REPORT

ON THE SCIENTIFIC RESULTS

OF THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

CARRIED OUT UNDER THE AUSPICES OF THE NORWEGIAN GOVERNMENT AND THE SUPERINTENDENCE OF

SIR JOHN MURRAY, K. C. B.
and DR. JOHAN HJORT

VOLUME III
PART II
1913—1921

PUBLISHED BY THE TRUSTEES OF THE
BERGEN MUSEUM

JOHN GRIEG, BERGEN
1932

REPORT

ON THE SCIENTIFIC RESULTS

OF THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

CARRIED OUT UNDER THE AUSPICES OF THE NORWEGIAN GOVERNMENT AND THE SUPERINTENDENCE OF

SIR JOHN MURRAY, K. C. B.
and DR. JOHAN HJORT

VOLUME III
PART II
1913—1921

PUBLISHED BY THE TRUSTEES OF THE
BERGEN MUSEUM

JOHN GRIEG, BERGEN
1932

CONTENTS.

CTENOPHORA

FROM THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

DR. TH. MORTENSEN

WITH 1 PLATE AND 4 FIGURES IN THE TEXT

The material of Ctenophora collected by the "Michael Sars" Expedition is not very large, but upon the whole in a fairly good condition. The specimens are preserved in formaline, which has the great advantage of keeping them nearly as transparent as the living specimens.

The species found are only five, viz. *Pleurobrachia pileus* (O. Fr. Müller), *Mertensia ovum* (Fabr.), *Beroë cucumis* Fabr., *Beroë Forskåli* M. Edw. and a new deep-sea Ctenophore, which is described here under the name of *Aulacoctena acuminata* Mrtsn. That these five species represent all the Ctenophores met with by the expedition, is rather improbable. It can scarcely be doubted that also some Lobate Ctenophores have been taken, but as these can only be preserved when treated separately and with the utmost care, it could not be expected that specimens should be found in the preserved materail, it being nearly impossible on such an expedition to find the time necessarry for the proper treatment of these difficult objects.

While the four firstnamed species afford little interest beyond the distribution, the deep-sea form is of unusual interest. Hitherto only two deep-sea Ctenophores have been found. The German Deep-sea Expedition, by which deep-sea Ctenophores were for the first time observed, found in the Atlantic and Indian Ocean a form apparently allied to *Mertensia*. The same form was also taken by the German South Polar Expedition, one specimen off Kerguelen, another off the Cap Verde Islands, and was described by Dr. F. Moser[1]) under the name of *Mertensia Chuni*. Also a deep-sea Cydippid was taken by the German deep-sea Expedition; it is still known only from the short notice given by Chun[2]). The new form discovered by the "Michael Sars" is thus only the third deep-sea Ctenophore made known, and from that reason alone may attract attention. The study of its anatomy has considerably increased its importance. While in general it agrees with the morphology of the Ctenophores as hitherto known, especially from the surface forms, it affords several new and important features, which necessitate the establishment not only of a new genus for it, but also of a new family, to which the *„Mertensia" Chuni* evidently likewise belongs.

It would be very interesting to learn the anatomical structure of the deep-sea Cydippid from the German Deep-sea Expedition, in order to see, whether this form perhaps also belongs to the same family. That it is stated to be a "Cydippe", evidently, means nothing more definitely beyond the fact that it is a tentaculate Ctenophore of the order Cydippidea. This concerns the question, whether all deep-sea Ctenophores belong to the same family or whether deep-sea forms have developed within several of the larger groups of the Ctenophores. It is, of course, impossible to say anything more definitely at present about this very interesting problem, so long as the whole number of deep-sea forms known amounts to no more than three, of which only two have been studied. But the fact that these two forms, though so very different looking, appear to be nearly related, is already suggestive, and it is certainly not inappropriate to call attention to the problem already now.

That there will prove to exist still more deep-sea Ctenophores, can scarcely be doubted. It is noticeable, it is true, that only these few forms have been found in all the many deep-sea tow-nettings hitherto carried out, and this is certainly not suggestive of the existence of a great number of different forms of deep-sea Ctenophores. But the fact that only so few specimens of these forms have been found counterbalances this evidence. It is beyond doubt that these forms must exist in vast numbers somewhere — this is simply necessary for the existence of the species. But when we have in all found only 6 specimens of one form *("Mertensia" Chuni),* 3 of another (the new form from the "Michael Sars") and one specimen of the third (the Cydippid of the German Deep-sea Expedition), this fact evidently means that there still remains much to be discovered in regard to the occurrence of these forms — and there are then ample possibilities for the existence of other, hitherto undiscovered forms among them. Even with regard to the occurence of the surface

[1]) F. Moser: Die Ctenophoren der deutschen Südpolar-Expedition. Deutsche Südpolar Exp. 1901—1903. Bd. XI. Zoologie III 1909, p. 126, Taf. XX Fig. 1—4.

[2]) C. Chun: Aus den Tiefen des Weltmeeres. II Aufl. 1905. p. 545,

Ctenophores there are still many unsolved problems; it is then not to be wondered at that this also holds good for the deep-sea forms.

The new form discovered by the "Michael Sars" was taken on Station 64 (34° 44′ N., 47° 52′ W. 2000 m. wire; $^{24}/_{6}$ 1910), in young fish trawl, 2 specimens, one large and one small; station 81 (48° 2′ N. 39° 55′ W., 1500 m. wire; $^{17}/_{7}$ 1910), in $^{3}/_{4}$ m. net, fragments of a large specimen. The small specimen was sacrificed for sections, which, however, proved very poor and of little use. The animal being very little transparent, it was necessary, in order to study the anatomical structure, to make dissections. For that purpose the fragments from Stat. 81 proved very useful, so that the large specimen from Stat. 64 could be spared to some degree.

The photographs (Pl. I, figs. 1—4) were made by Docent R. H. Stamm. I beg herewith to express my thanks for his kind assistance.

I shall describe this form under the name of

Aulacoctena acuminata n. g., n. sp.

The large specimen measures 45 mm. in length, 21 mm. in breadth. It is distinctly compressed after the sagittal axis, measuring only 16 mm. in thickness.

The outline of the body (Pl. I, fig. 1) is ovate, narrowing slightly towards the oral end. The aboral end is produced into a long, slender process, measuring — as is seen from the figure of the small specimen (Pl. I, fig. 3) — about $^{1}/_{5}$ of the total length. (In the large specimen this apical prolongation was partly lost, and this was also the case in the broken specimen). Along each side of the body, between the subtentacular costae, there is a very deep furrow (Pl. I, fig. 2), in the bottom of which lies the tentacular apparatus. The furrow continues from the oral end nearly to the tip of the apical prolongation. The mouth edge forms two rounded lobes, in the transversal plane; the corners are, however, not so deep as would appear from fig. 2, the furrow being here somewhat split up at the lower end. Also between the other costae the body may be somewhat depressed, but this is evidently due to the preservation.

The costae are nearly equal in length, the subtentacular ones being only slightly longer than the others; they cease at about $^{1}/_{4}$ of the body length from the oral end—judging from the furrows in which they are retractet; the combs could not be discerned so far down. On the aboral prolongation the costae continue nearly to the tip.

The aboral prolongation is deeply invaginated on the top, being thus a hollow tube. The bottom is slightly widened and elevated in the middle, and here lies the apical organ. (Pl. I, fig. 5). The costae continue as ciliated ridges down along the inside of the tube to the apical organ. (I have been unable to discern with certainty more than 4 of them, but that all 8 costae continue to the apical organ in the same way can scarcely be doubted). Of the structure of the apical organ I can give no information. The polar fields continue some way up the inside of the tube—how far, could not be ascertained, the tip being broken; but in any case, it will be nearly to the upper edge. Close to the apical organ, in the bottom of the invagination, lie the two excretory pores, in the typical oblique position, not in the median sagittal line.

The gastrovascular system. (Pl. I, fig. 5 textfig. 1—3). From the rather small, flattened infundibulum proceeds a short, spacious infundibular canal. The excretory canals are very short; whether they are simple or divided in the usual way, could not be settled; but the fact that the pores lie distinctly to the side would seem to indicate that they are divided, the one branch forming a blind ampulla. The adradial vessels issue separately, not from a common interradial vessel (see the diagram, textfig. 3, compared with fig. 4, the diagram of a typical tentaculate Ctenophore). The subsagittal adradial vessels issue directly from the infundibulum, very close to the median line. They proceed downwards, close to the pharyngeal wall, for nearly half the length of the pharynx, giving off sligthly branching, but not anastomosing, proliferations along their inner and abradial, but not along the adradial side. About halfway down a branch passes outwards to the meridional vessel, while the adradial vessel continues downwards, ending blindly (texfig. 1). The subtransversal adradial vessels issue distally, over the tentacle basis. They give off each one long branch, which passes downwards as a simple canal, parallel to the tentacle sheat, ending blindly. In the broken specimen only one of the adradial subtransversal vessels gave off this branch (textfig. 1 and 2).

The meridional vessels continue aborally from the entrance of the adradial vessel nearly to the tip of the apical prolongation. In their whole length the meridian vessels give off numerous proliferations to both sides. These are white and, as they lie close to the surface, very conspicuous, forming one of the most prominent features of the animal. They issue not regularly alternating or opposite and are alternatingly — but not regularly — shorter or longer, the longer ones being often more or less branched. They do not form anastomoses, but may cover one another more or less, as they are so numerous and large that there is not room for them all in the same plane. Those issuing from the subtentacular vessels along the lateral furrows are especially conspicuous and beautifully arranged (Pl. I, fig. 8). None of the proliferations pass through the jelly to the pharyngeal wall,

as is the case in *Beroë*, where there is otherwise a similar arrangement of proliferations from the meridional vessels.

The pharyngeal vessels issue close to the tentacular basis. They proliferate like the pharyngeal part of the subsagittal adradial vessels; in the lower part the proliferations are longer, nearly meeting in the sagittal middle line of the pharyngeal wall, but they do not form anastomoses. At the oral edge the pharyngeal and meridional vessels end blindy. (Pl. I, fig. 6).

The pharynx is very large. In the upper half its lumen is nearly obliterated on account of very strongly developed, sagittal folds, which do not correspond to the usual pharyngeal folds of Ctenophores. They are arranged in four longitudinal bands, following the four subsagittal adradial vessels, from which proliferations pass in among the folds. The true pharyngeal folds follow the pharyngeal vessels, from which likewise proliferations pass into them; they are much less developed, but are double as usual. (Textfig. 2). The lower half of the pharynx is more spacious. (Pl. I, figs. 5—6). The whole of the pharynx is compressed in the sagittal plane, as typical in Ctenophores, but this feature is obliterated in the upper part on account of the strong development of the sagittal folds, except at the uppermost end. Here the walls are closely appressed, so as to get almost the appearance of a narrow vessel, as seen from the outside (textfig. 1). The walls are here strongly ciliated, this part evidently corresponding to the ciliated pouch of the typical Ctenophores. The oesophagus is not long, but distinct, compressed in the sagittal plane as usual. On the inner lips and the outbending wall (the outer wall of the diaphragm) there appears to be a powerful ciliation.

The histological structure of the gastrovascular canals I have not been able to see in a satisfactory way. In the proliferations there are two lateral thickenings, the outer an inner side being thin; in the meridional vessels there appears to be only one thickening, on the outer side, the whole inner side being thin-walled. Rosettes could not be discerned.

In the meridional vessels and even in the proliferations from these, far down in the body, I have found, in the broken specimen, some large Copepods. This is, however, scarcely a definite proof that this Ctenophore, contrary to the custom of all the rest of them, digests its food not in the pharynx, but in the gastrovascular system. It may perhaps be due to the Copepods having themselves penetrated into the cavities of the digestive system during the capture in the hoof, after the specimen was broken. They do not show signs of having been under the digestive action of the Ctenophore. The strong development of folds in the pharynx would also seem to afford evidence for the absorption of the food in the pharynx after the usual Ctenophoran fashion.

The arrangement of the gonads could, unfortunately not be made out. Probably they will be found to have their place in the proliferations of the meridional vessels, in the same way as in *Beroë;* but even in sections I could see nothing which could be definitely recognized as gonads.

The tentacular apparatus (Pl. I, figs. 5, 7, 9). The tentacular basis is rather short slightly widened at the lover end. It is not longitudinally divided, but appears in sections to be built as usual, the tentacular vessels with their ectodermal covering of colloblast-forming cells occupying the sides, the root of the tentacle occupying the middle part of the basis. It affords the unique feature that the colloblast-layer sends a prolongation into each of the subtransverse adradial vessels, continuing nearly to the point, where it opens into the meridional vessel. This is probably simply a fold of the colloblast-layer of the tentacular basis, but I have been unable to find out, how this peculiar arrangement—an ectodermal prolongation lying within an entodermal tube—has arisen. These two processes from the tentacular basis, very conspicuous on account of their yellow colour, give the puzzling impression, that there are two lateral tentacles to each tentacular basis: indeed, I thought so myself at first, before I had yet studied the anatomy of the animal more closely.

The tentacle is, so far as I have been able to ascertain, unbranched, but ends in a peculiar large knob. (Pl. I. fig. 9). This reminds one somewhat of the peculiar appendages on the tentacles of *Hormiphora;* but it is certain that the knob here occupies the end of the tentacle, and I have found only one such knob on each tentacle. Its shape is somewhat different, now with a constriction at the point, now without such constriction; this is doubtles due to muscular contraction. It appears to be completely covered with colloblasts, though these have been lost in places in the preserved specimens.

The tentacular sheath is directed downwards (Pl. I, figs. 5, 6) and opens at the oral edge, where the lateral furrow ends.

The colloblasts (Pl. I, figs. 10—11) are comparatively large and beautiful objects. The spiral filament is very strongly developed, but there is no central filament to be seen. The grains of the cupule show a definite arrangement in small rosettes.

The jelly is very tough and resistent, nearly as cartilage. It is full of muscles, arranged rather regularly. In tranverse sections the muscles are seen to go from one rib to the other, while others go between the outer and

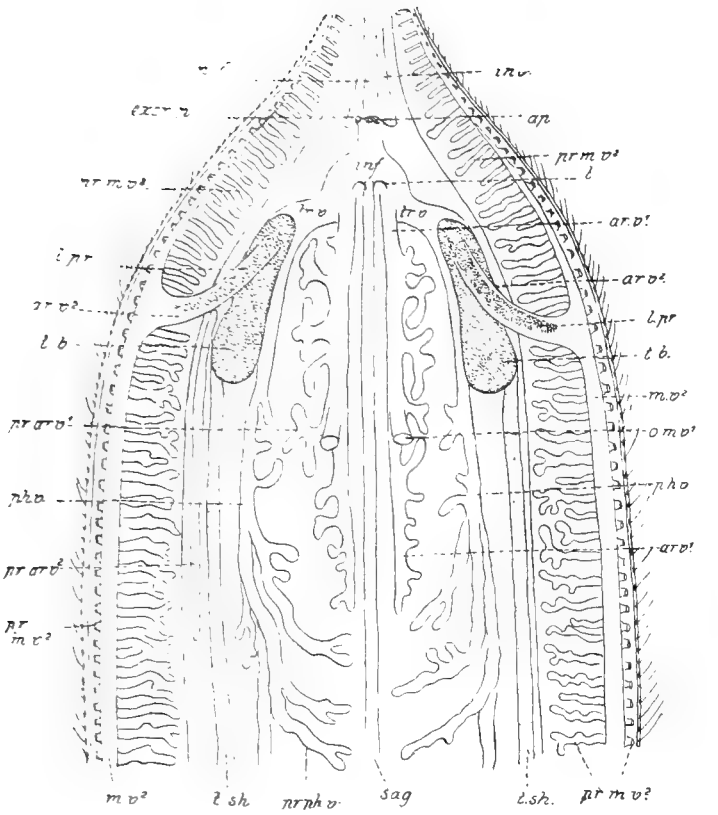


Fig. 1. Gastrovascular system of *Aulacoctena acuminata*; slightly diagrammatic. $^{3}/_{1}$. ap. apical organ, ar v ^{1} subsagittal adradial vessel; ar. v.^{2} subtransversal adradial vessel; excr p. excretory pore; inf. infundibulum; inv. apical invagination; l. inner lips of oesophagus; l. pr. lateral process from tentacle basis; m v.^{2} subtransversal meridional vessel; o. m. v.^{1} opening of the adradial vessel into the subsagittal meridional vessel. p f. polar field; ph. v. pharyngeal vessel; pr. ar. v.^{1} proliferations from subsagittal adradial vessels; pr. ar. v.^{2} proliferation from subtransversal adradial vessel, pr m. v.^{2} proliferations from the subtransversal meridional vessels; those of the side turning towards the spectator have been cut near the basis, while those of the other side, lying in the side wall of the lateral furrow are complete; pr. ph. v. proliferations from the pharyngeal vessels; sag. the narrow. sagittal edge of the pharynx; t. b tentacular basis, t. sh. tentacle sheath; tr. v. transverse vessel.

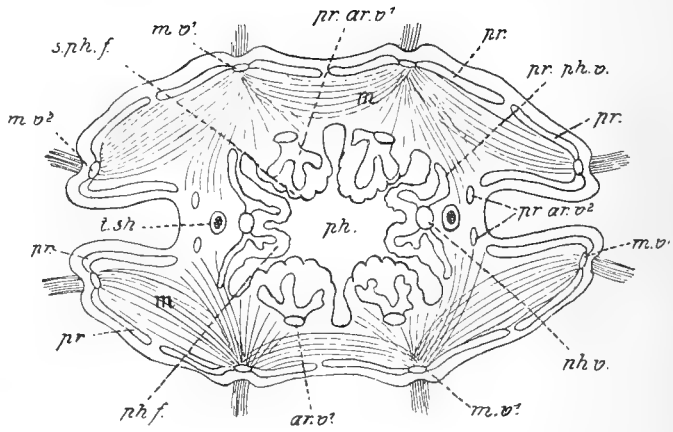


Fig 2 Transverse section of *Aulacoctena acuminata;* slightly diagrammatic. $^{3-5}/_{1}$. ar. v.^{1} subsagittal adradial vessel; m. muscle fibres; m. v.^{1} subsagittal meridional vessel; m. v.^{2} subtransversal meridional vessel, ph. pharynx; ph. f. pharyngeal folds; ph. v. pharyngeal vessel; pr. proliferations from meridional vessels; pr. ar. v.^{1} proliferations from subsagittal adradial vessels; pr. ar. v.^{2} proliferations from subtransversal adradial vessels; pr. ph. v. proliferations from pharyngeal vessel; s ph. f. sagittal pharyngeal folds; t. sh. tentacle sheath.

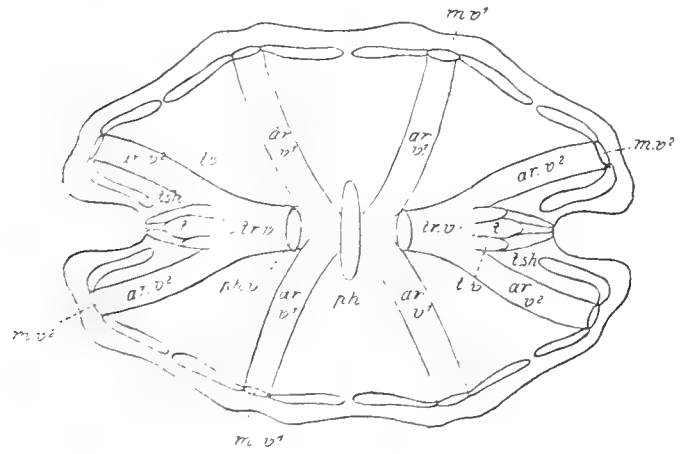


Fig. 3.

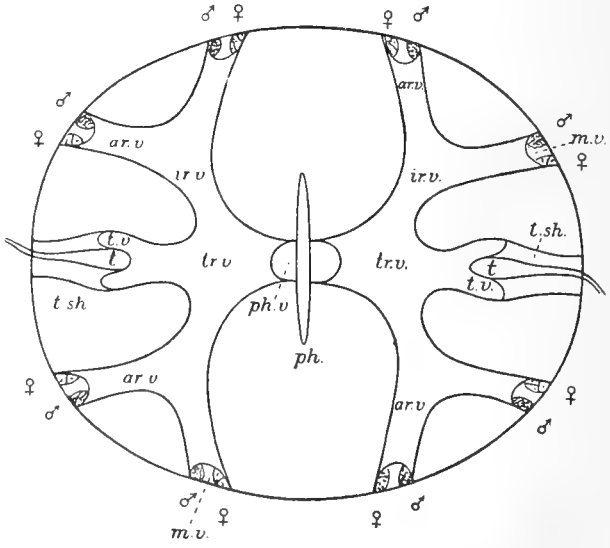


Fig. 4.

Fig. 3—4. Diagrams of the gastrovascular system of *Aulacoctena* (3) and of a typical tentaculate Ctenophore (4). ar. v. adradial vessels, ^{1} subsagittal, ^{2} subtransversal; ir. v. interradial vessel (not found in *Aulacoctena);* m. v. meridional vessel, ^{1} subsagittal, ^{2} subtransversal; ph. pharynx; ph. v. pharyngeal vessel; t. tentacle; tr. v. transverse vessel; t. sh. tentacle sheath; t v tentacular vessel.

inner wall of the body (textfig. 2); also longitudinal muscles are distinct, especially in the aboral part. All these crossing fibres form together a close, somewhat regular meshwork. The muscle cells show some very peculiar protoplasmic swellings (Pl. I, fig. 12), looking almost like a ganglionic chain of an Arthropod. Several of these swellings may be found on the same thread, in irregular distances. Branching of the muscle cells has not been observed, but very probably will be found at their ends. They are all rather much folded, nearly spirally; this is evidently the result of contraction on preservation. Amoeboid cells are very scarce in the jelly.

Granular cells are exceedingly numerous in the sagittal folds of the pharynx, while the true pharyngeal folds contain such cells only in very small numbers.

The colour is now yellowish, semitransparent; originally it was more red, the colour being bound to the folds of the pharynx.

The nearest relative of this very interesting Ctenophore is evidently, the *"Mertensia" Chuni*, for which I have established ("Ingolf" Ctenophora, p. 36) the genus *Bathyctena*. Like *Aulacoctena* it has proliferations from the meridional and pharyngeal vessels, a feature otherwise not known among tentaculate Ctenophores. The pharyngeal walls are strongly folded in *Bathyctena*; but i does not appear from Dr. MOSER's description, whether these folds are arranged in the same way as in *Aulacoctena*. Through the kindness of Professor VANHÖFFEN I have had opportunity to see the two specimens of *Bathyctena* from the German South Polar Expedition. The condition of these specimens does not permit any further preparation, but I observed in the pharynx of the larger specimen a pair of whitish lobes ending, where the widening of the pharynx begins. These lobes, which are not indicated in the figure (Taf. XX, 3) given by Dr. MOSER, I am inclined to regard as corresponding to the sagittal pharyngeal folds of *Aulacoctena*. There seems also to be an indication, that they are separated in the middle line. In the smaller specimen these lobes could not be observed. Whether the development of folds in the pharynx is mainly the same in both forms or not, I think that the character of the proliferating meridional and pharyngeal vessels is important enough to justify the establishment of a separate family for these two forms. I shall give here diagnoses of this family and the two genera belonging to it.

Bathyctenidæ n. fam.

Tentaculate Ctenophores, compressed after the sagittal plane. Proliferations from the meridional and the pharyngeal vessels. The pharynx walls strongly folded. Tentacle sheath opening orally. Jelly very tough. Deep-sea forms.

1. ***Bathyctena*** Mrtsn.

Body rounded; no lateral furrow. Apical organ not sunken. Pharynx in the lower part strongly widened in the transversal plane.[1]) No lateral processes from the tentacular basis.

Only species known: *B. chuni* (Moser).

2. ***Aulacoctena*** Mrtsn.

Body ovate, with a deep lateral furrow and an apical prolongation, deeply invaginated; the apical organ lies in the bottom of the invagination. The pharynx not widened in the transversal plane in the lower part. The upper part of the pharynx with strongly developed sagittal folds. The subsagittal adradial vessels issue directly from the infundibulum, the subtransversal issue distally, at the sides of the tentacle basis. Proliferations also from the adradial vessels. Tentacle basis with lateral processes. Tentacles simple, with a terminal knob.

Only species known: *A. acuminata* Mrtsn.

It still remains to consider the question, to which group of the other Ctenophores the Bathyctenidæ are related. The sagittal compression decidedly suggests the Mertensiids as their nearest relations, as is also expressed in the fact that *Bathyctena* was originally refered to the genus *Mertensia*. The proliferations of the meridional and pharyngeal vessels certainly recall the Beroids, but the fact that the deep-sea forms are tentaculate at once shows that this is merely an analogous development, the proliferations having developed independently in both Beroids and Bathyctenids. It is worth recalling that Mertens[2]) states to have observed in *Mertensia ovum* „baumartig verzweigte Gefässe" proceeding from the upper part of the subtransversal meridional vessels towards the inner part of the gastrovascular system. If this proves to be correct, it will, evidently, mean another connecting point between the Mertensiids and the Bathyctenids.

With the Pleurobrachiidæ and the Cestidæ the deep-sea forms show no nearer relation; with the Lobatæ and the Platyctenidæ they have the large oral lobes in common.

Our present knowledge evidently leads to the conclusion that the Bathyctenids are derived from the Mertensiids, along the same line as the Lobatæ and the Platyctenidæ.

---

[1]) This diagnosis is, of course, not complete; but in the present state of our knowledge it seems not warranted to extend it and give any definite statement about the arrangement of the gastrovascular system.

[2]) H. MERTENS: Beobachtungen und Untersuchungen über die beroëartigen Acalephen. Mem. Acad. Imp. St. Petersbourg. Ser. 6, Vol. 2. 1833. (See also; Ingolf-Ctenophora, p. 63).

The Ctenophores from the surface waters collected by the "Michael Sars" are the following;

1. ***Mertensia ovum*** (Fabr.).

Station 76. (47° 11′ N, 47° 6′ W., $^{9}/_{7}$ 1910; 1 m. net, 50—0 m.—2 specimens.

One of these specimens is comparatively well preserved, it is, indeed, the best preserved specimen I ever saw of this form. The meridional vessels are distinct (in all other specimens, which I have examined, they are quite indiscernable); they are strongly folded, so that I thought at first to see here the proliferations observed by MERTENS. There can, however, be no doubt that the folds are simply due to the contraction on preservation. The locality is in the Labrador Stream.

2. ***Pleurobrachia pileus*** (O. Fr. Müll.).

Station 71. (43° 18′ N., 51° 17′ W. $^{30}/_{6}$ 1910).
1. Surface; 1 m. net, 11 specimens.
3. 100 m. wire; 1 m. net, 4 specimens.
8. 300 — young fish trawl; 8 specimens.

— 72. (44° 35′ N., 51° 15′ W. $^{1}/_{7}$ 1910).
3. 30—0 m., 1 m. net, 16 specimens.

— 97. (56° 15′ N., 8° 28′ W. $^{4}/_{8}$ 1910).
3. 50 m. wire; young fish trawl; 1 specimen.

— 102. (60° 57′ N., 4° 38′ W. $^{9}/_{8}$—$^{10}/_{8}$ 1910).
22. 1 m. net; surface; 1 specimen.
$^{3}/_{4}$ — 200 m. wire; 2 specimens.

The specimens are upon the whole very well preserved, so that there can scarcely be any doubt of the determination. The species *Pleurobrachia brunnea* recently described by A. G. MAYER[1]) from the coast of New Jersey appears not to be among them; to be sure, it will probably always be very difficult to discern the most prominent of the specific characters of this species, viz. the terminal knob of the tentacles, in preserved specimens; but the shape and colour of the specimens does not suit to *Pl. brunnea*. The captures of the "Michael Sars" of *Pl. pileus* do not appear to me to warrant any conclusion regarding its bathymetrical distribution.

3. ***Beroë cucumis*** Fabricius

Station 10. (45° 26′ N., 9° 20′ W. $^{19}/_{4}$—$^{21}/_{4}$ 1910).
300 m. wire; yong fish trawl, 2 fine, medium sized specimens.
6. 1 m. silknet; 100 m. wire out; 3 small specimens.
7. 1 m. silknet; 200 m. wire! 2 small, badly preserved specimens.

— 42. (28° 2′ N., 14° 17′ W. $^{23}/_{5}$—$^{24}/_{5}$ 1910).
Young fish trawl; 900 m. wire; 2 very badly preserved small specimens. (The identification not beyond doubt).

— 49. (29° 6′ N., 25° 2′ W. $^{1}/_{6}$ 1910).
24. 1 m. silknet; 270 m. wire out; 1 small, badly preserved specimen.

Station 53. (34° 59′ N., 33° 1′ W. $^{8}/_{6}$—$^{9}/_{6}$ 1910).
32. Young fish trawl; 600 m. wire; 1 small. poorly preserved specimen.
42. Young fish trawl; 1600 m. wire; 1 medium sized specimen.
45. Bottom net; 2100 m. wire; 1 small specimen.
54. Young fish trawl; 1600 m. wire. Fragment of a large specimen.

- 56. (56° 53′ N., 29° 47′ W. $^{10}/_{6}$—$^{11}/_{6}$ 1910).
2. Silknet; surface; 1 large specimen.
Young fish trawl; 300 m. wire; 1 large specimen.

- 63. (36° 5′ N., 43° 58′ W. $^{22}/_{6}$ 1910).
16. 3 m. silknet; 4500—1500 m. wire; 1 small specimen.
22. 3 m. silknet; 1356—450 m. wire; 1 large specimen.

— 64. (34° 44′ N., 47° 52′ W. $^{24}/_{6}$ 1910).
34. Young fish trawl; 2000 m. wire; 2 medium sized specimens.
50. Young fish trawl; 2000 m. wire; 1 small, badly preserved specimen.
? 3 m. net; 3000 m. wire; 1 large, badly preserved specimen.

- 71. (43° 18′ N., 51° 17′ W. $^{30}/_{6}$ 1910).
1. 1 m. net; surface; several small specimens.
3. 1 m. net; 100 m. wire; 1 medium sized specimen.

— 76. (47° 11′ N , 47° 6′ W. $^{9}/_{7}$ 1910).
1 m. net; 50—0 m.; 1 medium sized specimen.

- - 80. (47° 34′ N., 43° 11′ W. $^{11}/_{7}$ 1910).
18. 3 m. net; 3000, 2500, 2000 m. wire; 1 large specimen.

— 81 (48° 2′ N., 39° 55′ W. $^{12}/_{7}$ 1910).
16. 1 m. net; surface; 1 medium sized specimen.
27. $^{3}/_{4}$ m. silknet; 2500 m. wire; 1 small, badly preserved specimen; the determination not quite certain.
33. 3 m. net; 3000 m. wire; 1 medium sized specimen.

— 82. (48° 24′ N., 36° 53′ W. $^{13}/_{7}$ 1910).
13. $^{3}/_{4}$ m. net; 1500 m. wire; 1 small specimen. (The determination not quite certain).
38. Young fish trawl; 2000 m. wire; 1 small, badly preserved specimen.

— 84. (48° 4′ N., 32° 25′ W. $^{15}/_{7}$ 1910).
21 a. Young fish trawl; 2000 m. wire; 1 large specimen.
37 Young fish trawl; 3000 m. wire; 1 small specimen.

— 87. (46° 48′ N., 27° 46′ W. $^{17}/_{7}$ 1910).
11 a. Young fish trawl; 2000 m. wire; 1 large specimen.

— 88. (45° 26′ N., 25° 45′ W. $^{18}/_{7}$ 1910).
17. $^{3}/_{4}$ m. net; 1500 m. wire; 1 medium sized specimen.

90. (46° 58′ N., 19° 6′ W. $^{21}/_{7}$ 1910).
23. $^{3}/_{4}$ m. net; 1500 m. wire; 1 medium sized specimen.

— 92. (48° 29′ N., 13° 55′ W. $^{24}/_{7}$ 1910).
41. Young fish trawl; 1000 m. wire. 1 medium sized specimen.

— 98. (56° 33′ N., 9° 30′ W. $^{5}/_{8}$ 1910).
31. 3 m. net; 1500 m. wire; 1 large and 1 small specimen.
35. 1 m. silk net; surface; 1 medium sized specimen.

- - 101. (57° 41′ N., 11° 48′ W. $^{7}/_{8}$ 1910).
20. Young fish trawl; 2000 m. wire; 1 small specimen.

- - 102. (60° 57′ N., 4° 38′ W. $^{9}/_{8}$ 1910).
3. 3 m. net; 1500 m. wire; 5 medium sized specimens.
5. Young fish trawl; 1000 m. wire; 2 small, badly preserved specimens.
6. $^{3}/_{4}$ m. silk net; 1400 m. wire; 1 small, 1 medium sized specimen.
36. 1 m. net; 100 m. wire. 1 small specimen.

[1]) A. G. MAYER: Ctenophores of the Atlantic Coast of North America. Publ. Carnegie Inst. Washington, No. 162. 1912.

The rather considerable number of catches of this species shows that it is found all over the Atlantic—a result which is, however, by no means surprising, in view of the fact that it has a cosmopolitan distribution. That the species was not taken in the open Atlantic by the Plankton-Expedition may probably be due to the apparatus used by that Expedition.

Concerning the bathymetrical distribution the catches of the "Michael Sars" do not give any reliable results. The number of specimens taken is not nearly large enough to warant conclusions from the differential catches. When there is f. i. one specimen in the surface haul and 2 specimens in the haul with 1500 m. wire, there is not at all sufficient evidence that the two latter have not been taken also at the surface.

4. ***Beroë Forskåli*** M. Edw.

Station 88. (45° 26′ N., 25° 45′ W. $^{18}/_{7}$ 1910.)
41. 1 m. net; 200 m. wire; 1 large specimen.

The specimen is in a rather fragmentary condition, but otherwise so well preserved, that the determination is beyound doubt.

In the "Ingolf" Ctenophora (p. 92) I expressed my conviction that this species would prove to occur also in the Atlantic, not only in the Mediterranean and the Indo-Pacific Oceans, from which it was hitherto alone recorded. That my suggestion was correct, is definitely proved herewith, while the two Atlantic localities given in the work quoted could not put the matter beyond doubt, being founded on old, poorly preserved specimens, which could not be identified with full certainty. Otherwise the species is now seen to be abundant also in the West India Sea and along the U. S. Atlantic coast, as far North as Chesapeake Bay. I conclude this from A. G. MAYER's statement of *Beroë ovata* in his "Ctenophores of the Atlantic Coast of North America" (p. 51). It is evident that the species which he designates as *Beroë ovata* is the same as *Beroë Forskåli*. When A. G. MAYER thus maintains *Beroë ovata* as distinct from *B. cucumis*, while I, in my contemporaneously with his work published "Ingolf" Ctenophora, maintain that *B. ovata* cannot be distinguished from *B. cucumis*, these two statements are realy not contradictory, because the *B. ovata* of A. G. MAYER is quite a different species from that called by that name by CHUN and other workers, viz. *B. Forskåli*, which nobody would think of confounding with *B. cucumis*.

Explanation of the Plate I.

Aulacoctena acuminata Mrtsn.

Figs. 1—4 photographs by Docent R. H. STAMM; figs. 5—12 drawn by the author.

Fig. 1. Large specimen, seen from the sagittal side. $^{1\cdot5}/_{1}$.

„ 2. The same specimen, seen from the tentacular side. A thin glass tube has been laid into the lateral furrow, in order to make it more distinctly seen in the photograph. The glass tube is seen in the upper half. The oral slit is a little widened. $^{1\cdot5}/_{1}$.

„ 3. Small specimen, seen from the sagittal side. $^{1\cdot5}/_{1}$.

„ 4. Fragment of a large specimen upper part, opened so as to show the folds of the pharynx; the lateral processes from the tentacular bases are seen, also the apical invagination, in the slightly widened bottom of which lies the apical organ. Along the sides are seen the proliferations from the subtransversal meridional vessels along the wall of the lateral furrow. $^{1\cdot5}/_{1}$.

„ 5. The same fragment as fig. 4, somewhat more dissected. The upper part of the pharynx is filled out by the large sagittal folds; below these some proliferations from the pharyngeal vessels are seen in the pharyngeal wall. Between the openings of the subsagittal adradial vessels (o. adr. v.) is seen the oesophagus with the thickened inner lips. ap. apical organ; inf. infundibulum; inv. apical invagination; l. pr. lateral process from the tentacle basis; ph. v. pharyngeal vessel; pr. proliferations from the subtransversal meridional vessels; s. w. side wall of the body: t. b. tentacle basis; t. sh. tentacle sheath. $^{3}/_{1}$.

„ 6. Lower end of the pharynx. ph. v. pharyngeal vessel, pr. proliferations from the subtransversal vessels; s. t. v. subtransverse meridional vessel; s. w. side wall of the body; t. sh. tentacular sheath. $^{3}/_{1}$.

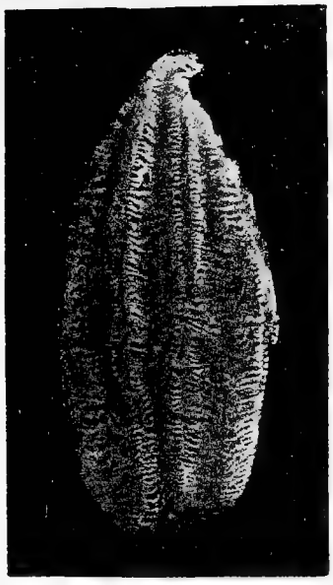
„ 7. Tentacular basis, seen from the outside. adr. v. adradial vessel; l. pr. lateral process from the tentacle basis; o. tr. v. opening of the transverse vessel; ph.v. pharyngeal vessel; pr. ar. proliferation from the adradial vessel; t. sh. tentacular sheath. $^{10}/_{1}$.

„ 8. Proliferations from subtransverse meridional vessel, along the wall of the lateral furrow. $^{6}/_{1}$.

„ 9. Terminal knob of the tentacle. $^{17}/_{1}$.

„ 10—11. Colloblasts. $^{730}/_{1}$.

„ 12. Muscle fibre with protoplasmic swellings. $^{730}/_{1}$.



1.

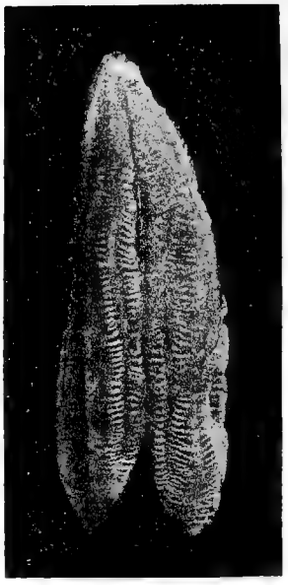
12.

3.

4.

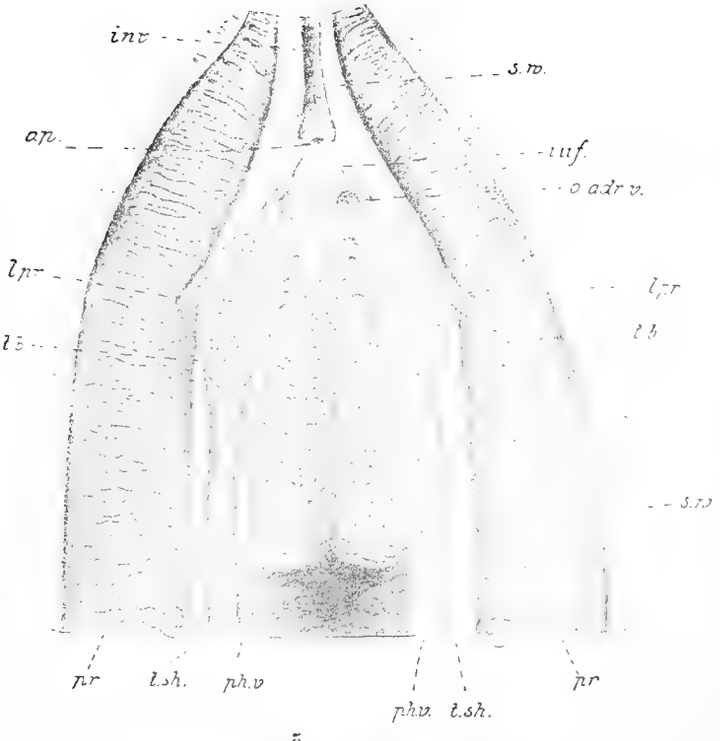
10.

11.



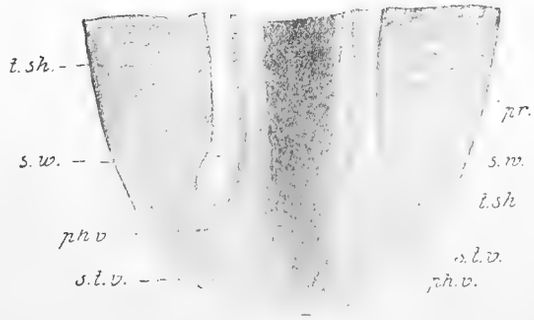
2.

7.



5.

8.



6.

9.

Fig. 1—4 R. H. Stamm phot., 5—12 Th. Mortensen del.

PELAGIC NEMERTEANS

FROM THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

AUGUST BRINKMANN

WITH 2 PLATES

Introduction.

It is now forty years since the first pelagic nemerteans were brought to light during the voyage of the "Challenger", and although new finds have subsequently been made by various other expeditions, notably that of the "Valdivia", the material has throughout been but scanty in amount, and only partly available for thorough investigation. With regard to this peculiar animal group therefore, interesting as it is from the point of view of general zoology on account of the remarkable transformations occasioned by the need of adaptation to pelagic life, our knowledge is still irregular and incomplete in the extreme. It has even, in several cases, been found quite impossible to identify species previously described, owing to the superficial character of the original descriptions.

The "Michael Sars" expedition brought home a very rich amount of material of this group, for the most part in a good state of preservation; this materiel has since been placed at my disposal by the Norwegian Director of Fisheries, Dr. Johan Hjort, who was in command of the expedition, conjointly with Sir John Murray.

I had then already, some ten years before, commenced the study of the pelagic nemerteans, specimens of which I had received from several Danish expeditions, and in course of the work other collections came to hand. It was the material from the "Michael Sars" however, which rendered it possible to make a thorough investigation into the taxonomy, distribution and anatomical structure of this group.

Any work dealing with nemerteans must necessarily be based upon highly detailed treatment of the subject by means of serial sections, and should, moreover, if it is to prove of real value to subsequent investigators, include exhaustive descriptions, supplemented, as regards anatomy, by a great amount of illustrative matter. Such a method of proceeding would however, in the present instance, involve a demand for space altogether transcending the limits assigned to this chapter in the report of the expedition, and disproportionate to the small number of species treated; the scope of the work has here therefore been very essentially curtailed. The plan now adopted, after consultation with the Editor, Dr. Hjort, is to give a fairly detailed diagnosis of all new or little-known species, with a statement of their respective geographical distribution as indicated by the material. The entire subject will thereafter be treated at length, with the requisite illustrations, in a separate monograph on the pelagic nemerteans shortly to be issued among the publications of the Bergen Museum. In this latter work will be found the full explanation of the classification also employed in the present report, a system based upon a number of species over and above those here concerned, and, in the case of several species, upon a considerably greater number of specimens than furnished by the expedition.

With regard to the terminology employed, it will suffice to mention that this is in all essentials identical with that formulated by Bürger (3) in his monograph on the nemerteans.

Bergen, June 1915.

Aug. Brinkmann.

HOPLONEMERTINI

Hubrecht 1879.

Surface epithelium in single layer. Two layers of musculature in the body wall. Mouth opening in front of or below the brain. Intestine straight. Intestinal cæcum and diverticula developed. Nerve system in the parenchyma. Cerebral organs — if present — separate from the brain. Proboscis with a highly developed armature. Blood lacunæ lacking.

MONOSTILIFERA nov. subordo.

Hoplonemerteans with one stylet on the stylet basis.

POLYSTILIFERA nov. subordo.

Hoplonemerteans with several stylets on the stylet basis.

Reptantia nov. tribus.

Polystilifera living on the bottom. Cerebral and nephridial organs and diverticula on the proboscis sheath developed.

Pelagica nov. tribus.

Pelagic polystilifera. Cerebral and nephridial organs, diverticula on the proboscis sheath and metameral transverse vessels lacking. ♂ sexual glands confined to the head region.

Bathynemertidæ nov. fam.

Medium sized pelagic nemerteans. Body not particularly broad and only slightly flattened. Hinder end without caudal fin. Stomach and intestinal cæcum large. The intestinal diverticula with ventral branch; between this and the dorsal are placed the lateral nerve and blood vessel. The muscular system of the body wall much reduced. The muscular wall of the proboscis sheath consists of interwoven circular and longitudinal muscle fibres.

Bathynemertes nov. gen.

Body tapered at both ends. Mouth and proboscis pore united. The proboscis sheath extends throughout the whole length of the body. Many eggs are developed in the ovaries.

Bathynemertes Hubrechti nov. sp.

(Plate I, Fig. 5.)

As shown in the figure, the shape of the body in this species is only slighthly affected by the pelagic conditions, there being still considerable resemblance to the *Drepanophorus* species of the bottom, from which all known pelagic nemerteans are derived.

Length 56 mm. greatest breadth 10 mm. greatest thickness 5.5 mm. The surface epithelium slightly, the basement layer very strongly developed.

The tip of the snout forms a funnel-shaped depression at the bottom of which lies the proboscis pore, the mouth opening being a broad transverse fissure in the ventral wall of the funnel. An œsophagus being absent, the mouth opening leads directly into the stomach which is developed to an unusual degree with highly folded walls, permitting a considerable expansion; its length is about 3 mm. Behind the brain it leads gradually into the pyloric tube which is no less than 8 mm. long.

The intestine is narrow, and furnished with about 40 pairs of large lateral pouches or diverticula which are highly ramified, the ramification proceeding from a dorsal and a ventral main branch. The intestinal cæcum is well developed: it has a length of 8 mm. and is furnished with five pairs of diverticula, likewise highly ramified.

The proboscis is surprisingly strong, but relatively short, its length not exceeding that of the body. Its wall contains 29 proboscidial nerves. Structure of the stylet apparatus as in *Drepanophorus*. The rhynchodæum is very short; the proboscis sheath however, may be found extending right out into the point of the tail. The musculature in the wall consists of a network of interwoven circular and longitudinal fibres, exactly as in *Drepanophorus*.

The specimen in question is a young ♀ with ovaries not yet fully developed; they lie between the pouches of

the intestine in a single row on either side of the proboscis sheath, commencing in the cæcal region. The ovaries open to the exterior on the outer side of the lateral nerve. A considerable number of eggs are developed in each of the ovaries.

Habitat; St. 92 (Lat. 48° 29′ N; long 13° 55′ W.) ^{23}—$^{24}/_{7}$, 2000 metres depth (3000 metres of wire).[1])

Plotonemertes nov. gen.

Forepart of the body thickened to a club-shape. Mouth and proboscis pore separate. Muscles following the lateral nerve lacking. The male has a large double integumental glandular organ on the under side of the tail.

Plotonemertes adhærens nov. sp.
(Plate I, Figs. 9–10.)

This species is likewise based upon a single specimen. As will be seen from Fig. 9, the shape of the body differs from that in *Bathynemertes* by the club-shaped thickening of the forepart; the proboscis is unusually thick, owing to the presence of a highly developed exterior basement layer, a character which renders the species easily distinguishable. The male is further easily recognised by the large double integumental glandular organ on the under side of the tail, some idea of which may be obtained from Fig. 10. Judging from the structure of the organ it can be pushed out, and the enormous glandular apparatus would appear to indicate that it is an adhesive organ, probably used to grip the female during fecundation.

The species is somewhat smaller than *Bathynemertes*, length 30 mm., greatest breadth 9 mm., greatest thickness 4 mm.

The muscle layers of the body wall are highly reduced, this being especially the case with the circular layers, but the longitudinal musculature is also very thin laterally.

The mouth opening lies very close to the terminal proboscis pore, being however distinctly separated from it. Oesophagus lacking. Stomach well developed, its length together with that of the pyloric tube making in all 4.75 mm. The intestine narrow but furnished with over 50 pairs of large and highly ramificated diverticula. The well-developed intestinal cæcum has 6 pairs of diverticula.

The proboscis is more than twice as long as the animal itself; its maximal thickness is about 2 mm. In its wall are 27 proboscideal nerves; the stylet apparatus developed as in *Bathynemertes*. The proboscis sheath is likewise similar in structure to that of the species mentioned, but does not extend to the hindmost quarter of the body.

Save for the lack of metamerical commissures between the lateral and the dorso-median vessel, the vascular system exhibits but one peculiartty, a short, median vessel extending from the dorsal anastomose of the lateral vessels in the tail, into which the dorso-median vessel opens, out to the extreme point of the tail.

The lateral nerves are connected by numerous ventral transverse anastomoses.

The specimen in question is a young male. The testicles form an almost regular row in the head on either side of the proboscis sheath; the one row contained 8, the other 11, opening ventrally.

Habitat; St. 80 (Lat. 47° 34′ N; long. 43° 11′ W.) $^{11}/_{7}$, 2000 metres depth (3000 metres of wire).

Pendonemertes nov. gen.

Body thickening to a club-shape at the fore end, the hinder end somewhat applanated. Mouth and proboscis pore separate. Muscles following the lateral nerve well developed[1]). The proboscis sheath does not extend to the rear half of the body. Only few eggs are developed in the ovaries.

Pendonemertes Levinseni nov. sp.
(Plate I, Fig. 4).

The "Michael Sars" expedition brought home two specimens of this form, which is of especial interest, since the species — or at any rate the genus to which it belongs — must be regarded as the original form of a closely related series, the families of *Pelagonemertidæ* and *Armaueriidæ*.

The shape of the body is still but very slightly different from the *Drepanophorus* species of the bottom; the fore part is almost circular in section, the hinder end somewhat flattened, though not forming any caudal fin.

The dimensions of the two specimens were as follows:

	Length.	Greatest breadth.	Greatest thickness.	Length of prob. sheath.
I	26 mm.	6	4	13
II	20 „	5	3.5	11

The musculature of the body wall is here also highly reduced, even the longitudinal muscle layer being laterally almost entirely lacking.

The stomach is well developed, leading close behind the brain into the pyloric tube, the two sections together making up a length of 3.6 mm.

The intestine has between 30 and 40 pairs of diverticula; here again they are, with the exception of the

[1]) The question of depth as estimated from length of wire is further discussed on p. 10.

[1]) These muscles were first designed by Bürger (6) under the name of "Seitenstammuskel" as found by him in *Balaenanemertes* chuni.

caudal region, ramifying out from a dorsal and a ventral main branch. The intestinal cæcum has three pairs of diverticula.

The proboscis resembles in structure that of the *Plotonemertes* but is considerably thinner; 16 proboscideal nerves are developed. The stylet apparatus is developed as in the remaining members of the family.

The proboscis sheath terminates at the limit between the fore and hinder portion of the body, its muscular layers are interwoven as in the forms previously described. From this musculature a strong muscle extends on either side, commencing in the cerebral region close behind the ventral commissure of the brain and running close to the lateral nerve of the respective side, following it to the tail.

The vascular system in this species exhibits the same peculiarity as in the case of *Plotonemertes,* with a similar blind vessel terminating in the extreme end of the tail and running from the posterior surface of the caudal commissure.

The lateral nerve stems are situate far up in the parenchyma.

Both the specimens were female, with from 20—24 pairs of ovaries situate between the diverticula of the intestine and opening ventrally just outside the lateral nerves. In each ovary, only two, or in exceptional cases three, eggs are developed; these reach, however, a considerable size.

Habitat; St. 25 (Lat. 35° 46′ N; long 8° 16′ W.) $^{8}/_{5}$, 1000 metres depth (1500 metres of wire).

St. 94 (Lat. 50° 13′ N; long. 11° 23′ W.) $^{26}/_{7}$, 1000 metres depth (1500 metres of wire).

Planktonemertidæ nov. fam.

Medium-sized pelagic nemerteans. Body very broad and more or less flattened. The diverticula of the intestine and intestinal cæcum commonly with ventral branch, in any case always highly ramified. Circular and longitudinal musculature in the proboscis sheath interwoven. Musculature of the body wall highly reduced.

The typical genus of the family is *Planktonemertes* Woodworth (21); is is not represented in the material.

Crassonemertes nov. gen.

Body very broad and thick. Tail short, somewhat flattened and sharphy distinct from the body. Mouth and proboscis pore separate but situate very close together. Vascular and nerve commissure immediately in front of anus. The proboscis sheath extends into the tail.

Crassonemertes robusta nov. sp.
(Plate I, Fig. 8.)

This species, with its remarkably heavy form, is represented by a single female specimen.

The animal in question, which had been preserved in formalin, was yellowish white and entirely opaque.

Length 25 mm. greatest breadth 10 mm. greatest thickness 4.5 mm.

Musculature of the body wall so reduced as to be of probably but little importance for swimming. The species should in all likelihood be considered as principally a floating organism.

Stomach highly developed — it had been forced somewhat out of the mouth opening by process of fixation; *vide* Fig. 8, Pl. I. — passing over behind the brain into the pyloric tube, the latter 6 mm. long.

The intestine fairly broad at the fore end, but quite narrow at the rear; it forms some 40 pairs of diverticula which are ramified to a quite unusual degree and so closely adjacent one to another that the ramifications appear interwoven. The intestinal cæcum is furnished with at least five pairs of diverticula, likevise highly ramified, the ramification throughout emanating from a dorsal and a ventral main branch.

Proboscis of about the same length as the body. The stylet basis is bent almost to a right angle and furnished with at least 10 stylets. Some 20—21 proboscideal nerves are developed.

The proboscis sheath terminates 2 mm. in front of the anus; the musculature in its wall consists of interwoven bundles of circular and longitudinal fibres.

The rhynchodæum is short, opening at the base of a depression in the epithelium, this depression, however, is not so large as to include the mouth, as is the case with *Bathynemertes* and *Planktonemertes*. The vascular system here exhibits the same original features as in *Bathynemertes*, the caudal commissure being situate far out at the tip of the tail.

Ovaries to the number of 35 pairs are developed, being still quite young and forming elongated sacs on the outer side of the lateral nerves with the dorsal portion curving in over the latter. Numerous young egg cells were found in the ovaries, and a considerable number of eggs are doubtless developed in each ovary.

Habitat: St. 101 (Lat. 57° 41′ N; long. 11° 48′ W) ^{6}—$^{7}/_{8}$, abt. 1666 metres depth (2500 metres of wire).

Bürgeriellidæ nov. fam.

Body broad but relatively slightly flattened. The intestinal diverticula highly reduced in number, projecting from the intestine at considerable

intervals. Ramification of the diverticula altogether extreme. The muscle layers of the proboscis sheath are arranged in an inner layer of circular, and an outer one of longitudinal fibres.

Bürgeriella nov. gen.

Characters of family.

Burgeriella notabilis n. sp.
(Plate I, Figs. 6—7.)

It has been found necessary to institute a new family for this highly peculiar form, of which unfortunately only a single specimen (male) is known; it is doubtless derived from forms such as the *Planktonemertidæ,* but cannot be included in this group, differing therefrom in particular as regards the structure of the intestine and of the proboscis sheath.

Unfortunately, nothing is known as to the appearance of the animal in a living state: judging from that of the specimen preserved in formalin, however (Plate I, Fig. 6) it would seem likely that it is then quite transparent, which would render the intestine even more conspicous. From the habitus figure it will be seen that the extreme and remarkable ramification of the intestine renders this form immediately distinguishable from all other nemerteans.

Bürgeriella is a very imposing form among pelagic nemerteans, and is in point of size only surpassed by species of the genus *Dinonemertes.*

Length 52 mm. greatest breadth 15 mm. greatest thickness 4 mm.

The muscular layers of the body wall are thin, the parenchyma however, being highly developed.

The mouth and proboscis pore are distinctly separate. Œsophagus lacking. The stomach remarkably short, narrow and capable of only slight expansion; at a distance of only 1 mm. behind the mouth-opening it leads into a narrow pyloric tube about 6 mm. long.

The intestine is narrow, and furnished at intervals with slender but highly ramified diverticula; here also the ramification proceeds from a dorsal and a ventral main branch; these secondary ramifications however, differ from those observed in other nemerteans in being long, slender, and frequently branching off again. The diverticula being placed at relatively considerable distance one from another, they are further developed to a high degree of ramification on their anterior and posterior surfaces, so that each diverticulum forms a large arboriform appendix to the intestine, not, however, extending so far as to occasion any interweaving of the branches with those from the adjacent stems.

The intestinal cæcum is furnished with 6 pairs of diverticula, which are ramified in the same manner as the remaining diverticula, but are, however, somewhat smaller than these. (Plate I, Fig. 7).

The proboscis is slightly longer than the body. The stylet apparatus does not differ from the type commonly found among pelagic nemerteans. 21 proboscideal nerves are developed.

The proboscis sheath terminates 5 mm. from the hinder end; its wall is comparatively thin, and the structure different from that found in all other pelagic nemerteans, inasmuch as the layer of circular muscle fibres is situate on the inner side of the longitudinal layer.

The lateral nerve stems extend far into the parenchyma, lying between the dorsal and ventral branch of the intestinal diverticula. Beneath the intestine they form strong transverse anastomoses in the parenchyma, in addition to which several transverse anastomoses were found dorsally and ventrally between the circular and longitudinal muscle layers of the body wall, originating in nerve branches from the lateral nerves.

At the fore end of the body, 6 pairs of testicles are developed (Plate I, Fig. 7), and are here not arranged metamerically, but more or less displaced, the testicular region being, approximately shaped like a horse-shoe.

The discharge ducts are of greatly varying length, leading to external apertures roughly arranged in two groups close behind the brain; only the apertures from the hindmost testicles are somewhat nearer the caudal region. The testicular wall contains a layer of circular musculature.

Habitat: St. 92 (Lat. 48° 29′ N; long. 13° 55′ W.) ^{23}—$^{24}/_{7}$, depth abt. 1333 metres (2000 metres of wire).

Dinonemertidæ nov. fam.

Pelagic nemerteans of frequently considerable size. Body broad and flattened. A caudal fin is developed by extreme flattening of the tail. Mouth and proboscis pore distinctly separate. The diverticula of the intestine very numerous, with but little or no ramification; the ventral branch always rudimentary or altogether lacking. Testicles in two single rows in the head, at times greatly reduced in number.

Dinonemertes Laidlaw 1906.

Large species. Body broad and flattened, but relatively thick owing to high developement of the parenchyma. Mouth opening situate in front of brain. The diverticula of the intestine vithout lateral ramificatiôn. The brain centrally situated. The proboscis sheath does not extend into the rear third of the body. The muscle layers in the wall of the proboscis sheath separate, not interwoven.

Dinonemertes investigatoris Laidlaw 1906.
(Plate I, Figs. 1—3).

Synonyms:
Dinonemertes investigatoris Laidlaw 1906 (14).
Dinonemertes investigatoris Brinkmann 1912 (in Murray and Hjort (18) p. 577).

Prior to the return of the "Michael Sars" with the material collected, this species, a giant form among pelagic nemerteans, was only known from the type specimen taken during the cruise of the "Investigator" near the Laccadive Islands, and briefly described by Laidlaw.

Had not this description been accompanied by a good habitus figure, it would hardly have been possible to recognise the species: by the aid of this however, and with the further assistance of a series of sections kindly placed at my disposal by Mr. Laidlaw, I was able to identify as belonging thereto a couple of specimens from the material of the "Michael Sars", both female, the one fullgrown, the other young.

The very considerable size of the species will be seen from the following measurements:

	Length.	Greatest breadth.	Greatest thickness.
I	203 mm.	56	15
II	107 „	23	7

Figs. 1 and 2 (Plate I) give a good idea of the form, remarkable for its enormous breadth in proportion to the length, the parallel sides, and the marked flattening of the tail, which forms a true caudal fin. The difference in shape of the fore part of the body as between the grown and the younger specimen (Plate I, Fig. 3) is due to the fact that the latter has cast its proboscis, and that the rhyncocoel has been emptied of the rhyncocoelomic fluid, causing a contraction of the head.

With regard to appearance in a living state, it is stated that the animal is transparent, with the intestine a bright red. As will be seen from the figures, the transparency has been lost in these specimens which were preserved in formalin, the intestine being only visible through the thinner caudal region.

An examination of the anatomical structure having been made, the results may be briefly summed up as follows:

The muscle layers of the body wall are but very sligthly developed in comparision with the considerable size of the animal; this is especially the case with the circular layers which nowhere exceed 0.05 mm. in thickness. The longitudinal musculature can, in the median region dorsally and ventrally, attain a thickness of 0.5 mm.; laterally, both layers are very thin. Between these layers are interposed a few scattered bundles of diagonal musculature.

The mouth opening is situate subterminally; the oesophagus is lacking. The stomach and pyloric tube, which have no exact mutual limit, have, in the larger specimen, an aggregate length of 14 mm., which is relatively short. The stomach is however, capacious, and its wall so folded as to permit a high degree of expansion.

The intestine is narrow, and furnished with about 70 pairs of diverticula, these lacking altogether the ramifications so frequently encountered in other pelagic nemerteans; the only indication of such development — noticeable moreover in the forepart of the body alone — is a slight pouch-like protrusion on the dorsal side, to some degree overlapping the edge of the rhynchocoel, and an extremely attenuated rudiment of a ventral branch.

The intestinal cæcum is short, and furnished with three pairs of diverticula, the foremost originating terminally.

The structure of the proboscis resembles in essentials that common to the remaining pelagic nemerteans; its length is about twice that of the body. The stylet basis is strongly curved, and armed with numerous stylets. At least 30 proboscideal nerves are developed. The proboscis pore is situated terminally, leading into a short rhynchodæum. The proboscis sheath, extending out from this, is likewise short, reaching only to within the middle third of the body. The circular musculature of the proboscis sheath is strongly developed and forms a layer in the outer portion of which the longitudinal musculature lies enclosed, not however, as interwoven bundles, but forming a distinct thin layer by itself. This does not altogether apply to the extreme fore-part in the cerebral region, where the arrangement more resembles that found in the *Drepanophorus*.

The vascular system exhibits various peculiarities. The mediodorsal vessel forms a small net of anastomosing branches as it passes through the wall of the proboscis sheath; they reunite however, immediately after passing through, and form again a single, undivided vessel. Metameral vascular anastomoses are lacking. The most remarkable feature in the vascular system is however the course of the lateral vessels. These run, in other forms — excepting only such complications as may arise in the nephridial region — straight down through the sides of the animal, following the lateral nerves, whereas in the present species they are intricately intertwined, forming a close mass of loops, partly surrounding the ovaries, and again extending up between or even above the intestinal diverticula. Examination has shown conclusively that no anastomoses are formed between the loops. The importance of this peculiar arrangement doubtless lies in the fact that it provides a means of conveying to the ovaries a sufficient quantity of nutriment during the development of the eggs, which are exceptionally large; this explanation is supported, *inter alia*, by the circumstance that the loops increase considerably both in number and size with the growth of the animal.

There are about 50 pairs of ovaries, each forming a large curved organ, and containing, when fully developed, some 6—8 eggs, which attain a size of no less than 2.5 mm.

Habitat:

The type specimen[1]) was taken east of the Laccadives, (Lat. 12° 2′ N; long. 73° 46′ E) at a depth of 1154 fathoms. The implement used was a bottom trawl, the individual was however doubtless taken during the hauling up; both the specimens from the "Michael Sars" are certainly pelagic. These latter were taken at St. 81 (Lat. 48° 2′ N; long. 39° 55′ W) on the $^{12}/_{7}$ 1910, and St. 64 (Lat. 34° 44′ N; long. 47° 52′ W) on the $^{24}/_{6}$ 1910, depth 2000 metres (3000 metres of wire). The horizontal area of distribution is thus extensive, the species having been found both in the Indian Ocean and in the Atlantic.

Nectonemertidæ (Verrill 1892) Brinkmann emend.

Slender, small to medium sized forms, with almost parallel sides. The body relatively small and only sligtly flattened. The hinder end is shaped into a higly developed caudal fin narrowing at the root. The diverticula of the intestine lack ventral branch. The male, when mature, has a pair of large lateral tentacles a little beyond the fore end.

Nectonemertes Verrill 1892 (partim).

Syn. *Hyalonemertes* Verrill 1892.

Characters of the family.

Nectonemertes mirabilis Verrill 1892.

(Plate II, Figs. 14—22).

Synonyms:

♂ *N. mirabilis* Verrill 1892 (20).
N. mirabilis Bürger 1895, 1904, 1905 (3, 4, 5).
N. mirabilis Coe 1905 (7).
N. Grimaldi Joubin 1904, 1906 (12, 13).
N. pelagica Cravens & Heath 1907 (8).
N. japonica Foshay 1912 (9).
♀ *Hyalonemertes atlantica* Verrill 1892 (20).
Hyalonemertes atlantica Bürger 1895, 1904, 1905 (3, 4, 5).
♂ & ♀ *Nectonemertes mirabilis* Brinkmann 1912, 1915 (1, 2).
Nectonemertes mirabilis Brinkmann in Murray and Hjort, 1912 (18).
non; *N. mirabilis* and *H. atlantica* Bürger 1907 (1912) (6).

From the list of synonyms given above[2]) it will be seen that my view as to this species differs essentially from those of previous writers. This may be explained by the fact of my having had so large a quantity of material to deal with, comprising no less that 82 specimens from the present expedition alone.

First of all, with regard to Verrill's two "species", a perusal of the works quoted shows that of *N. mirabilis* 16 specimens are known, all being males, while *H. atlantica* is represented by two individuals, both female. The only noteworthy difference Verrill has been able to demonstrate as between the two "species" — apart from the difference of sex — is the existence of the two lateral tentacles which characterise the former. An examination of the "Michael Sars" material from this point of view revealed the fact that all specimens with tentacles were male, all others with genital organs so far developed as to be visible through a magnifying glass, being female.

As long as only 16 and 2 specimens respectively were known, it was of course permissible to regard the peculiar distribution of the sexes as possibly accidental; when, however, the same was found to be the case with the 82 from the „Michael Sars" the accident theory was no longer tenable and another had to be sought. And in my opinion, the true explanation is that we have here to deal with males and females of one and the same species.

This hypothesis is strongly supported by the fact that the tentacles exhibit a series of gradual stages af developement from young to full-grown specimens (Plate II, Figs. 16—22); it is advanced to a certainty by the fact that I have succeeded in demonstrating that the development of the tentacles progresses simultaneously with that of the testicles. Further confirmation is moreover afforded by the fact that a like secondary sexual difference can be shown to exist in two other species of the same genus.

N. mirabilis has been very closely investigated by Cravens and Heath; the specimens which they found to differ from Verrill's first description, and which they therefore placed under the new species *N. pelagica* have all been found to fall within the range of variability of the present species; the same applies to *N. Grimaldi* Joubin, as also *N. japonica* Foshay.

Thorough demonstration of this will be found in the monograph on pelagic nemerteans by the present writer;[1]) it will here suffice to indicate the area of distribution of the species, as evidenced by the finds made by the „Michael Sars".

The specimens of *N. mirabilis* hitherto known were taken at widely different localities, Verrill found it off the east coast of North America, Cravens and Heath off the west coast of California, Joubin off the west coast of Europe, while Foshay brought it from Japan. The species

[1]) Laidlaw states that this was a male. On examining his section series, however I found it to be a female with eggs almost mature.

[2]) In the preliminary survey of the more prominent species among the material, (in Murray & Hjort p. 577) I mentioned *N. lobata* Joubin as synonymous with *N. mirabilis*. Closer investigation subsequently showed this to be erroneous; the form belongs to the genus *Balænanemertes* Bürger (6).

[1]) Vide Introduction.

thus appears to be of very considerable horizontal distribution. The "Michael Sars" investigations show it as extending throughout great areas of the North Atlantic, being, however, of most common occurrence in the western half of that sea.

As to the depth at which *N. mirabilis* lives, this has up to now been an entirely open question. Verrill (20) writes "whether they occurred at the surface or near the bottom I am unable to say;" he considers the form as pelagic, but bases his opinion merely upon its shape and structure, which he very correctly notes as highly adapted to pelagic life. Joubin (12) succeeded in showing that the animal really was pelagic, but neither he nor subsequent investigators have been able to say anything as to the depths at which it lived.

The "Michael Sars" expedition has now, thanks to the thoroughness of the methods there introduced by Dr. Hjort, furnished all requisite information for elucidation of this question. The plan adopted was, it will be remembered, to take a large number of horizontal hauls simultaneously at the same station but from different depths, these hauls being of so long duration — several hours — as to assure an overwhelming quantitative superiority of the material actually collected at the depth desired, when compared with the amount which might accidentally find its way into the net while being hauled in. It is thus possible, by comparing the results of the different hauls, to determine the depth at which an organism lives. This can of course, only be ascertained with absolute certainty in the case of species which are numerously represented: fortunately, however' *N. mirabilis* was taken in such quantities at certain stations as to furnish thoroughly adequate material for the purpose.

The accompanying table (p. 11) shows the distribution of the material among the different stations and at the various depths; all hauls made at these stations are here noted, including also those with negative result as regards *N. mirabilis.*

The depth is reckoned as equivalent to $^2/_3$ of the length of wire out. This calculation is unfortunately not based upon direct measurement by self-registrering apparatus attached to the nets; no such attempt was made during the expedition, and the experiment would also undoubtedly involve considerable technical difficulty. In thus disregarding Dr. Hjorts estimates of depth, according to which the depth of the catch should be set at about half the length of wire out, I am acting upon my own experience from this and other expeditions, which leads me to believe that the true position may be most nearly gauged by taking $^2/_3$ or possibly even a little more. To reckon with $^1/_2$, or even less — down to $^1/_3$ — as suggested by Lea (15) would, from the observations noted below, be entirely misleading.

At Station 102 of the present expedition (depth by sounding 1098 metres) a series of pelagic hauls was made with nine implements, the lowest working on 1500 metres of wire. According to the estimate of Hjort and Lea, this net would have fished some 300 metres above the bottom; the catch, however included a nudibranch *(Cuthonella abyssicola)*[1]) which is a decided bottom organism, and (according to Ørjan Olsen 19 p. 6) three specimens of a pycnogonide, *Nymphon grossipes,* which is beyond all reasonable doubt a bottom form. This net must thus, with 1500 metres of wire out, have reached a depth of 1098 metres, i. e. a little over $^2/_3$ of the length of wire.

In the course of an expedition made in 1914 on board the research vessel "Armauer Hansen" belonging to the Bergen Museum, similar observations were made. At Station 3 the soundings showed a depth of 1400 metres, and the lowest haul in a series corresponding to that above mentioned brought up bottom organism in large numbers, the length of wire out being 2000 metres. At Station 4, the depth was taken immediately before and after the haul, showing 830 and 770 metres respectively; here also the lowest net in a series, working with 1200 metres of wire, brought up quantities of bottom material. In both cases therefore, the nets must have fished at a depth equivalent to about $^2/_3$ the length of wire.

And finally, direct measurements (Jespersen 11) tend in the same direction.

I have been at some pains to justify my estimate as to depth in proportion to length of wire, this factor being, as we shall subsequently see, of the utmost importance when considering the distribution of the species in connection with the hydrographical conditions.

We may now commence with the hauls from Stations 80 and 81, as shown in the table here given. The nets fishing here at depths of 0, 66, 133, 200, 400 and 666 metres brought up not a single specimen of *N. mirabilis;* the hauls from deeper levels however, produced 29 and 22 specimens respectively. This in itself warrants the conclusion that the upper limit of distribution at these two stations must lie at about 1000 metres and that the specimens were actually caught at this or greater depths; not taken accidentally while hauling in. This is rendered the more probable by the size of the implements used: the young-fish trawl — a very large net — worked at 666 metres with negative result for both stations whereas the small $^3/_4$ metre nets fishing at 1000 metres brought up 7 and 2 specimens respectively.

[1]) According to verbal statement by Konservator Grieg.

Nectonemertes mirabilis

Catches made by the "Michael Sars" 1910.

Calculated depth (2/3 of the length of wire out). meter	Length of wire out. meter	Station and duration of haul. (H = hours). 53 — 6 H.	62 — During night	64 — During whole day	70 — 5 H.	80 — 6 H.	81 — 3 H.	82 — 3.5 H.	84 — 4 H.	87 — 3 H.	88 — 6.5 H.	90 — 3 H.	92 — 4 H.	101 — 3 H.	Total number of *N. mirabilis* caught in each depth
0	0	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	0
66	100	1 sn. ÷	1 sn. ÷	1 sn. ÷	3/4 sn. ÷	×	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	0
133	200	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	×	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	0
200	300	y. ÷	y. ÷	y. ÷	y. ÷	×	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	0
400	600	y. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷ (700 m. wire)	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	0
666	1000	1/2 sn. ÷ (1100 m. wire)	y. ÷	y. ÷	×	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	0
1000	1500	y. ÷ (1600 m. wire)	×	×	3/4 sn. III (1200 m. wire)	3/4 sn. VII	3/4 sn. II	3/4 sn. IV	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	16
1333	2000	1/2 sn. ÷ (2400 m. wire)	y. II	y. I	y. ÷ (1700 m. wire)	y. XVI	y. XVII	y. ÷	y. VI	y. I	y. III	y. II	y. III	y. I	52
1666	2500	3 ln. I (2600 m. wire)	3/4 sn. ÷	3/4 sn. ÷	×	3/4 sn. I	3/4 sn. ÷	3/4 sn. I	3/4 sn. I	3/4 sn. ÷	×	×	×	3 ln. ÷	4
2000	3000	×	3 ln. ÷	3/4 sn. I	×	3 ln. V	3 ln. III	3 ln. ÷	y. I	y. ÷	×	×	3 ln. ÷	×	10

3/4 sn., silknet of 3/4 meter's diameter. 1 sn., silknet of 1 meters diameter. y., Dr. C. G. Joh. Petersen's young fish trawl. 3 ln., large net. Ring 3 metres in diameter, met a strimps net. ×, no haul. ÷ no nemerteans in the haul. I, II . . . . number of *N. mirabilis* caught.

The quantity of *N. mirabilis* from the remaining stations, albeit comparatively small, yet fully serves to confirm the observations made at 80 and 81; the 66 nets worked at these stations in depths of less than 1000 metres — including one young-fish trawl from each station at 666 metres — made but a single catch of the species (St. 70, 3 spec.) at 800 metres, while a single capture is recorded (St. 82) at 1000 metres depth, and beyond these, only at 1333 metres or deeper.

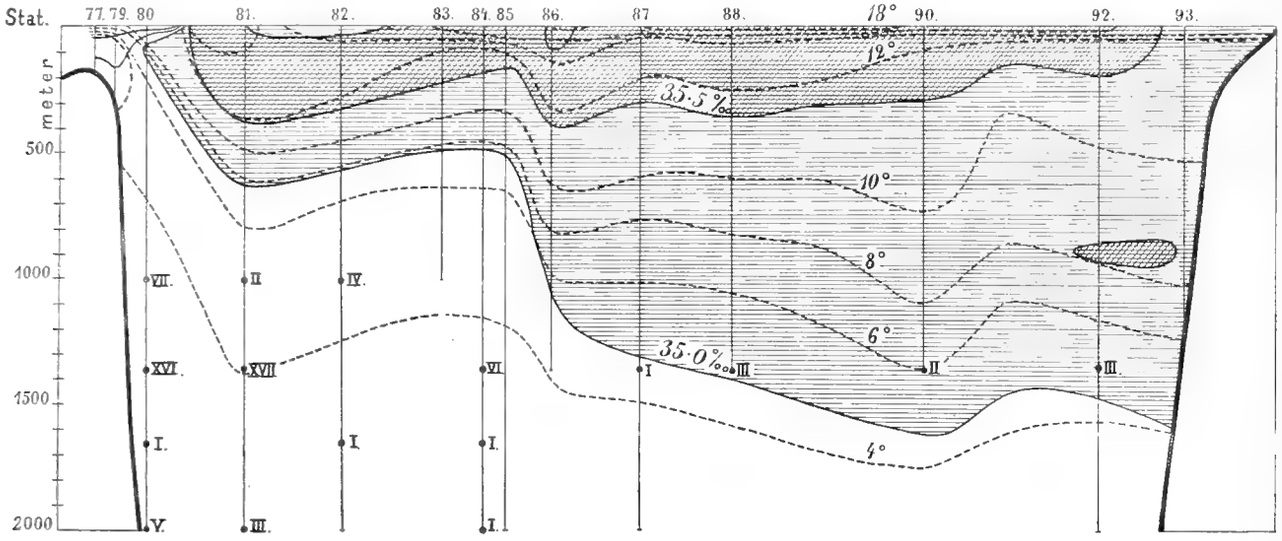
The lower limit of distribution cannot be determined by this method; with a species of relatively infrequent occurrence it is impossible to ascertain, by comparison of the hauls, whether or not the nets fishing below 1000—1333 metres may have taken the specimens found while being drawn up through upper portion of the area of distribution.

The extensive hydrographical investigations made partly at the same stations as the zoological, afford an opportunity of seeking to characterise the vertical distri-

bution of the species according to the water layers in which it is found.

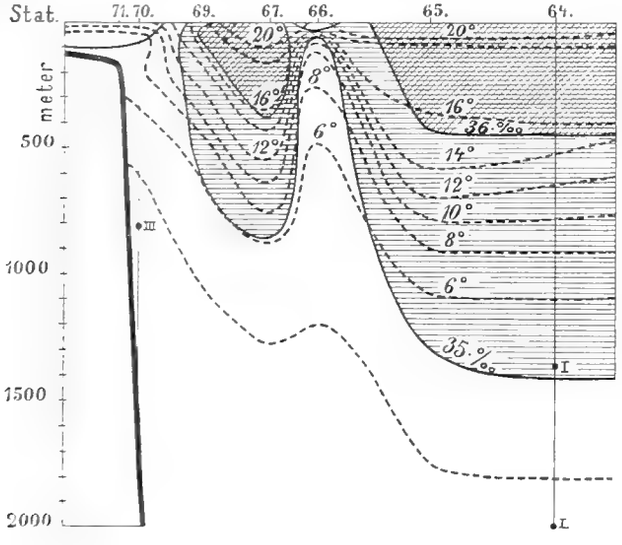
On the hydrographical charts given below I have noted the places of capture, with number of specimens in roman numerals at the side. Not a single one of the 82 specimens in the material was taken in water of more than 6°, and nearly all in layers of less that 35 ‰ salinity.[1])

be obtained in such investigations, that *N. mirabilis* is a distinctly stenohaline and stenothermic species of marked bathypelagic character, its upper limit of vertical distribution being determined by the water layers to which it is confined. It will be seen from the charts that this becomes deeper at the eastern stations, where the isotherms and isohalines are lowered by the water masses of the Gulf Stream. The species is thus not found in the intermediate and upper layers of the Gulf Stream, which again serves to explain the fact of its never being encountered in the Norwegian Sea. Hydrographical charts of the connecting waters between the Atlantic and the Mediterranean (e. g. Jespersen 11) show that the Atlantic waters typical of the species do not penetrate into the Mediterranean; here accordingly, the species has not been found. On the other hand, the connection between these Atlantic water layers and the equivalent strata in the Pacific serves to explain the occurrence of the species in that sea.



Hydrographical section, "Michael Sars" 1910". Newfoundland to Ireland. After Helland Hansen in Murray and Hjort (18) pag, 115.

In this figure and the section below the depths of the hauls is reconed as epuivalent to 2/3 of the length of Wire out.



Hydrographical section, "Michael Sars" 1910. Newfoundland to Sargasso Sea. After Helland Hansen in Murray and Hjort (18) pag. 298.

Save for some unimportant differences, the charts show, with as high a degree of accuracy as could possibly

[1]) The hauls at Stations 53, 62 and 101 are not noted on the hydrographical sections; according to information received from Prof. Helland Hansen, who is dealing with the hydrographical material of the expedition, the nature of the water layers at the mentioned stations was such that the catches here likewise fall within the given limits of temperature and salinity.

Habitat:

Verrill (1892):

"Albatross", St. 2036 (Lat. 38° 53′ N; long. 69° 25′ W) Bottom trawl 1735 fathoms, 1 spec.

— St. 2076 (Lat. 41° 13′ N; long. 66° 1′ W) Bottom trawl 906 fathoms, 1 spec.

— St. 2229 (Lat. 37° 39′ N; long. 73° 17′ W) Bottom trawl 1423 fathoms, 1 spec.

— St. 2236 (Lat. 39° 11′ N; long. 72° 09′ W) Bottom trawl 636 fathoms, 1 spec.

— St. 2428 (Lat. 42° 48′ N; long. 50° 56′ W) Bottom trawl 826 fathoms, 1 spec.

St. 2724 (Lat. 36° 47′ N; long. 73° 25′ W) Bottom trawl 1641 fathoms, 1 spec.

Joubin (1904):

"Princesse Alice", St. 1849 (Lat. 36° 17′ N; long. 28° 53′ W) Plankton haul (vertical) 3000—0 metres 1 spec.

Craven & Heath (1906):

"California" (Monterey Bay) On fishing lines, 400—500 fathoms depth, 3 spec.

"Albatros", St. 4393 (south coast of California) bottom trawl, 2113—2259 metres depth, 2 spec.

Foshay (1912):

Near Misaki, Japan, depth? net used? 6 spec.

„Michael Sars (1910):[1])

St. 53	(Lat. 34° 59′ N;	long. 33° 01′ W)	$^{8}/_{6}$	1	spec.
St. 62	(„ 36° 52′ N;	„ 39° 55′ W)	$^{20}/_{6}$	2	„
St. 64	(„ 34° 44′ N;	„ 47° 52′ W)	$^{24}/_{6}$	2	„
St. 70	(„ 42° 59′ N;	„ 51° 15′ W)	$^{30}/_{6}$	3	„
St. 80	(„ 47° 34′ N;	„ 43° 11′ W)	$^{11}/_{7}$	29	„
St. 81	(„ 48° 02′ N;	„ 39° 55′ W)	$^{12}/_{7}$	22	„
St. 82	(„ 48° 24′ N;	„ 36° 53′ W)	$^{13}/_{7}$	5	„
St. 84	(„ 48° 04′ N;	„ 32° 25′ W)	$^{15}/_{7}$	8	„
St. 87	(„ 46° 48′ N;	„ 27° 46′ W)	$^{17}/_{7}$	1	„
St. 88	(„ 45° 26′ N;	„ 25° 45′ W)	$^{18}/_{7}$	3	„
St. 90	(„ 46° 58′ N;	„ 19° 06′ W)	$^{21}/_{7}$	2	„
St. 92	(„ 48° 29′ N;	„ 13° 55′ W)	$^{23}/_{7}$	3	„
St. 101	(„ 57° 41′ N;	„ 11° 48′ W)	$^{6}/_{8}$	1	„

Nectonemertes primitiva nom. nov.

(Plate II, Figs. 11—13.)

Syn. *Nectonemertes mirabilis* Bürger (1907) 1912 (6).

After having shown that *N. mirabilis* and *H. atlantica* Verrill were male and female of one and the same species, the tentacles on the sides of the head being a secondary sexual character of the male, it appeared natural to consider the specimens shown in Figs. 11—13 (Pl. II), — which are entirely identical in structure save for the tentacles and genital organs, and differ characteristically from *N. mirabilis*, — as male and female of another species.

Comparison shows, that the species is identical with that represented by a single specimen described by Bürger as *N. mirabilis*.

With regard to the appearance of the animal in a living state, the reader may refer to Bürger's description and figure. The preserved specimens are, as will be seen by comparison, shorter, relatively broader, and with the tail flipper far more developed than *N. mirabilis*. The species is considerably smaller than the foregoing.

[1]) Implement and depth not noted here, these being included in the table p. 11.

	Length	Greatest breadth	Greatest thickness
♂	12 mm.	4	2
♀	14 „	4	2

The tentacles were only 1.5 mm. long, which must undoubtedly be ascribed both to considerable contraction and also to the youth of the specimen, which was not fully mature.

Of specific points of difference when compared with *N. mirabilis*, the following may be noted:

The stomach is narrower and shorter than in the mentioned form, and already in the cerebral region leads into the pyloric tube, the length of which is only 0.8 mm. The cæcum also is smaller, and has but four pairs of diverticula, which are relatively small.

The genital organs of the male exhibit a most striking difference of species. The testicles of *N. mirabilis* are numerous, and arranged in two oval groups ventrally in the head, whereas in the present case, there are but four pairs of testicles, arranged in a double row (Pl. II, Fig. 12) their discharge ducts extending forward in the head.

The ovaries also are considerably less numerous, there being 10 pairs developed. And as there are 50 pairs of intestinal diverticula, the numbers by no means permit of one pair of ovaries being placed between each two pairs of diverticula.

Habitat:

Bürger (1912):

"Valdivia", St. 66 (Lat. 3° 55′ S; long. 7° 48′ 5″ E) vertical net 3000—0 metres.

"Michael Sars", St. 51 (Lat. 31° 20′ N; long. 35° 7′ W) $^{5}/_{6}$ at 666 metres depth, (1000 metres of wire).

St. 53 (Lat. 34° 59′ N; long. 33° 1′ W) $^{8}/_{6}$, at 200 metres depth (300 metres of wire).

The material from the „Michael Sars" shows that the species lives at remarkably slight depths.

Nectonemertes minima Brinkmann 1915.

(Plate II, Fig. 23).

Syn. *Hyalonemertes atlantica* Bürger (1907) 1912 (5).
Nectonemertes minima Brinkmann 1915 (2).

I have recently given a preliminary description of this species based upon material from another expedition, in which it was shown that Bürger had been dealing with a female specimen, which he had erroneously endeavoured to identify with Verrill's *H. atlantica (N. mirabilis* Verrill ♀). The male is easily distinguished from the two foregoing species, partly by its small size, and partly by the fact that the testicles, which are placed in a single row on either side of the head, have laterally

directed discharge ducts opening approximately at the lateral edge of the head.

The material from the "Michael Sars" included three specimens of this species, all female. These are by no means so easily distinguished from the foregoing species as the males; they can however, be recognised, *inter alia*, by the extremely reduced stomach and pyloric tube; by the fact that the numerous (about 60) intestinal diverticula are still distinctly developed behind the caudal commissure right out to the anus, and by the lack of ramification. The intestinal cæcum is furnished with three pairs of diverticula.

Habitat: St. 98 (Lat. 56° 33′ N; long. 9° 30′ W) $^{5}/_{8}$ closing net, 1000—550 metres.

St. 101 (Lat. 57° 41′ N; long 11° 48′ W) $^{6}/_{8}$ abt. 1300 metres depth (2000 metres of wire).

Phallonemertidæ nov. fam.

Pelagic nemerteans of medium size, the body slender with almost parallel sides, flattened ventrally, and rounded dorsally. The hinder end is broad, and much flattened, forming a caudal fin. The intestinal cæcum well developed, the diverticula of the intestine only showing traces of a ventral branch, but otherwise with fairly considerable ramifications. The lateral nerves are situate ventrally close to the inner side of the body wall. The testicles are placed in two single rows at the fore end, each testicle terminating in a cylindrical penis.

Phallonemertes nom. nov.

Syn. *Bathynectes* Brinkmann 1912 (1).[1])

Characters of the family.

Phallonemertes Murrayi Brinkmann 1912.

(Plate II, Figs. 24—25.)

Syn. *Bathynectes Murrayi* Brinkmann 1912 (1).

Some years ago I made a preliminary communication as to this highly peculiar species, which is distinguished by the fact, that the papillæ forming the aperture of each separate testicle are greatly extended, being apparent as penis-like appendices on the under side of the head. (Plate II, Fig. 24). For the general structure, the reader may refer to my original description; it will here suffice to set forth the facts bearing upon the distribution of the species. The "Michael Sars" expedition brought home 17 specimens from the following stations:

[1]) The name has been changed, as it was found to have been previously used for a genus of crustaceans.

St. 53 (Lat. 34° 59′ N; long. 33° 1′ W) $^{8}/_{6}$ 2600 m. wire 3 spec.
„ 64 („ 34° 44′ N; „ 47° 52′ W) $^{24}/_{6}$ 3000 - „ 2 „
„ 81 („ 48° 02′ N; „ 39° 55′ W) $^{12}/_{7}$ „ - „ 8 „
„ 82 („ 48° 24′ N; „ 36° 53′ W) $^{13}/_{7}$ „ - „ 1 „
„ 84 („ 48° 04′ N; „ 32° 25′ W) $^{15}/_{7}$ „ - „ 1 „
„ 92 („ 48° 29′ N; „ 13° 55′ W) $^{23}/_{7}$ „ - „ 2 „

In addition to these, one specimen was taken by the "Ingolf" Expedition in 1895 at St. 38 (Lat. 59° 12′ N; long. 51° 05′ W) $^{30}/_{7}$ bottom trawl, depth 1870 fathoms, and one by the "Thor" expedition of 1906, at St. 76 (Lat. 49° 27′ N; long 13° 33′ W) 2800 metres of wire.

From this it will be seen, that the species is at present only known fron the North Atlantic. Here also, Dr. Hjort's method of serial hauls furnishes interesting information as to the vertical distribution. We find, in the first place, that the species is undoubtidly pelagic — the „Ingolf" specimen must thus have been taken while hauling in — and further, that it is distinctly bathypelagic. This will be seen from the table opposite, showing all positive stations for the species on the "Michael Sars" expedition and noting all implements used at these stations. Although the catch was in no case large, there can be no reasonable doubt that the specimens were taken at about the depth where the implements concerned were working. The upper limit of distribution cannot therefore be much above 2000 metres, and is undoubtedly never higher than abt. 1333 metres, at which depth a young-fish trawl was drawn at five of the stations with negative result as regards the species in question.[1])

If we compare the depths of these hauls with the chart on p. where the hydrographical condition for the last five stations are noted, it will be seen that the species is a stenothermic and stenohaline bathypelagic form; the temperature of its habitat as there indicated varying between 3° and 4°, the salinity only between 35 ‰ and 34.9 ‰.

Chuniellidæ nov. fam.

Medium sized forms. Body pointed at hinder end. Tail more or less applanated, without, however, forming any caudal fin. The longitudinal muscle layer of the body wall strongly developed dorsally and ventrally, but laterally thin. Lateral nerves ventrally situated, immediately inside the musculature. Intestinal diverticula without ventral

[1]) In allowing even this amount of latitude for the upper limit of distribution, I do so only to be absolutely on the safe side: the bundary might doubtless without imprudence be placed as low as 1666 metres, at which depth the hauls were likewise negative. I have not done so, however, because the small $^{3}/_{4}$ metre net used at that depth is of so slight fishing capacity that a species of so infrequent occurrence might well have escaped it.

Phallonemertes Murrayi.

Catches made by the "Michael Sars" 1910.

Calculated depth (2/3 of the length of wire out). meter	Length of wire out. meter	Station and duration of haul. (H = hours). 53 6 H.	64 During whole day	81 3 H.	82 3.5 H.	84 4 H.	92 4 H.	Total-number of specimens
0	0	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	0
66	100	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	0
133	200	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	1 sn. ÷	0
200	300	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	0
400	600	y. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	0
666	1000	1/2 sn. ÷ (1100 m. wire)	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	0
1000	1500	y. ÷ (1600 m. wire)	×	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	0
1333	2000	1/2 sn. ÷ (2400 m. wire)	y. ÷	y. ÷	y. ÷	y. ÷	y. ÷	0
1666	2500	3 In. III (2600 m. wire)	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	3/4 sn. ÷	×	3
2000	3000	×	3 In. II	3 In. VIII	3 In. I	y. I	3 In. II	14

For explanation of the al notation, see the table pag. 11.

branch. Musculature of the wall of the proboscis sheath composed of an inner layer of longitudinal and outer of circular fibres. Testicles numerous, arranged in two longitudinal rows in the head, along the lateral nerves.

Chuniella nov. gen.

Characters of the family.

Chuniella lanceolata nov. sp.

(Textfig. 1).

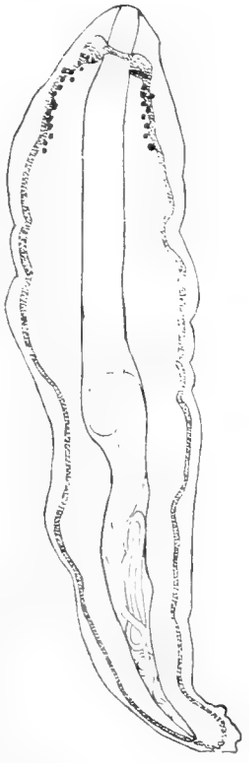
This species presents a combination of characters rendering it impossible to place it in any of the other families; I have therefore, despite the fact that only one specimen exists, and this moreover, evidently a very young individual, found it necessary to give it a separate family and genus, to which, as far as can be seen from the descriptions, Bürger's (6) *Drepanophorus pelagicus* and *Planktonemertes agassizi* likewise belong.

From the appearance of the specimen, I took it at first for a young stage of *Nectonemertes,* and no special habitus figure was therefore made, but only an outline drawing, which I here reproduce (Textfig. 1, p. 16). A series of sections afterwards made, however revealed quite a different structure.

The development of the testicles shows that we have here to deal with a young specimen, and the dimen-

sions given below can therefore hardly be considered as any standard for the species.

Length 10 mm., greatest breadth 2.25 mm., greatest thickness 1.2 mm.



Textfig. 1, *C. lanceolata*; In the fore end the testicles are seen as black spots.

The circular musculature beneaht the epithelium is extremely thin, properly existing as a layer only in the rear third of the body, where also the longitudinal musculature reaches its greatest development; it is extremely thin laterally, and forms a dorsal and a ventral muscular plate of 65 μ maximal thickness.

Mouth and proboscis pore are separate. Oesophagus lacking. The stomach is small and short, passing over immediately behind the brain into the pyloric tube, which is relatively long. The intestine is narrow, and furnished with about 30 pairs of extremely large but only slightly ramified diverticula; the appearance here should as a matter of fact rather be described as broad, short protuberances than actual ramification; there is no trace of any ventral branch. The intestinal cæcum is very strongly developed, and furnished with five pairs of diverticula. The fore end of the cæcum extends in front of the brain.

The proboscis attains a length about twice that of the body; its stylet apparatus resembles that of the remaining pelagic nemerteans, and there are 21 proboscidial nerves developed.

The proboscis sheath terminates about 1 mm. from the hinder end of the body. The musculature in its wall behind the brain consists of an inner longitudinal and an outer circular layer.

The cerebral ganglions are large. With regard to the lateral nerves it may be noted that their caudal commissure is situate behind the ventral anus.

The specimen examined was a male. The testicles were numerous, 19 being developed on the right side, and 12 on the left; they are only found in the fore-part, where they lie close to the lateral nerves (Textfig. 1), and are still in their first stage of development, forming small sacs about 0.08 mm. long, in which as yet only a single layer of cells with large nuclei is visible; the disharge ducts are not developed.

Habitat: St. 92 (Lat. 48° 29′ N; long. 13° 55′ W). $^{23}/_{7}$. Depth about 1000 metres (1500 metres of wire).

Armaueriidae nov. fam.

Fore part of the body broad, the posterior end tapered and ending in a feebly developed caudal fin. The intestinal diverticula without a ventral branch. The dorso-median vessel developed in its full length, but at no place being in connection with the proboscis sheat. Dorsal commissure of the vessels in the head lacking. Testicles arranged in two almost regular rows in the head, never united to groups.

Armaueria nov. gen.

Characters of the family.

Armaueria rubra n. sp.

No figure of the animal was drawn as only the series of sections made me aware of the fact that three specimens — 2 ♂ and 1 ♀ — in the material belonged to the above mentioned new genus and family and that they not, as one should believe judging from the form and size of the body, constituted a species of the well known genus *Pelagonemertes*.

The fore part of the body is rounded and in the proboscis sheat region very thick and only slightly flattened. The caudal fin is feebly developed. The species belongs to the dwarfs among the pelagic nemerteans (5, 3—8,8 mm., with a greatest breadth of ca. 2,5 mm. and a greatest thickness of up to 1.5 mm.).

The circular muscle layer of the body wall is strongly reduced in all parts of the body; in the fore part and the sides of the body the same is the case with the longitudinal muscle layer, but dorsally and ventrally in the middle of the body and towards the tail these muscles form a strong layer 100—115 μ thick.

The opening of the mouth is placed terminally and leads directly into the stomach; this and the pyloric tube are short, and the latter opens close behind the brain in a very wide intestine, furnished with about 25 pairs of unbranched lateral pouches. The intestinal cæcum is short and only provided with one pair of diverticules.

The proboscis is considerably longer than the animal and is coiled up in its sheat. In the part next to the insertion 14 nerves are developed in the proboscis wall but more distally the number is reduced to 7. The armature of the proboscis is like that found in *Dr panophorus*.

The proboscis pore is situated dorsally, leading into a short rhynchodæum, which forms an angle with the proboscis sheat, which is short and of an ovoid shape and generally does not enter the rear half of the body. The musculature of the wall is anteriorly composed of an inner circular and an outer longitudinal layer but close

behind the brain some of the longitudinal fibres penetrate the circular layer, so that these muscles in the greatest part of the wall form a distinct layer within the longitudinal musculature, without beeing interwowen with it as is the case in many forms.

As mentioned in the diagnosis of the family the dorsal commissure of the vessels in the head is lacking and the dorso-median vessel is never in connection with the proboscis sheat and never enters the rhynchocœlomic cavity.

The longitudinal nerve-stems are placed close to the lateral edges of the body.

The testicles form an almost regular row in the head on either side along the nerve-stems; the opening of their ducts are placed lateroventrally. The ovaries are not numerous as only 8 pairs could be counted, the openings of which sometimes are lying outside the stems of the vessel and nerve, sometimes between them and sometimes to the inside of them.

Habitat:

St. 80 (Lat. 47° 34′ N; long. 43° 11′ W) $^{11}/_{7}$ about 1666 metres depth (2500 metres of wire).

St. 81 (Lat. 48° 2′ N; long. 39° 55′ W) $^{12}/_{7}$ about 1666 metres depth (2500 metres of wlre).

St. 88 (Lat. 45° 26′ N; long 25° 45′ W) $^{18}/_{7}$ about 1333 metres depth (2000 metres of wire).

Pelagonemertidæ (Moseley) Brinkmann emend.

Small or medium sized pelagic nemerteans. The body usually applanated and fairly broad in proportion to length. The caudal fin is, where present, formed by lateral excrescences from the tail, not by flattening of same. Mouth and proboscis pore separate. Stomach, pyloric tube and intestinal cæcum much reduced. As a rule, the intestinal diverticula of the body form a dorsal and a ventral main branch. The musculature of the proboscis sheath is composed of an inner longitudinal and an outer circular layer. The bundles of muscle fibres following the lateral nerves always developed. The dorso-median vessel rudimentary or lacking. The testicles are found in two groups at the fore end of the head. Rudimentary eyes generally found.

Natonemertes nov. gen.

Body pointed at the hinder end, whithout tail fin, Testicles in two groups behind the brain. Intestinal cæcum with one pair of diverticula.

Natonemertes acutocaudata n. sp.

(Plate II, Fig. 26).

The "Michael Sars" expedition brought home a single specimen of this interesting new genus, which forms a connecting link between *Pendonemertes* and forms like *Pelagonemertes* and *Balœnanemertes*.

Length 9 mm., greatest breadth 4 mm., greatest thickness 2.25 mm. The dimensions are those of a comparatively small species: it is probable, however, from the degree of development of the testicles, that the specimen in question had not yet reached its full size.

Colour, in formalin, a pale pink.

The surface epithelium, of which some portions were preserved, distinctly showed the bulb-shaped sensory organs known from *Nectonemertes*.

The muscle-layers of the body wall greatly reduced, and laterally almost altogether lacking.

Mouth and proboscis pore separate. The stomach very short, passing over already in the region of the brain into a short pyloric tube. The intestine furnished with 15—20 pairs of large, slightly ramified diverticula, showing, where best developed, some trace of ventral branches. The intestinal cæcum is very short and only provided with one pair of diverticula.

The proboscis is long and powerful; the slightly curved stylet base is armed with two rows of stylets. 12 proboscidial nerves are developed. The proboscis sheath extends right out into the tail, terminating immediately in front of the anus. The muscle bundles following the lateral nerves are very thin.

The dorso-median vessel ends blindly shortly after passing through the walls of the proboscis sheath.

The testicles are ovate, and form two groups with four in each, close behind the brain.

Habitat: St. 101 (Lat. 57° 41′ N; long 11° 48′ W) $^{6}/_{8}$, at 1333 metres depth (2000 metres of wire out).

Balænanemertes Bürger (1907) 1912.

Small species. The caudal fin strongly developed. Male and female with short lateral tentacles one on either side of the head. The testicles lie close together in two groups beside or in front of the brain.

Balænanemertes lobata Joubin 1906.

Syn. *Nectonemertes lobata* Joubin 1906 (13).

This species is hitherto known only in Joubin's type specimen, the description of which is unfortunately altogether superficial. Only the large quantity of material available — of which one specimen from the present expedition — rendered it possible to identify it at all.

The specimen in question was slightly larger than the type. Length 7 mm., greatest breadth 2.5 mm., greatest thickness 1.6 mm., length of tentacles 0.8 mm.

No information is available as to the appearance of the animal in a living state.

The shape agrees well enough with Joubin's contour figure; here also the tentacles are seen to project, not from the foremost curvature edge of the head, but from its sides. The shortness of the tentacles is due to contraction.

