

Summer	— Western basin	4115	per hour	= 1	per 1.3 cubic meters
	Eastern	7116	-	= 1	- 0.8 —
	Bay of Cadiz	11170	-	= 1	- 0.4 —
Winter	— Western basin	242	-	= 1	- 22.7 —
	Eastern	1911	-	= 1	- 4.6 —

Combination of the foregoing, suggests that the total stock may be about 20 times as strong in summer (June—September) as in mid-winter (February).

Breeding Season.

The eudoxid was first definitely identified in Villefranche, in May, by MOSER (1925, p. 240) who kept specimens in aquaria until the release of cormidia, which latter lived for ten days. Specimens kept by her earlier in the season did not release cormidia, although some bore as many as 60—80 stem-groups. From this it appears that the breeding season opens in the Mediterranean in the late spring. And while no eudoxids were found in the "Thor" collection, the tremendous augmentation in abundance of adults from February to June (p. 107) similarly points to spring and early summer as a period of active reproduction. The scanty data for late August—September afford a hint that the peak of the reproductive season is reached early in summer, because catches average somewhat smaller than do the June catches. The fact that the population averaged only about $\frac{1}{20}$ as rich in winter as in summer points to a preponderance of death rate over production (if any occurs so late in the season) of about this same order of magnitude during the autumn.

Abundance.

On comparing the summer stocks (when the population is largest and the available data most abundant) of several species which were found most frequently at their respective levels of greatest abundance, we find *C. appendiculata* 27 times more abundant than *Lensia multicristata*, 48 times more abundant than *L. fowleri*, and at least 4 times more abundant than *Abylopsis tetragona*¹. Even the low winter stock of *appendiculata*, though only about $\frac{1}{20}$ of the summer population, is at least twice as abundant as the summer stock either of *multicristata* or *fowleri*. Nor do the maximum catches of these two more than about equal the maximal winter catches of *appendiculata* (1 per 22.7 cubic meters in the western basin), whereas the maximal summer catches of *appendiculata* were at least 44 times as great.

Thus, *C. appendiculata* is not only one of the most regularly occurring siphonophores in the Mediterranean, but also by far the most abundant. The largest catch was at the rate of 11170 per hour, or 10053 per 5000 cubic meters.

EUDOXOIDES SPIRALIS Bigelow (p. 44).

Fig. 73.

Horizontal Distribution.

This species, originally described from the Eastern Tropical Pacific (BIGELOW, 1911b), has subsequently been found in Japanese waters (BIGELOW, 1913), Great Barrier Reef, Australia (TOTTEN, 1932; RUSSELL and COLMAN, 1935), Indian Ocean (BROWNE, 1926), at many localities in the South Atlantic, south to Latitude 45° S. (MOSER, 1925; LELOUP, 1934; LELOUP and HENTSCHEL, 1935), likewise in the Tropical and Sub-tropical North Atlantic, northward to the vicinity of the Cape Verdes (LELOUP, 1934) on the one side, and in the region between Cape Hatteras, Bermuda and the Bahamas (BIGELOW, 1918) on the other. It has

¹ *H. hippocampus* is not included in these calculations, though sometimes common because it is impossible to determine what relationship the number of nectophores taken, bore to the number of colonies present in the water.

also been recorded at the following localities in the Mediterranean:— Adriatic (MOSER, 1917), Naples (MOSER, 1917), Villefranche (LELOUP, 1935), and at nine stations in the western basin (LELOUP, 1933). Evidently, then, it is cosmopolitan in warm seas.

Corresponding to its general affinity for relatively high temperatures, the "Thor" records for it outside the Mediterranean were all south of the latitude of Cape St. Vincent (Fig. 73), nor did the "Research" find it in the Bay of Biscay (BIGELOW, 1911 a).

Inside the Mediterranean, it was generally distributed in both basins along the track followed by the "Thor", with no apparent regions of concentration. Rich hauls were correspondingly widely scattered in both the east and west. The distribution is, in short, typical of a species, the stock of which is maintained by local reproduction in both basins. Nor was there any suggestion of significant immigration from the Atlantic: the catches near the Straits, west of Longitude 0° all were small.

E. spiralis, seems, however, to have been absent from the Sea of Marmora: this is interesting because one might expect a species with so wide a vertical range (p. 110) to be carried thither with the undercurrent from the Aegean Sea where it was taken in moderate numbers at 3 stations. Its failure at the single station in the Adriatic was no doubt accidental, since it was found there by MOSER (1917).

Vertical Distribution.

Summer. For *spiralis*, as for perhaps all siphonophores, the distribution is so irregular from place to place — perhaps within short intervals of time — that individual stations may show it either more abundant shoal than deep or vice versa. Averages of all the catches, do, however, reveal a decided consistency.

The "Thor" data outside the Straits of Gibraltar are not sufficient to be significant in this respect, partly because it was taken there at only 2 stations in winter, two in June, and one in September, but more especially because no shoal tow was made at the station (St. 91) where the largest Atlantic catch was made (96 per hour at 200 meters). Hence the following discussion must be confined to the Mediterranean.

In the western basin of the Mediterranean, the average catch per hour (corrected) at the 22 stations where tows were made at 16 and at 200 meters, was 55 nectophores at 16 meters and 7 nectophores at 200 meters. Occasionally, it is true, the deeper haul yielded much the larger catch, but among the 8 stations where one or another haul yielded as many as 10 specimens, the 16 meter catch was 10 times as great as the 200 meter catch at 6 stations, while the reverse obtained only at two. At 8 stations where tows were made at 43 meters as well as at 16 and 200 meters, the average (corrected) numbers per hour's tow were 97 at 16 meters; 130 at 43 meters; but only 2 at 200 meters. At 3 stations where tows were made at 43 and at 200 meters, the average numbers per hour (corrected) were 16 times as great at the shoaler level as at the deeper. The mean for the 16 meter and 43 meter haul combined (54 per hour) was 8 times as great as for the 200. Actually the contrast was even wider than this 8 to 1 relationship might imply, for while only 10 out of 34 (or 29%) shoal hauls (at the 25 stations where the species was taken at some level), failed to yield it, 17 out of 25 (or 68%)

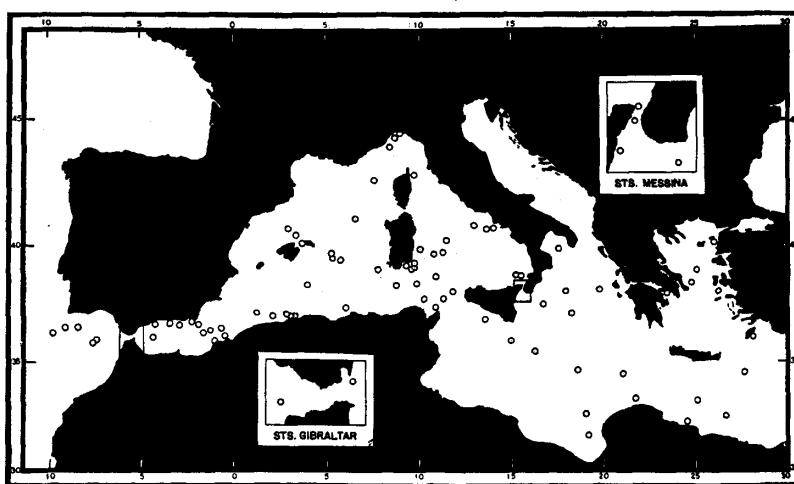


Fig. 73. "Thor" captures of *Eudoxoides spiralis*.

were blank at 200 meters, if we allow for contamination¹. Furthermore, the maximum catch per hour (corrected) was much greater at 16 meters (433 colonies) and at 43 meters (333 colonies) than at 200 meters where it was only 30 colonies.

The catches, in summer tows, at depths greater than 200 meters were as follows (Table 35).

Table 35.

Depth of tow	Hauls at stations where taken	Catch per hour (uncorrected)
400	3	2, 0, 10
666	3	0, 0, 0
600	1	2
800	3	0, 0, 0

Although the distribution is so irregular that the average abundance at different levels is influenced by the particular group of stations under consideration, the foregoing is good evidence that the chief zone of abundance of *spiralis* in the western basin in summer was in the upper strata centering somewhere between the surface and 50—60 meters, that the species averaged perhaps not more than $\frac{1}{8}$ to $\frac{1}{10}$ as numerous at 200—400 meters, and that it occurred only casually at greater depths.

In the eastern basin, available data suggest a somewhat different depth-relationship, i. e. great scarcity (instead of abundance) close to the

surface as illustrated by the 16 meter hauls, combined with comparatively uniform abundance from 40—50 meters down to 200 meters, average numbers (corrected) per hour, at the 13 pertinent summer stations, being as follows:—

16 meters	11 tows	6 colonies
43 —	2 —	68 —
200 —	11 —	58 —

It is unfortunate, in the present instance, that so few tows were made at 43 meters, for the irregularity of distribution, from station to station, forbids any conclusion, whether the whole stratum from 43 meters down to 200 meters was one of roughly equal abundance, or whether it chanced that the two tows in question were made at stations where *spiralis* was unusually scarce at the shoaler of these two levels². Paucity of data similarly makes it doubtful whether the small yields of two hauls at 400 meters — a total of only 4 specimens — actually indicates a correspondingly sudden impoverishment of the population in the eastern basin with increasing depth below 200 meters. But a mean hourly catch of only 8 (uncorrected, or 3 corrected) in 7 hauls at 666 meters, contrasted with about 60 at 200 meters, seems sufficient evidence that the population is decidedly impoverished below say, 300—400 meters in the eastern basin, as is also the case in the western. And while the population at individual stations may be richer deep than shoal (as at St. 147, where the haul from 666 meters yielded 18, the haul from 200 meters none at all) it is doubtful whether significant numbers were living deeper than 600 meters in the eastern basin, for the catches in hauls from 800 meters and deeper, were so small that they may all have been picked up by the nets at lesser depths.

Winter. Catches at the 14 winter stations in the western basin, where *spiralis* was taken, show essentially the same vertical distribution as in summer, i. e. concentration near the surface, with a sparse population extending down to about 400 meters, as follows (Table 36).

Taken at face value, the foregoing would suggest slightly greater relative abundance, in the deeper strata in winter than in summer. But with such wide variations from station to station, hauls made at slightly different localities would no doubt have

Table 36.

Depth	No. of hauls	Extreme catches per hour	Mean catch per hour (corrected)	Ratio
16	3	0—241	63	10
43	5	0—88	42	7
200	6	0—64	14	2
400	2	0—74	37	6
> 400	1	0	0	0

¹ Actually there were 11 blank hauls (or 44%) at 200 meters.

² Corrected numbers per hour at these stations were:—

St. 183. 43 meters, 104; 200 meters, 8.

St. 186. 43 meters, 36; 300 meters, 8.

yielded somewhat different results. For the same reason, one can only say, of the eastern basin, that *spiralis* was rather definitely concentrated close to the surface at the two winter stations where it was taken (St. 10, 11, Table 37), instead of deeper down as seems to have been the prevailing state in summer (p. 110).

Summer and winter combined. The catches of *E. spiralis* for all the Mediterranean hauls made at the stations which yielded it are combined in Table 38.

This distribution is in line with the fact that the great majority of the *spiralis* taken by the "Meteor" were from hauls from 0—50 and 50—100 meters (LELOUP and HENTSCHEL, 1935) with only a few from the deeper closing nets. Most of the "Albatross" series (BIGELOW, 1911b; 1913) were also from the surface hauls.

Thus it seems that over its range as a whole, the species averages much the most abundant within, say, 100 meters of the surface and often close to the surface. It has, however, been taken so often in open hauls from great depths¹, as well as in a few closing net hauls down to at least 800 meters (BROWNE, 1926; LELOUP and HENTSCHEL, 1935) as to make it very probable that wherever it is plentiful in the shoal strata, a sparse population of it may be expected to extend downward to an indefinite depth.

Seasonal Variation in Abundance.

The average numbers, per hour's towing, at the respective levels of maximum abundance, for all stations in the Mediterranean combined, where it was taken were:—

Summer:— 36 stations, about 80 per hour (corrected).

Winter:— 8 stations, about 85 per hour (corrected).

While the closeness of this agreement is perhaps fortuitous, there is certainly no indication here of any great variation in the average abundance in winter and summer. Maximum abundance similarly differed little, if chance variation be taken into account:—

Summer:— 433 per hours tow (corrected).

Winter:— 242 per hours tow (corrected).

In short it seems that no definite alternation takes place in the strength of the population between summer and winter. However, the relative frequency of this species seems significantly greater in the warm half of the year than in the cold, for it was taken at 49% of all summer stations in the Mediterranean, where tows were made at 43 meters or deeper, but at only 21% of corresponding winter stations.

Breeding Season.

In the cases of most of the other diphycids of the Mediterranean, the breeding season is reflected in a great increase in abundance (at some level in the water) from mid-winter to early summer. This, however,

¹ Most of the *spiralis* taken by the "Gauss" (MOSER, 1925) were from vertical hauls from 400 meters to the surface, and some from open nets from much greater depths.

Table 37. Winter catches in the eastern basin,
Stations 10, 11.

Depth	Hauls	Extreme catches per hour	Mean No. per hour (corrected)	Ratio
16	2	2—234	118	10
43	2	0— 1	1	1
200	2	0	0	0
400	1	17	17	1
666	1	0	0	0
800	1	0	0	0

Table 38.

Depth	No. of hauls	Extreme catches per hour	Mean No. per hour (corrected)	Ratio
16	45	0—333	49	10
43	30	0—433	30	6
200	46	0—374	19	4
666	10	0— 74	2	0.4
800	11	0— 1	< 1	< 0.2

is not the case for *E. spiralis*, the numbers of which showed no great change from season to season (p. 111). On the contrary, captures of gonophores or of free eudoxids at 50% of the stations at which the species was taken at any depth in winter, and at about 30% of the summer stations of occurrence, suggests that it breeds about as generally in the cold half of the year as in the warm, though with the possibility still open that breeding is most active at periods of the year not covered by the "Thor" cruises.

LENSIA CONOIDEA Keferstein and Ehlers (p. 48).

Fig. 74.

Horizontal Distribution.

Since *L. fowleri* and *L. subtiloides*, or both, have often been treated as synonyms of *L. conoidea*, it is not possible to delimit the range of the latter from the published accounts. There are definite records of it from the northern Pacific, the Malayan region, the Gulf Stream and the coast of Norway. It also seems

probable that it was represented among the specimens recorded as "*truncata*" from the South Atlantic to almost 60° S. by MOSER (1925), LELOUP (1934), LELOUP and HENTSCHEL (1935), and by HARDY and GUNTHER (1935) and from the Mediterranean by MOSER (1917), LELOUP (1933). It was originally described from Naples by KEFERSTEIN and EHLERS (1860), and has since been reported there by SPAGNOLINI (1868, 1870). LOCHMAN (1914) and LELOUP (1935) also record it from Villefranche.

The "Thor" records include the Bay of Biscay, and the offing

of Portugal (Fig. 74). They also now show it to be widespread in the western basin of the Mediterranean, for it was taken, at least in small numbers, at 63% of the stations there in mid-January (19 out of 30 stations), at 51% (16 out of 31) of the June stations, and at 40% (11 out of 28) of August stations. The captures, furthermore, are so generally distributed along the route of the "Thor" that it is probable that the stock in the western basin is self-maintaining, with little if any help from immigration from the neighboring Atlantic, where the species was also generally distributed winter and summer (Fig. 74).

In the eastern basin and tributaries, on the contrary, it was not taken at all during the winter cruise (10 stations), and at only 8 out of 27 of the summer stations — evidently it is much less regular there than in the western basin. And most of these eastern basin records are based on very few specimens (a total of 16 for 25 of the stations). But two very rich catches in the Sea of Marmora bespeak very active local reproduction there, one of 1665 nectophores in a haul from 66 meters being the richest of all.

Vertical Distribution.

Previous records of this species have shown that its vertical range is a wide one, extending from the surface down to very considerable depths. Thus, in Norwegian waters, as illustrated by the Bergensfjord,

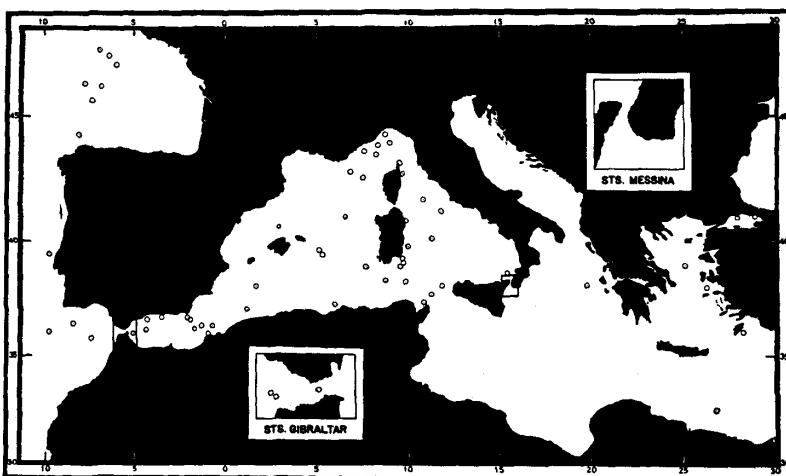


Fig. 74. "Thor" captures of *Lensia conoidea*.

it is to be found at all depths, i. e., down to some 400 meters (RUNNSTRÖM, 1932). The "Meteor" expedition also had it at many stations in hauls varying from 0—50 meters down to 900—1100 meters.

A wide vertical range again appears, from the "Thor" data, the catches per hour (corrected) for all the hauls Atlantic and Mediterranean combined, made at stations where *conoidea* was taken at any depth, being shown in Table 39.

The combined picture is, thus, of a species occurring much more regularly, and in much greater numbers, below than above the 40 meter level, and one which may occasionally occur in large numbers at any depth down to the greatest sampled by the "Thor" (1300—1400 meters). Mean catches, taken alone, would suggest a definite maximum at the 66 meter level. But as this resulted from a single rich catch, it was very likely a matter of pure chance that the calculation gave so high a mean value at this particular level, and not at some other.

Separation of the Atlantic from the Mediterranean catches reveals a regional contrast of the same sort as for several other species, in that the lower limit to regular occurrence lies considerably deeper in the Mediterranean (>800—1000 meters) than in the Atlantic (about 600 meters), as follows (Table 40).

Table 40.

Depth	No. of hauls at stations where taken	Atlantic		No. of hauls at stations where taken	Mediterranean	
		Extreme catches per hour corrected	Mean catch per hour corrected		Extreme catches per hour corrected	Mean catches per hour corrected
6, 16, 43	19	0—19	2	50	0—12	2
66	0	0	0	4	0—1665	421
133, 166, 200, 266	11	0—349	88	30	0—281	24
400, 466, 533, 666	6	0—192	46	19	0—107	10
800, 933, 1066, 1333	4	0—5	1	15	0—592	67

Segregation of the data by seasons, whether for Atlantic and Mediterranean stations combined (Tables 41, 42), or for the latter alone, shows that the upper 40 meters, sparsely populated in winter, become almost entirely depleted of *conoidea* in summer. It also suggests that on the whole, the zone of most regular occurrence lies shoaler in winter, i. e., at 200—600 meters, than in summer when blank hauls were on the whole relatively fewer at depths of 800 meters or more¹. If this be actually characteristic, it points to a general sinking, of the population from winter to summer. But the variations in the catch from station to station are so great (note especially the tremendous catch in the one summer haul at 66 meters) that far more data would be needed before a definite statement could be made.

The comparative scarcity of *L. conoidea* in the upper 50 meters the year round, and its almost complete disappearance from the overlying strata in summer in the Mediterranean, but the widespread occurrence thence down to great depths, contrasts with its vertical distribution in the Atlantic between 20° N. and 35° S., where the "Meteor" closing net hauls (LELOUP and HENTSCHEL, 1935) show it as occurring most frequently

¹ This generalization leaves out of account the ostensible 100% frequency, in summer, at 66 meters. But this depended on a single haul only; had more hauls been made at this level, at stations where *conoidea* occurred, a very different frequency might have resulted.

Table 41. Winter.

Depth	No. of hauls at stations where taken	Catch per hour corrected		% of hauls taking <i>conoidea</i>
		Extremes	Mean	
16, 43	25	0—80	5	36
66	3	0—15	7	67
133, 200	16	0—349	64	69
400, 466, 666	9	0—107	19	70
1066, 1333	7	0—11	2	58

Table 42. Summer.

Depth	No. of hauls at stations where taken	Catch per hour corrected		% of hauls taking <i>conoidea</i>
		Extremes	Mean	
6, 16, 23, 43	43	0—16	1	19
66	1	1665	1665	100
133, 200	32	0—41	7	63
400, 466, 666	18	0—281	30	45
800, 1066, 1333	11	0—592	91	82

at depths less than 200 meters, irrespective of the time of year. And its vertical distribution is of still another type in the Bergensfjord, where RUNNSTRÖM (1932) describes it as present in the deeper layers throughout the year, but as rising to the upper 100 meters only between March and September, to the surface only in August.

Seasonal Variation in Abundance.

The vertical range of this species being so wide and the variations in abundance from station to station so great, the best approximation to a true picture of the relative abundance at different seasons may be expected from comparison of the mean abundance for all levels combined. This is 19 nectophores (corrected) per hour's tow for winter; 55 for summer, if the one phenomenal catch at 66 meters be omitted; 259 if the latter be included in the calculation. Apart, however, from this one case, the maximal catches did not differ very greatly from season to season, though with some preponderance in favor of summer, i. e., 107 and 349 per hour in winter; 281 and 592 per hour in summer (see Tables 41, 42).

Breeding Season and Depth.

The fact that the species was somewhat more abundant in summer than in winter, points to an excess of production over death rate between February and June¹. And the tremendous catch made in the Sea of Marmora on August 11, 1910, was clearly the result of a local wave of early summer breeding. But the presence of considerable numbers of *L. conoidea* in winter as well as in summer, contrasting with the wide seasonal fluctuation which obtains for sundry other calycoaphores, is evidence that some reproduction also takes place in the autumn. This accords with RUNNSTRÖM's (1932) discovery that eudoxids are present throughout the year in Norwegian waters. The vertical distribution described above (p. 113) indicates that eudoxids are set free, and that the larval stages are passed, throughout the whole vertical range of this species, but with the chief production taking place at depths greater than 50—60 meters. In fact it is doubtful whether any significant production, in the Mediterranean, ever takes place close to the surface. In this phase of its life history, the stock living in different localities show interesting contrasts correlated no doubt with hydrologic conditions, but in ways not yet clear. In some Norwegian localities, illustrated by the Bergensfjord, eudoxids occur regularly near the surface as well as deep, at least in summer (RUNNSTRÖM, 1932), but in others i. e. in the Oslofjord, they have been described as confined to the surface waters (SVERDRUP, 1921).

Abundance.

Mean abundance at all depths combined, at stations where the species was taken, was 22 per hour (corrected) or 1 per 250 cubic meters of water in winter; 33 per hour (corrected) or 1 per 166 cubic meters of water in summer; or if the upper 50 meters of water be omitted, 39 per hour (corrected) or 1 per 141 cubic meters of water in winter, 53 per hour (corrected) or 1 per 107 cubic meters of water in summer.

The maximum catches at any level were:—

¹ LELLOUP (1935) found eudoxids common in spring.

349 per hour (corrected) or 1 per 13 cubic meters of water in the Atlantic in winter, 192 per hour (corrected) or 1 per 29 cubic meters of water in summer; 250 per hour (corrected) or 1 per 22 cubic meters of water in the western basin in winter, 592 per hour (corrected) or 1 per 9 cubic meters of water in summer; 1665 per hour (corrected) or 1 per 3 cubic meters of water in the Sea of Marmora in summer.

LENSIA FOWLERI Bigelow (p. 53).

Fig. 75.

Horizontal Distribution.

The original series (BIGELOW, 1911a) was from the Bay of Biscay, where the "Thor" again had it at eight stations, likewise at two in the Bay of Cadiz (Fig. 75). Specimens unmistakably identifiable as *fowleri* have also been recorded from the West Indies (BIGELOW, 1911b, 1918); the Eastern Tropical Pacific (BIGELOW, 1911b); off the Great Barrier Reef, Australia (TOTTON, 1932; RUSSELL and COLMAN, 1935); the Indian Ocean (BROWNE, 1926); and the Southern Atlantic (LELOUP, 1934; MOSER, 1925). *L. fowleri* has not been recorded previously in the Mediterranean under its own name, but it may have been represented among specimens reported thence by MOSER (1917) and by LELOUP (1933) as "*truncata*" (*L. conoidea*, p. 48, 112), for the "Thor" collection shows it to be widespread in both basins.

In the western basin (summer and winter), it was taken at 45 out of 57 stations where tows were made at 200 meters or deeper — and also at two stations (57, 58) where the deepest towing levels were 133 and 66 meters respectively, the localities of occurrence (Fig. 75) being generally distributed along the routes traversed by the "Thor". The presence or absence (apart from abundance) of the species at various stations suggests some concentration in the Alboran Sea, between Sardinia and the Pantellarian Channel, and in the region between Corsica and the French Riviera, contrasting with an apparent scarcity in the Catalonian Sea and to the southwest of Central Italy. But the distribution of captures is not regular enough to show whether, or to what degree, these apparent regional differences are associated with the major circulatory movements of the western basin (outlined by NIELSEN, 1912, Pl. 11).

In the eastern basin, the species seems to have been more regularly distributed in the northern part (Ionian and Aegean Seas) than in the southern to the south of the latitude of Crete, for it was taken at 14 out of 17 deep towing stations (82%) in the former subdivision, but at only one of the seven deep towing stations (14%) in the latter. Yet there is no evidence that it penetrates the Adriatic, the Sea of Marmora, or the Black Sea.

The fact that the localities of record are so widespread argues that the populations in the two basins are indigenous, i. e. not dependant for their persistence on immigration either from the Atlantic via the Straits of Gibraltar or from the one basin to the other via the Pantellarian Channel. The general tendency of this

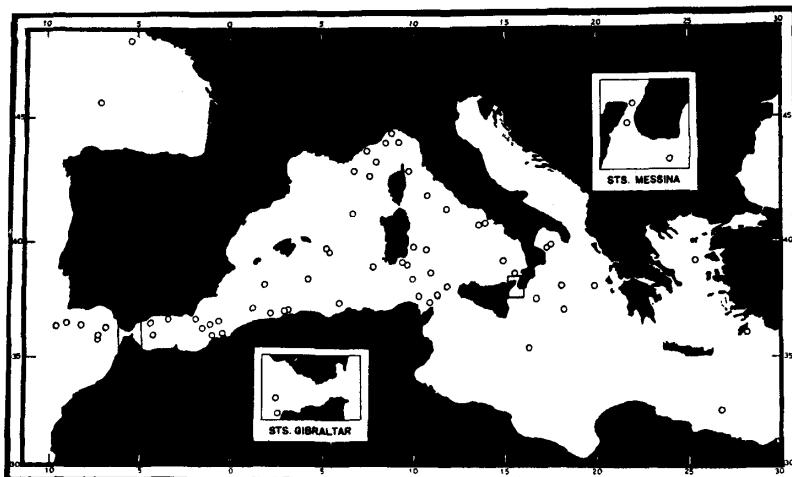


Fig. 75. "Thor" captures of *Lensia fowleri*.

species to hold to the deeper water layers would, indeed, make it more likely that the Mediterranean contributes it to the Atlantic, than the reverse, though the catches just inside and just outside the Straits of Gibraltar were so small that no mass-movement can have been taking place in either direction at the times of the cruises. In the case of the Pantellarian Channel, the catches per hour (corrected) at Stations 137, 138 and 139 (Table 43) seem to have favored some drift of *fowleri* northward (i. e., from the eastern basin to the western) in the undercurrent (see NIELSEN, 1912, Fig. 11).

But there being no definite upper boundary to the occurrence of *fowleri*, no doubt a certain number come within the sweep of the surface drift in the opposite direction.

Table 43.

Depth	St. 137	St. 138	St. 139
16	0	0	0
166	10	—	—
200	—	0	107
533	—	—	0
666	—	10	—

Vertical Distribution.

In general, there were only trifling numbers of *fowleri* in the surface layers (16 and 43 meters). The few tows at 66 and 133 meters showed it somewhat more abundant at these levels. A much richer population was found near 200 meters, with the population again averaging only about $\frac{1}{4}$ as great at 400 meters as at 200. Deeper than this, it seems that *fowleri* was only a stray, since most of the deep catches were negligible

if the probable contamination from the overlying layers be allowed for, as illustrated by Table 44 which includes all Mediterranean stations winter and summer, where the species was taken.

While the Atlantic catches were too small for much statistic significance, they yield much the same picture so far as they go, at the stations where *fowleri* was taken, and where hauls were made deep, as well as shoal, (Table 45).

Segregation of the Mediterranean data by seasons shows that the largest catches were made at about the same depth (near 200 meters) in winter as in summer, whether for the Mediterranean as a whole or for the western basin alone. Neither does any seasonal variation appear in the location of the uppermost limit to its regular occurrence, in spite of the difference of about $7^{\circ}\text{ C}.$ in the temperature ($13.5^{\circ}\text{--}21^{\circ}\text{ C.}$ in the western basin) of the upper strata between the warmest and the coldest seasons. Actually, the two records in the 6 and 16 meter hauls were for July and August, while the four records for 43 meters were in January, February, June, and July. The summer hauls for the Mediterranean also closely correspond with the combined winter-summer picture, as respects the decrease in the abundance with depth from 200—400 meters downward, and in the existence of

Table 44.