With regard to the anatomical structure, the following features may be specially mentioned:

The muscle layers of the body wall are reduced, the maximal thickness of the longitudinal layers being only 35 μ.

The stomach and pyloric tube are extremely short, the point of transition between them lying beneath the brain. The intestine shows 22 pairs of large diverticula, placed — in contrast to all other known species of the genus[1]) — at considerable intervals, as in the case of *Pelagonemertes*. They are furnished with some few short pouches but exhibit no other trace of ramification. The same applies to the pair of large diverticula on the intestinal cæcum.

The structure of the tentacles is the same as in *B. chuni* Bürger (6), and the same applies to the proboscis, which has 17—18 proboscideal nerves.

The lateral muscles following the nerve stems are here, in contrast to the mentioned species, only very slightly developed.

The proboscis sheath is considerably longer than in *B. chuni*, without however, extending out into the point of the tail.

The dorso-median vessel terminates slightly in rear of the point where it enters the rhyncocoelomic cavity.

The specimen in question is a ♀ with 7 pairs of ovaries developed, the apertures lying on the inner side of the lateral nerve stems. Only one egg is matured in each ovary.

Habitat: Joubin's type specimen was taken in the North Atlantic. (Lat. 36° 17′ N; long. 28° 53′ W) in a vertical haul 3000—0 metres. The specimen from the "Michael Sars" was taken at St. 84 (Lat. 48° 04′ N; long. 32° 25′ W) $^{15}/_{7}$ at 2000 metres depth (3000 metres of wire).

Balænanemertes Hjorti n. sp.

As regards external habitus, this species follows in nearly all essentials the species, hitherto known with an exception however, in the case of the tentacles, which are here only apparent as short points, despite the fact that the specimen in question was fully mature.

In contrast to *B. chuni* and *B. lobata,* the intestinal cæcum is furnished with two pairs of diverticula. The intestinal diverticula are clearly divided into a dorsal and a ventral main branch, between which are found the lateral nerve and vessel. As a specific character may be further noted the development of a thick muscle layer extending from the insertion of the proboscis down between the proboscis sheath and the ventral cerebral commissure.

The specimen in question is a male, with 7—8 testicles, spherical in form, and containing fully developed spermatozoa.

Habitat: St. 92 (Lat. 48° 29′ N; long. 13° 55′ W). $^{23}/_{7}$, at 1000 metres depth, (1500 metres of wire out).

Balænanemertes lata n. sp.

This species also is known in but a single specimen. And indeed, as regards the smaller species of pelagic nemerteans generally, the number of specimens in the material of the expedition is remarkably small; with the unusually large catches made, however, it is reasonable to suppose that some might have escaped observation.

The species closely resembles *B. Hjorti*, not only in the slight degree of development of the tentacles, but also as regards the intestinal cæcum, which here also is furnished with two pairs of diverticula, though these are here considerably more developed, and with a not inconsiderable degree of ramification. It may be distinguished from the foregoing species by the entire lack of musculature between the proboscis sheath and the ventral cerebral commissure, as also by an altogether extreme development of the muscles extending from the insertion of the proboscis to the dorsal and latero-ventral parts of the body wall.

The testicles are elongated, almost sausage-shaped, some of them opening on the under side of the head.[1])

Habitat: St. 84 (Lat. 48° 04′ N; long. 32° 25′ W). $^{15}/_{7}$, abt. 1333 metres depth, (2000 metres of wire out).

[1]) Only three are mentioned in this report; to these must be added four new species in the rest of the material I have had to work upon.

[1]) It should be noted that the various species of the genus *Balænanemertes* are most intimately related one to another, so much so that only a detailed and richly illustrated description—such as that given in the monograph by the present writer, referred to in the introduction—will be of any use for purposes of absolutely certain identification.

List of literature cited.

1. Brinkmann, A. *"Bathynectes Murrayii"* n. gen. n. sp. Eine neue bathypelagische Nemertine mit äusseren männlichen Genitalien. Vorläufige Mittheilung. Bergens Mus. Aarbok No. 9, 1912.
2. Brinkmann, A. „Die pelagischen Nemertinen der deutschen Südpolarexpedition 1901—1903". Vorläufige Mittheilung. Bergens Mus. Aarbok 1915—1916. Naturv. Række No. 1.
3. Bürger, O. „Die Nemertinen des Golfes von Neapel". Fauna u. Flora des Golfes v. Neapel. Vol. 22. 1895.
4. Bürger, O. „Nemertini". Das Tierreich 1904.
5. Bürger, O. „Nemertini". Bronn „Klassen und Ordnungen des Tierreichs". Vol. 4, 1897—1907.
6. Bürger, O. „Die Nemertinen". Wissensch. Ergebn. d. d. Tiefsee Exped. Vol. 16, Lief. 2 (1907) 1912.
7. Coe, W. R. „Nemerteans of the west and northwest coasts of America". Bull. Mus. comp. zool. Harward Coll. Vol. 47, 1905.
8. Cravens, M. R. and Heath, H. "The anatomy of a new species of *Nectonemertes*". Zool. Jahrb. Abth. f. Anat. Vol. 23, 1907.
9. Foshay, E. A. *„Nectonemertes japonica*, a new nemertean". Zool. Anz. Vol. 40. 1912.
10. Hubrecht, A. A. W. „Th genera of european nemerteans critically revised, with description of several new species." Notes from the Leyden Museum. Vol, 1, 1879.
11. Jespersen, P. *"Sternoptychidae" (Argyropelecus* and *Sternoptyx)*. Rep. danish oceanogr. exped. 1908—10. Vol. 2. Biology (A.2). København 1915.
12. Joubin, L. „Note sur une nouvelle némerte pélagique *(Nectonemertes Grimaldi)*". Bull. du musée oceanogr. de Monaco No. 20, 1904.
13. Joubin, L. „Description des némertiens bathypélagiques capturés au cours des dernières campagnes du prince de Monaco". Bull. du musée oceanogr. de Monaco No. 78, 1906.
14. Laidlaw, F. F. „On two new genera of deep-sea Nemertines". Ann. Mag. nat. hist. Ser. VII. Vol. 17, 1906.
15. Lea, E. „Muraenoid larvae". Report on the scientif. res. of the „Michael Sars" north atlantic deep sea exped. 1910. Vol. III, part I, 1913.
16. Moseley, H. N. "On *Pelagonemertes Rollestoni*". Ann. Mag. nat. hist. Ser. IV. Vol. 15, 1875.
17. Moseley, H. N. On a young specimen of *Pelagonemertes Rollestoni*". Ann. Mag. nat. hist. Ser. IV. Vol. 16, 1875.
18. Murray, J. and Hjort, J. "The depths of the ocean". London 1912.
19. Olsen, Ø. "Pycnogonida". Report on the scientific results of the "Michael Sars" north atlantic deep sea exped. 1910. Vol. III, part I, 1913.
20. Verrill, A. E. "The marine Nemerteans of New-England and adjacent waters". Trans. Connecticut Acad. Vol. 8, 1892.
21. Woodworth, W. Mc. M. "Preliminary account of *Planktonemertes Agassizii*, a new pelagic nemertean". Bull. Mus. comp. zool. Harward Coll. Vol. 35, 1899.

Explanation of the Plates.

Plate I.

Fig. 1. *Dinonemertes investigatoris.* Fullgrown specimen, dorsal view. $^5/_6$ natural size.

„ 2. As fig. 1, but lateral view. $^5/_6$ natural size.

„ 3. *Dinonemertes investigatoris.* Young specimen, ventral view. $^5/_6$ natural size.

„ 4. *Pendonemertes Levinseni.* Ventral view. × 2.

„ 5. *Bathynemertes Hubrechti.* Dorsal view. × 1.5.

„ 6. *Bürgeriella notabilis.* Dorsal view. × 1.2.

„ 7. Forepart of the same specimen as fig. 6, but ventral view after clarification in cedar oil. For the sake of convenience, the first pair of diverticula on the intestinal cæcum have not been included in the figure. × 7.

„ 8. *Crassonemertes robusta.* × 3.

„ 9. *Plotonemertes adhærens.* Lateral view. × 2.5.

„ 10. Caudal region of the specimen shown in Fig. 9; ventral view, showing the double glandular organ of the surface above. × abt. 10.

Plate II.

Fig. 11. *Nectonemertes primitiva* ♀. Ventral view. × abt. 7.

„ 12—13. *Nectonemertes primitiva* ♂. Ventral and lateral view. × abt. 7.

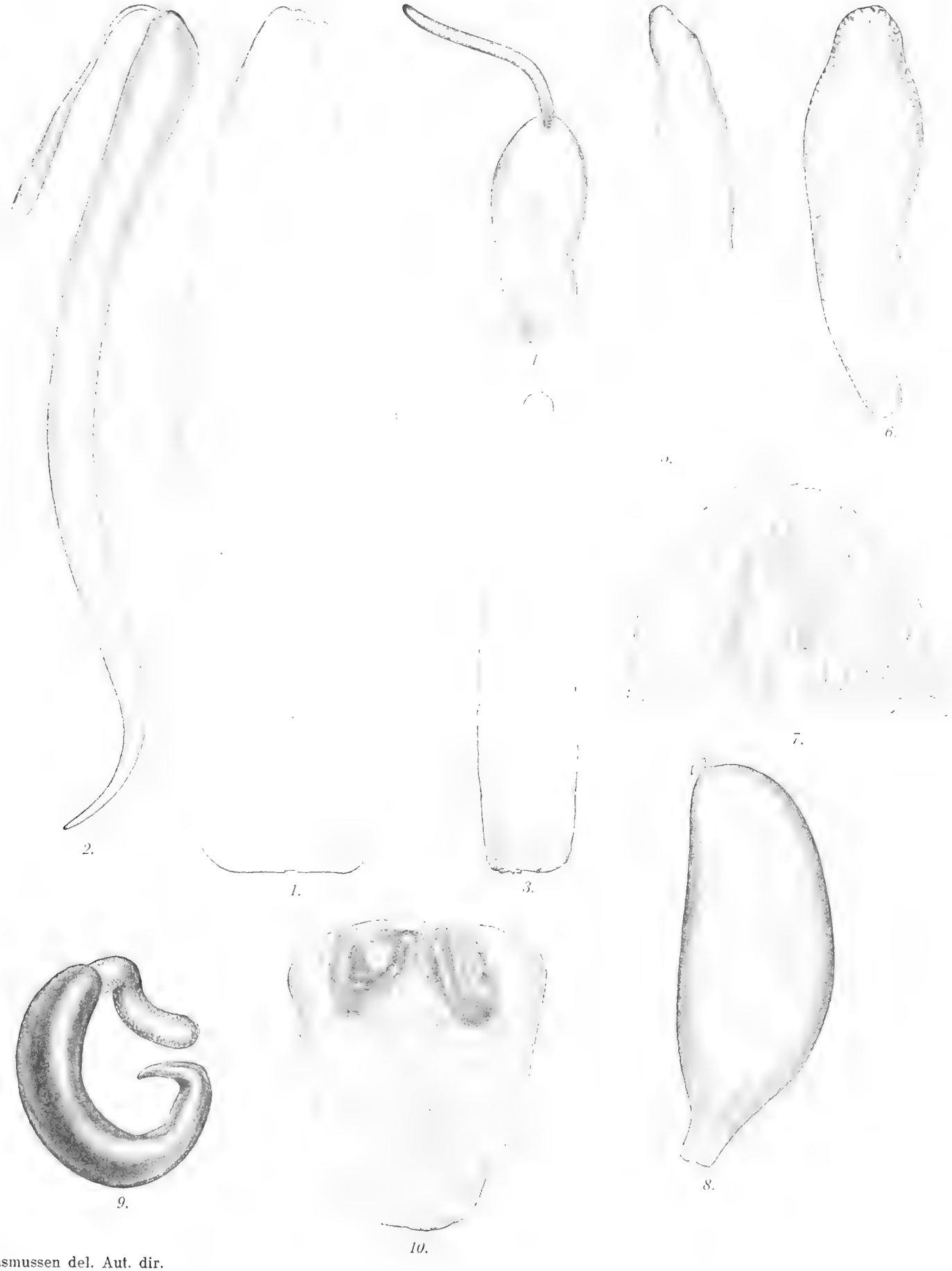
„ 14—15. *Nectonemertes mirabilis* ♂ (14) and ♀ (15). Ventral view. × 2.4.

„ 16—22. Series of males of *N. mirabilis*, showing growth of tentacles. × 3.5.

„ 23. *Nectonemertes minima.* Ventral view. × 8.5.

„ 24—25. *Phallonemertes Murrayi,* ♂ (24) and ♀ (25) both ventral view. Penes distinctly visible on lower side of head of male. × 2.4.

„ 26. *Natonemertes acutocaudata.* × 7.



Rasmussen del. Aut. dir.

11. 11. 15. 25.

13. 12. 26. 24. 23.

16. 17. 18. 19. 20. 21. 22.

Rasmussen del. Aut. dir.

SPONGIA

FROM THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

EMILY ARNESEN

WITH 5 PLATES

I. Preliminary notes.

When the collection of sponges from the cruise of the "Michael Sars" was offered to me for examination, I had at first some hesitation in accepting the onerous task on account of the difficulties in consulting the literature and in procuring the material for comparison, which I regarded as absolutely necessary in such a difficult group as the Sponges, especially as I had to deal with the Hexactinellida and the Tetractinellida, not previously studied by me. My doubts, however, disappeared, when the well-known spogiologist, Mr. Topsent, most kindly offered to place at my disposal his library and collections in the laboratory at Dijon, and I must therefore in the first place heartily thank him for his great kindness and valuable assistance.

The general results with regard to the sponges obtained during the cruise of the "Michael Sars" may be stated as follows: Of the 24 trawlings only 9 included sponges.

19 of the 24 hauls with the trawl were made in the eastern part of the southern section of the cruise, and sponges were obtained at 8 stations, while in the northern section with its 4 stations, sponges were found only at 1 station in the eastern part. Nothing remarkable with regard to the geographical and bathymetrical distribution has been observed. As the cruise extended mostly over very deep water, Calcarea were not likely to be largely represented, and in fact only one specimen, from st. 102, was taken. The other groups, Hexactinellida, Tetractinellida and Monaxonida, were found to be rather evenly distributed over the field of research: Of the Hexactinellida 9 species belonging to 8 genera were obtained at 6 stations: of the Tetractinellida 8 species belonging to 6 genera at 4 stations, and of the Monaxinida, all belonging to the suborder Halichondrina, 15 species referred to 14 genera at 7 stations (see the table II). New species were found only among the Monaxonida, and included representatives of the genera *Chondrocladia, Stylotella, Echinoclathria, Thrinacophora* and *Ciocalypta*.

In the classification I have followed Schulze for the Hexactinellida, v. Lendenfeld for the Tetractinellida, Topsent for the Monaxonida, and Dendy for the Calcarea. With regard to the Monaxonida it ought to be mentioned, that different authors held rather divergent views: Thus while Ridley and Dendy the authors of the first modern system of this group (1887) divided it into 4 families: Homorhaphidae Heterorhaphidae, Desmacidonidae and Axinellidae, Topsent (1894) sets forth in his: "Reforme de la Classification des Halichondrina" another view, dividing the group into 3 families: Haploscleridae, Pocilloscleridae and Axinellidae. In 1902 Lundbeck adopted in the main the system of Ridley and Dendy. Finally in 1911, after his researches on the larval development of different forms belonging to the Halichondrines, Topsent altered his previous system so as to include: Halichondridae, Hoploscleridae, Pocilloscleridae, Axinellidae (Sur les affinités des Halichondria et la classification des Halichondrines d'après leurs formes larvaires.—Arch: Zool. exper. et génér. 1910 (5) Tome VII, Note & Rev. No. 1, pp. I.—XV).

Accordingly the classification of the Halichondrina seems to call for further investigations of larval development in order to place it on a sound footing. I therefore have found it most practical to follow Topsent's earlier system, but omitting the arrangement into subfamilies, which as far as I can see can hardly be maintained, in the present state of our knowledge.

List of species obtained by the "Michael Sars" systematically arranged:

Calcarea:
Ordo Calcarea Dendy.
Fam. *Grantiidae* Dendy 1913.
Grantia intermedia Thacker.

Silicea:
Subcl. Triaxonia F. E. Schulze,
Ordo Hexactinellida O. Schmidt.

A. Hexasterophora F. E. Schulze.
Fam. *Euplectellidae* Ijima.
Subfam. *Euplectellina* Ijima.
Euplectella suberea Wywille Thomson.
Malacosaccus floricomatus Topsent.
Subfam. *Corbitellinae* Ijima.
Regradrella phoenix O. Schmidt.
Fam. *Rosellidae* F. E. Schulze.
Asconema setubalense Saville Kent.
Fam. *Coscinoporidae* (Zittel) F. E. Schulze.
Chonelasma sp.?
Fam. *Aphrocallistidae* F. E. Schulze.
Aphrocallistis beatrix Gray form. *bocagei* Percival Wright.
B. Amphidiscophora F. E. Schulze.
Fam. *Hyalonematidae* J. E. Gray.
Hyalonema sp.?
Hyalonema infundibilum Topsent.
Pheronema grayi Saville Kent.

Subcl. Demospongiae Sollas.
Ordo I Tetractinellida Marshall.
A. Sigmatophora Sollas.
Fam. *Tethyopsillidae* (Lendenfeld) Topsent.
Tethyopsilla zetlandica Carter.
B. Astrophora Sollas.
Fam. *Stelletidae* Sollas.
Stelletta hispida Buccich.
Thenea muricata Bowerbank.
Fam. *Pachastrellidae* Carter.
Characella pachastrelloides (Carter) Sollas.
Fam. *Geodiidae* Gray.
Isops pachydermata Sollas.
Sidonops sp.?

Ordo II Monaxonida Ridley and Dendy.
Halichondrina Vosmaer.
Fam. *Haploscleridae* Topsent.
Petrosia friabilis Topsent.
Fam. *Poecilloscleridae* Topsent.
Chondrocladia michael-sarsii sp. n.
Asbestopluma pennatula O. Schmidt.
Cladorhiza gelida Lundbeck.
Stylotella columella (Bowerbank) Topsent.
Stylotella topsentii sp. n.
Myxilla pectinata (Topsent).
Lissodendoryx complicata Arm. Hansen.
Dendoricella abyssi (Topsent) Lundbeck.
Grayella fallax Topsent.
Echinoclathria hjortii sp. n.
Anchinöe nobilis Ridley and Dendy.
Fam. *Axinellidae* Ridley and Dendy.
Axinella polypoides O. Schmidt.
Thrinacophora murrayi sp. n.
Ciocalypta weltnerii sp. n.

II. Descriptive part.

I. CALCAREA.

Grantia intermedia Thacker.

Pl. II. fig. 1.

Vide Litter: **32** pag. 770.

St. 102. Two specimens.

Of the two small egg-shaped sponges collected at this station, one is about 14 mm. high by 4 mm. broad with a well developed oscular fringe, about 1 mm. in length, round a conspicuous osculum at the summit; the other is 9 mm. high by 4 mm. broad, with an oscular fringe 1 mm. in length. Colour in spirit pale brown. Surface coarsely hispid with large oxeote spicules projecting in different directions. The thickness of the wall in the larger specimen is about 1.7 mm. of which about 0.14 mm. come on the dermal cortex, the rest on the chamber layer and the feebly developed gastral cortex.

I have not been able to trace the canal system, but the tubar skeleton shows a conspicuous articulate construction, though with slight signs ot becoming scattered. The skeleton consists of triradiate, quadriradiate and oxeote spicules.

In the cortex the vast majority are triradiates, but quadriradiates may occur. The triradiates are usually, irregular, showing a tendency to become sagittal. The rays are bent or straight, and of variable length, ordinarily about 0.37 mm. long by 0.014 mm. thick (resembling Thacker's figures. Textfig. 162 a. op. cit).

The tubar skeleton is composed as far as I could make out exclusively of quadriradiates, the facial rays of which form the walls of the six-sided skeletal tube, while the apical ray emerging from each angle projects into the lumen. They are usually sagittal with an oral angle of about 120°; the longest of the facial rays is about 0.440 mm. and the other two about 0.270 mm.; the apiçal ray is only about 0.030 mm. All the rays are of the same thicknes and resemble the triradiates.

The thin gastral cortex is composed of quadriradiates intermingled with triradiates both of about the same shape as those occurring in the tubar and dermal skeleton. The apical ray—somewhat longer than in the quadriradiates of the chamber layer—projects into the gastral cavity.

Large, oxeote spicules emerge from the surface of the sponge without definite order at different angles. Their proximal ends are hidden in the tubar layer of the body-wall. They are spindle shaped, usually not sharply pointed at the ends. They were all broken, so that I have not been able to measure their length exactly, but most certainly they are at least about 2—3 mm. long with a thicknes varying between 0.04—0.07 mm. The oxeote spicules composing the oscular fringe are very long and fine, reaching a length of 2—3 mm. and a thicknes of 0.004 —0.008 mm.

Remark: *Grantia intermedia* Thacker, has been found once off Cape Verde (Crossland Collection) at a depth of 20 fathoms (Boa Vista Island). Thus belonging to the warm water fauna, while the form here described has been dredged north of the Wywille Thomson ridge (st. 102), at a depth of 1098 m.

This great difference in habitat makes it perhaps uncertain that they belong to the same species, but they agree so well in anatomical structure, except that the tubar skeleton here is exclusively composed of quadriradiates instead of triradiates intermingled with quadrtadiates as in the type—a feature, which in the meantime cannot be held to justify a separation into two species.

Locality: North of the Wywille Thomson Ridge (Lat 60° 57′ N, Long 4° 38′ W); depth 1098 m.: bottom blue mud.

II. SILICEA.

Euplectella suberea Wywille Thomson.

Pl. I, fig. 1.

Vide Litter: **30** pag. 9.

St. 25. Several fragments (about 15).

The specimens obtained are all in rather bad condition, but nevertheless they are doubtless to be recognized as *Euplectella suberea* Wywille Thomson.

Usually they consist only of the basal tuft with a small remnant of the body-wall. Only one specimen, though also much damaged, represents the entire sponge, in which only traces of the tuft are left. This specimen has a subcylindrical form and is 10 cm. high with a diameter

of 5 cm. in the broadest part. Externally it resembles Wywille Thomson's second figure in the Challenger Report (**60** pl. V fig. 1), showing similar spiral series of round parietal gaps alternating with series of meshes closed by a flat arching of soft tissue, and the radial rays of the strong pentacts from the longitudinal and circular strands forming the underlying lattice-like meshwork project in spiral rows as lateralia, 2—3 cm. in length. The delicate marginal wreath consists of isolated spicules projecting outwards and upwards.

Spiculation: As to the spiculation in the specimens examined I find that the spicules on the whole correspond well with those figured by Schulze (**60** pl. V and pl. VI fig. 3). All the different forms of principalia, comitalia and parenchymalia are present.

It is specially noteworthy that the rough diacts with the four rudimentary actines from the circular membrane of the parietal gap—spicules characteristic of the species —have been observed in abundance with all their variations. But of the microscleres I have only been able to observe with certainty the hexasters (80 μ), the small gastral and the large dermal floricomes resembling those in **60** fig. 4 and fig. 5. All the other forms seem to be absent.

Geographical distribution. As will be seen from the table *E. suberea* has a wide distribution in the Atlantic.

Date	Locality	Depth	Name of Expedition or Authoraty	Litterature
1877	North of Scotland			Wywille Thomson: The Voyage of the Challenger. The Atlantic vol. I p. 138.
1881	Off the Berlingness	6049 m.	"Travailleur"	Milne Edwards: Comptes rendus T. XCIII p. 871.
1885	North Atlantic	900—2300 m.	"Talisman"	H. Filhol: La vie au fond des mers p. 282.
1886			Edmond Perrier	Edm. Perrier: Les explorations soumarines p. 337.
1887	West of Gibralter: (Lat. 36° 25′ N. long, 8° 12′ W.; Lat. 35° 47′ N. long, 8° 23′ W.)	1097 m. 1994 m.	"Challenger"	F. E. Schulze: Rep. on Challenger Hexactinellida p. 76.
	Between Pernambuco and Bahia: (Lat. 10° 11′ S. long, 35° 22′ W.)	2926 m.		
1892	Lat. 38° 23′ 45″ N. long, 30° 51′ 30″ W.	927 m.	"Hirondelle"	Emile Topsent: Result. Camp. scient. Prince du Monaco. Spongiaires de l'Atlantic nord. p. 24.
	Lat. 39° 18′ 5″ N. long, 33° 32′ 15″ W.	1372 m.		
	Lat. 41° 40′ 41″ N. long, 29° 4′ 23″ W.	2870 m.		
1904	Azores:			
	Lat. 37° 54′ N. long, 24° 43′ 15″ W.	2178 m.	"Princesse Alice"	Emile Topsent: Result. Camp. scient. Prince du Monaco. Fasc. XXV Spongiaires des Açores, p. 38.
	Lat. 39° 11′ N. long, 30° 44′ 40″ W.	1846 m.		
	Lat. 39° 51′ N. long, 26° 54′ 45″ W.	1940 m.		
	Lat. 39° 54′ N. long, 29° 01′ 45″ W.	1900 m.		
1904	S. W. of Cap Bojador:			
	Lat. 24° 35,3 N. long, 17° 4,7′ W.	2500 m.	"Valdivia"	F. H. Schulze: Hexactinellida. Wiss. Ergeb. d. Deutsch Tiefsee-Exp. "Valdivia".
	Pembachannel Zanzibar[1]):			
	Lat. 5° 24,0′ N., 39° 19,8′ E. long.	818 m.		
1910	Spanish Bay:			
	Lat. 35° 34′ N., 8° 25′ W. long	2300 Globigerina Ooze	"Michael Sars"	

[1]) Though not belonging to the Atlantic it is of interest to mention this locality here.—The specimen recorded from the Pembachannel (figured pl. II fig. 15 op. cit.) and one specimen from off Cape Bojador (figured pl. II fig. 6 op. cit.) are in spite of differences in the spiculation from the type referred to Eup. suberea with the remark, that it is doubtfull, whether they are to be reckoned "als Variationen innerhalb des Speciesbegriffes *Euplectella suberea* W. Th. oder als typische Charaktere differenter, von dem alten durch Wyv. Thomson und mich (Schulze) aufgestellte Artbegriff zu trennender Species zu gelten haben" (op. cit. p. 15).

Malacosaccus floricomatus Topsent.
Pl. I, fig. 2.
Vide litter: **41** pag. 33.

St. 10. One specimen.

At stat. 10 one specimen of a subcylindrical, stalked sponge of a very loose consistency was procured. The body of this sponge is 7 cm. long and has in the middle a diameter of 3 cm. diminishing towards the base to 2 cm. The subcylindrical somewhat twisted stalk is 8 cm. long and of 4 mm. in diameter with a basal bulb 6 mm. in diameter. The surface is finely hispid owing to the projection of the distal rays of the sword-like dermal hexacts, to be described later. Orifices, about 1 mm. in diameter, are rather densely spread over it. Whether there was an opening at the summit cannot be decided, as the upper part was cut off. There is no gastral cavity though a cut certainly appears on one side at the summit, about 1 cm. deep and 0.7 cm. in diameter. But as the walls of this cut exhibit no special spiculation, which is similar to that in the parenchyme I do not think it can be regarded as a rudimentary cloacal cavity.

The specimen thus exhibits a striking resemblance to *Malacosaccus floricomatus* Topsent (op. cit. pl. I, fig. 10). The spiculation also shows more affinity to this species than to the closely allied, *M. unguiculatus* Schulze, though it has not been possible after careful examination to find either the hypodermal spined hexacts (op. cit. pl. VII, fig. 3 c), or the floricomes with numerous secondary rays, like those found by Topsent under the superficial encrustment at the top of the stalk. But all the other forms of spicules have been observed: Thus in the dermal surface there is a layer af swordlike hexacts (like those figured op. cit. 3 a, 3 b), and between them small onychasters, 0.07 mm. in diameter (op. cit. fig. 3 g), together with a few, very slender floricomes. In the parenchyme between the large, flexible, absolutely smooth hexacts there are many robust floricomes (op. cit. fig. 3 f), with a diameter between 0.190—0.300 mm. These are specially large and abundant in the wall of the above mentioned cut. Further there were onychasters, discohexasters and oxyhexasters of the same forms as figured by Topsent in respectively (fig. 3 h, 3 i, 3 k op. cit.).

The rather flexible stalk has a peripheral coating of smaller, slenderer spicules and a central rigid part of rather robust ones. The spicules in both places are hexacts, differently transformed, mostly reduced to triactins (like fig. 3 d op. cit.). In the remaining patches of the skin the same spiculation has been observed as in the dermal skeleton of the body. Besides this there was in the coating of the basal hulb a dense felt, consisting of rather slender hexacts with rays of most variable length and beset with few exeedingly fine prongs—much like those described by Topsent (p. 38) in the "revêtement particulier" from the upper part of the stalk.

I think I am justified in referring—at least provisionally the specimen at my disposal to *Malacosaccus floricomatus* Topsent, in spite of the absence of the hypodermal spined hexacts and the floricomes with numerous rays.

Geographical distribution. *Malacosaccus floricomatus* Topsent has been recorded from the east of the Azores:

St. 749	Lat. 38° 55′ N., long 21° 18′ 45″ W.	Depth: 5005 m.	Bottom: "vase blanche et globigerines"	3 specimens and 2 stalks

The "Michael Sars" specimen came from the Bay of Biscay:

St. 10	Lat. 45° 26′ N., long 9° 20′ W.	Depth: 4700 m.	Bottom: yellow mud	1 specimen

Regadrella phoenix O. Schmidt.
Pl. I, fig. 3.
Vide litter: **41** p. 39, **30** p. 22.

St. 23. Seven specimens and several basal cups.

Of this species the "Michael Sars" obtained at stat. 23 seven or eight tolerably well preserved specimens, though all without basal cups. About double the number of basal cups were, however, taken at the same station. But as they were found in a separate bottle (together with *Aphrocallistes)* it is impossible to decide, whether they belong to the upper parts of the above mentioned specimens.

The basal cups were generally separated, but often they were attached very close to each other. Some of the cups had inside a coating of *Hamacantha bowerbankii,* and at the common base of fixation a small *Characella pachastrelloides* was attached.

All the specimens seem to have been torn off very close to the base. The largest one is 17 cm. long with a diameter at the middle of about 8.5 cm. and the smaller ones 12 cm. long with a diameter of 5 cm. The sieve-plate, the skeleton of which is pretty well preserved on nearly all the specimens, resembling exactly Topsent's fig. 3 pl. VI **41**, has a diameter of 3 to 5 cm. The

dermal surface is much abraded, exposing the parenchymal strands. The thin-edged, circular, parietal apertures, arranged in somewhat irregular oblique rows, have a diameter up to 5 mm.

Spiculation. As to the spiculation: I have observed all the spicules figured by Schulze (**26** & **29**) and Ijima **11**, except the graphiocomes, which were not found, though carefully looked for in several specimens: Onychasters, 0.111—0.147 mm. in diameter, and generally with only two secondary branches were observed in abundance and lophocomes, though fewer in number, 0.145—0.185 mm. in diameter. In the sieveplate-border the characteristic oxypentactins with unequal rays (figured **11** pl. V, fig. 5, fig. 6) were present and in the free edge of the cuff sword-like hexactins, like those figured in pl. XIII, fig. 2 **26**, the distal rays of which project as marginal prostalia. Bristle-like prostalia as indicated by Schulze and Filhol I have not observed.

In the dermal surface—though much abraded—the typical hexacts, reproduced in **11** fig. 23 & fig. 24 pl. X, were found and in the gastral surface pentactins.

Geographical distribution. *Regadrella phoenix* has a wide geographical range. Thus, besides having been obtained at several stations in the Atlantic,—as the following list shows,—it has also been recorded from the Pacific by "Albatross" **29** Galapagos, 717 m. and off the Coast of Chili, 3200 m., and in the Indian Ocean by the "Valdivia" **30** Nicobar, 805 m., 1 basal cup.

List of the localities in the Atlantic, where *Regadrella phoenix* has been recorded:

Date	Locality	Depth	Number of specimens	Name of expedition	Literature
1880	Near the Lesser Antilles:				O. Schmidt: Spongien des Meerbusens von Mexico Bd. II 1880 p. 61.
	Santa Crux	453 m.			
	Barbados	404—526 m.			
1899	St. Lucia and St. Vincent	514 m.	1 Skeleton	"Albatross"	F. E. Schulze: Amerikanische Hexactinelliden nach dem Materiale der Albatross-Expedition Jena 1899 p. 20.
	Near the Azores:				
1888		861 m.	1 mutilated base	"L'Hirondelle"	E. Topsent: Spong d. L'Atlant nord.— Result camp. scient. du Prince Monaco. Fasc. II 1892 p. 25.[1]
1895		1022 m.	2 bases and several fragments	"Princesse Alice"	E. Topsent: Spong. des Açores.— Result. camp. scient. du Prince Monaco Fasc. XXV 1904 p. 39.
1896		1360 m.	1 macerated fragment	"	
1902		1250 m.	2 fleschy bases	"	
1885	Coast of Morocco[2]	882 m.		"Talisman"	H. Filhol: La vie au fond des Mers. Paris 1885, p. 284.
1896	Gulf of Gascony	1220 m.	Fragments		E. Topsent: Result. sci. cam. du Caudan. Annal. Univers. Lyon: 1896, p. 275.
		1410 m.	Several magnificent specimens in perfect condition		
	Spanish Bay:				
1910	35° 32′ N., 7° 7′ W.	1215 m.	7 and several fragments	"Michael Sars"	

[1]) In the work cited *Regadrella phoenix* O. Schmidt has been identified with *Rhabdodictyum delicatum* O. Schmidt.

[2]) If *Regadrella phoenix* O. Schmidt be synomymous with *Trichaptella elegans* Filhol (**37** p. 276) as Topsent suggests but as Schulze (**29** p. 22) doubts.

Asconema setubalense Saville Kent.

Pl. I, fig. 4.

Vide litter: **12** a.

St. 102. One specimen.

From this station there is one specimen of a little bag-shaped sponge, 5 cm. long and 3.5 cm. wide, open at both ends, apparently a piece torn from a larger sponge. Its feltlike consistency and characteristic spiculation prove beyond doubt that it is an *Asconema*. All the different kinds of diacts (op. cit. pl. XXI, fig. 7—10) forming the parenchymal interlacement, the dermal and gastral hexacts and pentacts have been observed. Though we have not found all the four forms of rosettes generally occurring in *Asconema setubalense* the great discohexasters (op. cit. fig. 11) and the oxyhexasters with brushlike secondary rays (op. cit. fig. 6) being absent—we do not hesitate to refer the fragment to this species. Specimens wanting the great discohexasters have previously been recorded by the "Albatross" (var. *pauperata* Schulze **29** p. 26), and specimens lacking also other miscrosleres are known from off the Azores 599—1600 m. (**41** p. 41). The specimen at my disposal seems to represent a variety between *pauperata* and the simpler variety from off the Azores.

Geographical distribution: *Asconema setubalense* Sav. Kent has hitherto only been recorded from the Atlantic, where it seems to have a wide range:

Date	Locality	Depth	Bottom deposit	Name of expedition or authority Literature
1870	Off coast of Portugal	?		"Norna" Sav. Kent: On the "Hexactinellidæ" etc. - Monthly Micr., Journ. Nov. p. 241.
1885	Off coast of Morocco	410 m.	Rocky ground	"Talisman" & "Travailleur". Filhol: La vie au fond des mers p. 285.
1887	N. W. of Scottland	598 -786 m.		"Triton" (st. 4) John Murray vide: F. E. Schulze: *Hexactinellida*. Rep. Challenger, vol. XXI p. 116.
	Azores:			
1886	Lat. 43° 57′ N. long, 9° 27′ W.	300 m.	Gravel, rock	"Hirondelle"
1887	Lat. 38° 23′ 45″ N. long, 30° 51′ 30″ W.	927 m.	Gravel, black mud	E. Topsent: Résult. camp. scient. Prince de Monaco. Fasc. II. Spong. de L'Atlant. Nord. 1892 p. 27.
1887	Lat. 46° 4′ 40″ N. long, 49° 2′ 30″ W.	1267 m.	Stones, mud, shells	
1888	Lat. 38° 48′ 30″ N. long, 30° 19′ W.	861 m.	Sand, stones	
1895	Lat. 37° 42′ 40″ N. long, 25° 05′ 15″ W.	1385 m.	Arenaceous mud	"Princesse Alice"
1896	Lat. 38° 20′ N. long, 28° 04′ 45″ W.	1550 m.		E. Topsent: Résult. camp. scient. Prince de Monaco. XV. Spong. des Açores. 1904, p. 40.
1896	Lat. 39° 11′ N. long, 20° 24′ 15″ W.	1600 m.		
1897	Lat. 38° 52′ 50″ N. long, 27° 23′ 05″ W.	599 m.	Coarse sand	
1899	East coast of America:			
	Lat. 40° 02′ N. long, 68° 50′ W.	642 m.	Sand	"Albatross" F. E. Schulze: Amerik. Hexact. nach dem Mater. d. Albatross Exp. 1899, p. 25.
	Lat. 40° 01′ N. long, 68° 54′ W.	1170 m.	Sand	
	Lat. 40° 03′ N. long, 68° 56′ W.	532 m.	Sand, ooze	
	Lat. 42° 49′ N. long, 68° 50′ W.	—		
	Lat. 44° 35′ N. long, 57° 20′ W.	—		
	Lat. 41° 54′ N. long, 65° 48′ 35″ W.	185 m.	Stones and sand	
1910	Lat. 60° 57′ N. 4° 38′ W.	1098 m.	Blue mud	"Michael Sars"

Chonelasma sp.?

Pl. I, fig. 5

Vide Litter: **26** pag. 320.

St. 10. One specimen.

The specimen obtained by the "Michael Sars" was a 3—4 cm. long mamelliform piece, somewhat irregular apparently representing an entire individual. The expanded base has most likely been detached directly from the bottom. The sponge is hollow, and the cavity was filled with mud containing a small annelid. The surface exhibits irregular, rounded hillocks and indistinct foldings. The openings of the incurrent and excurrent canals are irre-

gularly scattered and of variale size. No trace of skin or other soft parts is left—only a pumice-like dictyonal framework exhibiting an irregular meshwork of confused strong hexacts with a prickly surface and provided with rather robust pegs. The thickness of the wall is 1—2 mm., and there seems to be no noteworthy differences between the dermal and the gastral surfaces.

Geographical distribution. Of this genus 5 species have been described from the Pacific *(Ch. lamella* Schulze, *Ch. hamatum* Schulze, *Ch. doederleinii* Schulze, *Ch. calyx* Schulze (**26** p. 320—326.) and *Ch. tenerum* Schulze (**29** p. 81).

From the Atlantic only 2 established species are known *Ch, Schulzei* Topsent (**34** p. 33) and *Ch. ijimai* Topsent (**41** p. 53) dredged by the "Hirondelle" and "Princesse Alice" off the Azores at depths between 861—1919 m.—The "Caudan" specimen from the Gulf of Gascogny (1710 m.) and the specimens recorded from the West Indies, Bermudas and off the coast of Portugal being all but small undetermined fragments.

The *Chonelasma* from the "Michael Sars" expedition was obtained at the trawling station 10 (Lat. 45° 26′ N., Long, 9° 20′ W.) during the cruise from Plymouth to Gibralter at the entrance to the Bay of Biscay at a depth of 4700 m. on a bottom of globigerina ooze.

This specimen cannot with certainty be referred to any distinct species, as the parts on which the specific characters are based are absent, but it may perhaps be identical with *Ch. Schulzei* Topsent, as this species according to Topsent (**41** p. 51) seems to be rather common among the Azores and perhaps occurs also off the coast of Portugal—the undetermined fragments recorded from that locality by the "Challenger" exhibiting at least, according to the same author, a close affinity to *Ch. Schulzei.*

Aphrocallistes beatrix J. E. Gray sensu F. E. Schulze.
Pl. I, fig. 5, 6.
Vide Litter: **30** p. 144.

St. 23. Several specimens.

At this station several pieces of *Aphrocallistes* were taken, but only abraded diactinal skeletons or mere fragments of skeletons, so that it has been difficult to determine the species. Of this genus six species have been described, but according to Schulze **(30)** they are all referable to two species appearing under different aspects "wie etwa die Tarrus-, Nardorus- and Auloplegma-Form irgend einer Kalkschwammspecies" (op. cit. p. 147). The two species regarded as main types are *Aphrocallistes beatrix* J. E. Gray and *Aphrocallistes vastus* F. E. Schulze. The others *Aphr. bocagei* Perc. Wright, *Aphr. ramosus* F. E. Schulze and *Aphr. azoricus* Topsent, are to be regarded as three different aspects of *Aphr. beatrix,* while *Aphr. whiteavesianus* Lambe is to be regarded as belonging to *Aphr. vastus* F. E. Schulze.

Aphr. vastus with its by-form belongs to the Pacific *[Aphr. vastus* from Japan, 329 m. (**26**, p. 317) and *Aphr. whiteavesianus* from Vanconver 730 m.]. The other, *Aphrocallistes beatrix,* has been recorded both from the Indian Ocean, the Atlantic and the Pacific.

The type species is known only from the Indian Ocean [Malacca, Bombay and the Andaman **28**], the *ramosus*-form[1]) from the Pacific (**26**, p. 319) and the *azoricus*-form from the Atlantic (**41**, p. 48), while the *bocagei*-form, has a wide range both in the Atlantic [W. Ireland, Coast of Spain, Portugal, France, Cape Verde, Azores, W. Indies etc., between 500—1300 m.], in the Indian Ocean and in the Pacific.

To judge from the geographical data, above mentioned and from the external appearance of the skeletons the "Michael Sars" specimens most likely belong to the species *beatrix* J. E. Gray sensu *Schulzei.*

The main type most surely is not present, only the *bocagei*-form, nearly all the specimens exhibiting the ordinary habit of that form, a tube gradually widening upwards with numerous radial finger-like swellings on the lateral walls "and the axis of the tube exhibiting as a rule a slight curvature" (like those figured **26**, fig. 1, pl. LXXXIII, and **30**, fig. 6, pl. XIV). Sometimes there are two parallel tubes the lateral swellings of which anastomose. The structure of the diactinal framework corresponds with Schulze's description (p. 314, **26**). In most specimens sieve-septa, like those figured in op. cit., pl. LXXXIII, fig. 2 often in several stages are present. A terminal sieve-plate has not been observed as all the upper parts have visibly been broken of.

In some specimens there are small patches with loose spicules still preserved at the base of the finger-like outgrowths, showing a striking resemblance to the spiculation in the ramosus-form.

As the ramosus-form has only been recorded from the Pacific, the "Michael Sars"'s locality would in case furnish a noteworthy extension of its distribution, the specimens having been obtained from the Spanish Bay (lat. 35° 32′ N, long. 7° 7′ W) at a depth of 1215 m.

Hyalonema Gray.

Of this genus the „Michael Sars" obtained 8 specimens from stations 10, 23, 35 and 53.

But nearly all the specimens are in a more or less bad condition, and therefore very difficult to identify.

[1]) The form obtained off the Azores and determined by Topsent as *Aphrocallistes ramosus* Schulze **34** the autor has later **41** recognized as *Aphrocallistes azoricus* Topsent.

From station 10 there are only two small fragments, one a piece of the body-wall, the other apparently a portion of a central conus—both impossible to recognize.

From station 35 was obtained a twisted basal tuft, 33 cm. long and 0.5 cm. in diameter, with a fragment of the body, 13 cm. long, adhering to its proximal prolongation. The basal tuft bears a single *Palythoa*. The consistency of the body is very loose. Its spiculation comes closest to that of *H. lusitanicum* Barb. du Bocage; but it is doubtful whether it may be identified with this species, especially on account of the pinnules, which in form and size exhibit more likeness with those in *H. thomsoni* Marsh; the distal ray of the great pinnules being 0.77 mm. long and the basal rays 0.09 mm. long; in the small ones the distal ray is 0.26—0.38 mm. long; the basal rays vary much both absolutely and relatively, often they are as long as the distal ray.

The two specimens from station 53 are also in a bad condition, the one consisting only of a hollow, 5 cm. long fragment—most probably a compartment—attached to a firm basal tuft 11 cm. long, which projects into the body for about 3 cm.; the other specimen has a basal tuft 10 cm. long, the proximal prolongation of which projects as a rigid conus into the middle of the body to a hight of 1.2 cm. above the margin and apparently dividing the body into four compartments of which only the one is left. As the body-wall of the three compartments has been destroyed, the central conus thus lies quite free. The spiculation exhibits most likeness with that of *H. lusitanicum*. Thus we find the characteristic smooth micro-oxyhexacts, straight and bent, with rays 0.074 mm. long. The pinnules—though the distal ray is shorter and the basal rays seldom blunt as in *H. lusitanicum*—decidedly resemble as regards their bushy appearance, the pinnules of this species. As to the three kinds of amphidiscs they too agree tolerably well in respect of form, but the mesamphidiscs (0.05 mm.) and macramphidiscs (0.17 mm.), are smaller—thus approximating in size to those of *H. thomsoni*. The rest of the spiculation consists of diacts variable in size and thickness, straight or curved, pointed at both ends, and of middle sized oxyhexacts and pentacts with their rays running into a marked point. In the basal tuft there are strong spicules with a variable number of cylindrical rays with rounded rough ends (like those figured **26** pl. XXVIII, fig. 12).

The identification of *H. lusitanicum* is on the whole difficult imperfectly known as it is—erected by Barb. du Bocage for a basal tuft of a sponge found at great depths off Portugal. Had it not been for the amplification of the diagnosis by Schulze based upon a damaged specimen labelled as a gift from du Bocage in the British museum, it would have been impossible to recognize it.

The specimens recorded by the "Gaudan" in the Gulf of Gascogny, 1710 m., are only "lambeaux isolés, avec une touffe de soies fixatrices couverte de *Palythoa*", and those obtained by the "Valdivia" **(30)** south-west of Cape Bojador, 2500 m., are also only fragments, of which the author remarks „vielleicht handelt es sich um *H. lusitanicum* Barb. du Boc. oder *H. kentii* Schmith."

The only specimens of *Hyalonema* in a condition to be recognized with any certainty are those from station 23, which I think must be referred to *H. infundibulum* Topsent.

The "Mihael Sars" specimens were found at the following localities:

Locality	Depth & bottom	Number of specimens
Spanish Bay:		
35° 32′ N., 7° 7′ W.	1215 m.	2 macereted specimens.
35° 34′ N., 7° 35′ W.	1615 m.	20—30 specim. (denuded).
Between Gran Canaria and Cape Bojador:		
28° 8′ N., 13° B. 5′ W.	1365 m.	2 specimens.
Unkown locality		11 dried specimens.

Hyalonema infundibulum Topsent.
(Pl. I, fig. 8).
Vide litter: **34**, p. 28, **37**, p. 277, **41**, p. 32.

St. 23. 2 specimens and 1 fragment.

This form was first obtained by the "Hirondelle" (1888) off Flores (Azores) at a depth of 1372 m. (bottom: sable vaseux et coquilles brisées), and identified by Topsent as *Hyalonema thomsoni* Marsh **34**. Later, after having found in the material from the "Gaudan"-Expedition (37), at a depth of 1710 m., "un échantillon d'Hyalonema semblable à celui de l'Hirondelle'" he thinks "maintenant avoir affaire à une éspèce voisine de *H. Thomsoni* par la spiculation, mais nettement distincte par ses caractères extérieurs" -and he erects the species *H. infundibulum* Tops.

I believe that the specimens from the "Michael Sars" station 23 (in the Spanish Bay) are to be identified with this species. As to the exterior they agree very well with fig. 12, pl. III (op. cit.), and according to the description (p. 278 op. cit.) they have a cylindroconical form, the superior part of which, as the diagnosis runs "s'enfonce en un entonnoir largement évasé, dont la paroi, tapissée d'une fine membrane criblée partout adhérente aux tissus sous-jacents, se perce de quatre grandes fentes allongées et irregulières, qui rayonnent autour d'un axe creux, et aussi d'un plus grand nombre d'orifices plus petits et inégaux. situés plus en dehors et dispersés."

It is to be noticed, that Topsent's specimens have no basal tuft nor even a trace thereof, while among the 3 specimens from the "Michael Sars" expedition the one has a tuft 15 cm. long, and the second a hole at the base, from which most probably a tuft has been torn out; the third specimen is only a small piece of the body. Besides this, the "Michael Sars" specimens are larger than those of Topsent, the one with basal tuft, being 11 cm. long with a diameter at the margin of 8.5 cm., and the other one 8 cm. in length with a diameter at the margin of 7 cm.

Spiculation. As to the spiculation I have observed, besides the ordinary smooth diacts and the middle sized hexacts, the characteristic micro-oxyhexacts with straight and prickly rays, 0.110 mm. long—thus somewhat longer than those measured by Topsent, which were only 0.080 mm. (80 μ). Further there are three kinds of amphidiscs, which agree well in form and size with those of *H. infundibulum* —though also somewhat longer than those measured by Topsent: macramphidiscs with a nearly hemispherical umbel and faintly echinated shaft, generally without central nodul, length 0.222 mm.—0.296 mm.; mesamphidiscs with a more bell-shaped umbel being 0.081 mm.—0.120 mm. long and micramphidiscs, 0.022 mm.—0.037 mm. long. As to the pinnules I find those of the "membrane criblée du cloaque" corresponding well with Topsent's description and figure (pl. 8, fig. 3). My measurements give for the unpaired ray 0.120 mm.—0.222 mm. and for the paired ones 0.040 mm.—0.055 mm. The other, more bushy kind of pinnules in my specimens seldom reach the length indicated by Topsent—thus the unpaired rays rarely exceed 0.200 —0.300 mm. and the cruciate ones, often thickly spined, are of variable length (from 0.045 mm. to often nearly the lenght of the distal ray). Besides these spicules there are in the basal pad strong tetracts and hexacts with rough echinated rays. Both agreeing well with those in *H. thomsoni,* and especially *H. thomsoni var. exigua* (**26**, fig. 15 & 17, pl. XXXIV).

The diacts of the basal pad have often echinated ends. The basal tuft consists of few, only 12—16, rather thick spicules, the ends of which are all broken, so that no anchors could be observed.

The presence of a basal tuft, and the approximation as regards the measurements of the spicules to those of *H. Thomsoni,* support Topsent's suggestion (**41**, p. 32), that *H. infundibulum* may represent only a variety of *H. Thomsoni.*

Geographical distribution: *H. infundibulum* has been taken off the Azores (1372 m.) and in the Bay of Biscay (1710 m. depth).

The "Michael Sars" specimens come from the Spanish Bay (35° 32' 7° 7' W); 1215 metres.

Pheronema grayi Saville Kent.
(Pl. I, fig. 9).
Vide litter: **12**, p. 182, **34**, p. 29, **41**, p. 29).

St. 23. 2 specimens (denuded).
St. 24. 20—30 specimens (denuded).
St. 41. 2 specimens.
Unnamed locality 11 dried specimens.

Though all the specimens from the "Michael Sars" Expedition are denuded, having lost most of their prostalia lateralia and even often the basalia, they seem to be identical with *Pheronema grayi* Saville Kent, to judge from the globular form (the largest specimens measuring about 13 cm. × 13 cm. and 13 cm. × 11 cm., the smaller ones 7 cm. × 7 cm.) and the funnel-shaped cloacal aperture (diam. 3 cm.—4 cm.). Though, it is to be noticed that one of the two specimens obtained at station 41 decidedly shows a cylindrical form (7.5 cm. × 5.5 cm.) thus resembling *Ph. carpenteri.* The prostalia pleuralia have a scattered disposition, while the prostalia basalia undoubtedly show a tendency to be grouped in bundles; the basal tuft measures 15 cm. The marginal fringe is rather defective, while the zone, 2 cm. below, is as a rule pretty well preserved.

As to the spicules they agree well with the description and figures given by Saville Kent (pl. LXIII, **12**) and by Topsent (pl. VII, fig. 9, p. 29, **34**, and pl. VII, fig. 2, p. 29, **41**).

Geographical distribution: Of the seven recognised species of *Pheronema* three are known from the Atlantic *(Ph. grayi, Ph. annæ,* and *Ph. carpenteri).* While the two lastnamed species are from the western Atlantic, *Ph. grayi* has been recorded from off Setubal, Portugal, (depth 1098 m.) and was met with in profusion at the Azores at different stations between 793 and 1557 m.

Tethyopsilla zetlandica (Carter).
(Pl. VI, fig. 6).
Vide litter: **15**, p. 31.

St. 24. (NB! There is some doubt wether the specimens are from st. 24 or 41). Two specimens.

One specimen is spheroidal in shape with a diameter of 4 cm., the other oblong, 4 cm. × 6 cm. Surface rather abraded, though showing a dense hispidity. Root-tuft about 5 cm. long—present only in the oblong specimen. Colour in spirit light yellowisch brown. Cortex 2—3 mm. thick.

Spicula: Megasclera: *Cortical oxea,* fusiform, bent or straight with long and evenly tapering ends, about 1.7 mm. long by 0.030 in the middle. *Somal oxea,* anisoactinate, nearly double the size of those in the typical form. *Protriaene,* rhabdome 8.5 mm. long by about 10.050 mm. in the proximal part and tapering from the

middle to the distal end, where it is filiform (0.017 mm. thick). *Anatriaene,* about double the length of those in the type; cladi 0.120—0.170 mm. long.

Geographical distribution: *Tethyopsilla zetlandica* (Carter) has been recorded from the Atlantic (Shetland, Islands and Bahia), Pacific (64 284 m.) and Indian Ocean (15 m.).

The specimens of "Michael Sars" were dredged in the Spanish Bay (35° 34′ N, 7° 35′ W); depth 1615 m. (NB! If st. 41 proves the right the locality is: Between Gran Canaria and Cap Bojador. (Lat. 28° 8′ N, 13° 35′ W); depth 1365 m.; yellow mud.

Stelletta hispida Buccick.
Pl. IV, fig. 8.
Vide litter: **15**, p. 41.

St. 23. One specimen.

A rounded mass about 4 × 7 × 9 cm. without any base of fixation. Surface much abraded with a net of spined ridges. Cortex, 4 mm. thick, bluish-brown; choanosome light yellow.

Spiculation. Megasclera: *Choanosomal oxea* straight or curved, 3.5—5.9 mm. long by 0.060—0.085 mm. thick. *Cortical oxea,* 1.3 mm. long, 0.017 mm. thick. *Protriæne* (Ptagiotriæne?), rhabdome 1.85—2.40 mm. long by 0.100—0.140 mm. thick, cladi 0.100—0.325 mm. long by 0.085 mm. thick. Microsclera: *Strongylaster* and *tylaster,* the single actine of which is about 0.0035—0.007 mm. long. *Oxyaster* with actines of about 0.007—0.018 mm. length.

Geographical distribution. *Stelleta hispida* has been recorded only from the Mediterranean.

The "Michael Sars" specimen is from the Atlantic: Spanish Bay (lat. 35° 32′ N, long 7° 7′ W.); depth 1215 m.

Thenea muricata Bowerbank.
Vide litter: **15**, p. 54.

St. 23. 3 fragments.

Three rather damaged fragments—the largest of which has a diameter of about 6 cm. It is often difficult to distinguish this species from the closely allied *Th. Schmidtii* Sollas, and the locality affords no clue, the specimens recorded being from a geographical area, the Lusitanian province, where both species are met with. But the small number of plesiasters, one of the usual distinguishing characters, seems to prove, that it cannot be *Th. Schmidtii.*

Geographical distribution: *Th. muricata* has been recorded from the North Polar Ocean down to the Azores.

The "Michael Sars" material was obtained in the Spanish Bay (35° 32′ N, 7° 7′ W); depth 1215 m.

Characella pachastrelloides (Carter) Sollas.
Pl. IV fig. 4.
Vide litter: **5**, p. 403, **34**, p. 40, **15**, p. 76, **41**, 95

St. 23. One specimen.

A small lump about 3 cm. × 3 cm. attached to a basal cup of *Regadrella phoenix.* The surface, rather damaged, is hispid and rough. Pores very fine, and the oscula, about 1 mm., in diameter, are dispersed. Colour in spirit yellowish.

Spiculation. The spicules of the specimen from the „Michael Sars" Expedition agree fairly well with the spicules of those collected by the Princesse Alice (**41**, p. 95) though on the whole they are somewhat larger in the former. The spiculation of the microscleres is rather doubtful, and no orthotriaenes have been observed.

The spicules are: Megasclera: *Oxea,* 3—4 mm. long by about 0.08 mm., in the thickest ones, *Dichotriaenes* with rhabdomes varying from about 0.800—1.7 mm. by 0.111 mm. in the thicker part; protocladi about 0.170 mm. and deuterocladi about 0.500 mm. Microsclera: large microxea 0.260—0.370 mm. and small microxea, often centrotyles, about 0.05 mm., the spinulation of which is rather doubtful. Amphiasters, 0.026 mm. (very few).

This species has now been recorded from the following localities:

Stat.	Locality	Depth m.	Bottom	Number of Specimens	Name of Expedition Literature
25	Near Cape St. Vincent	682			"Porcupine" Carter: Sponges from the Atlantic Ocean. Annals & Mag 4 ser 18, 1876 p. 403.
60	43° 57′ N., 9° 27′ W.	300	Sand, gravel, rock	1 small fragment	"Hirondelle" Topsent: Sponges Atlantic Nord: Result. des Camp. Scient. Monaco. Fasc II 1892 p. 41.
229	38° 22′ N., 30° 34′ 39″ W.	736	ferruginous gravel	4 large samples	
584	38° 31′ N., 26° 49′ 15″ W. / 38° 30′ 30″ N., 26° 50′ 15″ W.	845	Rock	1	
587	38° 36′ 40″ N., 27° 17′ 15″ W.	793	Sand	Several	
597	38° 27′ N., 28° 03′ 25″ W. Between Pico and San Gorge.	523	Rock	1	
866	38° 52′ 50″ N., 27° 23′ 05″ W. Near Terceira.	599	Coarse sand	Several	"Hirondelle" Topsent: Spong. Açores. Result. des Camp. Scient. Monaco. Fasc. XXV 1904 p. 95.
1367	37° 34′ N. 28° 56′ 45″ W.	563	Fine sand	2 fragments	
23	35° 32′ N., 7° 7′ W.	1215	Yellow mud	1	"Michael Sars"

Isops pachydermata Sollas.
Pl. IV fig. 3
Vide litter: **15**, p. 98.

St. 23. One specimen.

An irregular rounded mass about 3 cm. long and 2 cm. broad attached together with a small *Sidonops sp?* to a piece of coral and nearly entirely enveloping it. The uniporal pores and oscula open with chones at the summit of small tubercles. Colour in spirit cream white. Cortex about 1 mm. thick.

This form, if not a typical *Isops pachydermata* Sollas, seems at least to be a variety of this species. As will be seen, the measurements of the spicula agree tolerably well with those in *Isops pachydermata* Sollas but for the subcortical spherasters, which are about double the size and for the presence of the dichotriaenes, sparsely observed — if they really belong to the sponge and not to the foreign bodies, abundantly present.

The spicules are: Megasclera: *Oxea,* fusiform, usually curved, not sharply pointed, about 2.50 mm. long by 0.06 mm.; *orthotriaene*, rhabdome conical, 1.2—1.7 mm. long by 0.044 immediately below the ramification, cladi 0.680 mm. long by 0.037 at their origin; *dichotriaene,* rhabdome 0.595 mm. long, protoclad 0.206 mm. long and deuteroclad 0.255 mm. long. Microsclera: *sterraster,* ellipsoid, 0.250—0.390 mm. by recpectively 0.187—0.272 mm.: *small spheraster* with a large centrum, total diameter 0.018 mm.; *subcortical oxeote spheraster,* total diameter 0.067 mm., centrum well developed, the length of single actine 0.025 mm.; *oxyaster* with 2—8 actines, the length of a single actine in the triod form about 0.060 mm.

Geographical distribution: *Isops pachydermata* Sollas has been recorded from:

St.	Locality	Depth m.	Bottom deposit	Temperature	Nr. of specimens	Expedition or authority Litterature
56	32° 9′ N., 65° 0′ W. (Bermuda)	1966	Coral mud	3°44	?	"Challenger" Sollas: Tetractinellida, p. 236,
234	39° 2′ N., 30° 15′ W.	454	ferruginous gravel	?	One very fine specimen	Topsent: Spongia Atl. Nord in Res. Camp. Sci. Monaco fasc. II. 1892, p. 49.
242	38° 9′ N., 30° 19′ W. (Azores)	861	Sand, cinders	?	Two small	
23	35° 32′ N., 7° 7′ W. Spanish Bay...	1215	yellow mud	10°17	One	"Michael Sars"

Sidonops sp.?
Pl. IV fig. 5.

St. 23. One specimen.

St. 24. Two specimens.

All the specimen are spheroidal, that from station 23, attached together with *Isops pachydermata* to a piece of coral, having a diameter of about 2.5 cm. and those from station 24, both free, having respectively a diameter of 6 cm. and 7 cm. They are much abraded, but seem all to have been densely hispid. Colour in spirit yellowish brown. The specimen from station 23 is provided with one praeosculum, 2 mm. in diameter. Of the specimens from station 24 only the larger one has a praeosculum (diameter 7 mm.). I have not been able to identify any of the specimens with any known species. On the other hand I do not consider the material in hand sufficient for erecting a new species.

The spiculation of the specimen from station 23 resembles much that of *Sidonops baretti,* but for the absence of the anatriaenes and protriaenes, which have not been observed, and for the presence of orthotriaenes.

The spicules here observed are: Megasclera: Large *amphioxea,* 4—5 mm. long by 0.170 mm.; small *oxea* 0.370 mm. long; *dichotriaenes*, the rhabdome of which is 4.10 mm. long by 0.170 mm., the protoclad 0.170 mm. and the deuteroclad 0.340 mm.; *orthotriaenes,* rhabdome 5.1 mm. by 0.170 mm. and cladi 0.510 mm. Microsclera: *sterraster,* 0.296—0.370 mm. in diameter; *spined oxyaster* 0.050 mm. in diameter; *spheraster* 0.011 mm.

The spiculation of the specimen with præosculum from station 24 includes: Megasclera: large *amphioxea* 0.510—0.680 mm. long by 0.085 mm.; small *oxea* 0.320 mm. long; *dichotriaenes,* rhabdome 8.5 mm. by 0.170—0.250 mm., protoclad 0.425 mm. long and deuteroclad 0.680 mm. long; anatriaenes, rhabdome about 23 mm. long, cladi 0.170—0.200 mm. long; *protriaenes,* rhabdome 18.7 mm. long; cladi 0.340—0.530 mm. long by 0.068. Microsclera: *sterraster,* 0.102—0.153 mm. in diamer; *spined oxyasters,* 0.1295 mm. in diameter; *spheraster* 0.007 mm. in diameter.

The spicules of the other specimen from station 24 are of similar dimensions.

Locality: Between Gibraltar and Gran Canaria, lat. 35° 32′ N, long 7° 7 W, 1215 metres, and lat. 35° 34′ N, long 7° 35′ W, 1615 metres. Bottom in both places yellow mud.

Petrosia friabilis Topsent.
Pl. III fig. 5.
Vide Litter: **24**, p. 69.

St. 23. One fragment.

A mass 6.5 cm. × 3 cm. × 4.5 cm. of a rather firm but friable consistency. Several circular, sharply marked oscula with a diameter varying from 3 to 6 mm. Colour in spirit dirty yellowish white. The sponge is traversed by large canals. The dermal membrane is rather thick and consists of a dense reticulation of oxea of the same kind as in the choansome, but they are here irregularly arranged. The shape of the oxea agrees well with Topsent's figure (pl. X fig. 4, op. cit.) and with his preparations, which I have had for comparison, but the proportions are somewhat larger varying from 0.333—0.444 mm. in length and being about 0.015 mm. thick.

Geographical distribution. The species has been recorded from the Azores (130—927 m.) and from the southern entrance of the Bay of Biscay (134—300 m.) (op. cit. p. 69) where it is, according to Topsent, a very common species.

The locality of the „Michael Sars" specimen is the Spanish Bay (35° 32′ N, 7° 7′ W), 1215 m.

Temperature 10.17° c. (at 1200 m.).

Chondrocladia Michaelsarsii sp. n.

St. 23. One specimen and fragments.
St. 35. One specimen and fragments.
St. 41. Several fragments.

The general appearance of the "Michael Sars" specimens recalls Oscar Schmidt's figures of *Chondrocladia conrescens* O. Schmidt (**25**, Taf. X, fig. 89) and Fristedt's figure (**9**, pl. 31, fig. 26) of *Cladorhiza nobilis* Frist., found by Lundbeck to be synonymous with *Chondrocladia gigantea* Arm. Hansen (**17**).

With Lundbeck's own figure (**17**, pl. IV, fig. 1) of *Ch. gigantea* Arm. Hansen it shows on the contrary less resemblance.

Only two specimens are tolerably well preserved, one from station 23 and one from station 35.

The specimen from station 23 has a body 32 cm. in length (+ 7 cm. for the stalk and root) and that from station 35 is 50 cm. in length (+ 1 cm. for the stalk and root). The stalk is in both nearly uniform in thickness throughout the whole length: in the larger specimen 1—2 cm. and in the smaller one 0.5—0.7 cm.

The stem has whorls of irregularly clubshaped branches, about 2 cm. long, set with small globular swellings. Ordinarily there are four branches in each whorl. The branches coalesce with each other and the neighbouhring stems seem to do the same, as sometimes two stems form a cross. One of the specimens is forked at the upper end, while the other is undevided and tapering somewhat towards the apex. The surface is minutely hispid, with either irregular, circular or oval apertures here and there. The further anatomical structure corresponds in all essentials with Lundbeck's description of *Chondrocladia gigantea* Arm. Hansen (**17**, p. 104). Thus there is a crusty layer, easily peeled off, while the dermal membrane proper is difficult to detach. Further there is a copious system of subdermal cavities and canals (where generally annelids have taken shelter). A rope-like, twisted skeletal axis runs throughout the sponge and diverges into the branches. In the stalk—which is rather muddy there is no lacunous layer between the coating and the axis.

Spiculation. The megasclera are smooth styli: In the axis they are from 1.7 mm. to 3.4 mm. in length, or even longer, and generally about 0.056 mm. in thickness, while in the other parts of the body they obtain only a length of about 1.2 -1.7 mm. with a thickness of 0.011—0.030 mm., but there is no distinct separation between them. Thus they are somewhat longer than in *Ch. gigantea* (1.2—2 mm. and 0.56—1.2 mm.) and aproach those in *Ch. concrescens* Ridley and Dendy (4.5 mm).; in shape, they are more like those in the former, perhaps not so suddenly tapering at the upper end. Besides the smooth styli there are in the stalk-coating finely granular styli, generally 0.37 mm. long and 0.007 mm. thick, thus also somewhat larger than in *gigantea* (0.118—0.340 mm.) but otherwise resembling them (pl. XIII, fig. 2 c). The microsclera are *isanchorae unguiferae* of the typical chondrocladia-shape, generally with 7 teeth, but sometimes having 6 or 8, and all of one size, about 0.099 mm.—thus agreeing with the "Challenger"-forms. Plenty of sigmata with compressed ends, 0.037—0.063 mm., have been observed in all parts of the sponge, though most abundantly in the branches.

As will be seen from the above description the Chondrocladia obtained by the "Michael Sars" can not easily be identified with any one of the species in question: *Ch. gigantea* Arm. Hansen, *Ch. concrescens* O. Schmidt and *Ch. concrescens* Ridley and Dendy.—Lundbeck thincks the *Ch. concrescens* of Schmidt and that of Ridley and Dendy are two different species, and he is certainly right I believe.—Our form has affinities with each of the three, thus in the abcenee of small anchoræ and in the proportions of the large it corresponds with Ridley and Dendy's concrescens, whilst in general ana-

tomical structure it seems to be identical with *Ch. gigantea* Arm. Hansen—and here special notice must be taken of the presence of a stalk-coating with granular styli, which have been observed as mentioned with certainty only in *Ch. gigantea* the "Schlammbelag" in Schmidt's concrescens seems most doubtful. As to external aspect it reminds one most of the species figured by Fristedt (= *Cladorhiza nobilis* op cit.), but it resembles also *Ch. concrescens* Schmidt.

Though as a whole, the relationship seems after all to be closest with the concrescens of Ridley and Dendy, and were it not for the absence in this of a stalk-coating with granular styli, the widely separated localities, and the differences in depth as shown by the following list, I would be inclined to refer it to that species.

From these considerations I think it most practical in accordance with the present state of our knowledge to erect a new species, nearly related to the three above mentioned inter se closely allied species. Further researches may perhaps elucidate the true generic relations between them.

Geographical distribution etc. of *Chondrocladia gigantea* Arm. Hansen, *Chondrocladia concrescens* O. Schmidt, *Chondrocladia concrescens* Ridley and Dendy and the *Chondrocladia* from the "Michael Sars" expedition 1910:

Name of species	Locality	Depth	Temperature	Deposit	Number of specimens	Name of Expedition and Literature
Chondrocladia gigantea Arm. Hansen	(St. 48) Lat. 64° 34′ N. long, 10° 22′ W.	547 m.	— 0°3	Dark grey clay	1 spec. & several fragments.	Norw. North Atlant. Exp. 1887 (Arm. Hansen: Spongidæ) Vide also:
	(St. 51) Lat. 65° 53′ N. long, 7° 18′ W.	2127 m.	— 1°1	Biloculina clay		Lundbeck: *Porifera Desmacideonida* (pars) Danish Ingolf Exp. 1905 p. 102.
	(St. 137) Lat. 67° 24′ N. long, 8° 58′ W.	827 m.	— 1°	Clay		
	East Greenland	238 m.			1 „	"Vega" Exp. 1887, Fristedt: Sponges from the Atlant & Arct Ocean etc. Vide also Lundbeck (op. cit.).
	Off Nova Scotia?	329 m.				Verrill: Proc. of the U. St. Nat. Mus. II. 1879, p. 204.
	Between Iceland and Faeroe: (St. 4) Lat. 64° 07′ N. long, 11° 12′ W.	433 m.	+ 2°5		Fragments	Danish Ingolf Exp. 1905. Vide (op. cit.).
	(St. 64) Lat. 62° 06′ N. long 19° 00′ W.	1904 m.	+ 3°1			
	(St. 101) Lat. 66° 23′ N. long, 12° 05′ W.	982 m.	— 0°7			
	(St. 138) Lat. 63° 26′ N. long, 7° 56′ W.	861 m.	— 0°6			
	Faeroe Channel: Lat. 62° 53′ N. long, 4° 17′ E.	823 m.	— ?		3 spec.	"Michael Sars" Cruise 1902. Vide, Lundbeck op. cit., p. 108.
	Lat. 62° 38′ N. long, 4° 40′ E.	640 m.	— 0°5			
	North W. Atlantic	**238-2127**	**+ 3°1 — 1°1**			
Chondrocladia concrescens O. Schmidt	West Indies & Florida: Lat. 33° 44′ N. long, 83° 13′ W.	907-1620 m.	?		2 spec.	Oscar Schmidt: Spongien des Meerbus. von Mexico 1879 p. 83. Vide also Lundbeck op. cit.
Chondrocladia concrescens Ridly and Dendy	North Pacific (st. 248): Lat. 37° 41′ N. long, 177° 4′ W.	5304 m.	1°72			"Challenger" Exp. 1887: Ridley and Dendy, Monaxonida. Rep. Challenger, vol. XX.
Chondrocladia Michaelsarsi sp. n.	Spanish Bay (st. 23): Lat. 35° 32′ N. long, 7° 7′ W.	1215 m.	10°17 (at 1200 m.)	Yellow mud	1 spec. & fragments	**"Michael Sars" 1910.**
	Off Cape Bojador (st. 35, st. 41): Lat. 27° 27′ N. long, 14° 52′ W.	2603 m.	?	Yellow mud	1 spec.	
	Lat. 28° 8′ N. long, 13° 35′ W.	1365 m.	?	Yellow mud	Fragments	
		1215-2603 m.				

Asbestopluma pennatula O. Schmidt.
Pl. III, fig. 3.
Vide litter: **40**, p. 28, **17** p. 44.

St. 102. One specimen.

This species is represented only by the upper part (9.3 cm. long) of the sponge. which consists of two dichotomous and anastomosing main branches. The breadth of the stem at the lower somewhat twisted end—probably the beginning of the stalk—is 0.1 cm. The branchlets are nearly invisible and commence from the lowest third of the stem. The specimen is mostly denuded.

Skeleton. The axis, consisting of closely connected parallel *styli* and single *subtylostyli* with their points turned upwards, has rather large canals. It is surrounded by a dense layer of styli arranged parallel to the longitudinal axis. The skeleton of the branchlets oppositely inserted in the narrow side of the stem consists of an axis of subtylostyli arranged in a fanlike manner in the longitudinal direction of the stem. Patches of the coating have been found consisting of densely interwoven finely spinulous tylostrongyla.

Spiculation: Megasclera are *styli*, 0.850—1.15 mm. long and 0.023 mm. thick; *subtylostyli*, about 0.500 mm. long and 0.018 mm. thick, and *tylostrongyla*, irregularly curved and spinulous, varying between 0.040—0.170 mm. in length and reaching up to 0.003 mm. in thicknes. Microsclera are *large anisochelae* 0.070 mm. long, *small anisochelae* 0.014 mm. long and *sigmata* 0.018—0.037 mm. long.

These spicula may be identified in all details with the figures of Lundbeck (pl. X fig. 4 a—o, 5—7. op. cit.).

Remark. As to the synonymi of this species I follow Lundbeck. After the reexamination of my species *Esperella plumosa* erected in 1903 (**2**) I agree with him in regarding it as a synonym of *Asbestopluma pennatula* O. Schmidt. I myself then thought at first it was *Clardohiza nordenskjöldii* Fristedt; but as Fristedt did not mention the small chelæ I could not be certain. But now since Lundbeck states they are present, there is no doubt any longer. I have also had Armauer Hansen's *Esperia bihamatifera* for comparison and find it to be identical with this one.

Geographical distribution: This species has been recorded only from northern areas as is seen from the following list:

Locality	Depth	Name of expedition	Literature
Off Bukkenfjord & Haugesund			O. Schmidt: Jahresber. der Commiss. zur Wiss. Unters. deutsch. Meere in Kiel — für 1872—73, 1875 p. 119.
Trondhjems Fjord			Arnesen: Spongien von der Norw. Küste, Bergens Mus. Aarbog 1903, No. 1, p. 11.
Lyngen Fjord, Norway			Lundbeck: The Danish Ingolf. Exp. vol. VI, Part 2, 1905, p. 51.
Barent Sea		"Willem Barents"	Vosmaer: Niederl. Arch. für Zool. Suppl. Bd. I, 1882, p. 47.
Loc?		The Norw. North-Atlantic-Exp.	Arm. Hansen: Spongiadæ. Norw. North Atl. Exp. Bd. III, p. 15.
East coast of Greenland		"Vega"-Exp.	Fristedt: Vega-Exp. Vet. Iakt. IV, 1887, p. 455.
Gulf of St. Lawrence			Lambe: Proc. Roy. Soc. Canada, Ser. 2 II, Sect. IV, 1896, p. 189.
Between Faeroe-Island and Iceland & South of Iceland and Danmark strait		Ingolf-Exp.	Lundbeck: Desmacidonidæ (Pars), The Danish Ingolf. Exped., vol. VI, Part. 2. 1905, p. 51.
N. of W. Thomson Ridge 60° 57′ N, 40° 38′ W.	**1098 m.**	**"Michael Sars" 1910**	

Stylotella columella (Bowerbank) Topsent.
(Pl. III fig. 2).
Vide litter: **4**, vol. III p. 243, **34** a, p. 536.

St. 37. Two specimens.

Both specimens are erect with lobate or flat anastomosing branches; the one is 30 cm., the other 10 cm. high, both with a base about 2.5 cm. in diameter. The surface is smooth, uneven, with a thin pellucid dermal membrane. Distinct, round or oval pore-areas are to be seen all over the surface (like those mentioned in *Myxilla panpertas* var.). Colour in spirit light brownish. The plurispiculous fibres of the rate consist of *tornostrongyla*

often verging upon styli, 0.444 mm. long and 0.006—0.011 mm. tick. As I have had Topsent's preparations for comparison I am sure of the identity.

Geographical distribution: This species has been recorded from Exmouth, England (Bowerbank, op. cit.), off Roscoff (Topsent, op. cit.) and from the Mediterranean Coast of France (**38**, p. 123).

The specimens from the "Michael Sars" were taken between Gran Canaria and Cape Bojador (lat. 26° 6′ N, long. 14° 33′ W), depth 39 metres; deposit shingel; bottom temperatur 15.63° C.

Stylotella topsenti sp. n.
Pl. III fig. 4 & pl. V, fig. 4.

St. 37. One specimen.

Sponge erect, ramouse, with a few long flexible branches dichotomising in whiplike ends (fig. 4). The transverse section of the branches is oblong or triangular. Oscula, about 2 mm. in diameter, are serially arranged along the narrow sides of the branches. Dermal membrane distinct and pellucid (only patches preserved). Consistency rather tough. Colour i spirit light brownish.

Skeleton consists of a somewhat irregular network of densely packed parallel *styli* imbedded in strong spongin fibres. There is no pronounced difference between the fibres, but those radiating towards the surface are somewhat stronger than the other ones. The meshes of the network and the dermal membrane are filled with dense masses of scattered spicules.

Spiculation. The *spicula* of the fibres are *styli* varying in length from 0.230 to 0.296 mm. by 0.195 mm. (in the thickest part). They are either straight, cylindrical, with long and sharply pointed ends or, usually, somewhat fusiform and slightly bent; the other end is simply rounded off. The scattered spicules in the meshes and in the dermal membrane consists partly of styli of the same kind as in the fibres, but there are also some very slender, irregularly curved ones, the form of which is difficult to define, but usually they have blunt ends.

The above described form does not agree in any respect with any one of the Atlantic species described by Bowerbank and Topsent (St. Jullieni **38**, p. 137), but in form and proportions of spicules it is like one of the four Australian species of Lendenfeldt—(*St. digitata* Lndf. **14**, p. 185)—which has a digitate branching form and straight or slightly curved spicules, 0.250 in length and 0.004 mm. in thickness.

Locality. Off Cape Bojador; depth 39 metres; shingel; bottom temperature 15.63° C.

Cladorhiza gelida Lundbeck. (?)
Vide litter: **17**, p. 83, **42**, p. 5.

St. 102. Several fragments.

At station 102 a few, mostly denuded fragments of *Cladorhiza* were obtained, which externally exhibits most resemblance to Lundbeck's figure of *Cl. gelida* Lndb. (Pl. III fig. 1, op. cit.), but shows certain peculiarities.

Thus besides the filiform appendages tapering towards the point in the characteristic way of *Cl. gelida,* there are also filiform appendages, ending in a globular or club-like swelling (5 cm. long). Further the spicules are about double the size of those indicated by Lundbeck and Topsent. Several fragments have been examined from different parts of the sponge, with the same result, though in the branchlets a few spicules approximating in size to those in the type have also been observed.

All the types of micro-spicules indicated by Topsent (Pl. II fig. 4, **17**) have been found except the small sigmates. Thus, the *anisancoræ unguiferae* were present in great abundance, generally varying from 0.051—0.055 mm. (thickness 0.007 mm.); in the branchlets a few measured only 0.037. *Large sigmata*, 0.159—0.259 mm. (greatest thicknes 0.259 mm.) were likewise abundant in all parts, while only a few *ancistres*, of about the same size, have been observed. *Sigmansistres*, 0.051—0.092 mm., were numerous especially in the branchlets, where the large sigmata were less frequent.

This difference in the size of the spicules in my specimens, as compared with those in *Cl. gelida* Lndb., has made me hesitate to refer them to that species. But perhaps *Cl. gelida* is like *Cl. longipinna* R. and D. (**21**, p. 92) in having spicules of different sizes (anisancorae varying from 0.034—0.060 mm.) in different parts of the sponge — the larger ones belonging to the lower surface. At least two of my specimens are fragments broken off very near to the base of the sponge, all the rest being only detached branches — so that it may be so. I therefore think it right to refer them provisionally to *Cl. gelida* Lndbk.

Geographical distribution: *Cladorhiza gelida* Lundbeck is known as an inhabitant of the cold area having been recorded from:—

Date	Locality	Depth m.	Temperature	Name of expedition	Literature
1885	Lat. 31,63° 10′ N. long, 5° 00′ E. (St. 31)	363		Norw. North-Atlant Exp.	Vide—Lundbeck: Porifera Desmacidonidae (pars) in Danish Ingolf-Exp., vol. VI. 2. 1905, p. 86.
1902	Lat. 6,0° 19′ N. long, 5° 39′ W. (Faroe-Channel)	1131	÷ 0,15° C.	„Mich. Sars“	Ibidem p. 87.
1905	Lat. 69° 57′ N. long, 6° 44′ W. (St. 112)	2317	÷ 1,1° C.	Ingolf-Exp.	Ibidem p. 83.
	Lat. 69° 31′ N. long, 7° 06′ W. (Norwegian Sea between Jan Mayen and Iceland.....	2394	÷ 1° C.		
1909	Lat. 76° 56′ N. long, 9° E. (Spitzbergen (Horn Sound) ...	1535		„Princesse Alice“	Topsent: Etudes sur qlq. cladorhiza. Bull. Institut oceonographic Monaco, No. 151. Sept. 1909, p. 6.
1910	**60° 51′ N., 40° 38′ W,**	1098		**„Michael Sars“**	

Myxilla O. Schmidt. — (Dendoryx Gray 1867).

Myxilla established by Oscar Schmidt in 1862 is a genus wich has been much discussed, and its diagnosis has often been changed. Thus while Ridley and Dendy make no distinction between the forms with or without accessory spicules, Topsent (**34**) refers the former to *Myxilla* and the latter to *Dendoryx*, after having revived (in 1888) Gray's *Dendoryx* of 1867. Thiele however (**33**, p. 953) states, that Topsent's diagnosis of *Dendoryx* must be applied to *Myxilla*. And finally Lundbeck follows Thiele and includes in *Myxilla* (type *M. rosacea* Lundbeck) thus diagnosed all forms with isancoræ. In this sense also Topsent now recognizes the genus (type *M. incrustans*), as I know by letter enclosing the draft of his paper: "Sur les Eponges de la Scotia" in which he deals with the question. He recognizes the genus *Myxilla* with the above diagnosis and maintains *Dendoryx* in the following sense: "*Dendoryx*, novo sensu, type *D. irrigularis* (Bow.) Gray, à squelette reticulé et hérissé aux noeuds, avec isochèles."

Thus, the following species, with which I have identified several specimens from station 53, cannot be called ***Dendoryx*** *pectinata*, but ought to be called ***Myxilla*** *pectinata* — were it not for the peculiar form of the isancoræ, which has caused Lundbeck (**17**, p. 153) to suggest, that it may perhaps be an *Iotrochata* without *birotula*. It is difficult to decide this question in the present state of our knowledge, and I therefore consider it most convenient, pending further investigations, to place it under the genus *Myxilla*:

Myxilla pectinata (Topsent) n. var.

(*Dendoryx pectinata* Topsent olim).

Pl. II fig. 2.

Vide litter: **34**, p. 100. **41**, p. 172.

St. 53. Several specimens.

From this station there are several nut-shaped sponges, about 2—3 cm. in diameter, covering usually the whole inside of musselshells. They have a rather soft consistency — very like small lumps of mud. In spirit the colour is yellowish-grey; but to judge from some spots of the skin still left on the rubbed surface, it was most probably in the living state darker in colour.

Spiculation. Megasclera. The *styli* forming the reticulation of the main skeleton are curved, robust, 1.036 mm. long and 0.026—0.037 mm. thick (near the base), and smooth (occasionally isolated spines are faintly to be observed). The *tylota* forming the dermal skeleton have well marked heads, and are 0.740 mm. long by 0.015 mm. thick. Microslera: The isancoræ have a doubly curved shaft with the characteristic spoon-like ends, the margin of which is set with pointed teeth, forming a half-circlet shaped comb. I have not been able to count 10 teeth, as in the typical *pectinata*, but only 7 or 8. They appear as two distinct kinds without transitional forms. The larger ones, few in number, are 0.081—0.111 mm. long by 0.0074 mm. thick, the smaller ones 0.030—0.037 mm. long. In the larger ancoræ narrow but rather long alæ are to be observed, much like those in *Myxilla diversiancorata* Lundb. (fig. 27 pl. XV), but not seen in Topsent's figure (pl. X, fig. 6 c, **34**).

Remark: Wether *Dendoryx pectinata* Tops. olim, as above mentioned, turns out to be a *Myxilla*, or, as

Lundbeck suggests, may pehaps be an *Iotrochata*, it is at any rate closely allied to the pluridentate species of *Myxilla*, like *M. diversianorata* Lundb., *M. pluridentata* Lundb., *Stelodoryx procera* Tops. (**41**, p. 175) and *Dendoryx dentata* Tops. (p. 172) — the two last mentioned belonging to *Myxilla* according to Lundbeck (**17**, p. 150). The smoothness of the styli (like those in *Stelodoryx procera* Tops.), and the larger proportions of the spicula, have made me hesitate in referring the specimens in hand to *pectinata*, on the other hand the ancoræ agree so well with the ancoræ peculiar to this form — even if the teeth are fewer in number, and the size is the same as in *D. dentata* (0.080 mm. instead of 0.060 mm., and 0.030 —0.036 instead of 0.020 mm.) — that I think the "Michael Sars" material must represent a variety of *M. pectinata*. Both are from the same locality, the Azores group, but the "Michael Sars" material comes from deeper water (2615 —2865 m.) than the form from the "Hirondelle" and "Princesse Alice" (845—1495), "repandue dans tout l'archipel des Açores".

Locality. Between Gran Canaria and Cape Bojador. (Lat. 34° 59′ N. long, 33° 1′ W.); depth 2615—2865 m. Globigerina ooze.

Lissodendoryx complicata Arm. Hansen.

Vide litter: **17**, p. 166.

(Pl. II, fig. 1).

St. 102. 2 specimens.

For external appearance the specimens in hand agree nearly absolutely with Lundbecks figures, (pl. V, fig. 11 op. cit.). Both are bush-shaped, with compressed anastomosing branches arising from a narrow base—no stalk, nor attachment has been observed. One specimen is 4 cm. high by about 5 × 5 cm. in the other dimensions; the other is 6 cm. high by about 5 × 4 cm.

The spiculation agrees well with the description and figures of Lundbeck (pl. XVI, fig. 4 a—g op. cit.). Though noticed, the large sigmata were found very sparsely in the internal parts and none in the dermal membrane, where only arcuate chelæ and small sigmata were abundant.

Geographical distribution. Leaving out of consideration the undoubtedly erraneous temperature (+ 6°.5 C.) given by Armauer Hansen (**10**). *Lissodendoryx complicata* Arm. Hansen is an inhabitant of the cold area, having been recorded from the following localities:—

Locality	Depth	Temperature	Number of specimens	Litterature
(Stat. 84?). (Probably confounded with stat. 87 according to Lundbeck (**17** p. 166) Lat. 64° 2′ N. long, 5° 35′ E.	911 m. (clay)	(+6°,5 C)?÷1°,1 C.	2	Norw. North Atlant-Exp. III, Spong. 1885, p. 7—8, p. 12.
Baffin Bay. Lat. 68° 08′ N. long 58° 17′ W.	169 fath = 309 m.		1	"Vega" Exp. Vetensk. Iakt. VI, 1887, p. 460.
North of Farøe and South of Jan Mayn:				
(St. 141) Lat. 63° 22′ N. long, 6° 58′ W	679 fath = 1242 m.	÷ 0°,6 C.	14	Danish Ingolf-Exp.. vol. VI, Part. 2, 1905, p. 168.
(St. 143) Lat. 62° 58′ N. long, 7° 09′ W.	388 fath = 710 m.	÷ 0°,4 C.		
Lat. 70° 32′ N. long, 8° 10′ W	470 fath = 860 m.			(East Greenland-Exp. 1891—92) (Vide: Ingolf-Exp. 1905).
	Between: 309—1242 m.	÷ 0°,4 C—÷1°,1 C.	Total 18	

Locality: The "Michael Sars" specimens are from the Farøe-Channel. (Lat. 60° 57′ N, long, 4° 38′ W). 1098 m. Blue mud.

Dendoricella abyssi (Topsent) Lundbeck *var nov.*

Syn: *Desmacidon abyssi* Topsent **41**, p. 204.

(Pl. II, fig. 4).

St. 10. One specimen.

A grey clubshaped sponge of rather firm consistency, 3.5 cm. long and 2.3 cm. broad by 1 cm. thick, somewhat restricted at the base so as to form a short stalk-like attachment fixed to a stone. One rather large osculum, 5 mm. in diameter, has a somewhat folded margin at the summit. Perhaps there were more oscula, but as the upper part of the sponge is somewhat damaged, this cannot be determined. The surface is shaggy and has a

reticulated appearance owing to the close-set grooves separated by narrow ridges—most like that of *Dendoricella rhopalum* Lundb. (**17**, p. 127, pl. IV, fig. 4 & 5).

Skeleton. The dermal membrane of the ridges is supported by more or less erect or horizontal fan-like brushes of tornota, with their free ends projecting beyond the surface. The membrane of the grooves has only isochelæ. The choanosome consists of dendritic and anastomosing polyspicular strands of oxea. The outermost ramifications bend towards the surface at more or less acute angles.

Spiculation: The spicules of the ectosome are tornota, often verging upon oxea, about 9.925 mm. long and 0.018 mm. thick and usually straight.

The spicules of the chanosome are straight or usually slightly and evenly curved oxea, generally of equal thickness through-out their length. They are usually 1.5 mm. in length and 0.037 mm. in thickness. The Microsclera, exceedingly abundant in the dermal membrane, but also usually present in the choanosome, are *isochelæ arcuatæ* with a strongly curved shaft, somewhat laterally compressed and with tooth-like alæ, which are of about the same length as the rather short tooth resting on an oblong little tubercle. The length varies from 0.045 mm. to 0.063 mm. and the thickness of the shaft is about 0.0037 mm., seen from the front. Several developmental forms were observed.

The specimen above described shows a striking resemblance to *Desmacidon abyssi* Topsent = *Dendoricella abyssi* (Topsent) Lundbeck (**41**, p. 204) but in many respects also to *Dendoricella rhopalium* Lundbeck (**17**, p. 127)—both inter se closely allied deepsea-forms, but from rather different localities, the one *(D. abyssi)* having been recorded (5 specimens) from the Azores (4020—5005 m.) and the other *(D. rhopalium)* from Denmark-strait and Davis-strait (20 specimens; depth 2076—2625 m.). The "Michael Sars" specimen is from a locality intermediate between those mentioned although belonging to the same area as *D. abyssi.* I therefore think it must be referred to *Dendoricella abyssi* (Tops.) Lundb.—if not to the typical form, at least to a variety.

Locality: The "Michael Sars" specimen was obtained at the southern entrance of the Bay of Biscay (45° 26′ N, 9° 20′ W), 4700 m. Globigerina ooze.

Grayella fallax (Topsent).
Syn: *Yvesia fallax.* Topsent **34**, p. 106.
(Pl. II, fig. 3).

St. 37. One specimen.

In external appearance the specimen in hand does not much resemble the type figured by Topsent (op cit. pl. VI, fig. 13), being 14 cm. long and about 7 cm. in breadth with erect conical lobes diverging from a somewhat narrow base, while the type-specimen is a little massive sponge, "sans papilles, ni pedicelle, 8 mm. cubes de volume". The colour in spirit is yellowish. The surface is minutely granular, and the dermal membrane rather pellucid and easily detached (for large parts of it have been rubbed off).

The spiculation agrees better with that of *Grayella (Yvesia) fallax* Topsent than with that of any other species of the genus.

Spiculation: The smooth, straight tornota forming the main skeleton, are 0.266 mm. long with a thickness of 0.006 mm. The spined, curved styli of the dermal membrane varying from 0.111—0.185 mm. (thickness 0.006) are somewhat longer than in the type. The isochelæ of the same shape as those figured by Topsent op. cit. pl. X, fig. 14 c., are 0.016 mm. long.

Geographical distribution. *Grayella (Yvesia) fallax* Topsent has been recorded by the "Hirondelle" from the Azores (st. 226—between Pico and Fayal), depth 130 m. on a bottom of "gravier, sable et coquilles brisées".

The "Michael Sars" specimen was taken between Gran Canaria and Cape Bojador (lat. 26° 6′ N, long 14° 33′ W); depth 39 m.; on a bottom with shingle, at a temperature of 15.63° C.

Echinoclathria Carter.
Vide litter: **6**, p. 204, **21**, p. 159.
Echinoclathria hjorti sp. n.
Pl. II, fig. 5 & pl. V, fig. 3.

St. 37. One specimen.

A digitate sponge with flat branches anastomosing in one plane, thus assuming the outline of a fan about 28 cm. high and 20 cm. in the broadest part. The texture is rather tough and parchment'ike. The surface forms a reticulation of very fine meshes, 0.5—1 mm. in diameter. The trabeculae between the meshes have their edges turned outward making the surface minutely uneven. The dermal membrane (mostly rubbed off) is thin and opalescent. The colour of the interior of the sponge is pale dirty yellow. Oscula scattered.

Skeleton consists of a rather close reticulation of strongly developed horny fibres cored and echinated by robust smooth styli.

Spiculation. The megasclera are: 1) robust smooth styli, straight or somewhat curved, sharply or gradually pointed, often with a slight restriction above the base, varying in length from 0.185 to 0.444 mm., with a thickness of 0.030 mm. near the base. Generally the

larger ones are in the fibres, while the smaller ones project from the fibres and are scattered between them. 2) Fusiform tylostyli, smooth, straight or somewhat curved, with a round markedly constricted head and sharply pointed, usually varying in length from 0.111—0.148 mm, with a thickness of 0.0037—0.0148; they are scattered and not exceedingly abundant. 3) Very slender, smooth *subtylostyli* or *tylostyli*, with an oval not markedly constricted head and not always sharply pointed. They vary much in size, 0.185—0.407 mm., and are scattered throughout the sponge. In the dermal membrane they are the only megascleres present and form there a dense felt, in which the spicules are arranged parallelly to the surface. Single, very thick strongyl-tornote spicules, apparently abnormalities, have also been observed. The microsclera are small *palmate isochelæ*, 0.0222 mm. long, not very abundant, but scattered all over the sponge. There have also been observed in abundance smooth, not much curved, toxa, ordinarily with the opening of the curvature about 0.166 mm.; at first I thought they belonged to a foreign sponge, (there being many foreign bodies and spicules present), but they are so regularly distributed throughout the whole sponge, that I must believe they belong to it.

Exept the presence of the toxa this sponge in all other respects corresponds perfectly well with the genus *Echinoclathria* Carter. I therefore provisionally at least refer it hereto leaving to a closer examination of this genus, the diagnosis of which only is a prelimary one (Ridley and Dendy op. cit., p. 160), to decide whether the toxa really belong to it or not.

The species to which it makes the nearest approach are undoubtedly *Ech. carteri* R. & D and *Ech. favus* Carter. But as the specific diagnoses of these two species are indefinite, and they may according to Ridley and Dendy ultimately prove to be connected with intermediate forms, I think it most convenient provisionally at least to regard the "Michael Sars" species as distinct especially on account of the different habitats—the earlier known species being from the south coast of Australia, while the "Michael Sars" material is from the north-atlantic coast of Africa. Both agree in having been recorded from rather shallow water—the „Challenger"-material being from within a bathymetrical range of 30—120 meters and that of "Michael Sars" from 37 meter depth.

Locality: Between Gran Canaria and Cape Bojador (Lat. 26° 6′ N, long 14° 33′ W); depth 39 metres; bottom shingle; temperature 15.63 C.

Anchinoë Gray.

Syn: *Stylistichon* Topsent.
Vide litter: **34**, p. 111.

In the letter from Mr. Topsent previously mentioned he remarks that in a paper about to be published: „*Sur les Èponges des Mers du Nord prises par le Prince de Monaco*", he now regards his genus Stylistichon, established in 1892, as a synonym of Gray's genus Anchinoë; in this genus he includes Ridley and Dendy's species of Myxilla, which have a skeleton composed of fibres with echinating spicules. Accordingly the species under consideration, with which I have identified one specimen from station 37, must be called *Anchinoë nobilis* (Ridley and Dendy).

Anchinoë nobilis (Ridley and Dendy).

Syn: *Myxilla nobilis* Ridley and Dendy (**21**, p. 140).
Pl. II, fig. 6.

St. 37. One specimen.

Sponge erect, of a somewhat flattened oval shape with conical digitate processes. Base of insertion not very broad. Texture rather tough. Colour in spirit mouse-grey. Surface uneven, but not hispid. The dermal membrane is translucent, thin, and may easily be peeled of. The most remarkable feature of the surface are the densely placed circular or oval areas, 1—2 mm. in diameter, bounded by a distinct, minutely granular ring. They are pore-areas, in some of which the openings of the subdermal cavities are to be seen with the naked eye. Oscula are small and scattered, their margin flush with the surface, or a little sunken.

Skeleton. The dermal skeleton consists of strongyla arranged in penicillate, erect or somewhat recumbent, bundles supporting the dermal membrane. They are especially localised round the poreareas, where they form a dense palissade bending over the subdermal cavities, here projecting above the surface with their distal ends and forming the minutely granular rings previously mentioned. The spaces of the membrane between the pore-areas have usually only isancoræ and a very few isolated horizontal strongyla.

Spiculation. 1) Acanthostyli verging upon acanthotylostyli, straight or usually slightly curved, 0.59 mm. long and 0.019 mm. thick, gradually tapering towards the apex. The sharp spines are not very close-set except at the base. 2) Smaller acanthostyli, verging upon tylostyli, 0,222 mm. long and 0.007—0.015 mm. thick, usually straight and gradually tapering towards the apex. They are covered by long and sharp closely set spines, especially at the base. 3) Strongyla, smooth usually straight, 0.407 mm. long and 0.0074 mm. thick. They are, all very uniform typical strongyla, except that occasionally they show a tendency towards an abrupt truncation with a faint spinulation at the one end, as in *Myxilla nobilis* R. & D, (fig. 14 & fig. 15, pl. XXVII, p. 140 op. cit). Microsclera are isancoræ spatuliferæ with 3 teeth and a rather curved shaft, 0.044 mm. long and 0.0074 mm. thick.

Remark: The differences in the proportion of the spicules, the presence of typical strongyla (generally not with spinulation at one end as in Ridley and Dendy's *M. nobilis*), and the stronger spinulation in the larger acanthostyli (in Ridley and Dendy's *M. nobilis* restricted to the base) make it most probable, that this is not the typical form of *Anchinoë (Myxilla) nobilis*, but rather a variety of it, connecting this species still closer to the allied *Myxilla (olim.) paupertas (Bow.)* Vosm., especially to the variety from the Azores (Topsent **41**, p. 168).

This is supported by the difference in habitat of the two species: *Anchinoë (Myxilla) nobilis* with its varieties from the Challenger Expedition having been recorded from the western part of the southern Atlantic (Rio de la Plata, 600 fms., and coast of Patagonia), while *Myxilla paupertas* is from the European side of the Atlantic.

Locality: Between Gran Canaria and Cape Bojador (Lat. 26° 6′ N, long 14° 33′ W); depth 39 m.; bottom shingle.

Axinella polypoides O. Schmidt.

Vide litter: **22**, p. 62.
Pl. IV, fig. 1.

St. 37. One specimen.

Sponge ramose, about 28 cm. high, devided into two main branches, from which secondary branches dichotomise, usually in one plane from the inside of the two main branches. The base of the stem is about 2 cm. in diameter, and the branches about 1 cm. The transverse section of the branches is oblong or nearly triangular. Towards the end they are more cylindrical and terminate conically. Colour in spirit brownish. The consistency is very firm owing to the strong axis of spicules. The cortical layer is rather thick and tough, but peels of readily. The dermal membrane has been rubbed off, mere patches being left. Fine pores are spread all over the surface, and at intervals larger, serially arranged, flat stellate depressions (oscula) are to bee seen (though not very distinctly on account of the bad condition of the specimen).

Skeleton: The axis is very firm, consisting of densely interwoven fusiform oxea, straight, or regularly bent in the middle, 0.3700—0.4010 mm. long, with a diameter varying from 0.0185 to 0.296 mm. The choanosome consists of oxea, of the same kind as in the axis, and of styli of about the same size (ordinarily 0.4010 mm. by 0.0185 mm.); styli ar also to be found in the axis.

Geographical distribution: This species has been recorded from Lesina, usually in deep water, off the coasts of England and Florida (**23**, p. 80) and off the Mediterranean coast of France.

Locality: Off Cape Bajador (Lat. 26° 6′ N. long 14° 33′ W); depth 39 m.; bottom shingle; bottom temperature 15.63° C.

Thrinacophora Ridley.

Vide litter: **21**, p. 193.

Thrinacophora murrayi sp. n.

Pl. IV fig. 2 & pl. V, fig. 5.

St. 37. One specimen.

Sponge erect, dichotomously branching in one plane, thus having a fan-like outline. Height about 18 cm., diameter of the stem about 15 mm. and of the flattened branches 15—5 mm. Colour in spirit greyish yellow. Texture tough, but flexible. Dermal membrane distinct (mostly abraded). Pores rather small. Oscula seem to be serially arranged, but are difficult to distinguish, the specimen not being in good condition.