Depth	No. of tows	Extreme catches per hour (corrected)	Mean No. per hour (corrected)
16	37	0— 0	0
43	25	0— 2	< 1
200	45	0—278	38
400	11	0— 40	11
666	13	0— 12	3
800	6	0— 13	2
> 800	7	0	0

Table 45.

Depth	No. of hauls	Extreme catches per hour (corrected)	Mean No. per hour (corrected)
16, 43	12	0— 2	0
200	8	0— 34	7
400	4	0— 1	< 1
666, 800	3	0— 1	1
1066	2	0— < 1	1

a sparse population down to depths greater than 666 meters. It is unfortunate that no systematic towing was done between 43 and 200 meters, for this gap in the data leaves open the possibility that the center of abundance for this species may have lain somewhere between these levels, or (more likely) that it may have been as abundant at 100 meters as at 200. And the earlier records of the species equally leave this question open. Thus the distribution of catches in the Bay of Biscay in vertical hauls with open nets (4 from 0 meters; 4 from 91—0 meters; 7 from 137—0 meters; 39 from 183—0 meters; 1 from 457—0 meters; and 4 from 550—0 meters; BIGELOW, 1911 a) contrasted with the fact that seven closing-net hauls from 180—366 meters

failed to take it, suggests a concentration not far from the 150 meter level. And BROWNE (1926) similarly records this species from 8 open hauls from 180—0 meters in the Indian Ocean, but not in hauls from 137—0 meters. On the other hand, the "Meteor" data suggest a comparatively uniform distribution, from a depth not greater than 50 meters down to perhaps 200 meters, with occasional specimens living at least as deep as 600 meters, as appears from the following calculation (Table 46) from LELOUP and HENTSCHEL's (1935) tables of specimens caught per 100 meters of towing, in vertical hauls with closing-nets¹.

The Eastern Pacific series collected by the "Albatross" (BIGELOW, 1911b), were all from hauls with open nets from 550—0 meters; none were taken in the surface hauls. Most of the "Bache" series from the Western Atlantic (BIGELOW, 1918) were also from open hauls from depths ranging from 1000—0 to 200—0 meters, a few, however, from the surface. And towings made in 1908 in West Indian waters from the S. Y. "Virginia" yielded it twice from 150—0 meters², but not at all at the surface.

Combination of the foregoing, shows that while *L. fowleri* may occasionally appear right up to the surface, its zone of chief abundance and most regular occurrence is usually at about 100—200 meters, throughout its horizontal range.

Seasonal Variation in Abundance.

L. fowleri was taken at 40 out of 51 summer stations (79%, western and eastern basins combined) in the Mediterranean, where tows were made at 200 meters or deeper. In winter, it was taken at 15 out of 24 stations (63%) with tows at 200 meters or deeper and also at two shoaler stations (57, 58). Considering the wide margin of error inherent in calculations of this sort, we find no evidence here of any significant difference in the frequency of this species, between winter and summer; in this it contrasts strongly with *L. multicristata*, for example (p. 119).

But the population was much more abundant in summer than in winter. Thus the maximum catches in the western basin were 278 nectophores (corrected) per hour in summer, but only 18 nectophores (corrected) per hour in winter. Indeed, all the 15 hauls which yielded 20 or more *fowleri* per hour there were made in the months of June, July, and August, whereas only 7 winter catches at any depth yielded as many as 10 per hour.

In the eastern basin also, the mean catches per hour were also about 5 times as great in summer (mean, 22 per hour corrected, in 13 tows) as in winter (mean, corrected, about 4 per hour in 7 tows)³.

Breeding Season and Abundance.

The facts that the species was several times as abundant in summer as in winter in the more populous layers, and that the densest populations were also encountered in summer, is good evidence that reproduction takes place most actively at some time between January—February and July—August, there being no evidence that this increase was due to waves of immigration. No young were found. But the facts that the species appears only casually in the shallow (43 meters) tows, that the level of chief abundance was as deep in summer as in winter, and that the vernal augmentation is most marked at the depths where the species is already most numerous, are good evidence that the chief reproduction of this species takes place in the deeper layers, i. e.,

¹ The calculation includes all closing-net hauls made at the stations where the species was taken at any depth.

² Specimens now in the Museum of Comparative Zoology.

³ Considering only stations where *fowleri* occurred.

Table 46.

Depth, meters	No. of hauls at "Meteor" stations where taken	No. of specimens per 100 meters of towing
0—50	4	1
50—100	11	2
100—200	3	1
200—400	7	0.14
400—600	1	0.5
600—800	2	0.5

at 100—200 meters or thereabouts. Whether reproduction was still continuing during the summer cruise, or whether a definite number of broods are produced per year, cannot be determined from the collections. It is, however, interesting that the indicated vernal augmentation is much smaller for *L. fowleri* than for *L. multicristata*. But this difference does not necessarily mean that reproduction is not as successful for *fowleri* as for *multicristata*, it being equally possible that breeding for the former was at its peak either earlier in the season than the date of the summer cruises of the "Thor", or later.

The richest Mediterranean catches were at the rate of 278 per hour or 250 per 5000 cubic meters in summer, 18 per hour in winter. The richest Atlantic catch (at any season) was 34 per hour.

LENSIA MULTICRISTATA Moser (p. 55).

Fig. 76.

Horizontal Distribution.

Earlier reports have shown this species to be widespread in the Eastern Tropical Pacific (BIGELOW, 1911 b), in the Indian Ocean (BROWNE, 1926), in the South Atlantic (MOSER, 1925; LELoup, 1934; LELoup and HENTSCHEL, 1935), and as far north in the North Atlantic as the Bay of Biscay (BIGELOW, 1911 a). It was therefore no surprise to find it at several "Thor" stations in the Bay of Biscay, off the coast of Portugal and in the Bay of Cadiz (Fig. 76).

It had previously been overlooked in the Mediterranean, but the "Thor" data now prove it to be widespread in the western basin, where it occurred at 28 (58%) of the 48 stations where tows were made at 200 meters or deeper, the localities being generally distributed, winter and summer, from north to south, and

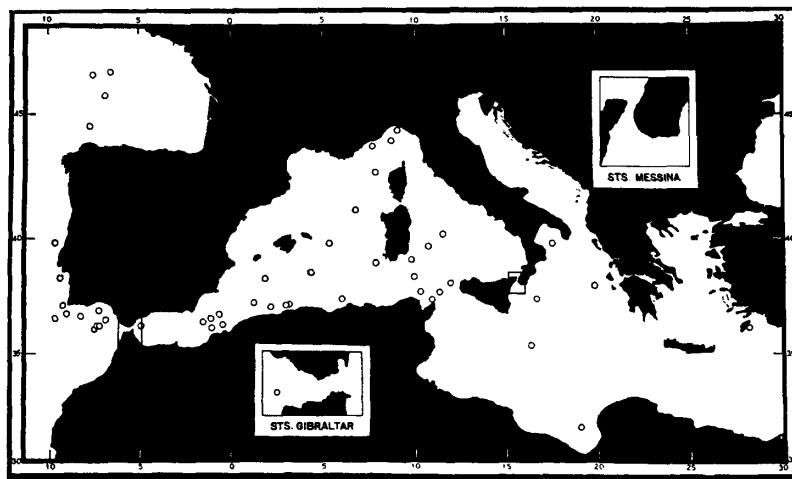


Fig. 76. "Thor" captures of *Lensia multicristata*.

from east to west (Fig. 76). It seems, however, that the Pantellarian Channel marks the eastern limit of its regular occurrence, for it was taken at only seven widely scattered stations in the eastern basin, and not at all in the Adriatic, in the Aegean Sea or in the Sea of Marmora.

The species was also less numerous at the stations where it did occur in the eastern basin than in the western, the mean catch per hour, at the level of greatest abundance, being only 19 in the one case (maximum, 53), but 100 in the other (maximum, 392).

Vertical Distribution.

With one exception, the previous captures of the typical form of *L. multicristata* were with open nets from considerable depths. Thus, in the Bay of Biscay, the "Research" failed to take it at all in 16 hauls at the surface or in 12 hauls from 46—0 meters: only one haul out of 13 from 91—0 meters yielded it (10 specimens), and only 4 out of 22 hauls from 180—0 meters (a total of 11 specimens). But 2—3 specimens were taken

in each of 5 hauls from 274—0, 366—0, and 457—0 meters¹. Similarly, all but one of the "Gauss" series of 73 specimens were from vertical hauls from 1500—0 and 3000—0 meters, the sole exception being from the surface (MOSER, 1925). BROWNE'S (1926) five Indian Ocean specimens were from open hauls from depths of 732 meters or more, none from the many shoal tows. And the one specimen reported by LELoup and HENTSCHEL (1935) was from a closing net from 400—600 meters. All the "Meteor" records for the *grimaldii* form (p. 57), were also from depths of at least 200 meters, most of them from at least 400 meters.

The foregoing is good evidence that this species occurs chiefly at a depth of several hundred meters, only occasionally near the surface. And the "Thor" data show that this applies equally to it in the Mediterranean. In the western basin, the calculation, whether for all seasons combined (28 stations), or for summer alone (23 stations), shows it as occurring only casually shoaler than 43 meters, as increasing in abundance downward from 200 meters to a maximum at about 400 meters and as decreasing, again, from this level, downward, mean numbers (corrected) per hour's tow for the summer cruise being shown in (Table 47).

This locates the maximum for this species as about 200 meters deeper than for *L. fowleri*, and 350 meters deeper than for *Chelophyes appendiculata* (pp. 116, 103, Fig. 83). Present indications are that the lower boundary to its regular occurrence is at about 700—800 meters. And an analysis of the five winter catches yields no evidence that the level of maximum abundance in the western basin lies any closer to the surface or that it rises toward the surface tows any more often in summer than in winter.

L. multicristata was taken at so few stations (7) in the eastern basin that conclusions as to its vertical distribution are not so well based for that part of the Mediterranean as for the western. It is, however, striking

that whereas it was taken frequently in 200 meter hauls in the latter, it was only taken in tows from 400 meters or deeper in the eastern basin, as appears from the table of catches (corrected) per hour's towing there (Table 48).

It is interesting that comparison of Mediterranean catches, just discussed, with Atlantic

Table 48.

St.	43 meters	200 meters	400 meters	666 meters	800 meters	1333 meters
10	0	0	41	—	0	—
13	0	0	—	13	—	—
143	—	0	—	1	—	—
144	—	0	—	—	—	1
147	—	0	—	7	—	—
160	—	0	—	53	—	—
186	0	0	—	—	40	—

catches shows the regular range of this species as extending downward about as far in the Atlantic (to about 666 meters) as in the western basin of the Mediterranean, in which it differs from such other species as *Enneagonum hyalinum* (p. 86), *Abylopsis tetragona* (p. 89), *Muggiae atlantica* (p. 100), *Chelophyes appendiculata* (p. 103), and *Lensia conoidea* (p. 113).

Seasonal Variation.

Segregation of the catches according to the time of year shows that this species was much more generally distributed through the western basin in summer than in winter, as follows:—

¹ It was not taken in any of the closing net hauls, deep or shallow.

Summer:—	Stations with hauls at 200 meters or deeper	40
	with <i>multicristata</i>	21 = 52%
	Stations with hauls at 400 meters or deeper	19
	with <i>multicristata</i>	11 = 58%
Winter:—	Stations with hauls at 200 meters or deeper	18
	with <i>multicristata</i>	5 = 28%
	Stations with hauls at 400 meters or deeper	10
	with <i>multicristata</i>	3 = 30%

It is also clear that a considerable augmentation takes place in the abundance of the species there, from early winter to summer, at the level of maximum abundance, smaller increases at other levels, mean abundance (corrected) at different levels being as follows (Table 49) at stations where taken.

Table 49.

Depth		Winter	Summer
43 meters	1 specimen per.....	5500 Cu. M. of water;	> 5500 Cu. M. of water
200	1 — — -	275 — - — ;	161 — - —
400	1 — — -	687 — - — ;	36 — - —
666	1 — — -	< 5500 — - — ;	74 — - —
800	1 — — -	< 5500 — - — ;	< 5500 — - —

Otherwise expressed, while the species was equally scarce (almost non-existent) close to the surface on the one hand and at and below 800 meters on the other, it was about 1.5 times as numerous at 200 meters, about 19 times as numerous at 400 meters, and more than 70 times as numerous at 666 meters in summer as in winter. And omission, from the calculation, of the correction for contamination, would not much affect the picture.

Similarly, the maximum abundance was significantly larger in summer (one specimen per 14 cubic meters of water at 400 meters) than the winter maximum (1 specimen per 55 cubic meters of water which happened to be at 200 meters)¹.

In the eastern basin, however, the frequency of occurrence at the stations where hauls were made deep enough (200 meters or more) to catch the species, if present, was about the same in winter (2 out of 7 stations = 29%) as in summer (4 out of 19 stations = 21%), nor was there any significant seasonal variation in the number of specimens taken.

Interchanges via the Straits of Gibraltar and via the Pantellarian Channel.

The "Thor" stations just inside the Straits of Gibraltar yielded a considerable number of *multicristata* in hauls from 200 meters (255 specimens in 6 hauls), but none at all in hauls from 43 meters or from 16 meters. Thus, the upper boundary of the species was close enough to the surface, at the time, to come within the sweep of the outflowing bottom current. And all but one of the *multicristata* (171 specimens in 14 hauls) taken outside the Straits were also from hauls at 200 meters or deeper, with maximum catches in the 400 and 666 meter hauls, i. e., from depths too great to be affected by the inflowing surface drift, and for the most part deeper than the sill-depth of the straits.

This, added to the generally bathypelagic habit of the species (p. 118) suggests a greater probability of significant numbers being carried out of the Mediterranean than into the latter, but makes it unlikely that interchange, in either direction, is of sufficient magnitude, much to affect the local abundance of the species.

¹ Assuming that the entire catch was made in the horizontal parts of the tow in each case.

Vertical distribution argues, similarly, against mass contributions from the western basin through the Pantellarian Channel, into the eastern basin, which accords with the fact that the species is so much less widespread in the latter, and so much less abundant there. It is possible, however, that the presence of *L. multicristata* in the eastern basin, at all, depends on occasional immigration, for conditions favored such an event on the date of Station 137, when the capture of 118 specimens per hour in a tow from only 166 meters in the Channel suggests the presence of considerable numbers shoal enough to be caught in the eastflowing water (NIELSEN, 1912, p. 134). The contrast between western and eastern basins, with regard to seasonal variation, outlined above, also argues that the stock existing in the latter is supported by immigration from the west, as well as by local reproduction.