Skeleton. The skeleton consists of a thick central axis formed by a dense reticulation of strong fusiform oxea and occasionally of styli cemented together by a horny material, which gives the sponge its firm and elastic character. The axis is coated by a comparatively thin choanosome, which readily peels off. The choanosome consists of a looser irregular reticulation of styli and oxea like those in the axis. From the mesh-edges the spicules project beyond the surface in small brushes. The long setiform spicules forming the axis of the brushes in *Thr. cervicornis* Ridley & Dendy have not been observed. The dermal membrane contains only trichodragmata and isolated long, slender styli.

Spiculation. Megasclera are straight or curved fusiform oxea varying from 0.2960—0.4076 mm. in length with a thickness of 0.0185 mm.; they occur especially in the axis, but are also abundant in the coating. The styli, especially abundant in the choanosome seem to be of two sizes, the slender, smaller ones being 0.2730 mm. long and 0.005 mm. thick, and the larger ones 0.5920 mm. long and 0.0185 mm. thick. They may be straight, but are usually more or less irregularly curved. Microsclera include only trichodragmata, about 0.040 mm. long and 0.010 mm. broad.

It is impossible to identify this form with any one of the earlier known species: *Thr. cervicornis* Ridley & Dendy *Thr. funiformis* Ridley & Dendy and *Thr. spinosa* H. V. Wilson (**45**, p. 400) *[Thr. spissa* Topsent has been removed to *Rhaphisia spissa* Topsent (**41**, p. 233)—and *Thr incrustans* Kieschn. is a doubtful species (**33**, p. 935)]. But it seems to be nearly related to the two first mentioned inter se closely allied forms.

Locality. The specimen was obtained between Gran Canaria and Cape Bojador (Lat. 26° 6′ N. long 14° 33′ W), 39 metres on shingle; temperature 15.63° C. It is thus the first known Thrinacophora from the Eastern Atlantic (*Thr. funiformis* having been recorded from off the coast of Brazil (Bahia), 7—20 fathoms, *Thr. cervicornis* from off the Philippine Islands, 18 fathoms, and *Thr. spinosa* Wilson from off Costa Rica).

Ciocalypta weltneri sp. n.
Pl. II, fig. 7 & pl. V, fig. 1.

St. 37. 3 specimens in spirit, 2 dried.

There is little doubt that the specimens preserved in alcohol and those in the dried state, in spite of slight divergences to be mentioned later, belong to the same species.

They have all a circular or oval cushion-like base, from which fingerlike, cavernous or hollow processes stand upwards, in external appearance thus resembling *C. pennicillus* Bwhk. (**4** vol. III, pl. XIII, fig. 2—4) and *C. tyleri* Bwbk. (**4**, pl. IV, fig. 9—12). The dried specimens, much abraded and the fingers pressed down into the cushion, are very like *C. tyleri*, which also is figured in the dried state. Those in alcohol having retained their dermal membrane show a more even surface, though minutely granular. The dried specimens measure at the base respectively 8 cm. × 7 cm. and 8 cm. × 4 cm.; and they are both about 2—3 cm. in height. The spirit specimens are all about 4 cm. × 4 cm. with a height of 2—3 cm. The fingerlike processes are 2—5 cm. in lenght and 0.4—1 cm. in breath (in the middle). They show a tendency to coaslesce; in one of the spirit specimens with especially broad fingers, two of them have coalesced throughout their whole length. The surface is rough to the touch and the consistency rather tough, with large subdermal cavities (the dried specimens are friable).

Skeleton. The skeleton of the basal cushion consists of a confused and dense reticulation of strong vertically running fibres, connected with horizontally ill-defined secondary fibres or isolated spicules. This structure continues upwards into the fingers, where strong reticulated strands run up in the centre or in the walls. From these strands dense tufts of spicules diverge at right or somewhat acute angles towards and into the dermal membrane. The dermal membrane is further provided with a dense, rather regular network of spicules of the same kind as in the main skeleton. In the dried specimens, where only patches of the membrane are left, the network has not been observed, but only isolated spicules.

Spicules: The main form of spicules both in the outer and central parts are fusiform oxea, usually bent and evenly pointed, but sometimes with the one end less tapering than the other. Length 0.800—1.400 mm. by 0.037—0.055 mm. in thickness. Intermingled with the oxea are styli or subtylostyli, about 0.700 mm. long by 0.037 mm. thick, and occasionally thick strongyla, measuring 0.300—0.800 mm. by 0.037—0.055.

Remark. There can hardly be any doubt that the above described sponges belong to the genus Ciocalypta Bwbk., but it has not been possible to identify them with any described species. As already mentioned, they have a close resemblance to *C. pennicillus* Bwbk. and *C. tyleri* Bwbk., but having both styli (subtylostyli) and oxea, they can not be referred to either of them. This form is the only one, except the British *pennicillus*, recorded from the eastern Atlantic. The others having been recorded from off the mouth of Rio de la Plata, the Philippines Islands (**21**, p. 174—175) and the Australian coast (**33**, p. 74—76, **7**, p. 240, **4**, p. 21).

Locality. Between Gran Canaria and Cape Bojador (Lat. 26° 6′ N, long 14° 33′ W). Depth 39 m. Bottom shingle. Temperature 15.63° C.

Table I.

Distribution of the Sponges collected by the "Michael Sars" 1910 with details of capture.

Locality, date	Gear, depth etc.	Name of species	Order	Specimens obtained
St. 10 Bay of Biscay 45° 26′ N., 9° 20′ W. 19—21 april	Trawl Depth 4700 m. Globigerina ooze Temp. 2° 56 at 4500 m.	*Hyalonema sp.?*	Hex.	2 fragments
		Malacosaccus floricomatus Tops.	„	1
		Chonelasma sp.?	„	1
		Dendoricella abyssi (Tops.) Lundb.	Mon.	1
St. 23 Spanish Bay 35° 32′ N., 7° 7′ W. 5—6 may	Trawl Depth 1215 m. Temp. 10° 17 at 1200 m.	*Pheronema grayi* Sav. Kent	Hex.	2
		Hyalonema infundibulum (?) Topsent	„	2 and 1 fragm.
		Regadrella phoenix O. Schmidt	„	7 and several basal cups
		Aphrocallistes beatrix Gray forma *bocagei* P. Wright	„	Several
		Chondrocladia michaël sarsi sp. n.	Mon.	1 and fragments
		Petrosia friabilis Topsent	„	1 fragment
		Stelletta hispida Buccish	Tetr.	1
		Thenea muricata Bow	„	3 fragments
		Characella pachastrelloides	„	1
		Isops pachydermata Sollas	„	1
		Sidonops sp. (?)	„	1
St. 24 Spanish Bay 35° 34′ N., 7° 35′ W. 6—7 may	Trawl Depth 1615 m. Temp. 8° 0 at 1575 m.	*Pheronema grayi* Sav. Kent	Hex.	20—30
		Tethyopsilla zetlandica Carter	Tetr.	2
		Sidonops sp.?	„	2
St. 25 Spanish Bay 35° 36′ N. 8° 25′ W. 7 may	Trawl Depth 2300 m. Globigerina ooze Temp. 5° 27 at 2000 m.	*Euplectella suberea* Wyv. Thomson	Hex.	About 25 fragments
St. 35 Canaries—Bojador 27° 27′ N., 14° 52′ W. 18—19 may	Trawl Depth 2603 m. Globigerina ooze	*Hyalonema sp.*	Hex.	1 basal tuft.
		Chondrocladia michaël sarsi n. sp.	Mon.	1 and several fragments
St. 37 Off C. Bojador 26° 6′ N., 14° 33′ 20 may	Trawl Depth 39 m. Shingle Temp. 15° 63	*Echinoclathria hjorti n. sp.*	Mon.	1
		Grayella fallax Topsent	„	1
		Axinella polypoides O. Schmidt	„	1
		Ciocalypta weltneri n. sp.	„	5
		Trinacophora murrayi n. sp.	„	1
		Stylotella columella (Bow) Topsent	„	2
		Stylotella topsenti n. sp.	„	1
		Anchinoë nobilis Ridley & Dendy	„	1
St. 41 Canaries—Bojador 28° 8′ N., 13° 29′ W. 23 may	Trawl Depth 1365 m. Globigerina ooze	*Chondrocladia michaël sarsi n. sp.*	Mon.	Several fragments
		Pheronema grayi Sav. Kent	Hex.	2
St. 53 S. W. of Azores 34° 59′ N., 33° 1′ W. 8—9 june	Trawl Dept 2615—2865 m. Globigerina ooze Temp. 4° 50 at 1600 m.	*Hyalonema sp.?*	Hex.	2 fragments
		Myxilla pectinata Topsent	Mon.	Several
St. 102 N. of W. Thomson-Ridge 60° 57′ N., 4° 48′ W. 9—10 august	Trawl Depth 1098 m. Blue mud	*Grantia intermedia* Thacker	Calc.	2
		Asconema setubalense Sav. Kent	Hex.	1
		Cladorhiza gelida Lundbeck	Mon.	Several fragments
		Asbestopluma pennatula O. Schmidt	„	1
		Lissodendoryx complicata Arm. Hansen	„	2
Unknown locality		*Pheronema grayi* Sav. Kent	Hex.	11

Table II.

Bathymetrical distribution of the sponge-species collected by the "Michael Sars".

Figures in brackets denote number of localities.

Depth (metres)	Number of species belonging to the				
	Calcarea	Hexactinellidæ	Tetractinellidæ	Monaxonidæ	Total
0—100	..	..	..	8 (1)	8 (1)
101 500	..	..	..	..	..
501—1000	..	..	..	..	..
1001—1500	1 (1)	5 (3)	5 (1)	5 (3)	16 (8)
1501—2000	.	1 (1)	2 (1)	..	2 (2)
2001—2500	..	1 (1)	..	..	1 (1)
2501—3000	..	1 (2)	..	1 (1)	2 (3)
3001 3500	..	..	..	..	..
3501—4000	..	..	..	..	..
4001—4500	..	..	..	..	..
4501 5000	..	2 (1)	..	1 (1)	3 (2)

Literature.

1. Agassiz, Alexander: Three cruises of the Blake. Vol. II. Bull. Mus. Comp. Zool. Harward Coll. Cambridge. Vol. XV. Cambridge, Mass. 1888.
2. Arnesen, Emily: Spongien von der Norwegischen Küste. Bergens Museums aarb. nr. I—II. 1903.
3. Bocage, Barb. du: Sponges silicienses nouvelles du Portugal et de l'île St. Yago (Arch. de Cap-Verde). Jornal de Sciencias Math. Phys. e Nat publicado sob os anspios de Academia Real. das sciensias de Lisboa p. 159. 1869.
4. Bowerbank, I. S.: A Monograph of the British Spongiadae. Vols. I—IV. London. Ray. Soc. 1864, 1866, 1874, 1882.
5. Carter, H. I.: Descriptions and figures of Deepsea-Sponges and their spicules from the Atlantic Ocean, dredged on board H.M.S. Porcupine. Ann. Mag. Nat. Hist. (IV). Vol. 18. London. 1876.
6. Carter, H. I.: Catalogue of marine sponges collected by Mr. Jos. Willcox on the West Coast of Florida. Proc. Acad. Nat. Sci. Vol. I, pag. 202. Philadelphia. 1884.
7. Dendy, Arthur: Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson Esq. M. A. in the Neigbourhood of Port Philips Head. Part III. Proc. Roy. Soc. Victoria. Vol. IX. (New series). Melbourne. 1897.
8. Filhol, H.: La vie au fond des mers. Paris. 1885.
9. Fristedt, K.: Sponges from the Atlantic and Arctic oceans and the Behring sea. "Vega" Exp. Vetensk. Iaktt. Bd. 4. Stockholm. 1887.
10. Hansen, Armauer. Den norske Nordhavsexp. 1876—1878. Zoologi. Bd. III. Spongiadae. Christiania. 1888.
11. Ijima, I.: Studies on the Hexactinellida. Contribution I (Euplectellidae), Journ. Sci. Coll., vol. 15. Tokyo. 1901.
12. Kent, W. Saville: Notice on a new vitreous Sponge, Pheronema (Holtenia) Gray. Ann. Mag. Nat. Hist. (IV). Vol. 6, p. 182 London. 1870.

12 a. Kent, W. Saville: On the Hexactinnelidæ etc. Monthly micr. Journ. nov 1870.

13. Lambe, L. M.: Sponges from the Atlantic Coast of Canada. Proc. and Trans. Roy. Soc. Canada. Ser. 2, vol. II, sect. IV, p. 181. 1896.
14. Lendenfeld, R. von: Descriptive catalogue of the Sponges in the Australian Museum, Sydney. The Australian Museum. London. 1888.
15. Lendenfeld, R. von: Tetraxonia. Das Tierreich (herausgeg. F. E. Schulze). Lief. 19. Porifera. Berlin. 1903.
16. Lundbeck, W.: Porifera. Homorhaphidae and Heterorhaphidae. The Danish Ingolf-Expedition. Vol. VI. Part 1. Copenhagen 1902.
18. Lundbeck, W.: The Danish Ingolf-Expedition. Vol. VI. Part 2. Desmacidonidae (Pars). Copenhagen. 1905.
18. Lundbeck, W.: The Danish Ingolf-Expedition. Vol. VI. Part 3. Desmacidonidae (Pars). Copenhagen. 1910.
19. Milne-Edwards: Comptes rendus. T. XCIII, p. 871. 1881.
20. Perrier, Edmond: Les explorations soumarines. Paris 1886.
21. Ridley and Dendy: Report on the Monaxonida. Collected by H. M. S. Challenger during the years 1873—76. The Voyage of H. M. S. Challenger, Zoology. Vol. 20. Part. LIX. London. 1887.
22. Schmidt, Oscar: Die Spongien des Adriatischen Meeres. Leipzig. 1862.
23. Schmidt, Oscar: Grundzüge einer Spongien Fauna des Atlantischen Gebietes. Leipzig 1870.
24. Schmidt, Oscar: Spongien der Nordsee-Expedition 1872. Jahrenb. d. Commiss. zur wiss, Untersuch der deutsch. Meere in Kiel für die Jahre 1872–73. II und III Jahrg. S. 115—120. Berlin 1875.
25. Schmidt, Oscar: Die Spongien des Meerbusens von Mexico und des caraibischen Meeres. Jena 1880.
26. Schulze, F. E.: Report on the *Hexactinellida*. Collected by H. M. S. Challenger during the years 1873—76. The voyage of H. M. S. Challenger Zoology. Vol. 21, part LIII. London. 1887.
27. Schulze, F. E.: Revision des Systems der Hyalonematiden. Sitzungsber. K. Preuss. Akad. Wiss. phys. math. Classe. Bd. XXX, s. 541—589. Berlin. 1893.
28. Schulze, F. E.: Hexactinelliden des Indischen Oceanes II Theil. Die *Hexasterophora*. Abhandhl. K. Preuss. Akad. der Wiss. Berlin 1895.
29. Schulze, F. E.: Amerikanische Hexactinelliden nach dem Materiale der Albatross Expedition. Jena. 1899.
30. Schulze, F. E.: *Hexactinellida*. Wiss. Ergebn. Deutsch. Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898—1899 (herausg. von Carl Chun). IV Bd. Jena 1904.
31. Sollas, W. J.: Report on the *Tetractinellida*. Collected by H. M. S. Challenger during the years 1873—1876. The voyage of H. M. S. Challenger, Zoology. Vol. 25, part. LXIII. London. 1888.
32. Thacker, A. G.: On collections of the Cape Verde Island Fauna made by Cyril Crosland. M. A. [Cantab.] etc. Proc. Zool. Soc. London. II 1908.
33. Thiele, I.: Kieselschwämme von Ternate II in: Kükenthal. Ergebnisse einer zoolog. Forschungsreise in den Molukken und Borneo. Abhandl. d. Senkenberg. Naturf. Gesellsch. Bd. XXV. Heft 4. S. 934–969. Taf. XXVIII. Frankfurt a. M. 1903.

33 a. Thomson, Wyw.: Voyage of the Challenger, The Atlantic, vol I. 1877.

34. Topsent, Emile: Contribution à l'étude des Spongiaires de l'Atlantic Nord. Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier, Prince souverain de Monaso fasc. II. Monaco 1892.

34 a. Topsent, Emile: Essai sur la faune des Spongiaires de Roscoff. Arch. de Zool. exp. et gén. (II) vol. 9, p. 523. 1891.

35. TOPSENT, EMILE: Une réforme dans la classification de *Halichondrina*, Mém. Soc. Zool. de France, T. 7, p. 5—26. Paris. 1894.
36. TOPSENT, EMILE: Etude monographique des Spongiaires de France: I. *Tetractinellida*. Arch. de Zool. exp. et gén. (III). T. 2, p. 259—400. Pl. XI—XVI. Paris. 1894.
37. TOPSENT, EMILE: Eponges, Resultats scientifiques de la Campagne du „Caudan" dans le golf de Gascogne, août septembre 1895 fasc. II, p. 273—296, pl. VIII. Ann. de l'Université de Lyon. 1896.
38. TOPSENT, EMILE: Materiaux pour servir à l'étude de la Faune des Spongiaires de France. Mém. Soc. Zool. de France. T. 9, p. 113—133. Paris. 1896.
39. TOPSENT, EMILE: Eponges nouvelles des Açores (deuxième série), Mém. Soc. Zool. de France. T. 14, p. 448—466. Paris. 1901.
40. TOPSENT, EMILE: *Spongiaires*. Expedition antarctique belge, Résultats du voyage du S. Y. Belgica en 1897, 1898, 1899. Zoologie. R. 4. Anvers 1901.
41. TOPSENT, EMILE: Résultats des Campagnes scientifiques accomplies sur son yacht par Albert Ier Prince Souverain de Monaco. Fasci XXV. Spongiaires des Açores. Monaco 1904.
42. TOPSENT, EMILE: Étude sur quelques Cladorhiza et sur Euchelipluma pristina n. g. et n. sp. Bull. de l'Institut Oceanogr. Nr. 151. 1er sept. Monaco. 1909.
43. TOPSENT, EMILE: Sur les affinités des Halichondria et la classification des Halichondrines d'après leurs formes larvaires. Arch. de Zool. exp. et gén. 1910. Tome VII. Notes et revues Nr. 1, p. I à XV. (Extrait). Paris. 1911.
44. VOSMAR, G. C. J.: Report on the Sponges dredged up in the Arctic Sea by "William Barents" in the years 1878—1879. Niederland. Archiv für Zoologie. Supplementband. I. Leyden. 1882.
45. WILSON, H. W.: The Sponges collected in Porto rico in 1899. Bull. U. S. Fish. Comm. Voll. XX, part 2, 1900.

Postscript.

As the publication of my paper has been so unduly postponed and interrupted an explanation is necessary: The manuscript was sent to the press in the spring 1914. I received the first proof at the end of 1915 and had hoped to have the paper published in the beginning of 1916. But the great fire in Bergen in January 1916, which caused the destruction of the printing works, made this impossible. Later the difficulties of war have prevented it from being printed before now. I have accordingly not been able to take into consideration the literature published after the beginning of 1914.

Kristiania, September 1918.

Emily Arnesen.

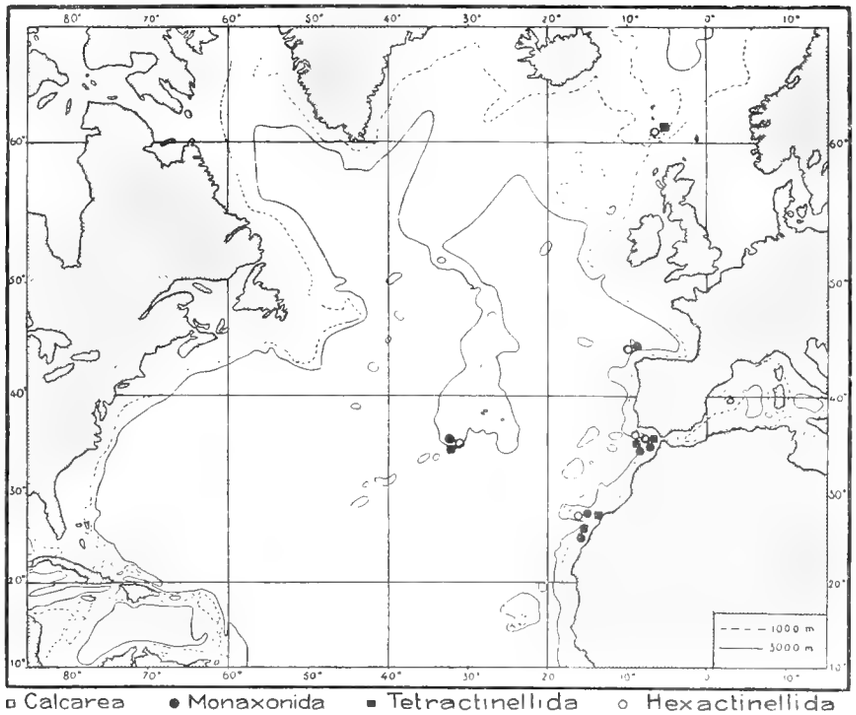


Chart 1. Stations where sponges were obtained by the "Michael Sars".

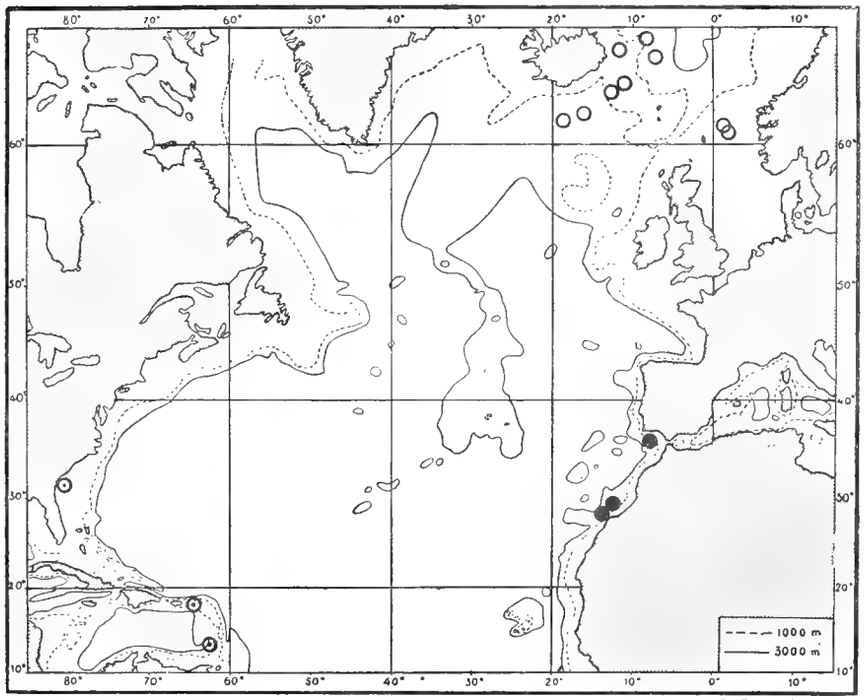


Chart 2. Distribution of Chondrocladia.

PLATES

Plate I.

Hexactinellida.

Fig. 1. Euplectella suberea, Wyv. Thomson. (1/2 nat. size)
„ 2. Malacosaccus floricomatus, Topsent. —„—
„ 3. Regadrella phœnix, O. Schmidt. —„ -
„ 4. Asconema setubalense, Sav. Kent. —„—
„ 5. Chonelasma sp.? —„ —
„ 6. Aphrocallistes beatrix, Gray, form. bocagei P.Wright —„ -
„ 7. Hyalonema sp.? —„—
„ 8. Hyalonema infundibulum, Topsent. —„—
„ 9. Pheronema grayi, Sav. Kent. —„ —

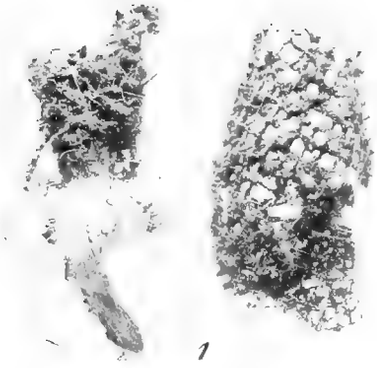
3

4

2

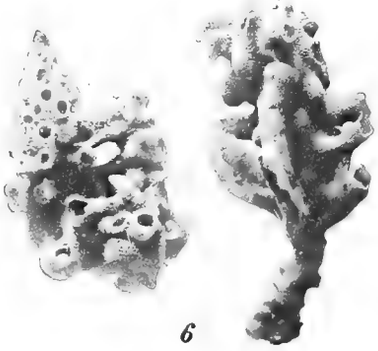
7

5



1

9



6

8

Arnesen phot.

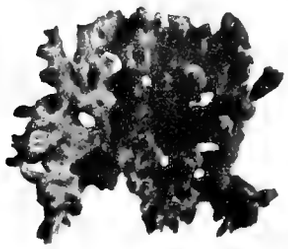
Plate II.

Calcarea.

Fig. 1. Grantia intermedia, Thacker. (× 3).

Monaxonida.

Fig. 1. Lissodendoryx complicata, Arm. Hansen. (1/2 nat. size)
„ 2. Myxilla pectinata, (Topsent). —„—
„ 3. Grayella fallax, Topsent. —.—
„ 4. Dendoricella abyssi (Topsent) Lundbeck. —„—
„ 5. *Echinoclathria hjorti sp. n.* —„—
„ 6. Anchinoë nobilis, Redley and Dendy. —„—
„ 7. *Ciocalypta weltneri sp. n.*
a. alcohol. b. dried.



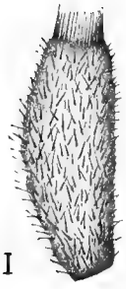
1

2

3

4

5



I

b

6

7

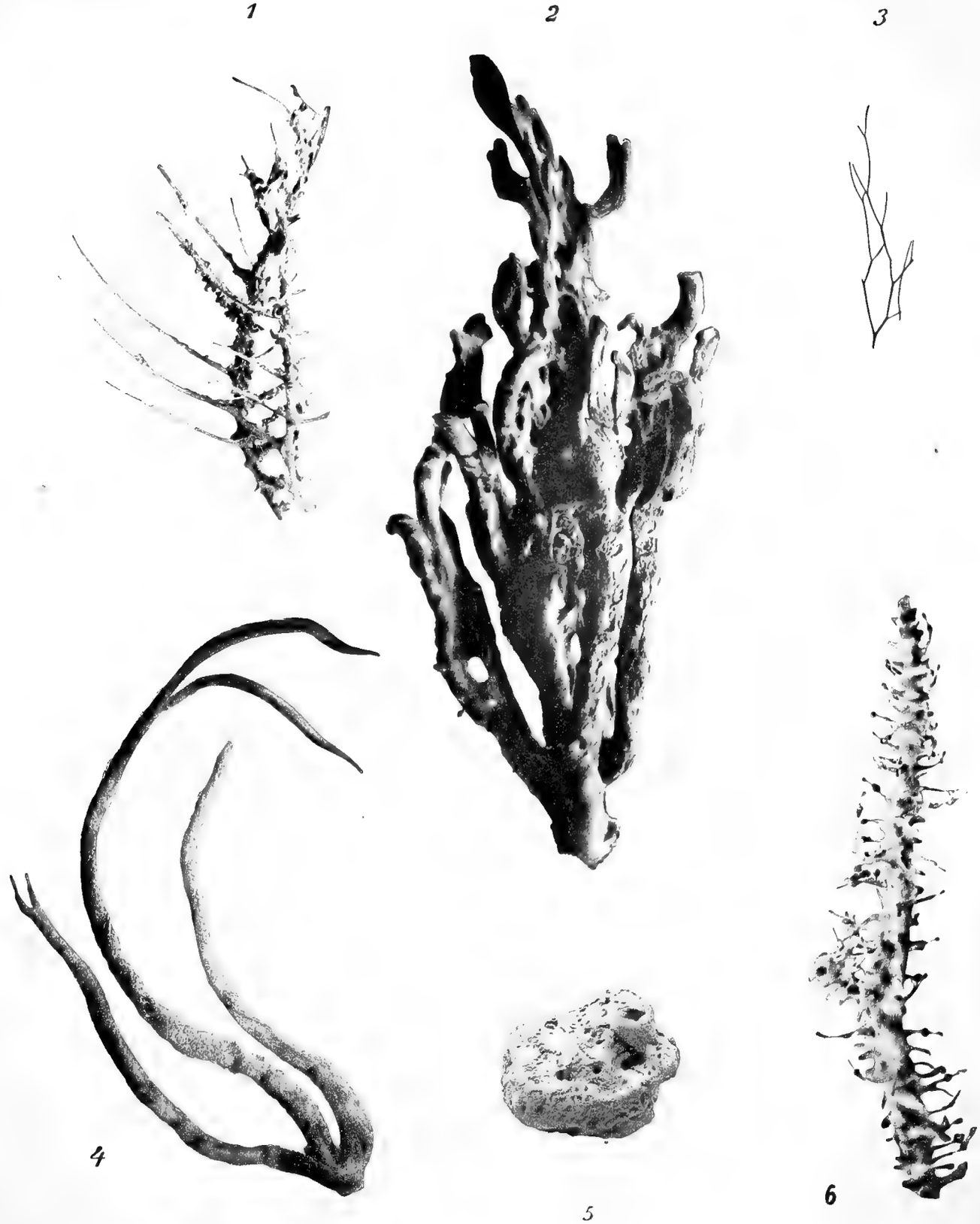
a

Arnesen phot.

Plate III.

Monaxonida.

Fig. 1. Cladorhiza gelida, Lundbeck. (1/2 nat. size)
„ 2. Stylotella columella, (Bow.) Topsent. —„—
„ 3. Asbestopluma pennatula, O. Schmidt. —„—
„ 4. *Stylotella topsenti sp. n.* (1/3 nat. size)
„ 5. Petrosia friabilis, Topsent. (1/2 nat. size)
„ 6. *Chondrocladia Michaël Sarsi, sp. n.* —„—



Arnesen phot.

Plate IV.

Monaxonida.

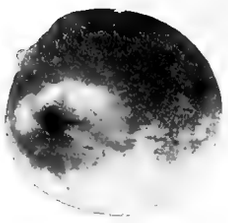
Fig. 1. Axinella polypoides, O. Schmidt. (1/2 nat. size).
„ 2. *Thrinacophora murrayi sp. n.*

Tetraxonia.

Fig. 3. Isops pachydermata, Sollas & Sidonops sp.? (1/2 nat. size)
„ 4. Characella pachastrelloides (Carter) Sollas. —„—
„ 5. Sidonops sp.?
„ 6. Thetyopsilla zetlandica (Carter). —„—
„ 7. Isops sp.? —„—
„ 8. Stelleta hispida, Bucc. —„—

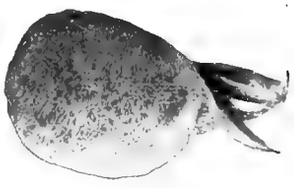
1

4



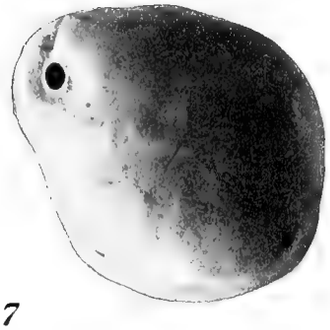
5

3



6

2



7

8

Arnesen phot.

Plate V.

Fig. 1. *Ciocalypta weltneri sp. n.* a. oxea × 230, b. subtylostyle × 230; c. style × 230.
„ 2. *Chondrocladia Michael Sarsi sp. n.* a. style × 95; b. granular style from the stalk coating × 375; c. isancora agnifera with 6 teeth, side view × 375; d. sigmata with compressed ends × 275.
„ 3. *Echinoclathria hjorti sp. n.* a. robust style × 375; b. tylostyli from the dermal membrane × 375; c. fusiform tylostyle × 375; d. strongyle-tornote spiculum × 375; f. toxe × 375.
„ 4. *Stylotella topsenti sp. n.* styli × 230.
„ 5. *Thrinacophora murrayi sp. n.* a. oxea × 230; b. styli × 230; c. trichodragmata × 375.

Bergh del.

BRACHIOPODA, SCAPHOPODA, GASTROPODA

AND

LAMELLIBRANCHIATA

FROM THE

„MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

JAMES A. GRIEG

ONE PLATE

During the cruise of the "Michael Sars" in the North Atlantic in 1910 only two species of Brachiopoda were taken, both within the limits of distribution previously known.

Of the Mollusca collected during the expedition the Cephalopoda have been dealt with by professor dr. CHUN and the Pteropoda by professor dr. BONNEVIE.

The present paper deals with the Lamellibranchiata (12 species), Scaphopoda (6 species) and Gastropoda (39 species), in all 57 species. Three of these are pelagic: *Janthina communis*, *Scyllæa pelagica* and *Fiona marina*. The other species belong to the bottom-fauna.

One species, *Pholadomya fragilis*, is new to science. New to the fauna of Europe are *Arca profundicola* and *Mytilimeria flexuosa*. The former hitherto known only, from the coast of North America, the latter also from the deep water to the west of the African coasts. In this connection may also be mentioned *Hero formosa* not hitherto known from Irish waters, and *Cassidaria echinophora* taken off the entrance to the Straits of Gibraltar previously authentically known only from the Mediterranean.

The largest, and incomparably most interesting, part of the collection of Mollusca was obtained from the great depths on the eastern side of the North Atlantic. From lesser depths on that side eleven species were taken at three stations off Ireland (st. 1, 3 and 96), one species, *Cassidaria echinophora,* from the entrance to Gibraltar Strait (st. 20), and one species, *Cymbium proboscidale*, from a station off the west coast of Africa (st. 37).

On the western side of the North Atlantic eight species were taken at two stations (70 and 72) SE of Newfoundland, the first mentioned (70, with seven species, including the one being new to science) situated in very deep water.

The "Michael Sars" also took a haul with the otter-trawl in the cold area of the Faroe-Shetland Channel (st. 102), obtaining six species, all of them characteristic of the depths of the Norwegian Sea.

During the years 1868—70 the "Lightning" and the "Porcupine" explored the seas off the western coasts of Europe, from the Faroes and Shetlands to the Mediterranean. The collections were dealt with by JEFFREYS,[1]) who showed that the depths of the Atlantic are inhabited by many species of Mollusca known also from the fiords of Norway and from the banks dividing the Atlantic from the Norwegian Sea. Among such species may be mentioned:—

Pecten vitreus	*Limopsis minuta*
Lima excavata	*Lyonsiella abyssicola*
Lima sarsi	*Torellia vestita*
Malletia obtusa	*Troschelia berniciensis*, etc.

He also showed that certain species are characteristic of the atlantic depths, many of them living both in the northern part of the North Atlantic, off the British Isles, and in the southern part, off the Spanish and Portuguese coasts, viz.

Amusium lucidum	*Limopsis aurita*
Leda pustulosa	*Dentalium capillosum*
Leda insculpta	*Calliostoma suturale*, etc.
Malletia cuneata	

Some of these are also found in the great depths of the Mediterranean, but as the "Michael Sars" did not investigate that sea, I need make no further allusion thereto. The "Challenger" Expedition showed that many of the species common to the North Atlantic and the Norwegian Sea occur also near the Azores, and several of them even still farther south (cfr. EDGAR A. SMITH: Report on the Lamellibranchiata[2]) and R. BOOG WATSON: Report on the Scaphopoda and Gastropoda.[3])

During the years 1880—83 the french expeditions of the "Travailleur" and the "Talisman" explored the Bay of Biscay and the waters south of it, as far as Senegal, the Cape Verde Isles and the Sargasso Sea. In 1895 the Bay of Biscay was explored by the "Caudan". Since 1887

---

[1]) "On the Mollusca procured during the "Lightning" and "Porcupine" Expeditions 1868—70" in the Proceedings of the Zoological Society of London; part 2 in the volume for 1879, p. 553; part 3, 1881, p. 693; part 4, 1881, p. 922; part 5, 1882, p. 656; part 6, 1883, p. 83; part 7, 1884, p. 111; part 8, 1884, p. 341; part 9, 1885, p. 27.

[2]) Report Sci. Res. "Challenger", Zool., vol, 13, 1885.

[3]) Idem, vol. 15, 1886.

the Prince of Monaco with the "Hirondelle" and the "Princesse Alice" has explored the waters round the Azores and off the west coast of North Africa. The collections of mollusca obtained by the French expeditions were investigated by LOCARD[1]), the collections of the Prince of Monaco by DAUTZENBERG, partly alone,[2]) partly in collaboration with H. FISCHER.[3]) In this review no reference has been made to the nudibranciate Gastropoda, the species taken by the "Michael Sars" in the Atlantic being either pelagic or belonging to moderate depths.

It appears from the papers of LOCARD, DAUTZENBERG and H. FISCHER that several Mollusca occurring in the great depths off the west coast of North Africa and around the Canary Islands and the Azores are also met with in deep water in the Bay of Biscay, e. g.

Modiola polita — *Trophonopsis grimaldi*
Dentalium caudani — *Buccinum atractodeum*
Neptunea abyssorum — *Pleurotomella bairdi,* etc.

The "Michael Sars" collection of Mollusca does not contain a very great number of species, still it increases the number of species common to both the northern and southern part of the eastern North Atlantic. In the Bay of Biscay (st. 10) were taken:—

Pleurotomella thaumastopsis
Bathybela nudator
Surcula tenerrima

the two first named being previously known from the Azores only, the third from the Azores and from the Sargasso Sea. Off Ireland (st. 95) were taken *Pleurotomella bairdi,* not previously known to the north of the Bay of Biscay, and *Clionella quadruplex,* known from the Azores and the west coast of Africa. Off the Hebrides (st. 101) were taken *Mytilimeria flexuosa,* known only from this side of the Atlantic, from the west coast of North Africa, and *Dentalium caudani,* not previously recorded to the north of Bay of Biscay.

Comparing the results of the various expeditions referred to it appears that many species are known only from the northern part of the northeastern Atlantic, and a still larger number only from the southern portion, where most of the expeditions carried on their biological researches. For instance the genus *Marginella,* which includes many deep-sea forms, is not known from the northern part, though it may be assumed with certainty that the number of widely distributed species will be increased as research work goes on. Even now so many forms common to both divisions of the northeastern Atlantic are known, that as regards the mollusca, we may be justified in regarding the deep water of the northeastern Atlantic as one faunistic region, a rather natural assumption when seeing that the hydrographical conditions are very uniform. There is also a marked similarity between the western and eastern sides of the North Atlantic, though not so close as between the north and south divisions of the eastern side, many of the species characteristic of the eastern side being unknown on the American side. This is the case with *Troschelia berniciensis,* a widely distributed form in the eastern Atlantic.

Very different from the North Atlantic molluscan fauna is that of the cold area of the Norwegian Sea. Illustrative in this respect is one of the stations of the "Michael Sars", viz. st. 102, where the following species were obtained:

Neptunea curta — *Bela scalaris*
Neptunea mohni — *Philine finmarchica*
Buccinum hydrophanum — *Cuthonella abyssicola.*

Of these the second and the lastnamed are characteristic cold-water forms, known only from the depths of the Norwegian Sea, while the other four species extend more or less into the warmer areas encircling the deep basin of that sea. Among mollusca also living in the cold area of the Norwegian Sea may be mentioned: —

Pecten frigidus — *Neptunea danielsenii*
Arca frielei — *Odostomia sublustris*
Natica bathybii

All these species are unknown from the depths of the Atlantic, and the species characteristic of the latter region are not met with in the Norwegian Sea, though exceptions occur. The "Triton", for instance, took *Troschelia berniciensis* in the cold area of the Faroe—Shetland Channel,[1]) and the, "Armauer Hansen" *Lyonsiella abyssicola* and *Scaphander puncto-striatus* in the cold area off the Tampen Bank[2]). Several southern warm-water species were also taken in the cold area of the Norwegian Sea by the Norwegian North Atlantic Expedition.[3]) These Atlantic mollusca, however, are also found on the banks around the Norwegian Sea basin, and the cold water stations where they were obtained are all situated so near to the warm area that the hydrographical conditions vary

[1]) LOCARD: Mollusques testacés et Brachiopodes, Resultats scientif. Camp. "Caudan", Fasc. 1, 1896.
— Mollusques testacés, Exp. Sc. du "Travailleur" et du "Talisman", Tome 1, 1897, Tome 2, 1898.

[2]) DAUTZENBERG: Contrib. Faune Malacol. des Iles Açores. Res Camp. Sc. par Albert I Monaco, Fasc. 1, 1889.

[3]) DAUTZENBERG et H. FISCHER: Mollusques prov. des dragages effectués à l'ouest de l'Afrique. Ibidem Fasc. 32, 1906.

[1]) JEFFREYS: Mollusca procured during the Cruise of H. M. S. Triton between the Hebrides and Faroes in 1882. Proc. Zool. Soc. Lond. 1883, p. 389.

[2]) GRIEG: Evertebratfaunaen paa havdypet utenfor "Tampen", Bergens Museums Aarbok 1914—15. no. 3.

[3]) FRIELE & GRIEG: Mollusca III, Norw. N. Atl. Exp. 1876—78. Zool. part 28, 1901.

from year to year and from season to season. Similarly genuine arctic species may be found in the frontier-zone between the warm and cold areas.

At station 102 two specimens of *Cuthonella abyssicola* were taken, the one in the trawl from a depth of 1098 metres, the second in a large plankton townet with 1500 metres of wire out. The actual depth at which a plankton-net is towed during a horizontal haul is commonly calculated at one-half of the length of wire out, which in the present case works out at about 750 metres; this would seem to indicate that one of the specimens of *Cuthonella abyssicola* had been caught about 350 metres above the bottom, but this conclusion is inadmissible, as all other evidence goes to establish *Cuthonella abyssicola* as a bottom species, the other specimen, like all those previously recorded, having been obtained from the bottom. If, on the other hand, the depth is calculated as two-thirds to three-fourths of the length of wire paid out, the net in question at st. 102 may have skimmed along the bottom, and this would account for the capture of bottom forms, for, in addition to *Cuthonella abyssicola*, the net brought up three specimens of *Nymphon grossipes* Bell[1]) and one of *Boreonymphon robustum* Bell[2]), which are well-marked bottom animals.

[1]) ØRJAN OLSEN, Pycnogonida, Rep. Sci. Res. Michael Sars North Atlantic Deep Sea Exp. 1910, vol 3, part 1, 1913, p. 6.

[2]) On this *Boreonymphon robustum* were attached two young specimens of *Scalpellum angustum* G. O. Sars, one on the abdomen, the other on the ventral side of the femur of the third left leg. The largest specimen measured 45 mm. in length. This species is not mentioned in Hoek's report on the Cirripedia from the "Michael Sars" Expedition (Rep. vol 3, part 1).

At st. 70, depth 1100 m., only plankton-nets were used. The lowermost appliance, a young-fish trawl was towed with 1700 metres of wire out. When hauled up it contained numerous bottom invertebrates, mollusca, echinodermata, annelids etc. Here the actual depth was two-thirds of the length of wire out. This conclusion agrees with what was observed during the cruise of the "Armauer Hansen" in may 1914. At stat 4, Lat. 62° 15′ N., Long. 0° 15′ E, a sounding immediately before lowering the plankton-gear gave a depth of 830 metres, a second sounding after hauling in the gear, 770 metres. The lowermost appliance, a fry-net, was towed with 1200 metres of wire paid out, and was found to be filled with mud, sand, stones and different bottom animals (cfr. the paper by the present author, cited on p. 4). In this case the actual depth works out at about two-thirds of the length of wire out. At station 3, Lat. 62° 10′ N, Long. 0° 8′ E, the lowermost appliance with 2000 metres of wire out came up with mud and bottom animals. No sounding was taken at this station, but 20 miles in one direction the depth was 1743 m., and 20 miles in the opposite direction 1060 metres. The depth may accordingly be computed at about 1400 metres (cfr. Jørgensen: Sternoptychidae (Argyropelecus and Sternoptyx)[1]).

[1]) Rep. Danish Oceanogr. Exp. 1908—10 to Mediterranean and Adjacent Seas, vol. 2, Biol. A 2, 1915, p. 4.

BRACHIOPODA

Terebratulina septentrionalis, Couthony.

Terebratulina septentrionalis, Couthony, Boston Journ. Nat. Hist. vol. 2 1838, p. 65, tab. 3, fig. 18.

30/6 st. 70, lat. 42° 59′ N, long. 51° 15′ W, 1100 m. Temp. 3°7 C. Some larger and smaller specimens, the largest 25 mm. long and 22 mm. broad.

Crania anomala, O. F. Müller.

Patelia anomala, O. F. Müller, Prodr. Zool. Dan. 1776, p. 237.

8/6, st. 53, lat. 34° 59′ N, long. 33° 1′ W, 2615—2865 m. yellow, hard, clayey mud. Five specimens attached to valves of *Limopsis aurita.*

MOLLUSCA

LAMELLIBRANCHIATA

Ostrea virginica, Gmelin.

Ostrea virginica, Gmelin, Syst. Nat. ed. 13, 1790, 3336.

27/7, st. 95, lat. 50° 22′ N, long. 11° 44′ W, 1797 m. One upper valve, probably thrown overboard from a steamboat.

Pecten vitreus, Chemnitz.

Pallium vitreum, Chemnitz, Conch. Cab. vol. 7, 1782, p. 335, tab. 67, fig. 637 a.

6/8, st. 24, lat. 35° 34′ N, long. 7° 35′ W, 1615 m., yellow mud, temp. 8° C. Two specimens belonging to the variety *abyssorum,* Lovén. Measurements of the largest specimen: alt. 10 mm., lat. 9 mm.

30/6, st. 70, lat. 42° 59′ N, long. 51° 15′ W, 1100 m., temp. 3°7 C. Six specimens belonging to the typical form. Alt. 11.5—19 mm., lat. 10.5—18 mm.

Modiola polita, Verrill & Smith.

Modiola polita, Verrill, Amer. Journ. Sci. ser 3, vol. 20, 1880, p. 392 & 400.

5/5, st. 21, lat. 35° 31′ N, long. 6° 35′ W, 535 m., yellow sand, temp. 11°52 C. Two specimens measuring:

	Alt.	Lat.	Crass.
No. 1.	44.5 mm.	24.5 mm.	3.5 mm.
No. 2	42.5 „	23 „	?[1])

Modiola polita was for the first time described from the coast of New England, depth 436 metres. Later on it was found by the "Blake" in the Mexican Gulf and in the West Indies. Its bathymetrical range in the Western Atlantic is according to Dall 203—1830 metres. In the Eastern Atlantic *Modiola polita* was first met with in 1880 by the "Travailleur" in the Bay of Biscay, 677 to 1353 metres, where it was also found by the "Caudan" in 80—1200 metres. The "Talisman" has taken it off the west coast of North Africa, in depths between 540 and 930 metres. In the Mediterranean the "Travailleur" dredged it off Spain in 322 metres, and Monterosato found it near Palermo.

Limopsis minuta, Philippi.

Pectunculus minutus, Philippi, Enum. Moll. Sic. vol. 1, 1836, p. 63, tab. 5, fig. 3.

30/6, st. 70, lat. 42° 59′ N., long. 51° 15′ W. 1100 m., temp. 3°7 C. One quite young specimen, alt. 4.5 mm. lat. 5 mm.

Limopsis aurita, Brocchi.

Arca aurita, Brocchi, Conch. foss. Subappennina, vol. 2, 1815, p. 485, tab. 11, fig. 6.

8/6, st. 53, lat. 34° 59′ N., long. 33° 1′ W., 2615—2865 m., yellow, hard clayey mud. Three living specimens and several empty valves. The largest living specimen measured: alt. 16.5 mm., lat. 14 mm., crass. 7 mm. One of the empty shells had a height of 20 mm. and a breadth of 15.5 mm.

Limopsis aurita is one of the most widespread bivalves in the North Atlantic. On the American side it occurs from New Jersey to the West-Indies, in the Eastern Atlantic from the Faroes to west coast of North Africa and the Azores. Further it has been observed in the

[1]) One valve damaged.

Mediterranean, and according to JEFFREYS in Japan[1]). DALL mentions it from Norway[2]), though this seems to be a misstatement for the preceding species. G. O. SARS, FRIELE, SPARRE SCHNEIDER, NORDGAARD, JEFFREYS and NORMAN mention only *Limopsis minuta* from the Norwegian coast, and the specimens of *Limopsis* I have had the opportunity of examining from the west and north coasts of Norway belong exclusivily to that species. The bathymetrical range of *Limopsis aurita* is between 38 and 3175 m.

Malletia cuneata, Jeffreys.

Solenella cuneata, JEFFREYS, Rep. Brit. Ass. 1873, p. 112.

8/6, st. 53, lat. 34° 59′ N., long. 33° 1′ W., 2615—2865 m., yellow hard clayey mud. One valve (left): alt. 9 mm., lat. 6 mm.

Arca profundicola, Verrill & Smith.

Arca profundicola, VERRILL, Trans. Conn. Acad. vol. 6, 1884, p. 439, tab. 44, fig. 23.

8/6, st. 53, lat. 34° 59′ N., long. 33° 1′ W., 2615—2865 m., yellow, hard clayey mud. One specimen measuring: alt. 4 mm., lat. 8 mm., crass. 2 mm. The type specimen measured 7, 12 and 5 mm. respectively. Our specimen conforms with the type in form and structure, but has a whitish yellow epidermis, the coating being dark-brown in the type specimen.

This species is closely related to *Arca pectunculoides,* and is, perhaps, only a deep-sea variety of it. Having however in my possession only a single specimen, which differs from the *Arca pectunculoides* occurring on the Norwegian coast, I have treated it as a distinct species, as VERRILL, DALL[3]) and KOBELT[4]) have done.

Arca profundicola has not been reported before from the Eastern Atlantic. It is known only from the great depths off New Jersey ("Albatross", st. 2226, lat. 37° 0′ N., long. 71° 54′ W., 3698 m.).

Astarte sulcata, da Costa.

Pectunculus sulcatus, da COSTA, Brit. Conch. 1778, p. 192.

9/4, st. 1, lat. 49° 27′ N., long. 8° 36′ W., 146 m., fine sand, temp. 9°57 C. One quite young specimen, alt. 3.5 mm., lat. 4.2 mm.

Syndesmya longicallus, Scacchi.

Tellina longicallus, SCACCHI, Ann. Civ. Regn. d. due Sic., vol. 4, 1834, p. 79, tab. 1, fig. 7.

[1]) Proc. Zool. Soc. Lond. 1879, p. 585.

[2]) Bull. U. S. Nat. Mus. vol. 37, 1889, p. 42.

[3]) Op. cit. p. 42, tab. 46, fig. 23.

[4]) KOBELT: Die GATTUNG Arca L., Mart. Chemn. Conch. Cab. Bd. 8, Abt. 2, 1891, p. 215, tab. 49, fig. 11.

19/4, st. 10, lat. 45° 16′ N., long. 9° 20′ W., 4700 m., yellow mud, temp. 2°56 C. One well-preserved right valve, alt. 11 mm., lat., 17 mm.

In 1869 the "Procupine" took this species off the Channel in a depth of 4456 metres (st. 37)[1]), this being the greatest depth hitherto recorded for the species, but now superseded by the present record establishing a bathymetrical limit of 4700 m.

Mytilimeria flexuosa, Verrill & Smith.
(Figs. 1—4.)

Mytilimeria flexuosa, VERRILL, AMER. Journ. Sci. ser. 3, vol. 22, 1881, p. 302.

6—7/8, st. 101, lat. 57° 41′ N., long. 11° 48′ W., 1853 m., hard clay. Three specimens and a right valve with an ascidian.

The specimens measure (in milimetres).

	No. 1	No. 2	No. 3
Alt.	50	49	46.5
Lat.	41.5	43.5	48
Crass.	48.5	45	46
Breadth % of height	83	88.8	103.2
Thickness % of height	97	91.8	98.9

These figures reveal the great variations the form of the shell is subject to, and this is still better demonstrated if the above figures are compared with those given by VERRILL and DALL. In VERRILLS type specimen the breadth of the shell is 88 % of the height, the thickness 104 %. In DALL'S specimen both the breadth and the thickness exceed the height viz 115.4 %.

DALL describes and figures minutely the anatomy of this species[2]) In the "Preliminary Cataloque of the shell-bearing marine Mollusks and Brachiopods of the Southeastern Coast of the United States"[3]) he gives furthermore a drawing of the outer surface of a left valve. VERRILL describes both the animal[4]) and the shell, and gives a drawing[5]) of the latter. LOCARD, finally, gives some drawings of a defective shell.[6]) As none of the drawings extant of the shell of this mollusk is altogether satisfactory, I take the opportunity of giving some fresh drawings of it.

Mytilimeria flexuosa was first found off the coast of New England, in 571 m., and was subsequently taken

[1]) Proc. Zool. Soc. Lond. 1881, p. 926.

[2]) Proc. U. S. Nat. Mus. vol. 17, 1894, p. 697, tab. 23, fig. 1, 3. 5 & 6, tab. 24, fig. 3. Cfr. Bull Mus. Comp. Zool. vol 12, 1886, p. 286,

[3]) Bull. U. S. Nat. Mus., no. 37, 1889, tab. 65, fig. 132.

[4]) Transact. Conn. Acad. vol. 6, 1884, p. 258.

[5]) Transact. Conn. Acad. vol. 5, 1882, p. 567, tab. 58, fig. 38. Cfr. VERRILL: Res. Explor. made by the steamer "Albatross" 1883, (1885) p. 575, tab. 30, fig. 132.

[6]) Exp. Sci. "Travailleur" et "Talisman", Mollusques Testacés tome 2, 1898, p. 210 tab. 10, fig. 14—17.

near the same place in depths of 137—1211 m. The "Talisman" in 1883 obtained it at two stations off the west coast of Africa, in 1495—2330 m. In European waters it has not hitherto been observed. Its discovery by the "Michael Sars" off the west coast of Scotland shows that *Mytilimeria flexuosa* must be distributed all over the great depths of the North Atlantic.

Pholadomya fragilis, n. sp.
(figs. 5—7).

30/6 st. 70, lat. 42° 59′ N., long. 51° 15′ W., 1100 m. temp. 3°7 C. One specimen, alt. 17 mm., lat. 18 mm., crass. 12 mm.

Both valves are of the same size and of a subtrigonal, short, arched form. The anterior region short, subtruncate, with the antero-dorsal margin convex. Posterior region about one and a half times the length of the anterior region, somewhat cuneiformly protracted with truncated tip, and the postero-dorsal margin straight. The ventral margin is convex. The umbones elevated and strongly inflected, so that they nearly touch. The shell is white, translucent, extremely thin and fragile. It is finely granulated and shows numerous fine zones of growth, which are most apparent in the truncate anterior region.

Of the genus *Pholadomya* three species are known:

Pholadomya lovéni, Jeffr.[1]) taken by the "Porcupine" to the west of Portugal, 1314 m., and of Spain, 523 m., also in the Mediterranean to the north of Cape Ferro, 2663 m.

French and Italian expeditions have taken it in the western Mediterranean, in 156—2227 m. The "Josephine" obtained it near the Azores in 586—1098 m. Subfossil it is found on the Norwegian west coast, in 100—200 m. As a fossil it has been found in the pliocene strata of Sicily.

Pholadomya africana, P. FISCHER[2]) was taken only by the "Talisman" off the west coast of Morocco in 2083—2324 m.

Pholadomya arata, VERRILL & SMITH[3]) was taken to the south of Martha's Vineyard, U. S. A., in 126—248 m., and Locard records it from the west coast of Africa ("Talisman" 1883, st. 80, 1130 m.).

Of these three species *Pholadomya africana* is the most nearly allied to *Pholadomya fragilis*, from which it differs slightly in form, especially as regards the antero-dorsal margin. A more significant difference is found in the number of longitudinal crests, *Pholadomya fragilis* having 18, the other species only 10—12. This difference cannot be discribed to difference in age, as the type specimen of *Pholadomya africana* is only slightly smaller than that of the other species, measuring: alt. 15 mm., lat. 16, mm. crass. 12 mm. According to LOCARD's drawings *Pholadomya africana* appears to have a somewhat coarser granulation, this feature being visible in *Pholadomya fragilis* only under a high magnification.

Cultellus pellucidus, Pennant.

Solen pellucidus, PENNANT, Brit. Zool., vol. 4, 1812, p. 84, tab. 66, fig. 23.

9/4 st. 1, lat. 49° 27′ N, long. 8° 36′ W, 146 m., fine sand, temp. 9°57 C. Two young specimens, the largest measuring 3.5 mm. in height and 14.5 mm. in breadth.

SCAPHOPODA.

Dentalium ergasticum, P. Fischer.

Dentalium ergasticum, P. FISCHER, Journ. Conch. vol. 20, 1883, p. 275

6/5 st. 24, lat. 35° 34′ N, long 7° 35′ W, yellow mud, temp. 8° C. Six specimens, the three largest measuring in millimetres:

	No. 1	No. 2	No. 3
Length	80	76	71
Breadth at base	8	9	8.5
" - apex	1	1.2	1.5
Length of fissure	11	8.5	8
Number of crests	45	44	50

According to LOCARD it attains a length of 113 mm.

Dentalium ergasticum is closely related to *Dentalium capillosum*, Jeffr. with which species it has been identified, though I fully agree with LOCARD in regarding it as a distinct species.[1]) The most conspicuous difference is that the fissure is very long in *ergasticum* while in the other species it is short and narrow.

D. ergasticum was taken by the "Caudan" in the Bay of Biscay, in depths ranging from 400 to 1700 m. The "Talisman" dredged it in 1139 to 2995 metres at the Azores, where it was also taken by the Prince of Monaco at a depth of 1285 m., and the "Travailleur" and the "Talisman" found it off the west coast of Africa in 1235—2180 m.

[1]) Proc. Zool. Soc. Lond. 1881 p. 934 tab. 10. fig. 7. Cfr. Proc. Zool. Soc. Lond. 1882, p. 686.

[2]) LOCARD in: Exp. Sci. "Travailleur" & "Talisman", Mollusques Test. t. 2. 1898 p. 165, tab. 7, fig. 42—45.

[3]) VERRILL in: Am. Journ. Sci. vol. 22, 1881, p. 301, and in Trans. Connect. Acad. vol. 5, 1882, p. 567, tab. 58, fig. 37, vol. 6, 1884, 278, tab. 30, fig. 4—6. Cfr. LOCARD in Op. cit p. 167, tab. 8, fig. 1- 5.

[1]) LOCARD: Mollusques Test. et Brachiopodes, Res. Sci. Camp. "Caudan", Fasc 1. 1896 p. 170, tab. 6, fig. 1. Cfr. Exp. Sci. "Travailleur" et "Talisman", Mollusques Test. tome 2. 1898, p. 108, tab. 6, fig. 9—14.

Dentalium capillosum, Jeffreys.

Dentalium capillosum, JEFFREYS, Ann. Mag. Nat. Hist. nr. 4, vol. 19, 1877, p. 153.

$^{23}/_{5}$, st. 41, lat. 28° 8′ N., long. 13° 35′ W., 1365 m., yellow mud. Two specimens, 61 and 44.5 mm. long respectively.

D. capillosum was discovered by the "Valorous" in Davis Strait in 1263—3267 m. In 1869 the "Porcupine" obtained it off the Hebrides in 992 m. and off the mouth of the Channel in 1577 m., and in 1870 off Portugal in depths between 403 and 2004 m.; the "Challenger" took it near Portugal in 860 m., at the Azores in 1830 m., and at Culebra Island in 714 m. The "Talisman" obtained it in the Bay of Biscay in 1190—2651 m., the Prince of Monaco near the Azores, and POURTALÉS at Bahia Honda in the Mexican Gulf, in 765 m.

Dentalium caudani, Locard.

Dentalium caudani, LOCARD, Res. Sci. Camp. "Caudan", Fasc. 1, 1896, p. 171, pl. 6, fig. 2.

^{6}—$^{7}/_{8}$, st. 101, lat. 57° 41′ N., long. 11° 48′ W., 1853 m., hard clay. Several specimens, the two largest of which measure:

	Nr. 1	Nr. 2
Length	104 mm.	103.5 mm.
Breadth at base	10 „	10.5 „
„ „ tip.....	1.2 „	1.5 „
Length of the fissure	1 „	2 „

LOCARD gives the length as 105 mm.

Our specimens must be referred to the variety *minor,* LOCARD[1]) as only the upper third of the shell is endowed with longitudinal ridges, the rest being smooth. Still it must be noted that this variety according to LOCARD only attains a size of 68 mm.

D. caudani was taken by the "Caudan" in the Bay of Biscay in 1300 m. The Prince of Monaco found it off Portugal in 1500 m., and off the west coast of North Africa in 1550—2330 m. The "Michael Sars" by finding it off the west coast of Scotland showed that *D. caudani* is distributed all over the great depths of the eastern North Atlantic from off Senegal to the Faroe—Shetland Channel.

Dentalium entale, Linné

Dentalium entalis, LINNÉ, Syst, Nat. ed. 10, 1758, p. 785.

$^{27}/_{7}$, st. 95, lat. 50° 22′ N., long. 11° 44′ W., 1797 m. One shell, empty and somewhat decomposed.

Dentalium occidentale, Stimpson.

Dentalium occidentale, STIMPSON, Shells of New England, 1851, p. 28.

[1]) Op. cit. p. 104, pl. 6, fig. 7.

$^{5}/_{5}$, st. 21, lat. 35° 31′ N., long. 6° 35′ W., 535 m., yellow sand, temp. 11°52 C. Eight specimens, the largest measuring 36 mm. in length.

Dentalium agile, M. Sars.

Dentalium agile, M. SARS, Christiania Vid. Selsk. Forh. 1868, p. 257. G. O. SARS, Remarkable Forms of Animal Life on the Norw. Coast, part 1, 1872, p. 31, pl. 3, fig. 4—15.

$^{6}/_{5}$, st. 24, lat. 35° 34′ N., long. 7° 35′ W.. 1615 m., yellow mud, temp. 8° C. One specimen, length 63 mm.

GASTROPODA.

Calliostoma suturale, Philippi.

Trochus suturalis, PHILIPPI, Enum. Moll. Siciliæ, vol. 1836, p. 185, pl. 10, fig. 23.

^{5} $_{5}$, st. 21, lat. 35° 31′ N., long. 6° 35′ W., 535 m., yellow mud, temp. 11°52 C. Several specimens, the largest of which measures: height 11 mm., largest diameter 11.5 mm.

C. suturale, which is known from the pliocene strata of Sicily, was taken living for the first time in 1869 by the "Porcupine" of the mouth of the Channel in 1327 m. (st. 36). Later on it was taken at a number of points between the Channel and North Africa, including the Mediterranean, in depths between 46 and 2330 metres, by the "Porcupine", the "Hirondelle", the "Travailleur" and the "Talisman".

Ianthina communis, de Lamarck.

Ianthina communis, de LAMARCK, Anim. sans Vert. t. 6, part 2, 1822, p. 206.

$^{7}/_{5}$, st. 25 A, lat. 35° 36′ N., long. 8° 16′ W., surface. Nine specimens, attached to *Velella spirans,* Forskål.

Pilidium radiatum, M. Sars.

Capulus radiatus, M. SARS, Nyt Mag. f. Naturvidsk. vol. 6, 1850, p. 184.

$^{30}/_{6}$, st. 70, lat. 42° 59′ N., long. 51° 25′ W., 1100 m., temp. 3°7 C. One living specimen. Length 15.5 mm., breadth 13 mm., height 5.5 mm. The specimen is not so high, and has a thinner shell than specimens from Northern Norway and from the Arctic regions I have had the opportunity of examining. Furthermore it differs from the typical *P. radiatum* in the total absence of the yellowish or reddish-brown radial bands on the shell.

Living specimens of *P. radiatum* have hitherto not been taken from greater depths than 836 m. (The "Voeringen", st. 164), though an empty shell is reported from a depth of 1187 m. (idem, st. 192).

Rissoa (Actonia) subsoluta, Aradas.

Rissoa subsoluta, ARADAS, Atti Acad. Gioenia, vol. 3, 1847, p. 21.

$^{9}/_{4}$, st. 1, lat. 49° 27′ N., long. 8° 36′ W., 146 m., fine sand, temp. 9°57 C. One specimen.

Eulimella acicula, Philippi.

Melania acicula, PHILIPPI, Enum. Moll. Siciliæ, vol. 1, 1836, p. 158, pl. 9, fig. 6.

$^{9}/_{4}$, st. 1, lat. 49° 27′ N., long. 8° 36′ W., 146 m. fine sand, temp. 9°57 C. One specimen.

Turritella terebra, Linné.

Turbo terebra, LINNÉ, Syst. Nat. ed. 12, 1767, p. 1239.

$^{9}/_{4}$, st. 1, lat. 49° 27′ N., long. 8° 36′ W., 146 m., fine sand, temp. 9°57 C. One specimen, rather young.

Aporrhais occidentalis, Beck.

Rostellaria occidentalis, BECK, Mag. de Zool. 1836, pl. 72.

$^{30}/_{6}$, st. 70, lat. 42° 59′ N., long. 51° 15′ W., 1100 m., temp. 3°7 C. One empty shell measuring 48 mm. in height, the largest diameter being 34.5 m.

A. occidentalis is distinguished from the European species *A. pes-pelicani* by the absence of spiral rigdes, by having larger and more strongly developed longitudinal ridges, and more rounded whorls. It is a West Atlantic species, distributed along the east coast of North America from New England to Labrador. In addition it has been taken on the west coast of Greenland. Its bathymetrical range is 4 to 1830 m.

Troschelia berniciensis, King
(fig. 8).

Fusus berniciensis, KING, Ann. Mag. Nat. Hist., vol. 18, 1846, p. 246.

$^{10}/_{4}$, st. 4, lat. 49° 38′ N., long. 11° 35′ W., 923 m., sand and mud, temp. 9°2C. One empty shell (fig. 8) belonging to the variety *elegans*, JEFFR. *(elongata,* LOCARD). Its height is 125 mm., the largest diameter 41.5 mm.

$^{6}/_{6}$, st. 24, lat. 35° 34′ N., long. 7° 35′ W, 1615 m., yellow mud, temp. 8°C. Three specimens belonging to the variety *carinata,* LOCARD. Height 15—67 mm., largest diameter 8—24 mm.

$^{18}/_{7}$, st. 88, lat. 45° 26′ N., long. 25° 45 W., 3120 m., sand and yellow mud. One very defective shell, height 27 mm.

^{6}—$^{7}/_{8}$, st. 101, lat. 57° 41′ N., long. 11° 48 W., 1853 m., hard clay. Four specimens belonging to the typical form. Height 59—77 mm., largest diameter 22.5—26 mm.

T. berniciensis is an East Atlantic species, distributed southwards to Cape Verde, the Canaries and the Azores. Northwards it is recorded by G. O. SARS[1]) from as far as Hasvik in Finmark. According to DAUTZENBERG and H. FISCHER[2]) the Prince of Monaco has taken it to the north of Spitzbergen, a statement which requires further support as *T. berniciensis* has not hitherto been observed in Spitzbergen waters.[3]) Neither is it known from the cold area of the Norwegian Sea excepting that the „Triton" took it in the cold area of the Faroe—Shetland Channel[4]) in 1882 (st. 8, 1331 m., ÷ 1°1 C.). This station is, however, situated near to the warm area, and in such places a few southern boreal species, the proper home of which is the Atlantic and the banks surrounding the basin of the Norwegian Sea, may be found in company with high-arctic and boreo-arctic animals, as I have shown in „Evertebratfaunaen paa havdypet utenfor Tampen".[5]) *T. berniciensis* is known from depths of 91 to 3120 m., but in a living state it has not been observed deeper than 2165 m.

Neptunea (Sipho) gracilis, da Costa.

Buccinum gracile, da COSTA, Brit. Conch., 1775, p. 124, pl. 6, fig. 5.

$^{27}/_{7}$, st. 95, lat. 50° 22′ N., long. 11° 44′ W., 1797 m. Five specimens and two defective shells. The height of the specimens varied between 14.5 and 54 mm., the largest diameter between 7 and 225 mm.

$^{27}/_{7}$, st. 96, lat. 50° 57′ N., long. 10° 46′ W., 184 m. One specimen of medium size, defective, the lower part broken off.

Sipho gracilis has not previously been recorded from greater depths than 1350 m. (the "Talisman" in 1883, st. 33). In obtaining it at st. 95 the "Michael Sars" extended its bathymetrical range to between 37 and 1797 m.

Neptunea (Sipho) pubescens, Verrill.

Sipho pubescens, VERRILL, Trans. Conn. Acad. vol. 5, 1882, p. 501, pl. 43, fig. 6, pl. 57, fig. 25.

$^{30}/_{6}$, st. 70, lat. 42° 59′ N., long. 51° 15′ W., 1100 m., temp. 3°7 C. Five specimens, of which two quite young and an older one were living. The last named measured, in height 56 mm., in largest diameter 23.5 mm. In the smallest specimen these dimensions were 10 and 5.5 mm. respectively, and in the largest of the two empty shells 70 and 28 mm.

I have had the opportunity of comparing the "Michael Sars" specimens with three specimens of the typical

---

[1]) G. O. SARS: Moll. Reg. Arct. Norvegiæ, 1878, p. 278.

[2]) Res. Camp. Sci. par Albert I, Monaco, Fasc. 37, 1912, p. 59.

[3]) Cfr. KNIPOWITSCH in: Ann. Zool. Acad. Imp. Sci. Petersbourg, vol. 7, 1902, p. 447.

[4]) Proc. Zool. Soc. London 1883, p. 391.

[5]) Bergens Museums Aarbok 1914—15, nr. 3.

Neptunea pubescens from Martha's Vineyard, 366—472 m., which mr. H. FRIELE has obtained from mr. VERRILL. The samples agreed both as to form and sculpture.

N. pubescens is a West Atlantic species distributed from Cape Hateras to the banks south of Newfoundland. Its bathymetrical range lies between 33 and 1239 m., though according to miss KATHERINE I. BUSH in the living state only between 113 and 1171 m.[1])

Neptunea (Sipho) abyssorum, P. Fischer.

Fusus abyssorum, P. FISCHER, Journ. Conch. vol. 31. 1883, p. 391.

$^{19}/_{4}$, st. 10, lat. 45° 26′ N., long. 9° 20′ W., 4700 m., yellow mud, temp. 2°56 C. Two living and three dead specimens, measuring 10—27 mm. in height and 6—15 mm. in largest diameter, besides the uppermost part of the spire of two other specimens, one of which must have been very large.

N. abyssorum is at home in the great depths of the North Atlantic. It is recorded from the Bay of Biscay, the west coast of North Africa, the Azores, the Sargasso Sea and the coast of New England. Its bathymetrical range lies between 1200 and 4789 m.

Neptunea (Sipho) curta, Jeffreys.

Fusus curtus, JEFFREYS, Brit. Conch. vol. 4, 1867, p. 336.

^{9}—$^{10}/_{8}$, st. 102, lat. 60° 57′ N., long. 4° 38′ W., 1098 m., dark sand and clay. Two specimens measuring in height 37 and 34 mm., in largest diameter 14.5 and 15.5 respectively.

I have designated this species according to the view maintained by FRIELE in his monograph of the Buccinidæ from the Norwegian North Atlantic Expedition[2]). The specimens otherwise agree best with *Fusus sabini,* described by JEFFREYS from the collections of the "Triton"[3]). Of that species I have had the opportunity of examining two specimens mr. FRIELE received from mr. JEFFREYS.

Six out of the eleven stations at which the "Vøringen" took *Neptunea curta* belong to the cold area of the Norwegian Sea, the temperature ranging between 0° and ÷ 1°4 C., and the depth from 249 to 1203 m. Of the other five two are situated between Norway and Spitzbergen in depths of 225 and 408 m., temperature + 1°5 and + 1°6 C. and three near the west coast of Spitzbergen, in depths of 110 to 475 m., temperature + 0°7 to + 1°1 C. KNIPOWITSCH also records the species from Spitzbergen, viz. from Storfiord and from Icefiord, with a bottomtemperature between + 2°5 and ÷ 2° C. The "Belgica" in 1905 took it off the east coast of Greenland in 53 to 300 m., temperature between + 0°4 and ÷ 1°79; the "Michael Sars" took it in 1902 off the coast of Romsdal, Norway (st. 7,915 m., ÷ 1°07 C.); and the "Triton" obtained it in the cold area of the Faroe—Shetland Channel (st. 8, 1331 m., ÷ 1°1 C., st. 9,1113 m., ÷ 1°1 C.). All these localities must be regarded as belonging to the cold area of the Norwegian Sea, even if they had, at the time in question, temperatures above the freezing point. The hydrographical conditions are known to be extremely variable in those waters and the bottom temperature may accordingly be found sometimes above, sometimes below, freezing point. Among the other localities where the species has been taken some, — e. g. Franz Joseph's Land, Franz Joseph's Fiord in East Greenland, Novaya Zemlya, the Kara Sea and the Siberian Polar Sea, belong to the "cold area", while to the "warm area" belong the southwestern part of the Barents Sea and most of the habitats along the west coast of Greenland and the east coast of North America, where Cape Cod marks the southern limit of distribution.

Bearing all these facts in mind one may term *Neptunea curta* an arctic species, with its centre of distribution within the cold area, but capable of extending into the boreal regions. Its bathymetrical range lies between 8 and 2582 m., 1203 m. being, however the greatest depth from which it has been taken in a living state.

Neptunea (Mohnia) mohni, Friele.

Fusus mohni, FRIELE, Nyt Mag. f. Naturvidsk. vol. 23, 1877, p. 6.

^{9}—$^{10}/_{8}$, st. 102, lat. 60° 57′ N., long. 4° 38′ W., 1098 m., dark sand and clay. Four living specimens and fragment of fifth one. The largest is 19 mm. in height and 10 mm. in greatest diameter.

This species has also been taken by the "Triton" in the cold area of the Faroe—Shetland Channel (st. 8, 1331 m., temp. ÷ 1°1 C.). It is a pronounced citizen of the deep sea, known only from the cold area of the Norwegian Sea, with 1098 to 2992 m. as the known bathymetrical range, and ÷ 0°74 to ÷ 1°6 as the range of temperature.

Trophonopsis (Trophon) grimaldi, Dautzenberg & H. Fischer.

Trophon grimaldi, DAUTZENBERG & H. FISCHER, Mem. Soc. Zool. France vol. 9, 1896, p. 439 pl. 18, fig. 1—2.

$^{5}/_{5}$, st. 21, lat. 35° 31′ N., long. 6° 35′ W., 535 m., yellow sand, temp. 11°52 C., several specimens, the largest 17.5 mm. high.

$^{5}/_{5}$, st. 23, lat. 35° 32′ N., long. 7° 7′ W., 1215 m., yellow mud, temp. 10°97 C. One younger specimen.

Trophonopsis grimaldi was discovered in the Mediterranean by the "Princesse Alice", in 552—1122 metres

[1]) BULL. Mus. Comp. Zool. vol. 23 nr. 6, 1893, p. 211.

[2]) Norw. N. Atlantic Exp., Mollusca I, 1882, p. 14, pl. 1, fig. 26, pl. 2, fig. 1—11.

[3]) Proc. Zool. Soc. London, 1883, p. 395 pl. 44, fig. 5.

where it was again taken by the "Travailleur" in 555 to 900 m., and also in the Bay of Biscay in 1226 to 1916 m.; it was taken by the "Talisman" off the west coast of Morocco in 1145 m.

Cassidaria echinophora, Linné.

Buccinum echinophorum, LINNÉ, Syst. Nat. ed. 12, 1767, p. 1198.

5/5, st. 20, lat. 35° 25′ N., long. 6° 25′ W., 141 m., fine sand, temp. 12°98 C. One empty shell, 88 mm. high, with a maximum diameter of 48 mm., belonging to the variety *mutica,* Tiberi. Among the drawings of this variety given by KOBELT in his "Iconographie der schalenträgenden europäischen Meeresconchylien" (vol. 2, 1901, p. 68) it corresponds most closely to figs. 2 & 3 in pl. 47.

KOBELT regards *C. echinophora* as a true Mediterranean mollusc, very common in the lesser depths. It was not known outside Gibraltar, until the "Michael Sars" took it immediately outside the Straits.

Cassidaria rugosa, Linné.

Buccinum rugosum, LINNÉ, Mantissa Plantarum, 1771, p. 549.

5/5, st. 21, lat. 35° 31′ N., long. 6° 35′ W., 535 m., yellow sand, temp. 11°52 C. Two empty, somewhat defective shells.

18/7, st. 88, lat. 45° 26′ N., long. 25° 45′ W., 3120 m., sand and yellow mud. A fragment.

Though only a fragment was taken at st. 88 it is from the position of the station probable that *C. rugos* a lives there. If so the bathymetrical range of the species is 80 to 3120 m. The greatest depth from which it was previously recorded is 2105 m. (the "Talisman" in 1885, st. 35).

Buccinum undatum, Linné.

Buccinum undatum, LINNÉ, Syst. Nat., ed. 12, 1767, p. 1204.

30/5, st. 70, lat. 42° 59′ N., long. 51° 15′ W., 1100 m., temp. 3°7 C. One shell, rather worn, 54 mm. high and 24 mm. in greatest diameter.

In addition a round cluster of eggs of a buccinid was taken at st. 70, measuring 33 by 29 by 27 mm., attached to a shell of *Pecten vitreus.* The egg-capsules were oblong, 6—7.5 mm. long and 5—6 mm. broad, with a brim 1—3 mm. broad, and provided with ridges on the upper side. Most of them were empty, and in none of them could embryos be recognised. Hence it is not possible to determine the species with certainty. But I am inclined to believe that they belong to *Buccinum undatum,* as the form, size and appearance of the capsules recalls those of that species (cfr. Dons: Om egglægningen hos enkelte Buccinider).[1])

[1]) Tromsø Museums Aarshefter, nr. 35—36, 1913, p. 16.

Buccinum groenlandicum, Chemnitz.

Buccinum groenlandicum, CHEMNITZ, Conch. Cab. vol. 10, 1788, p. 182, pl. 152, fig. 1448.

1/7, st. 72, lat. 44° 35′ N., long. 51° 15′ W., 75 m., temp. 2°03 C. Ten specimens, the largest one 46 mm. high and 26.5 mm. in greatest diameter.

Buccinum hydrophanum, Hancock.

Buccinum hydrophanum, HANCOCK, Ann. Mag. Nat. Hist. vol. 18, 1846, p. 325, pl. 5, fig. 7.

9—10/8, st. 102, lat. 60° 57′ N., long. 4° 38′ W., 1098 m., dark sand and clay. Three somewhat damaged living specimens.

B. hydrophanum was also taken in the cold area of the Faroe—Shetland Channel, by the "Triton" in 1882 (st. 4, 598—786 m., temp. 0° to ÷ 0°26 C.). The species is circum-polar and known both from the warm and cold area of the Norwegian sea. Its bathymetrical range is 4 to 1187 m.

Buccinum atractodeum, Locard.

Buccinum atractodeum, LOCARD, Contrib. faune malac. francaise, vol. 10, 1887, p. 107.

5/5, st. 21, lat. 35° 31′ N., long. 6° 35′ W., 535 m., yellow sand, temp. 11°52 C. Seven specimens, 59 to 71 mm. high and 33 to 41 mm. in maximum diameter.

I agree with LOCARD[1]) in regarding this species as different from the North European and British *Buccinum humphreysianum,* BENNETT. As to its relation to the Mediterranean *B. monterosatoi,* LOCARD, I am unable to form an opinion, as the latter species is unknown to me. To judge from LOCARD's description, he seems fully justified in looking upon both *B. atractodeum* and *B. monterosatoi* as distinct species.

B. atractodeum is an East Atlantic species distributed from the Bay of Biscay southwards to the west coast of Morocco. It also occurs in the Western Mediterranean. Its bathymetrical range is 435 to 1190 m.

Bela scalaris, Møller.

Defrancia scalaris, MØLLER, Index Moll. Groenl. 1842, p. 12.

9—10/8, st. 102, lat. 60° 57′ N., long. 4° 38′ W., 1098 m., dark sand and clay. One empty shell, 15 mm. long, belonging to the variety *abyssicola,* FRIELE. It agrees with the first of the two specimens of this variety figured by, FRIELE[2]) (pl. 7. fig. 12).

Bela scalaris has been recorded from the cold area of the Faroe—Shetland Channel under the name of

[1]) Exp. Sci. "Travailleur" & "Talisman", Mollusques Testacés, t. 1, 1897, p. 280, pl. 15, fig. 1—3.

[2]) Norw. N. Atlantic Exp., Mollusca II, 1886, p. 6, pl. 7, fig. 12—14.

Pleurotoma scalaroides, var., by JEFFREYS (the "Triton" in 1882, st. 8, 1171 m., ÷ 1°1 C.)[1])

The variety *abyssicola* seems to be a pronounced cold-water form, only exceptionally occurring in the warm area. The "Voeringen" took it at five localities in the cold area of the Norwegian Sea, in depths between 640 and 1203 m., temperature ÷ 0°7 to ÷ 1°3 C. According to DAUTZENBERG and FISCHER[2]) the Prince of Monaco found it in 1898 at two stations in the Norwegian Sea, one of these off Lofoten in 1185 m. belonging to the cold area, while the other station, between Finmark and Bearen Island in 394 m., probably lies within the warm area. The typical *Bela scalaris* on the contrary seems principally to be distributed within the boreal region, though it is also recorded from high arctic waters with bottomtemperatures below freezing point, viz. from Spitzbergen and the Kara Sea. Of the seven stations where the "Voeringen" obtained *Bela scalaris, f. typica,* only one belongs to the cold area, viz: st. 18, 753 m., ÷ 1°0 C.

Pleurotomella bairdi, Verrill & Smith.

Pleurotomella bairdi, VERRILL, Trans. Conn. Acad. vol. 6, 1884, p. 147, pl. 31, fig. 1.

$^{27}/_{7}$, st. 95, lat. 50° 22′ N., long. 11° 44′ W., 1797 m. One empty shell, 17 mm. high and 8 mm. broad. It agrees best with the form described by DAUTZENBERG and H. FISCHER under the name of *Pleurotoma polysarca.*[3]) With good reason they have latter on referred both this species and *Bela abyssorum*, LOCARD, to the species of VERRILL & SMITH.[4])

P. bairdi was discovered in 1883 by the "Albatross" off the east coast of North America, where later on its area of distribution according to DALL has been found to extend between Rhode Island and Delaware in depths of 1728—4064 m.[5]). In the East Atlantic it has been found by the "Travailleur" and the "Talisman" and by the Prince of Monaco in a great many localities between the Bay of Biscay and Cape Verde, and also at the Azores and at the Cape Verde Islands in depths of 454 to 4060 m.

Pleurotomella thaumastopsis, Dautzenberg & H. Fischer.

Pleurotoma thaumastopsis, DAUTZENBERG & H. FISCHER, Mem. Soc. Zool. France, vol. 9, 1896, p. 424, pl. 16, fig. 14.

$^{19}/_{4}$, st. 10, lat. 45°26′ N., long. 9°20′ W., 4700 m., yellow mud, temp. 2°56 C. One empty shell, 11.5 mm. high, 8 mm. broad, height of mouth 9 mm. It is much larger than the type specimen, and has a relatively larger diameter and mouth, but otherwise agrees both in form and sculpture.

P. thaumasotpsis was previously known from the Azores only, from depths of 1165 to 1300 m.

Clionella delicatulina, Locard.

Clionella delicatulina, LOCARD, Exp. Sci. "Travailleur" et "Talisman", Mollusques Testacés tome 1, 1897, p. 222, pl. 10, fig. 9—16.

$^{23}/_{5}$, st. 41, lat. 28°8′ N., long. 13°35′ W., 1365 m. yellow mud. One empty shell, 22 mm. high and 7.5 mm. broad, housing a pagurid. It belongs to the variety *costulata*, LOCARD (op. cit. fig. 15).

C. delicatulina was previously recorded by the "Talisman" from the west coast of Morocco, the Azores, and the sea between the Azores and the Canary Islands in depths of 1180—4060 m.

Clionella quadruplex, Watson.

Pleurotoma (Clionella) quadruplex, WATSON, Journ. Linn. Soc., Zool., vol. 16, 1881, p. 253.

$^{27}/_{7}$, st. 95, lat. 55°22′ N., long. 11°44′ W., 1797 m. One empty shell 33 mm. high, 11.5 mm. broad. In form and sculpture this shell agrees well with *Clionella quadruplex,* judging from the drawings of this species in WATSON's monograph of the Scaphopoda and Gastropoda from the "Challenger" expedition, at though the "Michael Sars" specimen is more worn and damaged.

C. quadruplex is known from the Azores, where it was discovered by the "Challenger", at a depth of 1830 m., and where it was afterwards taken in depths of 800 to 4020 m., as also off the west coast of Africa in depths of 930 to 2165 m. by the "Talisman" and by the Prince of Monaco.

Bathybela nudator, Locard.

Fig. 9—10.

Thesbia nudator, LOCARD, Exp. Sci. "Travailleur" et "Talisman", Mollusques Testacés, tome 1, 1897, p. 218, pl. 10, fig. 5—8.

$^{19}/_{4}$, st. 10, lat. 45° 26′ N., long. 9° 20′ W., 4700 m., yellow mud, temp. 2°56 C. One empty well-preserved shell, 40 mm. high, 19.5 mm. broad, height of mouth 22 mm., breadth of mouth 12 mm. The last whorl is relatively thicker than in the type specimen, the height of which was also 40 mm., but the breadth only 17.5 mm. Otherwise there is agreement in form and sculpture.

As to the nomenclature of this species I have followed KOBELT,[2]) as I am at one with him that it differs so much

[1]) Proc. Zool. Soc. London, 1883, p. 391.

[2]) Res. Camp. Sci. par Albert I, Monaco, Fasc. 37, 1912, p. 42.

[3]) Mem. Soc. Zool. de France, vol. 9, 1896, p. 422, pl. 17, fig. 11—12.

[4]) Res. Camp. Sci. par Albert I, Monaco, Fasc. 32, 1906, p. 15.

[5]) Bull. U. S. Nat. Mus. nr. 37, 1889, p. 104.

[1]) Report Sci. Res. Challenger, Zool., vol. 15, 1886, p. 370, pl. 19, fig 7 a—b.

[2]) Iconogr. scalentr. europ. Meeresconchylien, vol. 3, 1905, p. 276.

from the northern *Thesbia nana,* LOVÉN, that it cannot be referred to the same genus as that species.

B. nudator has hitherto been recorded only from the great depths to the north of the Azores (the "Talisman" 1883, st. 134, 4010—4060 m.).

Surcula tenerrima, P. Fischer, var.
Fig. 11—12.

Surcula tenerrima, P. FISCHER M. S., Locard. Exp. Sci. "Travailleur" et "Talisman", Mollusques Testacés, tome 1, 1897, p. 216, pl. 9, fig. 30—33.

19/4, st. 10, lat. 45° 26′ N., long. 9° 20′ W., 4700 m., yellow mud, temp. 2°56 C. One empty, somewhat eroded shell, 58 mm. high, 20.5 mm. broad, height of mouth with channel 37.5 mm., breadth of mouth 11 mm.

I have referred this shell to LOCARD's *Surcula tenerrima* as it resembles that species both as to form and sculpture though it is larger, LOCARD giving the height of his species as 35 mm. and breadth 12 mm. Furthermore the last whorl is rather more swollen in our specimen, the most significant difference being however that it has more numerous and finer spiral ridges. To judge from LOCARD's drawings some of the spiral ridges are larger and more prominent than the rest in the typical *S. tenerrima.* On the basis of these differences I have entered the "Michael Sars" specimen as a variety of *S. tenerrima,* not deeming them significant enough to found a new species upon them.

Previously *S. tenerrima* was known only from the Sargasso Sea, 3125 m., and from the depths to the north of the Azores in 4010 to 4060 m., where the "Talisman" dredged it together with the preceding species.

Pleurotoma projecticium, Locard.

Pleurotoma projecticium, LOCARD, Exp. Sci. "Travailleur" et "Talisman", Mollusques Testacés, tome 1, 1897, p. 197, pl. 9, fig. 1—6.

23/5, st. 41, lat. 28° 8′ N., long. 13° 35′ W., 1365 m., yellow mud. One specimen 14.5 mm. high, 5.5 mm. broad.

P. projecticium was taken by the „Travailleur" and the "Talisman" off the west coast of Morocco in 1590 to 1910 m., and in the Sargasso sea in 3530 m.

Cymbium proboscidale, de Lamarck.

Voluta proboscidalis, de LAMARCK, Annal. du Mus. vol. 17, 1811, p. 60.

20/5, st. 37, lat. 26° 6′ N., long. 14° 33′ W., 39 m., shingle. One rather large specimen with very damaged shell.

Marginella impudica, P. Fischer.

Marginella impudica, P. FISCHER, Journ. Conch. vol. 31, 1883, p. 392.

5/5, st. 21, lat. 35° 31′ N., long. 6° 35′ W., 535 m., yellow sand, temp. 11°52 C.

One specimen 7.5 mm. high and fragment of another about twice that size.

23/5, st. 41, lat. 28° 8′ N., long. 13° 35′ W., 1365 m., yellow mud. Four specimens two of them quite young. Dimensions of the five specimens in millimetres:

	No. 1	No. 2	No. 3 from st. 21	No. 4	No. 5.
Height.....	28.2	17	7.5	7.5	6.5
Breadth (max. diameter)	13	9	4.7	4.5	3.7
Height of mouth.	19.5	12.7	6.5	7.0	5.5
do. do. in % of height	69.1	74.7	86.7	93.3	84.6

The two largest specimens must be referred to the variety *minor,* LOCARD, from which they differ in size, as the variety *minor,* according to LOCARD, attains a height of only 25 mm.[1]). As will be seen from the table above the three small specimens have a comparatively lower spire than the large ones. In form they rather resemble *Marginella parvula,* LOCARD[2]) than *M. impudica,* but the reason why I have referred them to FISCHER'S species is that all five specimens exhibit the same sculpture and the same shining rosy colour, and that the comparative height of the spire seems to increase with increase of size, being greatest in the largest specimen, a litte smaller in specimen no. 2 and smallest in the three small ones, nos 3—5, while the broken specimen from st. 21 is intermediate between these and no. 2. It must have been about 14 mm. high, with the height of mouth about 78 % of the total height. From the dimensions of the three small specimens it is however seen that individual differences occur regarding the comparative height of the mouth, this ratio being greater in the specimen 6.5 mm. high than in the two 7.5 mm. high and of these two it is greater in the specimen from stat. 21.

Marginella impudica has been taken by the "Talisman" off the west coast of Africa and near the Canary Islands where also the Prince of Monaco obtained it. Its bathymetrical range is from 102 to 1355 m.

Bulla utriculus, Brocchi.

Bulla utriculus, BROCCHI, Conch. foss. Subalp., 1814, p. 633, pl. 1, fig. 6.

9/4, st. 1, lat. 49° 27′ N., long. 8° 36′ W., 146 m., fine sand, temp. 9° 57 C. One rather small, empty shell.

Scaphander lignarius, Linné.

Bulla lignaria, LINNÉ, Syst. Nat. ed. 12, 1767, p. 1184.

10/4, st. 3, lat. 49° 32′ N., long. 10° 49′ W., 184 m., fine sand. One specimen.

[1]) Exp. Sci. "Travailleur" & "Talisman", Moll. Test., tome 1, 1897, p. 110, pl. 3, fig. 22—24.

[2]) Op. cit. p. 117, pl. 4, fig. 4—6, pl. 5, fig. 4—6.

$^{10}/_{4}$, st. 4, lat. 49° 38′ N., long. 11° 35′ W., 923 m., sand and mud, temp. 9°2 C. One specimen with broken shell.

$^{23}/_{5}$, st. 41, lat. 28° 8′ N., long. 13° 35′ W., 1365 m., yellow mud. One strongly eroded shell.

The specimen from st. 3 is 38 mm. high and 23 mm. broad. According to JEFFREYS, *S. lignarius* may on the British coast attain height of 58.3 mm. and a maximum breadth of 38.1 mm.,[1]) while on the Scandinavian coasts, according to G. O. SARS[2]) and ODHNER,[3]) it attains a maximum height of only 28 mm. It thus appears to grow to a larger size off the British than off the Scandinavian coasts. The opposite is the case with *S. puncto-striatus*, which attains its greatest size, about 35 mm., in Northern Norway, and therefore apparently a more northern species than *S. lignarius*.

Scaphander puncto-striatus, Mighels.

Bulla punctostriata, MIGHELS, Boston Journ. Nat. Hist. vol. 4, 1841, p. 43, pl. 4, fig. 10.

$^{10}/_{4}$, st. 3, lat. 49° 32′ N., long. 10° 49′ W., 184 m., fine sand. One specimen the shell of which is 26.5 mm. high and 16.5 mm. broad.

$^{23}/_{5}$, st. 41, lat. 28° 8′ N., long. 13° 35′ W., 1365 m., yellow mud. Three empty shells.

$^{30}/_{6}$, st. 70, lat. 42° 59′ N., long. 51° 15′ W., 1100 m., temp. 3°7 C. One emtpty shell.

Philine finmarchica, M. Sars.

Philine finmarchica, M. SARS, Christiania Vid. Selsk. Forhandl., 1858, p. 49.

^{9}—$^{10}/_{8}$, st. 102, lat. 60° 57′ N., long. 4° 38′ W., 1098 m., dark sand and clay. Two specimens.

P. finmarchica is a boreo-arctic species known both from the warm and cold areas of the Norwegian Sea. Its bathymetrical range is from 38 to 1187 m.

Scyllæa pelagica, Linné.

Scyllæa pelagica, LINNÉ, Syst. Nat., ed. 10, 1758, p. 656.

$^{6}/_{6}$, st. 51, lat. 31° 20′ N., long. 35° 7′ W., surface. Four specimens and two eggstrings attacked to sargasso-weed.

^{6}—$^{7}/_{6}$, st. 52, lat. 31° 24′ N., long. 34° 47′ W., surface. Two rather large specimens.

$^{8}/_{6}$, st. 53, lat. 34° 59′ N., long. 32° 1′ W., surface. Fourteen specimens.

$^{22}/_{6}$, st. 63, lat. 36° 5′ N., long. 43° 58′ W., surface. One specimen.

$^{26}/_{6}$, st. 66, lat. 39° 30′ N., long 49° 42′ W., surface. One specimen.

$^{29}/_{6}$, st. 69, lat. 41° 39′ N., long. 51° 4′ W., surface. One specimen and strings of eggs attached to sargasso-weed.

Hero formosa, Lovén.

Cloelia formosa, LOVÉN, Øfvs. Kgl. Vet, Akad. Handl. vol. 1, 1844, p. 49.

$^{27}/_{7}$, st. 96, lat. 50° 57′ N., long. 10° 46′ W., 184 m. Two specimens, the one 15 and the other 24.5 mm. long, both with 6 pairs of branchiæ.

H. formosa has not hitherto been recorded from the Irish coasts, though it has been taken at many points near the coasts of England and Scotland. The northern limit of the species lies at Tromsoe.

Fiona marina, Forskål.

Limax marinus, FORSKÅL, Descr. Anim., Avium etc. 1775, p. 99. Ic. Rer. Nat. 1776, pl. 26, fig. G. g.

$^{7}/_{5}$, st. 25 A, lat. 35° 36′ N., long. 8° 25′ W., surface. Two specimens, 11 and 12 mm. long, one of them attached to a piece of cork, which also carried three individuals of *Lepas pectinata*, Spengler, some hydroidæ and five egg-clusters belonging to *Fiona marina*.

$^{22}/_{6}$, st. 63, lat. 36° 5′ N., long. 43° 58′ W., surface. Four specimens, 2 to 8 mm. long, attached to the pneumatophore of *Velella spirans,* FORSKÅL.

Facelina drummondi, Thompson.

Eolis drummondi, THOMPSON, Rep. Brit. Assoc. 1843, p. 250.

$^{27}/_{7}$, st. 96, lat. 50° 57′ N., long. 10° 46′ W., 184 m. One specimen, size 12 mm.

Cuthonella abyssicola, Bergh.

Cuthonella abyssicola, BERGH, Nudibranchiata, Challenger Report, Zool., vol. 10, nr. 1, 1884, p. 24, pl. 10, fig. 1—3, pl. 11, fig. 2, pl. 12, fig. 9—13.

^{9}—$^{10}/_{8}$, st. 102, lat. 60° 57′ N., long. 4° 38′ W., 1098 m., dark sand and clay. Two specimens, measuring in millimetres:

	No. 1	No. 2
Total length	23.0	19.0
Height of body	5.0	5.5
Max. breadth of body	7.0	6.5
do. do. of foot	8.5	7.0
Length of rhinophors	5.5	5.0
„ „ mouthtentacles	3.0	2.5
„ „ papillæ	up to 2.5	up to 3.5

The larger specimen has lost most of the papillæ, while the smaller one is intact. Both of them carry about

[1]) JEFFREYS: British Conchology, vol. 4, 1867, p. 443.
[2]) G. O. SARS: Moll. Reg. Arct. Norvegiæ, 1878, p. 292.
[3]) ODHNER: Northern and arctic Invertebrates III. Opistobranchia and Pteropoda, Kgl. Sv. Vetensk. Akad. Handl., vol. 41, nr. 4, 1907, p. 12.

35 obliquely standing rows of papillæ, sometimes with 5, but mostly 3 or 4 papillæ in each row. The rows are arranged in four indistinct groups, most prominent in the smaller specimen. The anal papillæ is situated at the commencement of the second group of papillæ i. e. at the 14th or 15th row. The radula is endowed with 21 tooth-plates, each carrying 8 to 10 denticles on each side.

The smaller specimen is uniformly yellowish white, the other is dusky yellowish brown. The appearance of the larger specimen recalls *Cuthonella ferruginea* described by FRIELE. The papillæ are dark rusty brown with light tips.

In my paper "Nudibranchiate mollusker indsamlede av den norske fiskeridamper "Michael Sars".[1]) I have demonstrated the great similarity between BERGH's *C.* be maintained as distinct. Comparison of the present specimens with those collected by the "Michael Sars" in 1900 and 1902 corroborates the view here taken.

C. abyssicola belongs to the cold area of the Norwegian Sea and the adjacent parts of the warm area. The type specimen was obtained in 1882 by the "Triton" in the cold area of the Faroe—Shetland Channel (st. 9, 1113 m., ÷ 1°1 C.). Later on the "Michael Sars" took it at two points in the cold area between the west coast of Norway and Iceland, and in the Danmark Straits in the border-zone between the warm and the cold areas. The bathymetrical range of the species is 576 to 1113 m. *abyssicola* and *C. ferruginea* and *C. berghi* described by FRIELE,[2]) and shown that the latter two species cannot

[1]) Kgl. norske Vid. Selsk. Skr. 1912, nr. 13, p. 11.

[2]) FRIELE: Mollusken der ersten Nordmeerfahrt des Fischereidampfers "Michael Sars" 1900, Bergens Museums Aarbog 1902, nr. 3, p. 10—11, pl. 2, fig. 1—4, pl. 3, fig. 3—10.

Bergen, february 20, 1915.

Explanation of the plate.

Figs. 1— 4. *Mytilimeria flexuosa,* VERR. & SMITH from st. 101. Natural size. 1, right valve, 2, dorsal region, 3, anterior region, 4, posterior region.

„ 5— 7. *Pholadomya fragilis,* n. sp. from st. 70. About twice natural size. 5, left valve, 6, dorsal region, 7, anterior region.

„ 8. *Troschelia berniciensis,* KING, *var. elegans,* JEFFR. from st. 4. Natural size.

Figs. 9—10. *Bathybela nudator,* LOCARD, from st. 10. 9, shell, magnified about $1^3/_4$ times, 10 sculpture, strongly magnified.

„ 11—12. *Surcula tenerrima,* P. FISCHER, from st. 10. 11. Shell, magnified about $1^1/_2$ times. 12 apex, magnified about 9 times.

Drawn with camera lucida.

Tabular List of the Bra-

collected by the "Michael Sars" North

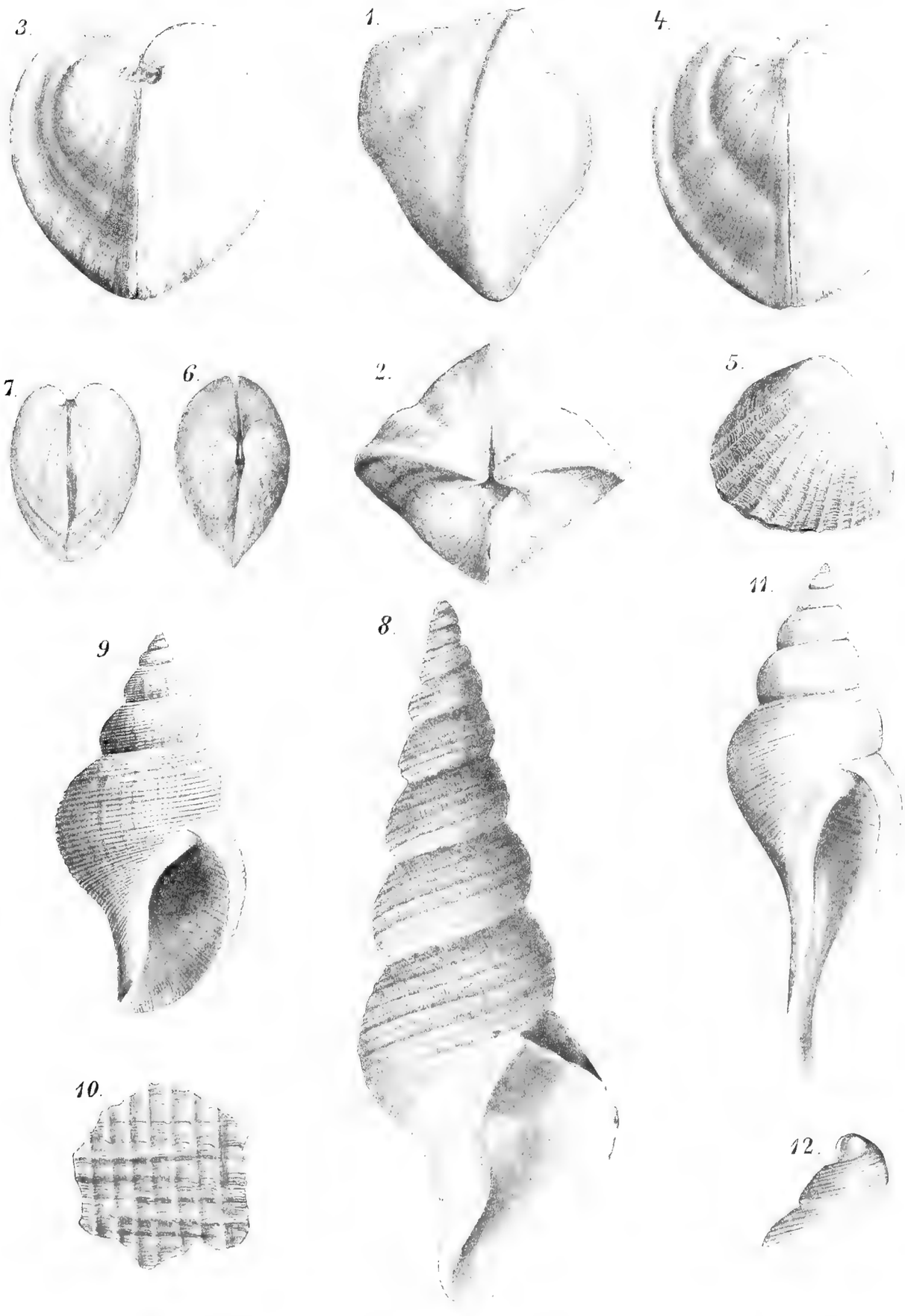
Station	1	3	4	10	20	21	23	24
Date	9/4	10/4	10/4	19/4	5/5	5/5	5/5	6/5
Latitude N.	49° 27′	49° 32′	49° 38′	45° 26′	35° 25′	35° 31′	35° 32′	35° 34′
Longitude W.	8° 36′	10° 49′	11° 35′	9° 20′	6° 25′	6° 35′	7° 07′	7° 35′
Depth in metres	146	184	923	4700	141	535	1215	1615
Bottom Deposits	fine sand	fine sand	sand and mud	yellow mud	fine sand	yellow sand	yellow mud	yellow mud
Bottom Temperature in Celcius	9.57		9.20	2.56	12.98	11.52	10.17	8.00
Brachiopoda								
Terebratulina septentrionalis, Couth.	—	—	—	—	—		—	—
Crania anomala, Müll.	—	—	—	—	—	—	—	—
Mollusca								
Lamellibranchiata								
Ostrea virginica, Gmel.	—	—	—	—	—	—	—	—
Pecten vitreus, Chemn.	—	—	—	—	—	—	—	×
Modiola polita, Verr. & Smith	—	—	—	—	—	×	—	—
Limopsis minuta, Phil.	—	—	—	—	—	—	—	—
„ aurita, Brocchi	—	—	—	—	—	—	—	—
Maletia cuneata, Jeffr.	—	—	—	—	—	—	—	—
Arca profundicola, Verr. & Smith	—	—	—	—	—	—	—	—
Astarte sulcata, da Costa	×	—	—	—	—	—	—	—
Syndesmya longicallus, Scacchi	—	—	—	×	—	—	—	—
Mytilimeria flexuosa, Verr. & Smith	—	—	—	—	—	—	—	—
Pholadomya fragilis n. sp.	—	—	—	—	—	—	—	—
Cultellus pellucidus, Penn.	×	—	—	—	—	—	—	—
Scaphopoda								
Dentalium ergasticum, P. Fischer	—	—	—	—	—	—	—	×
„ capillosum, Jeffr.	—	—	—	—	—	—	—	—
„ caudani, Locard	—	—	—	—	—	—	—	—
„ entale, Lin.	—	—	—	—	—	—	—	—
„ occidentale, Stimps.	—	—	—	—	—	×	—	—
„ agile, M. Sars	—	—	—	—	—	—	—	×
Gastropoda								
Calliostoma suturale, Phil.	—	—	—	—	—	—	—	×
Ianthina communis, Lamck.	—	—	—	—	—	—	—	—
Pilidium radiatum, M. Sars	—	—	—	—	—	—	—	—
Rissoa subsoluta, Aradas	×	—	—	—	—	—	—	—
Eulimella acicula, Phil.	×	—	—	—	—	—	—	—
Turitella terebra, Lin.	×	—	—	—	—	—	—	—
Aporrhais occidentalis, Beck	—	—	—	—	—	—	—	—
Troschelia berniciensis, King	—	—	×	—	—	—	—	×
Neptunea gracilis, da Costa	—	—	—	—	—	—	—	—
„ pubescens, Verr.	—	—	—	—	—	—	—	—
„ abyssorum, P. Fischer	—	—	—	×	—	—	—	—
„ curta, Jeffr.	—	—	—	—	—	—	—	—
„ mohni, Friele	—	—	—	—	—	—	—	—
Trophonopsis grimaldi, Dautz. & H. Fischer	—	—	—	—	—	×	×	—
Cassidaria echinophora, Lin.	—	—	—	—	×	—	—	—
„ rugosa, Lin.	—	—	—	—	—	×		—

25 A	37	41	51	52	53	63	66	69	70	72	88	95	96	101	102
7/5	20/5	23/5	6/6	6/6	8/6	22/6	26/6	29/6	30/6	1/7	18/7	27/7	27/7	6—7/8	9—10/8
35° 36′	26° 06′	28° 08′	31° 20′	31° 24′	34° 59′	35° 05′	39° 30′	41° 39′	42° 59′	44° 35′	45° 26′	50° 22′	50° 57′	57° 41′	60° 57′
8° 25′	14° 33′	13° 35′	35° 07′	34° 47′	33° 01′	43° 58′	49° 42′	51° 04′	51° 15′	51° 15′	25° 45′	11° 44′	10° 46′	11° 48′	4° 38′
	39	1365			2615—2865				1100	75	3120	1797	184	1853	1098
	shingle	yellow mud			yellow hard clay-ey mud						sand and yellow mud			hard clay	dark sand and clay
									3.70	2.03					

Station	1	3	4	10	20	21	23	24
Date	9/4	10/4	10/4	19/4	5/5	5/5	5/5	6/5
Latitude N.	49° 27′	49° 32′	49° 38′	45° 26′	35° 25′	35° 31′	35° 32′	35° 34′
Longitude W.	8° 36′	10° 49′	11° 35′	9° 20′	6° 25′	6° 35′	7° 07′	7° 35′
Depth in metres	146	184	923	4700	141	535	1215	1615
Bottom Deposits	fine sand	fine sand	sand and mud	yellow mud	fine sand	yellow sand	yellow mud	yellow mud
Bottom Temperature in Celcius	9.57		9.20	2.56	12.98	11.52	10.17	8.00
Mollusca								
Gastropoda								
Buccinum undatum, Lin.	—	—	—	—	—	—	—	—
„ grønlandicum, Chemn.	—	—	—	—	—	—	—	—
„ hydrophanum, Hanck.	—	—	—	—	—	—	—	—
„ atractodeum, Locard	—	—	—	—	—	×	—	—
Bela scalaris, Møller	—	—	—	—	—	—		—
Pleurotomella bairdi, Verr. & Smith	—	—	—	—	—		—	—
„ thaumastopsis, Dautz. & H. Fischer	—	—	—	×	—	—	—	—
Clionella delicatulina, Locard	—	—	—	—	—	—		—
„ quadruplex, Watson	—	—	—	—	—	—	—	—
Bathybela nudator, Locard	—	—	—	×	—	—	—	—
Surcula tenerrima, P. Fischer	—	—	—	×	—	—	—	—
Pleurotoma projecticium, Locard	—	—	—	—	—	—	—	—
Cymbium proboscidalis, Lamck.	—	—	—	—	—	—	—	—
Marginella impudica, P. Fischer	—	—	—	—	—	×	—	—
Bulla utriculus, Brocchi	×	—	—	—	—	—		—
Scaphander lignarius, Lin.	—	×	×	—	—	—	—	—
„ puncto-striatus, Migh.	—	×	—	—	—	—	—	—
Philine finmarchica, M. Sars	—	—	—	—	—	—	—	—
Scyllæa pelagica, Lin.	—	—	—	—	—	—	—	—
Hero formosa, Loc.	—	—	—	—	—	—	—	—
Fiona marina, Forskål	—	—	—	—	—	—	—	—
Facelina drummondi, Thomps.	—	—	—	—	—	—	—	—
Cuthonella abyssicola, Bergh	—	—	—	—	—	—	—	—

REMARKS: ***Ianthina communis, Scyllæa pelagica*** **and** ***Fiona marina*** **were taken pelagic at the surface.**

25 A	37	41	51	52	53	63	66	69	70	72	88	95	96	101	102
7/5	20/5	23/5	6/6	6/6	8/6	22/6	26/6	29/6	30/6	1/7	18/7	27/7	27/7	6—7/8	9—10/8
35° 36′	26° 06′	28° 08′	31° 20′	31° 24′	34° 59′	35° 05′	39° 30′	41° 39′	42° 59′	44° 35′	45° 26′	50° 22′	50° 57′	57° 41′	60° 57′
8° 25′	14° 33′	13° 35′	35° 07′	34° 47′	33° 01′	43° 58′	49° 42′	51° 04′	51° 15′	51° 15′	25° 45′	11° 44′	10° 46′	11° 48′	4° 38′
	39 shingle	1365 yellow mud			2615—2865 yellow hard clay-ey mud				1100	75	3120 sand and yellow mud	1797	184	1853 hard clay	1098 dark sand and clay
									3.70	2.03					



Bucher del.

ANTHOMEDUSAE AND LEPTOMEDUSAE

FROM THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

P. L. KRAMP

WITH 1 PLATE AND 6 FIGURES IN THE TEXT

The material of *Anthomedusae* and *Leptomedusae* brought home by the North Atlantic Deep-Sea Expedition 1910 is small, but it contains some very interesting species and increases our knowledge of the geographical distribution of certain species to a considerable degree. Some of the *Anthomedusae*, preferably the *Tiaridae*, have been examined and identified by Cl. Hartlaub, Helgoland, before they were sent to me in Copenhagen, and the *Tiaridae* have been included in his paper: *Tiaridae*, Nordisches Plankton XII, I Teil, 3. Lief. 1914.

The material contains 12 species. One species, *Tiaranna affinis*, is new to science and has been described by Hartlaub in the paper mentioned above. The following species were found:

Anthomedusae.

1. *Sarsia princeps* Haeckel.
2. *Oceania armata* Kölliker.
3. *Tiaranna affinis* Hartlaub nov. sp.
4. — *rotunda* (Quoy et Gaimard).
5. *Leuckartiara octona* (Fleming).
6. *Neoturris pileata* (Forskål).
7. *Pandaea conica* (Quoy et Gaimard).

Leptomedusae.

8. *Chromatonema rubrum* Fewkes.
9. *Laodicea undulata* (Forbes and Goodsir).
10. *Obelia sargassi* (Broch).
11. *Tiaropsis multicirrata* (M. Sars).
12. *Halopsis ocellata* A. Agassiz.

West of the submarine ridge running from Iceland over the Azores and further southwards, dividing the Atlantic into an eastern and a western part, only four species were found. The arctic species *Sarsia princeps*

List of Stations

where *Anthomedusae* or *Leptomedusae* have been found.

Number of Station	Date	Lat. N.	Long. W.	Depth in meters	Species found
19	May 2—3	36° 05′	4° 42′		*Tiaranna rotunda, Pandaea conica*
53	June 8—9	34° 59′	33° 01′	2615—2865	*Oceania armata*
69	— 29	41° 39′	51° 04′		*Obelia sargassi*
70	— 30	42° 59′	51° 15′	1100	*Chromatonema rubrum*
	July 5	St. Johns			*Tiaropsis multicirrata*
80	— 11	47° 34′	43° 11′	2000	*Sarsia princeps, Chromatonema rubrum*
81	— 12	48° 02′	39° 55′		*Chromatonema rubrum*
82	— 13	48° 24′	36° 53′		*Chromatonema rubrum*
84	— 15	48° 04′	32° 25′		*Chromatonema rubrum*
90	— 21	46° 58′	19° 06′		*Tiaranna affinis*
92	— 23—24	48° 29′	13° 55′		*Tiaranna affinis*
94	— 26	50° 13′	11° 23′	1565	*Halopsis ocellata*
97	August 4	56° 15′	8° 28′	139	*Halopsis ocellata*
98	— 5	56° 33′	9° 30′	1000—1360	*Leuckartiara octona, Halopsis ocellata*
99	— 6	57° 45′	13° 40′	149	*Leuckartiara octona, Laodicea undulata*
101	— 6—7	57° 41′	11° 48′	1853	*Leuckartiara octona, Neoturris pileata, Halopsis ocellata*

was found in the surface water east of the Newfoundland Bank (stat. 80), carried southwards by the Labrador Current from the Davis Strait. *Tiaropsis multicirrata*, a common medusa in the coastal waters of North America and North Europe, was taken at St. Johns. *Obelia sargassi* was found among floating sea-weed in the Sargasso Sea, hatched from hydroids growing on the sea-weed. *Chromatonema rubrum*, previously known from deep water off the New England coast and from the Davis Strait, was found at several stations south and east of the Newfoundland Bank (stat. 70, 80, 81, 82, and 84), so that this interesting species is now known to be distributed throughout the north-western basin of the Atlantic.

On the eastern slope of the Mid-Atlantic ridge (stat. 53, south-west of the Azores) one specimen of *Oceania armata* was found; this species is previously known from the Mediterranean and the Cape Verde Islands, but has not until now been found so far out in the Atlantic.—In the East-Atlantic basin, outside the contour of 4000 m. (stat. 90 and 92), only one species was found, viz. *Tiaranna affinis* n. sp.—In the Mediterranean, just inside the strait of Gibraltar (stat. 19), two species were found: *Tiaranna rotunda*, previously known from the Strait of Gibraltar and from the North Sea (a single specimen mentioned by HARTLAUB 1913); and *Pandaea conica*, a common Mediterranean species, found only once outside the Mediterranean, viz. in the South Atlantic by the "Valdivia" Expedition.—In the waters west of the British Isles three common North Atlantic species were found: *Leuckartiara octona, Neoturris pileata,* and *Laodicea undulata*. The most interesting find, however, is *Halopsis ocellata*, of which 6 specimens were found west of the British Isles (stat. 94, 97, 98, and 101); the species is known from the east coast of North America but has never been recorded from European waters.

ANTHOMEDUSAE.

I. Sarsia princeps Haeckel.

Codonium princeps	Haeckel	1879, System der Medusen, p. 13, Taf. I, Fig. 1—2.
Sarsia	—	— ibid., p. 655.
Codonium	—	Vanhöffen 1897, Drygalski's Grönland-Exped., Bd. II. p. 273.
—	—	Grönberg 1898, Zool. Jahrb., Abth. Syst., Bd. XI., p. 458.
Sarsia	—	Browne 1903, Bergens Museums Aarbog, p. 8.
—	—	Hartlaub 1907, Nordisches Plankton, XII, I. Teil., 1 Lief., p. 47, Fig. 44.
	—	Bigelow 1909, Proceed. U. S. Nat. Mus., vol. 37, p. 303, Pl. 30, fig. 1.

Of this species 6 specimens have been brought home by the "Michael Sars", all from stat. 80 on the eastern slope of the Newfoundland Bank:

Stat. 80. Lat. 47° 34′ N, Long 43° 11′ W, July 11th 1910, depth ca. 2000 m.

a. Young-fish trawl, 2000 m. wire: 1 specimen, height of the bell 24 mm. The walls of the bell have the same thickness everywhere, ca. 2.5 mm., also at the apical pole, no apical projection being present in this specimen; the apical canal, therefore, is very short, slightly everted at the distal end.

b. Young-fish trawl, 1000 m. wire: 1 specimen, height of the bell 24 mm. There is a well marked conical apical projection. The length of the apical canal is $^3/_4$ of the height of the gelatinous projection.

c. 1 m. ringtrawl at the surface: 4 specimens:
   1. An imperfect specimen.
   2. Height of the bell 14 mm. The length of the apical canal is $^2/_3$ of the height of the apical projection.
   3. Height 19 mm., the apical canal very short.
   4. Height 28 mm., the apical canal $^2/_3$ of the height of the apical projection, lobated at the distal end.

In all the specimens the manubrium is highly contracted, the length not exceeding $^1/_2$—$^2/_3$ of the height of the bell cavity.

New descriptions of this species have been delivered by GRÖNBERG (1898), BROWNE (1903), HARTLAUB (1907), and BIGELOW (1909).—HARTLAUB has given an excellent drawing; as to this drawing I shall only remark, that it does not show the limit between the gonadial and the gastral part of the manubrium. Perhaps the limit is less distinct, when the manubrium is so much expanded as is the case in the specimen figured by HARTLAUB. In all specimens I have seen there is a very sharp limit between the gonadial part and the stomach which forms, as a rule, a flask-shaped dilatation in the distal part of the manubrium. BIGELOW has given a very good photograph of a specimen from the south coast of Newfoundland.

The conical apical projection is not always distinct, and it is never sharply marked off from the sides of the umbrella. The length of the apical canal is as a rule $^2/_3$—$^3/_4$ of the height of the apical projection. At the distal end of the canal there is a knob-shaped dilatation. In one of the specimens from the "Michael Sars" the distal end of the apical canal is lobated like a hand. BROWNE (1903) has seen a similar abnormality in a specimen from Spitzbergen: "In this specimen the end of the canal is bifurcated, which is an abnormality".

Sarsia princeps occurs in almost all arctic seas (se HARTLAUB, op. cit. 1907). It is very abundant along the west coast of Greenland, where it is found exclusively in the cold water in the neighbourhood of the coast, not in the inflowing comparatively warm Atlantic water (see KRAMP 1913 and 1914). BIGELOW mentions one single specimen caught at St. Pierre, a small island off the central part of the south coast of Newfoundland, on October 1st 1908. This specimen as well as the specimens brought home by the "Michael Sars" have undoubtedly been carried by the Labrador Current from the Davis Strait southwards to the waters around Newfoundland.

In the Davis Strait the grown-up individuals are found near the surface in the summer time. According to VANHÖFFEN (1897) the young specimens are found in somewhat deeper strata (off the northern parts of the coast of Greenland), but the species has never been recorded from really deep water. It seems improbable, therefore, that the two specimens, caught by the "Michael Sars" in the young-fish trawl with 2000 and 1000 m. wire out,

have really been captured so far below the surface. The 1 m. ringtrawl caught 4 specimens at the surface; accordingly the species has been fairly common in the surface-water. It seems reasonable, therefore, that the young-fish trawl, which is a larger appliance, may have captured a specimen of the *Sarsia* during the hauling up through the upper strata.

2. *Oceania armata* Kölliker.

Oceania armata	Kölliker 1853, Zeitschr. wiss. Zool., Bd. IV, p. 323.
— *flavidula*	Gegenbaur 1856, ibid., Bd. VIII, p. 233, Taf. VII, Fig. 4.
Turritopsis armata	Haeckel 1879, System der Medusen, p. 65.
Callitiara polyophthalma	— ibid., p. 67, Taf. III, Fig. 1—5.
Oceania armata	Mayer 1910, Medusæ of the World, p. 147.

Stat. 53. Lat. 34° 59′ N, Long. 33° 01′ W (southwest of the Azores), June 8th—9th 1910, depth 2615—2865 m. 1 m. ringtrawl with 200 m. wire.—1 specimen, height of the bell 7 mm. HARTLAUB determ.

This species is common in the Mediterranean, known especially from Messina and Naples.—VANHÖFFEN[1]) and MAYER (1910) have demonstrated that *Callitiara polyophthalma* Haeckel from the Canary Islands is identical with *O. armata*. According to HAECKEL each tentacle is provided with two ocelli, viz. one abaxial crescent-shaped and one adaxial round ocellus; other authors mention only the adaxial ocellus. In the specimens from the "Michael Sars" no ocelli are visible.

Geographical distribution: Mediterranean; Atlantic near the Canary Islands and the Azores.

3. *Tiaranna affinis* Hartlaub n. sp.
Plate I, fig. 1.

HARTLAUB 1913, Nordisches Plankton XII, I, 3, p. 269.

Of this new species 7 specimens have been found in the East-Atlantic basin (west of France) outside the contour of 4000 m.

Stat. 90. Lat. 46° 58′ N, Long. 19° 06′ W, July 21st 1910. Young-fish trawl, 300 m. wire.—3 specimens.

Stat. 92. Lat. 48° 29′ N, Long. 13° 55′ W, July 24th 1910. Young-fish trawl, 300 m. wire.—4 specimens, treated with osmic acid or a similar fluid (HARTLAUB derterm. et descript.)

HARTLAUB'S description of this species in the "Nordisches Plankton" is based on the specimens from the last mentioned station (stat. 92). Unfortunately HARTLAUB has not seen the specimens from stat. 90. They are somewhat larger and better preserved than the described specimens, and they have not been treated with osmic acid (HARTLAUB states, that the species has a very intensive dark colour). Unfortunately I have not been able to make a thorough comparison between the specimens from the two stations, as the specimens from stat. 92, sent from HARTLAUB to me in Copenhagen, arrived in a completely dried-up condition.

The diameter of the three specimens from stat. 90 is 14—15 mm., the height of the bell about 12 mm. (in the specimens described by HARTLAUB the diameter as well as the height was only 8 mm). The gonads and the stomach ar well preserved and agree with HARTLAUB'S description and figure. Each of the gonads forms about 18—20 folds, somewhat irregular. As the reproduction of HARTLAUB'S drawing is not very good, I give a new figure (Pl. I, fig. 1). The perradial edges of the manubrium are so tightly connected with the radial canals, that no actual mesenteries are present. The margin of the bell is badly preserved; all the tentacles have been broken off, but evidently there has been two series, about 32 primary tentacles alternating with an equal number of minute tentacles.—The animal, as preserved in formalin, is colourless.

4. *Tiaranna rotunda* (Quoy et Gaimard).
Plate I, figs. 2—4.

Dianæa rotunda	QUOY et GAIMARD 1827, Annales des Sci. Nat., tome 10. p. 181, pl. 6 A, figs. 1, 2.
Tiara —	HAECKEL 1879, System der Medusen, p. 57.
— —	MAAS 1910, Bull, de l'Instit. Océanogr .....Monaco, No. 183, p. 8.
Tiaranna —	HARTLAUB 1913, Nord. Plankton, XII, 1, 3, p. 266.

Two individuals from the Mediterranean, near Gibraltar.

Stat. 19. Lat. 36° 05′ N, Long. 4° 42′ W, May 2nd —3rd 1910.

a. Vertical haul 900—300 m.—1 specimen.
b. Silk-net, horizontal haul with 900 m. wire.—1 specimen.

This species was described by QUOY and GAIMARD (1827) from specimens from the Strait of Gibraltar. According to the description there is "un assez grand nombre de tentacules"; the figure shows only 8 tentacles.

The next description was given by HAECKEL (1879) who states, that the number of tentacles is 8, and therefore refers the species to the new subgenus *Tiaranna*: "*Tiara*-Species mit constant acht Tentakeln". HAECKEL'S description is rather deficient. According to "Diagnose" the mouth-lips are "schwach gefranzt" according to the "Specielle Beschreibung" they are "stark gekräuselt". The mesenteries are said to be short, and the figures give only a very slight idea of the appearance of the species.

[1]) Verhandl. Gesellsch. Deutsch. Naturforsch. Ärzte, 64 Vers. Abth. Sitz., 1902, p. 121.—I have not seen this paper.

The species has been described again by MAAS (1910) who mentions 16—20 tentacles of usual size and a number of much smaller tentacles of the same shape.

HARTLAUB (1913) describes a specimen from the northern part of the North Sea. It is undoubtedly a young specimen, 6 mm. high with 8 tentacles.

The specimens brought home by the "Michael Sars" agree on the whole with the description given by MAAS. The umbrella is somewhat higher than a hemisphere. The gelatinous substance is very thick. The exumbrella is evenly rounded, without any trace of an apical projection. The manubrium is short and comparatively broad, though not as broad as in *Tiaranna affinis* (see above). Real mesenteries are not present, but the four perradial edges of the manubrium are in their whole length tightly connected with the proximal third of the four radial canals. The adjacent parts of the wall of the subumbrella are dragged inwards into the bell cavity, forming four gelatinous projections. The edge of the mouth is somewhat folded, faintly divided into four perradial lips. — The gonads are horseshoe-shaped. HARTLAUB will not use this term, because in his specimen the gonads are not folded in the middle. This is undoubtedly due to the fact that it is a young individual. In the specimens of the "Michael Sars" the folding of the gonads also embraces the interradial parts. The folding is fairly regular, about 12 transverse folds being present in each of the gonads. In the specimen from the vertical haul the gonads contain a number of comparatively large, whitish eggs, also in the interradial parts. — The four radial canals are slender. The velum is narrow. — There are about 28 tentacles with conical basal bulbs and a number of dwarf-tentacles, 2—3 between every successive pair of tentacles (Plate I, fig. 3). The dwarf-tentacles are spindle-shaped, hollow, the distal end provided with a cluster of nematocysts (Plate I, fig. 4). — No ocelli are seen.

Dimensions: a) The specimen from the vertical haul: diameter 15 mm., height 12 mm. — b) The specimen from the horizontal haul: diameter 18 mm., height 15 mm.

Colour: In formalin the stomach and the tentacles are orange.

The specimens mentioned by QUOY et GAIMARD, HAECKEL, and MAAS were all taken in the Strait of Gibraltar. HARTLAUB'S specimen was found in the nothern part of the North Sea. The specimens obtained by the "Michael Sars" were taken in the Mediterranean just inside the Strait of Gibraltar (stat. 19). The species has never been found further east in the Mediterranean. From what is known about the occurrence it is impossible to state, whether the species has its main distribution in the Mediterranean or in the Atlantic, though the specimen from the North Sea mentioned above, might indicate that the species occurs in the Atlantic.

5. *Leuckartiara octona* (Fleming).

Geryonia octona FLEMING 1823, Edinburgh Philosoph. Journ., vol. 8, p. 298.
Leuckartiara — HARTLAUB 1913, Nord. Plankton XII, I, 3, p. 285.

13 specimens from the waters west of Scotland, all identified by HARTLAUB and mentioned by him, op. cit. p. 290.

Stat. 98. Lat. 56° 33′ N, Long. 9° 30′ W (SW of the Hebrides), August 5th 1910. Young-fish trawl, 1000 m. wire. — 2 fairly large specimens.[1])

Stat. 99. Lat. 57° 45′ N, Long. 13° 40′ W (near Rockall), August 6th 1910. — 6 adult specimens.

Stat. 101. Lat. 57° 41′ N, Long. 11° 48′ W (between St. Kilda and Rockall), August 7th 1910.

a. Young-fish trawl, 1000 m. wire — 1 specimen
b. Depth unknown. — 4 adult specimens.

6. *Neoturris pileata* (Forskål).

Medusa pileata FORSKÅL 1775, Descriptiones animalium..., p. 110.
Neoturris — HARTLAUB 1913, Nord. Plankton, XII, I, 3, p. 326.

Stat. 101. Lat. 57° 41′ N, Long. 11° 48′ W (between St. Kilda and Rockall), August 7th 1910. — 1 specimen (HARTLAUB determ., mentioned op. cit. p. 328).

7. *Pandaea conica* (Quoy et Gaimard).

Dianaea conica QUOY ET GAIMARD 1827, Annales des Sci. Nat., tome 10, p. 182, pl. 6 A, figs. 3, 4.
Pandea - LESSON 1843, Hist. Zooph. Acal., p. 288.
Pandaea — HARTLAUB 1913, Nord. Plankton, XII, I, 3 p. 338.

Stat. 19, Lat. 36° 05′ N, Long. 4° 42′ W (Mediterranean, just inside the Strait of Gibraltar). May 2nd 1910, surface.—4 specimens, indentified by HARTLAUB and mentioned op cit. p. 339.

The label of the specimens is marked: Stat. 19, 2—V—1910, Surface.—Owing to a misreading HARTLAUB states, that the specimens in question were taken in the Bay of Biscay, Lat. 45° 26′ N, Long. 9° 20′ W, May 2nd 1910. — It will be seen, that the statement of the date is correct, but the position corresponds to "Michael Sars" stat. 10, April 19th—21st.—In fact, the species has never been found in the Atlantic north of the Strait of Gibraltar. It is known from different places in the Mediterranean and has been taken by the "Valdivia"-Expedition in the Agulhas Current in the South Atlantic (VANHÖFFEN, Deutsche Tiefsee-Expedition. Bd. 19, 5 Heft, 1911, p. 209).

[1]) By a misprint HARTLAUB has given the Lat. 56° 53′ N for 56° 33′ for these specimens.

LEPTOMEDUSAE.

8. *Chromatonema rubrum* Fewkes.

Plate I, figs. 5, 6.

Chromatonema rubrum FEWKES 1882, Bull. Mus. Comp. Zool., Harvard Coll., vol. 9. No. 8, p. 305, Pl. I, fig. 41.
Thaumantias — MAYER 1910, Medusæ of the World, I. p. 199.
— — KRAMP 1913, Vidensk. Meddel. Dansk naturhist. Foren., Bd. 65, p. 267.
— — — 1914, Meduser etc.. Conspectus Faunæ Groenlandicæ, p. 419.
? *Ptychogena erythrogonon* BIGELOW 1909, Mem. Mus. Comp. Zool., Harvard Coll., vol. 37, p. 150, Pl. 5 fig. 1, Pl. 38 figs. 8, 9, Pl. 39 figs. 1—7.
? — *Hertwigi* VANHÖFFEN 1911, Deutsche Tiefsee-Exped., p. 220. Taf. 22 Fig. 9. Textfig. 13.

Stat. 70. Lat. 42° 59′ N, Long. 51° 15′ W (southern edge of the Newfoundland Bank), June 30th 1910. Ringtrawl with 700 m. wire.—1 specimen.

Stat. 80. Lat. 47° 34′ N, Long. 43° 11′ W (eastern slope of the Newfoundland Bank), July 11th 1910, depth ca. 2000 m.

a. Young-fish trawl, 1000 m. wire.—2 specimens.
b. Ringtrawl, 1500 m. wire.—2 specimens.

Stat. 81. Lat. 48° 02′ N, Long. 39° 55′ W, July 12th 1910.

a Ringtrawl, 100 m. wire.—1 specimen.
b. Young-fish trawl, 1000 m. wire.—1 specimen.
c. Young-fish trawl, 2000 m. wire.—1 specimen.

Stat. 82. Lat. 48° 24′ N, Long. 36° 53′ W, July 13th 1910.

a. Young-fish trawl, 1000 m. wire.—1 specimen.
b. Young-fish trawl, 2000 m. wire.—1 specimen.

Stat. 84. Lat. 48° 04′ N, Long. 32° 25′ W, July 15th 1910.

a. Ringtrawl, 2500 m. wire.—1 specimen.
b. Young-fish trawl, 3000 m. wire.—1 specimen.

Description of the adult.—The bell is somewhat higher than a hemisphere, the gelatinous substance very thick. The manubrium consists of a quadrangular stomach and a short wide mouth-tube; the mouth is provided with four short lips. The stomach is attached to the subumbrella along the arms of a perradial cross, so that there are four triangular pouches between the dorsal wall of the stomach and the subumbrella. There are four radial canals. The proximal part ($^1/_2$—$^2/_3$) of each radial canal is wide and contains the gonads; the distal part is straight and narrow and communicates with the narrow ring-canal. The entrance from the side-wall of the stomach to the radial canal has the shape of a perpendicular slit, somewhat broader at the top than at the bottom. A transverse section of the gonadial part of the radial canal is pear-shaped in the proximal part, nearly circular in the distal part. The line along which the canal is attached to the subumbrella sends out a number of short lateral branches, so that the attachment of the dorsal wall of the canal has the shape of a pinnate figure. In each of the radial canals there are two rows of sack-shaped gonads, attached to the dorsal wall of the canal in the spaces between the above-mentioned lateral branches of the line of attachment and hanging down into the cavity of the canal. Each of the gonads has a narrow ectodermal lumen, the opening of which is seen as a small fissure in the dorsal wall of the canal (see figs. 5 and 6). The gonads do not communicate with one another. There are from 10 to 16 gonads on either side of the canal. The side-walls of the canal are as a rule tightened close over the sacks, so that the wall becomes faintly lobed or undulated (see fig. 6 b). Frequently some of the proximal gonads are developed in the dorsal wall of the stomach on both sides of the cross-arms.

There are about 24 tentacles, all of the same shape and size. The tentacular bulb is conical with a heart-shaped base. Between every two successive tentacles there are two (rarely one) short appendages, cylindrical or somewhat spindle-shaped, provided with a battery of nematocysts in the distal end. These appendages are, I think, homologous with cordyli (see below).—The velum is thin and narrow.

The colour of the manubrium, the radial canals, the ring-canal, and the tentacles is brightly orange or brick-red. The gonadial sacks are white.

Dimensions: The diameter of the specimens brought home by the "Michael Sars" varies from 16 to 27 mm. The specimen figured in plate I fig. 5 has the following dimensions: diameter of the bell 26 mm., diameter of the bell cavity 18 mm., height of the bell ca. 20 mm., the sides of the stomach 4.2 mm., distance from the centre of the stomach to the distal ends of the gonads 8—9 mm.

FEWKES' description of this species (1882) was based on 7 specimens, obtained by the U. S. Fish Commission off the coast of New England. His description was rather deficient. I have no doubt, however, but that the specimens found by the "Michael Sars" belong to the same species. The species was also found by the "Tjalfe"-Expedition in the Davis Strait (KRAMP 1913).—Thus this interesting and beautiful species seems to be common in the intermediate water of the North-West Atlantic basin.

BIGELOW (1909) has described a similiar medusa from the eastern tropical Pacific; he called it *Ptychogena erythrogonon*. BIGELOW possessed a series of specimens in different stages of development, the largest being 38 mm. in diameter with about 64 tentacles. The manubrium, the radial canals, the gonads, and the tentacles have the same shape and colour as in *Chromatonema rubrum*. According to the description BIGELOW'S species possesses

both cirri and cordyli. Only a few cirri were present in his specimens; they are cylindrical and provided with a cluster of nematocysts in the distal end. The cordyli are spindle-shaped and carry no nematocysts. One or two cordyli are present between every two successive tentacles. These cordyli are undoubtedly homologous with the small marginal appendages of *Chromatonema rubrum*. The two species are undoubtedly nearly related; in fact, I can see no other noticeable differences than the want of nematocysts in the cordyli of *"Ptychogena" erythrogonon*, and the size, *Chromatonema rubrum* reaching maturity when about 24 mm. in diameter with about 24 tentacles, whereas *Chromatonema erythrogonon* grows to a larger size and may possess 64 tentacles when fully developed.

Another similar form is described by VANHÖFFEN (1911) as *Ptychogena Hertwigi*, found in the Indian Ocean by the German deep-sea expedition. VANHÖFFEN describes his species as very like *Pt. erythrogonon* BIGELOW, but still larger, 50 mm. in diameter, yet with a smaller number of tentacles, viz 20. Cordyli are said to be wanting, but there are 5 "cirri" between each successive pair of tentacles. These "cirri", as shown in the figure in the text, seem to be partly cylindrical, partly somewhat club-shaped, partly spindle-shaped. They are, thus, undoubtedly homologous with the cordyli of *Chromatonema rubrum* and *erythrogonon*. According to the coloured figure (Taf. XXII) the gonads reach to the middle of the radial canals.—Also this species is undoubtedly nearly related to *Chromatonema rubrum* FEWKES and belongs to the same genus.

Further investigations will show, whether the three species mentioned above are distinct or only local varieties of one species, viz. *Chromatonema rubrum* Fewkes.

Synoptic Table of the Species of Chromatonema.

	C. rubrum Fewkes	*C. erythrogonon* Bigelow	*C. hertwigi* Vanhöffen
Diameter of full-grown medusa	24—27 mm.	38 mm.	50 mm.
Number of tentacles in full-grown medusa	ca. 24	ca. 64	20
Number of cordyli between each successive pair of tentacles	2 (1)	1 (2)	5
Occurrence	Northern Atlantic Ocean	Eastern tropical Pacific	Indian Ocean

Systematic position.—FEWKES (1882) who first described this species, called it by the preliminary name *Chromatonema rubrum* until its systematic position could be stated; he added that it was "apparently allied to *Staurophora*".—MAYER (1910) referred it to the genus *Thaumantias*, because it is a Leptomedusa with several tentacles but without otocysts, ocelli and cordyli. In my paper of 1913 I followed him in this respect.—The medusa described by BIGELOW (1909) and mentioned above, was referred by him to the genus *Ptychogena* owing to the presence of "lateral diverticula" from the radial canals and of "cordyli" between the tentacles. Also the medusa described by VANHÖFFEN (1911) was referred to the genus *Ptychogena*.

As a matter of fact, the genus *Chromatonema* bears a considerable likeness to various members of the family *Laodiceidae*. With regard to the general shape of the gastro-genital system *Chromatonema* is very like *Laodicea* and *Ptychogena*. In the latter genera, it is true, each of the radial canals bears only two lateral gonads, more or less folded, whereas in *Chromatonema* there are two rows of completely separated, sack-shaped gonads. It is not difficult, however, to refer these two types of gonads to a common origin, and they do not contradict the supposition of a phylogenetic relationship. They recall the typical structures of the gonads in the two main-groups of *Tiaridae*, viz. *Neoturridae* and *Calycopsidae*, as pictured by HARTLAUB (1913, fig. 295, p. 347).

The most characteristic feature of the *Laodiceidae* is the possession of cordyli. A typical cordylus is club-shaped and destitute of nematocysts. We know, however, cordyli in which the club-shape is not pronounced, and in *Ptychogena antarctica* BROWNE (1910) has observed nematocysts in some of the cordyli. These cordyli establish a transition from the typical cordyli to the small marginal appendages of *Chromatonema*. The structure and arrangement of the cell-layers in the latter are exactly as in a cordylus, the entoderm, consisting of cubical cells, surrounding a central lumen communicating with the circular vessel. This fact distinguishes the cordyli from the cirri, which are solid, the entoderm consisting of a single row of cells. I do not hesitate, therefore, to call the small marginal appendages of *Chromatonema* with the name of cordyli. Altogether, I have no doubt but that the genus *Chromatonema* has to be included into the family *Laodiceidae*. On the other hand, the shape of the gonadial system in *Chromatonema* has a great likeness to that structure in certain species of the *Tiaridae* among the *Anthomedusae*, especially *Calycopsis* which has 8 adradial rows of sack-shaped gonads, projecting inwards into the stomach and visible on the outer surface of this as rows of transverse fissures. Besides, the cordyli of *Chromatonema* bear a great likeness to the dwarf-tentacles of *Tiaranna rotunda*.—Altogether, *Chromatonema* belongs to the family *Laodiceidae*, and within this group it is the

genus which shows most points of connection with the *Tiaridae*.

9. *Laodicea undulata* (Forbes and Goodsir).

Stat. 99. Lat. 57° 45′ N, Long. 13° 40′ W (near Rockall), August 6th 1910. Young-fish trawl with 50 m. wire.

Small pieces of 5—7 individuals. The edge of the mouth is complexly folded. The gonads end in a distance of 2—3 mm. from the ring-canal. The tentacles are very numerous and situated closely together. Between every successive pair of tentacles there is a small projection, in some cases still bearing a cordylus. If cirri have been present they have all been broken off. A small but distinct ocellus is found at the base of every 3—5 of the tentacles.

As to synonomy and varieties, see BROWNE 1907, Ann. Mag. Nat. Hist. ser. 7, vol. XX, p. 459, and MAYER 1910, Medusæ of the World, I, pp. 201—204.

10. *Obelia sargassi* (Broch).

The hydroid:

Obelia hyalina Clarke 1879, Bull. Mus. Comp. Zool., Harvard Coll., vol. 5, Nr. 10, p. 241, Pl. 4, fig. 21.
— — Congdon 1907, Proceed. Amer. Acad. Arts and Sci., vol. 42, p. 468, figs. 7—9.
Laomedea sargassi Broch 1913, Rep. Sci. Res. "Michael Sars", vol. III, Part. I, p. 13.

Sargasso Sea, June 26th 1910. *Sargassum* at the surface, several specimens.

Stat. 69, Lat. 41° 39′ N, Long 51° 04′ W (Sargasso Sea), June 26th 1910. *Sargassum* at the surface, several specimens.

Among the material brought home by the "Michael Sars" there are a couple of glasses containing a number of minute medusæ of the genus *Obelia*. According to the labels the specimens have been taken on *Sargassum*, which probably means, that they arise from the gonothecæ of some hydroids growing on the *Sargassum*, undoubtedly *Laomedea sargassi* Broch (Syn. *Obelia hyalina* Clarke), which is very common on floating sea-weed and has been found in great abundance by the "Michael Sars" (see BROCH op. cit.). The liberated medusa has not been described. It is described here with the name:

Obelia sargassi. The medusæ have the general appearance of the genus *Obelia*. All the specimens seem to have been preserved immediately after their escape from the gonothecæ. The diameter is about 0.2 mm. They have 32—33 tentacles, a comparatively large number; most other species of *Obelia* have 24, seldom 28 tentacles at the time of liberation.—Gonads are not visible.

11. *Tiaropsis multicirrata* (M. Sars).

Thaumantias multicirrata M. Sars 1835, Beskriv. og Iagttag., p. 26, Pl. 5, fig. 12 a—c.
Tiaropsis diademata L. Agassiz 1849, Contrib. Nat. Hist. Acalephæ of N. America, p. 289, Pl. 6, figs. 1—18, Pl. 8, fig. 11.

St. Johns, Newfoundland, July 5th 1910, surface.

37 individuals, most of which are 10—12 mm. in diameter, only some few specimens being of smaller size. The smallest specimen is 6 mm.—There is no specific difference between the American *T. diademata* Agassiz and the European *T. multicirrata* M. Sars.

12. *Halopsis ocellata* A. Agassiz.

Halopsis ocellata A. Agassiz 1863, Proceed. Boston Soc. Nat. Hist., IX., p. 219.
— — — 1865, North. American Acalephæ, p. 99, figs. 143—150.
— — Haeckel 1879, System d. Medusen, p. 217.
— — Fewkes 1888, Bull. Mus. Comp. Zool., vol. XIII, Nr. 7, p. 233, Pl. III, fig. 3.
— — Hargitt 1904, Bull. U. S. Bureau of Fisheries, vol. 24, p. 51.
— Mayer 1910, Medusæ of the World, II, p. 323,
— Bigelow 1914, Bull. Mus. Comp. Zool., vol. 58, Nr. 2, p. 102.

Stat. 94. Lat. 50° 13′ N, Long. 11° 23′ W (south-west of Ireland), July 26th 1910, depth 1565 m. Ring-trawl with 1500 m. wire.—1 specimen.

Stat. 97. Lat. 56° 15′ N, Long. 8° 28′ W (between the Hebrides and the north coast of Ireland), August 4th 1910, depth 139 m. Ringtrawl with 50 m. wire. — 2 specimens.

Stat. 98. Lat. 56° 33′ N, Long, 9° 30′ W (south-west of the Hebrides), August 5th 1910, depth 1000—1360 m. Ringtrawl with 200 m. wire.—1 specimen.

Stat. 101. Lat. 57° 41′ N, Long. 11° 48′ W (between the Hebrides and Rockall), August 6th—7th 1910, depth 1853 m.

a. Young-fish trawl with 1000 m. wire.—1 specimen.
b. Ringtrawl with 200 m. wire.—1 specimen.

Description: The umbrella is watchglass-shaped, the gelatinous substance comparatively thick, particularly so in the central part of the disk, evenly diminishing in thickness towards the margin. The diameter of the largest specimen is about 40 mm. The manubrium consists of a flattened stomach and a short mouth-tube. The stomach is circular or star-shaped; its diameter is $^1/_5$—$^1/_4$ of the diameter of the disk. The length of the mouth-tube is about 4 mm.; the diameter at the narrowest part (at a short distance below the stomach) is about $^1/_2$ of the diameter of the stomach. The lower (distal) part of the mouth-tube is somewhat dilated, divided into four

folded lips, separated by slight incurvations, not by deep incisions. About 12 narrow radial canals issue from the periphery of the stomach[1]). In two of the individuals the radial canals are nearly equidistant at their origin; in the other specimens they originate in a somewhat irregular manner (se below). In the dorsal (umbrellular) wall of the stomach there is a number of ciliated grooves, forming a cross, the four arms of which are soon divided into three or four branches, each leading to one of the radial canals. They are centripetal continuations of the dorsal wall of the radial canals and indicate, that there are really four groups of canals, though in the full-grown medusa the canals are completely separated outside the periphery of the stomach. The radial canals are straight and narrow and connected with a narrow ring-canal. The distal ends of the radial canals are not always equidistant (see below). The gonads are situated along the radial canals, forming a narrow, somewhat folded band on each side of the canal, leaving both ends free, commencing 2—7 mm. from the periphery of the stomach and ending 1—2 mm. from the ring-canal. There is a large number of tentacles, as many as 350, fairly long and contractile. There is one fine cirrus (more seldom two cirri) between each successive pair of tentacles. The marginal vesicles are large open folds of the velum, containing a large number of lithocysts. The marginal vesicles are present in a number of 3—5 between each successive pair of radial canals. The velum is narrow, 2.5—3 mm. broad.

Table showing Variation of Halopsis ocellata.

Stat.	Length of wire	Diameter of bell	Diameter of stomach	Number of radial canals	Proximal part of radial canals free of gonads	Distal part of radial canals free of gonads	Number of tentacles
94	1500 m.	32 mm.	8 mm.	12	4—5 mm.	1 1.5 mm.	ca. 220
97	50 -	40 -	8 -	12	ca. 6 -	2 -	- 260
	— -	35 -	9 -	12	6 -7 -	1 -	- 350
98	200 -	40 -	8 -	13	4—5 -	1—1.5 -	- 275
101	200 -	28 -	8 -	13	ca. 4 -	1 -	- 270
—	1000 -	22 -	7 -	11	ca. 2 -	1 -	- 200

The specimens, preserved in formalin, are colourless.

Variation.—The table gives a view of the variation of the 6 specimens brought home by the "Michael Sars". It will be seen, that the diameter varies from 22 to 40 mm., the number of radial canals from 11 to 13, the number of tentacles from about 200 in the smallest specimen to about 350 in one of the larger individuals.

In order to illustrate the variation of the mode of origin of the radial canals, I have figured the stomachs of the six specimens seen from the aboral side.—In the specimen from stat. 94 (textfig. 1) the canals originate in groups of 2—3—3—4, altogether 12 canals. The distances between the canals when leaving the periphery of the stomach are very different. The number of tentacles between two successive radial canals varies from 12 to 27.—In the first of the specimens from stat. 97 (textfig. 2) the grouping

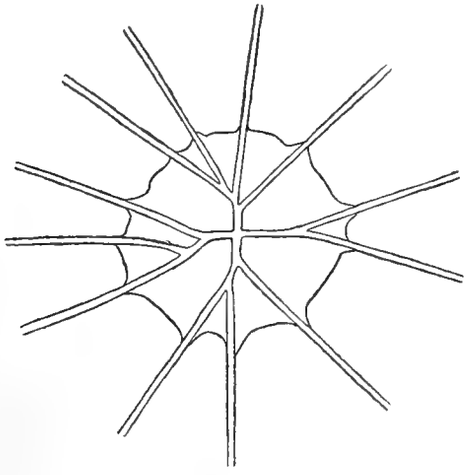


Fig. 1.

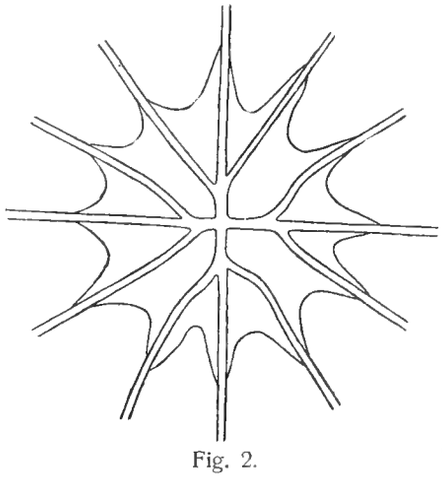


Fig. 2.

[1]) I have seen specimens from Iceland with 16 radial canals.

of the canals is very regular; there are 4 groups, each consisting of 3 canals, almost equidistant when leaving the stomach.—In the other specimen from stat. 97 (textfig. 3) the arrangement is very irregular. It is possible

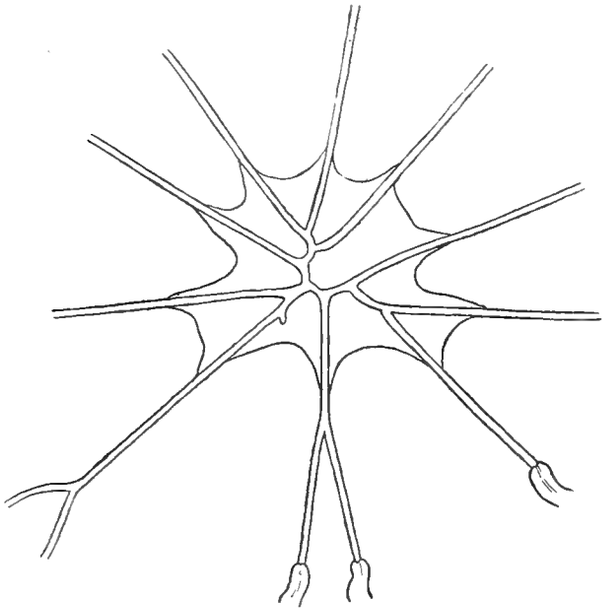


Fig. 3.

to distinguish four groups of grooves, but they do not issue from exactly the same point. The first group contains 4, the second 3 canals. In the third group there is only one canal at the periphery of the stomach, but just outside the stomach it divides into two canals. The

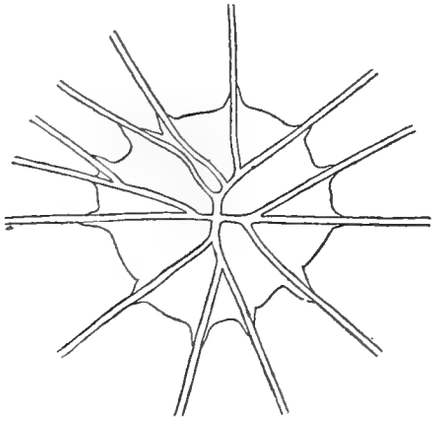


Fig. 4.

fourth group contains 2 canals one of which is bifurcated halfway to the margin of the bell. Thus altogether 12 canals reach the ring-canal. Near the base of the gastral groove corresponding to the last-mentioned canal the groove sends out a short branch, which is undoubtedly the first origin of a developing new radial canal.—In the specimen from stat. 98 (textfig. 4) there are four groups with 4—3—3—3, altogether 13 canals, leaving the stomach in a somewhat irregular manner.—In the specimen from stat. 101, taken with 200 m. wire (textfig. 5), the four groups contain 4—3—3—3 canals, fairly equidistant when leaving the stomach, but the distances between their distal ends are very different, the number of ten-

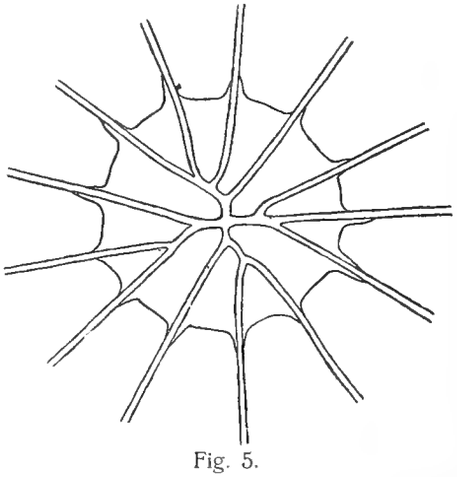


Fig. 5.

tacles between two successive radial canals varying from 15 to 24.—The canal system of the specimen from stat. 101 b, taken with 1000 m. wire (textfig. 6) is somewhat irregular. The stomach is very wry, and the four groups of grooves do not issue from the same point. The groups contain 3—3—2—3, altogether 11 canals. Two of the canals are connected by a short anastomosis just outside the stomach. The number of tentacles between two successive radial canals varies from 10 to 25.

Geographical Distribution.—All the specimens obtained by the "Michael Sars" were captured in July and August 1910 west of the British Isles. The species

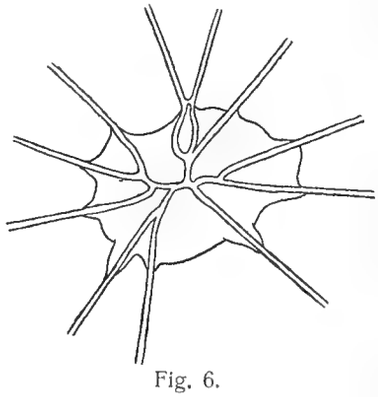


Fig. 6.

is not uncommon in the North Atlantic from Scotland to Iceland, though it has never been recorded from that area.[1])—Previously known from the Atlantic coast of

[1]) GÜNTHER: (Report on the Coelenterata . . . of the North Atlantic.—Ann. Mag. Nat. Hist., ser. 7, vol. XI, 1903, p. 420) mentions two small medusæ which "bear a considerable resemblance to the young of *Halopsis ocellata* as described by Agassiz", but from his description it does not seem probable that the specimens have belonged to that species.

North America: Nahant ("from July to September, quite commonly", A. AGASSIZ), Grand Manan ("several specimens", FEWKES), and the Gulf of Maine ("four fragmentary specimens", BIGELOW)..

Vertical Distribution.—The specimens have been captured in very different depths, from about 25 to several hundred meters below the surface (see above).

The genus *Halopsis* was described by A. AGASSIZ 1863 and 1865 as a genus belonging to the family *Aequoridae* and containing the species *H. ocellata* with about 16 radial canals and *H. cruciata* with 4 radial canals. Later authors have placed the last-mentioned species within the genus *Mitrocoma*, thus widely separating the two species. Since BIGELOW (1914) has found that *H. ocellata* has open sensory pits of the same shape as in *Mitrocoma*, this species must also be removed from the *Aequoridae* and placed among the *Mitrocomidae*.

According to AGASSIZ the genus *Halopsis* was distinguished from *Stomobrachium* Brandt by the fact that the radial canals in *Halopsis* "take their origin in clusters of three to five, radiating . . . from a large cross-shaped cavity", whereas in *Stomobrachium* they arise singularly from the periphery of the circular stomach. The specimens taken by the "Michael Sars" and described above agree in all respects with the description of *Halopsis ocellata* A. Agassiz with the exception of the size (the European specimens being somewhat smaller than the American specimens described by AGASSIZ) and the mode of origin of the radial canals. It was demonstrated above, however, that the canals, though separated outside the periphery of the stomach, are originally grouped into four clusters which are still indicated by the ciliated grooves in the dorsal wall of the stomach. Also in the numerous specimens from Grand Manan, mentioned by FEWKES (1888 p. 233), the radial canals arise singularly from the stomach, and the same was found by BIGELOW (1914) to be the case in the specimens from the Gulf of Maine.—I have no doubt, therefore, but that the specimens of the "Michael Sars" belong to the species *Halopsis ocellata* Agassiz.

As the mode of origin of the radial canals was the chief character by which AGASSIZ would separate the genera *Halopsis* and *Stomobrachium*, and this character fails, one might be inclined to think that the two genera cannot be kept apart. But nothing difinitely can be stated about the matter, as the two species of *Stomobrachium* (*St. lenticulare* Brandt and *St. tentaculatum* A. Agassiz) are very deficiently described, and have never been found again since the original descriptions were published (BRANDT 1835, AGASSIZ 1865). Neither cirri nor marginal vesicles have been observed in any of the species of *Stomobrachium*, whereas AGASSIZ describes the "large compound eyes" (*i. e.* marginal vesicles) and the cirri alternating with the tentacles in *Halopsis*.

List of Literature.

1863. AGASSIZ, A. in Proceed. Boston Soc. Nat. Hist., Vol. IX.—Boston 1865.

1865. — North American Acalephæ.—Mem. Mus. Comp. Zool. Harvard Coll., Vol. I.

1849. AGASSIZ, L.: Contrib. Nat. Hist. Acalephæ of N. America, Part. I.—Mem. Amer. Acad. of Arts and Sciences, New Ser. Vol. IV.

1909. BIGELOW: Coelenterates from Labrador and Newfoundland.—Proced. U. S. Nat. Mus., Vol. 37.

1909. — The Medusae.—Report.....Exped. to the eastern tropical Pacific, XVI.—Mem. Mus. Comp. Zool., Harvard Coll., Vol. XXXVII.

1914. — Oceanography and Plankton of Massachusetts Bay Nov. 1912—May 1913.—Bull. Mus. Comp. Zool., Harvard Coll., Vol. LVIII.

1835. BRANDT: Beschreibung der von Mertens auf seiner Weltumsegelung beobachteten Schirmquallen.—Mém. Acad. Sct. Pétersbourg, Ser. 6, Tom. 4.

1913. BROCH: Hydroida.—Report Sci. Results of the "Michael Sars" North Atlant. Deep Sea Exped. 1910, Vol. III, Part I.

1903. BROWNE: Medusae from Norway and Spitzbergen.—Bergens Museums Aarbog 1903.

1907. — Revision of the...Family *Laodiceidae*.—Ann. Mag. Nat. Hist., Ser. 7, Vol. XX.

1879. CLARKE: Report on the Hydroida collected during the Exploration of the Gulf Stream and the Gulf of Mexico.—Bull. Mus. Comp. Zool., Harvard Coll., Vol. V.

1907. CONGDON: The Hydroids of Bermuda.—Proceed. Amer. Acad. of Arts and Sciences, Vol. 42.

1882. FEWKES: On the Acalephae of the East Coast of New England.—Bull. Mus. Comp. Zool., Harvard Coll., Vol. IX.

1888. — On certain Medusae from New England.—Bull. Mus. Comp. Zool., Harvard Coll., Vol. XIII.

1823. FLEMING: Gleanings of Natural History....In a letter to Prof. Jameson.—Edinburgh Philosoph. Journal, Vol. 8.

1775. FORSKÅL: Descriptiones animalium quae in itinere orientali observavit.—Hauniae.

1856. GEGENBAUR: Versuch eines Systems der Medusen.—Zeitschr. wissensch. Zoologie, Bd. VIII.

1898. GRÖNBERG: Die Hydroid-Medusen der arktischen Gebiets.—Zool. Jahrb., Abt. Systematik, Bd. XI.

1903. GÜNTHER: Report on the Coelenterata from the intermediate waters of the North Atlantic.—Ann. Mag. Nat. Hist., Ser. 7, Vol. XI.

1879. HAECKEL: Das System der Medusen.

1904. HARGITT: The Medusae of the Woods Hole Region.—Bull. U. S. Bureau of Fisheries, Vol. 24.

1907. HARTLAUB: Craspedote Medusen. I. Theil, 1. Lief.—Codoniden und Cladonemiden.—Nordisches Plankton XII.

1913. — Craspedote Medusen. I. Theil, 3. Lief.—*Tiaridae*. Nordisches Plankton XII.

1913. KRAMP: Medusae collected by the "Tjalfe" Expedition.—Vidensk. Meddel. Dansk naturhist. Foren., Bd. 65.

1914. — Meduser og Siphonophorer.—Conspectus Faunae Groenlandicae.—Meddel. om Grønland XXIII.

1853. KÖLLIKER: Ueber Scheibenquallen.—Zeitschr. wiss. Zool., Bd. IV.

1843. LESSON: Historie Naturelle des Zoophytes.—Acalèphes.

1910. MAAS: Contributions au système des Méduses...—Bull. de l'Instit. Océanographique, Monaco, No. 183.

1910. MAYER: Medusæ of the World. I—II.

1835. M. SARS: Beskrivelser og Iagttagelser over nogle mærkelige eller nye i Havet ved den bergenske Kyst levende Dyr...

1827. QUOY ET GAIMARD: Observations Zoologiques ... Astrolabe.—Annales des Sciences Naturelles, Part. Zool. X.

1897. VANHÖFFEN: Die Fauna und Flora Grönlands.—Grönland-Exped. der Gesellsch. für Erdkunde zu Berlin 1891—1893. Unter Leitung von E. v. Drygalski.—II Bd.

1911. — Die Anthomedusen und Leptomedusen der Deutschen Tiefsee-Exped.—Wissensch. Ergebnisse d. Deutschen Tiefsee-Exped. ("Valdivia") 1898—1899, 19. Bd., Heft 5.

Explanation of the Plate.

Fig. 1. *Tiaranna affinis* Hartlaub nov. sp.—A specimen from stat. 90.— × 5.

— 2. *Tiaranna rotunda* (Quoy et Gaimard)— × 5.

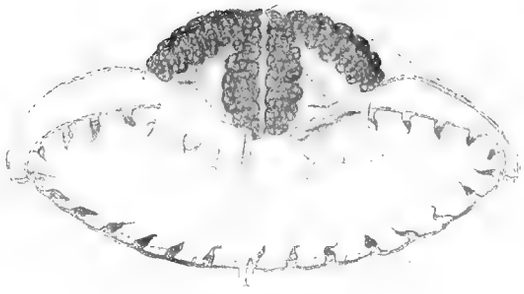
— 3. do.—A portion of the bell margin with common tentacles and dwarf-tentacles.— × 30.

— 4. do.—A dwarf-tentacle.— × 65.

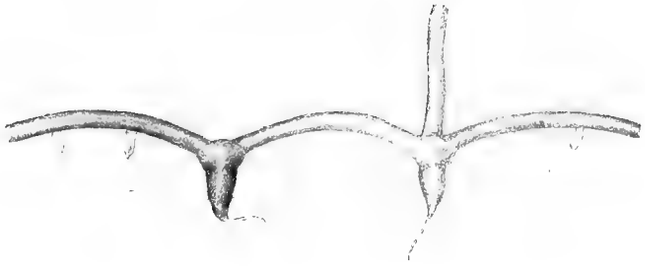
— 5. *Chromatonema rubrum* Fewkes.—A specimen from stat. 84 (2500 m. wire), seen partly from the top.— × 3.

Fig. 6. do.—Two sections of a specimen from stat. 84 (3000 m. wire).—a) radial section through the middle of a radial canal, showing one of the rows of gonadial sacks hanging into the cavity of the radial canal.—b) a section, nearly radial, following the side wall of a radial canal, through which the gonads are discerned.

1.

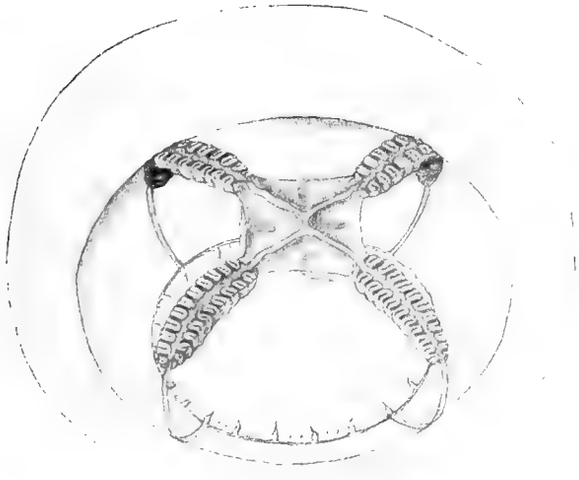


2.



3.

4.



5.

6b. 6a.

HETEROPODA

COLLECTED DURING THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

KR. BONNEVIE

(WITH 5 PLATES)

The Heteropoda, being warm-water animals should naturally not be expected to be numerously represented in material collected in the northern Atlantic, and the fact that the "Michael Sars" Expedition brought home no less than 12 species must be considered very satisfactory. The genera represented are: *Oxygyrus* with 1 species, *Atlanta* with 4 (?) species, *Carinaria* 1 species, *Cardiapoda* 1 species, *Pterotrachea* 4 species, and *Firoloida* 1 species.

Several of these species may, with more or less certainty, be indentified with previously described forms, but some of them may be considered new to science, or they have been so inadequately described that identification is almost impossible.

Tesch (1906) has rendered a great service to investigators by collecting all the species described in literature, with reproductions of the original figures. In dealing with new material, it seems important that full descriptions and illustrations should be given, even of species already described. Only in this way can a knowledge of the comparative anatomy of the Heteropoda, on which to base a natural system be arrived at.

Atlantidae.

Heteropoda with a spirally whorled shell large enough to conceal the whole body of the animal and with an operculum.

The two genera of this family are both represented in the collection.

Oxygyrus, Benson.

Species belonging to this genus have a nautiloid shell, the body-whorl being large, horny and translucent, while the narrow spire-whorls may be calcareous. The operculum is triangular, with growth-lines parallel to the bottom side, on both sides curving upwards round an oblique, mytiloid centre at the top. The median plate of the radula has three spines at its free end.

This genus, so well characterized by its nautiloid, horny shell, is represented by one species.

O. keraudreni, Rang.

Pl. I., figs. 1—3.

Shell (fig. 1 a-b) smooth, consisting of 3 whorls tightly connected and all lying in the same plane. The last whorl is much larger than the others, horny and translucent, while the inner ones are calcified. A broad, horny carina runs from the mouth of the shell along one half of the last whorl, and, suddenly tapering, also along part of the next half.

As will be seen from the generic description the structure of the operculum is more complicated than was formerly supposed.

Vayssière (1904) figures and describes the operculum of *O. keraudreni* as transversely striated, without a spiral at the top: "l'opercule n'est pas ici spirale comme chez les Atlanta, il est symmétrique et offre seulement de fines stries d'accroissement concentriques."

And Tesch (1905) in the same way describes it as "dreieckig ohne spiraligen Theil, nur mit parallelen Linien versehen".

A thorough investigation of the operculum proves, however, that the parallel lines of the lower part curve up at the sides, and form at the top a peculiar oblique centre, very similar to the growth-lines of a mytilus shell (fig. 2 a-b).

Parts of the radula are drawn in fig. 3 a-b. The three spines of the median plate are very unequal in size, the one in the middle being large and sharply pointed, while the lateral spines are short and blunt, each by a slight incision divided into two minute knots. — The two spines of the intermediate plates are placed one above the other; the lower spine is considerably larger than the upper one, and Vayssière (1904) therefore prefers to characterize the intermediate plates of this species as "unicuspidées". — The lateral plates of the radula are slender and curved, nearly as long as the intermediate plates.

Of this form three specimens were taken in the Western Atlantic, all at a depth of about 150 m. The

three specimens were of equal size, about 7 mm. across the shell.

Locality			Depth	Date 1910	Nr. of individuals
St.	Lat. N.	Long. W.			
64	34° 44′	47° 52′	150 m.	24/6	2
69	41° 39′	51° 4′	150 m.	29/6	1

Atlanta, Lesueur.

Shell flat, calcified, not nautiloid, but with whorls forming a more or less protruding spire on the right side. — Operculum oval or pear-shaped, with a spiral centre at growth-lines.

Radula: median plate with only one tooth, intermediate plates with one spine at the free end, and with (or without?) an accessory spine protruding from the concave underside. Lateral plates sickle-shaped, of varying length.

Of this genus 3 (or 4?) species are represented in the material from the "Michael Sars" Expedition.

A. peronii, Rang.
(Pl. I, Figs. 4—7).

Shell, (fig. 4) flat, 3—5 whorls. Spire not protruding. The carina does not reach the mouth of the shell, but continues on the other side, gradually tapering, in between the two last whorls, which in consequence are not tightly connected.

Operculum (fig. 6 a-b) pear-shaped with a spiral centre at its narrower dorsal end.

Radula (fig. 7). The spine of the median plate is scarcely longer than the lateral horns of the plate itself, the whole thus representing a plate with apparently three spines. — Intermediate plate with an accessory spine. Length of the lateral plates about 2/3 of that of the intermediate ones.

A. peronii was the heteropod most frequently met with during the "Michael Sars" Expedition, the collection including about one hundred specimens from no less than 18 different stations. Among these were specimens reaching the size of 6—8 mm., but a great number were small, 1—3 mm.; and many were represented only by fragments.

Among the larger specimens several were found with a brown or yellow stripe along the base of the carina, a character wich has been considered as distinguishing the two species *A. gaudichaudi,* Souleyet, and *A. rosea,* Souleyet; but the appearance of this stripe is so variable and so many transitions may be found, from the clear white carina of specimens which no doubt belong to *A. peronii* to others with a carina having a yellow or brown base, that I find no reason for considering this stripe alone as a character sufficient to justify the maintaining of these different species.[1])

According to Tesch (1906), *A. rosea* may, however, be distinguished also by its more protruding spire, and, especially, by a system of fine spiral lines on its inner whorls. But as to *A. gaudichaudi* the only character distinguishing it from *A. peronii,* besides the brown stripes, is the absence of an accessory spine on the intermediate plates of the radula.

I must confess, however, that I do not feel quite convinced of the correctness of the description given by Tesch on this point. The structure of the radula is known to be one of the most reliable characteristics of the natural relations between gasteropod species, and one would a priori not expect to find essential differences between radula-structures in species belonging to one and the same genus. — The absence of an accessory spine in some species,[2]) while it is present in a number of others,

Locality			Dept metres	Date 1910	Number of individuals	Size mm.
St.	Lat. N.	Long. W.				
23	35° 32′	7° 7′	600	May 5-6	1	3
39	26° 3′	15° 0′	7	„ 20-21	1	?
45	28° 42′	20° 0′	50	„ 28-29	5	1—4
„	—	—	100	—	5	1—5
48	28° 54′	24° 14′	0	„ 31	1	2
„	—	—	50	—	1	3
49	29° 6′	25° 2′	0	June 1	1	6
„	—	—	135	—	3	1—5
„	—	—	185	—	32	1—8
„	—	—	1000(?)	—	8	1—6
50	30° 8′	31° 19′	0	„ 4	1	?
52	31° 24′	34° 47′	0	„ 6	5	2—8
53	34° 59′	33° 1′	30	„ 8	6	1—2
56	36° 53′	29° 47′	50	„ 10-11	1	5
„	—	—	1000(?)	—	1	7
58	37° 37′	29° 25′	50	„ 12-13	2	6—8
62	36° 52′	39° 55′	0	„ 20-21	4	1—5
„	—	—	150	—	2	1—2
„	—	—	1000(?)	—	2	4—5
64	34° 44′	47° 52′	150	„ 24	16	1—7
„	—	—	300	—	1	6
„	—	—	500(?)	—	1	1
„	—	—	1000(?)	—	6	2—5
67	40° 17′	50° 39′	100	„ 27	6	2—7
69	41° 39′	51° 4′	150	„ 29	2	3—7
81	48° 2′	39° 55′	50	July 12	1	4
„	—	—	100	—	1	1
82	48° 24′	36° 53′	50	„ 13	3	1—3
84	48° 4′	32° 25′	50	„ 15	1	7
87	46° 48′	27° 46′	100	„ 17	1	7

[1]) Even Souleyet has (fig. 1, pl. 23) figured *A. peronii* with a yellow base at the carina.

[2]) According to Tesch in *A, affinis* and *A, oligogyra,* Tesch, and *A. gaudichaudi* and *A. inclinata,* Souleyet.

would be rather surprising, and the drawings by TESCH (1906, pl. VII, fig. 10 and 13, pl. VIII, fig. 16 and 26) are unfortunately not clear enough to serve as unquestionable proofs on this point, the lateral plates of the radula in his drawings concealing the part of the median plate where an accessory spine might be found. Until this negative character of *A. gaudichaudi* is definitely proved, its rank as a species different from *A. peronii* must therefore be questioned.

A. peronii was during the "Michael Sars" Expedition found scattered within the upper layers (10—300 m. in depth) of the Atlantic, as far north as lat. 48° 24′ N. At some stations (st. 49, 56, 62, 64), where it seems to have been brought up from greater depths (1000 m.), the specimens in question may have been caught during the passage of the gear towards the surface.

Atlanta fusca, Souleyet.

(Pl. I, figs. 8—9).

This well-defined species is represented by one small specimen, the body of which was in a very frail condition. My attempts at preparing the radula of this specimen were therefore not successful.

The shell of *A. fusca* is translucent, of a yellowish colour. The number of whorls is 3—4, the spire somewhat protruding beyond the width of the body-whorl. Carina gradually tapering towards the shell-mouth and encircling the entire body-whorl. On the inner part of the latter, as on the spire-whorls, there is a system of fine longitudinal stripes visible on both sides of the shell. The shell-mouth is ovoid, instead of pear-shaped as in other species.

The operculum is, in conformity with the ovoid shell-mouth, broadly oval, with the spiral lines centred at a considerable distance (about 1—3) from the upper end.

Radula unknown.

Locality			Depth metres	Date 1910	Nr. of ind	Sixe mm.
St.	Lat. N.	Long W.				
52	31° 24′	34° 47′	0	6/6	1	2

Atlanta macrocarinata, n. sp.

(Pl. I, figs. 10—13).

Shell white, transparent, very fragile, with 5—6 whorls forming a broadly cone-shaped spire. The body-whorl is only loosely connected with the spire, the largest specimens having a deep slit not filled by the carina, which separates the mouth part of the shell from the spire. Carina broad, encircling the whole body-whorl, on one side continuing to the shell-mouth, on the other side gradually, though rather steeply, tapering towards the beginning of the second whorl (figs. 10—11).

Operculum broadly pear-shaped, exceedingly clear and transparent; the spiral centre lying at a distance (about 1/4 of the height) from its upper end (fig. 13).

The radula (fig. 12) is of the typical Atlanta shape, but relatively much smaller than in other species of Atlanta. Median plate with one spine and short lateral horns. Intermediate plates with accessory spine, and lateral plates the shortest of which is more than half as long as the intermediate plate.

This species, so well characterized by the broad carina, which does not taper towards the shell-mouth, by the cone-shaped spire, and by the loose connection between the latter and the body-whorl, is represented in the "Michael Sars" collection by about 20 individuals, including many fragments, all from one station.

The largest specimens measured up to 2 mm., most of them did not, however, exceed 1 mm.

Locality			Depth metres	Date 1910	Number of individuals
St.	Lat. N.,	Long. W.			
64	34° 44′	47° 52′	150	24/6	ca. 20

Atlanta, sp. (?).

(Pl. I, figs. 14—15).

From one station near the Azores there is a fragmentary specimen, which by its operculum and radula proves to be different from all the species just mentioned. Its shell was, however, broken, hence a full comparison with other known species is excluded.

The colour of the shell is white. Its shape unknown.

The operculum (fig. 14) is pear-shaped with the spiral centre at the upper end more finely striped than is the case in *A. peronii.*

The *radula* (fig. 15) is relatively large, especially its intermediate plates, which are of the typical shape with accessory spines. Median plate with one tooth considerably longer than the corners of the plate.

Lateral plates relatively short, the shortest about half the length of the intermediate plate.

Locality			Depth metres	Date 1910	
St.	Lat. N.	Long. W.			
56	36° 53′	29° 47′	50	10-11/6	One fragment

Carinariidae.

(Pl. II, fig. 16—27).

Heteropoda with a shell too narrow to cover the whole body; without an operculum. The viscera are concentrated into a *nucleus* wholly or partly covered by the shell, while the rest of the bocly with the svimming fin is largely swollen and covered by a more or less transparent cutis. Males as well as females have a pair of tentacles anterior to the eyes.

This family includes three genera, two of which are represented in the material from the "Michael Sars" Expedition.

Carinaria, Lamarck.

Carinariidae with a shell covering the whole nucleus, which is connected with the rest of the body by a peduncle. The *cutis* of the latter is clear and transparent, and in most species rather swollen. Males as well as females have a sucker on the free border of their swimming fin.

Carinaria lamarcki, Pèron and Lesueur.

One shell without the animal, probably belonging to this species, was taken at. St. 23 (35° 32′ N., 7′ 7′ W.), depth 1215 m., date ^{5}-$^{6}/_{6}$ 1910. Length of the shell 15 mm., height 9 mm.

Carinaria lamarcki, Pèr. & Les., var ***challengeri,*** nov.

(Pl. II, figs 16—25).

Several small-sized specimens of *Carinaria,* the largest measuring 30—40 mm. in length, were taken near Gibraltar and off the African coast.

The body has the shape of a bow, the back being considerably longer than the ventral side (figs. 16—17). The *proboscis* is wide, continuing the body forward without any incision, nucleus and swimming-fin placed opposite to each other at the border of the posterior $^{1}/_{4}$ of the body. The rapidly tapering tail carries a dorsal fin and on the ventral side of it one finds near the posterior end a pair of transverse folds (fig. 20, 21, 24, 25 Cl). These folds, which may be covered by a dark pigment, are apparently more highly developed in young individuals (fig. 25) than in older ones (figs. 20, 24).

The eyes (fig. 18) are broad-based, the greatest width being about the same as the length. The circle of the retinal base of the eyes is not quite closed, but leaves a slit open on one side.

The height of the *nucleus* is about half its greatest length. The shell shows two whorls and a half, the body-whorl being undulated, having ridges vertical to the spiral line (fig. 25).

The cutis is clear and transparent, although with numerous cutis-spots (c. sp. fig. 20). On some specimens one also finds tubercles forming irregular groups along the dorsal and ventral sides of the body (fig. 23 t.).

The tail-fin rises abruptly at a distance behind the nucleus, and gradually tapers towards the posterior end of the tail, which in some individuals forms a short and narrow tail filament (fig. 24). The two ventral folds of the tail, which together seem to form a pair of claspers, may be found widely spread (fig. 25) or more or less tightly closed. Their pigment may be quite black or brown or greyish. In the largest specimen the clasper is inconspicuous (fig. 24).

The swimming fin, which in both sexes carries a sucker (s) on its posterior border, has a very coarse musculature consisting of equally distributed fibres running in two different directions obliquely from the base of the fin to its free border. According to the degree of contraction of these fibres the swimming fin may vary in shape from a low rectangle to a high one.

The *radula* (fig. 22) has a median plate with three long and pointed spines somewhat diverging from each other. On each side of these, in older individuals, or in the older part of the *radula* small rudiments of a lateral pair of spines are also found. The intermediate plates (fig. 22a) carry at their free ends a sharply pointed but very thin and fragile secondary spine. Lateral plates sickle-shaped, nearly as long as the intermediate ones. The *penis* (fig. 20, 23 p), which is found on the right side of the body of the males, in a line between nucleus and swimming fin, consists of two finger-shaped protrusions both fixed ventrally and diverging from each other towards the dorsal side.

There are many points of resemblance between this species and *C. lamarcki (C. mediterranea*, Vayssière), so many indeed, that for a long time I considered the specimens from the "Michael Sars" Expedition merely as young individuals of the much larger Mediterranean form. An examination of sections through the nucleus of one individuales proves, however, that in our form sexual ripeness is already attained in specimens 30—40 mm in length, while *C. lamarcki* reaches a size of 220 mm. Most probably this is the form wich was described by Smith (1888) from the "Challenger"-Expedition. I consider it a small-sized variety of *C. lamarcki.* Among the smallest individuals in the material, 10—12 mm. in length, a few (fig. 25) are very similar to the form described by Vayssière (1904) as *C. pseudo-rugosa.* His description seems, however to be based on a badly fixed specimen and it contains no indication as to whether or not the individual had reached sexual maturity. I am inclined to consider his specimen of *C. pseudo-rugosa,* as well as the small *Cari-*

narias from the "Michael Sars" Expedition, sections of which have proved them to be immature, as representing only young stages of the *challengeri* variety of *C. lamarcki*. In this case the darkly pigmented extension on the dorsal side of the tail, described and figured by VAYSSIÉRE, may be considered identical with the ventral extension in young individuals of our form, its dorsal position being due to a twisting of the body of the specimen described by VAYSSIÈRE, a supposition which, after a look at his illustration (1904, Pl. VI, fig. 83), does not seem improbable.

Locality			Depth	Date	Number of	Size
St.	Lat. N.	Long. W.	metres	1910	individuals	mm.
39 A	26° 3′	15° 0′	120	May 20-21	1 (?)	2,5
45	28° 42′	20° 0′	100	„ 28-29	2	10
51	31° 20′	35° 7′	0	June 5-6	2	10-30
52	31° 24′	34° 47′	0	„ 6-7	3 (?)	18-20
56	36° 53′	29° 47′	50	„ 10-11	1 + 3	10, 15-20
„	—	—	100	—	4	10-12
„	—	—	150	—	1	12

Cardiapoda, d'Orbigny.

Carinariidae with a spiral shell covering only a small part of the nucleus, the peduncle of which is more or less obviously directed backwards. Appearance of sucker on the swimming fin variable.

Cardiapoda richardi, Vayssière.

(Pl. II, figs. 26—27).

Body cylindrical, with an abruptly cut trunk, and with the peduncle of the nucleus directly continuing the body behind, running parallel with the tail. The latter rapidly tapers and forms at the end a long thread-like appendage. It carries along its whole length a narrow dorsal fin, and on the ventral side a pair of horizontal folds forming together a pair of claspers (Cb), like those found in young specimens of *Carinaria*.

The spherical nucleus has at its posterior border small spiral appendage, and at its anterior border 7—8 gills. It is carried by a peduncle directed backwards, and connected to the tail by means of a cutis stripe, which farther back forms the dorsal fin of the tail.[1]) The swimming fin is broadly oval, with coarse muscle bundles crossing each other in two directions, and without a sucker.

The eyes are large and the tentacles short and pointed, with a broad base.

[1]) Near the base of the nucleus there are in the specimen at hand two peculiar thread-like appendages diverging from points at the right side of the peduncle. The meaning of these appendages is unknown.

The proboscis forms a direct continuation of the trunk, though slightly constricted before eyes. It does not taper in front, but is abruptly cut and with the mouth opening dorsally.

The radula (fig. 27) has median plates with three spines, the one in the middle considerably larger than the lateral ones; these spines are so tightly packed that they might be considered as one spine with three points. The intermediate plates have at their free ends one spine overwhelmed by a short and blunt hook. The lateral plates are nearly as long as the intermediate ones.

The skin is smooth and (in the fixed animal) brownish in colour, translucent, but not transparent as in *Carinaria*. Small oblong cuticular spots are seen equally spread all over the body.

One specimen, 12 mm. in length (measured between the front end and the posterior border of the nucleus).

Locality			Depth	Date 1910	Number of	Size
St.	Lat. N.	Long. W.	metres		Individuals	mm.
52	31° 24′	34° 47′	50	June 6-7	1	12

Pterotracheidae.

Heteropods without a shell. The spindle- or pear-shaped nucleus embedded in the body at or near the posterior end of the animal.

This family includes the two genera *Pterotrachea* and *Firoloida,* both of which are represented in the material from the "Michael Sars" Expedition.

Pterotrachea, Forskål.

In this genus the body is continued behind the nucleus, forming a laterally compressed tail, which gradually diminishes in vertical extension towards the posterior end. No tentacles. The males have a sucker at the edge of the swimming fin. Two longitudinal rows of buccal teeth are found in the palate.

I fully agree with TESCH (1906) in his lament with regard to the distinction of species within this genus. The task of identifying new material with previously described species is not only a difficult and time-wasting one, but is in many cases absolutely impossible, most of the old descriptions and figures referring to generic characters only. Endeavours to unravel the synonymy of the described species of *Pterotrachea* can therefore be of very little scientific value; the only way of reducing the chaos to order will be to leave out of consideration all forms insufficiently described which can not be subjected

to renewed examination, and then by the exact methods of comparative anatomy attempt to formulate a series of characters which shall be of real systematic value.

TESCH (1906) has made a good move in this direction by drawing attention to the shape of the eyes and nucleus as a point of significance for the distinction of species; he also mentions the extension of the musculature on the under side of the proboscis. Upon these three characters he established the two subgenera: 1. *Pterotrachea s. s.* with cylindrical eyes, the retina of which is scarcely broader than the distal part, with a spindleshaped, long and narrow, nucleus, and with the cross muscles of the proboscis covering its whole ventral side; and 2. *Euryopsis* including those species with broad eyes, the right and left sides of which diverge greatly towards the base, with a short and swollen, pear-shaped nucleus, and with a muscle plate covering both the ventral and lateral sides of the proboscis, though only through half its lenght.

A distinction between these two subgenera will, according to TESCH, prove easy enough, but characters distinguishing the species are still wanting. And indeed, his material seems to justify this view, for its subdivision into the subgenera above mentioned is not difficult, while at the same time six new species described by TESCH, from the "Siboga" Expedition are characterized by only relative marks,[1]) which will not secure the recognition of one species if a comparison with the others is excluded. The size and development of the sexual organs, penis and sucker, are by TESCH repeatedly used as specific marks, although no information is given as to whether the individuals had reached sexual maturity.

I have thoroughly examined the specimens of *Pterotrachea* from the "Michael Sars" Expedition, in order to find, if possible, some features which might be considered characters of real specific value, i. e. constant in all the individuals of one species, but varying from one species to another.

The first result of my investigation is that I cannot accept the two subgenera proposed by TESCH, based upon differences in the eyes and nucleus and in the musculature of the proboscis.

[1]) Thus *P. challengeri*, is characterized (p. 85) "durch die kurze, gedrungene Gestalt des Schwanzes, und weiter durch die beträchtliche Entwickelung des Saugnapfes und des Penis," — *P. intermedia*, n. sp. (p. 86), erstens durch den längeren und niedrigeren Schwanz, dann auch durch den kleineren und schwächeren Saugnapf". — *P. microptera*, n. sp., finally is characterized by (p. 87), die relativ kleine Flosse, welche nie die Grösse wie bei den vorhergehenden Formen erreicht. "Bei den Männchen kommt als ganz besonderes Merkmal noch der auszerordentlich winzige Saugnapf hinzu, der kaum sichtbar ist".

I quite agree with TESCH that eyes and nucleus represent very important systematic characters, and that there is a conspicuous parallelism between these organs in so far as relatively long cylindrical eyes are found in species which have also a long and slender nucleus, while broad-based eyes are met with in animals whose nucleus is also broad and short. As already mentioned by GEWERZHAGEN (1914), these two types do not however, represent distinct groups in which the species of *Pterotrachea* may easily be distributed; they are only the initial and final steps of an evolution within the whole genus in a direction from the broad-based eyes and nearly spherical nucleus of *Cardiapoda* to long cylindrical eyes and a spindle-shaped nucleus. — A few steps of this evolution is illustrated in textfig. A, showing eyes and nuclei of five different species, or varieties, from the material at my disposal.

The third feature mentioned by TESCH, the proboscis musculature, will scarcely prove a character of systematic value, at least not of practical value in the determination of species or subgenera. For the fact is that the appearance of this musculature differs very much with its state of contraction, so much indeed that in some individuals it can not be distinguished at all, while in other individuals of the same species, in which the cross muscle fibres are contracted, the plate is more or less conspicuous.

For these reasons I cannot regard the subgenera of TESCH as expressions of the natural relations between the species of *Pterotrachea*, and therefore I shall make no use of them in my descriptions. A thorough examination of the material at my hand has however, proved the existence of a series of specific characters which, in the present state of our knowledge, seem quite distinct and unconnected by transitions.

Such characters are:

1) The shape of the eyes: whether they be cylindrical or broadbased, and the relation between their width and height.
2) The shape of the nucleus: the proportion between its width and heighth and between the latter and that of the whole body.
3) The cutis: a. Whether it is equally thick all over the body, or with a distinct shield-like swelling at certain parts of the body.
   b. Whether it is smooth or provided with spots, or tubercles, or both, and the arrangement of such structures.
   c. The existence of cuticularspines on the forehead, in front of the eyes, in both sexes, or only in one.

4) The presence or absence of peribuccal teeth, irregularly grouped round the edge of the mouth, in front of the two rows of buccal teeth always present in the palate.
5) The position of the pedal ganglion in correlation to the anterior edge of the fin. As is well known, this ganglion, which may be clearly seen without dissection through the transparent cuticular wall, is placed at a considerable distance from the head, near the base of the swimming fin. Its position seems absolutely fixed in each species. In many species it occupies the same position, viz: right above the anterior border of the swimming fin, but in some species it is placed more posteriorly, above the anterior third of the swimming fin.
6) The position and surroundings of the osphradium

Textfig. A.
1 a-b *P. gegenbauri.* 2 a-b *P. hippocampus* var. *apunctata.* 3 a-b *P. hippocampus,* var. *punctata.* 4 a-b *P. minuta.* 5 a-b *P. coronata.*

This character, little used by earlier investigators, has proved to be a very good specific mark. The long linear osphradium is distinctly conspicuous, lying anterior to the nucleus, surrounded in some way or other by a cuticular wall. Its shape and position seem to be quite constant in each species, and at the same time differ from one species to another: the osphradium may in one species be placed in the median dorsal line, while in another it is placed on the left side of the animal; the cuticular wall surrounding the osphradium may, according to the position of the latter, rise above the level of the body, or perhaps form a pocket-like structure on the left side above the heart; it may be smooth or tuberculated.
7) The arrangement, number and length of the gills.
8) The tail also gives a number of characteristic features of specific value: the number and width of its longitudinal muscle bands, and the structure of the cutis above these muscles. The latter may be smooth or tuberculated, or it may be swollen so as to form longitudinal ridges, especially along the dorsal and ventral sides of the tail.

A structure of specific value is also to be seen in the horizontally extended fin at the posterior

end of the tail; it may consist only of a pair of cuticular-folds on the sides of the tail, the dorsal ridge of the latter continuing to the end of the fin, or it may form a horizontally extended heart-like leaf, upon which the various ridges of the tail are not continued.

9) The male organs: the shape of the penis in mature animals, and especially the position of the sucker relatively to the median line of the swimming fin; it may be placed either at the middle of the edge of the fin, or anterior or posterior to that point.

10) The radula is in the genus *Pterotrachea* of relatively little importance as a specific character, the difference between the radulae of distinct species being slight, and the variations in one and the same species, on the other hand, great.

But, after all, a full description, or rather precise drawings, of the different parts of the radula may be of great importance in the recognition of a species. The number and arrangement of spines on the median plates, and on the free end of the intermediate plates, may, together with other characters, be sufficient to distinguish one species from another.

Most of the characters mentioned above vary from one species to another in the material investigated, but a few of them are constant in whole groups of species, and seem therefore to represent characters of subgeneric value.

Such is the case with regard to the presence or absence of a cutis-shield on the sides of the fore-trunk, and of peribuccal teeth, and also with regard to the position of the pedal ganglion.

In these characters one species brought home by the "Michael Sars" differs from all the others, a distinction sharp and important enough to group the species of *Pterotrachea* in my hands into two subgenera different from those proposed by TESCH. The characters of these subgenera will be given below.

Subgenus I. **Heterodens** includes species with a dorsal cutis shield on the fore-trunk, with peribuccal teeth, and with the pedal ganglion in a position considerably behind the anterior edge of the swimming fin.

Heterodens gegenbauri, Vayssière.
(Pl. IV, figs. 40—46).

Eyes (fig. 41, text fig. A. 1 a) large, cylindrical, their height about twice the diameter of the eye-lens.

The nucleus (fig. 43, textfig. A. 1 b.) does not rise above the level of the body, its length measuring about three times its greatets width.

The cutis is very clear and transparent, generally without cuticular spots, but covered with cone-shaped tubercles (concerning their distribution see below). No cuticular spines on the forehead. The cutis-shield, characteristic of the subgenus, forms a thick gelatinous mantle covering the back and the sides of the whole foretrunk. Its greatest width is behind the eyes, and from this line it gradually tapers towards the region of the swimming fin. The anterior part of the trunk is, therefore, broadly pear-shaped (fig. 40).

Buccal teeth in two rows, 6—7 in each row. Peribuccal teeth irregularly distributed in a circle round the entrance to the mouth (fig. 42 p. t.).

The pedal ganglion (pg) is found considerably behind the anterior edge of the swimming fin, at a distance from this point of about $^1/_3$ of the base of the latter (fig. 44 a).

The osphradium (o) is placed in the middle dorsal line, surrounded by a tuberculated cuticular wall (fig. 43).

Gills, about 20 in number, forming a continuous row posterior to the osphradium and nucleus.

The dorsal muscle bands of the tail scarcely developed, the ventral ones also very thin. Two pairs of lateral muscles, the most ventral of which is the broadest. Each muscle band is covered with a row of cuticular tubercles, the cutis forming longitudinal ridges along the dorsal and ventral edge of the tail (figs. 43, 46). These ridges are not continued upon the heart-shaped, leaf-like tail fin (fig. 46 a-b).

The swimming fin is semicircular, in the males with a sucker placed anterior to its middle point, between the first and second third of its border (figs. 40, 44 b).

The radula (textfig. B. 1) consists of about 24 rows of teeth. Median tooth with 5 gradually diminishing spines on each side of the middle spine. Intermediate plates with a small secondary spine at their free end. Lateral plates nearly as long as the intermediate plates.

Size of different individuals varying between 45 and 80 mm. in length, this variation greatly depending upon the different degrees of contraction of tail and proboscis; the variation in length of the trunk itself in full-grown specimens is very slight, the average being about 40 mm.

The characters mentioned above fully justify the indentification of our species with the one described by VAYSSIÉRE (1904) as *P. gegenbauri.* This author mentions the cutis-shield, so characteristic of the species, — a character which is, however, not approved of by TESCH (1906) as being of systematic value, representing in his opinion only the hanging folds („Kehlsack") so generally

occurring on the sides of the fore-trunk in a number of species of Pterotrachea.

There is, however, a well-marked difference between these structures: the cutis-shield of *P. (Heterodens) gegenbauri* forms a thick, elastic, gelatinous mantle, covering the back and sides of the whole fore-trunk, making the latter appear broadly pearshaped, while the soft neck folds in other species hang down ventrally, and thus affect very little the appearance of the body as seen from the dorsal side.

Generally no cuticular spots are found in this species, the cuticle being quite clear and transparent all over the body. In one specimen, however, a few cuticular spots were found on one side (the left) near the base of the swimming fin.

Clear conical tubercles are irregulary scattered all over the dorsal side of the trunk, and in two longitudinal rows on each side of the cuticular shield, while the cuticle of the ventral side is quite smooth. Such is the case also with the cuticle of the probocis.

The distribution of tubercles on the tail and round the osphradium has been described above; there remains now only to be mentioned a double row of tubercles (fig. 45) on both sides of the seminal duct in the male.

The penis (fig. 45) forms a very conspicuous organ on the right side of the male. Its copulatory part is formed by an S-shaped double leaf, while the glandular part is finger-shaped, clear and transparent and containing near its free end an oval brown body.

This species is represented by 10 specimens taken off the African coast and near the Azores.

Locality			Depth	Date	Number of	Size
St.	Lat. N.	Long. W.	metres	1910	individuals	mm.
23	35° 32′	7° 7′	1215	May 5-6	1	65
„	—	—	200	—	1	45
25	45° 46′	8° 16′	1700	„ 7-8	1	45
28	36° 0′	7° 19′	450—200	„ 9	1	?
34	28° 52′	14° 16′	200	„ 13-14	2	{80 70
42	28° 2′	14° 17′	150	„ 23-34	2	{65 75
56	36° 53′	29° 47′	150	June 10-11	1	80
58	37° 37′	29° 25′	300	„ 12-13	1	40

Among other species probably or possibly belonging to the subgenus *Heterodens*, may be mentioned: *Pterotrachea scutata*, Gegenbaur (1885), with its shield-like cuticular swelling on the fore-trunk, an *P. (Firola) talismani*, Vayssière (1902), which carries peribuccal teeth like *P. Gegenbauri*. A further investigation of these two species will, however, be necessary in order to decide whether they correspond also in regard to other characters.

Subgenus II, **Eupterotrachea**, includes the species of *Pterotrachea* without a cutis-shield, without peribuccal teeth, and with the pedal ganglion above the anterior edge of the swimming fin.

Eupterotrachea hippocampus, Vayssière.
(Pl. III, fig. 28—39).

Eyes (figs. 29, 36 a, textfig. A, 2—3 a) broad based, so that the diameter of the retina is somewhat like the height of the whole eye.

The nucleus (figs. 30, 38, textfig. A, 2—3 b) is short and broad (its width about one-half of its length), and does not reach the dorsal level of the body.

The cutis is soft and smooth, in fixed specimens hanging down as folds on both sides of the neck. — Tubercles are found scattered along the lateral muscle bands of the tail, and occasionally also on the osphradium wall. Cuticular spines before the eyes are found in two irregular groups in the females (Sp. fig. 36 a and b), while in the males they are either lacking or rudimentary (figs. 28, 37). As to the existence of cuticular spots in one variety of this species, see below.

Osphradium (o.) in the median dorsal line surrounded by a cuticular wall, smooth or with scattered tubercles (figs. 30, 38).

Gills short, 12—15 in number, forming a row posterior to the osphradium wall (figs. 30, 38).

The longitudinal muscles of the tail are weak, the dorsal and ventral ones are covered with cuticular ridges without tubercles figs. 33, 38, 39). The dorsal ridge is continued backwards upon the tail fin; the latter is therefore not leaf-like, as is the case with the species described above, but shows a triangular cross-section, (figs. 33, 39).

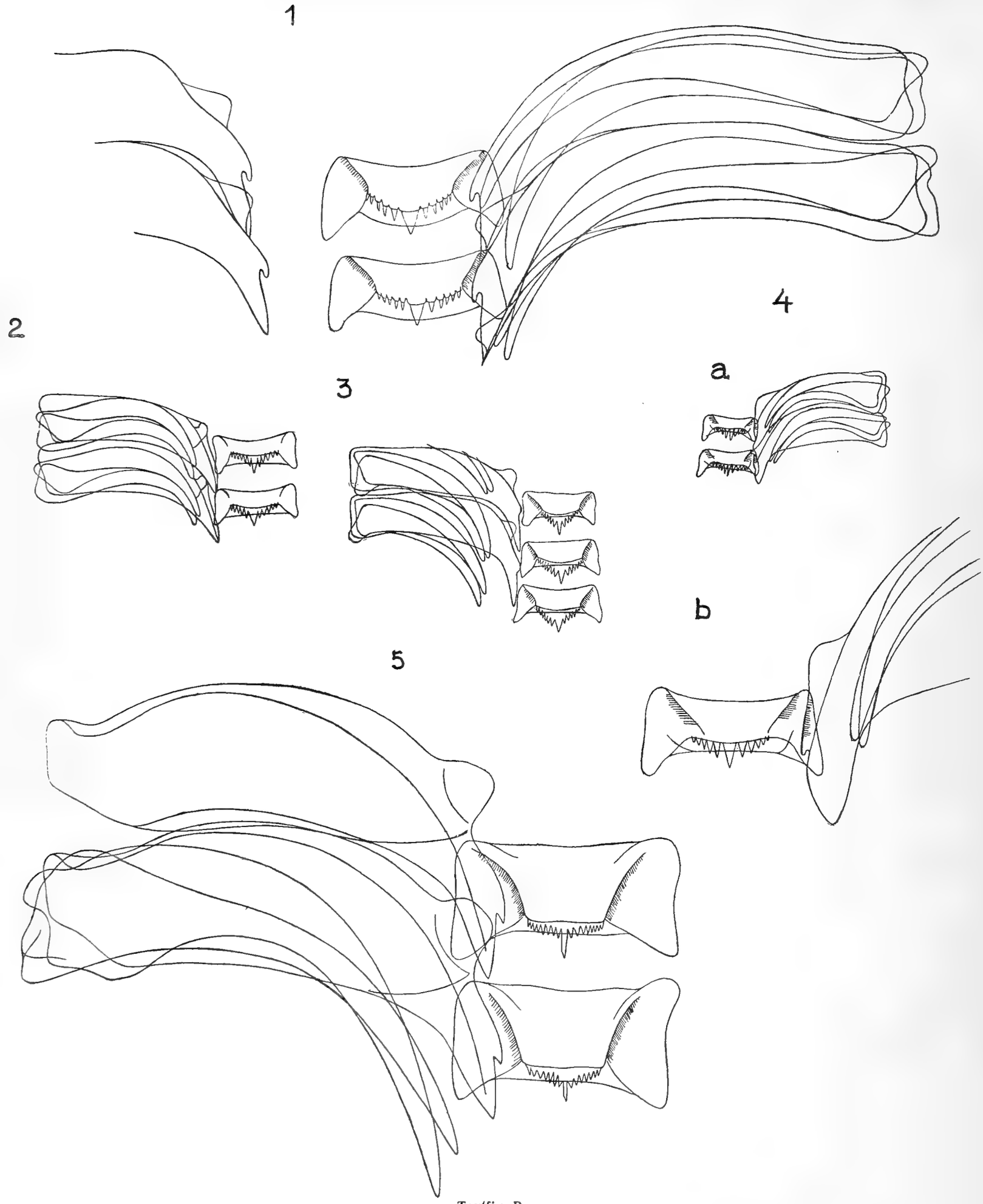
The radula (textfig. B, 2—3) shows about 23 rows of teeth. The median plate with a far protruding median spine and more than five small spines on each side. Intermediate plate without a secondary spine at its free end, although it may be present as a rudiment in one variety of the species (textfig. B, 3). Lateral plates nearly as long as the intermediate ones.