On the other hand, the fact that all catches in the eastern basin were in nets working as deep as 400 meters or deeper suggests impoverishment of the local stock by drifting in the opposite direction with the undercurrent. Theoretically, then, we might expect intermittent movements of individuals eastward at and slightly above the 200 meter level on the one hand, and westward in the bottom waters of the channel on the other. With so complex an interrelation, it is hardly to be expected that so few localities of capture could throw any light on the lines of dispersal.

Breeding Season, Breeding Area and Abundance.

The failure to find any juvenile stages of this small species was to be expected, with catches from nets of comparatively coarse mesh. Nevertheless, the quantitative distribution of the adults locates the chief breeding season, depth, and locality with fair probability. Judging from the vertical distribution of this species off Gibraltar (p. 119) immigration from the Atlantic can not be invoked to account for its much greater abundance in the western basin in summer than in winter. And as the eastern basin does not support a large enough population to serve as a significant source of supply the only reasonable explanation is that the vernal increase in the western basin is the result of local reproduction. This points to an increase in breeding activity between February (month of the latest winter stations) and June, culminating before autumn. It is unlikely, on the other hand, that local reproduction in the eastern basin is sufficient to counteract the death rate, judging from the fact that *multicristata* is never generally numerous there. The occasional rich centers (p. 119) recorded there seem too sporadic to affect the population as a whole. The fact that the level of maximum abundance was no closer to the surface in summer, when the stock had been recruited from the new brood (or broods), than in winter, suggests that the juvenile stages occupy about the same strata as the adults.

Assuming that the difference between the "Thor" catches for January—February and for June—September represents the normal variation in abundance between these two seasons, the summer—winter decrease points to an autumnal death rate of about 16% of the summer population.

The richest catch was at the rate of 392 per hour or 352 per 5000 cubic meters of water.

LENSIA SUBTILOIDES Lens and Van Riemsdijk (p. 58).

Fig. 77.

Horizontal Distribution.

This species, first described by LENS and VAN RIEMSDIJK (1908) from the Malayan region, has subsequently been reported from the Indian Ocean (BROWNE, 1926) and in great abundance from the Great Barrier Reef, Australia (TOTTON, 1932). Most other recent authors (BIGELOW, 1913; MOSER, 1925; LELOUP, 1933, 1934) have considered this a synonym of *L. conoidea* (under the name *D. truncata*), so that it is impossible to learn from evidence now available, how widespread it really is.

The one "Thor" specimen was from the Bay of Biscay (Fig. 77).

CHUNIPHYES MULTIDENTATA Lens and Van Riemsdijk (p. 60).

Fig. 77.

Horizontal Distribution.

Records for this widespread species, originally described from Malayan waters (LENS and VAN RIEMSDIJK, 1908), include the Eastern Tropical Pacific (BIGELOW, 1911b; 1931), the offing of California (BIGELOW and LESLIE, 1930), Eastern Sea between Japan and China (BIGELOW, 1913), Philippines (BIGELOW, 1919), and both sides of the Atlantic:— south to South Georgia, and north to the Bay of Biscay (BIGELOW, 1911a; MOSER, 1925; LELOUP, 1933, 1934; HARDY and GUNTHER, 1935). The fact that it was taken at 19 stations during the cruises of the Prince of Monaco between the Azores, Canaries, Straits of Gibraltar, coast of Portugal, and Gulf of Gascony (LELOUP, 1933), likewise by the "Thor" at two stations in the Bay of Cadiz, one off the coast of Portugal, and four in the Bay of Biscay, proves it generally distributed in this part of the Atlantic. But there is only one Mediterranean record for it (LELOUP, 1933, p. 39), the "Thor" having failed to find it at all there, in spite of the large number of deep tows made on her cruises (p. 3).

The case of *Chuniphyes* is especially instructive as regards the problem of immigration into the Mediterranean (p. 128), both because records of it now include a considerable number of stations outside the Straits of Gibraltar, and also because it is so large,

so characteristic in appearance, and so resistant in structure, that it would almost certainly have been recognized and recorded at many Mediterranean localities, if it occurred regularly there. Evidently, it passes the straits only as the rarest of stragglers, which do not long survive.

Vertical Distribution.

Previous captures of *Chuniphyes* have been either in open nets sent to depths greater than 400 meters, or in closing-net hauls deeper than 300 meters, the distribution being as follows¹ (Table 50).

The "Thor" records again show *Chuniphyes* as chiefly confined to depths greater than

¹ This tabulation combines all published records of the species, for which the depth of the haul was stated.

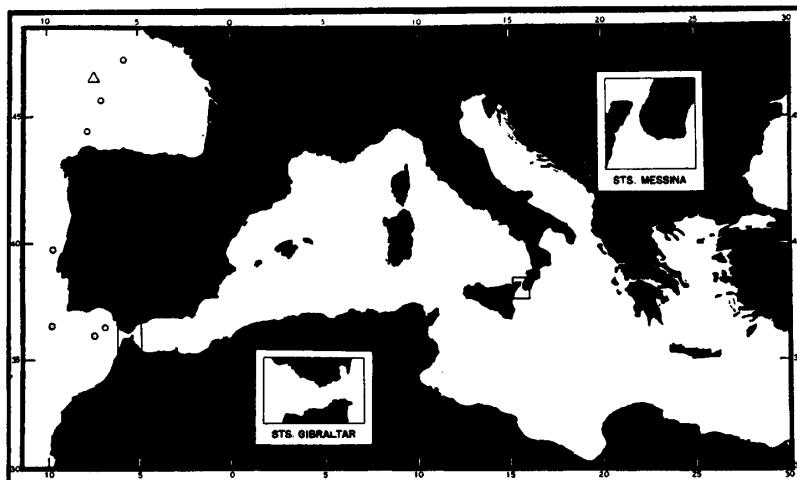


Fig. 77. "Thor" captures of *Lensia subtiloides* (triangle) and of *Chuniphyes multidentata* (circles).

Table 50.

Open hauls		Closing-net hauls	
Depths between meters	Cases	Depths between meters	Cases
450—0 and 650—0	8	500—300	1
800—0 and 1200—0	4	600—400	1
1500—0 and 1900—0	5	800—600	2
2000—0 and 2500—0	5	1000—800	1
2650—0 and 3250—0	13	2280—1830	1
4500—0 and 4800—0	2	2740—1372	1
		3660—1830	1

Table 51.

Depth	No. of tows made at stations where <i>Chuniphyes</i> occurred	Percentage of tows taking <i>Chuniphyes</i>
16 + 65	15	6
200 + 400	14	21
800 + 1033	4	100
2000 + 2866	2	100

200—400 meters, but as occasionally rising close to the surface, witness the capture of one nectophore in a haul with only 25 meters of wire, at Station 76, data being as given in Table 51.

The actual catches are listed on p. 60. The calculated vertical distribution of catches per hour (corrected) including all tows made (whether blank or productive) at the stations where the species occurred, is as follows (Table 52).

Table 52.

Depths	St. 65	St. 66	St. 69	St. 71	St. 74	St. 75	St. 76
16	0	0	0	0	0	0	2
43	0	0	0	0	0	0	0
200	0	0	0	5	0	0	0
400	0	0	0	57	53	0	0
800	—	8	—	—	—	—	—
1033	2	—	—	—	—	—	74
2000	—	—	15	—	—	—	—
2866	—	—	—	—	—	—	—

PHYSOPHORA HYDROSTATICICA Forskål (p. 63).

Fig. 78.

Horizontal Distribution.

Physophora hydrostatica has been recorded from the Indian Ocean (QUOY and GAIMARD, 1834; HUXLEY, 1859; HAECKEL, 1888), from the Malayan Archipelago (LENS and VAN RIEMSDIJK, 1908), from the Philippines (BIGELOW, 1913), from the Eastern Tropical Pacific (BIGELOW, 1911b, 1931), and from many localities in the Atlantic as far north as the Arctic Circle.

It has been reported at the following localities, in the Mediterranean:

Villefranche — VOGT (1854), METSCHNIKOFF (1874), MOSER (1917);
 Nice — RISSO (1826), VERANY (1846), VOGT (1851, 1854), LEUCKART (1854), GRAEFFE (1860), CLAUS (1860);
 Naples — DELLE CHIAJE (1828), O. G. COSTA (1836), SPAGNOLINI (1868, 1870), PAVESI (1869...), SCHMIDTLEIN (1880), BEDOT (1882), SCHNEIDER (1898), LO BIANCO (1899);
 Messina — PHILIPPI (1843), KÖLLIKER (1853), GEGENBAUR (1854), SARS (1857), KEFERSTEIN and EHLERS (1861), CLAUS (1878), KOROTNEFF (1886), CIALONA (1901);
 Adriatic — off Lucietta, Pomo Deep, Southern Deep — MOSER (1917).

The "Thor" did not take *P. hydrostatica* at any of the stations in the eastern basin, but found it at 11 stations in the Atlantic and in the western basin of the Mediterranean (Fig. 78). Of these, 4 were for winter, and 7 for summer showing that adult colonies occur the year-round, which is contrary to CHUN's (1887, p. 16) earlier suggestion that the adults ripen at the beginning of winter.

Vertical Distribution.

All records of *Physophora*, prior to 1887, were either at the surface, or close to the latter. In that year, however, CHUN (1887, p. 16) described it off Naples (where it is common) as disappearing from the surface at the beginning of summer, and reported the capture of one young colony in a closing net, at 900 meters, in October. Subsequent records have again been from the surface and from hauls with open nets sent to various depths down to 900—0 meters.

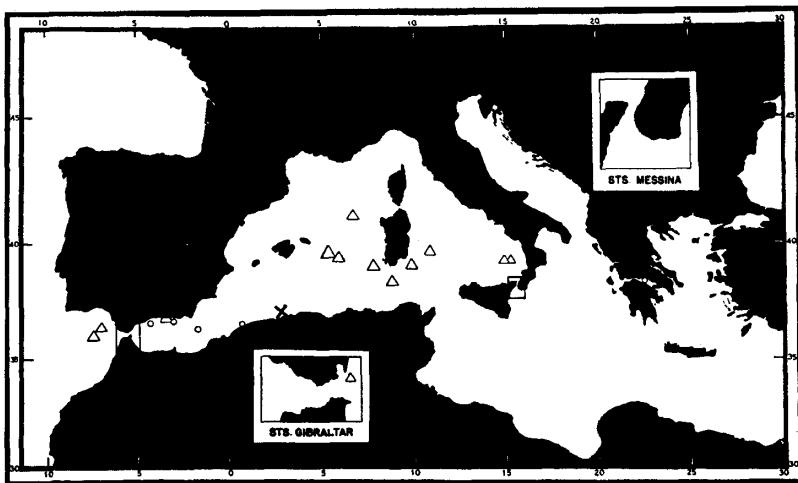


Fig. 78. "Thor" captures of *Physophora hydrostatica* (triangles), *Rhizophysa filiformis* (circles), and *?Anthophysa rosea* (cross).

So far as they go, previous data thus suggested that the species lives chiefly in the upper strata, but that there is no definite lower limit to its occurrence. And this is corroborated — at least for the Mediterranean — by the fact that four of the six stems of *Physophora* taken by the "Thor" were in hauls from 43 meters (4 stations), one in a haul from 200 meters, one from 400 meters. Loose parts in other hauls were more widely distributed as to depth of capture, with palpons in one haul from 16 meters; one from 133 meters; one from 200 meters and nectophores in one

haul from 16 meters; two hauls from 200 meters; one from 666 meters; and one from 800 meters. This suggests that these structures tend to sink if accidentally detached, as was to be expected.

? ANTHOPHYSA ROSEA (p. 64).

Fig. 78.

The single "Thor" capture is of considerable interest, geographically, for it is the first record for the genus in the Mediterranean.

It was, however, to be expected there, since the Prince of Monaco had it between the Azores and Canaries (BEDOT, 1904, p. 5, *Anthophysa formosa*).

RHIZOPHYSA FILIFORMIS Forskål (p. 65).

Fig. 78.

Horizontal Distribution.

The few "Thor" records (Fig. 78) add little to the geographic range of this warm-water species, for it was known, not only from various localities in the Tropical and Subtropical Atlantic, from the Malaysian region, and from the Eastern Tropical Pacific, but from the following west-Mediterranean localities as well:—

Nice — RISSO (1826), LEUCKART (1853);

Naples — SPAGNOLINI (1868, 1870), KOROTNEFF (1884), SCHMIDTLEIN (1880), SCHNEIDER (1898), LO BIANCO (1889), NEPPI (1921);

Messina — SARS (1857), GEGENBAUR (1854), KEFERSTEIN and EHLERS (1861);
Villefranche — VOGT (1851), FEWKES (1879).

So far the only record for it in the eastern basin of the Mediterranean is in the Gulf of Corinth ("Thor" St. 184).

Vertical Distribution.

The vertical distribution of the "Thor" specimens (7 colonies distributed among 5 hauls from 16, 43, 56, and 1333 meters) is in line with previous experience, this species having been taken frequently at the

surface and also in hauls with open nets from various depths. It is probable that it occurs most frequently in the upper 100 meters or so but that, on occasion, it may live much deeper.

The "Thor" captures added to the early records show that *R. filiformis* may be expected in the Mediterranean at any time of year.

PORPITA UMBELLA O. F. Müller (p. 66).

Fig. 79.

Horizontal Distribution.

Porpita is a regular inhabitant of the Mediterranean. Earlier records are:—

Mediterranean — ESCHSCHOLTZ (1829);
 Cette, Nice, or Specia — PAGENSTECHER (1869);
 Nice — VERANY (1846), LEUCKART (1854);
 Villefranche — LELoup (1935);
 Genoa — VERANY (1846);
 Naples — SPAGNOLINI (1868, 1870), SCHMIDTLEIN (1880), BEDOT (1882), KOROTNEFF (1884), SCHNEIDER (1898), LO BIANCO (1899), NEPPI (1921);
 Messina — KÖLLIKER (1853), GEGENBAUR (1854), KEFERSTEIN and EHLERS (1861), CIALONA (1901);
 Malta — FORSKÅL (1775);
 Lycia — FORBES (1844).

These, and the "Thor" captures (Fig. 79) show that its range includes both basins, as well as the channel connecting them.

The records of *Porpita* in the Mediterranean are fewer than for *Velella* and it seems never to be as abundant there, although SCHNEIDER (1898) reports occasional swarms off Naples, while LO BIANCO (1899) notes that it often appears in great numbers there, during the summer. The season of greatest abundance at Messina is reported as May (CIALONA, 1901). Most of the other records have also been for spring and summer.

The breeding season appears to endure from late spring to fall judging from LO BIANCO's (1899) report of the liberation of medusae from May to June and October, with young colonies of 5 mm. in July. This is corroborated by the fact that the "Thor" specimens all of which were small (p. 66) were taken in late summer.