Buccal teeth (fig. 31) broad-based, 5—6 in each of two rows in the palate.

The copulatory part of the penis (fig. 32) consists of a pair of broad, leaf-like lobes, while its glandular organ is finger-shaped, with a sucker-like extension at the end, and about twice as long as the two leaves.

In the females a broad, rounded cuticular papilla is found on the right side of the animal in front of the nucleus (fig. 30, P).

The size of the individuals of this species varies from 20—80 mm. in length, most of the full-grown specimens measuring 70—80 mm.



Textfig. B.

1. *Heterodens gegenbauri.* 2. *Eupterotrachea hippocampus,* var. *apunctata.* 3. *Do. do.* var. *punctata.* 4. *Eupterotrachea minuta,* a. enlargement like figs. 1-5, b. part of the *latter,* further enlarged. 5. *Eupterotrachea coronata.*

This species agrees on systematically important points very well with the description given by VAYSSIÈRE (1904) of his *P. (Firola) hippocampus*, so well indeed, that I do not hesitate to identify the two forms, although a few particulars remain doubtful. The concordance with *P. hippocampus* is evident with regard to the size and shape of the nucleus, the position and surroundings of the osphradium (not mentioned by VAYSSIÈRE), the shape of tail and tail fin, and also with regard to the structure of the radula.

The shape of the eyes, however, has not been considered by VAYSSIÈRE; nor does he mention any difference between males and females with regard to the cuticular spines of the fore-head, and finally the position of the fin in front of the middle point of the body, at stated by VAYSSIÈRE, was not to be found in the specimens at my disposal.

The 24 individuals of *Eupterotrachea hippocampus* brought home by the "Michael Sars" Expedition all coincide with regard to the characters mentioned above. They represent, however, with regard to the structure of their cutis two different varieties. One of these, var. *punctata*, is characterized by presence of numerous cuticular spots (c. sp.) on the ventral side, larger ones along the base of the swimming fin (fig. 34 a), and smaller ones along the cuticular folds of the fore-trunk. Also on the proboscis (fig. 29), and not only on the ventral side, numerous small cuticular spots are to be found. In specimens belonging to the other variety, var. *apunctata*, no cuticular spots are to be found (fig. 35—37).

Of the 24 individuals 21 were taken in the Eastern Atlantic, between the African coast and the Azores, while 3 individuals were taken at a station in the Western Atlantic.

St.	Locality Lat. N.	Long. W.	Depth metres	Date 1910	Number of individuals	Size mm.
	Var. apunctata:					
45	28° 42′	20° 0′	150	May 28-29	1 ♀	70
52	31° 24′	34° 47′	50	June 6-7	1 ♀	20
„	—	—	0	—	4 ♀	40—55
„	—	—	0	—	4 ♂	40—55
53	34° 59′	33° 1′	1300	„ 8-9	1 (def.)	ca. 40
	Var. punctata:					
47	29° 2′	22° 53′	0	May 30	1 ♂ (def.)	?
48	28° 54′	24° 14′	0	„ 31	5 ♀	45—77
„	—	—	0	—	2 ♂	70
49	29° 8′	25° 16′	130	June 1	1 ♂	42
„	—	—	180	—	1 ♀	55
67	40° 17′	59° 39′	100	„ 27	2 ♂	40—45
„	—	—	100	—	1 ♀	45

Eupterotrachea minuta, n. sp.

(Pl. IV, fig. 47—52).

Eyes (fig. 48, textfig. A, 4 a) cylindrical in their distal part, but with retinal plates broader than the diameter of the cylindrical part.

Nucleus spindle-shaped, slightly rising above the dorsal level of the trunk (fig. 51, textfig. A, 4 b). Its height is about four times its greatest width.

The cutis is soft and quite smooth, with the exception of a few cuticular spots round the base of swimming fin, and also on the ventral surface in front of this place (fig. 49).

The osphradium (o) has a position somewhat to the left of the median plane of the animal, and is surrounded by a wall without tubercles (fig. 51). The right side of this wall forms the median dorsal line, while the left side of the wall is found lower down on the side of the animal.

Gills, 11 in number, forming a very regular row with no great difference in their length, the largest gills being found on the left side of the animal.

Tail without tubercles along the muscle bands, but with dorsal and ventral cuticular ridges, the first of which is continued backwards upon the tail fin. The latter is, in the one individual at my disposal, somewhat torn so that its shape can not be accurately described.

The radula (textfig. B, 4 a—b). Number of rows of teeth unknown. The median plate with 5—6 spines on each side of the middle spine, which is not so far protruding as in *E. hippocampus* (cfr. textfig. B, 3and4). Intermediate plates with a secondary spine at their free ends. Lateral plates nearly as long as the intermediate plates.

Buccal teeth 5—6, cone-shaped with a narrow base (fig. 50).

Only one small individual of this species is at my disposal, and without making sections I am unable to determine whether it is mature or not: I therefore prefer to leave this question open until more material may be obtained. The individual is a male carrying a penis consisting of three small leaves, and a glandular organ, ending in a sucker-like plate (fig. 52).

Size, 47 mm. in length.

This species differs from the others in the collection, and from all other species hitherto accurately described, especially in the shape of the eyes and nucleus, which form an intermediate stage between the broad-based eyes and broadly oval nucleus (subgen. *Euryops* of TESCH) on one hand, and the cylindrical eyes and spindle-shaped nucleus (subgen. *Pterotrachea s. s.* of Tesch) on the other.

The same intermediate stage is represented also in the position of the osphradium, which lies on the left side of the animal, but still very near the dorsal middle line.

Locality St.	Lat. N. Long. W.	Depth metres	Date 1910	Number of individuals	Size mm.
49	29° 8′ 25° 16′	50	June 6	1 ♂	47

Eupterotrachea coronata, Forskål.
(Pl. V, fig. 53—59).

Eyes (fig. 55, textfig. A, 5 a) long, cylindrical; length of the eye more than double the diameter of the lens.

Nucleus long and slender, length abouth six times the greatest width. It rises above the dorsal level of the body for about 1/3 of its length (fig. 54, textfig. A, 5 b).

Cutis smooth, with a few cuticular spots round the base of the swimming fin (fig. 56, c. sp.), with an irregular group of spines (sp.) anterior to the eyes (fig. 53, 55), and with tubercles (t) on the tail only. Here they form two pairs of longitudinal rows covering the lateral muscle bands, and also occur on the dorsal and ventral ridges, and even on the tail fin (fig. 57).

The osphradium (o) is situated on the left side of the animal, and covered by a wall (without tubercles) which forms a pocket-like structure below the gills (fig. 54).

Gills, ca. 15 in number, very unequal in size, a few gills on the left side being large and well developed, while the others on both sides are quite rudimentary (fig. 54).

The muscle bands of the tail well developed, and, as already mentioned, all covered by rows of tubercles. The dorsal and ventral ridges end abruptly at the base of the tail fin, so that the latter is leaf-like, and with a deep incision, in which (in a few specimens) a tail filament was found inserted (fig. 51).

The radula (textfig. B, 5) contains 25 rows of teeth. Median plate with 6—10 spines on each side of the long and narrow middle spine. Intermediate plates with a pointed secondary spine at the free ends. Lateral plates very long, reaching the free end of the intermediate plates.

Buccal teeth conical, 6—7 in each of two symmetrical, longitudinal rows (fig. 59).

Copulatory part of the penis[1]) consists of a pair of broad leaves, while the glandular part is a finger-like structure tapering towards the distal end (fig. 58).

[1]) Reupsch (1912), in his very thorough essay on the anatomy of Heteropods, maintains that the glandular, finger-like portion of the copulatory organ plays the rôle of a penis, while the shorter ventral protrusion is by him considered as a „Kopulationshilfsorgan" only. His reasons for taking this wiew, differing from that of earlier investigators, do not, however, seem clear enough for me to follow him.

Size. This is the largest species in the material from the "Michael Sars" Expedition, full-grown individuals measuring up to 180—220 mm. in length.

This species, which is well known from the Mediterranean, was during the "Michael Sars" Expedition taken outside this sea, as well as about the Azores and in the Western Atlantic.

Locality St.	Lat. N.	Long W.	Depth metres	Date 1910	Number of individuals	Size mm.
19	36° 5′	4° 42′	150—200	May 2-3	2 ♂ ♀	150 ca. 180
„	—	—	450	—	1 ♂	ca. 220
23	35° 32′	7° 7′	200	„ 5-6	2 ♀ ♀	32 47
25	35° 36′	8° 16′	1700	„ 7-8	1 ♀	70
29	35° 10′	7° 55′	1000	„ 18-19	1 ♀	100
51	31° 20′	35° 7′	1000	July 5-6	1 ♂	80
52	31° 24′	34° 47′	0	„ 6-7	2 ♂ ♀	60 45
53	34° 59′	33° 1′	150	„ 8-9	2 ♀ ♀	27 28
56	36° 53′	29° 47′	50	„ 10-11	1 ♂	80
„	—	—	150	—	4 ♀	20—60
58	37° 37′	29° 25′	150	„ 12-13	1 ♀	100
67	40° 17′	50° 39′	100	„ 27	1 ♂	130

The vertical distribution of *P. coronata*, according to the above list, seems to extend from the surface down to a depth of 1000 and 1700 metres. It must, however be remembered that a few specimens may have been caught during the passage of the gear through the surface layers of the sea, and therefore the records from stations 25, 29 and 51 should not be taken as real evidence of the occurence of *P. coronata* in depths like those mentioned above. In all probability it belongs to the surface-layers of the ocean in depths between 0 and 200 metres.

As will be seen from the above descriptions of the species of *Eupterotrachea* in the material from the "Michael Sars" Expedition, they form a continuous series beginning with *E. hippocampus*, through *E. minuta*, ending with *E. coronata*. Within this series a development may be traced from broad-based eyes and a broadly pear-shaped nucleus on one hand, to cylindrical eyes and a long and slender spindle-shaped nucleus on the other, and at the same time from a median dorsal position of the osphradium to a position at the left side of the body. When more species of *Pterotrachea* have been accurately described, this series may probably be augmented by new points, either at the ends or in the middle of eth series.

Firoloida.

In species belonging to this genus the tail is rudimentary. The males have a pair of tentacles ahead of the eyes, and a sucker at the border of the swimming fin.

Firoloida desmaresti, Lesueur.
(Pl. V, figs. 60—66).

Eyes cylindrical, their total length more than twice the diameter of the lens (fig. 64).

Nucleus irregulary spherical or pearshaped, with the rudimentary tail protruding beneath its ventral side (figs. 61—62).

Cutis transparent and quite smooth, without spots, spines or tubercles.

The svimming fin is large, subspherical, its diameter being about three times the width of the body. The sucker of the male is placed on its anterior border (fig. 60, 63).

The radula carries about 25 rows of teeth. The median plate of each has its spines (three small spines on each side of a large one) secluded between the large sickle-shaped side — pieces of the plate. Intermediate plates have no secondary spines at their free ends. Lateral plates sickle-shaped, nearly as long as the intermediate ones (fig. 66 a—b).

The males carry a pair of tentacles protruding from the forehead close to the base of the eyes (fig. 65), a sucker on the anterior border of the svimming fin (fig. 63) and a pair of fingershaped appendages protruding from the anterior side of the nucleus, each of them containing a dark, more or less spherical, body [1]) (fig. 62).

In the females (figs. 61, 64) all these structures are lacking, but in a number of individuals we find a long egg-chord, by thin walls divided into chambers, in which the eggs are placed (fig. 61).

Locality			Depth metres	Dato 1910	Number of individuals	Size mm.
St.	Lat. N.	Long W.				
19	36° 5′	4° 42′	0	May 2-3	11 ♂	10—25
46	28° 56′	21° 45′	0	„ 29	4 ♀	11—25
47	29° 2′	22° 53′	0	„ 30	5 ♂	ca. 10
48	28° 54′	24° 14′	0	„ 31	4 ♂	ca. 20
49	29° 8′	25° 16′	1000(?)	July 1	1 ♀	20
56	36° 53′	29° 47′	0	„ 10-11	5 ♀ 9 ♂	18—30 12—20
„	—	—	150(?)	—	2 ♀ 2 ♂	17—20 12—13

[1]) The fixation of my material does not allow of any discussion concerning the special meaning of these peculiar structures, which probably form parts of the copulatory organ.

Bibliography.

GEGENBAUR, C. 1855: Untersuchungen über Pteropoden und Heteropoden.

GEWERZHAGEN, ADOLF 1914: Zur Organisation der Heteropoden, Sitz. ber. d. Heidelberger Akad. d. Wiss.

GROBBEN, CARL 1888: Zur Morphologie des Fusses der Heteropoden. Arb. aus dem Zool. Inst. d. Univ. Wien, T. VII.

CRASUCKI, ADAM 1911: Unters. über Anatomie und Histologie der Heteropoden, Bull. internat. de l'acad. de sci. de Cracovie.

MACDONALD, JOHN D. 1862: On the anatomy and Classification of the Heteropoda. Trans. Roy. Soc. Edin Vol. XXIII.

MACDONALD, JOHN D. 1871: Discovery of Buccal Teeth in the Genus Firola. Quart. Journ. Micr. Sci. Vol. XI N. Ser.

OBERWIMMER, ALFRED 1898: Zool. Ergebnisse X, Mollusken II, ges. von S.M. Schiff „Pola", Denkschr. Kais. Akad. Wiss. B. 65.

d' ORBIGNY, A. 1847: Voyage dans 1' Amerique meridionale, t. 5.

PANETH, JOSEF 1885: Beiträge zur Histologie der Pteropodon und Heteropoden, Arch. f. micr. Anat. Bd. 24.

RATTRAY ALEX. 1869: On the Anatomy, Physiology and Distribution of the Firoloidae. Trans. Linn. Soc. London. Vol. XXVII.

REUPTSCH, ERICH 1912: Beitr. zur Anatomie und Histologie der Heteropoden Zeitschr. f. wiss. Zool. Bd. 102.

SCHREIBER, KURT 1912: Eigentümliche Organe bei Heteropoden (Pterotrachea und Carinaria) Zool. Anz. Bd. 39.

SMITH, EDGAR A. 1888: Rep. on the sci. results of the voyage of H.M.S. Challenger, 1873—76. Vol. 23.

SOULEYET 1852: Voyage autour du Monde — — — de La Bonite. t. II.

TESCH, J. J. 1906: Die Heteropoden der Siboga-Expedition. Siboga-Expeditie. Mon 51.

TESCH, J. J. 1913: Das Nervensystem der Heteropoden. Zeitschr. f. Wiss. Zool. Bd. 105.

VAYSSIÈRE, A. 1902: Opisthobranches. Exp. Travailleur et Talisman.

VAYSSIÈRE, A. 1904: Mollusques Heteropodes provenant des campagnes des yachts Hirondelle et Prinsesse Alice. Result. d. Camp. sci. — — — du Prince de Monacco Fasc. 26.

Explanation of the Plate.

Pl. I. Atlantidae.

Fig. 1. *Oxygyrus keraudreni,* Rang (× 8). *a.* in lateral view. *b.* in dorsal view.
„ 2. The same, operculum *a.* mytiloid centre of the operculum (× 20) *b.* the whole operculum (× 20).
„ 3. The same, radula. *a.* (× 210), *b.* (× 80).
„ 4. *Atlanta peronii*, Rang, the whole animal in lateral view (x 8),
„ 5. Head of the same (× 20).
„ 6. Operculum of the same, *a.* (× 20), *b.* (× 40).
„ 7. Radula, (× 400), *a. s.* accessory spine.
„ 8. *Atlanta fusca,* Souleyet (× 20).
„ 9. Operculum of the same, (× 40).
„ 10. *Atlanta macrocarinata,* n. sp. (× 8). *a.* in dorsal, *b.* in lateral view.
„ 11. The same (× 20).
„ 12. Part of the radula (× 550). *a. s.* accessory spine.
„ 13. Operculum of the same (× 40).
„ 14. *Atlanta sp.* Dorsal part of the operculum (× 40).
„ 15. The same, radula (× 400). *a. s.* accessory spine.

Pl. II. Carinariidae.

Fig. 16—17. *Carinaria lamarcki,* var. *challengeri* n. var. Two specimens, nat. size.
„ 18. The same. Part of the head of. fig. 17, with eyes and tentacle (× 8).
„ 19. The same, swimming fin with sucker, *s.* Pedal ganglion, *p. g.* (× 8).
„ 20. The same, part of the body with nucleus, penis, P. and tail. Cl. clasper-like organ of the tail. *c. sp.* cuticular sport, (× 8).
„ 21. The same, tail with clasper, (× 20).
„ 22. The same, radula. *a.* (× 400), *b. c.* (× 80).
„ 23. The same. Part of the body of the specimen in fig. 16. c. sp. cuticular spots, *t.* tubercles. *P.* penis, *p. g.* pedal ganglion, *s.* sucker (× 8).
„ 24. Tail of the same specimen. Cl. clasper (× 8).
„ 25. Young specimen of the same species, (× 8).
„ 26. *Cardiapoda richardi,* Vayssiere. (× 8).
„ 27. The same. Radula (× 80).

Pl. III—V. Pterotracheidae.

Pl. III. Eupterotrachea hippocampus, Vayssière.

Fig. 28. *E hippocampus,* var. *punctata,* male, nat. size.
„ 29. Head of the same. (× 8).
„ 30. Part of the body of the same, with *n.* nucleus, *g.* gills, and *o.* osphradium. P, papilla of the female.
„ 31. The same. Buccal teeth, one of the two rows (× 80).
„ 32. The same. Penis (× 8).
„ 33. The same. Tail, showing the dorsal ridge continuing upon the horizontal tail fin (× 8).
Fig. 34 a—b. The same. Parts of the swimming fin. (× 8), *a*, base of the fin, with cuticular spots (c. sp.) and pedal ganglion (p. g.). *b*, border of the fin with sucker.
„ 35. The same species var. *apunctata.* Base of the fin.
„ 36 a—b. The same. Head of female in dorsal (a) and lateral (b) view. Sp. cuticular spines. (× 8).
„ 37. The same. Head of male; no cuticular spines. (× 8).
„ 38. The same. Part of the body with N, nucleus, G, gills, and o, osphradium (× 8).
„ 39. Tail of the same (× 8).

Pl. IV.

Fig. 40. *Heterodens gegenbauri,* Vayssière, nat. size, male.
„ 41. Head of the same (× 8).
„ 42. Part of the palate of the same, showing buccat teeth in two longitudinal rows, b. t., and in front of these the peribuccal teeth, p. t.
„ 43. Part of the body with nucleus (n), gills (g) and osphradium (o) (× 8).
„ 44 a—b. Parts of the swimming fin of a male (× 8). *a.* base of the fin with pedal ganglion, *p. g. b.* border of the fin with sucker.
„ 45. The same. Penis with seminal duct, surrounded by tubercles (× 8).
„ 46 a—b. Two different views of the tail. The dorsal ridge is not continued upon the horizontal tail fin. (× 8).
„ 47. *Eupterotrachea minuta, n. sp.* Male, nat. size.
„ 48. Head of same (× 8).
„ 49. Swimming fin of the same with sucker (s) and pedal ganglion (p. g.) (× 8).
„ 50. Buccal teeth (b. t.) of the same, (× 8).
„ 51. Part of the body of the same, with nucleus (n), gills (g) and osphradium (o), (× 8).
„ 52. Penis of the same (× 8).

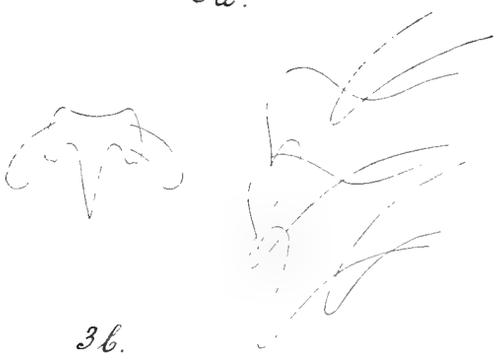
Pl. V.

Fig. 53. *Eupterotrachea coronata,* Forskål, nat. size.
„ 54. The same. Part of the body with nucleus (n), gills (g) and osphradium (o). (× 8).
„ 55. Head of the same (× 8).
„ 56. The same. Base of the swimming fin with cuticular spots (c. sp.) and pedal ganglion (p. g.) (× 8).
„ 57. Taii of the same (× 8).
„ 58. Penis of the same (× 8).
„ 59. Row of buccal teeth of the same (× 80).
„ 60. *Firoloida desmaresti,* Lesueur, male, (× 8).
„ 61. The same. Nucleus and egg-chord (e. c.) of a female (× 20).
„ 62. The same. Nucleus and copulatory organ of a male (× 20).
„ 63. The same. Swimming fin with sucker (s) and pedal ganglion (p. g.) (× 20).
„ 64. The same. Head of a female (× 20).
„ 65. The same. Head of a male (× 20).
„ 66 a—b. The same. Parts of the radula (× 400).

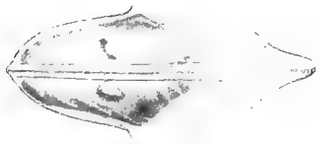
1a.

2a.

3a.



1b.



2b.

3b.

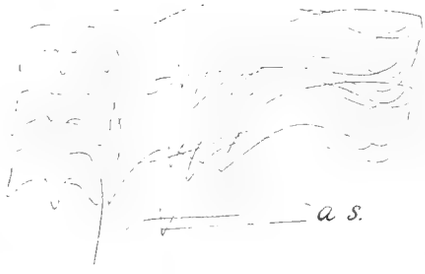
4.

5.

6b.

6a.

7.



a. 10 b.

a s.

9.

8.

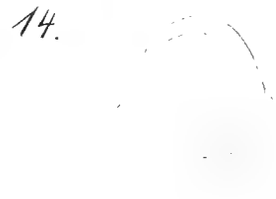
12.

a.s.

11.

13.

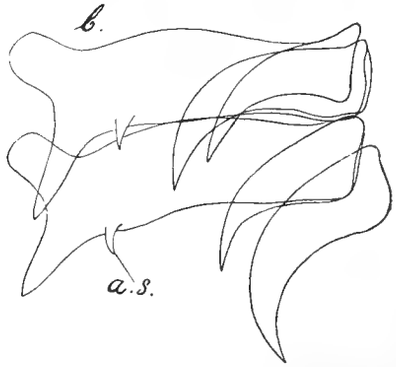
14.



15.

a.

b.



a.s.

16.

17.

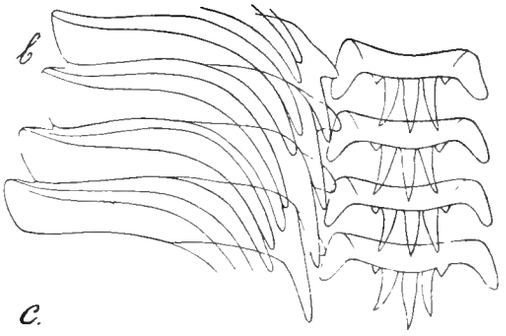
18

19.

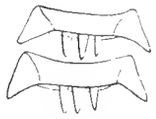
20.

a.

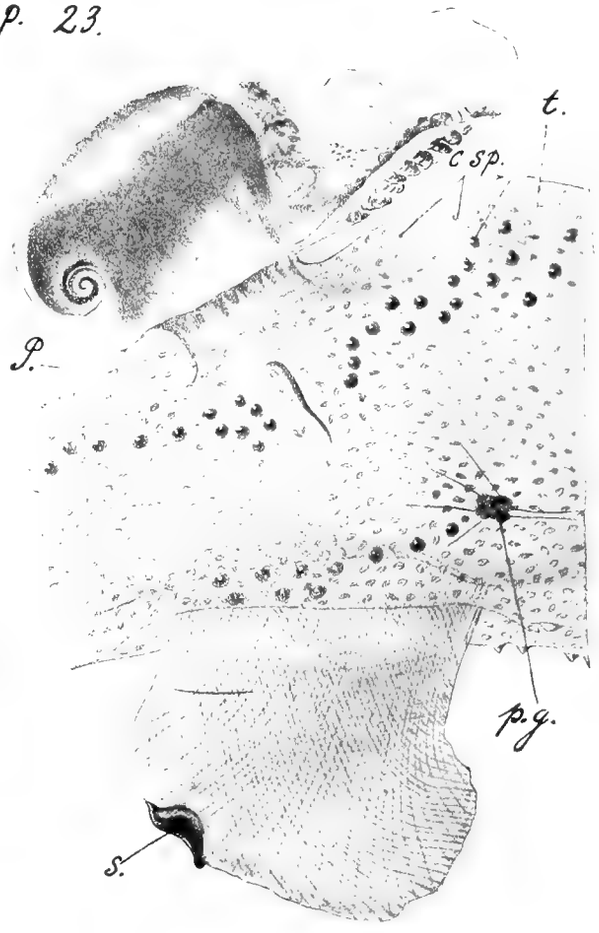
22.



c.



c.sp. 23.



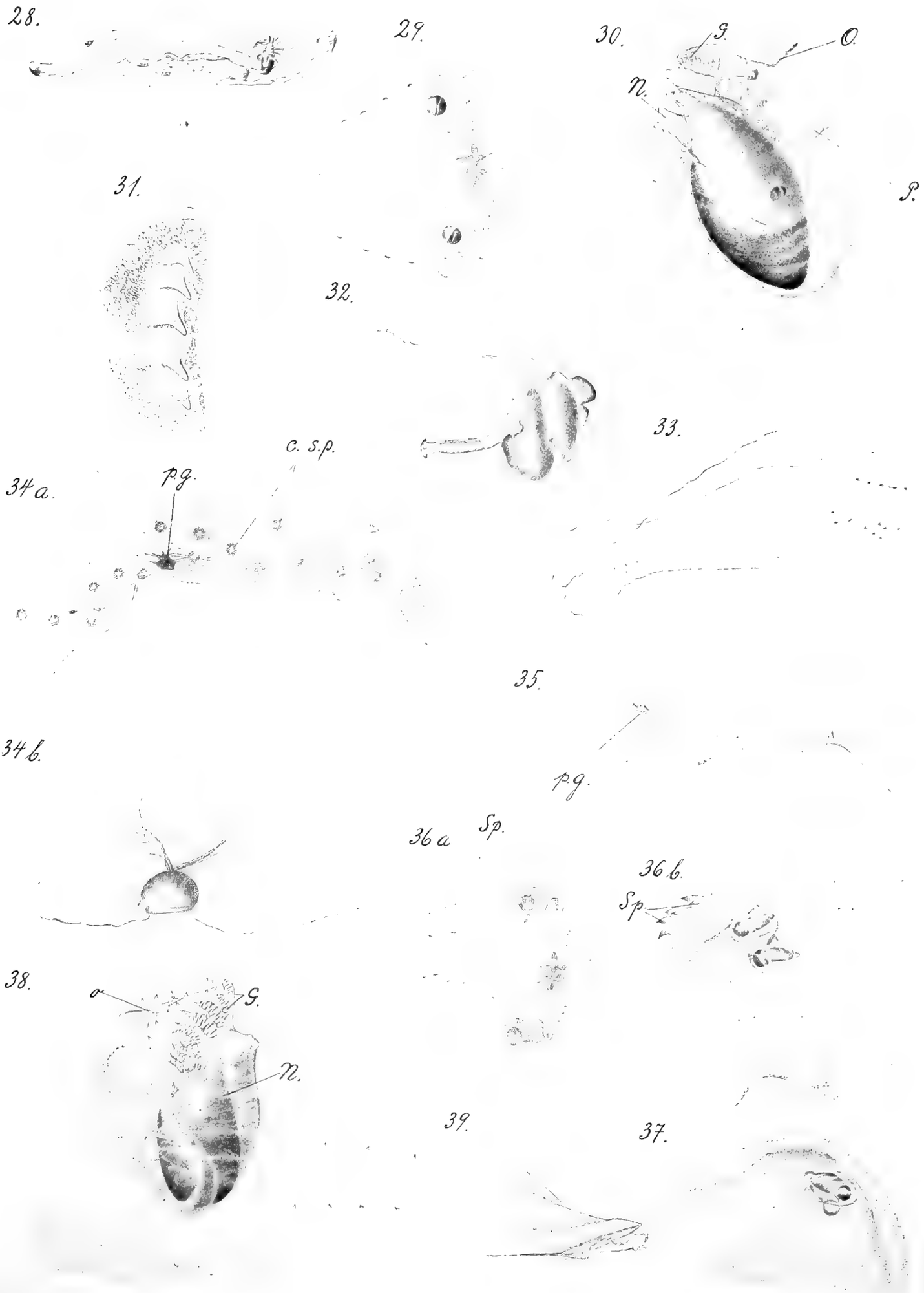
21.

24.

27.

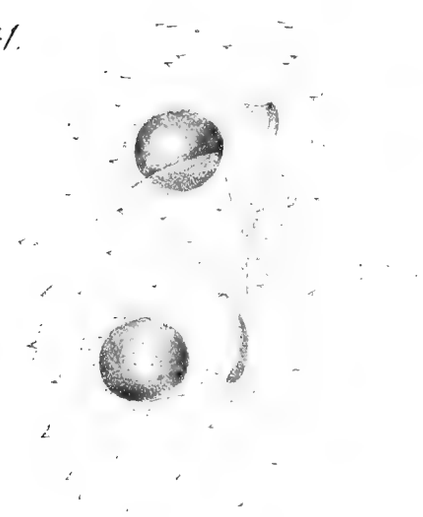
25.

26.


28.
29.
30.
S.
O.
n.
P.
31.
32.
33.
c. s.p.
34 a.
p.g.
34 b.
35.
p.g.
36 a
Sp.
36 b.
Sp.
38.
a
S.
n.
39.
37.

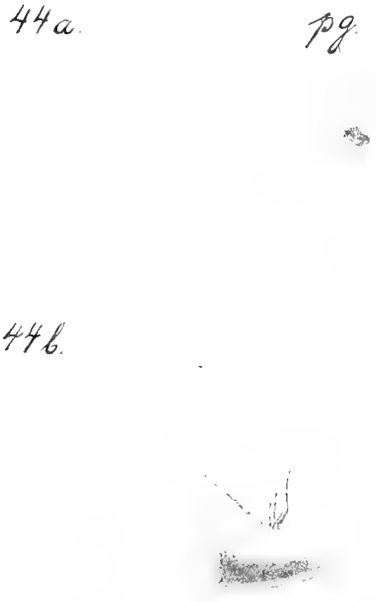

40.

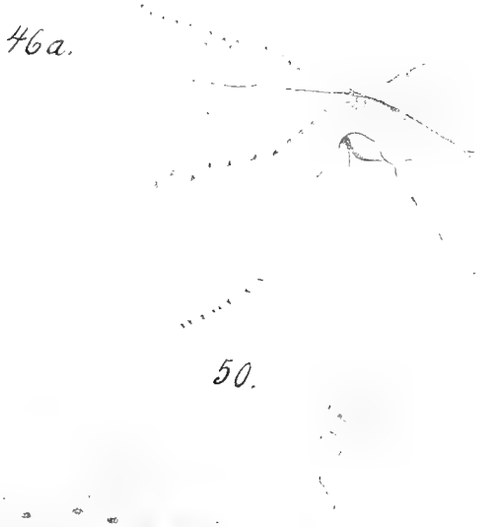

43.
o.
g.
n.
l.t.


41.


42.
p.t.


45

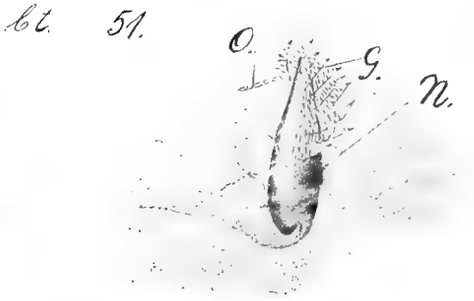

44a.
pg.
44b.


46a.
50.


46b.

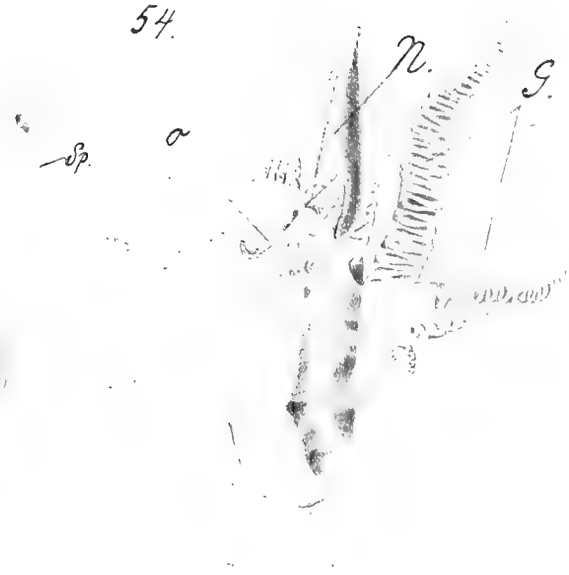

47.
49.


48.
pg.
s


lt.
51.
o.
g.
n.
52.

53.

54.



55.

58.

57.

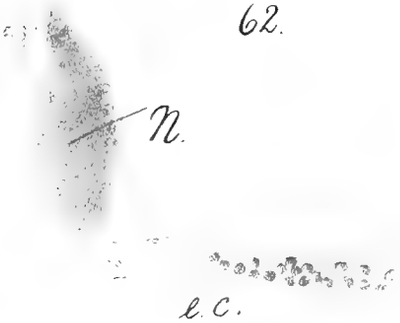
59.

56.

60.

61.

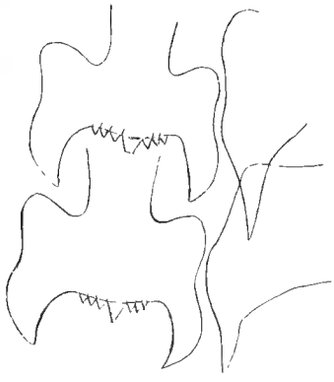
62.



64.

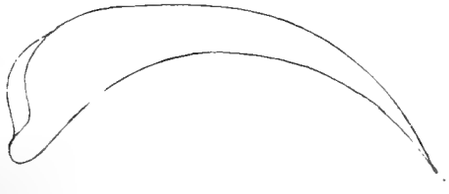
63.

66a.



65.

66b.



PENEIDES AND STENOPIDES

FROM THE

"MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

OSCAR SUND

WITH 2 PLATES, 49 FIGURES IN THE TEXT, AND CHARTS

Contents.

Introduction.

This paper, dealing with the Penæids and Stenopids, forms the first part of the memoir upon the decapod Crustaceans taken during the "Michael Sars" North Atlantic Deep-Sea Expedition in 1910. Subsequent papers will treat of the other prawns and of the Reptantia in a similar manner, and will contain a general account af the decapod fauna of the Atlantic from the geographical and biological points of view, based upon the material collected by the Expedition.

The technical terms used are those generally employed in modern works. In stating the size of a specimen I ahve made a departure from the usage hitherto common, giving the lateral length of the carapace (measured from the ocular sinus to the hinder edge of the carapace) where not otherwise stated. I have introduced this innovation because the total length is often very difficult to determine accurately and, when the rostrum is included, this measurement may give a false idea regarding the dimensions of the animal, as the relative length of the rostrum differs exceedingly, not only in the different species of decapoda, but also in different individuals of the same species.

For most species tables are inserted indicating (1) the dimensions, i. e. length of carapace, (2) the bathymetrical distribution, and (3) the number of specimens taken. The depths are estimated as equal to half the length of wire paid out (m. w.), and in the opinion of mr. Thor Iversen, the captain of the "Michael Sars" during the Expedition, this estimate is generally not far from the truth.[1]) But even if one knew the actual depth at which the appliances were towed, it must be borne in mind that an animal may occasionally be caught while hauling in. The influence of this source of error is however considerably lessened in the case of species taken in great numbers, as the number of specimens caught during the short time required to haul will always be small compared with the number taken during the long time devoted to towing horizontally. The following abbreviations are made use of:—

mxp.^{3} = third maxilliped
trl^3 = „ pereiopod (trunkleg) } after HANSEN 1896.
1 sn. = silknet, 1 metre in diameter.
y. = young-fish trawl (with an opening of four square metres).
3 ln. = large net, 3 metres diameter.
m. w. = metres of wire paid out.

In the tables indicating the catches, each specimen is represented by a figure denoting its size, following the sign for sex., e. g. ♂ 5 = a male with carapace 5 millimetres long; ♀ 6·7 ♂ 5·7 = two females and two males, the length of carapace being respectively 6 and 7, and 5 and 7 mm. The sign ⊙ is used to indicate immature specimens, the sex of which could not be determined.

I take the opportunity of offering my thanks to dr. HJORT for placing in my hands for examination the rich collections from the Expedition he so succesfully carried through.

The printing of this paper, which was ready in manuscript in 1915, has been delayed by the fire in jan. 1916 and by war-time difficulties. Litterature appeared since 1915 has consequently not been considered.

Bergen, jan. 1920.

---

[1]) Subsequent scrutiny of the records has, however, shown that the depth attained may go up to two thirds of the length of wire paid out. The steepness of the wire is apparently greater when a great length is out, on account of the lesser speed caused by the greater resistance from the great number of nets which were attached to the single wire. See also J. GRIEG: Brachiopoda etc. (in the present volume), p. 5.

PENEIDES.

Sergestidæ.

This family contains the genera *Sergestes*, *Leucifer*, *Aphareocaris* and *Petalidum*, of which the two last-named are not represented in the "Michael Sars" collections.

For information regarding the species not treated of in this paper, readers are, above all, referred to Hansen's papers (1896 and 1903).

Leucifer Reynaudii, H. Milne Edwards.

This tiny transparent animal, which looks so little like a shrimp, seems to belong exclusively to the surface of the sea. It was taken in the S. E. portion of the area only.

I have not had access to Milne Edwards' original description; but have determined the specimens by means of Bates' drawings and description in the "Challenger" Report.

Table of catches.

St.	Gear	m. w.	Number	Sex
29	1 sn	0	1	1 ♂
45	1 sn	200	1	1 ♂
„	1 sn	100	9	4 ♀ 5 ♂
46	1 sn	0	2	1 ♀ 1 ♂
47	½ sn	40	13	8 ♀ 5 ♂
48	½ sn	7800	1	1 ♂
49	y	370	1	1 ♀
51	1 sn	0	113	43 ♀ 70 ♂
52	1 sn	0	43	22 ♀ 21 ♂
8	9		184	105 ♂ 79 ♀

Sergestes.

For the synonymy of this genus I refer to HANSEN (1896).

Ever since the first *Sergestes* was captured the genus has been a source of difficulty, and even now, I believe, there is still much to be added to our knowledge of it, especially concerning the rôle which *Sergestes* plays as a component of the oceanic plankton. Two circumstances seem to have obscured our knowledge regarding *Sergestes*, (and this applies also to many other oceanic animals), viz: (1) the adults live generally at some distance from the surface and are consequently more difficult to obtain than the small larvæ, usually found in the uppermost waterlayers; (2) the adults seem to be powerful swimmers and hence were not so easily captured before the introduction of steamships in marine investigations allowed of the deep-sea appliances being towed at a greater speed than was formerly practicable.

During the "Michael Sars" Expedition in 1910 the Atlantic watermasses were investigated by means of effective tow-nets, etc., and the captures of presumably swiftly swimming animals like fish and prawns were considerable, not to be compared to anything brought home by former expeditions. Our knowledge of the genus *Sergestes* has been much extended by an examination of the rich material collected.

Firstly I should like to point out that *Sergestes* and some other prawns (Hoplophoridæ and Pasiphaidæ) form an essential part of the oceanic mesoplankton, and probably play an important rôle as food for fishes, whales and other large aquatic animals.

Not only are the "Michael Sars" plankton samples rich in quantity, but they also contain many new forms, and have led to a better understanding of the relationship of the forms previously described. Thus of *Sergestes* four new species are described in this paper, viz: *S. grandis*, *S. splendens*, *S. tropicus* and *S. pectinatus* and the adults of two species formerly known only as larvæ were found in great numbers in the Atlantic, viz.: *S. armatus*, *Kr.* and *S. corniculum*, *Kr.*

Since Hansen's two important papers on *Sergestes* were published (1896 and 1903) our knowledge of the genus cannot be said to have been greately extended. Explorations in the Mediterranean have proved the existence in that sea of a good number of the Atlantic forms (Pesta 1913, u, f).

The following key is in its main features similar to that given by Hansen in 1896, though synonyms and names applying only to larvæ are not included, while some slight alterations are introduced. *S. corniculum Kr,* is transferred to group B II, as made necessary by a study of the adult. The same is done with *S. rubroguttatus* Wood Mason which undoubtedly is nearly related to it.

A number of species not captured by the expedition, and of which our knowledge is rather incomplete, are not included, e. g. *S. hamifer* Wood Mason, etc.

The species taken by the "Michael Sars" are printed in heavy type and the letters after each name denote the main facts about their distribution, *A* signifying the Atlantic Ocean, *P* the Pacific, *I* the Indian and *N* the Norwegian Sea, *M* the Mediterranean.

Review

of the species of *Sergestes*.

Names of species treated in this paper are printed in heavy type.

A. First joint of antennular peduncles much longer than third.

I. Two outer joints of antennular peduncles robust, nearly as broad as first

1. Cornea small, not broader than stalk, integument soft.....
   - ***S. mollis*** Smith ..... A.
   - *S. inous* Faxon..... P.
   - *S. japonicus* Bate..... P.
   - *S. profundus* Bate ..... P.

2. Cornea larger than stalk, skin hard as in prawns.
   - a. No ocular spot or tubercle
     - α. No luminous organs (?) .....
       - S. *bisulcatus* W. Mason ..... I.
       - *S. bisulcatus* Stebbing ..... A.
       - *S. prehensilis* Bate..... P.
     - β. Luminous organs present
       - \+ On scaphocerite and uropods only .....
         - ***S. robustus*** Smith ..... N.A.M.
         - ***S. grandis*** n. sp. ..... A.
       - ++ Also on other parts .....
         - *S. Challengeri,* H. J. H..... P.
   - b. Ocular spot present .....
     - *S. gloriosus* Stebbing ..... A.
     - ***S. splendens*** n. sp. ..... A.
     - *S. Gardineri* Kemp, ... I.
   - c. Ocular tubercle present.....
     - *S. Kröyeri* Bate ..... P.
     - *S, phorcus* Faxon ..... P.
     - ***S. tropicus*** n. sp..... A.

II. Two outer joints of antennular peduncles slender much narrower than the first

1. Body very slender, cephalic portion very long ..... ***S. tenuiremis*** Kr..... A.P.I.
2. Body not so slender, no abnormal distance between mouth and eyes:
   - a. Hairfringe on more than half the length of outer uropod
     - ***S. arcticus*** Kr. ..... N.A.M.
     - *S. similis* H. J. H..... P.
   - b. Hairfringe on less than half the length..... ***S. Henseni*** (Ortm.) H. J. H. .. A.

B. First joint of antennular peduncle shorter than third or of same length.

I. Mxp.[3] not thicker and longer than trl.[3] Outer edge of outer uropods fringed with setæ for less than half their extent, the hairfringe limited proximally by a tooth.

1. No spine on epimeron of 5th abd. segment ..... ***S. atlanticus*** H. M. Edw..... M.A.I.P.
2. Curved spine present on 5th abd. epimeron ..... ***S. cornutus*** Kr. ..... A.

II. Mxp.[3] more robust than trl.[3] Tooth on outer uropods generally absent.

1. 6th joint of mxp.[3] divided into 6 subjoints .....
   - ***S. corniculum*** (Kr.) ..... M.A.I.P.
   - ***S. Edwardsi*** Kr. ..... A.
   - *S. rubroguttatus* Wood Mason[1]) I.
2. 6th joint of mxp.[3] div. into 5 subjoints. Mxp.[3] with "comb-like" row of short spines ..... ***S. pectinatus*** n. sp..... A.
3. 6th joint of mxp.[3] divided into 4 subjoints.
   - a. Hairfringe on less than half the length of outer uropod. *S. incertus* H. J. H. ..... A.
   - b. Hairfringe on more „ —„— —„— —„—
     - α. 20—25 spines on 6th joint of mxp.[3]..... ***S. vigilax*** Stimpson ..... A.
     - β. 13—15 „ - 6th „ - „
       - \+ 3rd joint of antennular peduncle as long as the 1st *S. diapontius* Bate, H. J. H. .... A.
       - ++ 3rd joint of antennular peduncle 1/3 longer than the 1st..... ***S. armatus*** (Kr.) ..... A.

[1]) The structure of the mxp.[3] not known to me, but probably like that of *S. corniculum*.

Sergestes tenuiremis Kröyer.

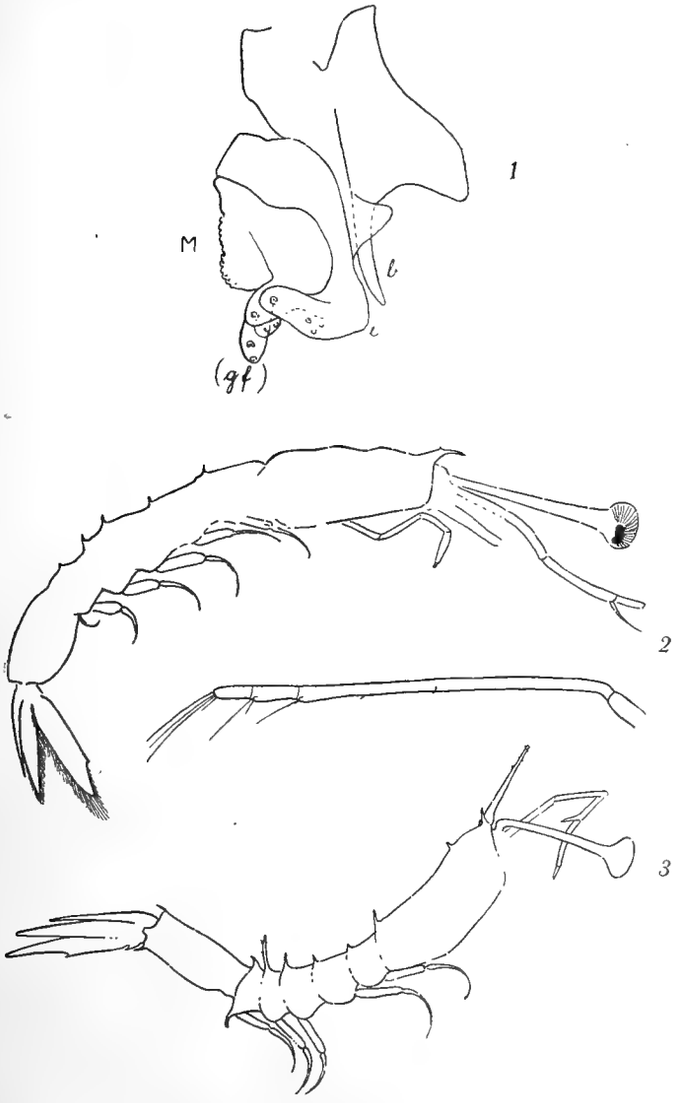
S. longicollus BATE 1888.
S. junceus BATE 1888.
S. tenuiremis HANSEN 1896.

Only a single young specimen was taken during the expedition, C = 7 (total length about 17 mm.), at st. 64. 1 sn, 100 m. w. The eyes are not black, and the sex cannot be determined.

According to HANSEN (1896) *S. tenuiremis* is known from all three oceans, though only from their warmer areas, the most northerly record being lat. 32° 16′ in the Atlantic. St. 64 lies in lat. 34° 44′ N.

Sergestes cornutus Kröyer.

S. cornutus KRÖYER 1855.
S. longispinus BATE 1888.
S. cornutus HANSEN 1896.



Figs. 1—3. *Sergestes cornutus*. 1) ♂ 5, st. 45, y 2000. Petasma, (50/1). 2) ⊙ 2·5, st. 64, y 300, (10/1). 3) ⊙ 1·7, st. 49, y 300, (15/1).

A few specimens of this species were taken in the southern part of the area explored by the "Michael Sars". Previously it was known from the central Atlantic as far north as the latitude of Florida, and, according to ORTMANN (1893), from the central Pacific.

Fig. 1 is a drawing of the petasma. The specimen is possibly not fully developed, as it is difficult to form an idea about the homology of the part compared with the structure found in other species. The process marked *b* certainly corresponds to *b* in the petasma of S. *robustus*.

HANSEN, in his description of the mastigopus states that the fourth segment of the abdomen does not carry any spine, but in nearly all the "Michael Sars" a dorsal spine is found, even up to a size of C = 4 (L = about 14 mm.) and where it is lacking it seems to have been broken off. Fig. 2 is a drawing of a specimen 7·5 mm. long (C. = 2·5). Fig. 3 is the smallest specimen in the collection (C = 1·4 mm.), taken at st. 49.

St.	Gear	m. w.	Number	Sex, size
45	y	2000	1	♂ 5
48	1 sn	0	2	♂ 4 ♀ 4
49	y	370	2	♀ 4 ⊙ 1·4
53	1 sn	200	1	⊙ 3·5
64	1 sn	200	3	⊙ 2·6, 2·2, 2·1
„	y	300	4	⊙ 2·5, 2·1, 2·0, 1·9
„	3/4 sn	600	1	⊙ 2·9
67	3/4 sn	800	1	⊙ 3·3
(6)	(8)		15	

Sergestes atlanticus H. Milne Edwards.

S. atlanticus, H. MILNE EDWARDS 1830
S. frisii, KRÖYER 1855.
S. ancylops, KRÖYER 1855.
S. pacificus, STIMPSON 1860 (fide HANSEN 1896).
S. ovatoculus, BATE 1888.
S. atlanticus, do. (partim).
S. atlanticus, H. I. HANSEN 1896 and 1903.

H. I. HANSEN in his papers of 1896 and 1903 has fully discussed the synonymy, and traced the development, of this species, which proves to have a world-wide distribution in the warmer seas. During the "Michael Sars" Expedition it was taken only along the southern section, and mostly in the upper waterlayers, though the adults seem to descend to intermediate depths.

Table of batymetrical distribution.

Depth[1])	Hauls	Size (C)		Total
		2—4	5—7	
0—200	18	53	36	89
200—500	3	4	4	8
over 500	13	6	22	28
Total....	34	63	62	125

[1]) The depth is estimated as half the length of rope ("m. w.").

Table of sizes. (C in mm.)

Size.....	1½	2	2½	3	3½	4	5	6	7
Males.....							7	5	3
Females ..							5	15	7
Young ... } Indet. .... }	3	22	1	18	3	16	10	6	4

Fig. 4. *S. atlanticus*, ♂ 7, st. 48, ½ sn 7800, petasma, (15/1).

In this species, the length of the carapace (C) seems not to exceed 7 mm. corresponding to a total length of about 20 mm. A figure is given of the petasma (fig. 4).

Table of catches. (Hauls made during night marked *)

St.	Gear	m. v.	Number	Sex, size
19	4 In	900	1	⊙ 2
25*	½ sn	3400	1	♀ 6
29	y	400	5	♀ 7, ♂ 6, 5, 5, 5
„	y	2000	2	♀ 6, ♂ 7
34*	y	400	1	♀ 7
42*	y	900	1	♀ 6
45*	1 sn	200	2	⊙ 3, 3
„*	y	300	3	♀(?) 7, 6, 6
„*	y	2000	2	♀ 7, 7
48	1 sn	0	1	⊙ 4
„	½ sn	7800	1	♂ 7
49*	y	2000	1	⊙ 3
51*	1 sn	0	4	♂ 7, ⊙ 3, 3, 2
52	1 sn	0	15	7, 7, 7, 6, 6, 6, 6, 5, 5, 5, 5, 4, 4, 2 1½
„	½ sn	100	1	⊙ 1½ (dubious)
„	3 sn	1200	1	7
53*	1 sn	0	9	6, 5, 5, 5, 5, 4, 4, 4, 3
„*	1 sn	100	11	♀ 6, 6, ♂ 6, 6, 6, 5, 5, 5, ⊙ 3½, 1½
„*	y	300	2	♀ 6, 6
„*	y	1600	1	⊙ 3
„*	3 In	2600	2	♀ 6, 5
56*	1 sn	0	2	⊙ 3½, 3½
„*	1 sn	100	1	⊙ 3
„*	y	2000	1	⊙ 4
„*	3 In	3000	2	♀ 7, 6
62*	1 sn	0	2	⊙ 4, 2½
64	1 sn	200	11	⊙ 4, 3, 2, 2, 2, 2, 2, 2, 2, 2, 2
„	y	300	15	⊙ 4, 4, 4, 3, 3, 3, 3, 3, 2, 2, 2, 2, 2, 2, 2
„	¾ sn	600	1	⊙ 2
„	y	1000	2	⊙ 5, 4, 2
„	y	2000	4	6, 5, 5, 3
„	¾ sn	2500	3	♀ 5, ♂ 6, 5
67	y	200	5	⊙ 4, 3, 3, 3, 3
„	y	1200	6	♀ 7, 6, 6, 6, ⊙ 4, 4
69	1 sn	200	1	⊙ 2
80	¾ sn	600	2	⊙ 5, 5
17	36		125	

Sergestes arcticus Kröyer.

S. arcticus, Kröyer 1855.
S. atlanticus, Bate 1888 (partin).
S. arcticus, Hansen 1906.
S. arcticus, Wasserloos 1908.

This species seems to bee commonest of the genus, and was indeed captured by the "Michael Sars" Expedition in all regions of the North Atlantic. Its anatomy is so well known that it is unnecessary to add anything but a drawing of the petasma (fig. 5), to show the homologies with *S. robustus*, the petasma of which I have taken as the standard of comparison (see fig. 11). It will be seen that the part *d* is not found in *S. arcticus*, while the part *c*, which in most species is unarmed, is in this species armed with a row of spine clusters. This structure is figured by Kemp (1910) pl. III.

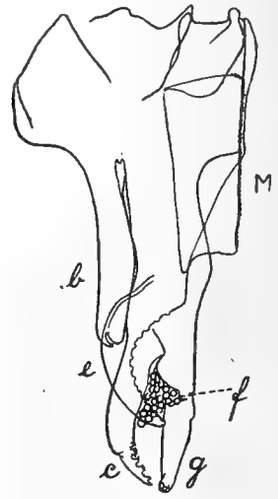


Fig. 5. *S. arcticus*, ♂ 16, st. 102, 3 In 1500, Petasma, (15/1).

The "Michael Sars" specimens are arranged according to size in the following table:

	Sizes (C in mm.)																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Males.....												3	5	1		1			
Females.....												2	2	4	5	5	4	3	2
Young.....	18	23	2	8	19	26	20	6	9	1	2								

The vertical distribution differs for the larvæ and for the adults, and is correlated with the fact that the latter posses a fair amount of red pigment (see Kemp 1910, p. 32), while the larvae are nearly colourless. (Compare this with the table of vertical distribution of the different sizes).

Depth m.	Hauls	Size (C in mm.)			Total
		1—9	10—15	16—19	
0—200	12	55	1		56
201—500	14	48	5		53
over 500	17	27	18	15	60
Total	44 1)	100	24	15	170

It appears that the grown up individuals do not ascend much beyond 500 m. from the surface, the species resembling in this respect *Acantephyra purpurea* and other prawns, the horizontal distribution of which it also shares, being found all over the Atlantic, as far north as 65° N. lat. between Iceland and Greenland. It has also been taken in the Norwegian Sea on several occasions both by Danish

1) One haul from unknown depth.

and Norse Expeditions, on the Norwegian Coast as far north as in the Trondhjem-fiord. In May 1911 it was taken in the Sogne-fiord along with *Pasiphæa principalis* and *P. multidentata* (SUND 1913). Generally it may be stated that *Sergestes arcticus* in the Northern Atlantic has nearly the same distribution as the genus *Pasiphæa*.

Table of catches. (Hauls during night marked *)

St.	Gear	m. w.	Number	Sex, stze
10	y	300	1	♀ 11
„	?	?	1	♀ 12
19	4 ln	900	5	♀ 12. 11, 10, ⊙ 6, 5
23*	y	400	1	⊙ 7
42*	1 sn	200	1	♀ 8
53*	y	1600	1	⊙ 5
62*	1 sn	0	2	⊙ 5, 4
„*	y	1000	4	⊙ 6, 6, 6, 5
64	1 sn	100		1 mast.
66	3/4 sn	1500	9	⊙ 7, 7, 7, 7, 6. 6, 6, 6, 4,
„	3/4 sn	1000	2	⊙ 6, 6
„	y	1500	4	⊙ 7, 7, 6, 6,
70	3/4 sn	70	3	⊙ 8, 7, 5
„	y	1700	19	♀ 19, 18, 18, 17, 17, 17, 16, 16, 15, ♂ 14, 13, 13, 13, 13, 13, 12, 12, 12, ⊙ 7
80	y	1000	5	♀ 15, 14, ⊙ 5, 5, 5
„	3/4 sn	1500	1	⊙ 6
„	y	2000	1	♀ 16
„	3 ln	3000	2	♀ 18, 16
81	1 sn	100	7	4 mast., 3 acanthosoma
„	3/4 sn	600	1	⊙ 3
82	1 sn	100	20	5 mast., 15 acanthosoma
„	1 sn	200	13	mastigopus
84	3/4 sn	600	1	⊙ 4
„	3/4 sn	1500	2	⊙ 5, 4
87	y	1000	12	⊙ 8, 7, 7, 7, 7, 6, 6, 6, 5, 5, 5, 5
88	1 sn	100	2	⊙ 8, 7
„	y	300	2	⊙ 7, 7
„	y	1000	4	⊙ 9, 9, 6, 6
90	3/4 sn	600	2	⊙ 5, 4
„	y	1000	3	⊙ 9, 9, 6, 6
92*	1 sn	100	2	⊙ 6, 4
„*	y	300	2	⊙ 9, 9
„*	y	2000	1	⊙ 4
94	3 ln	2000	1	♀ 14
98	1 sn	200	2	⊙ 5, 5
„	y	600	3	⊙ 9, 8, 7
„	y	1000	5	⊙ 9, 9, 6, 6, 6
„	3/4 sn	1450	1	⊙ 6
„	3 ln	1500	10	♀ 19, 16, 15, 15, 14, 13, ⊙ 9, 8, 7, 7
101	y	600	4	⊙ 7, 5, 5, 5
„	3/4 sn	1500	2	⊙ 6, 4
„	y	2000	2	♀ 17, ⊙ 5
„	3 ln	2500	3	♀ 15, 14, 13
102*	y	600	3	⊙ 6, 3, 3
„*	3 ln	1500	1	♂ 16
21	45		170	♂ 10, ♀ 27, ⊙ 133

Sergestes corniculum (Kröyer).

S. corniculum, KRÖYER 1860 (larvæ).
S. corniculum, BATE 1888 (do.)
S. corniculum, HANSEN 1896 (do.)
S, corniculum, HANSEN 1903 (do.)
? *S. rubroguttatus*, LO BIANCO 1904 (adult).
? *S. rubroguttatus*, PESTA 1913 (adult).
S. vigilax, STEPHENSEN 1913 (do.)

Young specimens of this species were described by Kröyer in 1860, and later on HANSEN (1896) gave further particulars, and added a description of stage still younger than that described by Kröyer. The adult was captured in the Mediterranean by the "Puritan" and a drawing of it was published by LO BIANCO (1904).—It was subsequently examined by Pesta and Stephensen, who gave drawings of the petasma. I am not quite sure that the Mediterranean species is identical with the Atlantic one; there seems to be a very slight difference in the form of the petasma but it may be accidental.

This fine large species is closely related to *S. rubroguttatus*, Wood Mason.

That I am right in referring the adult form to the species described from larval specimens by Kröyer is proved by a study of the outer maxillipeds. Fig. 6 shows the 6th joint in an adult and in a mastigopus; in the lastnamed the four distal subjoints are not yet distinctly divided from each other, and in neither can the subdivision of the two long proximal subjoints, mentioned by Hansen, be seen with certainty.

The branchial apparatus agrees closely with the description given by HANSEN (1896, p. 957). In the adult the relative lengths of the four posterior branchiæ (those above the 3rd and 4th pereiopods) are about as follows: 9—3—6—4.

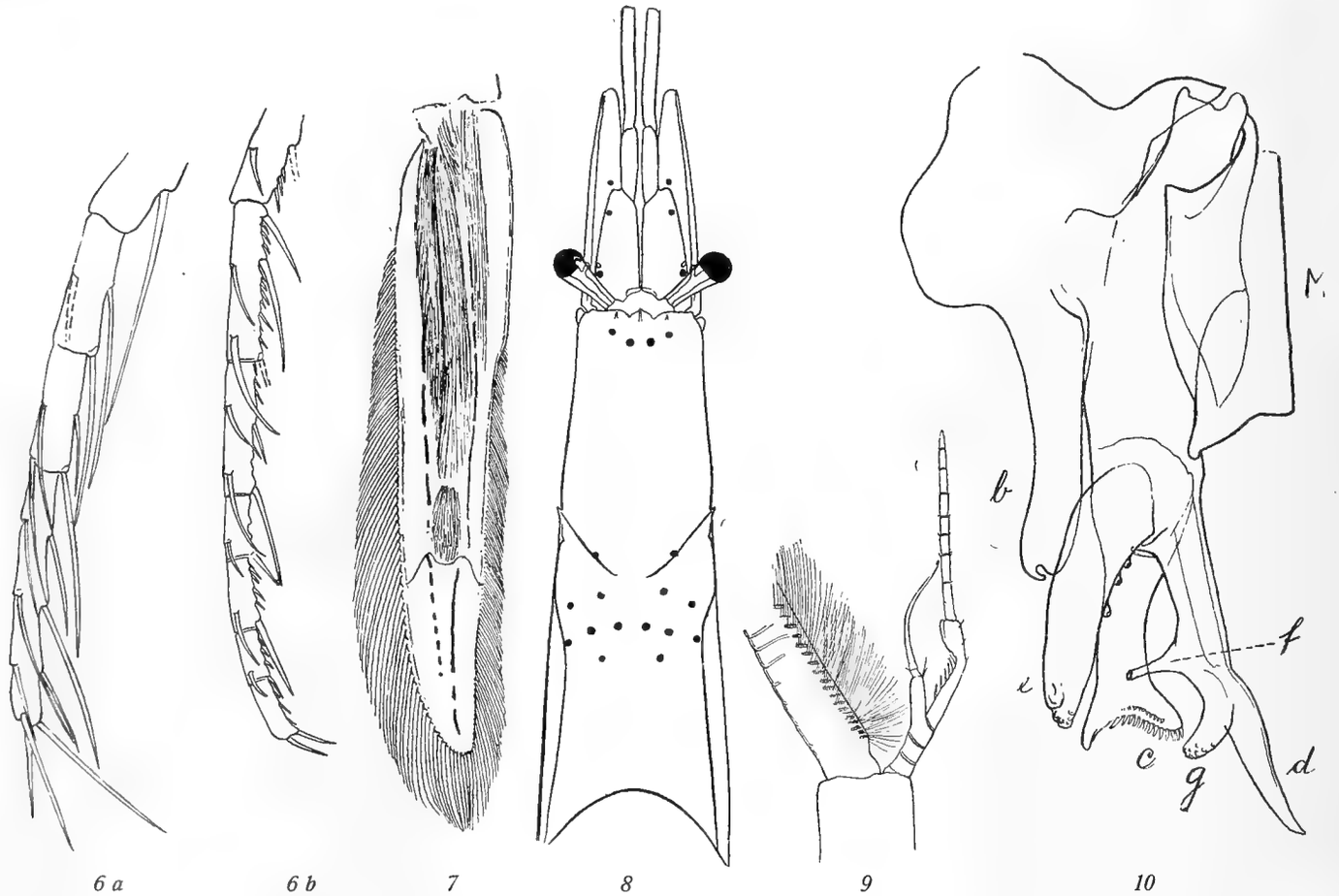
The mxp.^{3} do not differ very much from the pereiopods, an only the proximal two-fifths of the external uropods are devoid of setæ on the outer edge. Nor does this edge carry any spine (see fig. 7). The rostrum (Pl. II, fig. 1) is small, ending in a blunt tooth, directed forward. Ocular and hepatic spines present. Cervical groove distinct; so are also the branchiocardiac groove and ridge, which run backwards to the edge of the carapace. The pleon is smooth, the pleuræ rounded, and the sixth somite is very powerful, being nearly twice as long and one-half deeper than the fifth.

The integument is transparent (but not soft) save for some red spots on the fore part of the body (see fig. 8).—The pleon also probably carries such patches, but they are not visible in the preserved material. The stomach is of a bright red colour, clearly visible through the transparent body. *S. rubroguttatus* Wood-Mason is the only other species of this type of colouring.

The eyes reach about to the middle of the 1st segment of the antennular peduncles, the diameter of the cornea being about half the length of the ocular peduncles, which carry on their inner side and near the edge of the cornea a low colourless tubercle, which is seen to receive a branch of the optic nerve.

The antennular peduncle is slender, about two-thirds the length of the carapace. The first joint is slightly shorter than the third, which is about one half longer than the second. The internal flagellum in the male differs slightly from that in *S. rubroguttatus*, figured by Wood-Mason 1892. Compare his figure with fig. 9.

The scaphocerite reaches about to the middle of the third joint of the antennular peduncles. Its outer edge is gently curved from base to tip, and more strongly in the outer half. The terminal spine is short and stout.



6 a *6 b* *7* *8* *9* *10*

Figs. 6—10. *Sergestes corniculum.* 6 a) Outer end of third maxilliped, ⊙ 3·2, st. 67, y 200. 6 b) The same, ♀ 17, st. 62, 3 ln 3000. 7) Outer uropod, ♀ 15, st. 51, y 300, ($^{10}/_{1}$). 8) Forepart of ♂ 15, st. 51, y 300, ($^{5}/_{1}$). 9) First antenna, ♂ 17, st. 51, y 300, ($^{10}/_{1}$). 10) Petasma, ♂ 15, st. 51, y 300, ($^{30}/_{1}$).

The petasma is strongly and very characteristically developed. In general plan it resembles that of *S. robustus*, but the processes *c* and *d* are much more developed, while the processes *g* and *f* are reduced both in size and armature. Thus the process *f* in *S. corniculum* has only a single hook, situated on the tip, while the end of *c* is broadened and terminates with a row of "claws". Parallel with the terminal row is another, consisting of smaller claws.

The largest individual is a female, 55 mm. in total length, corresponding to a length of carapace of 19 mm.

Table of sizes.

Sizes (C)	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Males										1	1	1	2		3			8
Females										1	3	2	5	7	7	4	1	30
Young.....	1	2			2	5	3	3	1									17

This beautiful species was taken at most stations, except those situated in the NE quadrant of the area investigated, 55 specimens being procured.

The bathymetrical distribution is shown in the following table. Although the catches are not numerous it

appears that the species mostly lives in the intermediate waterlayers, and rises some hundred metres nearer to the surface during the dark hours.

Table of vertical distribution.

Depth (metres)	Hauls		Size (C in mm.)						
			3—10		11—19				
	D	N	D	N	D	N	D	N	
0—100	1	5	2	7		6	2	13	15
150—200	1	7	1	1	1	22	2	23	25
300—1700	4	6	4	2	2	7	6	9	15
Total	9	18	7	10	3	35	10	45	55[1]
Gr. tot...	27		17		38		55[1]		

Table of catches. (Hauls during night marked *)

St.	Gear	m. w.	Number	Sex, size
23*	1 sn	200	2	♀ 16, ♂ 13
„*	y	400	3	♀ 17, 16, ♂ 17
25	1/2 sn	3400	1	⊙ 10
29	y	400	2	♀ 12, ⊙ 9
34*	y	400	1	♀ 16
45*	y	300	2	⊙ 9, 11
49*	4 ln	1000-0	2	♀ 17, 17 (verticai haul)
„*	4 ln	3000	2	♀ 19, 17
51*	1 sn	200	1	♀ 15,
„*	y	300	6	♀ 17, 16, 15, 14, ♂ 17, 15
„*	y	2000	1	♀ 18
52	y	600	1	♂ 14
„	3 ln	1200	1	⊙ 7
53*	1 sn	100	4	⊙ 10, 8, 8, 4
„*	1 sn	200	2	⊙ 10, 8
„*	y	300	6	♀ 17, 16, 16, 15, 14, ♂ 15
„*	3 ln	2600	2	♀ 18. ⊙ 8
56*	y	300	1	♀ 18
„*	3 ln	3000	2	♀ 17, 15
58*	y	300	7	♀ 16, 15, 13, 13, 13, ♂ 17, 12
62*	1 sn	0	1	⊙ 4.2 (mast.)
„*	y	2000	1	⊙ 7
„*	3 ln	3000	1	♀ 15
64	1 sn	100	1	⊙ 3.0 (mast.)
„	1 sn	600	2	⊙ 4, 4
„	3 ln	3000	1	⊙ 9
67	y	200	1	⊙ 4.0
88	y	1000	1	♀ 18
15	27		57	8 ♂, 31 ♀, 18 ⊙

[1]) Two specimens from vertical haul not considered.

Sergestes robustus Smith 1882.

S. dissimilis, Bate 1888.
S. mediterraneus, Hansen 1896.
S. dissimilis, Hansen 1903(1, 2).
S. inermis, Hansen 1903(2).
S. robustus, Hansen 1908.
—„— Kemp. 1910.

Small individuals of this species were caught at nearly all the stations during the expedition, as well as a few fine adult specimens. The identification of this species proved to be very easy from Smith's description, especially as he has given a good drawing of the petasma, that appendage which should be used as the "ear-mark" in the genus *Sergestes*. Several doubtful species are in my opinion rendered „good" on the evidence furnished by the petasma. I have tried to use Smith's designations of the different parts of this appendage when dealing with other species, but in many cases the homology is rather doubtful, especially in very distantly related species, for instance *S. robustus* and *S. pectinatus*.

For the sake of a clearer understanding of the petasma I reproduce here Smith's drawing (fig. 11) and an additional figure of the outer portion, seen from behind, Smith's figure being seen from before. The "fingers" *f* and *g* seen from before look like separate members, but in fact form one piece, bent in two planes (see fig. 12).

The smallest individual in which I could detect a petasma was only 23 mm long (C = 7), and among the individuals of C = 8 I found three with petasma buds. Fig. 13 is drawn from a male of this size. There were twelve individuals with C = 8, in wich no petasma could be seen, but I dare not conclude that they are all females. When C excedes 9 I believe than the petasma should be easily seen, and I have therefore classed as females all the specimens above 9 mm (C) without petasma. The only adult female specimen is very like the male in appearance, except that the eyes are slightly smaller.

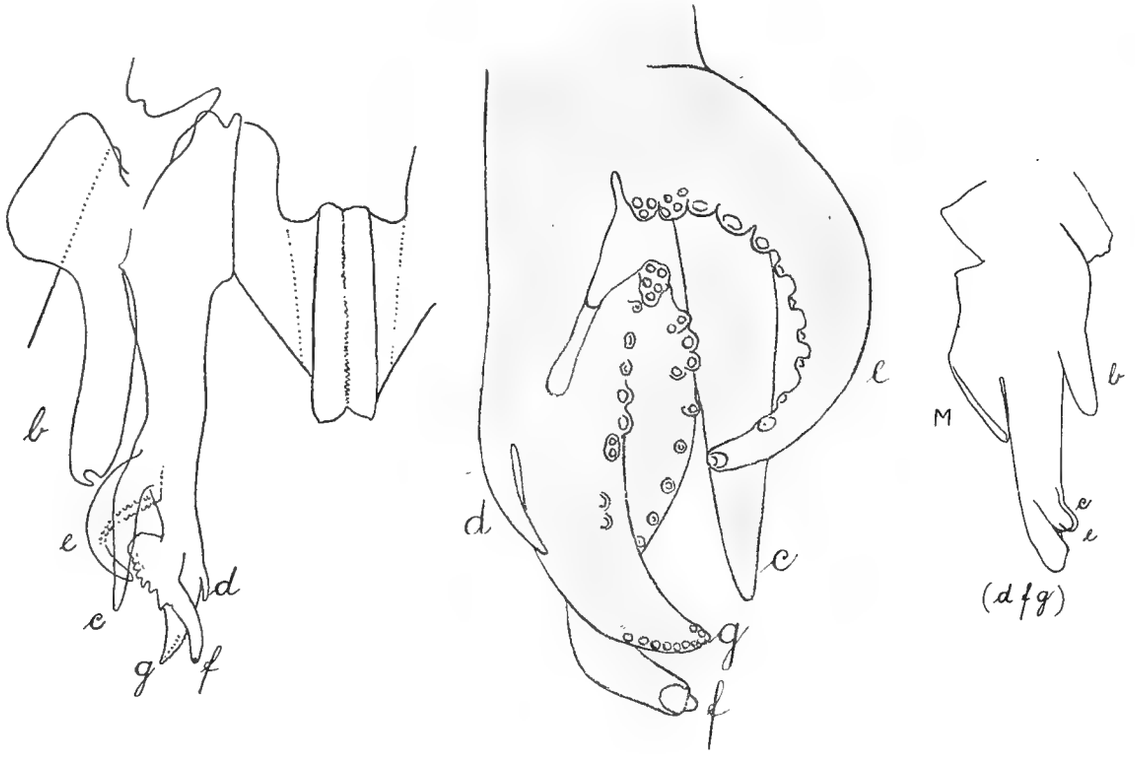
I cannot dismiss this opportunity of mentioning what I believe to be the luminous organs of *Sergestes robustus*. The structures in question are small opaque patches on the scaphocerite and on the outer uropods, arranged in a similar manner to that found in *S. challengeri. S. glorious* and *S. splendens*. In *S. robustus* there is a row of 14 patches on the scaphocerite: 7 along the outer edge of the muscle and 7 beyond the termination of it. On the outer uropod there are 12 patches, six situated in an irregular longitudinal row beyond the muscle, and six near the inner setose edge, in a row occupying the second fourth from the base of that edge. I have not been able to find such patches on other parts of the body

or appendages. On the outer uropods there are fine dotted lines, just as in *S. splendens*, which may also be luminous organs.

As the name denotes, *S. robustus* is one of the largest species in the genus. It should be mentioned that the abdomen in *S. robustus* is considerably longer than in *S. mollis*. The following table shows the number of specimens of each size and sex:

Length (total)		20		30			40			50			60			70			80		Total
L. of carap. (mm)	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			
Males			1	4	7	2	2						1	1	1		1	1			21
Females....				12	12	16	5						1								46
Young	10	26	44	4																	84

(The figures given for total length are only approximate).



11 *12* *13*

Fig. 11—13. *Sergestes robustus*. 11) Petasma, after SMITH (1884), (ca. 15/1). 12) Tip of Petasma, ♂ 18,st. 53, 3 In 2600, (50/1). 13) Petasma, ♂ 8, st, 67, y 1200, (50/0).

The peculiar feature of this table is that no specimens between 11 and 17 mm C. were caught. Is this to be interpreted as indicating that the material comprises two (or three?) yearclasses?

S. robustus was taken at 19 stations, on the northern and southern sections, to the W. of the British Isles, and, what is most remarkable, at st. 102 to the SE. of the Faeroes, in the part of the Faroe-Shetland Channel belonging to the Norwegian Sea, as well as in the Spanish Gulf and near the Canaries, but not on the route between the Canaries and the Azores.

It had previously been captured by „Blake" and the "Albatross" off the New England coast (Smith), in the Bay of Biscay by the "Caudan" (CAULLERY), in the Mediterranean near Crete (ADENSAMER) and near Sicily (LO BIANCO and RIGGIO). It has been taken at a number of localities to the W. of Ireland, and by Danish and Norwegian expeditions to the SW. of the Faroes. Generally it may be said that it is as yet known only from the Gulf Stream and from Mediterranean watermasses, inside and outside Gibraltar. Its apparent absence between the Canaries and the Azores may be accidental.

Vertical distribution of sizes.

Depth (metres)	Hauls	Size (C in mm)			Total
		5—8	9—12	17—22	
50—250	10	12	12		24
251—500	11	33	10		43
501—1000	14	36	5	1	42
> 1000	8	19	14	5	38
Total	43	100	41	6	147

From the vertical distribution as evidenced by the "Michael Sars" catches it appears that *S. robustus* is a deep-sea prawn, only the younger stages occurring in the upper strata, but never at the surface. There is a marked difference in the colouring of the adult and the young, the latter being almost transparent, only the purplish blue stomach shining through the carapace. The exceedingly beautiful colouring of the adult (scarlet lake with crimson spots, golden feather-bristles and blue reflections) is well described by Kemp (1910).

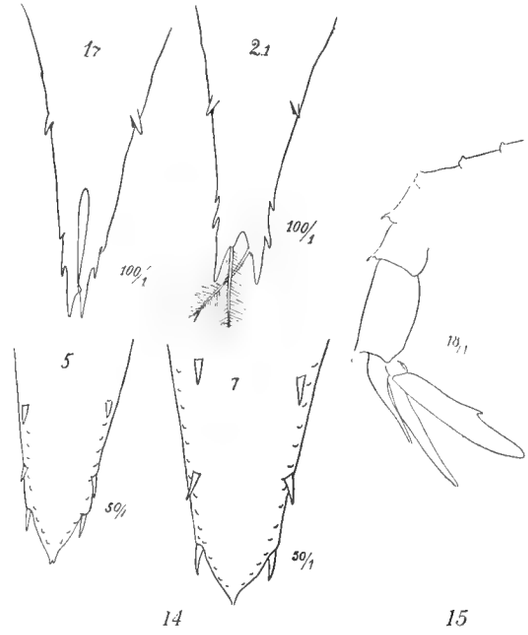
Table of catches, (Hauls made during neight marked *)

St.	Gear	m. w.	Number	Sex, size
23*	1 sn	200	5	♀ 11, 10, 9, 9, ⊙ 7
„*	y	400	2	♂ 10, ♀ 8
„*	T	(1215)	1	♀ 9
34*	y	400	1	♀ 9
„*	1/2 sn	600	2	♀ 9, 9
35	4 sn	2400-0	3	♂ 11, ♀ 11, 10
„	1/2 sn	4200	1	♀ 10
42*	y	900	4	♀ 11, 11, 10, 10
53*	y	300	2	♂ 10, ♀ 8
„*	y	600	2	⊙ 6, 6
„*	1/2 sn	2100	1	⊙ 7
„*	3 ln	2600	4	♂ 18, 17, ⊙ 7, 7
56*	1 sn	100	1	⊙ 7
„*	1 sn	200	1	⊙ 6
„*	y	300	5	⊙ 7, 7, 7, 7, 7
„*	y	1000	3	⊙ 7, 7, 7,
„*	y	2000	2	♀ 10, ⊙ 6
„*	3 ln	3000	13	♀ 10, 10, 10, 9, 9, 8, 8, ⊙ 7, 7, 7, 7, 6, 6
58*	y	300	3	♀ 10, ⊙ 8, 7
62	1 sn	200	2	♂ 9, ♀ 11
„*	y	1000	2	♂ 9, ⊙ 6
„*	y	2000	2	⊙ 7, 5
„*	3 ln	3000	2	♂ 19, 11
63	4 sn	1350-450	1	⊙ 8
64	y	2000	9	♀ 17, 10, 10, 10, 10, 10, ⊙ 9, 7, 7
„	3/4 sn	2500	2	♂ 8, ♀ 8
„	3 ln	3000	5	♂ 21, ♀ 8, 8, 8, ⊙ 7
66	y	1500	3	♂ 9, 7, ♀ 8
67	y	1200	14	♂ 8, ⊙ 7, 7, 6, 6, 6, 6, 5, 5, 5, 5, 5, 5, 5
81	y	2000	1	♂ 9
87	3/4 sn	1500	1	♀ 8
„	y	2000	2	♀ 8, ⊙ 7
88	y	1000	3	♂ 9, 8, ⊙ 7
„	3/4 sn	1500	1	♂ 9
„	y	2000	1	♀ 10
90	y	1000	4	♀ 9, 9, ⊙ 7, 7
92*	y	300	2	♂ 9, ♀ 9
„*	3/4 sn	600	2	♀ 8, ⊙ 6,
„*	y	1000	1	♀ 8
98	y	1000	18	⊙ 8 à 7, 9 à 6, 1 à 5 mm.
„	3/1 sn	1450	1	⊙ 6
„	3 ln	1500	10	♂ 22, ⊙ 8, 8, 7, 7, 7, 7, 7, 7, 7, 7
101	3/4 sn	1500	2	⊙ 6, 5
„	y	2000	2	⊙ 6, 6
102	y	1000	2	⊙ 7, 6
20	45		151	♂ 21, ♀ 46, ⊙ 84

Larvæ.

At the stations 51, 52, 53 and 64 a number of mastigopus stages were taken which I believe may be referred to *Sergestes robustus*. Their length is between 4 and 7 mm. (C = 1·7—2·5 mm.) and they agree perfectly with Bates' (1888), Ortmann's (1893) and Hansen's (1903) descriptions of *S. dissimilis*, which Hansen later (1908) cancelled as being the young of *S. robustus*[1]).

A study of the telson in these larvæ and in the subadult *S. robustus* and its nearest allies makes Hansen's statement probable, though some transitional stages (C = 3-4 mm.) are needed to make the series complete. Fig. 2 and 3, pl. I, are photographs of the head and tail-fan of a specimen 4·7 mm. long (C = 2·1), and in textfig. 14 outline drawings of telson of the same specimen and of



S. robustus (juv.). Fig. 14. Tip of telson in 4 young specimens. Size (C) inscribed in each drawing. The two smallest from st. 64 y 300, the others from s. 98, y 1000. Fig. 15. Abdomen of ⊙ 1.7 in fig. 14.

a smaller one (but subadult specimens of *S. robustus*) are given. I will be noted that the larvæ and the subadults possess the same number of lateral spines. In the smallest of the subadults (C = 5) the tip is still cleft while in the largest it has become simple. In one specimen with forked tip, not figured, a single tip was observed ready to take its place after moulting.

In the smallest larvae (C = 1·5—1·7) there were also spines on the 2nd and 3rd abdominal somites, in the very smallest (1·5) even on the first, while the specimens described by Bate (L = 10 mm.), by Ortmann (10—12 mm.) by Hansen (9·5 mm.) and the others taken

[1]) H. I. Hansen writes (1908): "It appears now that *S. dissimilis* is the mastigopus stage of *S. robustus*, so that intermediate stages have been described as *S. incertus* H. I. H. and as "the subadult stage of *S. mediterraneus* H. I. H." I presume that "*S. incertus*" in the passage cited is a misquotation for *S. inermis*.

by the "Michael Sars" (4·7—7·0 mm.) had spines on the 4th, 5th and 6th only, see fig. 15.

Larval examples of *Sergestes robustus* were taken on the following occasions:

St. 51, 0 m.w. one, C = 2·4 mm.
„ 52, 0 „ one, C = 1·5 „
„ 53, 60 „ one, C = 2·0 „
„ 64, 100 „ ten, C = 1·9—2·5 mm., one 1·5 mm.
„ „ 300 „ two, C = 1·7, 2·1.

Sergestes splendens n. sp.

This handsome species is a near relative of *S. robustus* which it resembles in the form of its powerful body (see fig. 16) though of much smaller size, the adult females not reaching a total length of 40 mm. The males are smaller. Though of such moderate size *S. splendens* has a stout and more muscular body than perhaps any other

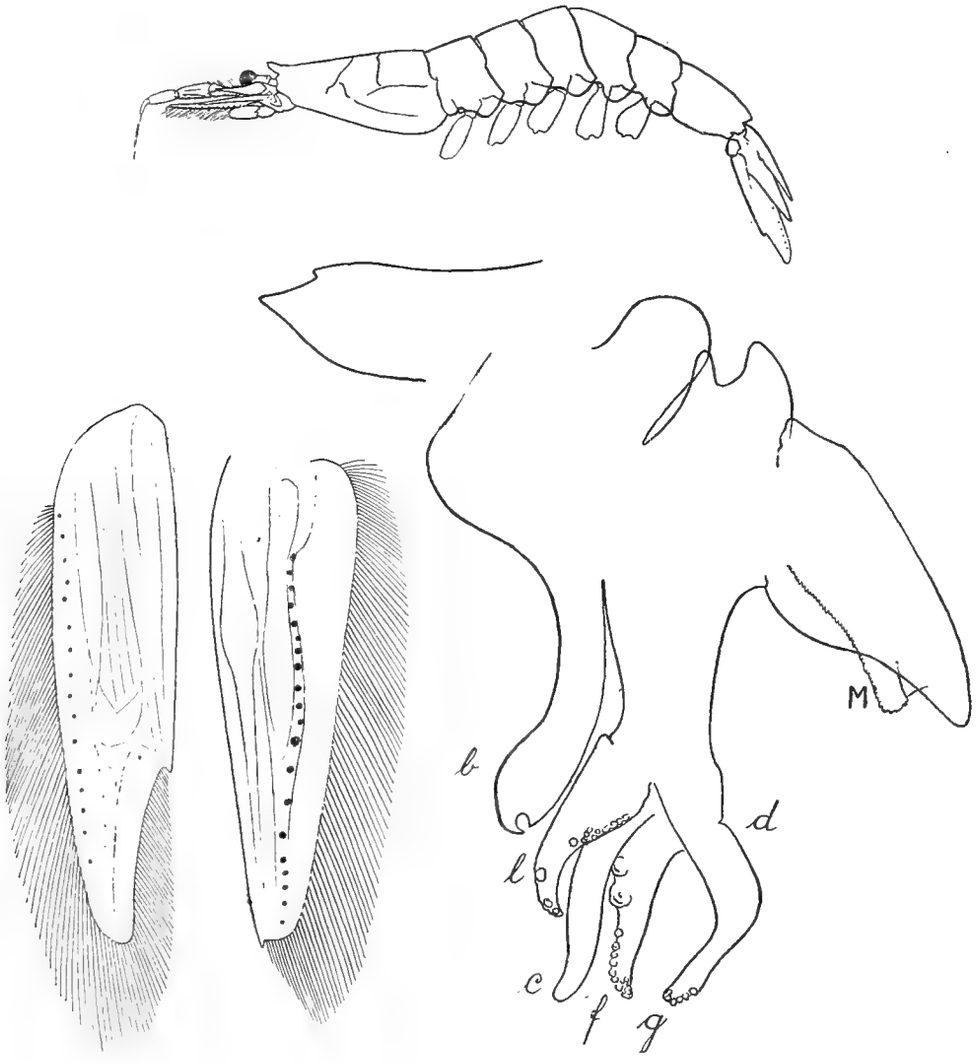


Fig. 16—18. *Sergestes splendens*, ♂ 10, st. 49, 3000. Outline of body (²/₁), rostrum (³⁰/₁), ext. uropod and scaphocerite (¹⁰/₁) and petasma (³⁰/₁).

Sergestes. The sizes of the specimens taken are given in the following table:

Number of	Length of carapace (mm.)									Total
	4	5	6	7	8	9	10	11	12	
Males.....	4	4	12	21	5	3	6			51
Females.....		14	5	22	3	3	6	1	1	55
Young	5									5

The rostrum is in most specimens of the form represented in fig. 16, though it is subject to some variation as will be seen from fig. 19.

The carapace has distinct grooves but no ocular spine, and the hepatic spine is represented only by a bluntly rounded lobe. The eyes are larger than those of *S. robustus*, and spherical. On the inner and upper side of the stalks there is the rudiment of an ocular tubercle.

The branchiæ are as in *S. robustus*, differing only in the relative size of the posterior branchia above the third pereiopod, this branchia being only two thirds as long as the anterior, while in *S. robustus* it is nearly as large. The posterior branchia above the fourth pereiopod is $^4/_5$ as long as the preceding one.

The first joint of the antennular peduncles is slightly shorter than the second and the third together. The second is about one fourth longer than the third, which is not much more than two times longer than broad.

The form of the scaphocerite and the outer uropod may be seen from fig. 17. On both appendages is noticed even in the smallest specimens a row of peculiar patches which I believe to be luminous organs, their position being analogous to that of the light organs of *S. gloriosus* Stebbing and *S. Challengeri* Hansen. In the young specimens the patches are fewer in number, while in the young of *S. robustus* no patches are visible till the animal has reached a size of a full-grown *S. splendens*.

The colouring of newly preserved formaline specimens consists of an intense scarlet on the fore part of the back, fading gradually into the transparent abdomen and legs. In the alcoholic specimens the colour is persistent only along the grooves of the carpace.

The nearest relative of *S. splendens* is undoubtedly *S. Gardineri* Kemp (Kemp 1913) which is proved by the petasma in these species, (see fig. 18) that of *S. splendens* carrying however only one process (*e* in the figure) were *S. Gardineri* has two. Other points of distinction may be derived from the relative length of the branchiæ, and of the joints of the antennular stalk; the presence in *S. splendens* of patches believed to be luminous organs, etc.

Also from the species described by Stebbing (1908) as *S. bisulcatus* *S. splendens* is easily distinguished by the presence of the lastnamed character and by its size (C. never exceeding 12 mm. in the 111 specimens, while Stebbings specimen measured 24, the total length being 76 mm). From *S. gloriosus* and *S. bisulcatus* Wood Mason our species is distinguished by its characteristic petasma which resembles only that of *S. Gardineri* as stated above.

Table of bathymetrical distribution.[1])

Depth (m.)	Hauls		Size (C in mm.)						Total	
			< 7		7—9		> 9			
	D	N	D	N	D	N	D	N	D	N
50—100	2	**5**	3			**10**		**3**	3	**13**
101—250	1	**5**		**10**	1	**40**		**5**	1	**55**
> 250	5	**6**	25	**1**	3	**3**	4	**3**	32	**7**
Total	24		28	**11**	4	**53**	4	**11**	36	**75**

[1]) Heavy figures denote the number of specimens taken during the night.

Horizontally *S. splendens* is apparently limited to the southern part of the area explored. The accompanying table of batymetrical distribution seems to indicate that the species avoids the upper waterlayers during the day, but ascends during the night, though it has not been taken at the very surface of the sea.

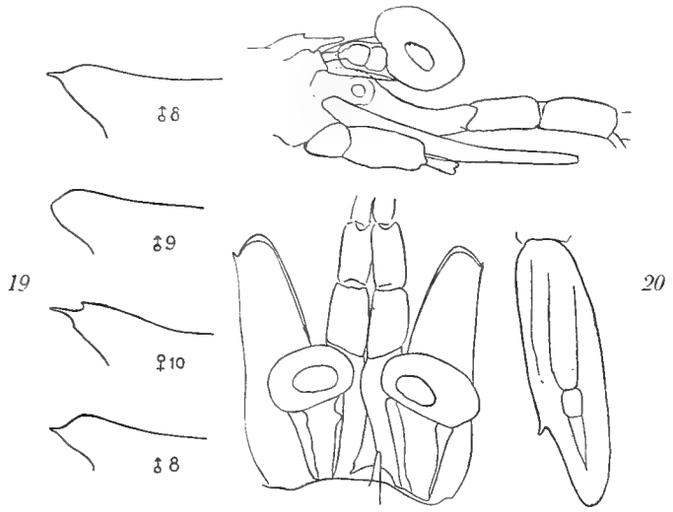
Table of catches.

St.	Gear	m. w	Number	Sex, size
29	y	400	1	♀ 9
42	y	300	1	♀ 8
45	1 sn	100	1	♂ 7
„	1 sn	200	6	♀ 7, 7, ♂ 7, 7, 7, 7
„	y	300	50	♀: 1 à 10, 2 à 8, 16 à 7, 1 à 6 and 4 à 5 mm. ♂: 1 à 10, 2 à 8, 18 à 7 and 5 à 6 mm.
„	y	2000	1	♀ 10
„	4 ln	3000	1	♀ 9
49	4 ln	3000	4	♀ 10, 7, ♂ 10, 6
51	1 sn	200	1	♂ 10
„	y	300	2	♂ 10, 9
„	$^1/_2$ sn	1000	1	♂ 6
52	$^1/_2$ sn	100	2	♂ 6, ♀ 5
53	1 sn	100	4	♀ 10, ♂ 9, 9, 8
„	y	300	1	♂ 10
„	y	600	2	♀ 9, 7
„	3 ln	2600	1	♂ 8
56	1 sn	200	1	♀ 11
„	y	300	1	♀ 10
62	y	2000	1	♀ 10
64	1 sn	100	1	⊙ 4
„	y	2000	3	♂ 10, ⊙ 4, 4
66	$^3/_4$ sn	1000	1	♀ 5
67	3 ln	2000	2	♂ 8 (L = 29), ♀ 12 (L = 39)
„	y	1200	22	♂: 4 à 6 and 4 à 5 mm, ♀: 4 à 6 and 8 à 5 mm, ⊙ 2 à 4 mm.
12	24		111	

Larvæ.

At stations 64 and 67 some larvæ were taken which I believe may be referred to *S. splendens*. They resemble this species very much in the form of the cephalic appendages, even the rudiment of the ocular tubercle being visible as a protrusion from the nerve (see fig. 20, which also shows the form of uropod typical of *S. splendens*). It is true that an ocular tubercle is present in many species of *Sergestes*, but none of these species were taken in the same area with the larvæ in question.

An examination of the telson points also to *S. splendens*. Fig. 21 shows the outlines of the telson in the three larvæ, and in a nearly adult *S. splendens*. It will be noted that the three pairs of dorsolateral spines found in the smallest larvæ, have disappeared in the two larger larvæ, but the form of the tip convinces one of the specific identity of the three larvæ, neither could any other differences be found than those connected with



Figs. 19—20. *S. splendens.* 19) Rostrum of 4 specimens, the sizes (C) of which are inscribed, from st. 53, 1 sn 100. 20) Head and uropod of ⊙ 3.15 from st. 67, 1 sn 50.

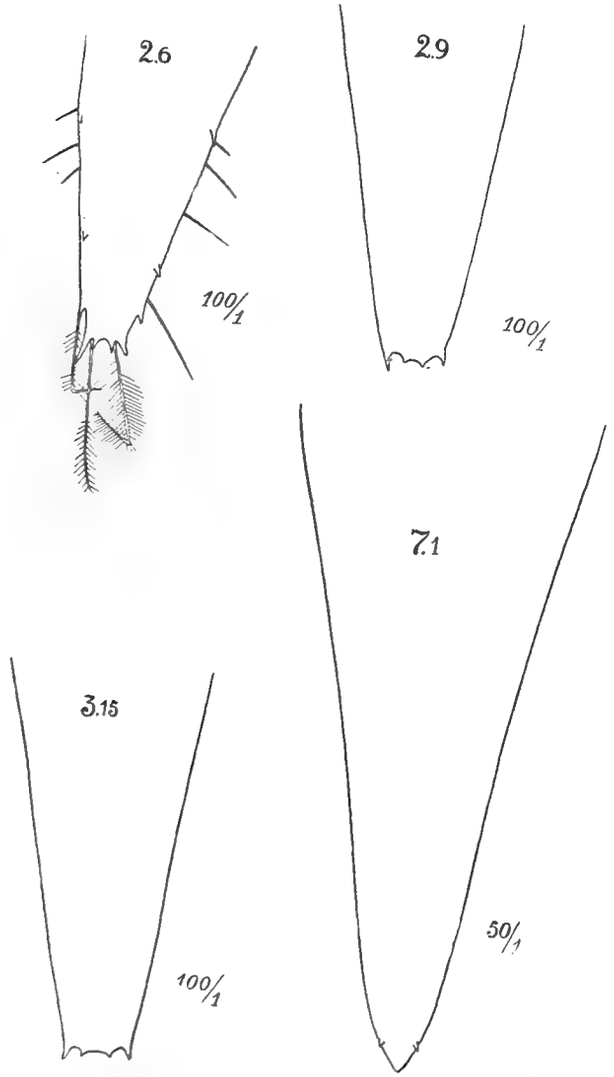


Fig. 21. *S. splendens.* Tip of telson of 4 specimens (the size of which are inscribed) from st. 64 and 67.

size. Now both *S. splendens* and *S. grandis* carry only one pair of spines on the telson, as does the larger of the larvæ in question. But these spines in *S. grandis* are situated very far from the tip, whereas in *S. splendens* they are found close to it (see fig. 21).

The larvæ referred to *S. splendens*, were taken on the following occasions:

St. 64, 1sn 100 m.w, one, C = 2·6, L = 6·15, Urop. = 1·25 mm.
„ „ y 2000 „ one, C = 2·9, L = 7·0, Urop. = 1·50 „
„ 67, 1sn 50 „ one, C = 3·15 L = 8·7, Urop. = 1·70 „

Pl. II, figs. 2 and 3, are photos of the head parts and tail-fan in the smallest of the specimens.

Sergestes grandis n. sp.

This species is very nearly related to the species described by FAXON (1895) from the Pacific under the name of *S. bisculatus* Wood-Mason. In 1893 Faxon had mentioned his species under the name of *S. phorcus*, which was withdrawn by himself as a synonym. Now after the publication of a more detailed account with illustrations of *S. bisculatus* by ALCOCK in 1901 it appears beyond doubt that Faxons species is not identical with that of Wood-Mason, so that the former must retain the original name of *S. phorcus*. In describing *S. grandis* I shall try to indicate the points in which it differs from the species mentioned.

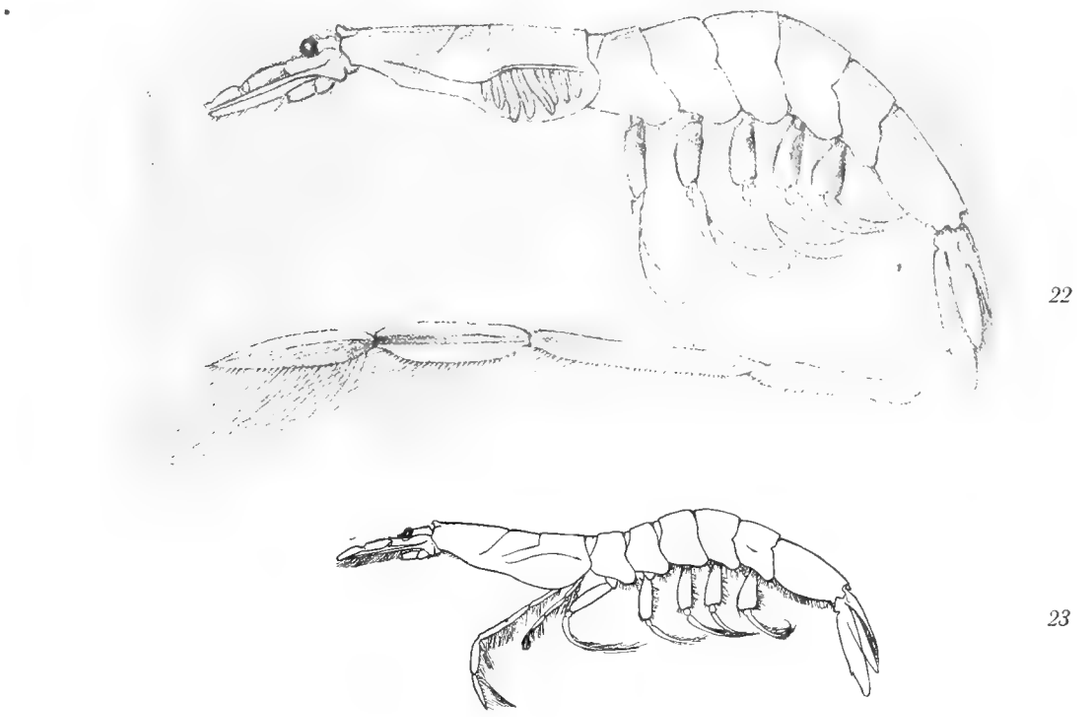
Figs. 22 and 23 show two females, one adult and one young. The relative length of carapace and abdomen is nearly as in Faxon's species, the abdomen, telson excluded, equalling about twice the length of the carapace, while i Wood-Mason's species, according to Alcock's figure (Illustr. . . . Investigator, pl. L), the carapace is half the length of the abdomen, telson included.

The rostrum, as in Faxon's species, is small, inclined about 30° from the back. Both edges are parallel, and the tip is excavated as in *S. splendens*.

Both transverse grooves are well defined, as are also the gastrohepatic and the branchiocardial, the last running nearly to the edge of the carapace, accompanied by a marked keel.

The branchial formula is the same as i Faxon's species; the second lamella above the third leg is not however concealed beneath the first, but plainly visible, and it is about $^2/_3$ as long as the first.

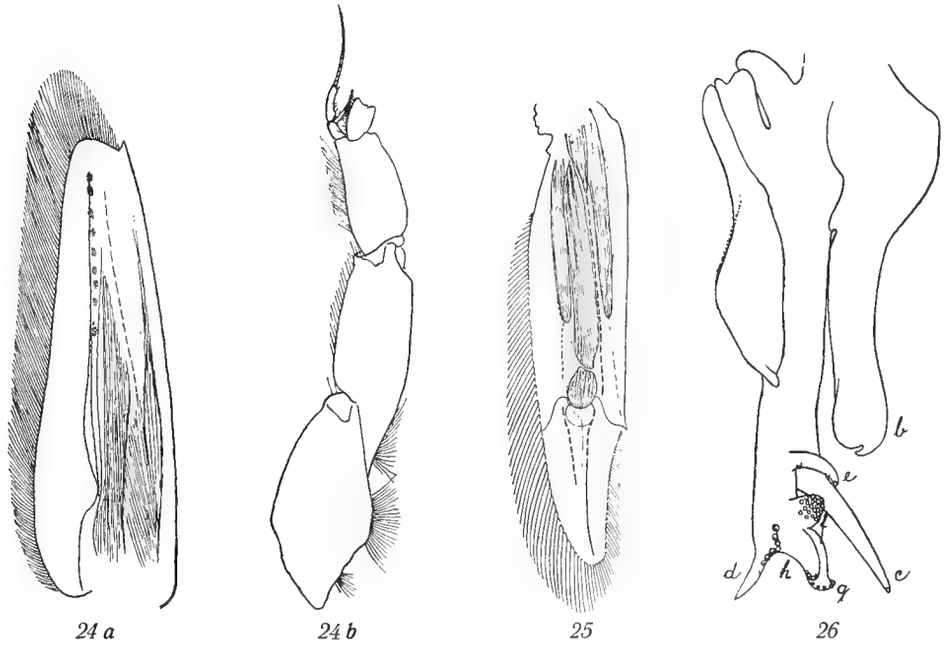
The eyes are as in *S. phorcus*. In the smaller specimens the lateral length of the cornea is less than half that of the stalk, while in the adult it is about two-thirds.



22

23

Figs. 22—23. *Sergestes grandis.* 22) ♀ 17, st. 52, y 600 (2/1). Below is shown the fourth pereiopod more enlarged. 23) ♀ 10, st. 34, y 400 (2/1).



24 a *24 b* *25* *26*

Figs. 24—26. *Sergestes grandis,* ♂ 20, st. 51, 3 ln 4000. 24 a) scaphocerite (5/1). 24 b) antennular peduncle (5/1). 25) outer uropod (5/1). 26) petasma (10/1).

The antennular peduncles are of the same type as those of *S. robustus*, though the 2nd joint is relatively slightly longer, resembling that of *S. phorcus* (see fig. 24).

The scaphocerite (fig. 24) differs from that of *S. phorcus*, the outer edge being less curved, and the inner being slightly concave in its outer two-thirds. Its under side carries more feather bristles than in any other *Sergestes* known to me. These bristles are sparsely implanted in a longitudinal bed along the middle of the scaphocerite, and their length equals about one-third of the breadth of the appendage. The scaphocerite carries a row of 9—10 luminous (?) patches.

The fourth pair of pereiopods differs from those both of *S. phorcus* and of *S. bisulcatus* in having the two last joints broader, the greatest breadth of the penultimate joint being more than one-fourth of its length.

The exopodite of the outer uropod is shown in fig. 25. The spine is situated slightly more than two-thirds from the base (in *S. phorcus* slightly less), the breadth is contained about $4^1/_2$ times in the length (in *S. phorcus* about 5 times). The general form recalls that found in *S. splendens*. In *S. bisulcatus* the uropod is of quite another type.

The telson has dorsally a broad shallow groove, the limits of which bend slightly together just before the middle and form the dorsolateral edges of the telson in its posterior part.

Male. The only male (from st. 51) differs from the females in the larger size of its eyes, a sexual difference also found in *S. robustus*. The grooves and keels on the carapace are less distinct, and the integument on the whole is stiffer than in the females, perhaps depending upon difference in time since the last moult.

The petasma (fig. 26) possesses one process more *(h)* than in that of *S. robustus*, thus strikingly resembling the petasma of *S. phorcus*, from which it differs however in the following points:—(1) the process *b* ends in a strongly curved hook, (2) the process *e* is much shorter. (Compare the drawing in FAXON, 1895, pl. LII).

Sergestes grandis, like *S. phorcus*, has been captured on a few occasions only, and apparently does not inhabit the superficial waterlayers. Some of the specimens showed traces of red pigment *(S. phorcus* is reported to be deep red). During the "Michael Sars" expedition it was taken as follows:—

St. 34, y,	400	m. wire,	one,	♀	10
„ 49, 4 ln,	3000	- „	one,	♀	12
„ 51, 3 ln,	4000	- „	one,	♂	20
„ 52, y,	600	- „	one,	♀	17
„ „ y,	1200	- „	two,	♀	18, 12·5

STEBBING (1908) also describes a *"S. bisulcatus"* from S. Africa taken i 250—300 fathoms, 29 miles E^{b}N. of Cape Point. He says that his specimens "agree so closely with Faxon's description that it would be rash to base a specific separation on the one or two minute differences which I have noticed". A glance of his figure however shows at once that his species has nothing to do with Faxon's. The form of the carapace is different in many respects, and it is not easy to understand how Stebbing could arrive at such a conclusion.

Neither is his species identical with that described here as *S. splendens*, with which it seems to have the nearest relations, as mentioned under that species.

Sergestes tropicus n. sp.

This species shares with *S. phorcus* Faxon (described as *S. bisculatus*, FAXON 1895)[1]), and *S. Kröyeri* Bates, and *S. gardineri* Kemp, the character of having a conspicuous tubercle on the eyestalk. Faxon does not mention it in the text but it is seen in his figure. *S. tropicus* is easily distinguished from *S. phorcus* by the form of the petasma, compare fig. 27 with Faxon's figure (1895, pl. 52, fig. 1 h), and from *S. Kröyeri* by the form of the rostrum (compare fig. 28 and fig. 29, the last being taken from HANSEN 1903).

The uropods (fig. 33) are narrower (breadth contained $4^1/_2$—5 times in length) than in *S. Kröyeri*, the uropods of which are "at most four times longer than broad".

From *S. gardineri* Kemp the present species is easily distinguished by the form of the petasma, of which KEMP (1913) gives an excellent drawing (pl. 7, fig. 4).

The third pair of maxillipeds are considerably shorter than the third periopods, the length of the joints (beginning with the second) being in a ♂ 21 from st. 64: 6·5, 6·0, 7·0, 6·7, 6·0 mm. The fifth joint is subdivided into three subjoints the relative length of which are as 36 : 11 : 20. The sixth joint is subdivided into 8 subjoints, the relative length of which are as 17 : 20 : 14 : 13 : 13 : 15 : 14 : 13.

The scaphocerite, which does not reach beyond the middle of the third joint of the antennular peduncles[2])

The telson ends in a point and carries three pairs of spines along the dorsolateral edges and three other pairs is broad and the lamellar portion is much in advance of the triangular tooth. (See fig 30 and 31 where also the ocular tubercle is visible).

[1]) As regards the name *S. bisulcatus*, see under *S. grandis*.

[2]) According to BATE (1888, p. 388) it reaches, in *S. Kröyeri* to the tip of the antennular peduncles.

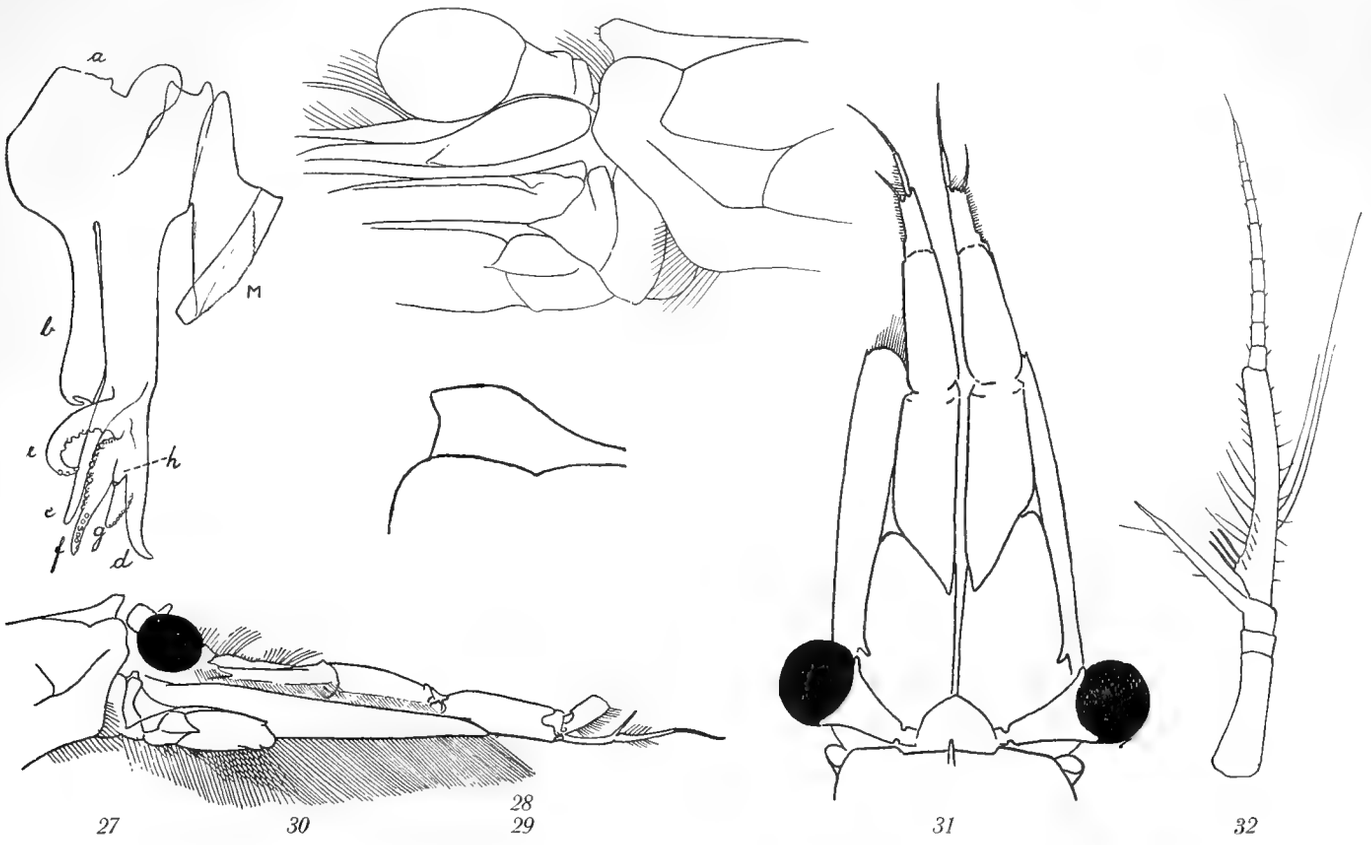


Fig. 27. Petasma of *Sergestes tropicus*, ♂ 18, st. 53, 3 ln 2600 ($^{10}/_{1}$). Fig. 28. Rostrum and eye of *S. tropicus*, ♂ 19, st. 49, 4 ln 3000 ($^{10}/_{1}$). Fig. 29. Rostrum of *S. kröyeri*, (after HANSEN, 1903). Fig. 30. Fore-end of *S. tropicus*, ♂ 18, st. 56, 3 ln 3000 ($^{5}/_{1}$). Fig. 31. The same ($^{6}/_{1}$). Fig. 32. Outer flagellum of antennular of the same specimen ($^{20}/_{1}$).

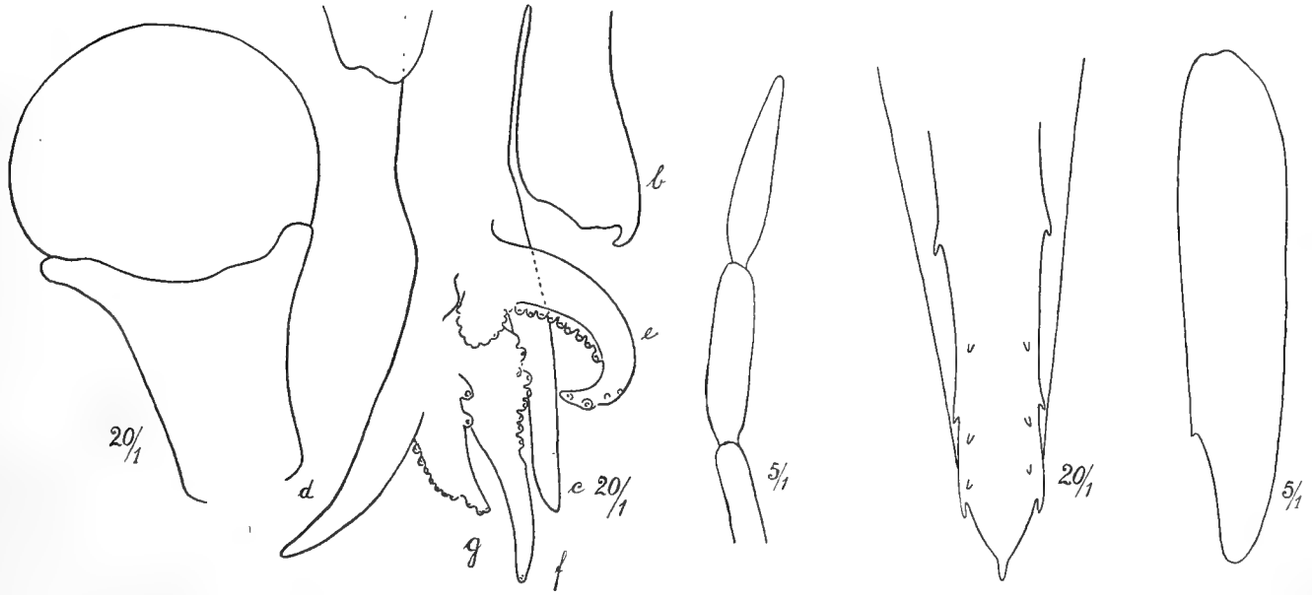


Fig. 33. *Sergestes tropicus*, ♂ 21, st. 64, 3 ln 3000. Right eye from above, petasma, end of 4. leg, telson and outer uropod. (Enlargements inscribed in the drawnings).

between those edges. This feature together with others in a large male from st. 64 is shown in fig. 33.

Both the uropods and the scaphocerite show a reticular or cellular pattern, also found in *S. mollis*. The integument is soft as in that species and supraocular and hepatic spines are absent.

The branchiæ are feeble compared with those of *S. robustus*, though not in such a state of reduction as found in *S. mollis* (see SMITH 1887). Relative length of four posterior branchiæ 6—2—4—3, the second branchia above trl.[3] being very small and onesided.

The form of the secondary antennular flagellum in the male is seen in fig. 32.

S. tropicus is one of the larger *Sergestes*, one female and one male measuring about 70 mm. (C = 21). It was found only in the southern part of the area examined, in all 18 specimens having been taken. It seems to be a deep-water species, as all the large specimens were taken at a depth of 1000 metres or more, even though most of the hauls were made during the night.

Colour orange, except mouthparts which are reddish-brown. The dark stomach can be seen through the body. The eyes are large and black, the tubercle is of the same colour as the stalk.

Table of catches,

St.	Gear	m. w.	Number	Sex, size
29	y	2000	2	♀ 19, ♂ 18
45	y	2000	1	♀ 13
49	4 ln	3000	4	♂ 21, 19, 12, ♀ 12
51	½ sn	700	1	⊙ 7, (def.)
„	½ sn	1000	1	♀ 9
„	y	3000	1	♀ 9
„	4 ln	4000	1	♀ 10
52	3 ln	1200	1	♀ 10
53	3 ln	2600	4	♂ 19, 18, 18, ♀ 11
56	3 ln	3000	1	♂ 18
64	3 ln	3000	1	♂ 21
8	11		18	9 ♂, 8 ♀, 1 ⊙

Sergestes mollis Smith.

S. mollis, SMITH 1884.
S. mollis, SMITH 1887.
S. japonicus, HANSEN 1896.
S. japonicus, HANSEN 1903(2).

I have been somewhat in doubt as to what name should be adopted for the numerous "Michael Sars" specimens which agree in every particular with SMITH's descriptions and figures, but have decided not to follow HANSEN in regarding *S. mollis* as a synonym of *S. japonicus* Bate (BATE 1881, 1888). The evidence given by Hansen in support of his view seems too scanty. He has compared the three 30 years old and mutilated "Challenger" specimens with Smith's description, and found no difference. He says:—"It should be specially mentioned that an examination of the branchiæ showed the most complete agreement with Smith's description and drawing". Still, he has not seen any Atlantic specimens, or he would have noticed that the form of the rostrum differs greatly from that of the specimen figured by BATE (1888, pl. 70), and until it can be shown that this difference is due to inaccurate drawing by Bate, it is safest to regard *S. mollis* and *S. japonicus* as distinct species.

Fig. 34. *Sergestes mollis* ♂ 17, st. 81, 3 ln 3000. Petasma (25/1).

The petasma (fig. 34) is remarkable for the rudimentary stage of the small hooks and tubercles on the processes. It is possible, though not very probable, that even the largest of our male specimens are not fully developed.

S. mollis is undoubtedly a deep-sea species, as will be seen from the following table of bathymetrical distribution (3 ind. from vertical hauls not consid.):—

Depth (metres)	Nr. of hauls		Sizes (C. in mm.) 4—10		11—17		18—26		Total		Grand total
	D	N	D	N	D	N	D	N	D	N	
350— 800	6	5	13	14	5	2			18	16	34
1000—1300	4	5	12	25	3	11	2	1	18	37	55
1500—2100	5	7		16	16	3	7	2	22	20	43
Total	15	17	25	55	24	16	9	3	58	74	132
Grand total	32		80		40		12		132		

This table affords no evidence of a diurnal vertical migration, like that found e. g. in the case of *S. splendens*. A similar difference regarding this habit is found in the peneid genus *Amalopenæus*, the large-eyed species of which have a marked diurnal movement, while nothing of that kind could be inferred from the data regarding the species which lives deepest and has the smallest eyes, viz. *A. Alicei*. The same rule holds good in the genus *Sergestes*, *S. mollis* having very small, *S. splendens* very large eyes. It will be noted that the large specimens were all taken at a depth of 1000 metres or deeper.

S. mollis was formerly known only from deep water along the Atlantic coast of the United States (Smith 84, 87). During the "Michael Sars" Expedition it proved to be fairly common, as it was taken nearly every time the deep-sea plankton appliances were towed, even as far north as between Scotland and Rockall (st. 101), but it has not been captured in the Norwegian Sea, where it probably does not occur, as we may infer from the non-occurrence there of other Atlantic deep-sea species, such as *Hymenodora gracilis* Smith, which is indeed replaced in the Norwegian Sea by a near relative: *H. glacialis* Bucholz.

Table of sizes.

Size	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total
Males											3	2	2	2		1								10
Females											2	4	4	4	2	3	3	1		2			1	26
Young	1	16	16	18	7	13	12	4	7	5														99

Table of catches.

St.	Gear	m. w.	Number	Sex, size
19	4 In	900	1	☉ 5
25	½ sn	3400	2	☉ 10, 8
29	y	2000	2	☉ 10, 8
35	½ sn	4200	1	☉ 12
42	y	900	8	☉ 9, 7, 7, 7, 7, 6, 6, 6
45	y	2000	12	♀ 16, 16, ☉ 11, 10, 9, 9, 8, 7, 7, 6, 6, 5
„	4 In	3000	5	☉ 10, 9, 7, 7, 7
49	y	2000	6	☉ 10, 10, 10, 9, 9, 7
„	4 In	3000	3	☉ 9, 9, 7
51	½ sn	700	1	☉ 4
„	y	2000	5	♂ 19, ☉ 13, 8, 7, 5
„	4 In	4000	2	☉ 13, 7,
53	y	1600	2	☉ 12, 12
„	3 In	2600	12	♀ 17, 15, ♂ 15, 14, ☉ 12, 9, 9, 8, 7, 6, 5
56	y	1000	3	☉ 5, 5, 5
„	3 In	3000	1	☉ 8
62	y	1000	2	☉ 6, 6
„	y	2000	2	☉ 11, 6
„	3 In	3000	7	♀ 23, ☉ 13, 12, 10, 10, 10, 9
63	4 sn	4500–1500	1	♀ 18
„	4 sn	1850–450	2	♀ 17, ☉ 10
64	y	2000	13	♀ 18, ♂ 15, ☉ 13, 7, 7, 6, 6, 6, 5, 5, 5, 5, 5
„	3 In	3000	9	♀ 20, 19, 19, 14, ♂ 17, 16, 14, ☉ 12, 11
66	y	1500	1	♂ 14
67	y	1200	9	☉ 10, 8, 6, 6, 6, 6, 5, 5, 5
80	3 In	3000	3	♀ 17, 15, 15
81	3 In	3000	7	♀ 23 (L = 71), 21 (L = 64), 17, 16, 15, 14 ♂ 17
82	y	1000	3	☉ 13, 12, 11
84	y	1000	1	☉ 5
„	3 In	3000	2	♀ 20, 19
87	¾ sn	1500	3	☉ 12, 7, 5
„	y	2000	1	♂ 16
92	y	3000	1	♀ 20
101	3 In	2500	2	♀ 26, 16
22	34		135	

Sergestes vigilax Stimpson, H. I. Hanseu

S. vigilax,, Stimpson 1860 *(mastigopus)*.
S. vigilax, Hansen 1896.

Hansen has described the adult very carefully, and there can be no doubt as to the specific identity of Stimpson's young specimens and the adult described by Hansen. In the material from the "Michael Sars" expedition all stages from the very smallest are present, and the development of the charcteristic rostrum and maxilipeds can be followed without interruption until they assume their final shape, (see fig. 35 and 36). The number of spines on the 6th joints of the maxillipeds I have found to vary between 20 and 22, or rather less than stated by Hansen (22—25). The 5th joint is subdivided into two subjoints, the distal one being about one-fourth the length of the entire joint.

The petasma (fig. 38) is of quite another type from that found in *S. robustus*, and shows the closest resemblance to that of *S. atlanticus*.

S. vigilax is a small species, as seen from the following table:—(specimens of 2½ mm. are entered as being 3 mm., etc.)

Size (C. in mm.)	1	2	3	4	5	6	7	8	Total
Males					2	13	4		19
Females					11	20	9	2	42
Young	1	39	50	26	11				127

S. vigilax is probably limited to the tropical Atlantic[1]). It was taken only on the southern section, from Africa to the Sargasso Sea. The catches were too few to allow any definite conclusions regarding the bathymetrical distribution to be drawn, but the table seems to indicate that (1) the adults prefer deeper water than the young, (2) that the adults sink during the night.

37 35 38 36

Fig. 35—38 *Sergestes vigilax*, 35) ♀ 7, st. 67, y 1200, rostrum (40/1). 36) ♂ 6, st. 29, y 400, end of 3. mxp. (20/1). 37) ♂ 6, st. 29 y 400, outer uropod (10/1). 38) ♂ 6, st. 29, y 400, petasma (30/1).

Depth (metres)	Number of hauls		Size < 4.9		Size > 4.9		Total		Grand total
	D	N	D	N	D	N	D	N	
0—50	5	*5*	43	*64*	4	*14*	47	*78*	125
100—200	4	*9*	8	*6*	2	*21*	10	*27*	37
300—	5	*6*	5	*3*	11	*6*	16	*9*	25
Total	14	*22*	56	*73*	17	*41*	73	*114*	187
Gr. total	36[2])		129		58		187		

Table of catches.

St.	Gear	m. w.	Number	Sex, size
23	y	400	1	♀ 7
„	T	(1215 m)	1	♀ 7
20	y	400	3	♂ 7, 5.5, ♀ 4.5
42	y	300	1	♂ 7
45	1 sn	100	15	♂ 7, ♀ 6, 5, 5, ⊙ 4, 4, 4, 3.5, 3.5, 3, 3, 2, 2, 2, 2
„	y	300	6	♀ 7, 7, 6, ♂ 6, 6, 6
„	y	2000	1	♂ 6
47	1/2 sn	40	4	⊙ 3, 3, 3, 3
49	y	370	6	⊙ 5, 3, 2.3, 2.2, 2.2, 2.0
„	4 ln	1000-0	1	♂ 7
„	y	2000	2	⊙ 2.6, 2
51	1 sn	0	27	♀ 7, ⊙ 6 à 1.5, 5 à 2, 9 à 2.5, 2 à 3, 3 à 3.5, 1 à 4 mm.
„	y	300	2	♀ 6, 6 (def.)
„	y	2000	1	♀ 6
„	y	3000	2	♀ 6, ⊙ 3.5
„	4 ln	4000	1	♀ 6
52	1 sn	0	22	♀ 6, 5, ⊙ 1 à 3.5, 1 à 3, 6 à 2.5, 6 à 2, 5 à 1.5, 1 à 1 mm.
„	1/2 sn	100	3	♀ 5, 5, ⊙ 4
„	3 ln	1200	2	♀ 6, ♂ 6
53	1 sn	0	1	⊙ 4
„	1 sn	60	22	⊙ 2 à 4.5, 2 à 4, 5 à 3.5, 5 à 3, 6 à 2.5, 2 à 2 mm.
„	1 sn	100	11	♀ 7, 6, 6, 6, 6, 6, 5, 5, ⊙ 4.5, 4.5, 4
„	1 sn	200	5	♀ 8, ♂ 6, 6, 6, 6
„	y	300	5	♀ 7, 7, 6, 6, 5
„	y	600	1	♀ 6
58	1 sn	100	1	♂ 6
„	y	300	1	♀ 7
62	1 sn	200	1	♂ 7
64	1 sn	100	12	⊙ 4 à 4.5, 1 à 4, 3 à 3.5, 1 à 3, 3 à 2.5
„	1 sn	200	2	⊙ 2.5, 2.3
„	y	300	3	⊙ 3.0, 2.8, 1.5
„	3/4 sn	600	1	⊙ 2.6
„	y	1000	8	♀ 6, ♂ 6, 5, 5 ⊙ 4.5, 4.5, 4, 3
„	y	2000	1	♀ 6
67	1 sn	50	6	⊙ 3.2, 2.8, 2.7, 2.3, 2.2, 1.7
„	y	200	2	⊙ 3, 2
„	y	1200	4	♀ 7.5 (L = 24) 6, 5, 5

[1]) HANSEN'S opinion (1896) that Bates' *S. parvidens*, which was taken both in the Atlantic and the Pacific, is the young of *S. vigiiax* is certainly wrong. The eyestalks are, as represented by Bate, much too short. In a specimen of *S. vigilax* of the same size they are much more than half the length of the carapace. It is equally certain that *S. macrophthalmus*, Stimps. is not the mastigopus of *S. vigilax*. The "Michael Sars" specimens of young *S. vigilax* agree fairly well with STIMPSON'S description, but they seem to have more numerous dorsal spines, which are found not only, as in *S. macrophthalmus*, on the hinder edge of the carapace and on the fourth and fifth abdominal joint, but also on the third and sixth joints up to a size of 7—8 mm. (C = 2,5 mm.). The size given by Stimpson (0,7 inch = 17 mm.) suggests that *S. macrophthalmus* is uot identical with *S. vigilax*, as this species has lost all its dorsal spines before it attains a total length of about 13 mm.

[2]) One vertical haul (one specimen) not considered.

Sergestes armatus Kröyer

S. armatus KRÖYER 1855 (mastigopus)
S. armatus HANSEN 1896 (—„—)

This species has hitherto been known only from its mastigopus stage, but during the "Michael Sars" expedition many adults were captured, which I shall briefly describe.

40 *39* *41*

Figs. 39—41. *Sergestes armatus.* 39) ♀ 14, St. 23, y 400, rostrum (5/1). 40) ♀ 14, St. 23, y 400, end of 3. mxp. (10/1). 41) ♂ 10, St. 51, y 300, petasma (30/1).

Rostrum adscendent, its outer third tapering to an acute point (see fig. 39). Supraocular and hepatic spines present, the latter situated upon a marked keel running from the base of the antenna and disappearing behind the spine. The branchiocardial keel and furrow are also distinct and reach the hinder edge of the carapace.

In the antennular peduncles, the aggregate length of which is about 85 % of the length of the carpace, the first and the second joints are nearly equal, the third being about one-third longer than either.

The very long third maxillipeds have the sixth joint divided into four subjoints, the relative lengths of which are as 21 : 30 : 16 : 33. All four subjoints carry strong spines arranged as shown in fig. 40. In all the specimens the distal subjoint is strongly curved.

The outer uropods are fringed with setæ along 2/3—3/4 of their external edge, and a spine is present only in some of the young specimens.

The petasma (fig. 41) recalls to some extent that of *S. vigilax.*

As far as can be judged form material preserved in formaline pigment is absent, except in the stomach, which is purplish.

S. armatus is a large species, compared with the others in Hansen's group II, as will be seen from this table:

Size (C in mm.)	3	4	5	6	7	8	9	10	11	12	13	14	Total
Males				1	1		1	1					4
Females				1	3	3	1	4	1		1	1	15
Young	5	4	2										11

The nearest relative of *S. armatus* Kr. is *S. diapontius* Bate H. J. H (= *S. penerinki* Bate H. J. H.), but is distinguished from it by the form of the antennular peduncles and the relative length of the hairfringed portion of the outer uropods.

S. armatus has been identified with certainty only in the Atlantic. Bate's specimens from the Pacific and from Australian waters, are not, according to HANSEN (1903), correctly determined.

Regarding the bathymetrical distribution not much is known, and the "Michael Sars" material is too scanty to allow of any definite conclusions being drawn. (See table of catches).

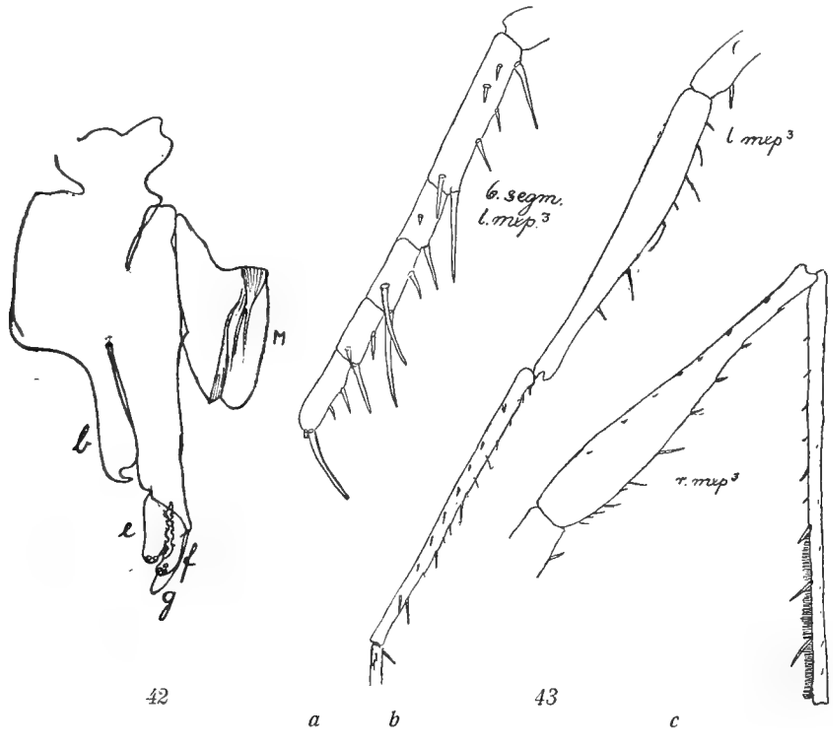
Table of catches.

St.	Gear	m. w.	Number	Sex, size
23	y	400	1	♀ 14
45	y	300	5	♀ 10, 10, 8, 8, 7
„	4 In	3000	1	♀ 10,
51	1 sn	0	2	⊙ 3, 3
„	1 sn	200	1	♂ 6
„	y	300	2	♀ 10, ♂ 10
53	y	300	2	♀ 9, 7
„	y	600	1	♀ 7
64	1 sn	100	3	⊙ 3½, 3, 3
„	1 sn	200	2	⊙ 4½, 4
„	y	300	3	⊙ 4, 4, 3
„	y	1000	2	♀ 8, ♂ 7
„	y	2000	1	♀ 6
67	1 sn	50	1	♀ 11
„	3/4 sn	600	1	⊙ 4½
„	y	1200	2	♀ 13 (L = 36), ♂ 9 (L = 31)
6	17		30	15 ♀, 4 ♂, 11 ⊙

Sergestes pectinatus (Hansen) nomen novum.

Sergestes Henseni (Ortmann) H. J. HANSEN 1896 (partim).

This interesting species was described by HANSEN (1896) from "National" specimens, but it is not, as he believed, identical with the species described from the same sample by ORTMANN (1893) as *Sergia henseni*. On comparing Ortmann's and Hansen's descriptions it appears without doubt that both authors have founded their descriptions on specimens of two distinct (though closely related) species. Ortmann described one species, for which I propose to retain the name *S. Henseni* while Hansen fixed his attention chiefly upon an example of another species, for which I here propose the name *S. pectinatus*, alluding to the peculiar structure of the mxp.[3] first seen by Hansen. That both species were present in the sample in question is certain from the following passage in Hansens description relating to the outer uropods (1896, p. 959): "— — in the one specimen the ciliated part occupies three-fifths, in the other almost four-fifths of its length. In no other species have I met with any similar variation in this feature, but it also exists in the larvæ". One of the specimens must have lost its maxillipeds, otherwise the error cannot be explained. Hansen's description may be completed by the following particulars. The rostrum is rudimentary, consisting of a horizontal spiniform process from the frontal margin, its length at most equalling one-fifth of the breadth of the cornea. The three joints of the antennular peduncles are of nearly equal length. The relative length of the hairfringed portion of the outer uropods is about four-fifths (in one specimen



42 a b 43 c

Figs. 42—43. *Sergestes pectinatus*. 42) ♂ 6, st. 45, y 300. petasma (30/1). 43) ♂ 5, st. 45, y 300. a) 6. joint of left 3. mxp. (40/1). b) 4. and 5. joint of same (15/1). c) 4. and 5. joint of right 3. mxp (15/1).

carefully measured 82 %). The petasma (see fig. 39) is of a type different both from that found in the "robustus-group" and from that of *S. vigilax*.

A peculiar interest is attached to a specimen (♂ 5) from st. 45, y 300 m. w., which presents all the characters of *S. pectinatus*, except in the left mxp.[3], which is shown in fig. 43. The sixth joint is subdivided in the typical manner, but the "comb" is wanting, being replaced by an armature of spines resembling that found in the mastigopus and in the adults of other species. I am inclined to regard this abnormality as an instance of atavistic regeneration pointing to the origin of *S. pectinatus* as a mutation from a nearly allied form. The right mxp.[3] is of the typical *pectinatus*-shape, the fifth joint being adorned with "comb" (the sixth joint is missing).

S. pectinatus is a very small species, apparently not exceeding C = 8 mm., (total length about 25 mm.), and the sexes may be distinguished even in specimens about 10 mm. in total length.

Size (C in mm.)	1	2	3	4	5	6	7	8	Total
Males			3	4	5	3			15
Females				7	10	8	2	1	28
Young	2	17	14						33

The larvæ differ from the adults in the following characters:—(1) the eyes are enormus, their greater diameter being from 31 to 50 % of the length of the carapace; (2) the relative size of the joints in the antennular peduncles shows an approximation towards the proportions found in *S. Henseni* (see under that species); (3) the percentage of hairfringed edge on the outer uropods is less, beeing from 74--78 % against about 80 % in the adult; (4) the sixt joint of the mxp.^{3} is subdivided as in the adult, but carries only spines, something like the abnormal mxp.^{3} found in an adult male (fig. 43).

It may be that Hansen is right in supposing that *Mastigopus tenuis* Bate (1888, pl. 65) is identical with Ortmann's *S. sargassi.* If so, the structure of the uropods and the process on the mxp.^{3} indicate its connection with *S. pectinatus,* the said process not being found in *S. Henseni.* In that case the antennular peduncles must have been incorrectly drawn by Bate.

S. pectinatus was captured only in the southern part of the area explored by the "Michael Sars", and Ortmann (1893) reports it (and *S. Henseni*!) from the equatorial region of the Atlantic.

It seems to live in the upper waterlayers.

Table of catches

St.	Gear	m. w.	Number	Sex, size
23	1 sn	200	1	♂ 5
34	y	400	1	♀ 4.5,
42	y	300	3	♀ 5, 5, ♂ 4
45	1 sn	100	6	♀ 4, 4, 4, ♂ 4, 4, 3
„	y	300	13	♀ 6, 6, 6, 6, 5, 5, 5, 5, 5, ♂ 6, 5, 5, 5
„	1/2 sn	1000	1	♀ 4
49	1 sn	100	1	⊙ 2.4
„	y	2000	1	♀ 6
„	3 ln	3000	1	♂ 5
51	1 sn	200	1	♂ 6
„	1/2 sn	700	1	♀ 5
„	y	300	3	♀ 6, 5, ♂ 3
„	y	2000	1	♀ 6
„	y	3000	1	♀ 8
53	1 sn	200	2	♀ 7, 7
56	1/2 sn	500	1	♀ 4 (def.)
62	1 sn	200	1	♂ 6
64	1 sn	100	7	⊙ 3, 2.5, 2,2, 2.2, 2.0, 2.0, 1.8
„	1 sn	200	4	⊙ 2.9, 2.7, 2.7, 2.0
„	y	300	5	⊙ 2.7, 2.5. 2.3, 1.3, 0.9 (L = 3)
„	3/4 sn	600	6	⊙ 3, 3, 3, 2.2, 2,2, 2.0
67	1 sn	50	4	⊙ 2.8, 2.2, 2.0, 1.5
„	y	200	6	⊙ 2.8, 2.6, 2.5, 2.4, 2.4, 2.3
64	y	1000	1	♂ 3.5 (L = 10)
„	y	2000	1	♀ 3.5
67	y	1200	3	♀ 5.5, 3.5, ♂ 2.5
13	26		76	

Sergestes Henseni Ortmann.

Sergia Henseni, Ortmann 1893.
Sergestes sargassi, do., (mastigopus).
Sergestes Henseni, Hansen 1896 (partim).
Sergestes vigilax, Stephensen 1913.

In describing *S. Henseni* it will be convenient to compare it with *S. pectinatus.*

The rostrum is of the same shape, but longer than in *S. pectinatus*, its length equalling 2/3 of the breadth of the cornea.

The distal joints of the antennular peduncles are nearly of the same length but the first is much longer. In one specimen the following proportion was found: 19—10—11, in another: 18—11—13.

The third pair of maxillipeds are much more slender than in *S. pectinatus*, and the sixth joint, which also however, is divided into 5 subjoints, is not provided with a "comb", but carries a crowded armature of long and short spines. (See fig. 44). The relative length of the joints is about as 25—36—9—9—20 (in the other species as 34—16—16—16—17).

The hairfringed portion of the outer uropods, which carries sometimes a small tooth, is much shorter than in *S. pectinatus*, about 60 %.

Ortmann's figure (1893, pl. 3, fig. 3) is drawn from a specimen of the present species. It is easy to understand that Hansen (1896) found this figure "rather deficient" because he compared it with a specimen of *S. pectinatus* (certainly overlooked by Ortmann). The petasma is slender as in *S. pectinatus*, but very different in shape (see fig. 45). A singular feature, which I have not observed in other species, is the presence of multiple spines on the process *f*, somewhat recalling the "morning-stars" of by-gonetimes (se fig. 46).[1])

The larvæ are easily separated from those of *S. pectinatus* by several characters, viz: (1) the eyes are smaller, their longer diameter (E) compared with the length of the carapace (C)[2]) being as follows:—

C—1·8	2·0	2·3	2·6	3·0	3·1	3·2	3·5
E—0·7	0·65	0·75	0·7	0·7	0·7	0·75	0·8;
in *Serg. pect.:*		C—1·5	2·0	2·0	2·2	2·8	
		E—0·85	1·0	0·8	0·9	0·9	

(2) the second joint of the antennular peduncles is shorter, though the measurements are rather uncertain owing to the difficulty in securing a horizontal position without injuring the specimens; below the values found:

[1]) A drawing of the petasma is given by Stephensen 1913 as fig. 6, though he refers his specimens to *S. vigilax.*

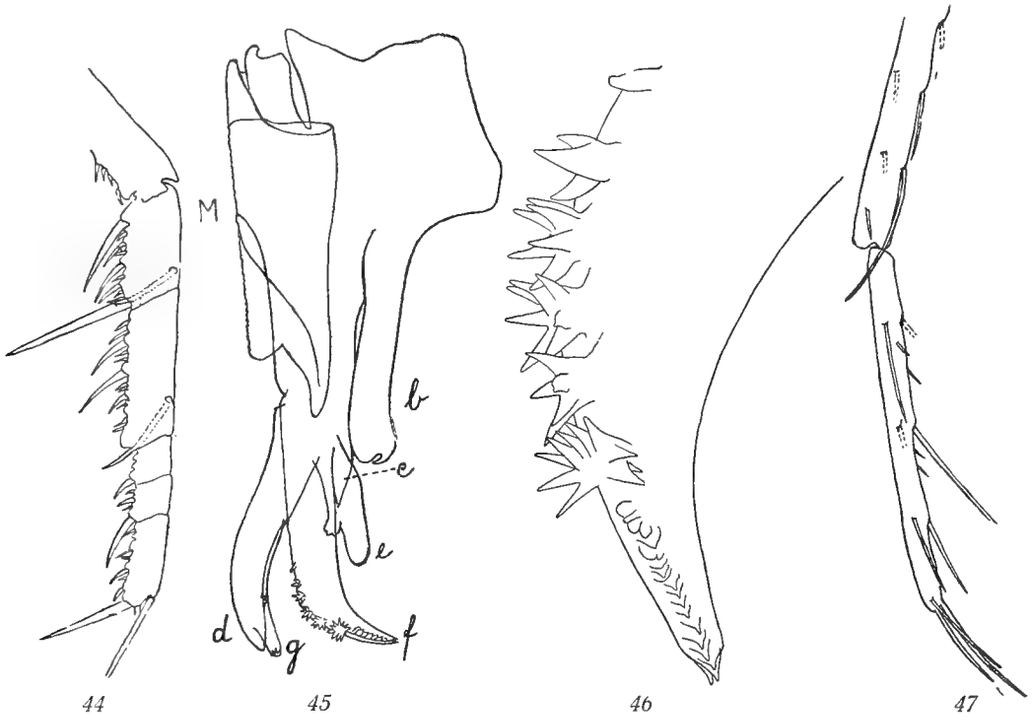
[2]) C is contained a little more than 3 times in the total length.

$$\frac{\text{2nd jnt.}}{\text{3rd jnt.}}\ 100 = 73 \cdot 78 \cdot 73 \cdot 78 \cdot 75 \cdot 82 \cdot 87 \cdot 75;$$

in *S. pect.* 82 · 96 · 82 · 89.

There is no appreciable variation with the size of the specimens. (3) the percentage of hairfringed edge on the uropods, which can be determined rather easily is very different from that in *S. pectinatus*. The following values were found (no appreciable variation with size): 61 · 63 · 64 · 65 · 63 · 63 · 62 · 60 · 64 · 63; in *S. pect.*: 74 · 75 · 78. (4) the external maxilliped is very similar to that of the adult, but there are only 4 subjoints, the fourth being later on divided into two. The armature is undeveloped, but the big spines are present and occupy similar positions as in the adult, see fig. 47. Attention is drawn to the fact that they are situated *in pairs* indicating a more primitive stage of development of the one-sidedness of the member, so pronounced in *S. armatus, vigilax etc.*

Sergestes Henseni is a much larger species than *S. pectinatus*, as the smallest males with petasma developed are about 5 mm. (C), while in *S. pectinatus* the petasma is present in males of only 3 mm. (C). Below is a table recording the size of all the specimens taken during the expedition. It should be compared with the corresponding data for *S. pectinatus*.



44 45 46 47

Figs. 41—47. *Sergestes Henseni*.. 44) ♀ 7.5, st. 23, y 400, 6. joint of 3. mxp. (20/1). 45) ♂ 7, st. 51, y 300, petasma (30/1). 46) ♂ 7, st. 51, y 300, process *f* of same (150/1), 47) ⊙ 2, st. 64, y 300, 3. mxp. (50/1).

C (mm.)	2	3	4	5	6	7	8	9	10	11	Total
Males				2	5	8	3				18
Females				4	15	13	1	3	4	1	41
Young	12	15	7								36

From the table of bathymetrical distribution it appears that *S. Henseni* lives in depths of about 150 metres. The data seem too scanty to allow of definite conclusions being drawn as to diurnal migrations or differences in habitat of the young and adult.

Depth (metres)	Hauls		Sizes (C in mm.)				Total		Grand total
			Below 5		5 —				
	D	N	D	N	D	N	D	N	
0—100	4	8	9	3	1	7	10	10	20
150—300	3	9	20	1	1	34	21	35	56
600—1500	3	8	1	0	5	10	6	10	16
Total	10	25	30	4	7	51	37	55	92
Grand total	35[1])		34		58		92		

According to our present knowledge the area of distribution is the same as that of *S. pectinatus*, with one remarkable exception one specimen caught as far north as st. 88 (about 45° N, 26° W).

[1]) On vertical haul not incl.

Table of cathes.

St.	Gear	m. w.	Number	Sex, size
23	1 sn	200	1	♀ 6
„	y	400	3	♀ 11, 10, ♂ 8
„	Tr	1250[1]	1	♂ 7,
29	y	400	1	♀ 9
„	y	2000	2	♀ 7, ♂ 5
34	y	400	2	♀ 10, 8
42	1 sn	200	1	♀ 7
„	y	300	1	♀ 6
45	1 sn	200	1	⊙ 3.5
„	y	300	16	♀: 3 à 7, 5 à 6, 1 à 5, ♂: 3 à 7, 4 à 6 mm.
„	y	2000	1	♂ 7
49	y	370	1	⊙ 3.1
„	3 ln	3000	1	♀ 7
51	1 sn	200	3	♀ 9, 6, ♂ 7
„	y	300	6	♀ 9, 7, 7, 7, ♂ 7, 7,
„	y	3000	2	♀ 7, 6
53	1 sn	0	1	⊙ 4
„	1 sn	100	1	⊙ 3
„	1 sn	200	1	♀ 5
„	y	300	4	♀ 7, 6, 6, ♂ 6
„	3 ln	2600	2	♀ 6, ♂ 8
56	y	2000	1	♀ 10
„	3 ln	3000	1	♀ 10
58	1 sn	200	1	♀ 6
„	y	300	1	♀ 7
62	y	300	1	♀ 6
„	3/4 sn	2500	1	♀ 6
63	3 ln	500—200	3	♀ 5, ⊙ 4, 4
64	1 sn	200	5	⊙ 3.0, 2.7, 2.3, 2.0, 2.0
„	y	300	18	⊙ 2 à 3.5, 5 à 3, 5 à 2.5, 6 à 2 mm.
„	y	2000	1	⊙ 2.0
67	1 sn	50	1	⊙ 1.4
„	y	200	3	⊙ 3.2, 2.6, 2.0
„	3/4 sn	600	2	⊙ 4, 3
„	y	1200	3	♀ 7, 5, ♂ 5
88	1 sn	200	1	♂ 8
15	36		95	

Sergestes Edwardsi Kröyer.

S. Edwardsi Kröyer 1955.
S. oculatus do. (mastigopus)
S. Edwardsi Hansen 1896.

Of this species only one specimen was taken during the expedition, a mastigopus about 10 mm. in length (C = 2,88), at st. 67, 1 sn. 50 m. w.

Sergestes (Acantosoma) sp.

Pl. I, fig. 1.

The single specimen was taken at st. 51, 1 sn, 200 m. w. I believe the photograph will give a better idea of the specimen than a description. The total length, excluding rostrum and telson is 2,5 mm. I may suggest that this Acanthosoma-form belongs to Hansen's group II, as the zoëa of *S. arcticus*, figured by Wasserloos (1908), is of quite another type. The form of the eyes suggest *S. Henseni* as being the adult.

[1]) Actual depth sounded.

Penæidæ.

Amalopenæus Smith 1882.

Gennadas Bate 1888.
Gennadas Bouvier 1908.
Amalopenæus Kemp 1910.

Amalopenæus elegans Smith.

Amalopenæus elegans Smith 1882.
Gennadas parvus Bate 1888.
—„— *elegans* Bouvier 1908 (ubi syn.)
Amalopenæus elegans Kemp 1910.

This is one of the commonest deep-sea prawns in the Atlantic; it was taken in great numbers in nearly every haul made in sufficient depth, — i. e. deeper than about 400 metres. In all 690 specimens were taken evenly distributed over the area investigated, excluding, of course, the Norwegian Sea. It seems however from the table of catches that the species is more abundant in the waters traversed by the northern route from St. Johns to the banks S.W. of Ireland, in this respect very much resembling the other pelagic prawn of quantitative importance, *Acantephyra multispina,* with which it disagrees in being found also in the southern portion of the area.

In the table of bathymetrical distribution[1]) the catches from the northern and southern sections are kept apart and it appears as if the species ventures to ascend a trifle higher up in the water in the northern section than in the southern.

Depth (metres)	Northern section				Southern section			
	< 5 mm.		5 mm. —		< 5 mm.		5 mm. —	
	Day	Night	Day	Night	Day	Night	Day	Night
200—375		1				3	10	3
450—850	253	2	100	4	14	36	6	14
1000—2100	29		85	2	23	14	32	38

It appears also that the young come somewhat higher up than the adult, though they are also decidedly dwellers of the deeps, even the smallest specimens in the collection displaying a similar red colouring as the adult, only the legs being more transparent. Even the smallest (C = 2 mm.) have gone through the whole metamorphosis. The larvæ, which are presumably very small, could not be detected in the collections.

[1]) St. 10 and vert. hauls not considered.

Table of catches (Hauls during night are marked with an*).

St.	Gear	m .w.	Number	Sex, size
10	?	?	11	6—9.5
19	4 sn	900—0	16	3—8
„	1 sn	900—300	3	6, 5, 3
„	y	400	10	5—8
25*	1/2 sn	3400	2	4, 6
29	y	2000	1	7
34	y	1000	1	⊙ 5
35	1/2 sn	4200	2	7, 3
„	T	(2603)	1	4
42*	y	900	10	7, 6, 6, 6, 5, 5, 5, 4, 4, 4
„*	1/2 sn	500	3	7, 5, 3
51*	y	2000	1	5
53*	y	1600	6	5, 5, 5, 4, 4, 3
„*	1/2 sn	2100	5	6, 5, 5, 5, 5
„*	3 ln	2600	13	5—7
56*	1/2 sn	750	3	5, 3, 3 (very defect)
„*	y	1000	29	5, 5, 5, 5 + 25 small (C = ca. 3)
„*	y	2000	8	6, 5, 5, 3, 3, 3, 3, 3
„*	3 ln	3000	4	5—7
62	y	1000	5	3, 3, 3, 3, 3
„*	y	2000	12	6, 6, 6, 5, 5, 3, 3, 3, 3, 3, 3, 3
„*	3/4 sn	2500	7	6, 6, 5, 5, 5, 5, 3
„*	3 ln	3000	1	6
63	4 sn	1350—450	2	6
„	4 sn	4500—1500	2	10, 9
64	y	2000	34	♀ 12.5 + thirteen ⊙ with C = 5—6 + 20 small, C = ca. 3
„	3/4 sn	2500	5	10, 6, 6, 6, 4
„	3 ln	3000	3	♀ 12, 9, ♂ 12
66	y	1000	9	3, 3, 3, 3, 3, 3, 3, 3, 3
„	3/4 sn	1500	11	8, 7, 6, 6, 6, 6, 4, 3, 3, 3, 3
67	3 ln	2200	1	♀ 9 (defect)
70	y	1700	8	12, 10, 9, 9, 8, 8, 7, 7
80	y	1000	1	6
„	3/4 sn	1500	1	♀ 10
„	y	2000	10	♀ 13, 12.5, 12.5, 11, 9, 7, ♂ 11, 10, 9, 9
„	3/4 sn	2500	5	♀ 13, 12, 10, ♂ 10, 7
„	3 ln	3000	5	♀ 12, 11, ♂ 10, 9, 9
81	y	2000	2	♀ 8, 7
„	3/4 sn	2500	2	2, 2, doubtful
„	3 ln	3000	12	♀ 12.5, 11, 9, 8, 7, 7, 7, 7, ♂ 9, 8, 7, 7
82	y	1000	13	♀ 8, 8, 8, 8, 7, 6, 6, ♂ 8, 8, 7, 7, 6, ⊙ 3
„	3/4 sn	1500	5	♀ 8, 7, 7, 6, ♂ 8
„	y	2000	2	♀ 11, ♂ 9
83	1 sn	1000	4	3, 3, 3, 3
84	y	1000	57	♀ 7, 6, ♂ 7, 7, 7 + 52 small, C = 2-3 mm.
„	3/4 sn	1500	8	♀ 7, ♂ 9, 7, ⊙ 2, 2, 3, 3, 3
„	y	2000	7	♀ 9, 7, ♂ 8, 7, 7, 6, 6
„	3/4 sn	2500	3	♂ 7, ⊙ 2.5, 2.5
87	y	1000	4	2—3
„	3/4 sn	1500	36	♂ 6, 5 the rest small, C = ca. 3
„	y	2000	10	♂ 6, 6 do, do.
88	y	1000	49	♀ 7, 6, 6, 4, 4 the rest ⊙ with C = 3
„	3/4 sn	1500	10	♀ 7, 7, 6, 6, ♂ 7, 6, 6, 6, 4, 3
„	y	2000	14	♀ 8, 6, 6, ♂ 7, 7 and 9 ⊙ with C = ca. 3
90	y	1000	17	♀ 7, and sixteen ⊙ with C = ca. 4
„	3/4 sn	1500	3	♀ 6, 6, ♂ 6
92*	3/4 sn	600	1	4
„*	y	1000	5	♀ 6, ♂ 6, 6, ⊙ 4, 4
„*	3/4 sn	1500	1	♀ 7
„*	y	2000	2	♀ 9, 8
94	3/4 sn	1500	2	3, 3
98	y	1000	38	♀ 8 + 37 ⊙ (3—4)
„	3/4 sn	1450	9	♂ 6, 3, 3, 3, 3, 3, 3, 3, 3
„	3 ln	1500	48	20 ♀ (2 à 8, 4 à 7, 14 à 6), 28 ♂ (1 à 8, 7 à 7, 20 à 6) mm.
101	y	1000	40	C = 3—4
„	3/4 sn	1500	8	♀ 7, ♂ 7, 6, 6 and four ⊙, C = 2.5-3
„	y	2000	22	♀ 8, 8, 7, 7, 6, 6, 6, 6, ♂ 7, 7, 7, 6, 6, 5 and eight ⊙, C = 3—4
„	3 ln	2500	20	13 ♀ (4 à 8, 4 à 7.5, 3 à 7, 2 à 6), 7 ♂ (3 à 8, 3 à 7, 1 à 6) mm.
27	69		705	

Amalopenæus valens Smith.

Amalopenæus valens, SMITH 1882.
Gennadas valens, BOUVIER 1908.

So far as the area investigated by the "Michael Sars" is concerned this species shows a similar distribution to that of *A. elegans*, though it was taken in greatest numbers in the SE part of the area. It has a more pronounced vertical migration than that species as shown in the table below:

Depth	Day	Night
50		1
100—300		55
500—2000	11	43

The blue patches characteristic of most species of the genus *Amalopenæus* are larger and the eyes are larger and darker than in *A. elegans*.

Table of catches. (Hauls made during night marked *)

St.	Gear	m. w.	Number	Sex, size
19	4 ln	900	2	⊙ 4, 3
23*	1 sn	200	2	♀ 8, 8
„*	y	400	10	5—8
„*	Tr	1215	7	6—7
„*	1 sn	500—0	1	7
25*	1/2 sn	2600	2	8, 11
29	y	2000	2	9, 8.5
34*	1/2 sn	600	1	4
„*	y	400	8	(5—8 mm.)
35*	4 ln	2400-0	1	♀ 10, ♂ 8, ⊙ 6, 4, 3
42*	y	300	2	6, 6
45*	y	2000	1	♂ 9
49*	4 ln	3000	1	8
51*	y	2000	1	5
„*	3 ln	4000	1	♀ 8
52	3 ln	1200	2	♀ 9, ⊙ 3
53*	1 sn	100	1	7
„*	y	300	5	6, 6, 6, 5, 2.5
„*	y	1600	2	7, 5
„*	3 ln	2600	12	(5—8 mm.)
56*	y	300	10	♀ 10, 10, 7, ♂ 11, 9, 8, 8, 7, 7, 5
„*	y	1000	1	♀ 10,
„*	y	2000	6	7—9
„*	3 ln	3000	10	6—10
58*	y	300	7	5—8
„*	3 ln	600	6	10, 9, 7, 7, 6, 6
62*	3 ln	3000	1	♀ 10
64	3 ln	3000	1	♀ 10
67	y	1200	2	8, 7
81	3 ln	3000	2	♀ 10, 8
82	y	2000	1	♂ 11
94	3 ln	2000	1	♂ 12
20	32		112	

Amalopenæus Tinayrei Bouvier.

Gennadas Tinayrei, Bouvier 1908.

This species resembles *A. valens* very much in appearance and seems to have a similar distribution horizontally and vertically, though it is probably wanting in the northeastern part of the area.

Depth	Day	Night
50—200		20
300—600	6	5
750—1500	3	7

Table of catches. (Hauls during night marked *).

St.	Gear	m. w.	Number	Sex, size
34*	y	400	1	♀ 6
42*	1 sn	200	2	♀ 7, 7
„*	y	300	4	8, 8, 7, 4
45*	y	300	3	♂ 6, 6, 6
51*	y	300	1	Ca. 6 (defect)
53*	1 sn	200	3	♂ 6, 6, 6
„*	y	600	2	5, 5
„*	3 ln	2600	4	7, 7, 7, 6
56*	1 sn	100	1	♂ 7
„*	1 sn	200	1	♂ 6
„*	y	300	1	♂ 6
„*	1/3 sn	750	3	3, 3, 3 (defect)
„*	3 ln	3000	1	6
58*	1 sn	200	1	6
„*	y	300	2	6, 6
62*	y	2000	1	5
„*	3/4 sn	2500	1	6
64	3/4 sn	2500	1	6
67	y	1200	4	7, 6, 5, 3 [1])
80	y	1000	1	♀ 7
81	3 ln	3000	1	♀ 7
82	3/4 sn	1500	1	♂ 6
84	y	1000	1	♀ 6
	23		41	

Amalopenæus Alicei Bouvier.

Gennadas Alicei, Bouvier 1908.

The appearance of this species is very different from the other species of the same genus; the bright red is replaced by a strong orange and no blue patches are found. The eyes are very small and their pigment faded. The adult specimens are of much greater size than the other species in the genus. The species is certainly an inhabitant of the very deepest strata where the amount of light is nearly imperceptible. From the table of catches it will be seen that *A. Alicei* was never taken above a depth of 1000 metres, even during night.

The geographical distribution of *A. Alicei* is at present not fully known but is probably very extended. It has been taken during several of the Prince of Monaco's expeditions in the North Atlantic, approximately within the same area where the "Michael Sars" obtained it.

Table of catches. (Hauls during night marked *)

St.	Gear	m. w.	Number	Sex, size
25*	1/2 sn	3400	1	c. 16 (defect)
29	y	2000	8	11, 11, 10, 9, 5, 4, 4, 4
35	1/2 sn	4200	1	8
45*	y	2000	3	12, 12, 10
„*	4 ln	3000	3	12 (two def.)
49*	y	2000	3	4, 4, 4,
„*	4 ln	3000	6	15, 14, 13, 12, 9
51*	y	3000	1	⊙ 10
53*	3 ln	2600	32	6—15 (mostly 12—14) mm.
56*	y	2000	2	14, 10
„*	3 ln	3000	4	15, 13, 11, 9
62*	y	2000	1	15
„*	3/4 sn	2500	1	15
„*	3 ln	3000	2	17, 16
64	y	2000	1	7
„	3/4 sn	2500	1	8
„	3 ln	3000	1	♂ 13, ♀ 11
80	3 ln	3000	1	♀ 12
82	y	2000	1	♀ 11
12	19		74	

Benthesicymus Sp. Bate.

Benthesicymus brasiliensis, Bate 1881.

This species was taken by the "Michael Sars" at st. 35 with trawl in a depth of 2603 metres. One defect female, total length 105 mm. The specimen differs from Bate's description by the presence of a very small spine in the hepatical area and a very small tubercle between the first pair of pleopoda. These characters may possibly have been overlooked by Bate, and this assumption is the reason why I do not propose a new name for the single specimen at hand.

B. brasiliensis has formerly been taken in the Southern Pacific and the South Atlantic, in depths between 600 and 4300 metres.

[1]) The smallest may perhaps be an *A elegans.*

Benthesicymus Hjorti n. sp.
(Pl. II, fig. 4).

This species bears a close resemblance to *B. crenatus* Bate sharing with it the outstanding feature of having the posterior edge of the fourth pleosomite saw-toothed (see fig. 48). Our species which might be considered the Atlantic representative of the Pacific species *B. crenatus*, differs from it in carrying only two teeth on the upper edge of the rostrum (the tip not included) and no spine on the carapace behind the rostrum.

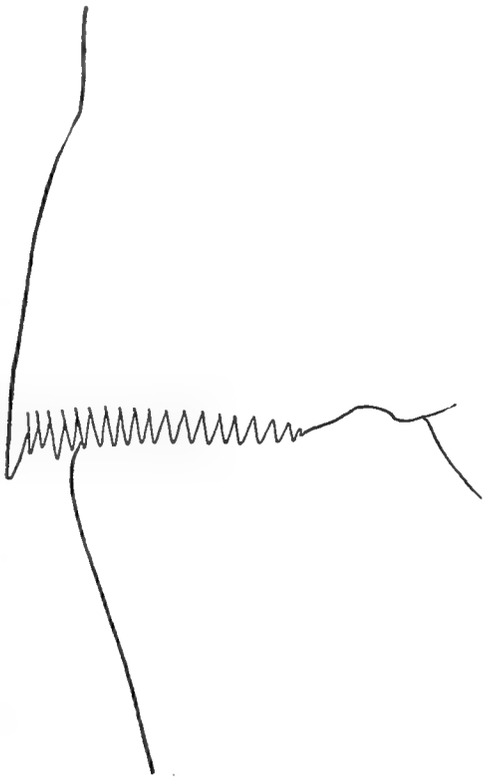


Fig. 48. *Benthesicymus Hjorti.* Detail of abdomen (5/1).

The eyes are devoid of pigment. The cornea is scarcely broader than the stalks which do not reach as far as the tip of the rostrum, neither to the extremity of the first joint of the antennular peduncles. This joint is of about the same length as the two outer joints together. The stylocerite ends in a short triangular tooth.

The carapace is very smooth, the sulci being nearly obliterated. Of spines only the branchiostegal is seen; it is very small.

The tail-fan is large. Telson is long, nearly three fourths as long as the outer uropod.

In all three specimens were taken, two males at st. 53 (trawl, 2615—2865 m.) and one female at st. 35 (trawl 2603 m.). Below is given some measurements, in mm., of these specimens.

	♂ st. 53	♂ st. 53	♀ st. 35
Length of carapace	35	26	44
Do, rostrum included	42	30	55
Length of scaphocerite, to tip of tooth	21	16	24.5
„ - outer uropod, do.	20	15	23
„ - do., total	24	18	28
„ - inner uropod	17	13	20
„ - telson	16.5	13	20.5

Benthesicymus longipes Bouvier.
Benthesicymus longipes, BOUVIER 1908.

This species has formerly been taken only once, near the Cap Verde Islands, in a depth 3890 metres.

Two of the specimens obtained by the "Michael Sars" were taken at a depth not exceeding 3000 metres (length of wire paid out 4000 metres) bottom being found in a depth of 3886 metres. The capture must therefore have occurred at a distance of not less than 800 metres ftom the bottom, thus establishing *B. longipes* as a plankton- animal.

"Michael Sars" 1910, st. 51, large net, 4000 metres wire out. Two males, length of carapace (C) 22 and 20 mm. respectively. St. 35, trawl, depth 2603 metres, one defect specimen (C = 19).

Benthesicymus ? carinatus Smith.
Benthesicymus? carinatus, SMITH 1884.

Only one, very mutilated specimen of *B. carinatus* was obtained, a female with a carapace length of about 30 mm., at st. 82, at a depth of about 2000 metres (large tow-net, 3000 metres wire out). Drawings of the very characteristic mouth parts are given in fig. 49. The form of these, especially of the 2. mxp., suggests for this species an intermediate position between the genera *Amalopenæus* and *Benthesicymus*.

Plesiopenæus Edwardsianus I. Y. Johnson.
Penæus Edwardsianus, I. Y. JOHNSON, 1867, p. 897.
Plesiopenæus Edwardsianus, E. L. BOUVIER, 1908, p. 64, ubi. syn.

Of this magnificent species good catches were made with the trawl at the following stations:
at st. 23, depth 1215 metres, 54 males and 83 females, and one young,
at st. 24, depth 1615 metres, one male and one female,
at st. 41, depth 1365 metres, 18 males and 7 females.

The length of carapace was measured in all the specimens except four defect ones. The females are generally much larger as will be seen from the measurements. In addition to those contained in the table four

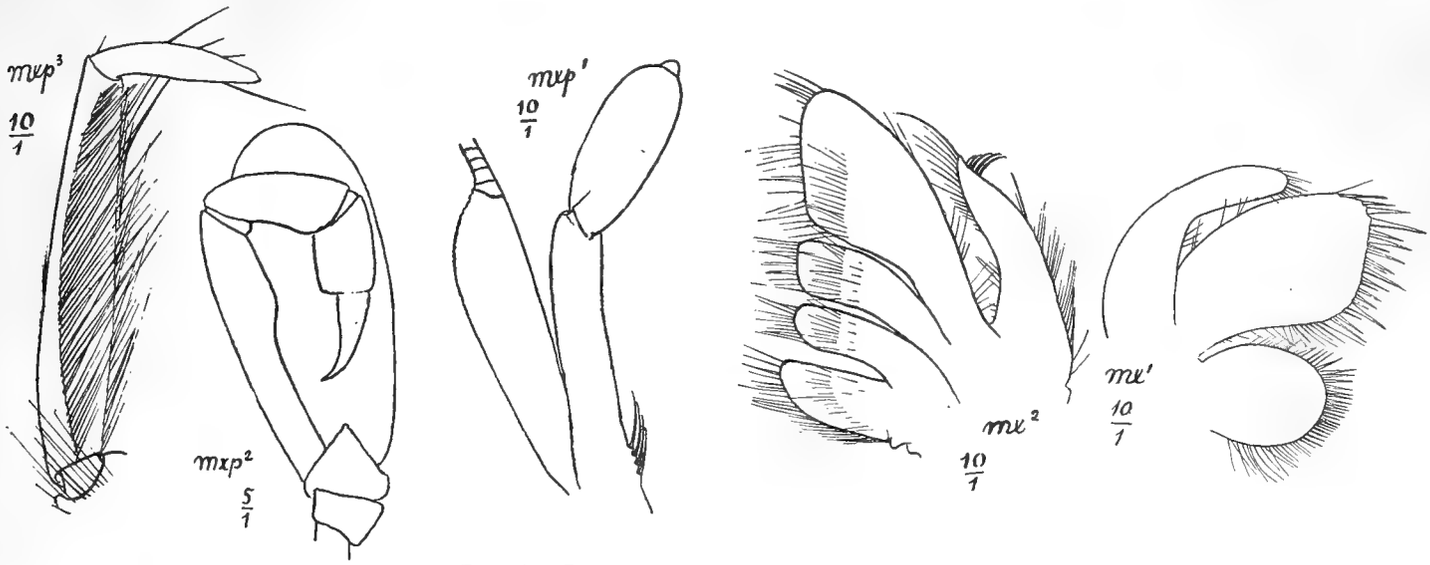


Fig. 49. *Benthesicymus carinatus.* Mouth parts.

defect specimens and one young of indefinite sex, measuring 30 mm. were taken.

The largest specimen, a female with a carapace 104 mm. long measured 334 mm. from tip of telson to tip of rostrum. The species has been taken on both sides of the Atlantic, in the Gulf of Bengal and in the Andaman Sea but not in the Mediterranean. Bathymetrical limits 344 to 1850 metres.

Length of carapace cm.	Number of	
	males	females
4.0	3	3
4.5	2	6
5.0	3	3
5.5	21	1
6.0	33	2
6.5	8	8
7.0	—	12
7.5	—	8
8.0	—	15
8.5	—	14
9.0	—	13
9.5	—	4
10.0	—	—
10.5	—	1

Aristeopsis tridens S. I. Smith.

Aristeus? tridens, S. I. Smith 1884, p. 404, pl. IX, fig. 1—6.
Aristeopsis armatus Sp. Bate var. *tridens,* Bouvier 1908 (ubi syn.).

This large prawn was obtained on two occasions during the expedition, both of the catches within the bathymetrical and horizontal limits of distribution as previously known, viz:

at st. 35, trawl, 2603 metres, 5 males and 3 females,
at st. 53, trawl, 2615—2865 metres, 21 males and 20 females.

The sizes of the specimens were as follows:

Length of carapace cm.	Number of	
	males	females
3.5	2	1
4.0	—	4
4.5	6	8
5.0	12	7
5.5	5	2
6.0	1	1

The total length is about 4 times that of the carapace measured from the orbital sinus.

As the species is perfectly well established by Smith (1884) and clearly distinguishable from *A. armatus* (Bouvier 1909), there seems to be little reason to encumber its name by referring it as a variety of another distinct though nearly related species.

Aristeomorpha foliacea Risso.

Penæus foliaceus, Risso, 1826.
Aristeomorpha foliacea, E. L. Bouvier, 1908, p. 53 (ubi syn.).

This species was taken together with *Parapenæus longirostris,* at st. 21, trawl, 535 metres.

Two females, length of carapace 58 and 65 mm. respectively.

The species is known from the Mediterranean and off Morocco in depths between 500 and 1300 metres.

Funchalia Woodwardi Johnson.

Funchalia Woodwardi, JOHNSON, 1867, p. 995—897.
Grimaldiella Richardi, E. L. BOUVIER, 1905 (juv. solum).
Funchalia Woodwardi, E. L. BOUVIER, 1908, p. 93, ubi syn.

No less than 67 specimens were obtained of this curious species, all of which are immature, the largest only about 7.5 cm. long while the type specimen taken by Johnson at Madeira in 1867 was $6^1/_2$ inches or about $17^1/_2$ cm. BOUVIER (1908) belives that *Funchalia* leads a bathypelagic life though being able to ascend to the upper waterlayers. From the catches of the „Michael Sars" Expedition it would appear that the young, at last of *Funchalia* are denizens of the upper waterlayers though not of the very surface, most of the 67 specimens (43) having been taken between 50 and 150 metres and the rest probably during the hauling up of the gear from greater depths.

As to the geographical distribution it may be noted that the species was taken both in the Sargasso Sea, S. of the Azores and W of North Africa while formerly it was known only from the neighbourhood of the Azores and the Canary Islands.

Table of catchës. (Hauls during night marked *).

St.	Gear	m. w.	Number	Sex, size
23*	y	400	8	4, 4, 5, 6, 7, 7, 7, 8
29	1 sn	200	1	12
„	y	2000	1	11
34*	½ sn	600	1	9
35*	4 ln	2400-0	1	8
38	½ sn	200	1	8
39*	1 sn	150	1	8
42*	y	900	1	5
„*	y	300	5	20, 12. 11, 11, 8
„*	1 sn	100	2	12, 11
45*	1 sn	100	6	8, 8, 7, 4, 3, **2**
„*	1 sn	200	17	18, 10, 9, 9, 8, 8, 7, 6, 6, 6. 6, 5, 4, 4, 4, 3, **2**
„*	3 ln	3000	4	20, 14, 10, 9
49*	4 ln	1000-0	2	9, 7
„*	y	2000	2	9, 5
„*	3 ln	3000	1	8
51*	y	2000	1	18
52	½ sn	100	2	5, 5
53*	1 sn	100	7	5, 3, 3, 3, 3, 2
58	y	300	1	3
67	y	1200	2	5, 3.5
14	21		67	

Parapenæus longirostris H. Lucas.

Penæus longirostris, H. LUCAS, 1849.
Parapenæus longirostris, E. L. BOUVIER, 1908, p. 102 (ubi syn.).

At st. 21 the trawl brought up from a depth of 535 metres four females of the above species. Their length of carapace was 29, 30, 32 and 36 mm. respectively, total length 15—17 cm.

The species has formerly been taken off the coasts of Portugal and Morocco and in the Mediterranean down to a depth of 500 metres.

STENOPIDES.

Spongicola Koehleri Caullery.

Spongicola Koehleri, CAULLERY, 1896.

This interesting species was discovered by the „Caudan" in the Bay of Biscay in a depth of 1410 meters in 1896. Since that time it has probably not been retaken until the "Michael Sars" expedition obtained one specimen at st. 23, from a depth of 1215 metres. C = 9, L = 24 mm.

Bibliography.

ALCOCK, 1901. A Descriptive Catalogue of the Indian Deep-Sea Crustacea Decapoda, Macrura and Anomala, in the Indian Museum.

BATE, 1888. Report on the scientific Results of the Voyage of H. M. S. "Challenger" during the years 1873—76 Zoology, vol. XXVI Crustacea Macrura. Edingburgh 1888.

BOAS, 1880. Studier over Decapodernes Slægtskapsforhold. (Vid. Selsk. Skr.) 6. Række naturv. og math., Avd. I, 2. Kjøbenhavn 1880.

BORRADAILE, 1907. "On the Classification of the Decapod Crustaceans". Ann. mag. Nat. Hist., Ser. 7. Vol. XIX.

BOUVIER, 1905. Sur les Pénéides et les Sténopides recueillis par les expeditions françaises et monégasques dans l'Atlantique oriental (Comptes rendus Acad. des Sciences), A. CXL, p. 9 80—983.

BOUVIER, 1906. "Sur les Gennadas ou Pénéides Bathypélagiques". Bull. Mus. Oceanog. Monaco., No. 80.

BOUVIER, 1908. Crustacés decapodes (Pénéidés) provenant des campagnes de l'Hirondelle et de la "Prinsesse-Alice" (1886—1907). Res. Camp. Sci. Monaco, Fasc. XXXIII.

CAULLERY, 1896 a. Crustacés Schizopodes et Decapodes; Résultats Scientifiques de la Campagne du Caudan. — Ann. Univ. Lyon XXVI.

CAULLERY 1896 b. Résultats scientifiques de la campagne du "Caudan" dans le golfe de Gascogne, août—septembre 1895. Crustacés schizopodes et decapodes. Lyon 1896.

FAXON, 1895. Stalk-eyed Crustacea of the Albatross Expedition. Mem. Mus. Comp. Zool., Harvard Coll., Vol. XVIII.

HANSEN, 1896. On the Development and Species of Crustaceans of the genus Sergestes. — Proc. Zool. Soc., London

HANSEN, 1903(1). On a new species of Sergestes obtained during the cruise of the Oceana. Ann. Mag. Nat. Hist. Ser. 7. Vol. XI.

HANSEN, 1903(2). On Crustaceans of the genera Petalidium and Sergestes from the Challenger. Proc. Zool. Soc., London.

HANSEN, 1908. Crustacea Malacostraca of the Danish-Ingolf Expedition.

JOHNSON, 1867. Descriptions of a new Genus and a new Species of Macrurous Decapod Crustaceans belonging to the Penæidæ discovered at Madeira. Proc. Zool. Soc., London 1867.

KEMP. 1910. The Decapoda Natantia of the Coasts of Ireland. Fisheries, Ireland, Sci. Invest., 1908, I.

KEMP, 1913. Pelagic Crustacea of the Percy Sladen Trvst Exp. in H.M.S. "Sealark". London Trans. Linn. Soc., Ser. 2, Zool. 16, pt. 1.

KRÖYER, 1859. Forsøk til en monografisk fremstilling af Krebsdyrslægten Sergestes med Bemærkninger om Decapodernes Høreredskaber. — K. D. Vidensk. Selsk. Skrifter, 5. Række. Nat. Math. Avd. iv. 2.

LO BIANCO, 1901. Le pesche abissali eseguite da F. A. Krupp. col Yacht Puritan nelle adiacenze di Capri ed in altro localita del Mediterraneo. Mitth. Zool. Stat. Neapel. Bd. XVI.

ORTMANN, 1893. Decapoden und Schizopoden der Plankton-Expedition. Kiel & Leipzig. 1893.

ORTMANN, 1901. Crustacea, zweite Hälfte: Malacostraca (Die Klassen und Ordnungen der Arthropoden). Leipzig 1901.

SARS, 1882. Oversigt af Norges Crustaceer . . . . (Forhandl. Vid. Selsk. Christiania) No. 18. 1882.

SMITH, 1882. Reports on dredging . . . . on the East Coast of the United states . . . . By the Blake XVII. — Pt. I. Crustacea Decapoda. Bull. Mus. Comp. Zool. Harvard Coll. Vol. X.

SMITH, 1884. Report on the Decapod Crustacea of the Albatross dredgings off the East Coast of the United States. Rep. U. S. Fish Commission for 1882.

SMITH, 1887. Report on the Decapod Crustacea from the Albatross dredgings off the East Coast of the United States during the Summer and Autumn of 1884. (Ann. Rep. Comm. Fish. and Fisheries for 1885). Washington 1887.

STEBBING, 1893. A History of Crustacea, Recent Malacastraca. London 1893.

STEBBING, 1908. South African Crustacea, Part III, Marine Investigations in South Africa. Vol. IV.

STEPHENSEN, 1913. The copulatory organ (Petasma) of Sergestes vigilax Stimpson (H. I. H.). Mindeskrift for Japetus Steenstrup. Copenhagen.

STIMPSON, 1860. Prodromus descriptionis animalium evertebratorum . . . . Pars VIII, Crustacea Macrura Proc. Ac. nat. Sc. Philaladelphia 1860.

WOOD-MASON, 1891. On the Results of Indian-Deep-Sea Dredging. Ann. Mag. Nat. Hist. 6, VII.

WOOD-MASON, 1892. Illustrations of the Zoology of H. M. Indian Marine Surveying Steamer "Investigator". Part I, Crustaceans.

Record

of horizontal hauls intended to provide samples of zooplankton during the "Michael Sars" expedition 1910.

The appliances used were:—conical silknets with mesh in end-part of 0.5 mm. (1/4 square millimeter) and with a diameter at the opening of 1/2, 3/4 or 1 meter (designated in the tables as 1/2 sn, 3/4 sn, 1 sn); conical nets made of shrimp-trawl net, diameter at the opening 3 m. ("3 ln"); and young-fish trawls og C. G. Joh. Petersen's model ("y"). In the first table (I) each haul is represented by a figure showing length of wire between the appliance in question and the ship. The actual depth is, of course unknown, but may roughly be guessed as about two thirds of the length of wire, in hauls near the surface perhaps somewhat less.—The surface-hauls were alle made by means of a one-meter silk net. Table II shows the duration of each haul in minutes. Table III giwes a view af all the horizontal zooplankton hauls, distributed over the different depths (i. e. wire out) and over the four are as into which the regions travesed during the voyage may conveniently be divided. NE comprises station 1—12 and 87—116, NW stations 70—86, SE stations 13—59 and SW stations 60—69. Operations began on the the 9th of april 1910, at st. 1 and ended aug. 14 1910 at st. 116.

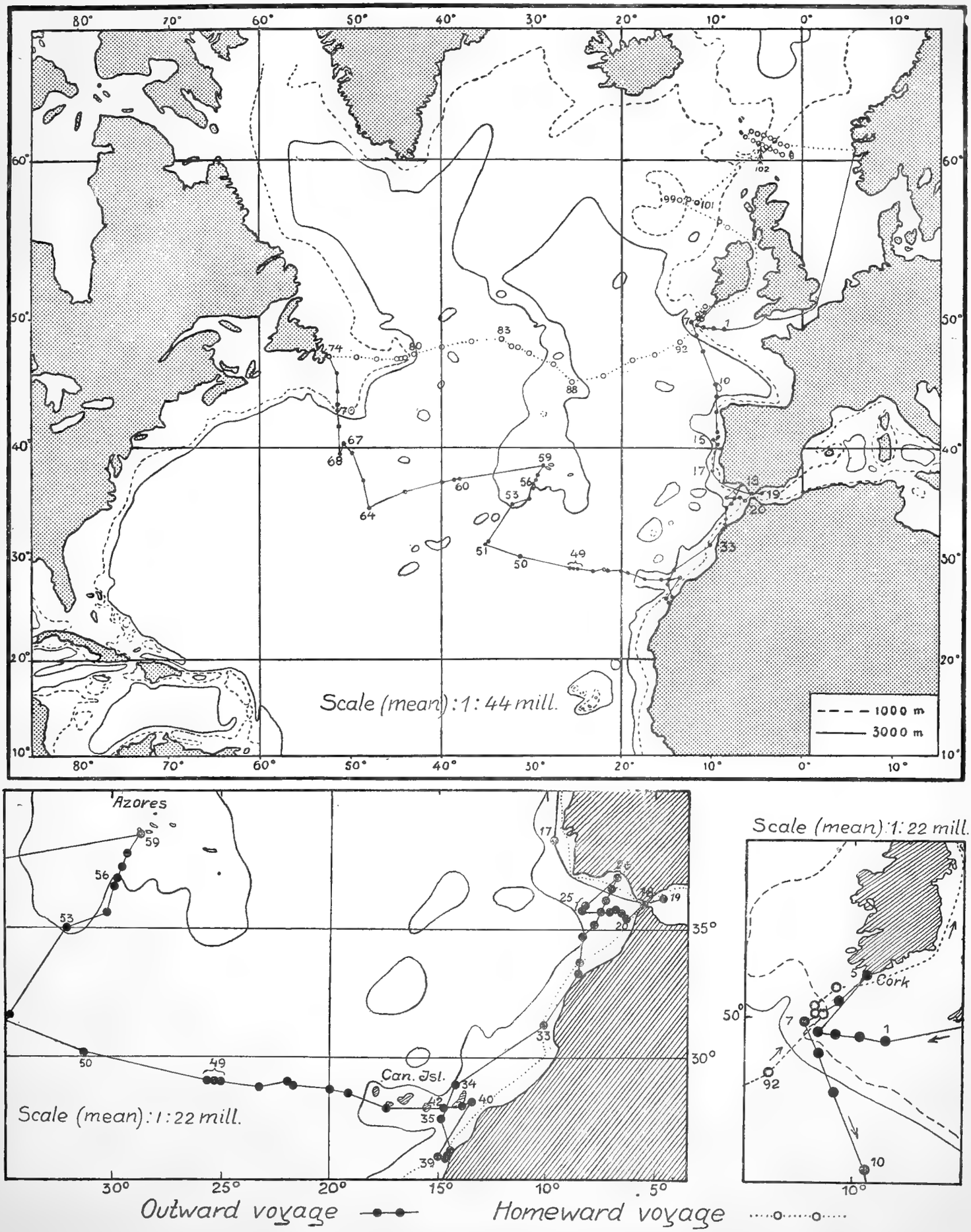
The position of the stations may be gathered from the three charts, pag. 35.

Table I. (Table I) (Table I)

St.	Date	Dur. of haul	Appliances towed simult. 1/2 sn	3/4 sn	1 sn	3 ln	y	St.	Date	Dur. of haul	Appliances towed simult. 1/2 sn	3/4 sn	1 sn	3 ln	y	St.	Date	Dur. of haul	Appliances towed simult. 1/2 sn	3/4 sn	1 sn	3 ln	y
		hours	m. w.	m. w.	m. w.	m. w.	m. w.			hours	m. w.	m. w.	m. w.	m. w.	m. w.			hours	m. w.	m. w.	m. w.	m. w.	m. w.
10	18-21/4	2 1/4			100*)		300*)	53*	8-9/6	6	1100				1600	83	14/7	1	1000 3)				
"	"	"			200*)			"	"	"	2100					84	15/7	4		600	100		300
"	"	3			970		1570	56*	11-12/6	10	500		100 2)	3000	300 2)	"	"	"		1500	200		1000
15*	22-23/4	1 2/3			100		300	"	"	"	750		200 2)		1000	"	"	"		2500			2000
"	"	"			200			"	"	"					2000	"	"	"					3000
"	"	"			600			58*	10-11/6	c. 10			100	600	300	86	16/7	1/2	100 3)				
19*	2-3/5	8					400	"	"	"			200			"	"	"	300 3)				
23*	5-6/5	6 1/2			200		400	62*	20-21/6	6 1/2		600	100	3000	300	"	"	"	600 3)				
"	"	"					1500	"	"	"		2500	200		1000	"	"	1	1000 3)				
25 A	7/5	3	2600					"	"	"					2000	"	"	"	2000 3)				
25 B*	8/5	5	3400					64	24/6	6		600	100	3000	300	87	17/7	3	300	600	100		300
29	9/5	1 1/4	1100		200		400	"	"	"		2500	200		1000	"	"	"		1500	200		1000
"	"	"					2000	"	"	"					2000	"	"	"		2500			2000
34*	13-14/5	4	600				400	66	26/6	2		200			1500	"	"	"					3000
"	"	"					1000	"	"	"		500				88*	18/7	6 1/2	300	600	100		300
35*	18-19/5	2	4300					"	"	"		1000				"	"	"		1500	200		1000
38	20/5	1 1/2	215		60		215	67	27/6	2		600	50	2200	200	"	"	"					2000
"	"	"			140			"	"	"		800			1200	90	21/7	3	300	600	100		300
39 A*	20-21/5	7	240		75		300	"	"	"		1700				"	"	"		1500	200		1000
"	"	"			150			69	29/6	2			100		300	"	"	"					2000
42*	23-24/5	7	500		100		300	"	"	"			200			92*	23-24/7	4		600	100	3000	300
"	"	"			200		900	70	30/6	5		100	200		300	"	"	"		1500	200		1000
45*	28-29/5	9 1/4	1000		100 1)	3000	300 1)	"	"	"		700			1700	"	"	"					2000
"	"	"			200 1)		2000	"	"	"		1200				94	26/7	3	250	600	100	2000	300
47	30/5	c. 10	45					71	"	2			100		300	"	"	"		1500	200		1000
"	"	"	6800					"	"	"			200			96	27/7	1		100			300
48	"	c. 12	150					80	11/7	c. 6		600		3000	300	97	4/8	3/4					50
"	"	"	7550					"	"	"		1500				98*	5/8	4		600	100	1500	300
49 B	1/6	c. 8	750		100	3000	370	"	"	"		2500				"	"	"		1450	200		1000
"	"	"	1000		270		2000	81	12/7	3		600	100	3000	300	99	6/8	1/2					75
51*	5-6/6	c. 11	700		100	4000	300	"	"	"		1500	200		1000	101	7/8	3		600	100	2500	300
"	"	"	1000		200		2000	"	"	"		2500			2000	"	"	"		1500	200		1000
"	"	"					3000	82	13/7	3 1/2		600	100	3000	300	"	"	"					2000
52	6/6	2 1/2	100			1200	600	"	"	"		1500	200		1000	102*	9-10/8	3		400	100	1500	300
53*	8-9/6	6	60		100	2600	300	"	"	"		2500			2000	"	"	"		1400	200		600
"	"	"	120		200		600	83	14/7	1/2	100 3)					"	"	"					1000

1) Appl. 100, 200, 300, m. w. only 6 1/4 hours. 2) Appl. 100, 200, 300 m. w. only 7 hours. 3) Fine silk horisontal closing net, d = 1/2 m.

Cruises of the "Michael Sars" 1910.



Portions of the voyage in larger scale in the two smaller charts. Figures denote station-numbers.

Table II.

Surface-hauls (with silknet, 1 m. diam.)

Duration of hauls given in minutes.

St.	Dur.	Ended at	St.	Dur.	Ended at	St.	Dur.	Ended at
5	10	14.40	44	10	14.00	70	300	13.10
10	90	21.45	46	10	day	71	120	sunset
„	60	11.00	47	10	day	73	15	day
15	100	23.30	48	720	23.30	75	5	day
18	15	23.30	49	240	16.30	78	15	17.00
19	10	9.15	50	10	8.30	80	360	18.09
25	60	22.50	51	15	20.45	81	180	18.30
26	10	21.40	„	660	5.30	82	60	16.00
27	10	1.10	52	150	24.00	84	240	17.30
28	10	7.10	53	390	4.30	87	180	13.30
29	75	20.15	56	150	4.30	88	390	8.45
31	10	16.10	58	500	4.15	90	180	18.00
32	10	20.10	59	15	16.45	92	240	2.30
35	45	19.45	60	10	9.05	94	180	15.00
37	10	9.15	62	390	4.30	97	45	20.10
38	10	12.00	64	600	17.00	98	240	6.30
39	10	4.00	66	120	17.40	99	20	9.20
42	10	5.00	67	120	15.15	101	180	16.00
43	10	18.00	69	120	10.30	102	180	night

Table VI.

Summary of hauls.

Wire out (m.)	Silk-net				Total	Large nets etc.				Total
	NE	NW	SE	SW		NE	NW	SE	SW	
During day (hours 6—18)										
Surface	8	6	14	5	33	—	—	—	—	—
40—150	5	7	6	3	21	2	—	—	—	2
151—450	7	6	3	3	19	6	5	3	3	17
450—1250	5	9	2	5	21	5	4	2	2	13
1251—2250	4	5	—	1	10	4	5	2	3	14
3251—4750	1	4	1	2	8	2	4	1	1	8
4751—7751	—	—	2	—	2	—	—	—	—	—
Total (day)	30	37	28	19	114	19	18	8	9	54
During night (hours 18—6)										
Surface	5	—	15	1	21	—	—	—	—	—
40—150	5	—	11	1	17	—	—	—	—	—
151—450	7	—	9	1	17	4	—	11	1	16
451—1250	3	—	9	1	13	4	—	5	1	10
1251—2250	4	—	1	—	5	5	—	5	1	11
2251—4300	—	—	2	1	3	1	—	5	1	7
Total (night)	24	—	47	5	76	14	—	26	4	44

Table III.

Number and duration of horizontal hauls.

Length of wire metres	Silknets (diam. 0.5, 0.75 and 1 m.)										Large nets or y. fish trawl of shrimp net									
	Number of hauls					Hours towed					Number of hauls					Hours towed				
Limits	NE	NW	SE	SW	Tot.	NE	NW	SE	SW	Tot.	NE	NW	SE	SW	Tot.	NE	NW	SE	SW	Tot.
0.....	12	6	28	6	52[1])	39.2	23.5	65.2	18.5	146.4										
40—50.....			1	1	2			10	2	12	1				1	0.5				0.8
51—150.....	10	7	16	3	36	32.8	18.5	101	14.5	166.8	1				1	0.5				0.5
151—250.....	10	5	11	4	30	34.8	17.5	65	16.5	133.8			1	1	2			1.5	2	3.5
251—450.....	4	1	1		6	15.5	0.5	8		24	10	5	13	3	31	33.8	17.5	83.8	14.5	149.6
451—750.....	7	6	6	4	23	26.5	22	40.7	16.5	105.7	1		3		4	3		18.5		21.5
751—1250.....	1	3	5	2	11	3	7	35.5	4	49.5	8	4	4	3	19	29.5	16.5	23.5	14.5	84.0
1251—1750.....	8	4		1	13	29.5	16.5		2	48	3	1	2	1	7	10	5	12.5	2	29.5
1751—2250.....		1	1		2		1	6		7	6	4	5	3	18	22.5	16.5	39.5	14.5	93
2251—2750.....	1	4	1	2	8	3	16.5	3	12.5	35	1		1		2	3		6		9
2751—3250.....											2	4	4	2	12	7	16.5	38.3	12.5	74.3
3251—4750.....			2		2			7		7			1		1			11		11
4751—6250.....																				
6251—6750.....																				
6751—7250.....			1		1			10		10										
7251—7750.....			1		1			12		12										
	53	37	74	23	187[1])	184.3	123	364.4	86.5	757.2	33	18	34	13	98	110.1	72	234.6	60	476.7

[1]) Series of of surface hauls at the same station here considered as one haul.

Plate I.

Plate I.

Fig. 1. *Sergestes* (Acanthosoma) sp. ($^{35}/_{1}$)

Fig. 2. *Sergestes robustus* (juv.) Forepart, st. 64, y 300 m. w. ($^{42}/_{1}$).

Fig. 3. *Sergestes robustus* (juv.) Tail-fan of the same specimen ($^{42}/_{1}$).

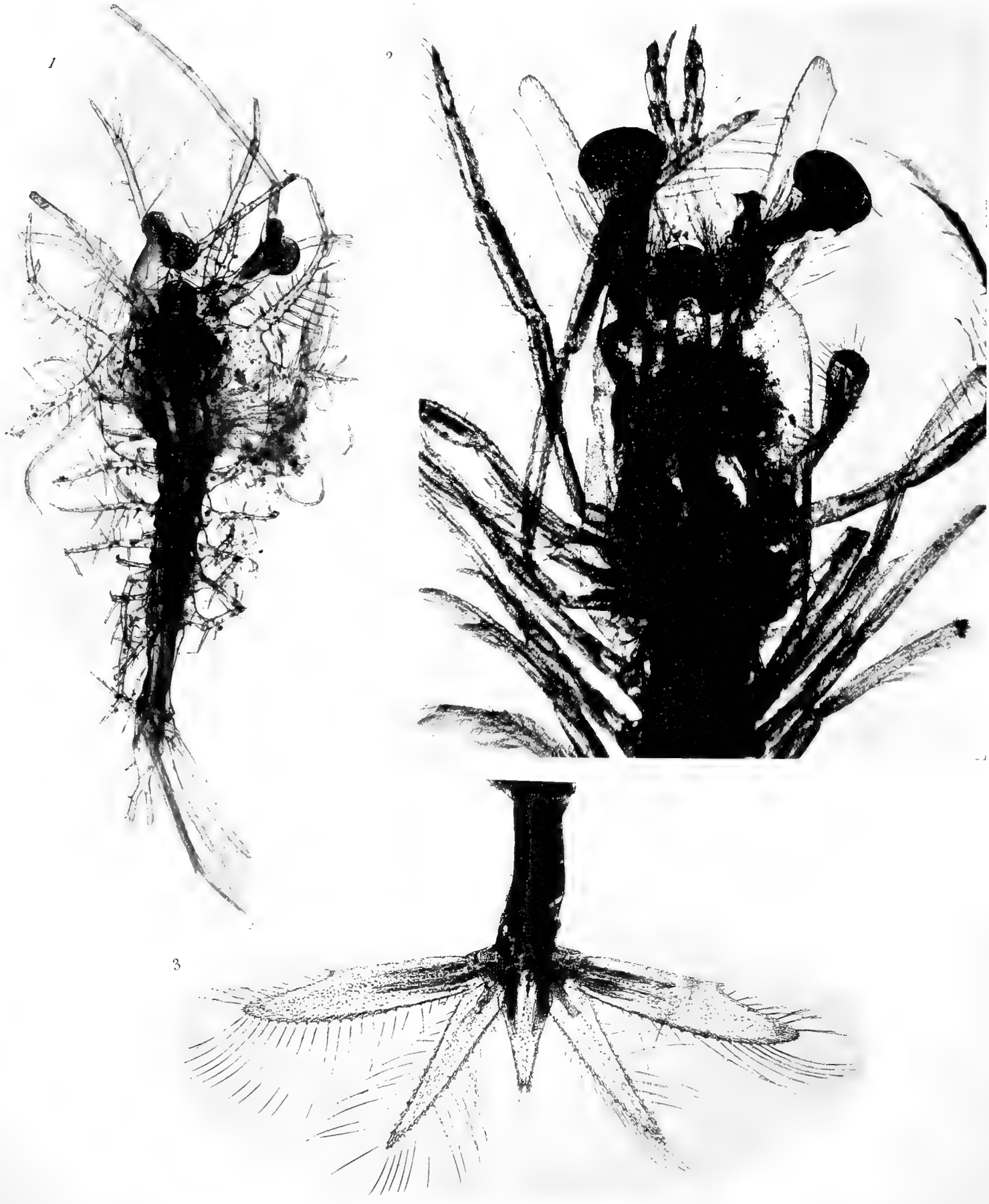

1
2
3

Plate II.

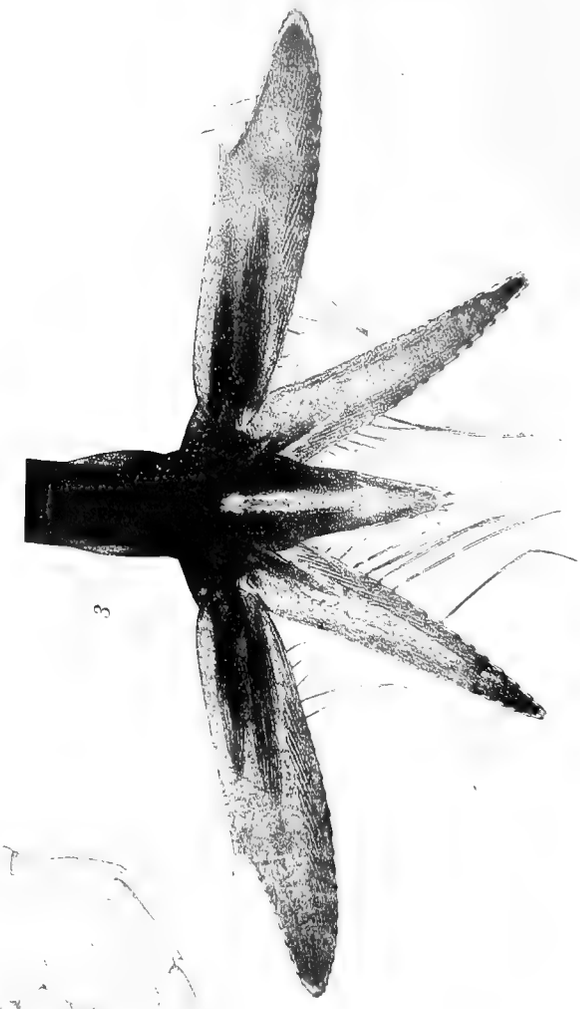
Plate II.

Fig. 1. *Sergestes corniculum*, ♀ 17, st. 51, y 300 m. w. Rasmussen del. ($^{2}/_{1}$).

Fig. 2. *Sergestes splendens*, head-parts of a young specimen, st, 64, 1 sn, 100 m. w. ($^{45}//_{1}$).

Fig. 3. *Sergestes splendens*, tail-fan of the same specimen ($^{45}/_{1}$).

Fig. 4. *Benthesicymus Hjorti* ♀ 44, st. 35, trawl, 2603 m. Rasmussen del. ($^{1}/_{1}$).



ECHINODERMATA

FROM

THE „MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION 1910

BY

JAMES A. GRIEG

WITH 5 PLATES, 10 ILLUSTRATIONS IN THE TEXT AND CHARTS

A very rich and interesting material of echinoderms was collected in the summer of 1910 during the cruise of the "Michael Sars" in the North Atlantic. The material which contained 92 species and 67 genera is distributed, as follows:

Holothurioidea:	14	genera	21	species
Asteroidea:	24	„	30	„
Ophiuroidea:	13	„	22	„
Echinoidea:	13	„	15	„
Crinoidea:	3	„	4	„

The greater and most interesting part of the collections was taken from the great depths of the North Atlantic, ***Peniagone ferruginea,*** one of the species found there, is new to science, and *Peniagone wyvillii* taken in the Bay of Biscay by the "Michael Sars" is new to the Atlantic region. It was previously known only from the Pacific. Several of the others are likewise of great interest from a zoogeographical point of view, as their vertical as well as their horizontal distribution has been extended by the explorations of the "Michael Sars". I may thus mention *Bathybiaster robustus* and *Solaster abyssicola* which were previously known only from the east coast of North America. The cruise of the "Michael Sars" furnished proofs that they occur also on the east Atlantic side; for *Bathybiaster robustus* was found west of Ireland (stat. 95) and the Hebrides (stat. 101), and *Solaster abyssicola* north of the Azores (stat. 88). The northern boundary of *Psilasteropsis patagiatus* and *Astronyx locardi* was formerly the Bay of Biscay. The "Michael Sars" found the firstnamed species off the Hebrides (stat. 101) and the latter off Ireland (stat. 95). *Benthodytes glutinosa* was previously taken only by the "Talisman"in the Sargasso Sea and south of the Azores at depths of 3 175 to 3 432 m. The "Michael Sars" collected the species off the entrance to Gibraltar, 2 603 m. (stat. 35) and besides a very young individual at the intermediary depth of about 1 400 m. southwest of Ireland (stat. 92). Under the description of the various species, however, an account of their horizontal as well as their vertical distribution will be given.

Only one haul was made in the cold area north of the Faroe-Shetland ridge (stat. 102) where 9 species were taken, all characteristic of the Norwegian Sea. Five of them are found principally in the cold area and occur only exceptionally in the warm and then in the border region only. The other four species on the other hand occur in the cold, as well as in the warm, area, where they have a wide distribution. But they are likewise wanting within the Atlantic region proper. They may perhaps be carried as larvae into the Atlantic by the south-going cold ocean currents across the ridge that divides it from the Norwegian Sea, but they do not settle there. It should be stated that three typical warm water species were also obtained at stat. 102, viz: *Plutonaster bifrons*, *Psilaster andromeda* and *Zoroaster fulgens*, but there is every reason to assume, as I shall show more fully below, that they did not live in the locality, but had accidentally remained clinging to the trawl from the foregoing station (stat. 101), where several specimens of these species were taken.