VELELLA VELELLA Linné (p. 66).

Fig. 79.

Horizontal Distribution.

This well known species is widespread in the western Mediterranean, as appears from the extensive list of published records:—

Mentone — FORSKÅL (1775), HOLLARD (1845);
 Cette — GRANGER (1879);
 Cette, Nice, or Specia — PAGENSTECHER (1869);
 Nice — RISSO (1826), VERANY (1846), VOGT (1854), LEUCKART (1854), BEDOT (1894);
 Monaco — MOSER (1917), BOONE (1933);
 Villefranche — BEDOT (1884), WOLTERECK (1905), MOSER (1917, 1925), LELoup (1935);
 Genoa — VERANY (1846), PAVESI (1869...);
 Livorno — SPAGNOLINI (1876);
 Capri — LO BIANCO (1903);
 Naples — O. G. COSTA (1836), SARS (1857), KEFERSTEIN and EHLERS (1861), SPAGNOLINI (1868, 1870), PAVESI (1869..), SCHMIDTLEIN (1880), BEDOT (1882), KOROTNEFF (1884), SCHNEIDER (1892, 1898), LO BIANCO (1899), NEPPI (1921), MOSER (1925);

Palermo — DE GREGORIO (1892);

Messina — KÖLLIKER (1853), GEGENBAUR (1854), CIALONA (1901), MOSER (1925);

Trieste — GRAEFFE (1884);

Rhodes — FORBES (1844).

The presence of *Velella* at any particular locality within its range, is largely fortuitous, as it is blown to and fro by the wind. Up to date, FORBES' record is the only one for the eastern basin, all the "Thor" records being from the western basin west of 5°W. (Fig. 79).

Velella is the most widespread and numerous of the Chondrophorae in the Mediterranean, tremendous swarms often appearing suddenly, in such numbers as to litter the shore (GRANGER, 1879) or as to become

a pest in small harbors (MOSER, 1917, p. 706). It also appears at all seasons, having been recorded in October (KEFERSTEIN and EHLLERS, 1861), in spring (MOSER, 1917, LELoup, 1935), May (HOLLARD, 1845, LEUCKART, 1854), June (GRANGER, 1879), and by WOLTERECK (1905) throughout the year. The "Thor" records are for summer.

Some indication that spring is the season of most frequent occurrence is to be gained from various lists. That kept at Villefranche from 1899—1913 (MOSER, 1917) — perhaps the most complete — shows a preponder-

ance in April, May, and June; that for Messina (CIALONA, 1910) records it in May. SPAGNOLINI (1870), however, reports many individuals in January 1865, 1867, in November 1866 and in March, 1867.

Though WOLTERECK (1905, p. 110, footnote) states that the larvae occur at great depths (1000 meters or more), he failed to record the season. But LO BIANCO (1899) noted buds and Chrysomitra at Naples from October to December and from April to June. Further he (1903) recorded juveniles and very young specimens from February to April in the waters about Capri, and LELoup (1935) reports the larvae at Villefranche in March.

SIPHONOPHORE FAUNA OF THE MEDITERRANEAN COMPARED WITH THAT OF THE ATLANTIC.

The unity of the marine fauna of the Mediterranean with that of the neighboring parts of the Atlantic is now well established. But certain interesting differences remain to be accounted for. And knowledge of the distribution of the siphonophores has so greatly expanded, within the past few years, that a resumé of present information seems timely.

As a starting point, we may take CHUN's (1897) discussion in which he pointed out that, while most of the siphonophores known at that time in the Mediterranean had also been found outside the Straits of Gibraltar several of the species most widespread in the neighboring parts of the Atlantic, and others recorded from the Straits of Gibraltar, had never been seen in the Mediterranean, though the siphonophores had been

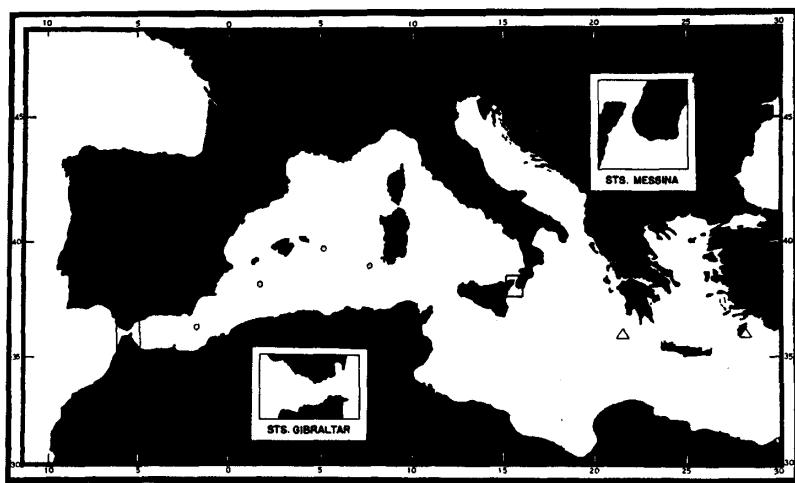


Fig. 79. "Thor" captures of *Porpita umbella* (triangles) and *Velella velella* (circles).

more intensely studied there than anywhere else. His list of species, supposedly characteristic of the Atlantic included the following (as they are now named):— *Diphyes dispar*, *Diphyes bojani*, *Abylopsis eschscholtzii*, *Abyla trigona*, *Bassia bassensis*, *Enneagonum hyalinum*, *Ceratocymba sagittata*, *Agalma okeni*, *Athorybia rosacea*, and *Rhizophysa eysenhardtii*.

At that time, on the other hand, the following Mediterranean species were not yet known from the Atlantic:— *Galetta turgida* Gegenbaur, *Lensia conoidea* Keferstein and Ehlers, *Clausophyes ovata* Keferstein and Ehlers, *Stephanomia rubra* Vogt, *Agalma clausi* Bedot, and *Lynchagalma utricularia* Claus.

Since that time the picture has been altered radically. Thus, *Stephanomia rubra* has been found in the Western Atlantic (BIGELOW, 1918, p. 426); *Clausophyes ovata* has been found at numerous localities in both the North and South Atlantic (MOSER, 1925; LELOUP, 1933, 1934) as well as in the Northwestern Pacific (BIGELOW, 1913); *Lynchagalma utricularia* is to be expected in the Atlantic because a form almost certainly identical with it has been found in the Tropical Pacific¹; the status of *Galetta turgida* is doubtful, and *Agalma clausi* has not been seen since the year 1888. In short, it becomes increasingly unlikely that the Mediterranean harbors any species of siphonophore (or of any other planktonic group of animals) which is peculiar to it, or even any which have its chief center of abundance there².

CHUN's (1897) list of supposedly "Atlantic" species has similarly suffered reduction, *Enneagonum hyalinum* (p. 20), *Ceratocymba sagittata* (p. 28), *Abylopsis eschscholtzii*, *Bassia bassensis* (p. 26), *Diphyes dispar* (p. 40), *Diphyes bojani*, *Agalma okeni*, and *Athorybia rosacea* having all been found in the Mediterranean. But all eight except the last of these (which has seldom been seen anywhere) certainly occur much less regularly there than in the Central Atlantic.

There still remains the following list of species known from one locality or another in the warm zone of the Atlantic between latitudes 30° S. and 40° N., or in the Straits of Gibraltar, but which have not yet been found in the Mediterranean, though it is, of course, possible, that any or all of them may eventually be discovered there as MOSER (1917, p. 716—720) has remarked. About half of these have been discovered since CHUN wrote.

<i>Heteropyramis maculata</i> Moser	<i>Eudoxoides mitra</i> Huxley
<i>Nectopyramis thetis</i> Bigelow	<i>Dimophyes arctica</i> Chun
<i>Mitrophyes peltifera</i> Haeckel	<i>Hippopodius cuspidatus</i> Moser
<i>Rosacea tuberculata</i> Moser	<i>Vogtia serrata</i> Moser
<i>Rosacea intermedia</i> Leloup	<i>Nectalia loligo</i> Haeckel
<i>Abyla quadrata</i> Moser	<i>Erenna richardi</i> Bedot
<i>Abyla haeckeli</i> Lens and Van Riemsdijk	<i>Rhodalia miranda</i> Haeckel
<i>Abyla trigona</i> Quoy and Gaimard	<i>Angelopsis globosa</i> Fewkes
<i>Abyla leuckartii</i> Huxley	<i>Rhizophysa eysenhardtii</i> Gegenbaur
<i>Sulculeolaria monoica</i> Chun	<i>Pterophysa</i>
<i>Galetta chuni</i> Lens and Van Riemsdijk	<i>Salacia uvaria</i> Fewkes
<i>Conophyes diaphana</i> Leloup	<i>Porpema globosa</i> Eschscholtz
<i>Chelophyses contorta</i> Lens and Van Riemsdijk	

and also the following eudoxoids of problematical parentage:—

Eudoxia russelli Totton (in *Malpighia, etc.*)
Eudoxia problematica Moser (in *Chlorophyses, sp.*)

Eudoxia galathea Moser (in *Lamellip. mitella*,)
Eudoxia tottoni Leloup (in *Amphicyathus*, sp.)

Numerically, this list is formidable, considering how few species of siphonophores exist. And while a considerable proportion are either known from a single catch or have been taken so seldom anywhere, that

¹ *Lynchagalma vesicularia* (Haeckel, 1888b).

² According to SCHNEIDER (1898) all the named species of *Forskalia* which have been reported from the Mediterranean are identical with forms also known from the Atlantic. But, as previously remarked (BIGELOW, 1911b, p. 270), it is idle to discuss these, until well preserved series of the genus have been reexamined.

Stephanomia rubra
Bedot

locality records of their occurrence are best omitted from the discussion of regional relationships, some of them — notably *Eudoxoides mitra* and *Dimophyes arctica* — are both common and widespread outside the Straits of Gibraltar. In short, it still appears that while there is no sharp distinction between the siphonophore faunae on the two sides of the Straits of Gibraltar, that of the Mediterranean is characterized by some qualitative poverty, as contrasted with that of the open Atlantic; a poverty that embraces not only the bathyplanktonic category, but also the shoaler-living communities as well.

It will, we think, be agreed that one key to the situation lies in the submarine topography and prevailing circulation in the Straits of Gibraltar. CHUN (1897) long ago emphasized the fact that the shoalness of the Straits would necessarily impose a barrier to the passage of any pelagic animal which lived deeper than the sill depth, which according to recent soundings is not greater than 300 meters (DE BUEN, 1934). And the prevailing drift of the undercurrent outward may be expected to emphasize this barrier to inward migration.

Obviously, the efficiency of this mechanical obstacle will depend on the depth of the upper limit to the normal occurrence of any species in question. And it is necessary to consider each separately (not to group them into artificial categories). Among Atlantic siphonophores, a number of species have been described by one author or another as characteristic of depths considerably greater than the sill depth of the Straits. But the records of recent expeditions leave only *Nectopyramis thetis*, *Heteropyramis maculata*, and the genera *Bathyphysa*, *Pterophysa*, and *Erenna* as still known only from tows (or entangled on the wire) which reached down deeper than 400—500 meters.

As none of these have ever been taken inside the Mediterranean (except for BEDOT's (1904, p. 15) record of *Bathyphysa grimaldii* just inside the Straits), we can assume, either that the barrier is absolute for them, or that such specimens as may occasionally be carried in across it meet conditions so unfavorable that they shortly perish, without leaving descendants in the deep strata of the Mediterranean. In this, they correspond to *Atolla bairdii* among the Medusae (KRAMP, 1924), to various representatives of the Pygmaeidae, Lanceolidae, Thaumatopsidae, Scinidae, and Vibiliidae among the hyperiid-amphipods (STEPHENSEN, 1926, p. 241), to certain penaeids among the decapods (STEPHENSEN, 1923) and to certain euphausiids (RUUD, 1936).

A few other species, namely, *Chuniphyes multidentata*, *Clausophyes ovata*, *Vogtia serrata*, *V. pentacantha*, *V. spinosa*, *V. glabra*, and *Rosacea plicata*, can also be described as primarily bathypelagic, because most of the records have been from tows which sampled the plankton down to at least 250 meters. But apparently they rise into the upper strata more often than do the *Erenna-Bathyphysa* group, for each of them has been taken occasionally close to the surface. All the members of this group are known from the Mediterranean; and two at least of them (*Vogtia pentacantha* and *V. spinosa*) are not uncommon there, in the deeper strata.

The vertical distribution of the "Thor" catches of *Chuniphyes* in the Bay of Cadiz in the winter of 1909 in relation to the hauls made there (p. 123) is especially suggestive in this connection for it shows that if this species occurred at all in the upper strata in the offing of the Straits, it was at least so rare there that none were picked up, in contrast to the abundant representation at depths greater than, say, 1000 meters. So long as individuals remain as deep as this, the threshold of the Straits obviously presents an impassable barrier. But experience has repeatedly shown that bathypelagic animals are from time to time carried upward, even right to the surface, by circulatory movements. And it is certain that the normal vertical range of *Chuniphyes* does extend upward at other times and places to a level from which this would be much more likely to occur than the Bay of Cadiz records might suggest: witness captures at 300—0, 400—0, and 500—0 meters in the Bay of Biscay (BIGELOW, 1911a, also "Thor" St. 71, p. 60) and one at 25—0 meters ("Thor" St. 76). Even if it be exceptional for any particular bathypelagic animal to rise directly within the influence of the inflowing surface current, the presence of the outflowing bottom current is not as effective a bar at the 200—300 meter level, as might appear, for the drift may become slack, or even temporarily reversed at times when the water is piled up in the eastern Mediterranean by prolonged westerly gales (NIELSEN, 1912, p. 171). Deep

Atlantic water may thus work its way inward, in eddies and swirls and so finally bring its bathypelagic fauna within the sweep of the easterly drift. Thus it is not surprising that some of the inhabitants, even of great