The difference between the deep-sea faunas of echinoderms of the Norwegian Sea and the Atlantic appears very distinctly by comparing stat. 101 and 102 which lie on either side of the Faroe-Shetland ridge. Neither of the localities gives a complete picture of the echinoderm faunas of the Atlantic and the Norwegian Sea, respectively, as several characteristic species are wanting in the collections from both stations; but the picture is more complete at stat. 101 than at 102. At the former 13 species were collected; five of these are known, besides from the Atlantic, also from the banks bounding the Norwegian Sea, the other 8 species on the other hand are restricted to the Atlantic region (I leave out of account here that some of them may also occur in the Pacific and Indian Oceans), but none of them are met with in the cold area of the Norwegian Sea.

Both regions may have genera in common, thus, to mention a few of them, *Bathybiaster*, *Ophiopleura* and *Pourtalesia;* but they are represented by different species. *Bathybiaster robustus*, *Ophiopleura aurantiaca* and *Pourtalesia wandeli* occur within the Atlantic region, while *Bathybiaster vexillifer, Ophiopleura borealis* and *Pourtalesia jeffreysi* live in the cold area of the Norwegian Sea.

HOLOTHURIOIDEA.

Mesothuria verrilli Théel.

Holothuria verrilli Théel, Bull. Mus. Comp. Zool., vol. 13, 1886, p. 6.

7/5. stat. 25 A, 35° 36′ N., 8° 25′ W., 2300 m., yellow mud. One specimen.

18/5. stat. 35, 27° 27′ N., 14° 52′ W., 2603 m., yellow mud. Common.

23/5. stat. 41, 28° 8′ N., 13° 35′ W., 1365 m., yellow mud. Two specimens.

Koehler[1]), Hérouard[2]) and Ludwig[3]) consider *Mesothuria verrilli* as a variety of *M. intestinalis*. Von Marenzeller[4]) also seems inclined to take this view, while Østergren[5]) and R. Perrier[6]) on the contrary maintain that they are distinct species. Judging from the material at my disposal I fully agree with the two last-mentioned scientists on this matter.

Mesothuria verrilli was first captured by the "Blake" off the West Indies, 760 to 1797 m. It was later taken in the Mediterranean and off the west coasts of Europe and North Africa between 45° 59′ and 22° 57′ N. Bathymetrical range on the east Atlantic side, 280 to 2518 m.

Mesothuria maroccana R. Perrier.

(Pl. 1, fig. 1).

Mesothuria maroccana R. Perrier, Comptes Rendus de l'Acad. des Sci., tome 126, 1898, p. 1665.

18/7. stat. 88, 45° 26′ N., 25° 45′ W., 3120 m., sand and yellow mud. A somewhat contracted specimen, 59 mm. long, 22 mm. broad, 17 mm. thick. The lateral ambulacral papillae are as much as 5 mm. long. Colour gray. The specimen agrees very closely in the arrangement of the ambulacral papillae, the form of the calcareous deposits, etc. with the description that Perrier gives of this species.

Mesothuria maroccana was hitherto known only from two specimens taken off the west coast of Morocco, 2105 to 2200 m.; but the variety of *Holothuria murrayi* described by Théel[7]) and collected by the "Challenger" off Gibraltar (stat. 5, 35° 47′ N., 8° 23′ W., 1995 m., temp. 3.6° Cel.) most likely also belongs to this species. The *Mesothuria murrayi* from the Azores described by Herouard[8]) seems likewise to belong to this species.

[1]) Koehler: Echinodermes, Res. Sci. Camp. du "Caudan", Fasc. 1, 1896, p. 106.

[2]). Hérouard: Holothuries, Res. Camp. Sci., Monaco, Fasc. 21, 1902, p. 18.

[3]). Ludwig: Ark. und subark. Holothurien, Fauna Arctica, Bd. 1, Lief. 1, 1900, p. 138.

[4]). v. Marenzeller: Holothuries, Res. Camp. Sci., Monaco, Fasc 6, 1893, p. 7.

[5]). Østergren: Subfamilie Synallactinidae unter den Apsidochiroten. Festskrift før Lilljeborg, 1896, p. 347.

[6]). R. Perrier: Holothuries, Exp. Sci. du "Travailleur" et du "Talisman", 1902, p. 307.

[7]). Théel: Holothurioidea 2, Rep. Sci. Res. "Challenger", Zool., vol. 14, part 39, 1885, p. 187, pl. 9, fig. 3.

[8]). Op. cit., p. 23.

Pseudostichopus villosus Théel.

Pseudostichopus villosus Théel, Holothurioidea 2, Rep. Sci. Res. "Challenger", Zool. vol. 14, part 39, 1885, p. 170.

8/6. stat. 53, 34° 59′ N., 33° 1′ W., 2615 to 2865 m., yellow hard clayey mud. One specimen, length 70 mm., breadth 24 mm.

The "Challenger" found *Pseudostichopus villosus* in the northern as well as in the southern part of the Atlantic, also in the Pacific, Antarctic and southern part of the Indian Oceans, 3016 to 5307 m., temp. 0.06 to 2.3° Cel. The "Princesse Alice" took it off the west coast of Morocco and the Azores, 3745 to 4360 m. *Pseudostichopus villosus* has therefore a world-wide distribution. According to the explorations of the "Michael Sars" its bathymetrical distribution is now 2615 to 5307 m.

Bathyplotes tizardi Théel.

Stichopus tizardi Théel, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 696.

6/5. stat. 24, 35° 34′ N., 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. Two specimens.

Ludwig („Arktische und subarktische Holothurien", p. 158) gives the range of this species as 44 to 60° N. According to more recent explorations the southern limit must be extended to 20° 41′ ("Talisman") and the northern limit to 63°30′ N. or to the Trondhjemsfjord. Bathymetrical distribution, 255 to 1615 m.

Deima atlanticum Herouard.

(Pl. 1, figs. 2, 3).

Deima atlanticum Herouard, Bull. Soc. Zool. de France, vol. 23. 1898, p. 88.

31/5. stat. 48, 28° 54′ N., 24° 14′ W., 2800 to 3000 m. One specimen.

The specimen, 94 mm. long and 63 mm. broad, has 11 tube-feet, 3 pair of lateral and 5 pair of dorsal papillae (I have used the term proposed by Ludwig in the Albatross "Holothurioidea")[1]), 14 tentacles with 2 to 8 small retractile processes. Colour of specimen in alcohol white.

Deima atlanticum was previously taken only by the "Princesse Alice" between Portugal and the Azores (stat. 753, 39° 50′ to 39° 54′ N., 20° 18′ to 20° 27′ W., 4360 m.). It is closely related to *Deima fastosum* Théel of the Pacific Ocean and it is also recorded under that name in Murray and Hjort's "Depths of the Ocean" (p. 541, fig. 384). It may, however, be easily distinguished from that species by the absence of a conical knot on the calcareous plates.

[1]). Mem. Mus. Comp. Zool., vol. 17, no. 3, 1894, p.63.

Oneirophanta mutabilis Théel.

(Pl. 2, figs. 1 & 2).

Oneirophanta mutabilis Théel, Bih. K. Sv. Vet. Akad. Handl., Bd. 5, no. 19, 1879, p. 6. tab. 1, figs. 4-6.

19/4. Stat. 10, 45° 26′ N., 9° 20′ W., 4700 m., yellow mud, temp. 2.56° Cel. 10 specimens.

The largest specimen was 108 mm. long and 47 mm. broad. It had 12 tube-feet on either side, 10 lateral and 6 dorsal papillae. The middle ambulacrum of the trivium had 5 very small tube-feet, two of them quite near the anus. The fifth pair of dorsal papillae were smaller than the rest. Another specimen, 60 mm. long, 27 mm. broad, had 12 tube-feet on the right and 13 on the left side. The middle ambulacrum of the trivium had 4 tube-feet. There were six pairs of lateral and dorsal papillae. The smallest specimen, 37 mm. long, 15 mm. broad, had 7 tube-feet on the right and 8 on the left side. The middle ambulacrum of the trivium had 3 tube-feet. The specimen was unfortunately a little mutilated, and therefore the number of lateral and dorsal papillae could not be exactly determined.

In the remaining specimens the number of tube-feet varied between 10 and 14 pairs on either side. In 2 specimens they were arranged in distinct double rows on either side. In a third this arrangement was found on one side only, on the other side they formed a single row. The number of lateral papillae varied between 4 and 10 on either side, and the dorsal papillae, between 5 and 8. In the specimen depicted (pl. 2, fig. 1.) the third and fifth pair of dorsal papillae were smaller than the rest. The same was the case in a second specimen; in the other specimens only 5 pairs were smaller. Colour in life, transparent.

Calcareous plates and deposits agree entirely with those in *Oneirophanta mutabilis*. I have therefore referred the specimens to this species, the more as the variations in the number of papillae and tube-feet come within the limits given by Théel[1]) and Ludwig[2]) for this greatly varying species.

Oneirophanta mutabilis has a world-wide distribution. The "Challenger" captured it in the Atlantic region off Montevideo, and the "Talisman" in the Bay of Biscay. It is further known from the Indian Ocean and the Pacific, Bathymetrical range, 2516 to 5307 m. The "Challenger", "Blake" and "Michael Sars" found the bottom temperature varying between 0.2° and 2.56° Cel.

[1]). Théel: Holothurioidea I, Rep. Sci. Res. "Challenger", Zool., vol. 4, part 13, 1881, p. 62.

[2]). Ludwig: Albatross Holothurioidea, p. 70.

Laetmogone violacea Théel.

Laetmogone violacea Théel, Bih. K. Sv. Vet. Akad. Handl., Bd. 5, no. 19, 1879, p. 11, Tab, 1, figs. 14a—d.

10/4. Stat. 4. 49° 38′ N., 11° 35′ W., 923 m., sand and mud, temp. 9.2° Cel. Three specimens.

5/5. Stat. 23, 35° 32′ N., 7° 7′ W., 1215, m. yellow mud, temp. 10.17° Cel. 8 specimens.

6/5. Stat. 24, 35° 34′ N., 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. 9 specimens.

There are besides 2 specimens without definite locality.

The "Michael Sars" took numerous specimens of this species in 1902 south of the Faroe-Iceland banks (stat. 76a, 59° 28′ N., 8° 1′ W., 1100 to 1300 m., temp. 8.07° Cel., and stat. 79, 61° 7′ N., 9° 33′ W., 750 m.).

Laetmogone violacea is known from the Atlantic, the Bay of Bengal, the Indian Archipelago, and the Pacific. Within the Atlantic region it appears to have its principal distribution on the east side, where it was found in a number of localities from the Faroe-Iceland banks to the Azores and the west coast of North Africa. On the west Atlantic side it is only recorded from the Davis Straits and the Bredefjord, Greenland (Mortensen)[1]). Bathymetrical range, 225 to 1739 m. Bottom temperature 2.2 to 10.17° Cel.

Laetmogone wyvilli thomsoni Théel

Laetmogone wyvilli thomsoni Théel, Bih. K. Sv. Vet. Akad. Handl., vol. 5, no. 19, 1879, p. 10, tab. 1, figs. 12—13.

10/4. Stat. 4, 49° 38′ N., 11° 35′ W., 923 m., sand and mud, temp. 9.2° Cel. 3 specimens.

6/5. Stat. 24, 35° 34′ N., 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. 3 specimens.

25/5. Stat. 41, 28° 8′ N., 13° 35′ W., 1365 m., yellow mud. One specimen.

Laetmogone wyvilli thomsoni is known only from the east side of the Atlantic region, where it was previously taken by the "Caudan" in the Bay of Biscay and by the "Princesse Alice" off the Azores. It ranges from 28° 8′ to 49° 38′ N., while *L. violacea* is found from 20° 41′ to 61° 7′ N. *Laetmogone wyvilli thomsoni* is further known from the Antarctic, the Pacific and the Indian Archipelago. Bathymetrical distribution, 631 to 3294 m. Bottom temperature, 0.3—9.2° Cel.

Benthogone rosea Koehler.

Benthogone rosea Koehler, Echinodermes, Res. Sci. Camp, du "Caudan", Fasc. 1, 1896, p. 114, tab. 1, figs. 2, 3, tab. 3, fig. 36, tab. 4, fig. 46.

6/5. Stat. 24, 35° 34′ N., 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. 5 specimens.

7/5. Stat. 25 A, 35° 36′ N., 8° 35′ W., 2300 m., yellow mud. 10 specimens.

[1]) Mortensen: Conspectus Faunae Grønlandicae, Echinodermer, 1913, p. 322.

$^{23}/_{5}$. Stat. 41, 28° 8′ N., 13° 35′ W., 1365 m., yellow mud. One specimen.

$^{27}/_{7}$. Stat. 95, 50° 22′ N., 11° 44′ W., 1797 m. Common. Two specimens were preserved.

The largest specimen was 220 mm. long and 47 mm. broad. Several specimens had retained some of the colouring. Judging from these the colour of the ventral surface was a deeper dark violet than in the specimen depicted by Koehler. It was very light violet on the dorsal surface, while Koehler's specimen has a yellowish hue.

Benthogone rosea is an east Atlantic species, previously taken by the "Caudan" in the Bay of Biscay, and by the "Talisman" off the Azores and the west coast of North Africa. Horizontal distribution, 20° 41′ to 50° 22′ N., bathymetrical range, 1103 to 2300 m.

Peniagone wyvillii Théel.

(Pl. 3, figs. 3—5).

Peniagone wyvillii Théel, Holothurioidea 1, Rep. Sci. Res. "Challenger", vol. 4, part 13, 1881, p. 42, pl. 10, figs. 3, 4, pl 44, figs. 5, 7, pl. 37, fig. 6.

$^{8}/_{6}$. Stat. 53, 34° 59′ N., 33° 1′ W., 2615 to 2865 m., yellow hard clayey mud, 5 specimens.

The two best preserved specimens measured:

Total length to the point of the dorsal processes	92 mm.,	73 mm.
Basal length	62 „	54 „
Greatest breadth	27 „	24 „
Height	29 „	25 „
Length of the biggest dorsal processes	22 „	16 „
Breadth of the biggest dorsal processes	11 „	9 „

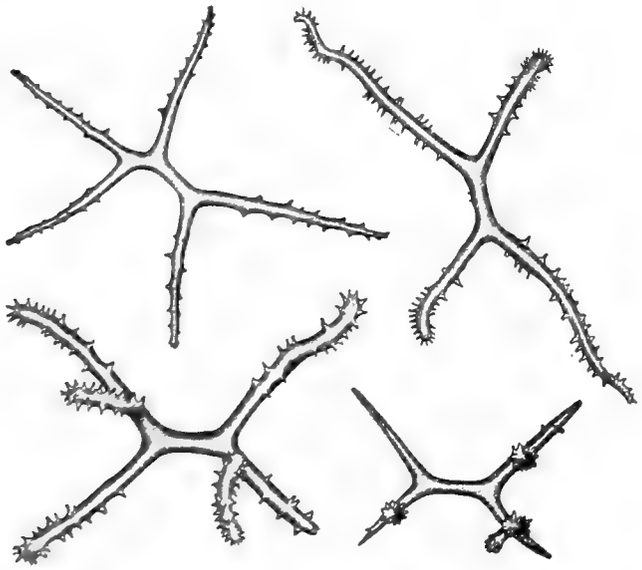


Fig. 1. Calcareous deposits from the body of *Peniagone wyvillii* Théel.

8 tentacles and 6 ambulacral papillae along both sides of the ventral surface. The hindmost of these papillae is situated at 7 mm. from the anus in the largest of the specimens. There is a space of 6 to 7 mm. between the papillae respectively. The largest papillae are 9 mm. long. Besides these large papillae three very small ones are found at the lower border of the anus. The disc of the tentacles is 5 mm. broad. The body, and more especially the dorsal surface, is very sparcely covered with calcerous deposits. They are cruciform and spiny and frequently furnished with protuberances (fig. 1). The calcareous deposits of the ambulacral papillæ like those of the body are in part cruciform in part rod-shaped (fig. 2). The spicules may sometimes be branched. The calcareous deposits of the tentacles resemble those of the ambulacral papillae. But while the cruciform deposits are most frequent in the papillae, the spicules predominate in the tentacles.

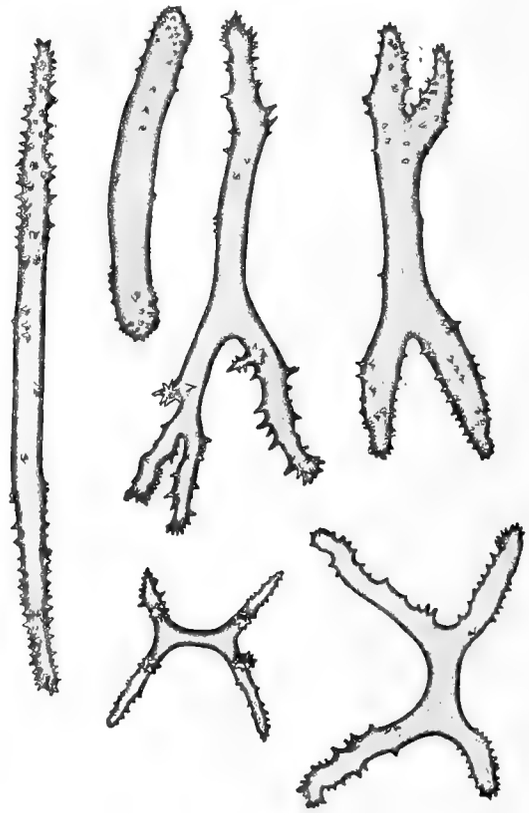


Fig. 2.
Calcareous deposits from the tube-feet of *Peniagone wyvillii* Théel.

The colour of the specimen in formol was hyaline reddish, put into alcohol it changed to grayish. The disc of the tentacles was pale red.

The specimens agree closely in appearance with *P. wyvillii*, and I have therefore referred them to that species. Théel indeed states that *P. wyvillii*, like the other species of the genus *Peniagone*, has 10 tentacles,

while I found only 8 in the 3 specimens whose tentacles were intact. This difference cannot be of great significance, however, for, judging from the material at hand, the tentacles are apparently easily lost, but as easily restored. It is therefore probable that my specimens also originally had 10 tentacles.

Peniagone wyvillii is new to the Atlantic region, as it was previously collected only by the "Challenger" off Christmas Island (stat. 271, 0° 33′ S., 151° 34′ W., 4438 m., temp. 1° Cel.).

Peniagone ferruginea n. sp.

(Pl. 1, figs. 4—6.).

$^{31}/_{5}$. Stat. 48, 28° 54′ N., 24° 14′ W., 2800 to 3000 m.

One specimen which measured:

Total length to the point of the dorsal processes	34	mm.
Basal length to mouth	25	„
Largest breadth of body	14	„
Height of body	6	„
Length of largest dorsal processes	10	„
Breadth of dorsal processes	10	„

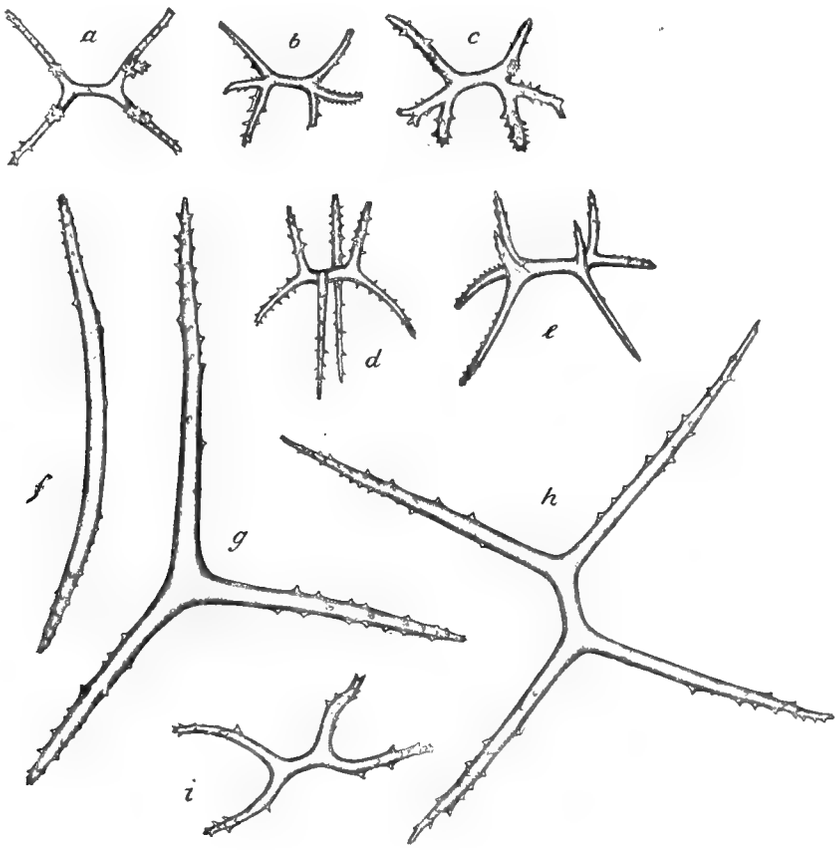


Fig. 3. Calcareous deposits from *Peniagone ferruginea* n. sp. *a—c* from abactinal surface, *d*, *e* from actinal surface, *f—h* from the tentacles, *i* from the tube-feet.

The body is oval and about twice as long and one half as high as it is broad. The somewhat elongated mouth is situated on the anterior ventral surface. The anal opening is sub-dorsal, about 1.5 mm. above the posterior extremity of the body. There are ten tentacles with a disc diameter of 3 mm. and provided with retractile processes. 5 ambulacral papillae are situated on either side of the edge of the posterior half of the body. The largest of these are 4.5 mm. long and 2.5 mm. broad. The hindmost papilla is situated at 2 mm. from the anus. The space between the papillae is 1.5 to 3 mm. respectively. Besides these large ambulacral papillae there are three very small papillae directly below the anus. On the dorsal surface, at the base of the dorsal processes there are two small papillae on either side, 1.5 mm. in length and 0.5 mm. in diameter.

The body-wall is very thin and, together with the ambulacral papillae and the tentacles, is abundantly furnished with calcareous deposits. The dorsal deposits are chiefly composed of spiny crosses with arms provided with small processes (fig. 3 a). These processes may frequently be as strongly developed as the branches which give the deposits a rather irregular shape (figs. 3 b, c). Simple, smooth, cruciform deposits and some peculiar saddle-formed ones may likewise be found, but they are rare. The deposits of the ventral surface are similar

to those of the dorsal surface, but the saddle-formed ones (figs. 3 d, e) predominate there, while the cruciform deposits are more scarce. More or less spiny crosses (fig. 3 f) are frequent in the ambulacral papillae. In other respects the same forms of deposits are found as in the body. The rod-shaped spicules (fig. 3 g) are characteristic of the tentacles. They may be more or less spiny and more or less curved. Figs. 3 h, i represent forms which are likewise frequently found in the tentacles. There are besides the same forms as occur in the body.

The colour of the disc of mouth and tentacles is dark bluish-violet, the rest of the animal, plain grayish rusty-brown.

The specimen, kept in alcohol, is not very well preserved, as it has become rather contracted and a tip of the right lateral process is torn off. Also some of the tentacles and lateral ambulacral papillae are wanting. The forms of the animal given by me (pl. 1, figs. 4—6) are therefore in part reconstructed.

At a first glance the specimen reminds one of *Periamma rosea* described by Perrier[1]) in his monograph on the holothurians of the "Travailleur" and "Talisman". The calcareous deposits show, however, that it does not belong to this species, nor even to the genus *Periamma,* but that it is a *Peniagone* — I recognize the genera of *Elpidiidae*, adopted in the classification given by Perrier in the monograph mentioned[2]). Perrier recognizes 12 species of *Peniagone*, four of them from the Atlantic, three from the Indian Ocean, four from the Pacific, and one from the Antarctic. Koehler and Vaney[3]) added three species from the Indian Ocean to this number[4]). The specimen herein described differs from all of the species cited, by its external form as well as by the structure of the deposits. It must therefore constitute a new species which I call *Peniagone ferruginea* on account of the rusty-brown colour of the specimen.

Peniagone azorica v. Marenzeller.

Peniagone azorica v. Marenzeller, Holothuries, Res. Camp. Sci. Monaco, Fasc. 6, 1893, p. 12, tab. 1, fig. 4, tab. 2, fig. 5.

$^{18}/_{7}$. Stat. 88, 45° 26′ N, 25° 45′ W, 3120 m., sand and yellow mud. One specimen.

The specimen measured 78 mm. in length, 22 mm. in breadth. It was therefore considerably larger than v. Marenzeller's type-specimen which measured 50 and 13 mm., respectively. The dorsal processes were 19 mm. in length, 8 mm. broad at the base. It had, like v. Marenzeller's specimen, 21 ambulacral papillae, 9 of which were placed along either side of the body, and 3 at the anus. The largest were 8 mm. in lenght. The disc of the tentacles was 4 mm. wide.

I may add to the description which v. Marenzeller and Herouard[1]) give of the deposits of this species, that they were numerous, not only in the body but also in the tentacles, where they existed chiefly as straight or curved rods of different sizes. Sometimes the rods were branched. Irregularly branched and cruciform deposits, some of them similar to those on the ventral surface, occurred also, though sparingly (fig. 4).

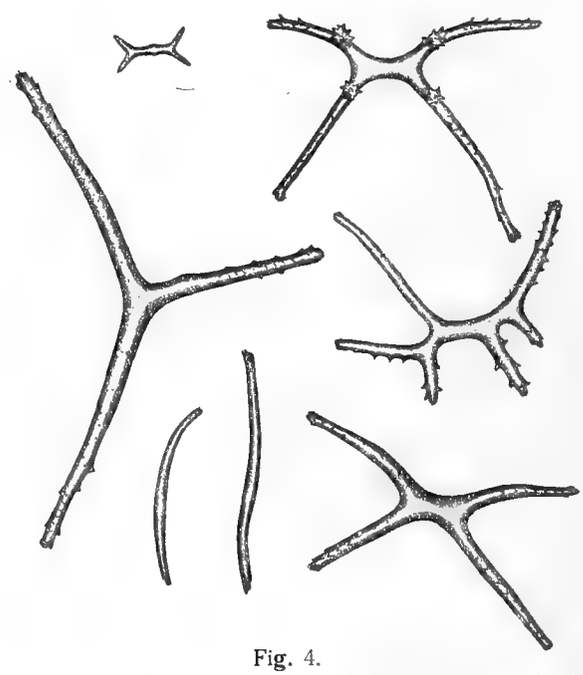


Fig. 4.
Calcareous deposits from the tentacles of *Peniagone azorica* Marenz.

Peniagone azorica was previously found only off the Azores by the "Hirondelle" and "Princesse Alice". According to the explorations of the "Michael Sars" its horizontal distribution will be from 38° 8′ to 45° 26′ N. Bathymetrical range, 2870 to 4020 m.

Euphronides auriculata R. Perrier.

Euphronides auriculata R. Perrier, Comptes Rendus de l'Acad. Sci., tome 123, 1896, p. 902.

$^{7}/_{5}$. Stat. 25 A, 35° 36′ N, 8° 25′ W, 2300 m., yellow mud. Two specimens.

The best preserved specimen was 70 mm. long and 13 mm. broad.

---

[1]) Op. cit., p. 419, tab. 13 fig. 10—12, tab. 20 fig. 1—11.

[2]) Op. cit., p. 405.

[3]) Koehler and Vaney: Investigator Deep-See Holothurioidea, 1905.

[4]) The two species, *P. ecalcarea* and *P. discrepans,* described by Sluiter in „Die Holothurien der Siboga Expedition" evidently do not belong to the genus *Peniagone,* I have therefore paid no regard to them.

[1]) Op. cit., p. 42, tab. 6, figs. 21—25.

The posterior dorsal process was 20 mm. long and situated at a distance of 16 mm. from the posterior extremity of the body. The two anterior dorsal processes were 6 mm. long and situated at a distance of 21 mm. from the anterior extremity of the body. The other specimen was 83 mm. long.

The ventral deposits were cruciform, as noted by R. Perrier in his monograph of the holothurians of the "Travailleur" and "Talisman"[1]). There were besides straight or curved deposits, as well as all transition-forms between them and the cruciform ones. The most common form of the dorsal deposits was that described by Perrier (pl. 20, fig. 12). But there were also found more simple cruciform deposits similar to those on the ventral surface.

Euphronides auriculata is an east Atlantic species taken by the "Travailleur" and "Talisman" off the west coast of Marocco and the Canary Is. The "Challenger" collected it off Gibraltar (stat. 5, 35° 47′ N., 8° 23′ W., 1995 m., temp. 3.1° Cel.); for, as Perrier correctly remarks, the example of *Euphronides depressa* Théel[2]) taken at the lastnamed locality differs from the two specimens found off Juan Fernandez (stat. 300, 33° 42′ S., 78° 18′ W., 2516 m.) and must therefore be referred to *E. auriculata*, and this is moreover confirmed by the fact that the "Michael Sars" found the last-named species in the same waters in which the "Challenger" specimen was taken. The horizontal distribution is from 27° 31′ to 37° 47′ N. Bathymetrical range, 1918 to 2300 m.

Benthodytes gigantea Verrill.

Benthodytes gigantea Verrill, Am. Journ. Sci., ser. 3 vol. 28, 1884, p. 216.

30/6. Stat. 70, 42° 59′ N., 51° 15′ W., 1100 m., temp. 3.7° Cel. 4 large and some very young specimens.

The specimens were unfortunately so very badly preserved, that it was impossible to give a good illustration of this species of which only a sketchy drawing by Verrill exists[3]). I merely give an outline drawing of the actinal surface showing the arrangement of its ambulacral papillae (fig. 5), as this is not clearly seen in Verrill's figure. It is unnecessary to give a detailed description of *Benthodytes gigantea,* as Verrill's description is very exhaustive. I shall therefore confine my remarks to the calcareous deposits, as they were not dealt with by Verrill.

The body was scantily furnished with three-rayed deposits, whose points were slightly branched or provided with a small perforated plate (fig. 6). The deposits of the tentacles, whose form may be best explained by the accompanying illustration (fig. 7), were comparatively more numerous than those of the body.

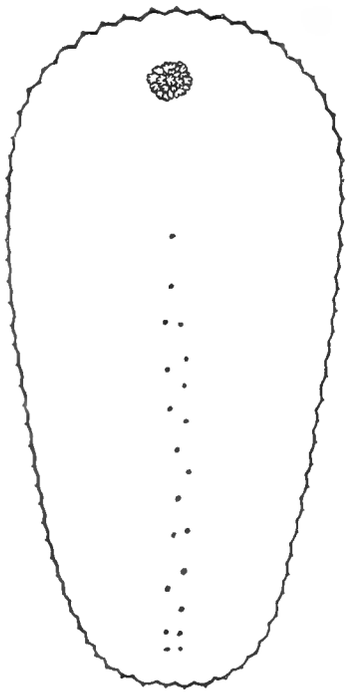


Fig. 5. Diagrammatic view of the actinal surface of *Benthodytes gigantea* Verr., illustrating the arrangement of the tube-feet.

The best preserved of the large specimens measured 298 mm. in length. Anterior breadth 84 mm., posterior breadth 61 mm. According to Verrill this species generally attains a length of 250 to 300 mm., and a breadth of 75 mm. It may however be as much as 475 mm. long and 127 to 152 mm. broad.

The very young specimens were 10—14 mm. long end 4—5 mm. broad.

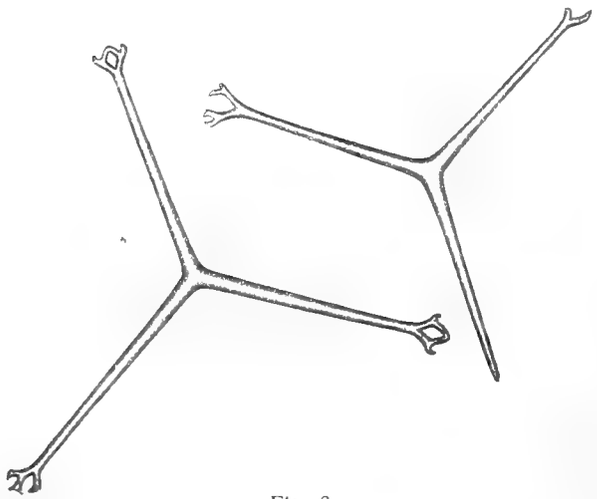


Fig. 6.
Calcareous deposits from the body of *Benthodytes gigantea* Verr.

[1]) Op. cit. p. 437, tab. 20, fig. 13.

[2]) Théel, Challenger Holothurioidea 1, p. 93.

[3]) Verrill, Res. Explor. "Albatross" 1883 (1885), pl. 10 fig. 31, pl. 11 fig. 31 a, b.

Benthodytes gigantea is known only from the north-eastern coast of North America. The "Albatross" found it in a number of localities, very numerous in some of them, off the coast of New England at a depth of 1691 to 3720 m. According to the explorations of the "Michael Sars" the bathymetrical distribution will be 1100—3720 m.

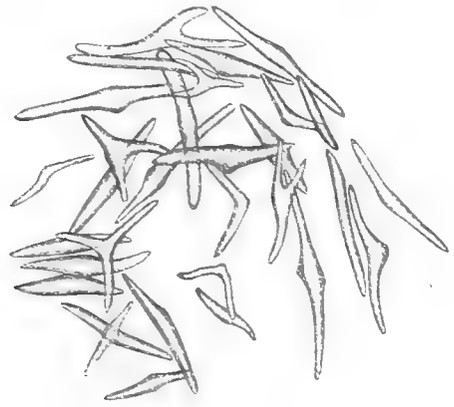


Fig. 7.
Calcareous deposits from the tentacles of *Benthodytes gigantea* Verr.

Benthodytes typica Théel.
(Pl. 3 fig. 6, 7).

Benthodytes typica Théel, Holothurioidea 1, Rep. Sci. Res. "Challenger" Zool., vol. 4 part 13, 1881, p. 103, tab. 27 fig. 7, tab. 35 fig. 4, tab. 38 fig. 5.

$^{8}/_{6}$. Stat. 53, 34° 59′ W., 33° 1′ W., 2615—2865 m., yellow hard clayey mud. One specimen, whose dimensions were as follows: length 94 mm., breadth in front 21 mm., in the middle 39 mm., behind 32 mm.

As may be seen from pl. 3 figs. 6 & 7 the animal has an elongated body with a greatest breadth of about 40 per cent of its length. It was rounded in front and straight cut behind with an incision at the anus. I ought to mention that the animal was slightly mutilated a little below the mouth. It is therefore possible that it had been much contracted, whereby the border between fore-part and body had become a little too distinct. The brim was narrow in front, but broad along the sides of the body.

Fig. 8. Spicules from the body of *Benthodytes typica* Théel.

There were 20 tentacles. The middle ambulacrum of the trivium had about 30 papillæ in each row. The dorsal ambulacra have each 5 or possibly 6 small papillæ. The body was scantily covered with thorny calcareous rods (fig. 8). The rods of the ventral surface seem also a little more thorny.

The colour of the fore part was a deep, dark violet which extended a little over on the dorsal surface of the body. The middle part of the trivium, as well as the canals connected with the ambulacral systems, were of the same colour, which in the case of the canals, could be distinctly seen through the brim. The dorsal surface was bluish transparent. The disc of the tentacles was yellowish brown.

The specimen contained well developed eggs, with a diameter of 1.3 mm.

The specimen agreed in most of its characteristic with *Benthodytes typica* but differed from it in the form. The typical *B. typica* is oval, while the specimen in question was elongated. This difference may however be due to preservation or other accidental circumstance. Moreover the present specimen had 5, or possibly 6, papillae in each of the dorsal ambulacra while Théel's species is said to have "about eight". The papillæ are so small, however, as to be easily overlooked. I therefore do not attach much importance to this difference and refer the specimen to *B. typica* as it agreed in all other characteristics with that species, as already stated.

Bentodytes typica was taken by the "Challenger" off Gibraltar (Stat. 5, 35° 47′ N., 8° 23′ W., 1995 m., temp. 3.1° Cel.). Afterwards it was taken by the "Hirondelle" off the Azores at 2870 m. Furthermore Théel[1]) records it, though doubtfully, from the West Indies and the Gulf of Mexico, 1885—3514 m. Its horizontal distribution on the East Atlantic side is from 34° 59′ to 41° 40′ 41″ N., on the West Atlantic from about 15° to 24° 33′ N.

Benthodytes glutinosa R. Perrier.
(Pl. 3, figs. 1 & 2).

Benthodytes glutinosa R. Perrier, Comptes Rendus de l'Acad. des Sci., tome 123, 1896, p. 903.

$^{18}/_{5}$. Stat. 35, 27° 27′ N., 14° 52′ W., 2603 m., yellow mud. One specimen, 62 mm. long. 21 mm. broad. A coloured drawing of the specimen preserved in formol is given on pl. 3, figs. 1 & 2

$^{23}/_{7}$. Stat. 92, 48° 29′ N., 13° 55′ W., 2000 m. wire. One very young specimen, 13 mm. long, 4.5 mm. broad.

The structure of this species, like the others of the genus *Benthodytes*, shows that it is a natatory animal. The young specimen from stat. 92 gives a further proof of this. It was taken in the next to the lowest gear, a young fish trawl set with 2000 m. wire, consequently at a depth of about 1400 m. The lowermost gear was set with 3000 m. wire or a depth of about 2000 m.[2]) There

[1]). Bull. Mus. Comp. Zool., vol. 13, no. 1, 1886, p. 2.

[2]). In accordance with my statement in "Brachiopoda, Lamellibranchiata etc." (This rep., vol. 3, part. 2, p. 5). I have estimated the depth at $^{2}/_{3}$ of the length of the wire (cfr. Brinkmann: Pelagic Nemerteans, this rep. vol. 3, part. 2, pag. 10.)

was unfortunately no sounding at stat. 92, but judging from the maps of the depths in the North Atlantic the depth can not have been less than 3000 m. The specimen must therefore bave been taken about 1600 m. above the bottom.

Benthodytes glutinosa was previously taken by the "Talisman" off the Azores and in the Sargasso Sea. According to the explorations of the "Michael Sars"i its horizontal distribution will be from 27° 27′ to 48° 29′ N., the bathymetrical distribuation from 1400 to 3432 m.

Benthodytes janthina v. Marenzeller

Benthodytes janthina v. Marenzeller, Holothuries, Res. Camp. Sci., Monaco, Fasc. 6, 1893, p. 10, tab. 1, fig. 3, tab. 3, fig. 4.

19/4. Stat. 10, 45° 26′ N., 9° 20′ W., 4700 m., yellow mud, temp. 2.56° Cel. One specimen, 220 mm. long. 83 mm. broad.

A coloured sketch made immediately after the animal had come on deck shows that the colour of the ventral side was intensely violet, that of the dorsal side light violet, considerably lighter than in the specimen illustrated by v. Marenzeller, the colour of which agrees more with that of the ventral side in the specimen under discussion. In alcohol the ventral side is a deep blackish blue, the dorsal side light grayish blue.

Benthodytes janthina was previously found by the "Hirondelle" and the "Princesse Alice" off the Azores and the west coast of Morocco. The "Michael Sars" collected the species in the Bay of Biscay, hence its horizontal distribution will be from 34° 4′ to 45° 26′ N., the bathymetrical distribution from 2252 to 4700 m.

Cucumaria abyssorum Théel.

Cucumaria abyssorum Théel, Holothurioidea 2, Rep. Sci. Res Voy. "Challenger", Zool. vol. 14, part 39, 1886, p. 66, tab. 4 fig. 6, 7, tab. 5 fig. 1, tab. 16 fig. 6.

18/9. Stat. 88, 45° 26′ N., 25° 45′ W., 3120 m., sand and yellow mud. 3 specimens.

Théel and Ludwig[1]) have given a very detailed description of this species to which I shall merely add that the majority of the calcarious deposits in the tentacles are composed of bowed rods whose form may be seen from the present figures (figs. 9 a—c). They very much resemble the deposits in the ambulacral papillæ. Fig. 9 d is an extreme form of this type. Further straight rods, as well as a few scattered cruciformed deposits (fig. 9 e) are found in the tentacles.

Cucumaria abyssorum was taken by the "Challenger" in the Antarctic, Indian, and southern part of the Pacific Oceans, 3516—4061 m., temp. 1.2—2° Cel. The "Albatross" took it off the west coasts of Central America and Mexico, 1656—4084 m., temp. 2.1—2.9° Cel. and the "Hirondelle" at the Azores, 2870 m. Thus the species has a world-wide distribution.

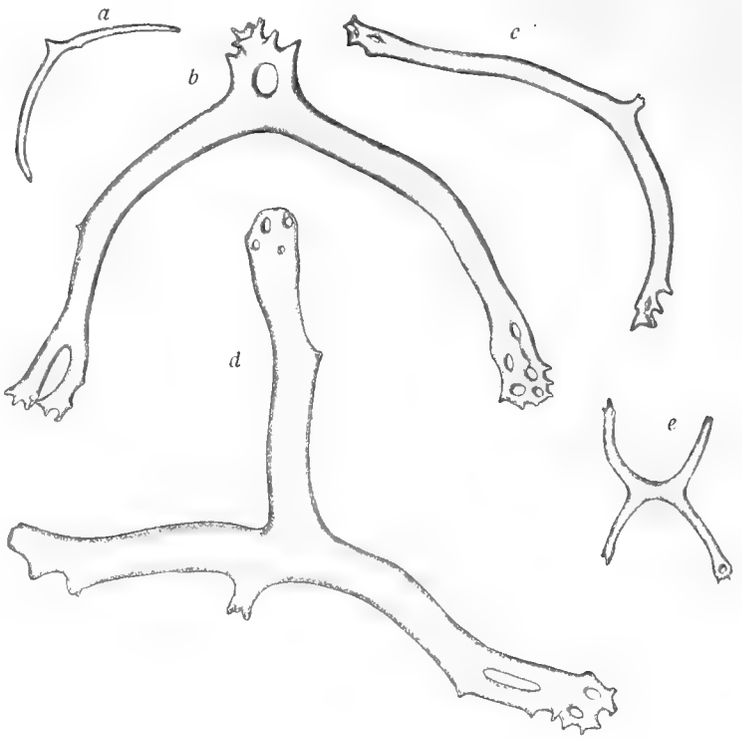


Fig. 9.
Calcareous deposits from tentacles of *Cucumaria abyssorum* Théel.

Holothuria tubulosa Gmelin.

Holothuria tubulosa Gmelin, Syst. Nat., ed. 13, 1788, p. 3138.

20/5. Stat. 37, 26° 6′ N., 14° 33′ W., 39 m., shingle. Common.

The specimens were chestnut brown on the dorsal and lemon yellow on the ventral side.

Holothuria tubulosa is known from the Mediterranean, the Canaries and the south west coast of France. The bathymetrical distribution is 0—40 m.

Stichopus tremulus Gunnerus.

Holothuria tremula Gunnerus, K. Sv. Vet. Akad. Handl., vol 28, 1767, p. 119, tab. 4, fig. 3.

10/4. Stat. 3, 49° 32′ N., 10° 49′ W., 184 m., fine sand. Rather common.

10/4. Stat. 4, 49° 38′ N., 11° 35′ W., 923 m., sand and mud, temp. 9.2° Cel. Several specimens.

Ludwig states in "Arktische und subarktische Holothurien" (p. 136) that the northern border of *Stichopus tremulus* is at 71°, the southern at 43° or the northern coast of Spain, and that its bathymetrical distribution is from 18—1229 m. The researches of the "Talisman" and

[1]) Ludwig: Albatross Holothurioidea, p. 122.

the "Travailleur" show, however, that its southern distribution extends to Cape Garnet, or to 25° 41′ N. and that it descends to a depth of 1918 m.

Labidoplax digitata Montagu.

Holothuria digitata Montagu, Transact. Linn. Soc., vol. 11, 1815, p. 22, tab. 4, fig. 6.

5/5. Stat. 21, 35° 31′ N., 6° 35′ W., 535 m., yellow sand, temp. 11.52° Cel. One specimen.

Labidoplax digitata is known from the Mediterranean and the west coast of Europe northward to Great Britain. Its bathymetrical distribution is from 18—618 m.

ASTEROIDEA

Pontaster tenuispinus Düben & Koren.

Astropecten tenuispinus Düben & Koren, Kgl. Vet. Akad. Handl. 1844 (1846), p. 251, tab. 8, figs. 20—22.

9/5—10/5. Stat. 102, 60° 57′ N., 4° 38′ W., 1098 m., dark sand and clay, temp. ÷ 0.9° Cel. Common.

The largest specimen measured: arm-radius 77 mm., disc-radius 14 mm., the smallest specimen was 33.5 mm. and 6.5 mm. respectively. In 10 specimens of different sizes varied r : R, between 1 : 4.47 and 1 : 5.9.

The specimens belong to the variety *platynota* Sladen[1]) from the cold area of the Faroe-Shetland channel. They have a paired arrangement of the marginal plates, spatuliform pedicellariæ and a not very prominent papularium. The armature of the adambulacral and marginal plates as well as the dorsal paxillæ was large and well developed.

Benthopecten spinosus Verrill.

(Pl. 4, fig. 1).

Benthopecten spinosus Verrill, Amer. Journ., ser. 3, vol. 28, 1884, p. 218.

30/6. Stat. 70, 42° 59′ N., 51° 15′ W., 1100 m., temp. 3.7° Cel. One specimen.

26/7—27/7. Stat. 95, 50° 22′ N., 11° 44′ W., 1797 m., temp. 3.5° Cel. 5 specimens.

[illegible]. Stat. 101, 57° 41′ N., 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. 12 specimens.

All the specimens were more or less mutilated. Only in 4 specimens from stat. 101 was at least one of the arms intact. These four specimens measured:

	mm.	mm.	mm.	mm.
Arm-radius	52	48	38	32
Disc-radius	7	6	5.5	5
Breadth of arm at base	7	5.5	5	5
r : R	1 : 7.4	1 : 8	1 : 6.9	1 : 6.4
A : R	1 : 7.4	1 : 8.7	1 : 7.6	1 : 6.4
Number of dorsomarginal plates	27	26	22	20

[1]) Sladen: Asteroidea, Rep. Sci. Res. "Challenger", Zool. vol. 3, 1889, p. 29, tab. 6, fig. 7, tab. 7, figs. 3 & 4.

The largest specimen has a disc-radius of 11 mm. Thus all of the specimens were younger individuals. Verrill mentions specimens that were twice as large as the largest of the specimens from the "Michael Sars".

The species varies greatly with respect to the discovering as well as the armature of the adambulacral and marginal plates, as pointed out by Verrill. 5—6 papillæ are normally found in the inner row on the adambulacral plates, but the number may vary between 4 and 7. One large papilla and a small one outside of it are normally found in the transverse row. But two large papillæ may also occur, one outside the other as in *Pararchaster semisquamatus* Sladen, or a small papilla may be situated on either side of the large papilla. Also two small papillæ may be found instead of the small one outside the large one. One or two large spines besides some very small ones are found on the ventro-marginal plates. One large spine is most commonly found on the dorsomarginal plates, two such spines being an exception. Moreover most of the plates have some spinelets most commonly grouped around the large spine. These spinelets were in some specimens entirely wanting however (pl. 4, fig. 1). Of the large spines the one on the medial odd plate of the disc-angle is larger and stouter than the rest. In a specimen from stat. 95 (disc-radius 8 mm.), this spine was 8.5 mm., while those on the adjoining plates measured 6 mm. In an other specimen from stat. 101 (disc-radius 5 mm.) these measurements were 5.5 mm. and 3.5 mm. respectively.

In two specimens, the medial odd marginal plates were bifurcated in one of the angles of the disc. The bifurcation included not only the dorsal but also the ventral plate. Each of these plates was furnished with a large spine.

The peculiar "spiracle-like or double comb-formed" pedicellariæ on the actinal interradial area were observed only in some of the larger specimens. The number of pedicellariæ seems to vary greatly. They were absent in some specimens, while a number of them were met with in others of a similar size. The inter-radial areas have a varying number of pedicellariæ even in the same individual. Thus 0—1—2—1—2 pedicellariæ were observed in a specimen from stat. 95 (disc-radius 8 mm.). No pedicellariæ could be found between the ventro-marginal plates.

Verrill[1]) has correctly referred *Parachaster semisquamatus var. occidentalis* and *Parachaster armatus* described by Sladen in his report on the "Challenger" Asteroidea[2]), to that species, *Pararchaster fisheri* E. Perrier

[1]) Proc. U. S. Nat. Museum, vol. 17, 1894, p. 245. Cfr. Amer. Journ. ser. 3, vol. 49, 1895, p. 129.

[2]) Op. cit. p. 10 & 19, tab. 1 figs. 5 6, tab. 4, figs. 5—6.

a specimen of which was taken by the "Talisman" off the west coast of North Africa must likewise be referred to it[1]). The agreement between these species is clearly demonstrated by comparing Perrier's and Verrill's figures.[2]) I ought to state that pedicellariæ are wanting in Verrills drawing of the specimen, while Verrill himself makes mention of such. The main difference between these forms is then that the pedicellariæ between the ventro-marginal plates are wanting in *Benthopecten spinosus (Pararchaster armatus)*. But it is difficult to determine how constant this character is, as only one example of Perrier's species exists. Most probably it is very variable, however, as indeed indicated by that very specimen. The number of pedicellariæ on the left side of the arms was 1 to 2 with a rudimentary third on one arm, on the right side 1 to 3. Arm *a* had 5 pedicellariæ, *b* 4, *c* 3 and a rudimentary fourth, *d* 3 and *e* 3. Most probably Mortensens *Pararchaster nov. sp. (P. fisheri Perrier aff.)* from the slope south of Iceland ("Thor" 1903 stat. 164)[3]) must be referred to *Benthopecten spinosus*.

The "Challenger" has taken *Benthopecten spinosus* off the east coast of North America between 37° 25′ and 42° 8′ N., at 2269—3111 m., temp. 2.33—3.33° Cel., as well as off Portugal. According to Verrill it is distributed along the east coast of North America between 35° 10′ and 42° 47′ N., from 1319—3698 m., but being most common at a depth of 2200—2900 m. It is further recorded by Verrill from the Mexican Gulf, 2334—2617 m., and from Jamaica, 2999 m. The "Thor" took it south of Iceland (stat. 164, 62° 10.8′ N., 19° 36′ W., 2094 m., temp. at depth of 1850 m., 2.75° Cel.), the "Helga" off the west coast of Ireland (51° 22′ N., 12° 41′ W., 1797 m.) and the "Talisman off the west coast of North Africa (1883, stat. 73, 25° 39′ N., 18° 26′ W., 1435—1056 m.). *Benthopecten spinosus* thus appears to be a deep-sea species whose distribution includes the entire northern part of the Atlantic and the habitat of which is restricted to the waters whose temperature is not below 2.33° Cel. I may mention for comparison with the temperatures given above, that the "Albatross" in 1883 found a bottom temperature not lower than 2.78° within the range of distribution of this species.

[1]) E. Perrier: Echinodermes, Exp. Sci. du "Travailleur" et du "Talisman", 1894, p. 263, tab. 20, fig. 2.

[2]) Transact. Connecticut Acad., vol. 10, 1900, p. 217, tab. 30, fig. 7 a.

[3]) Schmidt: Fiskeriundersøgelser ved Island og Færøerne i sommeren 1903 (1904) p. 24.

Plutonaster bifrons Wyville Thomson.

Archaster bifrons Wyville Thomson, The Depths of the Sea, 1873, p. 122, figs. 17 and 74.

10/4. Stat. 4, 49° 38′ N., 11° 35′ W., 923 m., sand and mud, temp. 9.2°Cel. One specimen.

6/5. Stat. 24, 35° 34′ N., 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. 15 specimens.

7/5. Stat. 25 A, 35° 36′ N., 8° 25′ W., 2300 m., yellow mud. Two smaller specimens.

8/5. Stat. 25 B, 35° 46′ N., 8° 16′ W., 2055 m., yellow mud. Four smaller specimens.

23/5 Stat. 41, 28° 8′ N., 13° 35′ W., 1365 m., yellow mud, temp. 6° Cel. 13 specimens.

27/7. Stat. 95, 50° 22′ N., 11° 44′ W., 1797 m., temp. 3.5° Cel. 17 specimens.

6/8 7/8. Stat. 101, 57° 41′ N., 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. Common.

9/8—10/8. Stat. 102, 60° 57′ N., 4° 38′ W., 1098 m., dark sand and clay, temp. ÷ 0.9° Cel. A very defective and macerated specimen, which had most likely remained in the trawl from stat. 101.

The two smallest (stat. 25 A) and two of the largest specimens (stat. 101) measured:

Arm-radius	33.5 mm.	37 mm.	92 mm.	97 mm.
Disc-radius	8 „	11 „	18.5 „	19.5 „
Number of dorso-marginal plates ..	25 „	26 „	37 „	38 „
r : R	1 : 4.19	1 : 3.36	1 : 4.97	1 : 4.97

The proportions of r : R varied between 1 : 3.36 and 1 : 4.47 in 10 specimens with an arm-radius of up to 55 mm. in length, but in two specimens only the proportion exceeded 1 : 4.2. In 10 specimens with an arm-radius exceeding 70 mm. the proportion varied between 1 : 3.81 and 1 : 4.97, but in one individual only it was less than 1 : 4. The relative length of the arms is subject to great individual variations, thus the smaller of the two specimens from stat. 25 A. had proportionately the longest arms, and in three specimens with an arm-radius of 45 mm. the proportion r : R varied between 1 : 4.09 and 1 : 4.74. But such individual variations apart from the measurements clearly demonstrate that the relative length of arms in *Plutonaster bifrons* increases with the age.

Colour in life, reddish violet.

Plutonaster bifrons is one of the most widely distributed starfishes of the East Atlantic. It is known from numerous localities between Cape Verde Is. and the Faroe-Shetland Channel or from 19° 12′ to 60° 21′ N., leaving out the doubtful find at stat. 102. It is besides found in the Mediterranean. The bathymetrical distribution is from 106 to 2489 m. It is a true warm-water species which was, however, captured three times in the cold

area of the Faroe-Shetland Channel ("Porcupine" 1869 stat. 57, 60° 14′ N., 6° 17′ W., 1156 m, ÷ 0,8° Cel. and stat. 58, 60° 21′ N., 6° 51′ W., 988 m., ÷ 0.6° Cel. and "Knight Errant" 1880, stat. 8, 60° 3′ N., 5° 51′ W., 988 m. ÷ 1.56° Cel.).

Plutonaster agassizi Verrill.
(Pl. 4, figs. 2—4).

Archaster agassizi Verrill, Amer. Journ., ser. 3 vol. 20, 1880, p. 403.

30/6. Stat. 70, 42° 59′ N., 51° 15′ W., 1100 m. Temp. 3.7° Cel.
One specimen, measuring:

Diameter	154	mm.
Arm-radius	79	„
Disc-radius	24	„
Breadth of arm at 4—5 dorso-marginal plate	13	„
Breadth of paxillary area at same place	7	„
Breadth of arm in the middle	10	„
Breadth of paxillary area at the same place	4	„
Size of madreporic area	2.5 × 6	„
Distance of madreporic area from centre of disc	11.5	„
Number of dorso-marginal plates	31—32	
Number of ventro-marginal plates	30—31	
r : R	1 : 3.29	

The marginal plates are very small and high in the arm-angles increasing proportionately in length as they advance towards the points of the arms, where they are almost quadrate as the following measurements distinctly show:

1st dorso-marginal plate	2	mm.	long,	5	mm.	high.
10th —„—	2.5	„	„	4	„	„
20th —„—	2	„	„	3	„	„
25th —„—	1.5	„	„	2	„	„
1st ventro-marginal plate	2.5	„	„	6.5	„	„
10th —„—	3	„	„	4.5	„	„
20th —„—	2	„	„	2.5	„	„
25lh —„—	1.5	„	„	1.5	„	„

The ventro-marginal plates are furnished with a well-developed conical knob, the height of which equals the length of the plates. It is wanting, however, in 3 to 6 of the outermost plates, as well as in a few of the others. The knob is rudimentary in some plates. Most of the dorso-marginal plates are bare, and only a few of them bear a little rudimentary knob.

7 to 9 papillæ were counted along the free margin of the mouth plates and also 7 to 9 adambulacral papillæ of about uniform size. Outside the latter a group of small short papillæ were found, the outermost of which corresponded in size and in form to the granules of the actinal plates. This group of secondary papillæ was arranged in 2 to 4, most commonly i 3 rows. The arrangements were not very distinct, however. No pedicellariæ were observed on the actinal face.

Although Verrill's description of *Plutonaster agassizi* is far from exhaustive it yet clearly shows that his species is identical with *Plutonaster rigidus* Sladen, and as this name dates from 1889 while Verrill's is from 1880, the latter has the priority. I agree with Koehler in referring *Plutonaster granulosus* Perrier to *Pl. agassizi.* Further *Pl. intermedius,* taken off the Antilles by the "Blake", must be referred to the species under discussion. Perrier states that *Pl. intermedius* is distinguished from *Pl. agassizi* by the presence of 8 mouth-papillæ while the other has 9, by having 7 adambulacral papillæ, while there are 9 in the other species, by having two rows of secondary adambulacral papillæ as against 3 rows in the other form, by having commonly a knob on the dorso-marginal plates, while the knob is wanting in the other form, and finally by possessing 22—27 marginal plates, while the other has 31.

The last-named difference can be of no great significance, however, as Perrier's type-specimen was a small individual. Nor is the presence or absence of knobs on the dorso-marginal plates a reliable specific characteristic. Perrier writes about the knob-covering on the dorso-marginal plates of *Pl. intermedius*: "— — — — — elles portent, en général, un piquant conique, sauf sur la moitié terminale des bras ou elles sont inermes; ce piquant peut d'ailleurs avorter accidentellement, même sur les plaques qui sont situées dans l'arc interbrachial"[1]). He further says ("Stellerides des dragages du Blake")[2]) that the dorso-marginal plates of the interbrachial angles at least are furnished with knobs. Verrill remarks on *Pl. agassizi*: "In one large series there are among the adult specimens all gradations from those having no marginal spines whatever to those that have a large spine on nearly every marginal plates of both series. Therefore it is useless to recognize varieties on this character like the variety *semiarmata* of Sladen"[3]). The specimen under discussion as before mentioned has a knob on some of the dorso-marginal plates.

The armature of the adambulacral and the mouth-plates does not seem either to afford reliable specific characters. The specimen in question has 7—9 papillæ along the free margin of the mouth papillæ. Thus the number of papillæ characteristic of *Pl. intermedius* (8) as well as of *Pl. agassizi* (9) is found in the same specimens. It is noteworthy, however, that Sladen in his description of *Pl. agassizi s. rigidus* uses the expression "about nine

[1]) Perrier: Echinodermes, Exp. Sci. du "Travailleur" et du "Talisman, 1894, p. 316.

[2]) Nouv. Arch. du Museum d'Hist. Natur., ser. 2 tome 6, 1883, p. 251.

[3]) Proc. U. S. Nat. Museum, vol. 17, 1894, p. 248.

..... spinelets"[1]). He must have been aware then that the number of papillæ may vary. Some adambulacral plates of the "Michael Sars" specimen have 7 furrow-papillæ like *Pl. intermedius*, others 8 and again others 9 as in the specimen described by Sladen. The number given in Verrill's diagnosis is „about seven or eight . . . spines", which likewise shows that the number of papillæ may vary. Moreover the arrangement of the secondary papillæ is subject to variation as shown by the specimen under discussion. *Pl. intermedius* can therefore not be considered as a distinct species, but only as a variety of *Pl. agassizi.*

Plutonaster agassizi was first taken off the east coast of North America, where it was found by several American expeditions and by the "Challenger" at several localities between 35° 45′ and 41° 53′ N, 333—3111 m. It was later on taken by the "Blake" off the Antilles, 24° 24′—24° 36′ N, 1524—1748 m., and by the "Michael Sars" south of New-Foundland. The Prince of Monaco took it off Madeira and the Azores and in the Bay of Biscay, 1165—1900 m. On the west Atlantic side it is distributed from 24° 24′ to 42° 59′ N, and on the east Atlantic side from 32° 39′ to 43° 33′ N. The bathymetrical distribution is 333—3111 m.

Dytaster agassizi Ed. Perrier.

Dytaster agassizi Ed. Perrier, Echinodermes, Exp. Sci. du „Travailleur" et du „Talisman", 1894, p. 302, tab. 19, fig. 2.

$^{18}/_{7}$. Stat. 88, 45° 26′ N., 25° 45′ W., 3120 m., sand and yellow mud, temp. 2.5° Cel. 34 specimens.

The smallest specimen measured: arm-radius 29 mm. disc-radius 6.5 mm., the largest 61 mm. and 12 mm. respectively. r : R is thus in these specimens 1 : 4.46 and 1 : 5.08. This proportion varied, however, between 1 : 4.46 and 1 : 5.65 in 15 specimens. In the two smallest specimens only was R $<$ 5r. I Perriers type specimen, which was a little larger than the largest of my specimens, the proportion was R $=$ 5.15 r.

The ventro-marginal plates commonly bear one large spine, but they may have two, particulary in the angle of the arm, and more rarely three larger spines or one large and one or two smaller spines. The dorso-marginal plates bear one spine, but as an exception those in the arm-angle may have two smaller spines. The ventro-marginal as well as dorso-marginal plates may, however, be without spines, especially in the outer half of the arms.

The mouth-plates have 10—11 papillæ along the inner free margin. The adjoining adambulacral plate has 8 papillæ, the remainder 7—10, in the outer half of the arm not more than 6—8. Besides the furrow-papillæ two more rows of adambulacral papillæ were found with 4—5 papillæ in each row, the outermost of which was usually very indistinct, however, and its papillæ tiny.

According to Perrier the actinal areas of *Dytaster agassizi* are furnished with numerous pedicellariæ, of which he remarks: "une trentaine des ces pédicellaires couvrent presque l'aire interambulacraire ventrale, les autres sont disposés isolement le long de la gouttière ambulacraire comme les plaques dont ils dependent". The specimens examined by me have not such a great number of pedicellariæ, nor were they grouped in the manner described by Perrier. The number of pedicellariæ appears to be subject to great variations, however. In some specimens a few pedicellariæ only were found in each actinal area and there were even areas in which the pedicellariæ were entirely wanting. No specimens had more than about 20 pedicellariæ in each area, and they exhibited no grouped arrangement, but were scattered among the spines of the actinal plates. In spite of this difference I have referred the specimens to *Dytaster agassizi Perrier* as they agree with it in other characteristics. Thus the mouth- and adambulacral plates have the same armature, the actinal area has the same extension as in the specimens in questions, the 4th ventro-marginal is tangent to the 5th adambulacral plate, etc.

The colour in life is red.

Dytaster agassizi was first taken by the "Talisman" between Europe and the Azores, 4060 m. It was again found there by the Prince of Monaco in two localities, 4020—4360 m. According to the explorations of the "Michael Sars" its horizontal distribution will be from 38° 8′ to 45° 26′ N., and from 17° 58′ to 25° 45′ W. The bathymetrical distribution ranges 3120 to 4360 m.

Astropecten irregularis Pennant.

Asterias irregularis Pennant, British Zoology, vol. 4, 1777, p. 52.

$^{9}/_{4}$. Stat. 1, 49° 27′ N., 8° 36′ W., 146 m., fine sand, temp. 9.57° Cel. One specimen which measured: arm-radius 32 mm, disc-radius 8 mm., 28 dorso-marginal plates.

$^{10}/_{4}$. Stat. 3, 49° 32′ N., 10° 49′ W., 184 m., fine sand, temp. 10.3° Cel. Three specimens measured: arm-radius 37—39 mm, disc-radius 9—12 mm, 27—29 dorso-marginal plates.

Astrospecten irregularis is an East-Atlantic species, ranging from the Josephine Bank (36° 41′) to the Lofoten Is. (68° 20′). It is besides recorded from Tromsoe (Danielssen)[1]) and the Barents Sea (Hoffmann)[2]). I am, however, inclined to consider their records as based on misidentifications of *Leptoptychaster arcticus* as *Astro-*

[1]) Sladen: Challenger Asteroidea, p. 91.

[1]). Kgl. norske Vidensk. Selsk. Skrifter, bd. 4, h. 2, 1859, p. 159.

[2]). Niederländ. Archiv f. Zool., Suppl. Bd. 1, 1882, p. 9.

specten irregularis has not since been found again in those northern waters. Mr. Dons, keeper of the Tromsoe Museum, has thus kindly informed me that there is no specimen of *Astrospecten irregularis* in the Museum. I have not found it myself among the rich echinoderm material brought home from northern Norway and Barents Sea by Mr. Nordgaard and by the "Michael Sars".

Bathybiaster robustus Verrill.

Archaster robustus Verrill, Amer. Journ., ser. 3 vol. 28, 1884, p. 383.

[illegible] Stat. 95, 50° 22′ N, 11° 44′ W, 1797, temp. 3,5° Cel. 25 specimens.

[illegible] Stat. 101, 57° 41′ N, 11° 48′ W, 1853, temp. 3.3° Cel. 30 specimens.

The dimensions of the largest specimens from stat. 101 were:—Arm-radius 127 mm., disc-radius 23 mm., breath of arm at base 26 mm., 57 dorso-marginal plates. In the other specimen these figures are 80 mm., 17 mm., 18 mm. respectively and 53 dorso-marginal plates and in the third one 56 mm., 14 mm., 15 mm., 44 dorso-marginal plates. The proportions of breadth of arm to arm-radius is 1 : 4.88, 1 : 4.44 and 1 : 3.39 respectively in these specimens. The proportion r : R is 1 : 5.52, 1 : 4.72 and 1 : 4. Young individuals have proportionately broader and shorter arms than older ones, as will be even more evident from following table of measurements of some specimens from stat. 95.

Arm-radius	Disc-radius	Breadth of arm at base.	r:R	A:R	Number of dorso-marginal plates.
53	12	14	1 : 4.42	1 : 3.79	44
54	11	15	1 : 4.91	1 : 3.60	46
68	15	16	1 : 4.53	1 : 4.25	49
76	15	18	1 : 5.07	1 : 4.22	50
78	16	19	1 : 4.87	1 : 4.11	53
83	20	23	1 : 4.15	1 : 3.61	43
89	17	18	1 : 5.24	1 : 4.91	52
92	18	20	1 : 5.11	1 : 4.60	58
94	18	22	1 : 5.22	1 : 4.27	57
97	17	19	1 : 5.71	1 : 5.11	62
100	19	23	1 : 5.26	1 : 4.35	58
102	19	20	1 : 5.36	1 : 5.01	58

The measurements are in millimetres.

The table further shows that the proportion of r : R and of length of the arms to their breadth are subject to great individual variations. Thus the comparatively shortest length of arm is not found in the smallest specimen in the table but in one of middle size. Even in specimens of the same size these figures may vary. Thus in three specimens with an arm-radius of 99 mm. the proportion r : R is 1 : 5.21, 1 : 5.5 and 1 : 5.82 respectively, and A : R is 1 : 4.71, 1 : 4.75 and 1 : 5.50.

The marginal plates are high and narrow. Apart from the innermost interbrachial plates the proximal plates are largest, gradually decreasing in size towards the points of the arms. In the largest specimen the measurements were:

1st	dorso-marginal plate	1.5	mm.	long	7.5	mm.	high
10th	—„—	2.5	-	„	7	-	„
20th	—„—	2.5	-	„	6.5	-	„
30th	—„—	2	-	„	4.5	-	„
40th	—„—	2	-	„	3	-	„
50th	—„—	1	-	„	1.5	-	„

At the upper edge of the dorso-marginal plates one or, very rarely, two conical knobs were situated, which may, however, be absent in young individuals. Larger specimens have often besides these a somewhat smaller knob in the centre of the plate. In younger specimens one or two knobs are situated along the distal margin of the ventro-marginal plates of the arm-angle. In larger specimens there are 3 or, more rarely, 4 knobs. The uppermost of these is situated a little below the edge nearest the dorso-marginal plates, the lowermost near the lower edge of the plate, and the third, about the middle of it. They decrease in number towards the points of the arms, the outermost plate bearing only one knob. The knobs of the ventro-marginal plates are smaller than those of the dorso-marginal ones. They may, however, be absent in the former as well as in the latter.

The central "epiproctal cone" is large and well-developed in young individuals, but gradually disappears with age. It may, however, also be present in older individuals and was thus very distinct in a specimen whose arm-radius war 92 mm. On the other hand it was absent in one with arm-radius 78 mm.

The abactinal skeleton is composed of round or irregularly polygonal plates which join, but never overlap Owing to the irregular shape of the plates small open spaces are formed between them in which a papula is placed. Each plate bears a little low cylindrical paxilla whose upper surface is furnished with as many as 12 granules. In the closely related *Bathybiaster vexillifer* the skeleton is composed of stellate overlapping calcareous plates, each bearing a paxilla similar in shape and appearance to that of *Bathybiaster robustus* but apparently a little more slender than in that species. The abactinal skeleton therefore affords a good specific character for these two closely related and in their habits so similar species.

The actinal skeleton is covered with scales. In some individuals several of the scales are converted into small

knobs, similar in form to those of the marginal plates, but smaller.

The long, narrow mouth-plates carry a double row of little, short and compressed papillæ, the largest specimen having about 20 in each row. The first adambulacral plate has a double row of papillæ with 12 papillæ in each row. The 2nd has 6 papillæ, the innermost of which is larger and more compressed than the rest, and resembles the large compressed middle papilla of the other adambulacral plates. These plates have 5—6 papillæ the middle one of which was larger as well as more slender and compressed than the rest and reached into the ambulacral furrow. Verrill[1]) writes:—"The peculiar purselike or bursiform pedicellariæ of the large inner adambulacral spines, characteristic of *Bathybiaster*, are often entirely wanting in our specimens, especially when small, and usually, when present, there are but few of them even in the large specimens. Possibly they may have been destroyed by rough usage in the dredges and washing sieves". An examination of the "Michael Sars's" specimens shows that this "purselike or bursiform pedicellaria" is identical with the "vexillum" of *Bathybiaster vexillifer*, which as demonstrated by Mortensen[2]) is no other than the middle papilla of the adambulacral plates, and as such it was described by me above. It is similar in form to the papilla in *Bathybiaster vexillifer*, but appears to be somewhat shorter and broader. It is often lost as already stated by Verrill, and was entirely wanting in some of the specimens examined by me; in others it was present in a few of the adambulacral plates only, and merely in a very few specimen it was found in all the plates.

Bathybiaster vexillifer Wyville Thomson.

Archaster vexilifer Wyville Thomson, The Depth of the Sea, 1873, p. 150, fig. 25.

$^{9}/_{8}$—$^{10}/_{8}$. Stat. 102, 60° 57′ N, 4° 38′ W, 1098 m., dark sand and clay, temp. ÷ 0.9° Cel. 24 specimens. The smallest specimen measured: arm-radius 52 mm., disc-radius 11 mm., the largest: 106 mm. and 21 mm. respectively.

Bathybiaster vexillifer was discovered by the "Porcupine" in 1869 in the cold area of Faroe—Shetland Channel (stat. 76, 60° 36′ N, 3° 58′ W, 630 m., temp. ÷ 1.1° Cel.) It was found subsequently at a number of localities in the cold area of the Norwegian Sea (the „Voeringen", 753—2222 m., temp. ÷ 1 to ÷ 1.6°, the "Michael Sars", 600—1960 m., temp. ÷ 0.41° to ÷ 1.07°, the "Armauer Hansen", 1400 m. temp. ÷ 0.74°, the "Thor", 877—1401 m., temp. ÷ 0.58 to ÷ 0.95°, the "Princesse Alice", 1185—1865 m. and the "Danmark", 304m.) It was likewise found by Swedish expeditions in the cold area of the Norwegian Sea, but no reference to the individual localities was given. *Bathybiaster vexillifer* is thus distributed in the Norwegian Sea between 60° 36′ and 79° 59′ N. and between 14° 24′ E., and 18° 30′ W. in 304—2222 m.and in temp. ÷ 0.41 to ÷ 1.6° Cel. It is besides found off western Greenland between 64° 5′ and 70° 47′ N., 223—1276 m.

Bathybiaster robustus was taken by the "Challenger" at three localities off the east coast of North America, 2269—3111 m., temp. 2.33—2.89°. It was likewise taken there by American expeditions in several localities between 35° 10′ and 41° 28′ N., 1290—2665 m. All the stations belong to the warm area, as, according to the records of the cruises of the "Albatross" in 1883 and 1884, the temperatures ranged between 2.78 and 3.89° at the depths at which *B. robustus* was found. *B. robustus* was not hitherto known to occur on the east side of the Atlantic. The stations off Ireland and the Hebrides also belong to the warm area. This species is therefore a pronounced warm-water form restricted to the depths of the North Atlantic, 1290—3110 m. while the closely related *B. vexillifer*, as shown above, is a true Arctic species.

Verrill remarks about these two closely related forms, "that they may prove to be indentical when a full series of each can be compared", and Koehler[1]) joins him in this view, as he considers *B. robustus* and its synonym *Phoxaster pumilus* Sladen[2]) identical with *B. vexillifer*". The two species, as I have stated before, however, have their distinct habitats, the one being restricted to the warm area of the Atlantic, the other to the cold area of the Norwegian Sea and the waters off the west coast of Greenland where the hydrographic conditions are probably also Arctic. Neither reaches the banks, that divide the Norwegian Sea from the Atlantic. This difference in distribution indicates that the species must be distinct and a closer examinations of their structure confirms this view.

In *B. robustus* the marginal plates have a more vertical position than in *B. vexilifer*, where the arms do not exhibit the rectangular straightened appearance seen in the former species. *B. robustus* has 1 to 2 spines on the dorso-marginal plates and 2 to 3, or more rarely 4, on the ventro-marginal ones. In *B. vexillifer* the dorso-marginal plate bear 0 to 1 in exceptional cases 2 spines; the ventro-marginal plates on the other hand, 1 or 2 very rarely 3 or 4 spines. In the first-named species the spines are larger than in in the other, and the

[1]) Proc. U. S. Nat. Museum, vol. 17, 1894, p. 256.

[2]) Mortensen: Echinoderms, Danmark Exp. Grønlands Nordøstkyst 1906—1908, Bd. 5 no. 4, 1910, p. 252.

[1]) Koehler; Echinodermes, Res. Camp. Sci. Monaco, Fasc. 34, 1909, p. 57.

[2]) Sladen: Challenger Asteroidea, p. 336, tab. 15, figs. 3—6, tab. 40, figs. 7—10.

uppermost spine of the dorso-marginal plates is the best developed one. In *B. vexillifer* on the contrary the lowermost spine of the ventro-marginal plates is the best developed one. In both species the spines may be absent in the marginal plates, but this is more frequently the case in *B. vexillifer* than in the other species. As stated before the "vexillum" is somewhat different.

According to Danielssen and Koren [1]) the colour of *B. vexillifer* is "pale yellow over the entire starfish; the marginal plates and ventral surface being paler than the other parts". Wyville Thomson gives the colour as "pale rose with a tinge of buff; the suckers semitransparent and pale pink". In *B. robustus* is according to Verrill "the colour in life, light buff or salmon". In alcohol or dried *B. vexillifer* has a yellowish white colour, while the other species is more reddish gray. These differences are of minor importance, however, and could at most justify their separation into two races or subspecies.

The divergencies in the structure of the abactinal skeleton are of more vital importance, being so great as to fully justify the separation into two species, one Arctic *(B. vexillifer)*, the other an Atlantic species *(B. robustus)*. In the first-named the abactinal skeleton is composed of stellate overlapping calcareous elements, in the latter on the other hand of round or polygonic plates which though joining one another, never overlap. We see here the same difference as between the Arctic *Solaster squamatus* and the boreo-arctic *Solaster papposus*. In the former the abactinal skeleton consists of overlapping scales or plates, in the latter of small calcareous rods forming a meshwork.

Psilaster andromeda Müller and Troschel.

Astropecten andromeda Müller and Troschel, System der Asteriden, 1842, p. 129.

[illegible]. Stat. 24, 35° 34′ N., 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. One specimen.

30/6. Stat. 70, 42° 59′ N., 51° 15′ W., 1100 m. temp. 3.7° Cel. One specimen.

6/8—7/8. Stat. 101, 57° 41′ N., 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. 23 specimens.

9/8—10/8. Stat. 102, 60° 57′ N., 4° 38′ W., 1098 m, dark sand and clay, temp. ÷ 0.9° Cel. A very defect and macerated specimen, which had most probably remained in the trawl from stat. 101.

The following table shows the dimensions of a few specimens from stat. 101. As will be seen from this table the proportion r : R varies between 1 : 3.7 and 1 : 4.8, and the breadth of arm to arm-radius 1 : 3.24 and 1 : 4.21. I may mention for comparison that in some specimens of similar dimensions from the Norwegian coast (Sogn). I found r : R = 1 : 3.7—4.3 and A : R = 1 : 3.4—3.9.

Arm-radius	Disc-radius	Breadth of arm at base.	Number of dorso-marginal	r : R	A : R
50	13.5	14	25	1 : 3.70	1 : 3.57
72	15	19	29	1 : 4.80	1 : 4.21
75.5	17.5	20	28	1 : 4.31	1 : 3.78
81	19	25	30	1 : 4.26	1 : 3.24
82	20	25	30	1 : 4.10	1 : 3.24
85	22	25	30	1 : 3.86	1 : 3.40
86	19	25	33	1 : 4.53	1 : 3.44
92	20	23	34	1 : 4.60	1 : 4

The measurements are in millimetres.

Several of the specimens from stat. 101 are remarkable for the abundant spiny armature of their ventro-marginal plates, particularly those of the interbrachia angles which carry 0—10 spines. 0—5 spines were found in the middle of the arm, while in the distal plates nearest the points of the arms spines were totally wanting. In Norwegian specimens I have never found more than 4 spines on the ventro-marginal plates. In the specimen from stat. 24 the plates of the interbrachial angles and those in the middle of the arm carry up to 7 spine and in the specimen from stat. 70 2—4. In the latter specimen as well as in some from stat. 101 a central spine was observed on a few of the dorso-marginal plates.

According to Perrier *Psilaster andromeda* descends to a depth of 2190 m., but this statement needs confirmation, as Perrier confused *Psilaster andromeda* and *Psilasteropsis patagiatus* (cfr. Koehler)[1]). *Psilaster andromeda* was not hitherto with certainty known from greater depths than 1795 m. According to the explorations of the "Michael Sars" the bathymetrical range of the species is from 19 to 1853 m. But it is rare at smaller depths than 80 m.

Psilaster andromeda is a decided warm-water species which was, however, taken twice in the cold area of the Norwegian Sea (Porcupine 1869, stat. 76, 60° 36′ N., 3° 36″ W., 630 m., temp. ÷ 1.1°, "Michael Sars" 1902, stat. 37, 62° 43′ N., 1° 26′ E., 775 m.). This must be due to the fact that both stations are close to the warm area. The hydrographical conditions are unstable in such localities which are sometimes washed by warm Atlantic, sometimes by cold Arctic water, as a result of which they are supplied now with larvæ of Atlantic or boreal, now with those of Arctic forms. The bottom fauna will therefore consist of a mingling of southern and northern species. What I have said about *Psilaster andromeda* also applies to *Plutonaster bifrons*, which is an inhabitant of the deep water of the Atlantic and

[1]) Danielssen & Koren: Asteroidea, Norske Nordhavs Exp., 1884, p. 89.

[1]) Koehler: Echinodermes, Res. Camp. Sci. Monaco, Fasc. 34, 1909, p. 60 and 62.

which therefore to a still higher degree is a warm-water species, but which was nevertheless taken three times in the cold area of the Faroe-Shetland Channel.

Psilasteropsis patagiatus Sladen.

Psilaster patagiatus Sladen, Asteroidea, Rep. Sci. Res. Challenger Zool., vol. 30, 1899, p. 232, tab. 7, figs. 11 & 12, tab. 41, figs. 3 & 4.

$^{6}/_{8}$—$^{7}/_{8}$. Stat. 101, 57° 41′ N., 11° 48′ W., 1853 m, hard clay, temp. 3.3° Cel. One specimen, measuring:

Arm-radius	92 mm.
Disc-radius	30 „
Breath of arm at base	36 „
Number of dorso-marginal plates	34 „
r : R	1 : 3.07
A : R	1 : 2.56

In the type specimen of this species the proportion r : R was 1 : 3.95 and A : R = 1 : 4.05. Koehler found in some large specimens from the collections of the Prince of Monaco the proportions r : R to vary between 1 : 4.18 and 1 : 4.72. The specimen under discussion is remarkable for its comparatively short and broad arms. It differs further from the type specimens by a more abundant spiny armature of the ventro-marginal plates, in as much as some of the plates of the arm-angles bore up to 10 spines, which recalls the armature observed in a few specimens of *Psilaster andromeda* from stat. 101. The specimens agree in other respects with the description and figures of *Psilasteropsis patagiatus* given by Sladen. 17 furrow papillæ were present on the middle adambulacral plates.

The type specimen was captured by the "Challenger" off the Cape Verd Is. The "Princesse Alice" also took it there, as well as off the coast of Morocco, at the Canary Is., the Azores and in the Bay of Biscay. The "Hirondelle" and the "Talisman" likewise collected it within the same area, though the exact localities can not be given, Perrier, as above stated, having confused the species with *Psilaster andromeda*. The "Helga" captured it off Ireland. The "Michael Sars" locality lies to the west of the Hebrides. Thus *Psilasteropsis patagiatus* is an East Atlantic species, ranging from 16° 34′ to 57° 41′ N. Bathymetrical distribution 1095—2165 m.

Dorigona arenata Ed. Perrier.

(Pl. 4, figs. 5—8).

Pentagonaster arenatus Ed. Perrier, Bul. Mus. Comp. Zool., vol. 9, 1881, p. 21.

$^{5}/_{5}$. Stat. 21, 35° 31′ N., 6° 35′ W., 535 m., yellow sand, temp. 11.52° Cel. Three specimens, of which the two best preserved ones measured:

Arm-radius	88.5 mm.	90 mm.
Disc-radius	19 „	21 „
Distance of the madreporic plate from centre of disc	4 mm.	4 mm.
Size of the madreporic plate	2.5 × 2 „	2.5 × 2.5 „
r : R	1 : 4.66	1 : 4.29
Number of dorso-marginal plates	37	32
Number of ventro-marginal plates	39	39

The dorso-marginal plates are joined together, beginning with the 5th or 6th plate.

Perrier states that pedicellariæ are wanting in the marginal plates of this species[1]). I found pedicellariæ present, however, on the dorso-marginal as well as on the ventro-marginal plates of the three specimens mentioned above, but the number of pedicellariæ-bearing plates seems to vary considerably in the different individuals In one of my specimens pedicellariæ were present on 6 dorso-marginal and on one ventro-marginal plate, in an other specimen on 71 dorso-marginal and on 67 ventro-marginal plates and in the third specimen on 89 dorso-marginal and on 116 ventro-marginal plates. I ought to mention that one or more of the arms of all the specimens were defective, which admits the possibility that the number of pedicellariæ-bearing plates might have been greater if the specimens had been intact. Most of the plates of the interbrachial angles were furnished with pedicellariæ. They may also, though more rarely, be found on the arm plates, particularly in the distal half of the arms, but in the outermost plates they appeared to be constantly absent. The majority of marginal plates bear one pedicellaria, but both the dorso-marginal and the ventro-marginal plates may have two or very rarely three pedicellariæ.

Pedicellariæ are wanting in the inter-radial actinal area. On the abactinal surface they are restricted to the papularium and are besides, as regards number, apparently subject to great individual variations. Only 6 pedicellariæ-bearing plates were counted in the first of the specimens in question, 28 in the second, and 8 in the third. None of the plates bore more than one pedicellaria, and most of these were situated near the margin, only exceptionally farther in on the plate, as is normal in the marginal plates. As in *Pentagonaster granularis* the pedicellariæ are composed of two rounded quadrate flaps about 0.64 mm. long and about 0.23 mm. broad. Those on the marginal plates have the same form, but are somewhat smaller.

The mouth-plates carry 6—8 papillæ and the adjacent adambulacral plates have 4—5 furrow-papillæ. The number of adambulacral papillæ is 6 to 7 in the middle of the arm and up to 9 in the outer half of the arm. Behind the furrow-papillæ there are three and, at the

[1]). Ed. Perrier: Echinodermes, Exp. Sci. du "Travailleur" et du "Talisman", 1894, p. 379.

extreme point of the arm, frequently only two more or less distinct rows of papillæ, the hindmost of which equal in size the granules of the adjoining ventro-lateral plates. The number of papillæ varies in the furrow row as well as in those behind it, as will be clearly seen from the following account of the number of papillæ in 7 successive adambulacral plates of the inner half of the arm of the largest specimen: 6—2—4—3, 5—3—2—3, 5—3—3—4. 5—4—3—4, 6—4—4—3, 7—4—5—4 and 6—3—5—5.

Dorigona arenata occurs on both sides of the North Atlantic. It was first found by the "Blake" off the West Indies between Grenada (12° N) and 24° 36′ N., at 298—1748 m, where it was later also taken by the "Albatross" On the east Atlantic side it was first taken by the "Challenger" southwest of the Canary Is. at 2791 m. The "Travailleur" and the "Talisman" took it later at 16 stations between the Canary Is. and the Bay of Biscay (44° 4′ — 29° 1′ N., 407 — 1805 m.) and there it was also found by the Prince of Monaco at 40 stations between 29° 6′ and 47° 45′ N., 1096 — 1588 m. The "Caudan" obtained it at three stations in the Bay of Biscay, 400 — 1410 m. It is finally recorded under the names of *Nymphaster protentus, N. subspinosus* and *N. arenatus* from the great depths west of Ireland, 381 — 1332 m. *Dorigona arenata* thus ranges on the west Atlantic side from 12° to 24° 36′ N., and on the east Atlantic side from 25° 45′ to 51° 23′ N. The bathymetrical distribution is 298 to 2791 m.

Paragonaster subtilis Ed. Perrier.

Goniopecten subtilis Ed. Perrier, Bul. Mus. Comp. Zool. vol. 9, 1881. p. 26.

19/4. Stat. 10, 45° 26′ N., 9° 20′ W., 4700 m., yellow sand, temp. 2.56° Cel. Two large unfortunately defective, specimens and a very young one. The disc-radius of the two former was 19.5 mm. and 15 mm. respectively. The small specimen measured:

Arm-radius	10 mm.
Disc-radius	4 „
r : R	1 : 2.5
Number of dorso-marginal plates	7– 8
Number of ventro-marginal plates	8—9

The small specimen differs from the two fully developed ones in having the dorso-marginal plates more scantily covered with granules, which form a marginal border; for the rest granules are absent or a few scattered ones only occur. In the two large specimen on the other hand the plates are completely covered with granules. In like manner the ventro-marginal as well as the abactinal plates of the small specimen present more scanty granulation. The terminal plates end in two spines which are turned forward, are comparatively broadly and straightly cut off and among which 2 to 4 more spines of smaller and more slender dimensions are found.

The adambulacral plates of the two large specimens carry 4 — 8 furrow papillæ, most frequently 5 to 6, and behind them 12 papillæ arranged in three distinct rows. Pedicellariæ were absent in both specimens.

Paragonaster subtilis is evidently identical with *P. strictus* Perrier, which I can not but consider as the juvenile form of this species as was also indicated by Perrier[1]). I agree with Koehler[2]) in further referring *P. elongatus* Perrier[3]) to the same species and likewise *P. cylindratus* Sladen[4]), which was found by the "Challenger" south of the Cape Verd Is. (1° 47′ N. 24° 26′ W., 3386 m., temp. 2.6° Cel.)

Verrill[5]) remarks about the relation between *P. cylindratus* Sladen and *P. formosus* Verrill, taken of the east coast of the North America between 37° and 41° 7′ N., at 2455 to 3698 m., that the latter "appears to have the adambulacral plates more salient and angular on the furrow-margin and the notches between them deeper; the furrow-spines appear to be more slender and form a more strongly curved or angular group, which is continued by three to five shorter ones in a fasciole-like row on the proximal and distal edges of the plates; there are about five on the furrow-edge proper; the spines on the actinal surface are more elongated and more regularly stellated, with a longer one in the middle of the group. —The spinules of the lower marginal plates have the same arrangements as in Sladen's species, but are slightly more slender and acute than shown in his figure; of the larger median series there are usually two or three irregular indefinite rows in the larger specimens, instead of a single definite row. These differences are, however, so slight that the two former may prove to be the same species".

One of the two larger specimens mentioned by me is a typical *Paragonaster subtilis*, the other agrees more closely with Verrill's form, which according to him I must regard as identical with *P. cylindratus*, and consequently also with *P. subtilis*, the type specimen of which was taken by the "Blake" off the Antilles (24° 33′ N., 84° 23′ W., 3532 m.)

Paragonaster subtilis must therefore be a North Atlantic species ranging on the American side from 24° 33′ to 41° 7′ N., 2455—3698 m., and on the European side

1) Ed. Perrier: Echinodermes, Exp. Sci. du "Travailleur" et du "Talisman", 1894, pag 363, tab. 24, fig. 7, tab. 25. fig. 5.

2) Koehler: Echinodermes, Res. Camp. Sci. Monaco, Fasc. 34, 1909, p. 86, tab. 4, fig. 2.

3) Ann. Sci., Nat., ser. 6, Zool. tome 19, 1885, no. 8, p. 38.

4) Sladen: Challenger Asteroidea, p. 314, tab. 51, figs. 3 & 4, tab. 53, figs. 3 & 4.

5) Proc. U. S. Nat. Museum, vol. 17, 1894, p. 257.

from 1° 47′ to 45° 26′ N., 2995—4700 m., bottom temp. 2.56°—3.3° Cel.[1]).

		R mm.	r mm.	r : R
P. subtilis	"Michael Sars"	10	4	1 : 2.5
„ *strictus*	"Talisman"	17	5	1 : 3.4
„ *cylindratus*	"Challenger"	30	8.5	1 : 3.53
„ —„—	—„—	51	12.5	1 : 4.08
„ *subtilis*	"Blake"	60	12	1 : 5
„ *formosus*	"Albatross"	74	18	1 : 4.11
„ *elongatus*	"Talisman"	87	18	1 : 4.83

The foregoing list of specimens of which measurements exist, shows that older fully-developed individuals are more long-armed than very young ones, for while R of the smallest specimen was 2.5 r, it was 4 — 5 r in the larger specimens.

Mediaster stellatus Ed. Perrier.

Mediaster stellatus Ed. Perrier, Mem. Soc. Zool. de France, vol. 4, 1891, p. 268.

30/6. Stat. 70, 42° 59′ N., 51° 15′ W., 1100 m., temp. 3.7° Cel. Five specimens, measuring:

	mm.	mm.	mm.	mm.	mm.
Arm-radius	32	38.5	47	48	54
Disc-radius	12.5	14	17	16.5	16
Breadth of arm in the middle	4.5	4.5	6	7	7
Breadth of paxillar area in the same place	2.5	2.5	4	4.5	5
r : R	1 : 2.56	1 : 2.75	1 : 2.76	1 : 2.91	1 : 3.37
Number of dorso-marginal plates	23	28	30	29	31
Number of ventro-marginal plates	24	28	29	29	31

The specimens agree with the description and illustrations which Perrier[2]) gives of this species. The adambulacral plates bear three rows of papillæ with 4 to 6, most commonly 5 papillæ in each row, of which the furrow-papillæ are the largest. The papillæ of the outermost row agree in size and form with the granules of the adjacent actinal plates. The larger paxillæ of the abactinal plates bear 22 to 54 granules, but pedicellariæ-bearing paxillæ have at most 20 granules. The pedicellariæ are more numerous in the larger specimens, than in the smaller ones, thus evidently increasing in number with the age of the animal.

Mediaster stellatus is known only from the great depths south and east of New-Foundland where it was previously taken by the Prince of Monaco in 1887 at a station north-east of the "Michael Sars" locality (stat. 161, 46° 4′ 40″ N., 49° 2′ 30″ W., 1267 m).

[1]). "Challenger" 2.6°, "Albatross" 3.3° (3 stations) and 2.8° (one station) "Michael Sars" 2.56°.

[2]). Ed. Perrier: Stellerides, Res. Camp. Sci. Monaco, Fasc. 11, 1896, p. 46, tab. 4. figs. 1 — 1 d.

Astrogonium fallax Ed. Perrier.

(Pl. 5, fig. 1).

Astrogonium fallax Ed. Perrier, Ann. Sci. Nat., ser. 6 tome 19, 1885, no. 8, p. 37.

30/6. Stat. 70, 42° 59′ N., 51° 15′ W., 1100 m. temp. 3.7° Cel.

Two specimens measuring:

Arm-radius	37 mm.	46 mm.
Disc-radius	11 „	14.5 „
Breadth of arm in the middle	5.3 „	6 „
Breadth of paxillar area in the same place	2.2 „	3 „
r : R	1 : 3.36	1 : 3.17
Number of dorso-marginal plates	29	35
Number of ventro-marginal plates	29	35

The largest specimen agrees with Koehler's figure of this species.[1]) In the smallest specimen some few of the ventro-marginal plates only have rudimentary spiny formations, the rest exhibit a scale-like granulation similar to that of the largest individual. The small specimen has likewise a similar armature of the adambulacral plates and similar uniform granulation of the plates of actinal area. I have therefore referred the smallest specimen also to *Astrogonium fallax*.

Astrogonium fallax was first found by the "Talisman" at 4 stations off the Azores, 1440 — 2220 m., and there it was also later taken by the Prince of Monaco at two stations, 1165 — 1385 m. Verrill[2]) further records it from the east coast of North America; but judging from Verrill's figures, this North American form appears to differ from the typical *Astrogonium fallax*. The uniform crowded granulation of the plates in the actinal area is characteristic of this species, while Verrill's drawing (fig. 2 a) exhibits a more scattered granulation, and the individual granules vary in sizes, a circumstance which was, however, also pointed out by Koehler.

Pentagonaster dentatus Ed. Perrier.

Pentagonaster dentatus Ed. Perrier, Nouv. Arch. du Museum d'Hist. Natur., ser. 2 tome 6, 1883, p. 242, tab. 8, fig. 3.

6/5. Stat. 24, 35° 34′ N., 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. Two specimens.

8/5. Stat. 25 B, 35° 46′ N., 8° 16′ W., 2055 m., yellow mud. Three specimens.

23/5. Stat. 41, 28° 8′ N., 13° 35′ W., 1365 m., yellow mud, temp. 6° Cel. Six specimens.

27/7. Stat. 95, 50° 22′ N., 11° 44′ W., 1797 m., temp. 3.5° Cel. A large specimen.

The specimens were measuring in millimetres:

[1]). Koehler: Echinodermes, Res. Camp. Sci. Monaco, Fasc. 34, 1909, p. 71, tab. 18, fig. 2.

[2]). Transact. Connecticut Acad., vol. 10, 1899, p. 190, tab. 30, figs. 2 — 2 b.

Stations	14	25 B	25 B	24	25 B	24	41	41	41	41	41	95
Diameter	26	42	49	56	59	62	65	70	81	83	90.5	130
Arm-radius	13.5	22.5	26	30	31.5	32	35	37	43	44	48.5	69.5
Disc-radius	9	13	14	18	16	21	21	21	26	23	30.5	47
Size of the madreporic plate	0.5 × 1	0.7 × 1	0.7 × 1	0.7 × 1.2	1 × 1.2	1 × 1.5	0.7 × 1.2	1.2 × 1.7	1.5 × 2	1.7 × 2	1.5 × 2	2 × 3
Distance of the madreporic plate from centre of disc	3	4.5	5	5.5	6	7	7	7	8	8	9	13
Number of dorso-marginal plates	6	8	9	6–7	10	7—8	9—10	8	8—9	12	7—8	9—10
Number of ventro-marginal plates	7	8	9—10	7	10	8	9—10	9	9	14—15	9	10—11
r : R	1 : 1.5	1 : 1.73	1 : 1.86	1 : 1.67	1 : 1.96	1 : 1.52	1 : 1.67	1 : 1.76	1 : 1.66	1 : 1.91	1 : 1.59	1 : 1.48

The largest of Perrier's specimens had an arm-radius of 67 mm., and a disc-radius of 38 mm[1]) It was thus but a little smaller than that from stat. 95, from which it differs by proportionately longer arms, the proportion r : R was 1 : 1.76, while in the specimen from stat. 95 it was 1 : 1.48. The latter has not, however, attained the maximum growth of this species. Farran mentions in „The deep-waters Asteroidea, Ophiuroidea and Echinoidea of the West Coast of Ireland[2])" two specimens of considerably larger size, which measured respectively: R 86 mm and 95 mm, r 50 mm and 63 mm, r : R = 1 : 1.72 and 1 : 1.51.

The specimen from stat. 95 is remarkable for its short arms. Apart from a few exceptions the "Michael Sars" specimens had longer arms and in a few of them the arm-radius was even nearly twice as large as the disc-radius. According to the measurements quoted by Perrier the proportion r : R seems to vary between 1 : 1.62 and 1 : 1.78. The largest specimens had the largest arms, while in the "Michael Sars" specimens in which r : R varied between 1 : 1.48 and 1 : 1.96, the middle-sized individuals had proportionately the longest arms. Individual variation is, however, present; thus the 62 mm. specimen from stat. 24 was very short-armed (1 : 1.52); while the 59 mm. specimen from stat. 25 B had very long arms (1 : 1.96). The Prince of Monaco's largest specimen had an arm-radius of 42 mm. and a disc-radius of 24 mm, r : R = 1 : 1.75[3]).

The arms were distinctly marked off in most of the specimens, the terminal plates being separated from the abactinal plates by 3 or 4 dorso-marginal ones or even by 5 plates in the most long-armed specimen.

The abactinal plates of the larger specimens were angular and furnished with one row of large round granules, but in other respects bare. In the smaller specimens, on the other hand, the majority of the plates were granulated throughout. The abactinal plates are thus originally entirely covered with granules, but the granulation disappears gradually with the growth of the individual, except along the border of the plates. It first disappears in the plates of the papularium, which in the smallest specimen bore only a ring of granules along the border, while the remaining abactinal plates were still covered with them.

The dorso-marginal plates of the large specimen from stat. 95 bore one row of granules along the border, but were otherwise bare. The ventro-marginal plates were granulated along the border nearest the dorso marginal plates, and the same was the case with a larger or smaller portion of the ventral part adjacent to the actinal plates. The ventro-marginal plates of the smallest specimens were covered with granuls throughout, and the lateral portion of the dorso-marginal plates was likewise granulated, while the dorsal portion was bare. In the remaining specimens the granulation of the dorso-marginal plates was similar to that of the largest specimen, while the ventro-marginal plates presented transition forms between the granulation of the largest and that of the smallest specimen. The terminal plates were bare.

The papularium was very large and papulæ were wanting only in a comparatively small interradial area from the centre of the disc to the middle interradial dorso-

[1]). Ed. Perrier: Echinodermes, Exp. Sci. du "Travailleur" et du 'Talisman", 1894, p. 391, tab. 25, figs. 1 a — b.

[2]). Fisheries Ireland, Sci. Invest. 1912, no. 6, (1913) p. 10.

[3]). Koehler: Echinodermes, Res. Camp. Sci. Monaco, Fasc. 34, 1909, p. 85, tab. 2, fig. 7.

marginal plates. They vere likewise absent from the area nearest the marginal plates. As will be seen from the foregoing table the madreporic plate was situated nearer to the centre of the disc to its border, the distance from the centre being about one third of the disc-radius.

No pedicellariæ could be discovered in the two smallest specimens. But in the remainder on the other hand several were found. They were present in the abactinal as well as in the dorso-marginal plates, while I did not succeed in finding them in the ventro-marginal or actinal plates. Perrier states, however, that pedicellariæ are found scattered on the actinal plates. They are very small and similar to those in *Pentagonaster granularis*, and are found on the radial as well as the interradial plates, and in the centre of the plates as well as along the border.

The adambulacral papillæ are arranged in 3—4 rows, among which one or several isolated papillæ are sometimes found. The furrow papillæ are the largest, while those in the outermost row are shortest and similar in form to the granules of the adjoining actinal plates. As in *Pentagonaster granularis* the number of papillæ found in a row varied greatly. In some of the middle adambulacral plates of the smallest specimen there were thus: 3—3—3, 4—3—2—3, 3—1—2—3 and so on; in the 81 mm. specimen: 6—4—1—5, 6—5—6, 6—4—2—5, 5—1—5—7—2, 5—5—5 and so on; and in the 130 mm. specimen: 5—5—4—6, 4—5—1—4—2—6, 4—4—5—4 and so on. In the three specimens from stat. 25 B the adambulacral plates had three row of papillæ with 5 to 6 papillæ in the furrow-row and 3 to 6 in the remaining rows. Some plates had besides an indefinite fourth row with 2 to 3 papillæ. In some specimens the papillæ behind the furrow-row were gathered in a cluster without definite order, instead of being arranged in rows.

The colour of the specimen from stat. 95 preserved in formol was orange-yellow on the abactinal and yellowish white on the actinal surface. The papulæ were white. The remaining specimens preserved in alcohol, had lost their colour entirely.