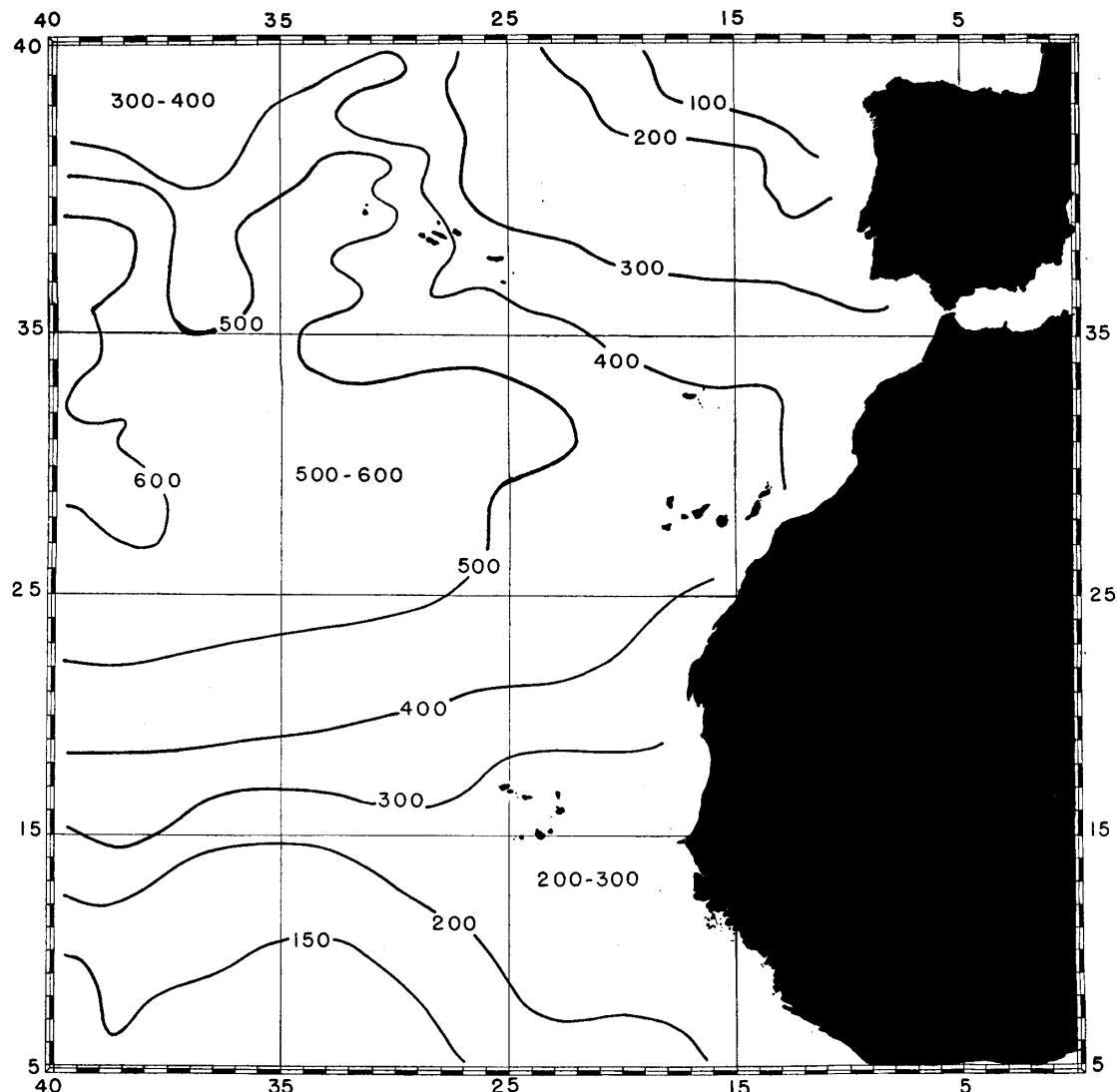


Fig. 80. Mean depth in meters, of the isothermobath of 12.5° C. in the eastern Atlantic, in the general offing of the Straits of Gibraltar,
(based on combination of available data.)

depths, pass in through the Straits, even though we have no evidence that any mass-immigration from this source was taking place at the times of the "Thor" cruises.

However, the number of individuals of any species of bathypelagic siphonophore so entering, is not likely to be great. And the water-masses with which they pass through the narrow portal of the Straits are so greatly diluted by mixture, immediately within the latter, that the immigrant population at any given time may well be so sparse (even in the immediate vicinity) as never to rise above the minimum density which

would be needed for the maintenance of a local stock, for the particular animal in question. Furthermore, the differential circulation must, at the same time, tend to carry them out again, for their chance of rising within the sweep of the outflowing bottom-drift inside the Straits, would seem more imminent than of rising high enough, outside, to be caught in the shoaler inflowing surface drift. And even if immigrants of this category ever do enter in numbers, and if they, or their immediate descendants do not chance to be swept out again, the high temperature and high salinity they must meet, when they again sink, in the Mediterranean, to the depths where they normally live, may well present a problem in adaptation so serious as to prevent the development of a permanent community:— not so much by discouraging their access, as JESPERSEN (1915) suggests may happen for certain fishes, but by abbreviating the survival of specimens which enter.

Chuniphyes for example, lives chiefly in salinities of 35.5—36.0‰, at its normal depth-range in the open oceans, but would encounter water of 37—38‰ in the western basin of the Mediterranean, of 38.5‰ and higher, in the eastern. This increase may well be unfavorable, though it must be admitted that as yet, nothing definite is known as to the salinity relationship of any siphonophore.

No general rule can be stated as to whether transfer from outside the Straits to inside, would involve a serious shift of temperature, even for bathypelagic species (i. e., those living chiefly deeper than 300—400 meters), for this would depend on the precise depth of the upper boundary of their usual occurrence in the oceans. Thus, the isothermobath for 12.5° (the whole mass of deep water in the Mediterranean is 12—13°) which lies at about 350 meters in the Bay of Cadiz ("Thor" St. 69) sinks to about 450 meters near Madeira (Fig. 80).

In the case of *Chuniphyes* (the bathypelagic siphonophore for which the most extensive information is available) the maximum temperatures for catches so far made in closing nets¹ have been between 4.4° and 9.2°, the minimum, possible, for these same hauls, 2.2° and 7.1°. And the highest temperatures in which the presence of more than an odd *Chuniphyes* has ever been established, are 10.6°, 11.1°, and 11.8°.² This, added to the frequency with which *Chuniphyes* has been taken, in various parts of the world in hauls which have reached down to depths where the temperature was lower than 5—10°, strongly suggest that its usual habitat is colder than 10° C., with the lower limit certainly as low as 4° C. and very likely as low as 2° C. The deep Mediterranean may thus be unfavorably warm for it, even though not immediately fatal. And it is not unreasonable to assume that this applies perhaps even more strongly to *Nectopyramis*, *Erenna*, *Nectalia*, *Bathyphysa*, and *Pterophysa*, judging from the fact that various bathypelagic animals have repeatedly been proven by experiment, to be extremely sensitive to temperatures only slightly above those from which they have been brought up.

The combination of the shoalness of the Straits, with the differential circulation prevailing there, and the hydrologic characteristics of the deep water of the Mediterranean, thus, combines against free population of the latter, from the deeps of the Atlantic. And there is certainly no evidence that any bathypelagic animal, of any group, has originated within the Mediterranean.

In the case of planktonic animals which range upward toward the surface, or which live chiefly in the upper 100—200 meters, the situation as regards access to the Mediterranean, differs from that just outlined, for the prevailing system of currents must effect constant interchange between Atlantic and Mediterranean, specimens living shoalest drifting inward through the Straits, but those living 50—100 meters down, drifting outward. And it is now well established that the vertical ranges of the great majority of the siphonophores of the upper waters do extend down indifferently at least as deep as this. The only notable exceptions so far known are *Velilla*, *Porpita*, *Physalia*, and *Porpema*; the first three of which are well known in the Mediter-

¹ Three in the Bay of Biscay from 2740—1370 meters, 2100—1370 meters, and 366—1830 meters (BIGELOW, 1911a); also 4 "Meteor" hauls in the Atlantic from 800—1000 meters, 600—800 meters; 400—800 meters, and 400—600 meters (LELOUP and HENTSCHEL, 1935).

² "Research" hauls from 457—0 meters and 574—0 meters in the Bay of Biscay (BIGELOW, 1911a) and 300—0 meters at "Thor" St. 71 (p. 60).

ranean, while the only records of the latter in the western hemisphere are, one from the South Atlantic (HAECKEL, 1889), and one from near the Cape Verde Islands (ESCHSCHOLTZ, 1829).

To illustrate the efficiency with which the prevailing inward current, via the Straits may populate the Mediterranean with planktonic animals produced in the Atlantic, we need merely quote the example of the larvae of the common eel (*Anguilla anguilla*).

In short, there would be every reason to expect such siphonophores as *Diphyes dispar*, *Diphyes bojani*, *Eudoxoides mitra*, *Lensia subtilis*, and *Abylopsis eschscholtzii* to appear in the Mediterranean with much greater regularity than appears to be the case, if conditions were favorable for their existence there, and if they occurred in the immediate offing of the Straits in anything like the abundance they do in the Azores-Canaries region. The most extensive sources of information available on the latter point (additional to the "Thor" records) are the Station records of the cruises of the Prince of Monaco (LELOUP, 1933, p. 42; RICHARD 1934), during which about 225 open-net tows, that might have been expected to catch siphonophores were made in the general region between the Straits and Longitude 15°W., during the years 1885-1914. These yield the following data, for the group of species in question:—

- a) *Diphyes dispar*, total Atlantic catches, 41 of which only one was between 15°W. and the Straits in that general area;
- b) *D. bojani*, total Atlantic catches, 14; catches between 15°W. and the Straits in that general area, 1;
- c) *Lensia subtilis*, no "Monaco" records;
- d) *Eudoxoides mitra*, total Atlantic catches, 8; catches between Longitude 15° and the Straits, 0;
- e) *Dimophyes arctica*, 2 stations near the Azores and southward;
- f) *Abylopsis eschscholtzii*, total Atlantic catches, 26; catches between 15°W. and the Straits, 0.

The poverty of the region just off the Straits, is still further emphasized if one considers the comparatively frequent occurrence farther south and west of such species as *Dimophyes arctica*, *Eudoxoides mitra* and *Lensia subtilis* (MOSER, 1925; LELOUP and HENTSCHEL, 1935) of which the "Monaco" cruises obtained only a sparse representation.

All this contrasts very strongly with the distribution of the Prince of Monaco's catches of *Chelophyes appendiculata* (common in the Mediterranean), 105 Atlantic catches of which 25 were in the vicinity of the Straits, east of Long. 15°W. *Abylopsis tetragona*, also, though taken at only 6 Atlantic "Monaco" stations, was found twice in the area in question.

In short, the problem, as regards the shoal living siphonophores is not only one of Mediterranean versus Atlantic, but equally why a whole category of species, which are very common either in the Canaries-Azores region, or farther west or south, appear so seldom, either in the Mediterranean, or even in the superficial 200-300 meters in the parts of the Atlantic from which immigration into the latter must draw most directly.

From this standpoint, it is natural to think first of temperature. And it will, we believe, be accepted without argument, that no animal acclimated to temperatures lower than, say, 10° C. could permanently exist shoaler than about 500 meters in this latter region, for even in mid-winter, the 300 meter level, immediately off the Straits does not cool below 12.5° C.; or below 13° C. anywhere in the Mediterranean.

The earlier view (BIGELOW, 1911b, p. 369) that *Dimophyes arctica* fell in this category, i. e. was barred from the Mediterranean by the high temperature of the latter, seemed to MOSER (1917; 1925) contradicted by its capture by the "Gauss", in hauls from mid-depths at a number of stations through the South Atlantic, even actually at the surface at the Cape Verdes, near the Equator, and at Port Natal, Southeast Africa. But analysis of the "Gauss" hauls which yielded it, does not accord with her conclusion (MOSER, 1925, p. 394) that its distribution is wholly independent of temperature, for the great majority of captures may have been in water colder than 10° C. and most of them (Antarctic) certainly were from temperatures lower than 2° C.

The "Meteor" records (LELOUP and HENTSCHEL, 1935) give still more definite evidence, in the same direction, for while one catch was certainly from water as warm as 22° C. (St. 174, 21°30' S., 15°36' W.,

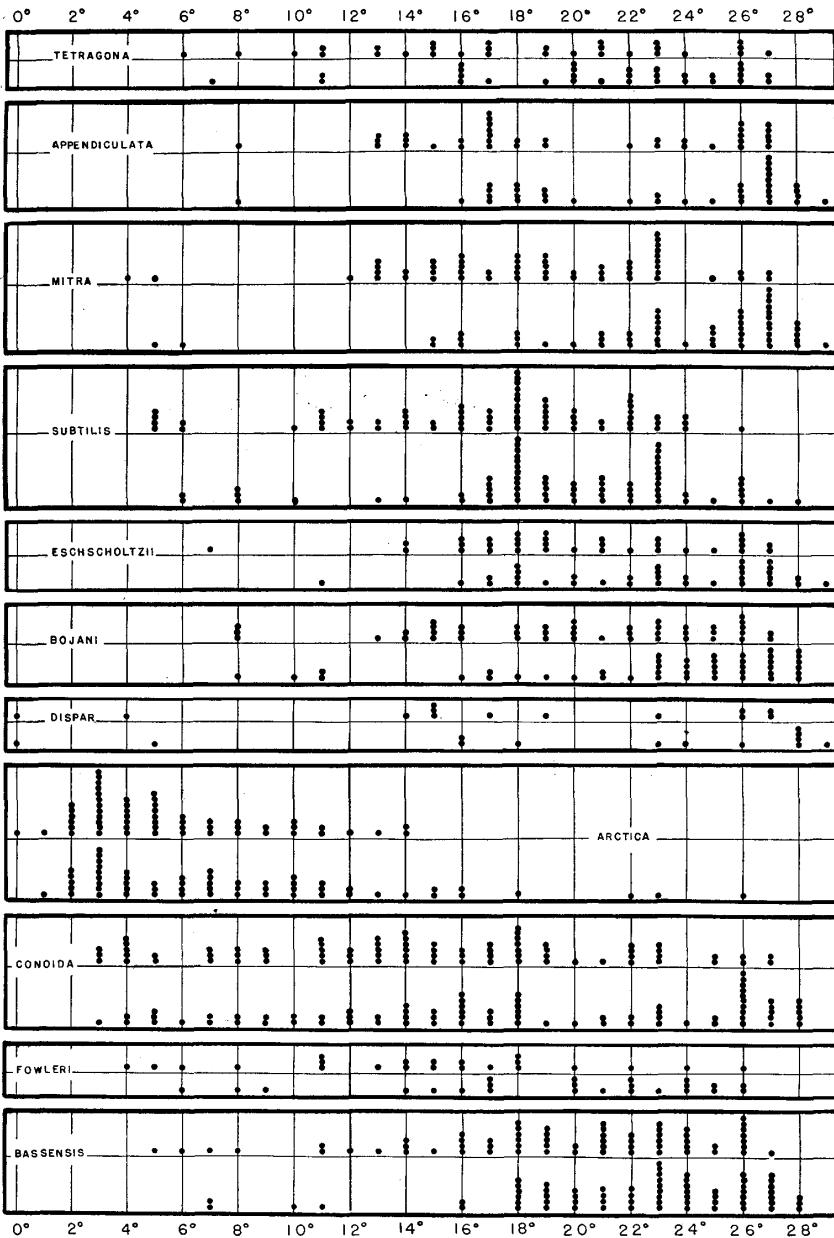


Fig. 81. Frequency-distribution of upper and lower limits of temperature, for "Meteor" closing net hauls that yielded the species named in the diagram, from data by WÜST (1932) and LELOUP and HENTSCHEL (1935); hauls that covered more than a 10° range of temperature are omitted from the calculation. For each species, the number of dots in the upper row equals the number of cases in which the indicated temperatures were the minimum (according to the depth limits of the hauls), in which the specimens could have been taken. The dots in the lower row show the number of cases in which the indicated temperature was the maximum possible for the same group of hauls.

point of view, because MOSER (1917, p. 719) has laid stress on the apparent agreement between the two, in their vertical and latitudinal distribution. However, the "Meteor" data show a very strong contrast, for

0—100 meters), the great majority were equally certainly from $<16^{\circ}$ C. and 75% of them from $<11^{\circ}$ (Fig. 81), partly because so far south and partly because of depth. Present indications therefore are that while *D. arctica* is cosmopolitan, so far as latitude is concerned, and while it may occasionally rise to the surface even in the tropics, as it does regularly in cold latitudes, it is much more abundant in the subantarctic and subarctic than anywhere between, and the great majority of the stock existing in mid- and low latitudes are so deep down in the water that they are living at temperatures lower than $\approx 12^{\circ}$ C. Under these circumstances, the occasional discovery of odd specimens near the surface, in warm seas, does not imply the ability to survive, much less to multiply there. Recent evidence tends, on the contrary to corroborate the earlier view that the whole vertical column, throughout the Mediterranean is too warm for the existence of a permanent population of this species; and (assuming the optimum to be less than 11° C.) this applies equally to the upper 500 meters off the Straits of Gibraltar.

It is interesting to compare the thermal status of *Dinophyes arctica* with that of *Lensia conoidea*, from the present

while the captures of *D. arctica* were definitely concentrated in temperatures lower than 12° (Fig. 81), those of *L. conoidea* were very evenly distributed over the whole range of temperature, between 3° and $26-27^{\circ}\text{C}.$, proving that this species is in fact, wholly independant of temperature. And the temperature-distribution for *Lensia fowleri* shows a similarly wide distribution (Fig. 81) in the upper range which corresponds to the fact that both *conoidea* and *fowleri* are not only regular inhabitants of the Mediterranean, but occupy the whole depth range there, from 100—200 meters downward for *fowleri* and from 50 meters, downward, for *conoidea* (p. 113).

Nor is it likely that any other siphonophore, inhabitating the upper 100—200 meters of the North Atlantic, would find the Mediterranean too warm for year-round existence, for while the distribution records — taken at face value — might suggest that this would apply to *Stephanomia cara* Agassiz, it is probable that this supposed species will prove identical with a form (*S. bijuga*) which has long been known from the Mediterranean, as well as the warm zones of the oceans.

The case is not so clear, as regards the possibility that winter temperatures in the Mediterranean may be unfavorably low, for species that are common in the Subtropical Atlantic, but are absent from the Mediterranean or that are only sporadic in their appearance there. This possibility was long ago suggested by CHUN (1897). And knowledge of the distribution of siphonophores, as it stood in the early years of the present century, seemed to justify definite conclusion that such is the case (BIGELOW, 1911b, p. 375). But subsequent discovery that most of the species supposedly characteristic of the Tropical Atlantic also occur in the Mediterranean (making it likely that all of them will eventually be found there), and that most of them live in comparatively low temperatures as well as in high, lead MOSER (1917, 1925) to decide, on the contrary, that it is not low temperature that is responsible for the scarcity in the Mediterranean, of any general category of siphonophores. In her view, "das Problem selbst nur an Schwierigkeit gewonnen hat durch den Nachweis, dass die Beziehungen der Siphonophorenfauna des Mittelmeeres zu der des Atlantik viel engere sind und die getroffene Auswahl dadurch noch merkwürdiger ist als es zu CHUN's Zeiten den Anschein hatte" (MOSER, 1917, p. 720).

Analysis of the catch records of the "Meteor" (LELOUP and HENTSCHEL, 1935) corroborate her conclusions, to the extent that we certainly have not to do with a sharp-cut case of temperature control; but at the same time, it strengthens the view that low temperature may still be one of the factors in the case. As most of the "Meteor" catches were made either in vertical open-net hauls from small depths, or in closing nets operated through short vertical distances, the upper and lower limits of temperature between which the specimens in question were living can be definitely determined in most cases to within $10^{\circ}\text{C}.$, often within $2-3^{\circ}\text{C}.$ The distribution is as follows¹, for the common Atlantic species that are found only occasionally, or not at all in the Mediterranean.

- a) *Diphyes bojani* (Fig. 81), total proven range, $8^{\circ}-27^{\circ}\text{C}.$; 85% certainly from $>15^{\circ}\text{C}.$, 60% from $20^{\circ}\text{C}.$ or warmer..
- b) *Diphyes dispar* (Fig. 81), proven range, $0^{\circ}-27^{\circ}\text{C}.$; 85% certainly from $>15^{\circ}\text{C}.$; 70% from 20° or warmer.
- c) *Lensia subtilis* (Fig. 81), proven range, $6^{\circ}-26^{\circ}$; 72% certainly from $>15^{\circ}$, 30% from 20° , or warmer.
- d) *Eudoxoides mitra* (Fig. 81), proven range, $5^{\circ}-27^{\circ}$; 72% certainly from $>15^{\circ}$, 41% from 20° or warmer.
- e) *Abylopsis eschscholtzii* (Fig. 81), proven range; $10^{\circ}-27^{\circ}$; 91% certainly from $>15^{\circ}$, 50% from 20° or warmer.
- f) *Bassia bassensis* (Fig. 81), proven range, $7^{\circ}-27^{\circ}$; 81% certainly from $>15^{\circ}$, 53% from 20° or warmer.

¹ Only those hauls are considered where the upper and lower limits of temperature were less than $12^{\circ}\text{C}.$ apart.

And TOTTON's (1932) records, for the Great Barrier Reef region, show that *L. subtilis* can support a temperature as high as 26–27°; *E. spiralis* even as high as 28°; while the other species named above may have been living there in water as warm as 27–29°.

If these distributions, with the obvious concentrations in the upper temperature range shown by the graph (Fig. 81) were the only evidence available, they would indicate that while any one of this group of species, may occasionally sink so deep, or stray so far south (or north) as to come within arctic temperatures, the winter chilling in the Mediterranean (to 12.40°–14.50°) might well be unfavorable enough to prevent the maintenance of an abundant year-round population. It appears, however, — so far as the "Meteor" data go — that precisely this same argument could be applied to *Chelophyes appendiculata*, which is actually the most nearly universal, and most abundant siphonophore, not only in the Mediterranean (winter and summer), but likewise in the Bay of Biscay (BIGELOW, 1911 a), for the temperature distribution of the "Meteor" catches of it were as follows: proven range, 0°–27°; 85% certainly from > 15°; 40% from 20° or more. And while the "Meteor" captures of *Abylopsis tetragona* show more scattering toward low temperatures (Fig. 81), they were, likewise, concentrated chiefly above 12°–13°.

Here we must let the question rest until more definite information comes to hand regarding the temperature-relations, and especially the breeding temperatures, of the various species. The most that can be said at present is that available evidence still seems to support the view that low winter temperature may act in some way as one of the factors responsible for the poverty of the calycophore-fauna of the Mediterranean, as regards certain tropical species, whereas other species, e. g. *C. appendiculata*, appear to be more tolerant in this respect, though equally at home in tropical temperatures in the Atlantic.

The possibility must also be taken into account, that local races of siphonophore species may exist, indistinguishable morphologically but with different temperature-optima, just as is now known to be true of various fishes. And it is suggestive, in this connection, that three surface forms, *Porpita*, *Velella* and *Physalia*, which are usually regarded as reliable tropical indicators in the opposite side of the North Atlantic, are so widespread in the Mediterranean (p. 135).

What role, if any, the high salinity of the Mediterranean may play here, is a matter about which absolutely nothing is known. We need only point out that there is no question of low salinity acting as a bar, as it apparently does in the Lagoon of the Great Barrier Reef at certain times of year (RUSSELL and COLMAN, 1935, p. 269).

WESTERN AND EASTERN BASINS OF THE MEDITERRANEAN.

The "Thor" collections allow the first comparison of the siphonophore fauna of the open waters of the western basin of the Mediterranean with that of the eastern, so making it at last possible to test the widespread idea that the former supports a much more abundant population of pelagic coelenterates than does the latter. This view first found expression by FORBES (1844, p. 147), who speaks of the scarcity of "acalephous animals" in the Aegean, and comments that "though continually on the look-out for these beautiful creatures only fifteen species were met with", adding that "the sheltered bays of Asia Minor and the squally seas of the Cyclades were alike unprolific" and that "of the *Physograda* [Siphonophores], several examples of a large *Stephanomia* were met with in the Gulf of Macri", and "of the *Diphydae* occasional individuals were seen", while "*Velella spirans* was collected by Lieut. Spratt on the shore at Rhodes, in December, 1842, and *Porpita glandifera* occurred once on the sandy shore between Patara and the mouth of the Xanthus". Generalizing, he added of the "Medusae" as a whole that "they abound near the gut of Gibraltar, a locality prolific in species as well as individuals. Their numbers decrease as we approach the shores of Greece. In the Aegean, as we have seen, they play an unimportant part".

MOSER (1917) within recent years, has emphasized the poverty of the siphonophore fauna of the Adriatic, near Trieste, where the successive studies of WILL (1844), BUSCH (1851), CLAUS (1878), von GRAEFFE

(1884), and STIASNY (1910, 1911) had increased the list of species only to 7, contrasting strongly with the much more varied and more abundant siphonophore populations which had long been known to exist in the Straits of Messina, in the Bay of Naples, and in the vicinity of Nice and of Villefranche along the north-western shores of the Mediterranean. And while MOSER (1917) herself was able to add 13 more species from the Adriatic, the total list, then known from the eastern half of the Mediterranean was still less than half as numerous as for the western.

It is, however, to be noted that all the systematic studies of siphonophores in the eastern Mediterranean, so far mentioned, were confined to the two tributary-seas, Adriatic and Aegean. And extension of the survey by the "Thor" to the open basin itself not only resulted in the addition of 8 more species (double starred in the list, p. 136), but the number of species of Calycophorae taken by the "Thor" in the eastern basin (17) fell only 3 short of the number taken in the western, although about twice as many tows were made in the latter as in the former (Fig. 1). Neither does the distribution of "Thor" captures of agalmids (in this case specific identifications are not possible, p. 62) suggest any notable preponderance in the one basin as contrasted with the other (Fig. 82). And when we contrast the intensive towing campaigns which had been previously carried out in the west by the Prince of Monaco (LELOUP, 1933) as well as from the various biological stations, with the paucity of early observations in the east, it seems not unlikely that all the siphonophores now known from west of the Pantellarian Channel may eventually be found to the east as well; — especially when one remembers how sporadic in their occurrence many siphonophores are anywhere. In this connection, one might mention the proverbially sudden appearances and disappearances of swarms of *Velella* or quote MOSER's (1917, p. 722) account of the appearance of a vast swarm of *Physalia* at Naples, where it was "so unbekannt, dass, als man dem einen alten, sehr erfahrenen Fischer ein Exemplar in die Station brachte, dieser an einen schlechten Witz glaubte und eine Schweinsblase zu sehen vermeinte, bis er sich am Meer selbst von dem Wunder überzeugte". Remembering that the two most recent captures of so conspicuous a siphonophore as *Porpema prunella* were 30 years apart (HAECKEL, 1888b; BIGELOW, 1911b), one in the western and the other in the eastern side of the Tropical Pacific, and those of its Atlantic relative, *P. globosa*, almost 50 years apart (ESCHSCHOLTZ, 1829; HAECKEL, 1888b, as *P. medusa*), it is dangerous to postulate that any siphonophore may not be found in any particular locality where conditions are suitable for its existence.

In short, it becomes increasingly unlikely that any pronounced qualitative difference exists, between the Siphonophorae of the western and eastern sides of the Mediterranean, but that the relationship here, via the Pantellarian Channel, is essentially the same as exists between the western basin and the neighboring parts of the Atlantic via the Straits of Gibraltar. At the most, it may be assumed that the species (p. 127) which enter the Mediterranean only occasionally, and which fail to establish permanent populations there, would appear still more sporadically in the eastern basin than in the western.

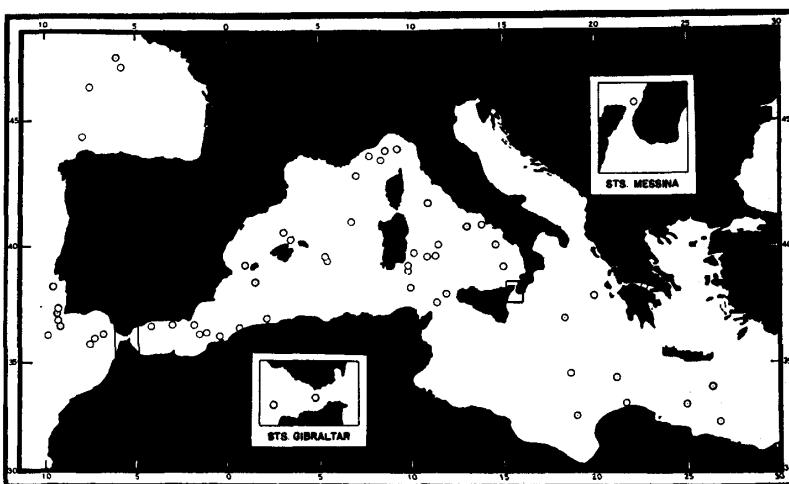


Fig. 82. "Thor" captures of Agalmidae, species not identifiable (p. 62).

List of siphonophores definitely known from the western basin¹. Those starred once are also known from the eastern basin; those double starred having been found there for the first time by the "Thor".

** <i>Muggiaea atlantica</i>	* <i>Chelophyses appendiculata</i>	** <i>Vogtia spinosa</i>
* <i>Muggiaea kochii</i>	* <i>Eudoxoides spiralis</i>	<i>Apolemia uvaria</i>
* <i>Sphaeronectes truncata</i>	* <i>Lensia conoidea</i>	* <i>Forskalia</i>
<i>Sphaeronectes irregularis</i>	** <i>Lensia fowleri</i>	<i>Agalma okeni</i>
** <i>Amphicaryon acaule</i>	** <i>Lensia multicristata</i>	<i>Agalma elegans</i>
* <i>Rosacea cymbiformis</i>	* <i>Lensia subtilis</i>	<i>Agalma clausi</i>
<i>Rosacea plicata</i>	* <i>Lensia campanella</i>	* <i>Stephanomia bijuga</i>
- <i>Rosacea medusa</i>	<i>Chuniphyes multidentata</i>	* <i>Stephanomia rubra</i>
- <i>Stephanophyes superba</i>	* <i>Galette chuni</i>	= <i>Anthemodes ordinata</i>
<i>Clausophyes oyata</i>	* <i>Galette australis</i>	- <i>Lynchagalma utricularia</i>
* <i>Abylopsis tetragona</i>	<i>Galette meteori</i>	<i>Athorybia rosacea</i>
<i>Abylopsis eschscholtzii</i>	* <i>Sulculeolaria quadrivalvis</i>	* <i>Physophora hydrostatica</i>
<i>Ceratocymba sagittata</i>	** <i>Sulculeolaria quadridentata</i>	* <i>Rhizophysa filiformis</i>
* <i>Bassia bassensis</i>	* <i>Hippopodius hippopus</i>	* <i>Porpita umbella</i>
<i>Diphyes dispar</i>	* <i>Vogtia pentacantha</i>	* <i>Velella velella</i>
<i>Diphyes bojani</i>	** <i>Vogtia glabra</i>	<i>Physalia physalis</i>

NUMERICAL ABUNDANCE, ATLANTIC AND MEDITERRANEAN.

The "Thor" collection for the first time affords numerical data from which some rough approximation can be arrived at as to relative abundance in the Atlantic as compared to the two basins of the Mediterranean, whether for individual species or for the siphonophore populations as a whole.

The average catches per hour, for all hauls in which the respective species were taken at all times of year, were as follows:-

Table 53.

Species	Atlantic		Mediterranean			
	No. per hour	No. per 5000 Cu. M.	Wester basin		Eastern basin	
			No. per hour	No. per 5000 Cu. M.	No. per hour	No. per 5000 Cu. M.
<i>Hippopodius hippopus</i>	0.9	0.8	4	3.6	7	6.3
<i>Enneagonum hyalinum</i>	1.0	0.9	6	5.4	0	0
<i>Abylopsis tetragona</i>	0.4	0.3	61	54.9	4	3.6
<i>Bassia bassensis</i>	97.	87.3	4	3.6	27	24.3
<i>Galette australis</i>	< 1.	< 0.9	3	2.7	1	0.9
<i>Muggiaea atlantica</i>	7.	6.3	7	6.3	2	1.8
<i>Chelophyses appendiculata</i>	112.	100.8	166	149.4	157	141.3
<i>Eudoxoides spiralis</i>	2.	1.8	9	8.1	15	13.5
<i>Lensia conoidea</i>	12.	10.8	8	7.2	6	5.4
<i>Lensia fowleri</i>	0.3	0.2	4	3.6	6	5.4
<i>Lensia multicristata</i>	2.	1.8	7	6.3	2	1.8

From this it appears that among the more common species, only one (*Bassia*) averaged decidedly more numerous in the Atlantic than in the Mediterranean, while the reverse was true of two, *Abylopsis tetragona* and *Lensia fowleri*. One species, *Abylopsis tetragona* was much the more abundant in the western basin,

¹ Doubtful species are omitted.

but is counter-balanced by another (*Bassia*), which was more abundant in the eastern, while the populations of the rest were of about the same order of magnitudes in the three regions. Thus, the data do not suggest any general longitudinal contrast in this respect, such as might have been expected from JESPERSEN's (1923) calculations of the amounts of macroplankton taken by the "Thor". And the following calculation of the mean number of siphonophores of all species combined, taken per hour's towing, shows an even closer agreement:¹

Atlantic: Total towing hours, 110; mean catch, 275 siphonophores per hour.

Mediterranean, Western basin: Total towing hours, 184.5; mean catch, 277 siphonophores per hour.

Mediterranean, Eastern basin: Total towing hours, 70; mean catch, 231 siphonophores per hour.

In short, the "Thor" records do not lend any support to the view that the western part of the Mediterranean is notably poorer in siphonophores as a whole than the neighboring part of the Atlantic, or that the eastern basin is poorer than the western.

RELATIVE VERTICAL DISTRIBUTION OF SIPHONOPHORES, AS A WHOLE.

Mediterranean. The mean catch per hour's tow² of all species, for all Mediterranean stations combined, was as follows:—

Table 54.

Depth	No. of tows	No. of nectophores per hour, all species	Depth	No. of tows	No. of nectophores per hour, all species
6 + 10 + 16	115	661	533 + 666	23	227
26 + 33 + 43 + 63 + 66	63	520	800 + 933	8	250
86 + 100 + 133	13	83	1066 + 1100 + 1333 + 1666 + 1733	14	153
166 + 200 + 266	75	275	2333	1	27
400	16	381	2666	2	7

By this tabulation, the upper 100 meters averaged perhaps twice as productive of siphonophores as any underlying stratum: averages show, however, a considerable population down to 1800 meters, but relatively few from thence downward, though significant numbers evidently existed right down to the bottom water of the Mediterranean.

Atlantic. Similar calculation for the Atlantic stations (Table 55), shows relatively much more definite concentration in the upper 300 meters, with correspondingly much sparser population at depths greater than 400 meters for the group as a whole, as well as for some of the more common species, individually; i. e. *Abylopsis tetragona* (p. 88), *Muggiae atlantica* (p. 100), *Enneagonum hyalinum* (p. 86), and *Chelophyses appendiculata* (p. 103).

As this decrease in the siphonophore-population

Table 55.

Depth	No. of tows	No. of nectophores per hour, all species
16	24	910
30 + 33 + 36 + 43 + 66	28	573
166 + 200 + 333	20	198
400	8	56
533 + 666	7	146
800	2	28
1066 + 1333	5	34
2000	1	18
2866 + 2900	2	15

¹ Towing hours in the tabulation include the vertical as well as the horizontal parts of the tows, calculated on the assumption that 1 hour equals 3700 meters as explained on page 68. All tows with the Young Fish Trawl are included, whether siphonophores were taken or not.

² The vertical as well as the horizontal portions of the tows are included, calculated on the assumption that 1 hour's tow equals 3700 meters as described on page 68.

with depth, in the parts of the Atlantic sampled by the "Thor", is of the same general order as LELoup and Hentschel's (1935, p. 24, Fig. 17) finding that calyphores along the route of the "Meteor" averaged only about half as abundant at 50—100 meters, about $\frac{1}{4}$ as abundant at 100—200 meters, $\frac{1}{9}$ as abundant at

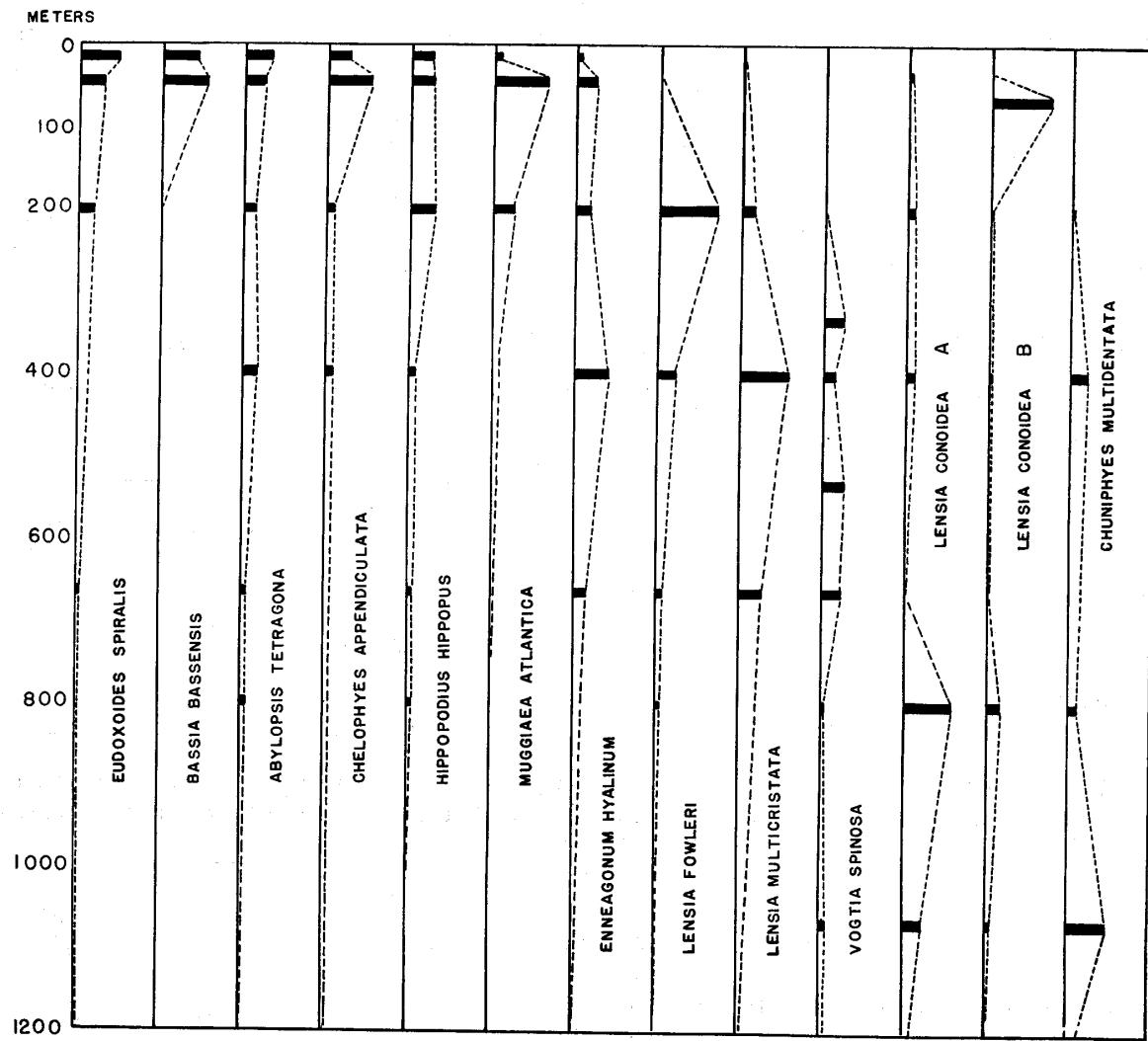


Fig. 83. Relative vertical distribution of the more common species, expressed as tenths of the sum of the mean catches per hour at all levels combined. For *Lensia conoidea*, column A represents distribution, if one very rich catch at 66 meters is omitted; column B, the distribution if this catch be included.

200—400 meters, and only about $\frac{1}{14}$ as abundant at 600—800 meters as they were close to the surface, it may be taken as characteristic for the Mid-Atlantic as a whole.

Lacking definite knowledge of the factors that control the vertical distribution of any siphonophore other than the Chondrophorae and *Physalia*, this very striking difference in the extent to which they populate the deeper strata in the Mediterranean, as contrasted with the Atlantic remains a riddle.

Considering how wide a range of temperature most of the common siphonophores are known to inhabit (p. 131), it seems unlikely that the somewhat lower temperatures in the deeper strata of the Atlantic

at mid-latitudes, as contrasted with the Mediterranean, would account for greater scarcity of the group at those depths in the former than in the latter; though for individual species it might have that effect, or vice versa. Neither do regional differences in the vertical stability of the water offer any apparent explanation. There is little difference in this respect between the Mediterranean and the Atlantic in summer, while in winter it is in the Atlantic that the upper 200 meters are the less stable (p. 95, Fig. 67), i. e. the more open to the vertical dispersal of any planktonic animals, whereas, in the case of the siphonophores as a whole, the regional relationship in vertical distribution seems to be the reverse. Figure 83 presents graphically, the relative vertical distribution of the more common species.

RELATIVE ABUNDANCE OF DIFFERENT SPECIES OF SIPHONOPHORES.

The mean numbers of the commoner species per hour's towing, and per 5000 cubic meters of water are tabulated on p. 136. The richest catches per hour and per 5000 cubic meters, for such species as were ever numerous enough to yield catches as large as 100 per hour, were:—

Table 56.

	Atlantic		Mediterranean	
	No. per hour	No. per 5000 Cu. M.	No. per hour	No. per 5000 Cu. M.
<i>Rosacea cymbiformis</i> (Nectophores)	152	136.8	120	108
<i>Hippopodius hippocampus</i> (Nectophores)	34	30.6	300	270
<i>Enneagonum hyalinum</i> (Colonies)	22	19.8	376	338.4
— — (Eudoxids)	31	27.9	581	522.9
<i>Abylopsis tetragona</i> (Colonies)	32	28.8	5,168	4,651.2
— — (Eudoxids)	74	66.6	23,664	21,297.6
<i>Bassia bassensis</i> (Colonies)	30,492	27,442.8	3,232	2,908.8
— — (Eudoxids)	16,828	15,141.2	3,408	3,067.2
<i>Galetta australis</i> (Nectophores)	2	1.8	192	172.8
<i>Muggiae atlantica</i> (Nectophores)	1,000	900	584	525.6 ¹
<i>Chelophyses appendiculata</i> (Nectophores)	11,170	10,053	7,116	6,404.4
<i>Eudoxoides spiralis</i> (Nectophores)	96	86.4	433	389.7
<i>Lensia conoidea</i> (Nectophores)	390	351	1,665	1,498.5
<i>Lensia fowleri</i> (Nectophores)	20	18	278	250.2
<i>Lensia multicristata</i> (Nectophores)	61	54.9	458	412.2

¹ A tow in the Straits of Gibraltar yielded 2804 nectophores per hour or 2526 per 5000 cubic meters of water.

Comparison of the two tables shows that in the Mediterranean, *Chelophyses appendiculata* was much the most abundant species, whether judged by the mean abundance of its colonies or by their maximum abundance. The only species that approached it there, was *Abylopsis tetragona*. But *Bassia bassensis*, *Muggiae atlantica*, and *Lensia conoidea* all appear in relatively more abundant aggregation, at their maximum, than would have been suggested by their low averages as compared to *C. appendiculata* and *A. tetragona*, illustrating the probability that any species of siphonophores may occasionally swarm even though the population of it averages small. No species other than those listed on p. 136, averaged as numerous as 1 per 5000 cubic meters, in either basin of the Mediterranean.

The relationship of the several species in the Atlantic was different, for while *C. appendiculata* averaged most abundant there, also, among the catches of colonies, *Bassia* closely approached it in average, and considerably surpassed it in maximum abundance, while *Abylopsis tetragona* (second in average rank in the Mediterranean) averaged very scarce in the Atlantic, nor were any swarms of it encountered there.

MAXIMUM ABUNDANCE OF SIPHONOPHORES AS A WHOLE.

The richest hauls of all siphonophores combined, were at the rate of 35828 colonies per hour, or 32245 per 5000 cubic meters of water in the Bay of Cadiz (St. 233, 25 meters of wire out), of 7218 colonies per hour, or 6496 per 5000 cubic meters of water in the western basin of the Mediterranean (St. 123, 65 meters of wire out), and of 7424 colonies per hour, or 6681 per 5000 cubic meters of water in the eastern basin (St. 183, 65 meters of wire out).

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