With respect to the interpretation of *Pentagonaster dentatus* I agree entirely with Farran, who maintains that *P. perrieri* Sladen *s. grandis* Perrier and *P. concinnus* Sladen are identical with it. *P. dentatus* is therefore a North Atlantic species and is known from the western as well as from the eastern side. It was first found by the "Blake" in the West Indies, between Grenada (12° N.) and 19° 7′ N., at 75 to 2196 m. The "Talisman" later obtained it off the west coasts of Morocco and Spain (20° 32′—38° 38′ N.), 930—1590 m., the "Caudan" in the Bay of Biscay, 950—960 m.; the Prince of Monaco in several localities between the Cape of Verd Is. and the Bay of Biscay (15° 17′—45° 9′ N.) 1095—1804 m., and English expeditions in several localities off the west coast of Ireland, 628—1455 m. While thus *P. dentatus* on the west Atlantic side was known only between 12° and 19° 7′ N. it was found on the east Atlantic side between 15° 17′ and 51° 35′ N. Its bathymetrical distribution is from 75 to 2196 m.

Luidia ciliaris Philippi.

Asterias ciliaris Philippi, Arch. f. Naturgesch., vol. 3, 1837, p. 70.

$^{10}/_{4}$, stat. 3, 49° 32′ N. 10° 49′ W., 184 m., fine sand, temp. 10.3 Cel. One specimen.

$^{20}/_{5}$, stat. 37, 26° 6′ N. 14° 33′ W., 39 m., shingle, temp. 15.6 Cel. One specimen.

$^{26}/_{7}$, stat. 94, 50° 13′ N. 11° 23′ W., 1 m. net, surface. 11 specimens, and 1 m. net, 200 m. wire. 4 specimens.

$^{6}/_{8}$—$^{7}/_{8}$, stat. 101, 57° 41′ N. 11° 48′ W., 1 m. net, 200 m. wire and $^{3}/_{4}$ m. net, 600 m. wire. From each gear one specimen only was obtained.

The specimens from stat. 94 and stat. 101 were young, with remnants from the larval stage adhering. The largest of them had a diameter of 3.7 mm.

The specimens from stat. 3 and stat. 37 were on the contrary fully-developed. The specimen from stat. 3 measured: arm-radius 270 mm., disc-radius 32 mm., breadth of arm at base 28 mm., $r : R = 1 : 8.44$. In the individual from stat. 37 these measurements are 182 mm., 20 mm. and 16 mm. respectively, $r : R = 1 : 9.1$.

Both specimens belong to the variety *normani* Ludwig. Likewise three specimens taken by the "Michael Sars" in 1902 and 1906 in the northern part of North Sea[1]) belong to this variety.

Luidia ciliaris is common in the western part of the Mediterranean, but apparently absent in the eastern part (cfr. Ludwig[2]). It further occurs off the west coasts of Africa and Europe from the Cape Verd Is. to the Faroe and Shetland Is. In the North Sea it is known only from the north-western part, where it was collected by the "Michael Sars" and the "Poseidon" between 58° 2′ and 61° 14′ N. and between 2° 21′ E. and 2° 19′ W., 70 — 215 m. and it was altso taken off and on by the bank-fishermen; also from the eastern coasts of Scotland and England, where it ranges as far south as Scaborough. Süssbach and Breckner[3]) statements "An der norwegischen Küste scheint sie selten aufzutreten und nur an ihren

[1]) The localities are:
1902, stat. 50, 61° 14′ N. 2° 13′ E., 155 m. temp. 6.78° Cel.
1906, „ 287, 60° 52′ N. 0° 36′ E., 130 m. „ 7.6° „
1906, „ 299, 60° 52′ N. 0° 18′ E., 130 m. „ 6.5° „

[2]) Ludwig: Die Seesterne des Mittelmeeres, Fauna und Flora des Golfes von Neapel, vol. 24, 1897, p. 80.

[3]) Süssbach & Brekner: Die Seeigel, Seesterne und Slangensterne der Nord- und Ostsee. Wissensch. Meeresuntersuch. N. F. Abt. Kiel, Bd. 12, 1910, p. 210.

südlichen Teilen" seems to be founded in mistake. As far as I know, *Luidia ciliaris*, is never collected off the Norwegian coast. But there is a specimen in the Riksmuseum in Stockholm that is recorded as taken off Bohuslän (cfr. Düben & Koren [1]), which is the more remarkable as *Luidia ciliaris* is not found in the eastern part of the North Sea, the Skagerak or the Kattegat. I am most inclined to think that Professor Lovén obtained the specimen from fishermen from Bohuslän, who had brought it from the fishingbanks of the north-western part of the North Sea.

Helland Hansen mention in "Farvandenes hydrografiske forholde" [2]) that some of the salty and rather warm water of the Atlantic passes into the North Sea through the channels between Scotland and Norway. It then flows southward along the coasts of Scotland and England, until it turns eastward across the North Sea immediately north of the Doggerbank. If we mark on a chart the localities in the North Sea, where *Luidia ciliaris* was obtained, we shall find that its distribution comes within the bounds of this Atlantic current and that the southern limit of the species is where the current turns eastward. Its southernmost locality of the east coast of England, Scaborough being abreast of the Doggerbank. *Luidia ciliaris* must therefore have migrated from north into the North Sea. Some water from the Atlantic also flows through the English Channel into the North Sea, but *Luidia ciliaris* can not have come that way, as it is not found in the southwestern part of the North Sea and, in the English Channel, not east of Plymouth.

The bathymetrical distribution is 4—220 m.

Luidia sarsii Düben & Koren.

Luidia sarsii Düben & Koren, Øfvs. Kgl Vet. Akad. Förhandl., vol. 1. 1844 (1845), p. 113.

5/6, stat. 53, 34° 59′ N. 33° 1′ W., 1 m. net, 100 m. wire. A very young fully transformed specimen.

10/6, stat. 56, 36° 53′ N. 29° 47′ W., 1 m. net, 100 m. wire. One specimen with adhering remnants from larval stage. Diameter 4.5 mm.

24/6, stat. 64, 34° 44′ N. 47° 52′ W., 1 m. net, 200 m. wire and youngfish trawl, 300 m. wire. From either gear one specimen with adhering remnants from larval stage. Diameter 3 mm.

5/8, stat. 98, 56° 33′ N. 9° 30′ W., 1 m. net, 200 m. wire. One specimen with adhering remnants from larval stage. Diameter 4 mm.

6/8—7/8, stat. 101, 57° 41′ N. 11° 48′ W., 1 m. net, 200 m. wire. 6 specimen with adhering remnants from larval stage. Diameter 3—4.2 mm.

9/8—10/8, stat. 102, 60° 57′ N. 4° 38′ W., 3/4 m. net, 400 m. wire. Two very young, fully transformed specimens. Diameter 5 mm. and 6 mm., disc-radius 0.7 mm. and 1 mm., arm-radius 3 mm. and 3.2 mm.

Luidia sp.

26/6, stat. 67, 40° 17′ N. 50° 39′ W., 1 m. net, 50 m. wire. One specimen with adhering remnants from larval stage. Diameter 3.5 mm.

The larva, which was not very vell preserved, could not be definetely determined, but as stat. 67 is situated south of Newfoundland, it seems reasonable to assume that it belongs to one of the species of *Luidia* common along the eastcoast of North America, *Luidia clathrata* Say or *L. elegans* Ed. Perrier.

Stichaster roseus O. F. Müller.

Asterias rosea O. F. Müller, Zool. Dan. Prod., 1776, p. 234.

10/4, stat. 3, 49° 32′ N. 10° 49′ W., 184 m., fine sand, temp. 10.3 Cel. One specimen.

Stichaster roseus is an east Atlantic boreal species that ranges northward to the banks of Tromsoe (the "Voeringen" stat. 173, 69° 18′ N. 14° 32′ E., 549 m.). It ranges south to the Bay of Biscay (45° 18′ N.), where it was obtained by the "Caudan" as well as by the "Princesse Alice". The "Caudan" found it to be numerous at depths from 100 to 180 m. The bathymetrical distribution of the species is from 4 to 1232 m., but the typical form does not descend to below some 500 m.

Zoroaster fulgens Wyville Thomson.

Zoraster fulgens Wyville Thomson, Depths of the Sea, 1873, p. 154.

6/5—7/5, stat. 24, 35° 34′ N. 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. Two smaller specimens.

23/5, stat. 41, 28° 8′ N. 13° 35′ W., 1365 m., yellow mud, temp. 6° Cel. 10 specimens.

30/6, stat. 70, 42° 59′ N. 51° 15′ W., 1100 m., temp. 3.7 Cel. One specimen.

9/7, stat. 75, 47° 22′ N. 49° 16′ W., 120 m. One specimen.

6/8—7/8, stat. 101, 57° 41′ N. 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. 8 specimens.

9/8—10/8, stat. 102, 60° 57′ N. 4° 38′ W., 1098 m., dark sand and clay, temp. ÷ 0.9° Cel. One very defective and macerated specimen, which had probably remained in the trawl from stat. 101.

The smallest specimen measured: Arm-radius 26.5 mm., disc-radius 6.5 mm., breadth of arm at base 8 mm., r : R = 1 : 4.08, A : R = 1 : 3.31. The remaining specimens measured: arm-radius 66—162 mm., disc-radius 6.5—15 mm., breadth of arm at base 8—13 mm., r : R varied between 1 : 6.6 and 1 : 12.36, A : R varied between 1 : 6.5 and 1 : 13.6. In some specimens taken by the "Michael Sars" in 1902 r : R varied between 1 : 6.4 and 1 : 11.5 and A : R between 1 : 6.5 and 1 : 10.5. In others mentioned by Sladen [1]) these figures were 1 : 6.87—1 : 10 and 1 : 7.86—1 : 9.89 respectively. From the foregoing we may infer

[1]) Kgl. Vetensk. Akad. Handl., 1844 (1846), p. 254.

[2]) Hjort: Norges Fiskerier I Norsk Havfiske, 1905, p. 19.

[1]) Bell: Cat. British Echinoderms, 1892, p. 88.

that the relative length as well as breadth of arm are subject to great variations and judging from the material at my disposal, older individuals appear to have proportionately longer and more slender arms than younger ones, the ratio, hovewer, being subject to individual variations.

The colour in life was pink or white.

Zoroaster fulgens was discovered by the "Porcupine" in 1869 north-west of the Hebrides, 992—1304 m. It was later taken on the east Atlantic side south of Iceland by the "Thor" (921 m.), in the Faroe—Shetland Channel by the "Triton" (1016—1043 m.) and the "Michael Sars" (1100—1300 m.), west of Ireland (732—1797 m.) by the "Flying Falcon" and the "Helga"; in the Bay of Biscay, 1300 m. by the "Caudan" as well as by the "Travailleur" and the "Talisman" between 23° and 44° N., 912—1975 m. On the west Atlantic side the "Challenger" found it off North America, 2287—2470 m. and off Pernambuco, 1235 m. The "Michael Sars" obtained it east of New Foundland, 120 m. Thus *Zoroaster fulgens* ranges from 23° to 62° 57′ N. on the east Atlantic side and from 8° 37′ S. to 47° 16′ N. on the west Atlantic side. The bathymetrical distribution is 732 to 2470 m., there is besides one specimen from a depth of only 120 m. The bottom temperatures at the localities, where temperature measurements were made, are: "Porcupine" 5.2°, "Challenger" 3.3—4.4°, "Triton" 7.5—7.6°, "Michael Sars" 3.3—8.07°. It will be seen from the foregoing that *Zoroaster fulgens* is a true warm-water species. It must therefore be due to a mistake, as stated before, when a specimen of this species was recorded from stat. 102 which belongs to the cold area of the Faroe—Shetland Channel. The specimen must have been left in the trawl from stat. 101, where several specimen of this species were taken. The same must have been the case as regards *Plutonaster bifrons* and *Psilaster andromeda* of both of which a very defective and macerated specimen exists from stat. 102, while several specimens were taken at stat. 101. Like *Zoroaster fulgens* they are true warm-water species as stated before, and do not belong to the cold area of the Norwegian Sea. The other echinoderms taken at stat. 102, viz: *Pontaster tenuispinus var. platynota, Solaster papposus var. septentrionalis, Solaster squamatus, Ophiopleura borealis, Ophioscolex glacialis and Hathrometra prolixa* are on the contrary decided arctic and boreo-arctic species. The same is true of the others invertebrates found at stat. 102, which I may mention:—*Buccinum hydrophanum, Neptunea curta, Neptunea mohni, Philene finmarchica, Cuthonella abyssicola, Scalpellum angustum, Colossendeis proboscidea, Colossendeis angusta, Nymphon grossipes, Borenymphon robustum* etc.

Solaster abyssicola Verrill.

(Pl. 5 figs. 2—4)

Solaster abyssicola Verrill, Amer. Journ., ser. 3, vol. 29, 1885, p. 152 and Ann. Rep. U. S. Fish. Comm. 1885, p. 541.

$^{18}/_{7}$, stat. 88, 45° 26′ N. 25° 45′ W., 3120 m., sand and yellow mud, temp. 2.5° Cel. Two specimens measuring:

Diameter	103 mm.	137 mm.
Arm-radius	54 „	70 „
Disc-radius	22 „	28 „
Breadth of arm at base	13—14 „	15—18 „
Height of arm at base	7—9 „	12—14.5 „
r : R	1 : 2.45	1 : 2.5
Number of arms	8	8
Number of inner adambulacral-papillæ	3—4	3—4
Number of outer adambulacral-papillæ	3—5	3—5

The abactinal skeleton is composed of stellate calcareous plates (pl. 5, fig. 4), whose four branches united with the branches of other plates forming a quadrate mesh-work. In some of these plates a branch may be absent whereby two mesh-spaces are turned into one larger of oblong rectangular form. Meshwork of irregular or triangular form may also occur, but seems to be comparatively rare. A short cylindrical paxillæ in the centre of the plate bear up to about 15 short divergent calcareous spines. The meshwork have normally 3—4 large papulæ, but the larger ones may have as many as 8. The skeleton of *Solaster endeca* (pl. 5, fig. 5) consists in part of calcareous plates similar to those of *Solaster abyssicola*, in part of short narrow calcareous rods. The network formed by the calcareous deposits is of an extremely irregular shape and bears several paxillæ, the mesh-spaces bear proportionately to their size from 1 to 7 papulæ. Besides isolated calcareous rods bearing one paxilla may be present in them, similarly as in the mesh-spaces of *Solaster papposus*.

The paxillæ in the plates of the actinal area are cylindrical and furnished with as many as 8 very small spines. They are arranged in rows and similar to the paxillæ of the abactinal skeleton, but smaller.

The outer row of adambulacral papillæ (pl. 5, fig. 3) bears 3—5 papillæ in both specimens, most often 4. They are comparatively short, covered by a thick membrane and united at the base. The inner row bears 3—4 papillæ of about uniform size and united by a membrane to half their length.

Solaster abyssicola has according to Verrill 5—7 adambulacral papillæ, while the two specimens under discussion have only 3—5. Notwithstanding this I have

referred the specimens to Verrills species because they agree well with it in other characteristic. The number of papillæ apparently does not afford a very reliable specific characteristic, however. In *Solaster papposus* I have found normally 5—7 papillæ in the outer adambulacral row, but the number may vary between 2 and 9, and in several *Solaster endeca* from Hardanger 5—9 papillæ were present.

Solaster abyssicola was previously known only from the east coast of North America, where it was taken according to Verrill at several stations between 35° 45.5′ and 39° 5.5′ N., 1543—3813 m. The species therefore appears to be new to the European fauna. It is possible, however, that this was the species taken by the "Thor" in 1903 south of Iceland (stat. 166, 62° 57′ N. 19° 58′ W., 931 m.). For it is recorded by dr. Mortensen under the name *Solaser n. sp.* (*S. earlii Verr. aff.*[1]), a species to which Verrill originally referred his *Solaster abyssicola*[2]).

Solaster papposus var. septentrionalis Sladen.

Crossaster papposus var. septentrionalis Sladen, Proc. Roy. Soc. Edinburgh, vol. 11, 1882, p. 704.

$^{9}/_{8}$—$^{10}/_{8}$, stat. 102, 60° 57′ N. 4° 38′ W., 1098 m., dark sand and clay, temp. ÷ 0.9 Cel. Two specimens measuring:

Diameter	73 mm.	71 mm.
Arm-radius	38 „	37 „
Disc-radius	17 „	16.5 „
r : R	1 : 2.24	1 : 2.24
Number of arms	10	10
Number of paxillæ in the actinal area	4—7	6—9
Number of inner adambulacral papillæ	4—6	5—6
Number of outer adambulacral papillæ	5—8	5—8

Disc arched, the arms, broad at base, taper rapidly toward the point. Paxillæ small and numerous, the largest bear about 30 spines. The abactinal skeleton consists of short, broad rods united together so as to form an irregular meshwork. In the mesh-spaces only a papula as a rule is present, there may be as many as three, however. In several mesh-spaces isolated rods occur besides. The skeleton most closely resembles that of a 77 mm. specimen of *Solaster papposus* from the Varangerfjord[3]).

[1]) Schmidt: Fiskeriundersøkelser ved Island og Færøerne 1903 (1904) p. 22.

[2]) Ann. Rep. U. S. Fish Comm. 1885, p. 541. Cfr. Amer. Journ. ser. 3, vol. 49, 1895, p. 200.

[3]) Grieg: "Michael Sars" Asteroidea, Bergens Museums Aarbog, 1906, no. 13, p. 64, tab. fig. 7.

Most of the plates of the inner adambulacral row bear five papillæ, but the number varies betwen 4 and 6. In the outer row 5 to 8 papillæ are found, most often 7, and those in the middle are largest, the distal ones smallest.

The colour is pink, lightest on the actinal side.

The specimens agree in all essentials with Sladen's *Solaster* (*Crossaster*) *papposus var. septentrionalis,* which was likewise taken in the cold area of the Faroe—Shetland Channel ("Knight Errant" 1880, stat. 2, 60° 29′ N. 8° 19′ W., 686 m., temp. ÷ 0.56° Cel.) I have therefore referred them to that variety. I ought to mention, however, that Sladen's form has somewhat shorter arms, and the proportion r : R is 1 : 1.94, while it is 1 : 2.24 in the two "Michael Sars" specimens. This difference is not of vital importance, however.

Solaster squamatus Døderlein

Solaster papposus var. squamatus Døderlein, Wissensch. Meeresuntersuch. N. F. Bd. 4, Abt. Helgoland, Heft 2, 1900, p. 208, tab. 6, figs 5—5 c.

$^{10}/_{8}$—$^{11}/_{8}$, stat. 102, 60° 57′ N. 4° 38′ W., 1098 m., dark sand and clay, temp. 0.9 Cel. Two specimens measuring:

Diameter	76 mm.	73 mm.
Arm-radius	43 „	38 „
Disc-radius	21 „	18 „
r : R	1 : 2.05	1 : 2.11
Number of arms	10	10
Number of paxillæ in the actinal area	5—8	4—9
Number of inner adambulacral papillæ	4—6	4—5
Number of outer adambulacral papillæ	5—8	4—7

These two specimens are distinguished from the two before mentioned individuals of *Solaster papposus var. septentrionalis,* which were likewise taken at stat. 102 by a somewhat more arched disc and comparatively shorter arms. The proportion r : R may, however, vary in *Solaster squamatus* between 1 : 1.8 and 1 : 2.6, most often it is 1 : 2.2—2.3, as will be seen from the material collected by the "Voeringen" and the "Michael Sars". The paxillæ are low, cylindrical and furnished with short spines; in *S. papposus var. septentrionalis,* on the other hand, they are conically pointed and bears longer spines, the middle ones longest, which further adds to their conical appearance.

The abactinal skeleton consists of scales, among which small spaces are found with most often one papullæ only. The skeleton resembles most nearly that of a 41 mm. specimens from the cold area east of Iceland ("Michael Sars", 1900 stat. 10, 64° 53′ N. 10° W., 360 m., temp ÷ 0.69° Cel.)[1])

[1]) Grieg: "Michael Sars" Asteroidea, pag. 62, tab. 1, fig. 4.

Colour in life orange-red on the abactinal surface with yellowish red paxillæ and yellowish white on the actinal surface.

Solaster squamatus appears to be indigenous to the cold area of the Norwegian Sea from 100—1159 m. It may, however, occasionally make its way a little into the warm area, where the temperature of the bottom-water may be comparatively high, and where the fauna consists mainly of warm-water species. The "Michael Sars" thus found it in 1902 at a locality, (stat. 85, 62° 53′ N. 9° 6′ W. 450 m., 3.98° Cel.) together with *Pentagonaster granularis, Poraniomorpha hispida, Ophiactis abyssicola, Gorgonocephalus lamarcki, Hathrometra tenella* etc. Among other arctic species, besides *Solaster squamatus*, which were taken at this station, I may mention, *Lophaster furcifer, Ophiura sarsi, Ophiopholis aculeata, Ophiacantha bidentata* etc. (cfr. Appellöff: Havbundens dyreliv)[1].

Lophaster furcifer Düben & Koren.

Solaster furcifer Düben & Koren, Kgl. Vet. Akad. Handl. 1844 (1846) p. 243, tab. 6, figs. 7—10.

$^{10}/_{8}$—$^{11}/_{8}$, stat. 102, 60° 57′ N. 4° 38′ W., 1098 m., dark sand and clay, temp. ÷ 0.9° Cel. Two specimens measuring:

Diameter	138 mm.	72 mm.
Arm-radius	73 „	32 „
Disc-radius	31 „	12 „
r : R	1 : 2.36	1 : 2.67
Number of ventro-marginal paxillæ	25	20
Number of inner adambulacral papillæ	3—5	3—4
Number of outer adambulacral papillæ	3—6	3—5

The specimens belong to the group, which I called the Arctic or cold water form[2]. Their appearance recalls two specimens, which the Duke of Orleans found in the Kara Sea)[3]. The interbrachial arc is rounded, and the abactinal skeleton consists of irregular stellate deposits, the branches of which unite with those of the adjacent plates, forming a meshwork. A large and robust paxilla is attached to the calcareous deposits, which in the disc-centre of the largest specimen measured about 2 mm. in height and about 1 mm. in diameter and bore as many as 20 spines covered with a thick membrane. The paxillæ of the ventro-marginal plates of the interbrachial arc measured about 2 mm. in breadth as well as in height and bore 30 to 40 spines. The paxillæ of the actinal plates had 4—10 spines.

The colour of the specimens in life was brick-red on the abactinal surface and orange-yellow on the actinal.

Walter K. Fisher has described two forms of *Lophaster* from the northern part of the Pacific. One of them, *Lophaster furcilliger*[1]) ranges from Alaska to southern California and the Galapagos Is. from 351 to 2013 m., the other, *Lophaster furcilliger vexator*[2]) inhabits the Bering Sea and ranges south to northern California. Its bathymetrical distribution is from 137 to 640 m., it is most common, however, at depths below 370 m. Fisher states in "Asteroidea of the North Pacific and adjacent Waters, Phanerozonia and Spinulosa"[3]) where these two forms are described in detail, that the latter form has an intermediary position between *L. furcilliger* and *L. furcifer*. From the typical *furcifer* it differs, "in having a more open abactinal skeleton with consequently more widely-spaced paxillæ, higher paxillæ with longer spinelets, much smaller actinal paxillæ (about as in *furcilliger*) and longer adambulacral spines. If equal-sized specimens of the two forms are compared, *L. furcifer* is seen to have wide rounded interbrachial arcs which merge gradually into the ray. *Vexator* has a smaller disk, never rounded interbrachial arcs, but acute angles, the rays being sometimes swollen at base so that the marginal and adjacent abactinal paxillæ of two rays interlock. *L. furcifer* reminds one of a five-rayed *Solaster*, whereas *L. vexator* suggests a five-rayed *Crossaster*". *L. vexator* again differs from *L. furcilliger* by its larger disc, thicker arms, more robust actinal as well as marginal paxillæ, more robust abactinal spines as well as more closely joined adambulacral plates. Without further entering upon the subject Mortensens remarks in "Conspectus Faunæ Grønlandicae. Echinodermer"[4]) about Fishers forms that these seem to be transition forms from *furcifer* through *vexator* to *furcilliger*, so that these forms can hardly be regarded as more than varieties of *furcifer*.

The Bergen Museum possesses very abundant material of *L. furcifer* from the Norwegian coast as well as the Norwegian Sea and extreme Arctic regions such as the Kara Sea, Spitsbergen and Jones Sound. This material shows that individuals from the Boreal regions, such as the coast near Bergen, have a pointed interbrachial arc, the arms comparatively narrow at base and tapering gradually toward the point. The individual from the neighbourhood of Bergen figured by Düben and Koren

[1]) Hjort: Norges Fiskerier I Norsk Havfiske, 1905, p. 105. Cfr. Murray & Hjort: The Depths of the Ocean, 1912, p. 533.

[2]) Grieg: "Michael Sars" Asteroidea, p. 70.

[3]) Grieg: Echinodermes, Duc d'Orleans: Campagne Arctique de 1907, 1910, p. 17, figs, 11 & 12.

[1]) Bull. Bur. Fisheries, vol. 24, 1905, p. 312.

[2]) Zool. Anzeiger, vol. 35, 1910, p. 574.

[3]) Bull. U. S. Nat. Museum, no. 76, 1911, p. 334, tab. 794, figs. 1 & 2, tab. 114, fig. 1. tab. 116, tab. 5 and p. 338, tab. 114, tab. 2.

[4]) Meddel. om Grønland, vol. 23, 1913, p. 336.

must be regarded as typical for this form. Judging from Verrill's figure[1]) the form of *L. furcifer* occurring off the east coast of North America is of similar appearance. In specimens from Arctic regions on the other hand the arc is most often wide and rounded, and the arms broad at base tapering rapidly toward the point. This is evidently the form on which Fisher based his remarks on *L. furcifer* and it is also the form depicted in works on Arctic echinoderms. Judging, however, from the material at my disposal, the form of the arc seems to be subject to variations and this is moreover borne out by the literature on the subject. Duncan and Sladens figure of *L. furcifer*[2]) has but slightly rounded arcs. In two specimens in the Kara Sea by the Duke of Orleans they are a little more rounded and this is more particularly the case in the individual from the cold area of the Norwegian Sea illustrated by Danielssen and Koren[3]). In a specimen from Gaasefjord, Jones Sound they are extremely wide and rounded[4]). There are, however, Arctic specimens, which differ very little in their form from the Boreal. This is the case with the *L. furcifer* from the cold area of the Faroe—Shetland Channel figured by Wyville Thomson in "The depths of the Sea" (p. 119, fig. 14). A very extreme example of such Arctic forms is presented by the specimens which I illustrated on "Michael Sars Asteroidea" (p. 71, fig. 9). It reminds one of *L. fucilliger vexator,* a fact which Fisher likewise calls attention to.

The abactinal skeleton of the Arctic *furcifer* consists of stellate deposits which are united so as to form a meshwork. Its structure appears, however, to be subject to great variations. In some individuals the deposits are close up to one another, so that the meshes become small and narrow, in other examples, such as one from Jones Sound, the deposits are isolated. Between these two are all shades of intermediary forms and also a meshwork like that which characterices *vexator* (cfr. Fisher pl. 114, fig. 2 b). In the Arctic *furcifer* the paxillæ are more scattered than in the boreal form, and they are larger, more robust and have longer spines. We may find examples whose paxillæ closely resemble those of *vexator.* The same is true of the actinal paxillæ and the adambulacral armature. With abundant material of the Atlantic *Lophaster* at hand, it will not be possible to distinguish it from the Pacific form. Fisher mentions intermediary forms between *L. furcilliger* and *L. furcilliger vexator* and my material shows transition forms between the latter and *L. furcifer.* I therefore fully agree with Mortensen in considering *furcilliger* and *vexator* as hardly more than varieties of *L. furcifer.* To the varieties of this species we must possibly also refer *Sarkaster validus Ludwig*[1]) which was taken by the "Albatross" in 1891 between Galapagos Is. and Las Tres Marias Is., 523—1244 m., and which as already pointed out by Fisher, is a *Lophaster* and presents agreements with *L. furcilliger.*

[1]) Verrill: Res. Explr. made by the Steamer „Albatross" in 1883, 1885, tab. 16, fig. 49.

[2]) Duncan & Sladen: Mem. on the Echinodermata of the Arctic Sea to the West of Greenland, 1881, tab. 3, fig. 9.

[3]) Danielssen & Koren: Asteroidea, 1884, tab. 8, fig. 12.

[4]) Grieg: Echinodermata, Rep. II Norweg. Arctic Exp. in the "Fram" 1898—1902, no. 13, 1907, tab. 3, fig. 1.

Pteraster reductus Koehler.

Pl. 5, figs. 6, 7.

Pteraster reductus Koehler, Bull. Inst. Oceanogr. Monaco, no. 99, 1907, p. 23.

$^{8}/_{6}$, stat 53, 34° 59′ N. 33° 1′ W., 2615—2865 m., yellow hard clayey mud, temp. 3 Cel. Three specimens of which the best preserved measured:

Diameter	37	mm.
Arm-radius	20	„
Disc-radius	15	„
Disc-radius measured on the actinal side to the marginal suture	12	„
Height	12	„
Greatest breadth of arm	17	„
Greatest breadth of arm measured on the actinal side between marginal sutures	14	„
Greatest breadth of the actino lateral area	5	„
Number of actino-lateral beams	15	„
r : R	1 : 1.33	„

In the two other specimens which are somewhat defective the arm-radius measured 22 mm. and 27 mm., respectively, disc-radius 13 mm. and 18 mm., greatest width of arms 16 mm. and 20 mm., r : R = 1 : 1.69 and 1 : 1.5.

Arms broad at base, tapering rapidly. Abactinal surface considerably arched, the actinal plane. Supradorsal membrane thin and fibrous. Paxillæ numerous, compact and furnished with cluster of some 20 long thin calcareous spinelets. Of the actino-lateral beams the third is longest. In the 37 mm. specimen it is 7 mm. long.

The tube-feet are large and present a paired arrangement in two rows. The innermost adambulacral plate has 6 papillæ, the remainder 5. These papillæ are united by a membrane and arranged in slightly curved, transverse rows, similarly as in *Pteraster personatus* Sladen[2]). The innermost papilla is 1—1.5 mm. in length, the outermost 3—4 mm. The mouth plates are well-developed

[1]) Mem. Mus. Comp. Zool. vol. 32, 1905, p. 185, tab. 15, figs. 75 & 76, tab. 29, figs. 171—173, tab. 30, figs. 174—177.

[2]) Proceed. R. Irish Acad., ser. 3, vol. 1, 1890, p. 694, tab. 27, figs. 1—5.

and provided with a high and broad ridge along the medianline, where they are united. Six long, thin papillæ united by a membrane are arranged in a row along the horizontal edge of the mouth plates. Secondary papillæ on the actinal surface of the plates are wanting.

The colour in life of the best preserved specimen was a deep purple red, on the abactinal surface of which a slight tinge still remained. The actinal surface and the tube-feet were pale red. The other specimen had completely lost its colour. The third specimen, preserved in formol, was ash-grey on the abactinal surface and light reddish gray on the actinal surface, the tube-feet reddish grey.

Numerous light reddish grey eggs with a diameter of 0.6 mm. were found in the interradial spaces.

I have referred the specimens to *Pteraster reductus* Koehler as they agreed with that species in most characteristics e. g. in the number of mouth- and adambulcral-papillæ, as well as in number of actino-lateral beams. But they differ from the typical *P. reductus* in that their third actino-lateral beam was longest while in Koehlers species the 4th was longest. Moreover the typical *P. reductus* has longer arms, its arm-radius according to Koehler being twice the length of disc-radius. Judging from *Pteraster militaris* no great importance is to be attached to this difference, however. Koehlers coloured illustrations of *P. reductus*[1]) likewise differ from the colour of the best preserved one of the specimens in question. But this difference of colour is of no more importance than the relative length of arms.

Pteraster reductus was found 1888 by the Prince of Monaco off the Azores and was likewise taken there by him in 1896 and 97. By the find of the "Michael Sars" its horizontal distribution will be from 34° 59′ to 41° 40′ 41″ N. and from 26° 26′ 15″ to 33° 1′ W. The bathymetrical distribution is from 1846 to 2870 m.

Hymenaster pellucidus Wyville Thomson.

Hymenaster pellucidus Wyville Thomson, The Depths of the Sea, 1873, p. 220.

$^{9}/_{8}$—$^{10}/_{8}$, stat. 102, 60° 57′ N. 4° 38′ W., 1098 m., dark sand and clay, temp. ÷ 0.9° Cel. A somewhat damaged specimen, measuring: arm-radius 29 mm., disc-radius 17 mm., r : R = 1 : 1.7.

The specimen had two adambulacral papillæ and two pair of secondary mouth-papillæ. Number of primary mouth papillæ four. Kalischewskij[2]) has etablished a variety *arctica* of this species with three pairs of secondary mouth papillæ, but his illustration shows only two pairs, which is what the typical form has. I agree wiht Koehler[1]) that these two forms can not be separated. An examination of the specimen collected by the "Voeringen" and the "Michael Sars" shows that the mouth-plates have 1—3 secondary papillæ[2]).

Hymenaster pellucidus is indigenous to the Norwegian Sea and adjacent waters where it ranges from the Faroe—Shetland Channel (60° 21′ N., to 81° 1′ N. and from the east coast of Greenland, (Forsbladfjord, about 26° W.) to 114° 31′ E. Perrier besides records it from the Azores[3]). I am inclined to think, however, that he confused it with another species. The bathymetrical distribution is 27 to 2814 m. Most of the localities of this species belong of the cold area, but it seems to invade the warm area to some extent, as the temperatures records vary between ÷ 1.7° ("Jermak") and 3.36° ("Michael Sars" 1902, stat. 86)[4]). The warm water stations, however, lie close to the limit of the cold area, and the hydrographical conditions may probably therefore vary there.

Hymenaster rex Ed. Perrier.

Hymenaster rex Ed. Perrier, Ann. Sci. Nat., ser. 6, Zool., vol. 19, 1885, no. 8, p. 69.

$^{7}/_{5}$, stat. 25 A, 35° 36′ N. 8° 25′ W., 2300 yellow mud. Two specimens, measuring:

Arm-radius	32 mm.	43 mm.
Disc-radius	25 „	37 „
r : R	1 : 1.23	1 : 1.16

The adambulacral plates have three papillæ of which the adoral one is largest. The mouth-plates bear two pairs of secondary papillæ and three papillæ along their free border and one of the mouth-plates of the largest specimen had even 4 primary papillæ. Some 20 actino-lateral spines were counted. The valves around the osculum have 10—12 spines. The colour of the specimens in alcohol is grayish-red on abactinal surface, slightly darker on the interradial than on the radial surface. The actinal surface is dark violet, the tube-feet bluish white.

[1]) Koehler: Echinodermes, Res. Camp. Sci. Monaco, Fasc 34, 1909, tab. 3, fig. 8 & 9.

[2]) Kalischewskij: Zur Kenntnis d. Echinodermfauna d. sibir. Eismeeres, Mem. Acad. Imp. Sci. St. Petersbourg, ser. 8. vol. 18, nr. 4, 1907, p. 36, tab. 1, fig. 9.

[1]) Koehler: Echinoderms, Res. Camp. Sci. Monaco, Fasc. 34, 1919 p. 93.

[2]) Grieg: Invértebrés du Fond, Duc d'Orleans: Croisière Oceanografique, 1909, p. 54.

[3]) Ed. Perrier: Stellerides, Res. Camp. Sci. Monaco, Fasc. 11, 1896, p. 40.

[4]) The recorded temperatures are: "Porcupine" ÷ 1.3°, "Voeringen" ÷ 1.3—1.1°, "Michael Sars" 1900 ÷ 1—0.11°, 1902 ÷ 0.32° —3.36°, "Thor" ÷ 0.58°, "Belgica" 0.4°, the Russian Spitzbergen Expeditions ÷ 1.1—0.3°, "Jermak" ÷ 1.7—3.1°, "Varna" ÷ 1.4—1.2° The temperatures varied between ÷ 0.8 and ÷ 1.5° at the depths in the Kara Sea, 84—116 m., where the "Dijmphna" found this species.

The "Michael Sars" specimens agree most closely with *Hymenaster rex* Perrier among the North Atlantic species of *Hymenaster*, but differ from that species by the presence of three primary papillæ in the mouth-plates, while typical *Hymenaster rex* has four, which was, however, found also in one mouth-plate of the largest specimen. Judging from Perriers drawing, the secondary mouth-papillæ are situted very close to the suture of the plates[1]); in the specimens under discussion they are placed nearer the centre of the plates. The valves around the osculum bear 10—12 spines, while *Hymenaster rex* has 14. Judging from *H. pellucidus* of which numerous specimens were at my disposal, these characteristics seem to be subject to variations. Notwithstanding the divergencies from typical *Hymenaster rex*, I refer the specimens to that species.

Hymenaster rex is an east Atlantic species, previously found only by the "Talisman" at three stations off the west coast of Africa between 23° 50′ and 46° 4′ N. and between 6° 46′ and 19° 37′ W., 1139—2285 m. The "Michael Sars" station also lies within these limits.

Echinaster sepositus Gray.

Rhopia sepositus Gray, Ann. Mag. Nat. Hist., vol. 6, 1840, p. 282.

26/5, stat. 37, 26° 6′ N. 14° 33′ W., 39 m., shingle, temp. 15.6° Cel. One specimen, arm-radius 77 mm., disc-radius 12 mm.

Echinaster sepositus is an east Atlantic species, ranging north to Bretagne (Roscoff) south to the Cape Verde Is. It occurs besides in the Adriatic and the western part of the Mediterranean. Bathymetrical distribution 1—1060 m.

Cribrella abyssalis Ed. Perrier.

Cribrella abyssalis Ed. Perrier, Echinodermes, Exp. Sci. du "Travailleur" et du "Talisman", 1894, p. 144, tab. 11, fig. 1.

23/5, stat. 41, 28° 8′ N. 13° 35′ W., 1365 m., yellow mud, temp. 6° Cel. One larger, not very well preserved, specimen.

Cribrella abyssalis was first taken by the "Talisman" off the west coast of Morocco, 1105—1635 m. It was later found in adjacent waters by the Prince of Monaco, 1470—2165 m. According to the discovery of the "Michael Sars" its horizontal range is between 28° 8′ and 38° 47′ N. and between 7° 55′ 45″ and 28° 4′ 5″ W. The bathymetrical distribution is 1105—2165 m.

Brisingella coronata G. O. Sars.

Brisinga coronata G. O. Sars, Christiania Vidensk. Selsk. Forhandl., 1871, p. 5.

5/5, stat. 21, 35° 31′ N. 6° 35′ W., 535 m., yellow mud, temp. 11.52 m. A defect specimen with 10 arms, whose disc-diameter was 18.5 mm., length of arm 177 mm.

6/8—7/8, stat. 101, 57° 31′ N. 11° 48′ W., 1843 m., hard clay, temp. 3.3° Cel. A fragment of an arm.

[1]) Ed. Perrier: Echinodermes, Exp. Sci. du "Travailleur" et du "Talisman", 1884, p. 186, tab. 13, fig. 2.

As regards the nomenclature of this species I have followed Fisher in "New Genera and Species of Brisingidæ"[1]).

Brisingella coronata is an east Atlantic species which was first recorded by G. O. Sars from Skraaven, Lofoten, 376—564 m. It was later found in the Foldenfjord, 530 m., the Tronhjemsfjord, 376—564 m. and the Sognefjord, 130 1229 m., bottom temperature 6.3 to 6.7°. The temperature was hardly below 8°, however, at the smallest depths in the Sognefjord. It was further found by the Prince of Monaco off Vegø (1899, stat. 1052, 65° 41′ N. 9° 30′ 15″ E., 440 m.)

In the Atlantic *Brisingella coronata* ranges from the Hebrides to the Cape Verde Is., 366—2330 m. According to Sladen the bottom temperature was 6.4 to 11° at the localities, where the "Porcupine" obtained the species. Records of temperature are wanting from the other stations. In the Mediterranean it was found in the western as well as in the eastern part, where it ranges as far as Samos and Samothrace. It occurs besides in the southern part of the Adriatic. The bathymetrical distribution in the Mediterranean is 100 to 2660 m. The "Pola" found a bottom temperature of 12.9 to 14.4° in the eastern part of the Mediterranean, but records are wanting from the two least depths (129 m. and 218 m.), at which it was taken by that vessel.

Brisingella coronata appears therefore to be a typical warm-water species. Its range is restricted to localities with a bottom-temperature of not less than 3.3°, its principal distribution, however, apparently occurring in waters with a bottom-temperature of not less than 6.3°

Freyella sexradiata Ed. Perrier.

Freyella sexradiata Ed. Perrier, Comptes Rendus de l'Acad. des Sci., Tome 101, 1885, p. 442.

19/4, stat. 10, 45° 26′ N. 9° 20′ W., 4700 m., yellow mud, temp. 2.56° Cel. Four defect specimens as well as fragments of several arms.

Disc-diameter.....	9 mm.	10 mm.	11 mm.	11 mm.
Breath of arms at base.....	4 „	3.5 „	3.5 „	4 „
Greatest breadth of ovarial enlargement.....	7.5 „	5 „	5.5 „	6.5 „

The smallest specimen has only five arms, the others six. Koehler also found that this species may have 5 arms[2]).

This species like *Freyella spinosa* has two gonads in each arm and they are similarly arranged in both species. *Freyella sexradiata* thus belongs to the genus *Freyellidea*, so named by Fisher in his revision of the

[1]) Ann. Mag. Nat. Hist., ser. 8 vol. 20, 1917, p. 423 & 427.

[2]) Koehler: Echinodermes, Res. Camp, Sci. Monaco, Fasc. 34, 1909, p. 129.

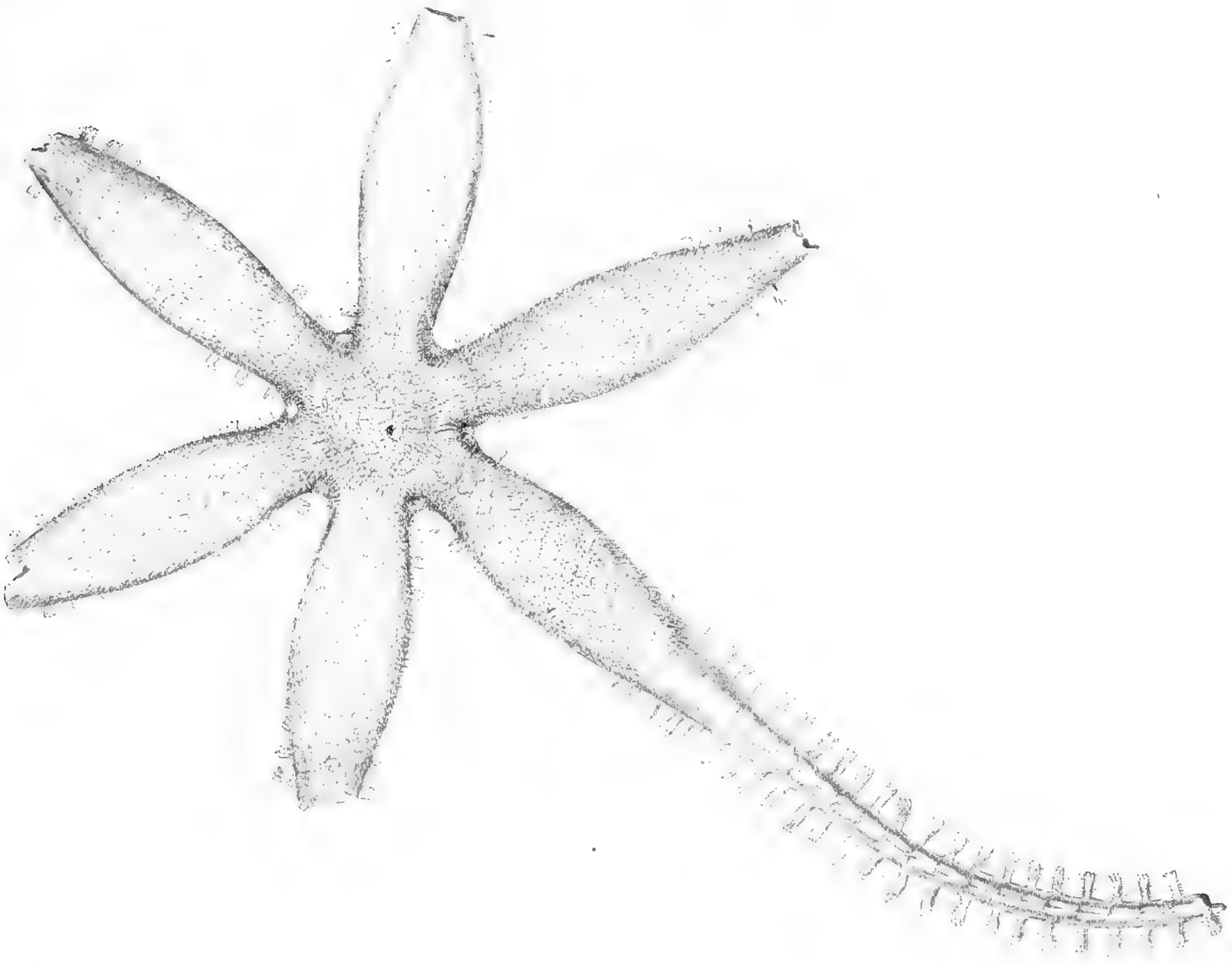


Fig. 10. *Freyella sexradiata* Ed. Perrier from stat. 10. Abactinal view, magnified 3 times.

family of *Brisingidæ*[1]), a name which he changed to *Freyella* in "Notes of Asteroidea II"[2]).

Freyella sexradiata was first found in 1883 by the "Talisman" north of the Azores (stat. 134, 42° 19′ N. 53° 36′ W., 4060 m.) It was later taken by the Prince of Monaco at two stations between the Azores and Portugal, 4020 m. and 4360 m. The "Michael Sars" obtained it in the Bay of Biscay. *Freyella sexradiata* is therefore an East Atlantic species known up to present time only between 38° 8′ and 45° 26′ N. and between 9° 20′ and 23° 36′ W. Bathymetrical distribution is 4020 to 4700 m.

Beside it, the following species of the genus *Freyella* occur on the eastern side of the North Atlantic:

F. edwardsi from the Bay of Biscay and west coast of Africa, 1786 m.

F, spinosa from west coast of Africa and the Azores, 4060—4310 m.

F. recta from the Azores, 3465 m.

F. tuberculata, between Canary Is. and Cape Verde, 4310 m.

From the western side of the North Atlantic are known:

F. americana from Nova Scotia, 320 m.

F. elegans between Nova Scotia and Cape Hatteras, 1115—3700 m.

A *Freyella* was besides taken south of Iceland ("Thor" 1903, stat. 164, 62° 10.8′ N. 19° 36′ W., 2093 m.), which according to Mortensen[1]), is closely relative to the last-named species.

[1]) Op. cit., ser. 8, vol. 20, 1917, p. 425 & 429.

[2]) Op. cit., ser. 9, vol. 2, 1918, p. 103.

[1]) Schmidt: Fiskeriundersøgelser ved Island og Færøerne i sommeren 1903 (1904) p. 24.

OPHIUROIDEA

Pectinura elata Koehler.

Pectinura elata Koehler, Ophiures. Exp. Sci. du "Travailleur" et du "Talisman", 1906, p. 249, tab. 18, figs. 1—3.

8/5 stat. 25 B, 35° 46′ N 8° 16′ W, 2055 m., yellow mud, 8 specimens.

8/6 stat. 53, 34° 59′ N. 33° 1′ W, 2615—2865 m., yellow hard clayish mud, temp 3° Cel. Two specimens.

The smallest specimen has a disc-diameter of 14 mm. the largest of 25.5 mm. Koehler states that this species har three arm-spines. I found 3 to 4 spines in all of the specimens under consideration, but the extreme arm-joints possessed only 2. One of the specimens from stat. 53 differed besides from the typical *Pectinura elata* by having the ventral surface of the disc covered with granules, in this respect agreeing more nearly with *Pectinura heros* Lyman. However, as it agreed with Koehler's species in other characteristics, such as the forms of the mouth-shields and the size of the arm spines, I have referred it to that species. The remaining specimen were typical *Pectinura elata*, apart from the somewhat divergent number of arm-spines.

Pectinura elata was previously taken only by the „Talisman" in 1883 at a station off the west coast of Africa, (25° 2′ — 25° 6′ N 19° 11′ — 19° 13′ W, 2325—2518 m.) Its horizontal distribution should thus at present be from 25° 2′ to 35° 46′ N and from 8° 16′ to 33° 1′ W. The bathymetrial distribution is from 2055 to 2865 m.

Ophiopleura borealis Danielssen & Koren.

Ophiopleura borealis Danielssen & Koren, Nyt Mag. f. Naturvidensk. vol 23, 1877, p. 77, tab. 5, figs. 1—4.

9/8—10/8 stat. 102, 60° 57′ N 4° 38′ W, 1098 m. Dark sand and clay, temp. ÷ 0.9 Cel. Three specimens with a disc-diameter of 31—40 m.

Ophiopleura borealis has not before been recorded from the Faroe—Shetland Channel. The southern limit of its distribution in the Norwegian Sea was formerly 62° 43′ N. It is a true Arctic species, known from Discovery Bay, the east coast of Greenland, the Norwegian Sea, Spitzbergen, Barents Sea, Franz Joseph Land, the Kara Sea and the Siberian Polar Sea as far as 124° 41′ E. The bathymetrial distribution is 9—1411 m. It lives preferably in the cold area, but was, however, also met within the adjacent warm area (bottom temperature 1.1 to ÷ 1.39°).

Ophiura convexa Lyman.

Ophiolypha convexa Lyman, Bull. Mus. Comp. Zool., vol 5 no. 7, 1878, p. 84 tab 3 figs. 84 & 85.

19/4 stat. 10, 45° 26′ N 9° 20′ W, 4700 m., yellow mud, temp 2.56 Cel. Four specimens. Diameter of disc 12—15 mm., length of arm 17—27 mm.

Ophiura convexa was taken by the "Challenger" in the South Atlantic off the west coast of Africa, 4300 m., as well as in the Pacific, 3751—4209 m. It was later obtained by the Prince of Monaco between the west coast of Africa and the Azores (29° 5′ — 39° 54′ N, 16° 58′ — 22° 22′ 45″W, 3825—4360 m.) and by the "Albatross" off New England, 2942—4710 m. Lyman besides doubtfully records its being found by the "Blake" off the Antilles, 209—494 m.[1])

Of the last-named form, which Koehler later described under the name *Ophioglypha coronata*[2]). I have had a specimen for examination from St. Lucia, and after comparing it with the "Michael Sars" specimens from the great ocean depths, I agree with him in considering this shallow-water form from the Antilles as distinct from *Ophiura convexa*.

Ophiura concreta Koehler.

Ophioglypha concreta Koehler, Bull. Soc. Zool. de France, vol. 26., 1901, p. 228.

18/7 stat. 88, 45° 26′ N 25° 45′ W, 3120 m., sand and yellow mud, temp. 2.5° Cel. Three specimens. Diameter of disc 21—26.5 mm. breadth of arms at border of disc 3—4 mm. In all of the specimens the arms were torn off.

Ophiura concreta was hitherto known only from two specimens, the one found in 1901 by the Prince of Monaco off the Cape Verde Is., 2478 m., the other in 1883 by the "Talisman" off the Azores, 2995 m.

Ophiura irrorata Lyman.

Ophioglypha irrorata Lyman, Bull. Mus. Comp. Zool., vol. 5 nr. 7, 1878, p. 73, tab. 4, figs. 106—108

18/7. Stat. 88, 45° 26′ N., 25° 45′ W., 3120 m., sand and yellow mud, temp. 2.5° Cel. Four specimens. Diameter of disc 15—18.5 mm., breadth of arms at border of disc 2.2—3 mm. The length of arm in the smallest specimen was 53 mm., without the point, which was wanting. One of the other arms was absent and in all of the specimens they were very defective.

Ophiura irrorata, like *Ophiomusium lymani*, is a world-wide species. It is known in the Atlantic from New England, the West Indies, the Bay of Biscay, Portugal, the Azores and the Canary Is. It was further found off the Cape of Good Hope, the Bay of Bengal, New South Wales, Japan, Bering Sea, the Gulf of California, the Gulf of Panama and the Galapagos Is. The bathymetrical distribution is 604—4315 m. (cfr. Clark[3]) and Koehler[4]), who also dealt with the complicated nomenclature of this species.

[1]) Bull. Mus. Comp. Zool. vol 10 no. 6, 1883, p. 243 tab. 4, figs. 40—45.

[2]) Bull. U. S. Nat. Museum no. 84, 1914, p. 12, fab. 2, figs. 3 & 4.

[3]) Bull. U. S. Nat. Museum, no. 75, 1911, p. 62.

[4]) Bull. U. S. Nat. Museum, no. 84, 1914, p. 18, tab. 1 figs. 3 & 4.

Ophiura tessellata Verrill.

Ophioglypha tessellata, Verrill, Proceed. U. S. Nat. Museum, vol. 17, 1894, p. 290.

$^{8}/_{6}$. Stat. 53, 34° 59′ N., 33° 1′ W., 2615—2865 m., yellow hard clayish mud, temp. 3° Cel. Two specimens. Diameter of disc 18 mm.

$^{18}/_{7}$. Stat. 88. 45° 26′ N., 25° 45′ W., 3120 m., sand and yellow mud, temp. 2.5 Cel. 15 specimens. Diameter of disc 9—24 mm.

This species was first described from the east coast of North America, where it was taken at a depth of 458—3720 m., most abundantly between 730 and 1820 m. It was later obtained by the Prince of Monaco in the Bay of Biscay, off Portugal, the Azores and the Cape Verde Is., 1267—2870 m. *Ophiura tessellata* is thus a North Atlantic species, ranging between about 39° and 41° 39′ N. on the western side and between 14° 47′ and 46° 52′ N. on the eastern side. The bathymetrical distribution is 458—3720 m.

Ophiura affinis Lütken.

Ophiura affinis Lütken, Kgl. danske Vidensk. Selsk. Skrifter, Nat. math. Afd., R 5, B 5, 1859, p. 45, tab. 2, fig. 10.

$^{9}/_{4}$. Stat. 1, 49° 27′ N., 8° 36′ W., 146 m., fine sand, temp. 9.57° Cel. One specimen.

$^{20}/_{5}$. Stat. 38, 26° 3′ N., 14° 36′ W., 77 m., red sand and shingle. Three specimens.

$^{27}/_{7}$. Stat. 96, 50° 57′ N., 10° 46′ W., 184 m., temp. 11° Cel. 6 specimen.

Ophiura affinis is a North Atlantic species, occurring off the coasts of North America, as well as of Europe, where it ranges as far north as the Trondhjemsfjord and south to the Mediterranean and Cape Bojador.

Ophiocten sericeum Forbes.

Ophiura sericea Forbes, Sutherlands Journ. Voy. Baffins Bay, vol. 2, 1852, App. p. 215.

$^{30}/_{6}$. Stat. 70, 42° 59′ N., 51° 15′ W., 1100 m., temp. 3.7° Cel. Numerous smaller specimens. Diameter of disc 2—5 mm.

Ophiocten sericeum is a boreo-arctic species which has its main distribution and attains its greatest development within the Arctic regions, but which is also widely distributed within the boreal area. It was occasionally met with in the Atlantic region proper, to which stat. 70 must belong, although there were found such boreal or boreo-arctic animals as *Terebratulina septentrionalis*, *Pilidium radiatum*, *Buccinum undatum*, *Scaphander puncto-striatus* etc. In the last-named region it was thus taken by the "Thor" in 1903 in deep water south of Iceland (stat. 164, 62° 10.8′ N., 19° 36′ W., 2128 m., and stat. 166, 62° 57′ N., 19° 58′ W., 947 m.)[1])

[1]). Schmidt: Fiskeriundersøgelser ved Island og Færøerne Sommeren 1903, p. 22 & 23.

Ophiocten latens Koehler.

Ophiocten latens Koehler, Ophiures, Exp. Sci. du "Travailleur" et du "Talisman", 1906, p. 267, tab. 18, figs. 11 & 12,

$^{19}/_{4}$. Stat. 10, 45° 26′ N., 9° 20′ W., 4700 m., yellow mud, temp. 2.56° Cel. Two specimens.

Of one of them the under surface of the disc only was existant, of the other the entire disc and a portion of one arm. This last-named specimen, whose diameter of disc was 9 mm and which consequently equalled in size the specimens from the "Talisman", agrees perfectly with the description, that Koehler gives of them. In the other, somewhat smaller specimen the form of the mouth-shields, the lateral mouth-plates and the innermost ventral arm-plates are similar to the "Talisman" specimens and I therefore also refer this specimen to Koehler's species.

Ophiocten latens was previously found only by the "Talisman" between the Azores and Portugal (42° 19′ N. 23° 26′ W., 4060 m.)

Ophiochiton ternispinus Lyman.

Ophiochiton ternispinus Lyman, Mem. Mus. Comp. Zool., vol. 10, no. 6, 1883, p. 255, tab. 5, figs. 67—69.

$^{6}/_{8}$—$^{7}/_{8}$, stat. 101, 57° 41′ N. 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. One specimen.

Diameter of disc 23 mm. The arms, which were torn off, were 4 mm. broad at the border of the disc. The largest arm-spines measured 3.5 mm. Five to six mouth-papillæ. The specimen is almost twice as large as the type-specimen, which had a disc-diameter of 12 mm. It differs from the latter by proportionately broader mouth-shields (length 2.7 mm., breadth 2.2 mm.) but agrees with it in other respects. The colour of the specimen preserved in alcohol was brownish gray.

One specimen of *Ophiochiton ternispinus* was found in 1869 by the "Porcupine" SW. of Ireland (stat. 42, 49° 12′ N. 12° 52′ W., 1577 m., 4.3° Cel.) It was later taken by Wandel off the west coast of Greenland (66° 49′ N. 56° 28′ W., 442 m.) The species is therefore most probably distributed at the great depths throughout the northern part of the North Atlantic.

Ophiomusium lymani Wywille Thomson.

(Pl. 5, figs. 8—10).

Ophiomusium lymani Wywille Thomson, The Depths of the Sea, 1873, p. 173, figs. 32 & 33.

$^{6}/_{5}$ stat. 24, 35° 34′ N. 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. One specimen.

$^{7}/_{5}$ stat. 25 A., 35° 36′ N. 8° 25′ W., 2300 m., yellow mud. 20 specimens.

$^{8}/_{5}$ Stat. 25 B, 35° 46′ N. 8° 16′ W., 2055 m., yellow mud. Common.

$^{18}/_{5}$ stat. 35, 27° 27′ N. 14° 52′ W., 2603 m., yellow mud. Arm fragments.

$^{3}/_{5}$ stat. 53, 34° 59′ N. 33° 1′ W., 2615—2865 m., yellow hard clayey mud., temp. 3° Cel. One specimen.

$^{30}/_{6}$ stat. 70, 42° 59′ N. 51° 15′ W., 1100 m., temp. 3.7 Cel. Common.

$^{27}/_{7}$ stat. 95, 50° 22′ N. 11° 44′ W., 1797 m., temp. 3.5° Cel. Common.

$^{6}/_{8}$—$^{7}/_{8}$ stat. 101, 57° 41′ N. 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. Very common.

Disc-diameter of the smallest specimens 2 mm., of the largest 33 mm. In the smallest specimens with a disc-diameter of 2 to 3 mm. (pl. 5, fig. 8) the dorsal side of the disc consists of the central plate, the five primary plates, the radial shields and two small plates placed interradially between the latter. By a disc-diameter of 4 mm. (pl. 5, fig. 9) a secondary plate between the primary plates and the radial shields is added to the disc, which thus possesses 31 plates. By a disc-diameter of 5 mm. (pl. 5, fig 10) this number is further increased by 5 secondary plates situated interradially between the primary plates, and the number goes on increasing rapidly with continued growth of the disc. The central plates with secondary plates becomes separated from the primary plates, and these from the radial shields, and so on.

Mortensen has shown in "Smaa faunistiske og biologiske Meddelelser"[1]) that ophiurids of various ages are found simultaneously in shallow water at the same locality within the boreal region, and that recently transformed young were collected at the same time with one-year old, fully developed two-year old and older individuals. In Arctic waters on the other hand only a single year-class as a rule is found of the ophiurids occurring at locality. A few year-classes may, however, as an exception occur simultaneously, cfr. Mortensen: Echinoderms from East Greenland[2]) and Grieg: „Michael Sars Ophiuroidea" [3]).

Among the ophiurids collected by the "Michael Sars" in 1910 in the North Atlantic *Ophiomusium lymani* only was represented by a greater number of specimens. In the following synoptic table the measurements of their disc-diameter will be given. As will be seen from this table the great mass of the individuals at a locality seem to belong to the same year-class. Two or three year-classes may, however, occur at the same locality, possibly more. At stat. 25 A there was a maximum of 11 individuals with disc-diameter 15—17 mm., which no doubt represented a year-class. Possibly one or two more year-classes may be found at this station, but the material was too scanty to determine this definitely. At stat. 25 B there was a maximum of 25 individuals with a disc-diameter of 18—19 mm. The 7 individuals with a disc-diameter of 12—13 mm. may possibly represent still another year-class. Three year-classes at least occurred at stat. 70 where a group of 30 individuals afforded a maximum at 23—25 mm., a small one of six individuals at 17 mm. and a great one of 56 individuals at 4—7 mm. It is probable, however, that the 3—5 mm. examples represented one year-class, and that there was besides a fourth about 10 mm. At stat. 95 a group of 19 individuals afforded a maximum at 27—29 mm. Concerning the remaining 11 to 23 mm. sizes no definite statement can be made, as only single specimens of this group were to hand. They probably represent at least one year-class, however. At stat. 101 there was a very marked maximum at 26 to 29 mm. Besides, the smallest individuals must also represent one year-class. Thus two year-classes at least are found in that locality.

Disc-diameter in mm.	Stat. 25 a	Stat. 25 b	Stat. 70	Stat. 95	Stat. 101	Disc-diameter in mm.	Stat. 25 a	Stat. 25 b	Stat. 70	Stat. 95	Stat. 101
	Number of specimens						Number of specimens				
2	—	—	2	—	—	19	1	13	2	1	7
3	—	—	4	—	—	20	2	7	2	—	4
4	—	—	17	—	—	21	—	10	1	1	4
5	—	—	19	—	—	22	1	—	1	1	5
6	—	—	9	—	—	23	—	—	8	1	4
7	—	—	11	—	—	24	—	—	13	—	7
8	—	—	—	—	—	25	—	—	9	1	16
9	—	—	3	—	—	26	—	—	3	2	24
10	—	—	5	—	—	27	—	—	1	7	30
11	1	—	2	1	—	28	—	—	—	7	43
12	—	1	2	—	—	29	—	—	—	5	24
13	1	6	1	1	—	30	—	—	—	2	13
14	2	—	—	1	2	31	—	—	—	1	8
15	3	5	1	1	2	32	—	—	—	—	4
16	3	10	2	—	2	33	—	—	—	—	3
17	5	10	6	1	—						
18	1	12	2	—	1		20	81	126	34	203

As examples for comparison I may mention *Pectinura elata, Ophiura tessellata, Ophiocten sericeum* and *Ophiacantha abyssicola.* At stat. 25 B 8 specimens of *Pectinura elata* were taken. Seven of these had a disc-diameter of 21—25.5 mm., and one of 14 mm. The last-named individual can hardly belong to the same year-class as the rest. At stat. 88 15 specimens of *Ophiura tesselata,* (disc-diameter 9—24 mm.) were obtained, which are grouped as follows: There are three examples each of 24 mm., 21 mm. and 18 mm. Two specimens measured 20 mm. The sizes 19, 16, 15 and 9 mm. are represented by only

[1]) Vidensk. Meddelelser 1897, p. 321.

[2]) Meddel. om Grønland, vol. 29 1903, p. 82.

[3]) Bergens Museums Aarbog 1903 no. 13, p. 23.

one example each. The smallest of these specimens must belong to a different year-class from that of the largest, but whether representatives of a third year-class are found among them it is impossible to decide, as the material is very scanty. *Ophiocten sericeum*, which was so numerous at stat. 70 seems to have been represented there by a single year-class, and as all of the individuals measured 2 to 5 mm., they were probably one year old. 33 examples of *Ophiacantha abyssicola* were obtained at stat. 101 (disc-diameter 4—8 mm.) These specimens may be grouped as follows:

4 (1), 5 (4), 6 (6), 7 (4) and 8 (8)

(The figures in brackets represent the number of specimens; the others the size of the disc-diameter in millimetres.)

The specimens from stat. 101 are grouped about a disc-diameter of 7 mm. thus probably also represent a single year-class.

If we were to draw any conclusion from this somewhat scanty material, it must be, that what has been said in the foregoing about *Ophiomusium lymani* applies equally to all of the deep-sea ophiurids of the North Atlantic.

For the purpose of comparison I shall give in the following table a summary of the grouping of sizes in some of the North Atlantic deep-sea star-fishes, of which more abundant material is at my disposal. In determining sizes I have found it most convenient to use the radius of the disc for the star-fishes and not the disc-diameter as in ophiurids.

As the table shows there is a great abundance of specimens of *Plutonaster bifrons*, particularly from stat. 101. We find a group of 96 individuals from this locality with a disc-radius of 8 to 21 mm., and one specimen at 24 mm. The group affords two maxima; one consisting of 28 individuals at 10—11 mm. and the other of 17 at 17—18 mm. Both of these must represent a year-class. It is not possible to determine definitely whether the 24 mm. specimens belong to the older of these year-classes or whether it represents a third one, but judging by the material from stat. 41 I am most inclined to think that stat. 101 had 3 year-classes. At stat. 95 there is a large group of 16 individuals with a disc-radius of 14—20 mm. and one 8 mm. specimen, which must belong to a year-class different from the large group. If we compare these specimens with those from stat. 101, it is evident that the large group must be of the same age as the group from stat. 101 which is grouped about a disc-radius of 17—18 mm., while the 8 mm. example must belong to the youngest year-class. At stat. 41 there were three year-classes. The material comprised 14 specimens, one of which measured 10 mm., another 27 mm., the remainder 14—22 mm. The latter must belong to the same year-class as the large group at stat. 95, while the 10 mm. specimen must be of the same age as the 8 mm. example in that locality. The 27 mm. specimen must belong to a third and older year-class. The material from stat. 24 is very little differentiated. It is composed of two small groups, one of 9 individuals with a disc-radius of 13—18 mm, the other of 6 individuals with a disc-radius of 18—20 mm. If we compare these groups with the material from the other localities it seems probable, that there were two year-classes at stat. 24.

The examples of *Dytaster agassizi* from stat. 88 must all belong to the same year-class, as they have a disc-radius of 6—12 mm. The 9—10 mm. group affords a maximum of 18 individuals or 53 per cent of the total number. The specimens of *Benthopecten spinosus* from stat. 101 must probably likewise represent a year-class. The features of the material were insufficiently marked, however.

Disc-radius in mm.	Benthopecten spinosus	Plutonaster bifrons				Dytaster agassizi	Psilaster andromeda	Bathybiaster robustus
	Stat. 101	Stat. 24	Stat. 41	Stat. 95	Stat. 101	Stat. 88	Stat. 101	Stat. 101
	Number of specimens							
5	1				—	—	—	—
6	2	—			—	2	3	—
7	2				—	3	1	
8	3	—	—	1	1	4	3	
9	2	—	—	—	5	8	—	—
10	2	—	1		12	10	2	—
11	—	—	—	—	16	4	—	1
12				—	7	3	—	1
13	—	1	—	—	7	—	—	—
14		4	1	2	4		1	—
15		4	1	2	4		1	3
16		—	2	5	6	—	1	2
17	—	—	2	4	8	—	1	2
18		1	2	2	9	—	2	2
19		3	2	—	4	—	2	6
20		2	—	1	2	—	3	5
21		—	1	—	1	—	1	3
22		—	1			—	2	
23	—				—	—	—	
24	—		—		1	—	—	—
25					—	—	—	—
26		—	—		—	—	—	—
27	—	—	1	—	—	—	—	—
	12	15	14	17	97	34	23	25

At stat. 101 23 *Psilaster andromeda* were taken which were grouped about 6—10 mm. (9 specimens) and 14—22 mm. (14 specimens). The grouping was not very distinct, however. If we compare this material with some from the Norwegian coast in the Bergen Museum, it appears that the smallest specimens (disc-radius 6—8 mm.) must belong to a year-class, different from that of the largest specimens (disc-radius 20—22 mm.) It is further evident that some of the intermediary examples (disc-radius 10—19 mm.), must represent a third year-class with a maximum at 12—15 mm. The smallest individuals must be two years old and the largest about four, and I should be inclined to consider the before-mentioned year-classes of *Plutonaster bifrons* as being of the same age as these.

The specimens of *Bathybiaster robustus* taken at stat. 101 are grouped as follows: Two individuals with disc-radius of 11—12 mm., and besides a group of 23 individuals with disc-radius of 15—21 mm. This group affords a maximum of 11 individuals at 19—20 mm. The fact that maximum included the largest individuals (there were only three larger examples at 21 mm.)seems to indicate that the two small individuals (11—12 mm.) may belong to a year-class distinct from the rest.

From the foregoing examples we may thus infer that what has been said before about the deep-sea ophiurids of the North Atlantic applies equally to the star-fishes of that region. The latter may also be represented by several year-classes in a locality, whilst only one of them is numerously represented. In my treatise "Nogen asteriders alder og aarsklasser" [1]) and "Remarks on the Age of some Arctic and North-Atlantic Star-fishes" [2]) I have entered more at length upon the subject of the grouping of the asterids occurring in a locality.

Ophiomusium lymani is a world-wide species, known from the Atlantic, the Pacific and the Indian Oceans, 130—3435 m. In the Atlantic where it appears to be the most widely distributed deep-sea ophiurid, it ranges north to 61° 10.8′ on the eastern side and to 66° 49′ on the western side.

Ophiomusium planum Lyman.

Ophiomusium planum, Lyman, Bull. Mus. Comp. Zool., vol. 5, no. 9, 1878, p. 218, tab. 3, figs. 46—48.

$^{10}/_{4}$, stat. 10, 45° 26′ N. 9° 20′ W., 4700 m., yellow mud, temp. 2.56° Cel. Three specimens. Disc-diameter 16.5—22 mm.

$^{5}/_{6}$, stat. 53, 34° 59′ N. 33° 1′ W. 2615—2865 m., yellow hard clayish mud, temp. 3° Cel. Three specimens. Disc-diameter 15.5—22.5 mm.

This species has normally three arm-spines, but as already pointed out by Koehler [1]), it may have four, of which the uppermost is placed at some distance from the rest. Some of the specimens under discussion had, however, sometimes as many as five spines, of which the three ventral ones stood very close together, while the two others were separated by a space from them and from one another. The mouth-shields likewise seem to be subject to variations. In the smallest specimens their form resembles that of typical *Ophiomusium planum*, while those in the larger specimens are more similar to the mouth-shields in *Ophiomusium armigerum*. As, however, the specimens agree with *Ophiomusium planum* in other characters, I have referred them to that species.

In the Atlantic *Ophiomusium planum* is hitherto taken only in the northern part, but is found there on the western as well as on the eastern side. It is distributed on the west Atlantic side from 24° 3′ to 37° 56′ 20″ N., 262—4064 m. It was first taken by the "Blake" in the West-Indies, where it was also later found by the "Albatross". The same vessel took it also off the east coast of North America. On the east Atlantic side it ranges from 15° 48′ to 45° 26′ N., 2325—5005 m. It was collected by the "Talisman" of the Cape Verde Is., the Canarys and the Azores, where is it later also taken by the Prince of Monaco. Finally the "Investigator" has taken it in the Gulf of Bengal, 2782—3563 m.

Ophiactis abyssicola M. Sars.

Amphiura abyssicola M. Sars, Oversigt af Norges Echinodermer, 1861, p. 18, tab. 2, figs. 7—12.

$^{23}/_{5}$ stat. 24, 28° 8′ N. 13° 35′ W., 1365 m. yellow mud, temp. 8° Cel. Two specimens.

$^{6}/_{8}$—$^{7}/_{8}$ stat. 101, 57° 41′ N. 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. 9 specimens.

The largest specimen measured: disc-diameter 8 mm., length of arm 40 mm. It is thus somewhat larger than Sars' type specimen.

This species is distributed along the west-coast of Norway as far as Senjen, but the northern limit of its range is 71° 25′ ("Voeringen" stat. 200). It was besides found east of Shetland Is., in the Faroe—Shetland Channel, off the west coast of Ireland, on the banks between the Faroe Is. and Iceland and in the Denmark Straits. It is further recorded by Mortensen from the west-coast of Greenland, whereas I have not seen it recorded from the east-coast of North America. The Prince of Monaco took it off the Azores. It ranges therefore from 28° 8′ to 71° 25′ N. on the east Atlantic

[1]) Bergens Museums Aarbok 1916—17, Naturvidensk. Række no. 1.
[2]) Ann. Mag. Nat. Hist., ser. 9. vol. 3, 1919, p. 400.

[1]) Koehler: Ophiures, Exp. Sci. du "Travailleur" et du "Talisman", 1906, p. 265.

side. The bathymetrical distribution is 118—1853 m. As already pointed out in "Michael Sars Ophiuroidea" (p. 30) *Ophiactis abyssicola* is a true warm water species. It may, however, occasionally occur in the cold area, and was obtained there by the "Porcupine" (2 stations), the "Voeringen" (4), the "Knight Errant" and the "Triton" (one station each) and the "Michael Sars" in 1902 (2 stations).

Amphiura chiajei Forbes.

Amphiura chiajei Forbes, Transact. Linn. Soc., vol. 19, 1843, p. 151, tab. 14, figs. 14—18.

5/5 stat. 21, 35° 31′ N. 6° 35′ W., 535 m., yellow sand, temp. 11.52° Cel. Several specimens.

This is an east Atlantic species, ranging northward to the Trondhjemsfjord, south to the Mediterranean, the west coast of the North Africa and the Azores. Its bathymetrical range 10—1015 m., with main distribution at depths less than 200 m.

Amphiura duplicata Lyman.

Amphiura duplicata Lyman, Ill. Cat. Mus. Comp. Zool., no. 8, part 2, 1875, p. 19, tab. 5, fig. 78.

5/5 stat. 21, 35° 31′ N. 6° 35′ W., 535 m., yellow sand, temp. 11.52° Cel. Four rather defective specimens. Judging from the figures, which Lyman gives of this species, the specimens under discussion agree as regards the form of radial shields, mouth-shields and arm-plates more closely with those in the report on the "Challenger Ophiuoroidea" (pl. 17., figs. 10—12).

Amphiura duplicata was first taken by the Hassler expedition off Barbados, 183 m. It was later obtained by the "Blake" at numerous stations in the West Indies, 134—2869 m. The Challenger found it off the Bermudas, 1967 m., the "Caudan" in the Bay of Biscay, 1710 m., and the Prince of Monaco off Azores, 1350—1800 m.

Ophiolebes claviger Ljungman.

Ophiactis claviger Ljungman, Öfvs. Kgl. Vetensk. Akad. Förhandl. vol. 21, 1864, p. 365, tab. 15, fig. 4.

30/6 stat. 70, 42° 59′ N. 51°15′ W., 1100 m., temp. 3.7 Cel. One specimen clinging to *Acanella arbuscula Johnst.s. normani Verr.* Disc-diameter 5 mm.

Ophiolebes claviger occurs sparingly along the west coast of Norway to Grøtø, where Danielssen obtained one specimen. Mortensen records it from the Skagerack and the west coast of Greenland, and Farran from the west coast of Ireland. I have been able to examine a specimen from the east coast of North America ("Blake" stat. 306, 41° 32′ 50″ N. 65° 55′ W, 959 m.) which the Bergen Museum received from Agassiz. To this species belongs undoubtedly the ophiurid from Nova Scotia, 167—223 m., which Verrill describes in "Res. Expl. made by the steamer Albatross 1883" (p. 548) under the name *Ophiolebes acanellæ*. If we compare this description with typical specimens of *Ophiolebes claviger* from the Norwegian coast, we shall find in this the same characteristics as in *Ophiolebes acanella*. It should be noted, however, that Verrill does not give any illustration of his species and that the description is very brief. It is therefore difficult to identify the species definitely.

Ophiolebes claviger should therefore range from 41° 32′ 50″ to 64° 53′ N. on the west side of the Atlantic and from 50° 42′ to 67° 50′ W. on the east side. Its bathymetrical distribution is 167—1232 m.

Ophiacantha abyssicola G. O. Sars.

Ophiacantha abyssicola, G. O. Sars, Christiania Vidensk. Selsk. Forhandl. 1871, p. 8.

5/6, stat. 24, 35° 34′ N. 7° 35′ W., 1615 m., yellow mud, temp. 8° Cel. 7 specimens.

7/5, stat. 25 A, 35° 36′ N. 8° 25′ W., 2300 m., yellow mud. One specimen.

8/5, stat. 25 B, 35° 46′ N. 8° 16′ W., 2055 m., yellow mud. Three specimens.

30/6, stat. 70, 42° 59′ N. 51° 15′ W., 1100 m. temp, 3.7° Cel. One specimen.

6/8—7/8, stat. 101, 57° 41′ N. 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. Rather common.

Koehler records this species as occurring throughout the Arctic waters of Europe and Asia[1]). But this statement must be based on a confusion with *Ophiacantha bidentata*, for *Ophiacantha abyssicola* is not known north of the Lofoten on the Norwegian coast. It was, however, taken by the "Voeringen" in two localities between Norway and Beeren Eiland (stat. 286, 72° 57′ N. 21° 51′ E., 408 m.) It is absent from the coasts of Finmarken and Murman and thence eastward. But it occurs along the west coast of Europe as far south as the Azores. It is further found off the east and west coasts of Greenland as well as of the east coast of North America, from which Verrill has described it under the name *Ophiacantha millespina*. *Ophiacantha abyssicola* is thus a North Atlantic species, ranging from 35° 34′ to 72° 54′ N. on the European side, and from the Bahamas (about 25°) to 63° 17′ N. (64° 42′ N.) on the American side. The bathymetrical distribution is 35—3508 m. It is a true warm-water species, which was, however, taken three times ("Voeringen", stat. 286, "Porcupine" 1869, stat. 54 and stat. 65) in the cold area. These cold water localities are situated very close to the warm area, however.

[1]) Koehler: Echinodermes, Res. Camp. Sci. Monaco, Fasc. 34, 1909, p. 182.

Ophiacantha aristata Koehler.

Ophiacantha aristata Koehler, Res. Sci. Camp. "Caudan" dans le Golfe de Gascogne, Fasc. 1, 1896, p. 84, tab. 4, figs. 43 & 44.

$^{23}/_{5}$, stat. 41, 28° 8′ N. 13° 35′ W., 1365 m., yellow mud, temp. 6° Cel. One specimen. Disc-diameter 4.5 mm. Colour pink.

The type specimen was obtained by the "Caudan" in the Bay of Biscay, 1700 m. It was besides found by the "Talisman" between 22° 57′ and 45° 59′ N. and between 6° 29′ and 31° 46′ W., 822—1635 m., by the Prince of Monaco between 27° 57′ 40″ and 42° 30′ N. and between 9° 37′ 45″ and 30° 28′ 54″ W., 1095—1743 m., as well as by the "Helga" off the west coast of Ireland (50° 42′—51° 37′ N. 11° 18′—11° 56′ W., 1116—1332 m.) *Ophiacantha aristata* is therefore an east Atlantic species, ranging from 22° 57′ to 51° 37′ N. Bathymetrical distribution 822—1743 m.

Ophiacantha crassidens Verrill.

Ophiacantha crassidens Verrill, Amer. Journ., ser. 3, vol. 29, 1885, p. 152.

$^{18}/_{7}$, stat. 88, 45° 26′ N. 25° 45′ W., 3120 m., sand and dark yellow mud, temp. 2.5° Cel. One specimen (disc-diameter 11.5 mm.) which agrees well with the descriptions that Verrill, Koehler and Farran give of this species.

Ophiacantha crassidens is a North Atlantic species which was first taken by the "Albatross" off Cape Hatteras, 1543 m. It ranges on the European side from 38° 45′ 30″ to 51° 50′ 30″ N., 986—3120 m. It was obtained by the Prince of Monaco off the Azores, 1095—1360 m., and by the "Helga" off the west coast of Ireland, 986—1801 m.

Ophioscolex glacialis Müller & Troschel.

Ophioscolex glacialis Müller & Troschel, System der Asteriden, 1842, p. 109, tab. 10, figs. 1 & 2.

$^{9}/_{8}$—$^{10}/_{8}$, stat. 102, 60° 57′ N. 4° 38′ W., 1098 m., dark sand and clay, temp. + 0.9° Cel. 8 specimens.

Astronyx locardi Koehler.

Astronyx locardi Koehler, Res. Sci. Camp. "Caudan" dans le Golfe de Gascogne, Fasc. 1, 1896, p. 88, tab. 3, fig. 25.

$^{27}/_{7}$, stat. 95, 50° 22′ N. 11° 44′ W., 1797 m., temp. 3.5° Cel. One specimen. Disc-diameter 24.5 mm. All of the arms were defective, the best-preserved one measured 145 mm. The specimen is but a very little larger than the type-specimens with which it agrees in all the characteristics.

Astronyx locardi was previously known only from the Bay of Biscay, where it was collected by the "Caudan" as well as the "Travailleur". According to the explorations of the "Michael Sars" its horizontal range will be from 44° 7′ to 50° 22′ N. and from 7° to 11° 44′ W. The bathymetrical distribution is 411—2030 m.

Astrochele lymani Verrill.

Astrochele lymani Verrill, Amer. Journ. ser. 3, vol. 6, 1878, p. 374.

$^{30}/_{6}$ stat. 70, 42° 59′ N. 51° 15 W., 1100 m., temp. 3.7 Cel. Two very young specimens, clinging to *Acanella arbuscula Johnst. s. normani Verr.* Disc-diameter 4 mm. and 5 mm. respectively the specimens are thus a little smaller than Verrill's type-specimen, whose disc-diameter was 7 mm.

Astrochele lymani is known only from the east coast of North America, 483—2933 m., where it is found in great numbers on *Acanella arbuscula Johnst.*

ECHINOIDEA.

Cidaris affinis Philippi.

Cidaris affinis Philippi, Wiegmanns Archiv für Naturgesch. Jahrg. 11, Bd. 1, 1845, p. 351.

$^{21}/_{5}$ stat. 39 B, 26° 3′ N., 15° W., 267—280 m., fine grey sand. Common. The smallest specimen had a test-diameter of 17 mm., the largest 39 mm., which seems to be the maximum size of the species. The colour of most of the smaller specimens was plain pink, but in some of them dark violet bands incircled the ambulacral areas and a violet band also sometimes surrounded the mouth and apical areas. The larger specimens were violet or brownish with primary spines plain red and with secondary violet with red points.

Cidaris affinis is known from the Mediterranean, the west coast of Africa and Europe and the West Indies. It is not possible at the present time, however, to state definitely its distribution, as it has been confused with *Dorocidaris papillata.* The bathymetrical distribution is 37—889 m.

I have already shown (p. 34) that the great mass of ophiurids occurring in a locality at the depths of the North Atlantic belong to the same year-class. But several year-classes may be represented in the same locality, only one of them numerously, however. The same is true of the echinoids as the following table will show. At stat. 39 B 121 specimens of *Cidaris affinis* were taken, with a diameter of 17—39 mm. The majority of these measure 17—28 mm. with a maximum of 51 individuals at 22—23 mm. There is besides a small group of 9 individuals which measure 34—39 mm. These must belong to a year-class different from the large group, which has its maximum at 22—23 mm.

At stat. 88 227 specimens of *Echinus alexandri* were obtained, test-diameter 25—46 mm. 126 specimens or 86.34 per cent measured 33—40 mm., and these afforded a maximum of 102 individuals or 40.52 per cent of the total number at 35—37 mm. This large group must represent a year-class and the few larger and smaller individuals must be representatives of other year-classes.

Test-diameter in millimetres	Number of specimens				
	Cidaris affinis	Echinus alexandri.		Echinus acutus.	
	Stat. 39 b	Stat. 88	Stat. 95	Stat. 101	Stat. 23.
17	1	—	—		—
18	1	—	—	—	—
19	5	—	—	—	—
20	7	—	—	—	1
21	15	—	—	—	—
22	23	—	—		—
23	28	—	—		—
24	15	—	—	—	—
25	13	1	1	—	
26	2	2	—		—
27	1	3	1		1
28	1	1	3	—	—
29		2	3	—	2
30		4	2	1	—
31		4	—	3	—
32		5	1	4	—
33	—	13	1	3	—
34	1	25	2	1	1
35	3	38	2	—	—
36	—	29	—	2	1
37		35	—	1	1
38	3	23	1	1	
39	2	21	—	—	—
40	—	12	1	—	1
41	—	2	—	1	—
42	—	3	—	1	—
43	—	1		1	—
44	—	2	—		—
45	—	—	—	—	—
46	—	1		—	—
60	—	—	—		1
	121	227	18	19	9

The material from stat. 95 is very scanty but the examples of *Echinus alexandri* collected there seem likewise to indicate the presence of more than one year-class at the locality. The specimens of *Echinus acutus* taken at stat. 101 afford a maximum of 10 individuals at 31—33 mm., which must represent a year-class. The three individuals at 41—43 mm. form another year-class. The grouping of these year-classes can not be definitely determined, however, owing to the scantiness of the material. At stat. 23 three year-classes at least must have been present, as the smallest individual at 20 mm. and the largest at 60 mm. represent one year-class each. The remaining specimens which measured 27—40 mm. represent at any rate a third one, but judging from the conditions at stat. 101 I am most inclined to believe that they belong to two different year-classes. At stat. 4 nine individuals were collected of which six measured 62—69 mm., one 32 mm. and two 10 mm. These three groups must each represent a year-class.

What has been said above applies also to the Echinothurids. 14 specimens of *Phormosoma placenta* were taken at stat. 4, 15 at stat. 70, 14 at stat. 101 and 25 at stat. 76 A, 1902. Their measurements were as follows:

Stat. 4: 60 (1), 67 (3), 70 (1), 72 (1) 73 (2), 75 (2), 77 (2), 79 (1), 83 (1).

Stat. 70: 6 (1), 8 (1), 9 (1), 10 (1), 12 (1), 14 (1), 16 (1), 26 (1), 27 (1), 54 (1), 59 (1), 61 (1), 65 (2), 71 (1).

Stat. 101: 44 (1), 48 (1), 54 (1), 63 (1), 64 (1), 67 (1), 68 (1), 69 (3), 71 (3), 75 (1).

1902, stat. 76 A: 67 (1), 73 (1), 76 (1), 78 (2), 79 (3), 80 (6), 82 (4), 83 (2), 84 (3), 85 (1), 86 (1).

(The numbers in brackets refer to the number of specimens, the others to the diameter of the test in millimetres).

As will be seen stat. 4 afford a maximum of six individuals at 73—75 mm, which must represent one year-class, while there is evidently another year-class between 60 and 70 mm. At stat. 70 we find at least a year-class at 6—16 mm., another at 26—27 mm. and a third gathered about 65 mm., perhaps also a fourth at 54 mm. At stat 101 there is a year-class grouped about 69—73 mm., and the smallest individuals must belong to a different year-class. At stat. 76 A most of the individuals are grouped about a diameter of 80 mm. and the smallest specimen must represent a different year-class. Six individuals, taken at stat. 23, show that as many as three year-classes may occur simultaneously in a locality. Their measurements were as follows:

21, 25, 38, 42, 43 and 74 mm.

16 specimens of *Arœosoma hystrix* taken in 1902 by the "Michael Sars" at stat. 76 A measured:

35, 85, 89, 96, 97, 98, 99, 102, 106, 108, 112, 131, 133 and 146 mm.

Three specimens measured 102 mm., the remaining measurements included but one individual each. Three year-classes at least of *Arœosoma hystrix* must hav been found at stat. 76 A, for the largest and the smallest individual must each represent a year-class, and the third one is grouped about 102 mm.

Of *Sperosoma grimaldii* four year-classes at the least were probably present at the same station, as the specimens taken there were of the following dimensions:

90 (1), 108 (1), 109 (1), 110 (1), 114 (1), 116 (1), 122 (1), 123 (1), 127 (2), 143 (2), 145 (1), 153 (1), 154 (1), and 188 (1).

At stat. 88 (1902), there seem at least to have occurred three year-classes, as the specimens measured: 75, 94, 105, 132 and 210 mm. respectively. The four *Sperosoma grimaldii* taken at stat. 25 must likewise have represented three year-classes, as they measured: 73, 195, 208 and 220 mm. respectively.

Dorocidaris papillata Leske.

Cidaris papillata Leske, Klein Nat. Disp., 1778, p. 61, tab. 39, fig. 2.

$^{10}/_{4}$. Stat. 3, 49° 32′ N., 10° 49′ W., 184 m., fine sand. One specimen. Test-diameter 55 mm.

$^{10}/_{4}$. Stat. 4. 49° 38′ N., 11° 35′ W., 923 m., sand and mud, temp. 9.2° Cel. Two specimens. Test-diameter 42 mm. and 44 mm.

Dorocidaris papillata is a North Atlantic species which occurs on the east as well as on the west side of the ocean. It is besides found in the Mediterranean. Very common on the banks along the western coast of Norway as far as Bodø (66° 42′ N., 11° 23′ E.), which is the northernmost locality of the species, it has not pushed on to the Norwegian fjords, however. Its southern distribution extends at least to the Cape Verde Is. (15° 17′ N., 23° 3′ 45″ W., Koehler), but the limits of its southern range can not be definitely fixed, as it has been confused with other species. The bathymetrical distribution is some 60 to 1800 m.

Porocidaris purpurata Wyville Thomson.

Porocidaris purpurata Wyville Thomson, Ann. Mag. Nat. Hist., ser. 4, vol. 10, 1872, p. 302.

$^{6}/_{5}$ stat. 24, 35° 34′ N. 7° 35′ W., 1615 m., yellow mud., temp. 8° Cel. Three specimens. Test-diameter 31 mm. and 37 mm. respectively.

$^{23}/_{5}$ stat. 41, 28° 8′ N. 13° 35′ W., 1365., yellow mud, temp. 6° Cel. Two specimens. Test-diameter 42 mm. and 44 mm. respectively.

This species was discovered by the "Porcupine" in the Faroe—Shetland Channel, 968—991 m. (Wyville Thomson) The "Michael Sars" obtained it in 1902 on the slope of the Faroe—Iceland banks toward the Atlantic depths (stat. 79 B, 61° 7′ N. 9° 33′ W., 750 m.). It was further found off the south coast of Iceland, 914—957 m. (Mortensen), the west coast of Ireland, 1116—1409 m. (Sladen and Farran), the Bay of the Biscay, 950—1804 m. (Koehler), the Canary Is., 1098 m. (Koehler) and Rio Ouro, 1439 m. (Mortensen). *Porocidaris purpurata* is thus distributed at the great depths along the entire east side of the North Atlantic. It was besides taken by the "Valdivia" off the Nicobar Is., 905 m. (Döderlein).

Aræosoma hystrix Wyville Thomson.

Calveria hystrix Wyville Thomson, Proc. R. Soc. London, vol. 18, 1869, p. 445.

$^{10}/_{4}$ stat. 4, 49° 38′ N. 11° 35′ W., 923 m., sand and mud., temp. 9.2° Cel. Two specimens. Test-diameter 120 mm. and 140 mm. respectively.

$^{23}/_{5}$ stat. 41, 28° 8′ N. 13° 35′ W., 1365 m., yellow mud., temp. 6 Cel. Four specimens. Test-diameter 88—109 mm.

The "Michael Sars" obtained several specimens of this species in 1902 at stat. 76 A, 59° 28′ N. 8° 1′ W., 1100—1300 m., temp. 8.07° Cel.

Aræosoma hystrix is indigenous to the eastern as well as the western side of the North Atlantic. The northern limit of its range is formed by the ridges and banks which separate the Atlantic from the Norwegian Sea. To the south it ranges to the Canary Is. The bathymetrical distribution about 180—1800 m.

Phormosoma placenta Wyville Thomson.

Phormosoma placenta Wyville Thomson, The Depths of the Sea, 1873, p. 171 and p. 459.

$^{10}/_{4}$ stat. 4, 49° 38′ N. 11° 35′ W., 923 m., sand and mud., temp. 9.2° Cel. Common. 14 preserved specimens measured 60—83 mm. in diameter.

$^{5}/_{5}$ stat. 21, 35° 31′ N. 6° 35′ W., 535 m., yellow sand, temp. 11.52° Cel. One specimen, diameter 63 mm.

$^{5}/_{5}$ stat. 23, 35° 32′ N. 7° 7′ W., 1215 m., yellow mud., temp. 10.17° Cel. Six specimens, diameter 21—74 mm.

$^{6}/_{5}$ stat. 24, 35° 34′ N. 7° 35′ W., 1615 m., yellow mud., temp. 8° Cel. Four specimens, diameter 74—90 mm.

$^{30}/_{6}$ stat. 70, 42° 59′ N. 51° 15′ W., 1100 m., temp. 3.7° Cel. 15 specimens, diameter 6—71 mm.

$^{27}/_{7}$ stat. 95, 50° 22′ N. 11° 44′ W., 7 specimens, diameter 52—60 mm.

$^{6}/_{8}$—$^{7}/_{8}$ stat. 101, 57° 41′ N. 11° 48′ W., 1853 m., hard clay, temp. 3.3° Cel. 14 specimens, diameter 44—75 mm.

The "Michael Sars" obtained this species together with *Aræosoma hystrix* and *Sperosoma grimaldii* in 1902 at stat. 76 A, 59° 28′ N. 8° 1′ W., 1100—1300 m., temp. 8.07 Cel.

The specimens from stat. 70 belong to the west Atlantic variety *sigsbei A. Agassiz* (cfr. Döderlein: Die Echinoiden d. deutschen Tiefsee Expedition[1])), the remainder to the typical form.

The typical *Phormosoma placenta* is an east Atlantic form ranging from the Faroe Is. and Iceland, 62° 58′ N. ("Ingolf") to Cameroon, 3° 10′ N. ("Valdivia") while the variety *sigsbei* has a west Atlantic distribution from the Davis Strait, 66° 49′ N. (Wandel) to the West Indies, 41° 29′ 45″ N. ("Blake"). It is probable that the species will be met with also at the great depths of the South Atlantic, as varieties of it are known from the Pacific and Indian Oceans. The bathymetrical distribution is 275—2500 m.

Sperosoma grimaldii Koehler.

Sperosoma grimaldii Koehler, Zool. Anzeiger, vol. 20, 1897, p. 302.

$^{7}/_{5}$ stat. 25 A, 35° 36′ N. 8° 25′ W., 2300 m., yellow mud. Three larger specimens, diameter 195—220 mm. and a smaller one, diameter 73 mm.

$^{23}/_{5}$ stat. 41, 28° 8′ N. 13° 35′ W., 1365 m, yellow mud. One specimen, diameter 106 mm.

Sperosoma grimaldii was first found by the Prince of Monaco off the Azores, 1213—1850 m. It was later

[1]) Wissensch. Ergebn. d. deutschen Tiefsee Expedition, Bd. 5, 1906, p. 128.

taken in a number of localities between the Bay of Biscay and the Cape Verde Is. According to Mortensen, it was collected by the "Talisman" off Morocco and the Azores and Farran[1]) records it from the west coast of Ireland. The "Ingolf" obtained it south of Iceland and the "Michael Sars" in 1902 south of the Faroe Is. (stat. 76 A, 59° 28′ N. 8° 1′ W., 1100—1300 m., 8.07° Cel.) as well as south of the Faroe—Iceland ridge (stat. 88, 63° 9′ N. 13° 27′ W., 880 m., 5.07° Cel.). *Sperosoma grimaldii* is therefore an east Atlantic species, ranging from 15° 17′ to 63° 9′ N. The bathymetrical distribution 300—2300 m.

Hygrosoma petersi A. Agassiz.

Phormosoma petersi A. Agassiz, Bull. Mus. Comp. Zool. vol. 8, 1881, p. 76.

7/5. Stat. 25 A, 35° 36′ N., 8° 25′ W., 2300 m., yellow mud. One large specimen, diameter 152 mm.

23/5. Stat. 41, 28° 8′ N., 13° 35′ W., 1365 m., yellow mud. Two specimens, diameter 110 mm. and 130 mm.

The primary spines were torn off in all of the specimens. The specimen from stat. 25 A, however, was pretty well preserved, also with respect to the colouring, which was intensely dark-violet with spines and tubefeet darker than the test. In the specimen depicted by Koehler in "Echinides et Ophiures provenant des campagnes du yacht l'Hirondelle"[2]) the latter are lighter than the test.

Hygrosoma petersi was first found by the "Blake' off the West Indies and the east coast of North America (between about 12° and 40° N.), where it was likewise later taken by the "Albatross" (Mortensen)[3]). The Prince of Monaco obtained it off the Azores, where it was also taken according to Mortensen by the "Talisman". It is recorded by Koehler[4]) under the name *Phormosama luculentum* from the Bay of Biscay, and was also later obtained there by the "Thor" (Mortensen)[5]). The "Michael Sars" localities are situated off Gibraltar and Cape Bojador' *Hygrosoma petersii* must therefore range on the east Atlantic side from 28° 8′ to 49° 20′ N. The bathymetrical distribution on the west side of the Atlantic is 730—2240 m., on the east side 1165—2870 m.

Salenia profundi Duncan.

Salenia profundi Duncan, Ann. Mag. Nat. Hist., ser. 4, vol. 20, 1877, p. 70.

18/7. Stat. 88, 45° 26′ N., 25° 5′ W., 3120 m., sand and yellow mud, temp. 2.5° Cel. 18 specimens, diameter 10—14 mm.

The "Michael Sars" found several specimens of this species in 1902 on the slope of the Faroe-Iceland banks toward the depths of the Atlantic (stat. 88, 63° 9′ N., 13° 27′ W., 880 m., temp. 5.07° Cel.) *Salenia profundi* was not previously known within the Atlantic regions north of the Bay of Biscay ("Caudan", stat. 3, 46° 26′ N., 6° 58′ W., 1710 m.). It ranges south to Tristan d'Acunha ("Challenger", stat. 335, 32° 24′ S., 13° 5′ W., 2608 m.) and was besides found in the Indian and Pacific Oceans. *Salenia profundi* is therefore a cosmopolitan species. The bathymetrical distribution is 183—3383 m.

Echinus esculentus Linné.

Echinus esculentus Linné, Syst. Nat., ed. 10, 1758, p. 663.

9/4. Stat. 1, 49° 27′ N., 8° 36′ W., 146 m., fine sand, temp. 9.57° Cel. One specimen, diameter 58 mm., height of test 40 mm.

Echinus esculentus is a boreal species, ranging south to the coasts of Spain and Portugal and north to Oexfjord, Finmark and 69° 18′ N. ("Voeringen" stat. 173 B) Bathymetrical distribution 0—1264 m.

Echinus acutus Lamarck.

Echinus acutus Lamarck, Anim. s. Vert., vol. 3, 1816, p. 45.

9/4 stat. 1, 49° 27′ N. 8° 36′ W., 146 m, fine sand, temp. 9.57° Cel. One specimen.

10/4 stat. 3, 49° 32′ N. 10° 49′ W., 184 m., fine sand, temp. 10.3° Cel. Several specimens.

10/4 stat. 4, 49° 38′ N. 11° 35′ W., 923 m., sand and mud., temp. 9.2° Cel. 9 specimens.

5/5 stat. 21, 35° 31′ N. 6° 35′ W., 535 m., yellow sand, temp. 11.52° Cel. One specimen.

5/5 stat. 23, 35° 32′ N. 7° 7′ W., 1215 m., yellow mud., temp. 10.57° Cel. 9 specimens.

27/7 stat. 96, 50° 57′ N. 10° 46′ W., 184 m. temp. 11° Cel. One specimen.

6/8—7/8 stat. 101, 57° 41′ N. 11° 48′ W., 1853 m., hard clay temp. 3.3° Cel. 19 specimens.

The specimens from stat. 1 and 96 belong to the form *flemingi Forbes*. Some of the specimens from stat. 4 may be referred to the form *microstoma* Wyville Thomson, others to *norvegicus* Düben & Koren. I give below the measurements of three *microstoma* and three *norvegicus* of about equal size:

	microstoma			*norvegicus*		
	mm.	mm.	mm.	mm.	mm.	mm.
Diameter of test	62	66.5	69	62	55.5	67
Height of test	34.5	55.5	39	33	39.5	43.5
Diameter of bucal area	13	13.5	14	16	18	20
Diameter of apical area	13	15	13	14.5	15	13.5
Diameter of anal area	6	6	7	5.5	6	6.5
Height in per cent of diameter	55.4	83.6	56.5	53.2	59.4	64.7

As will be seen from the foregoing numbers, the bucal area affords the only reliable distinguishing characteristic between these two forms, as it is much smaller

1) Fisheries, Ireland Sci. Invest. 1912 (1913) no. 6, p. 54.
2) Res. Camp. Sci. Monaco, Fasc. 12, 1898, tab. 1.
3) Mortensen: Some West Indian Echinoids, 1910, p. 23.
4) Res. Sci. Camp. "Caudan", Fasc. 1, 1896, p. 92.
5) Mortensen: Echinoidea, part 2, 1907, p. 170.

in *microstoma* than in *norvegicus*. Mortensen[1]), however, very justly remarks that this distinction is not reliable either, as the size of the buccal area is subject to considerable variations in *norvegicus*.

Echinus acutus is an east Atlantic species, ranging north to the Beeren Eiland ("Voeringen", stat. 275, 74° 8′ N.) and south to the Mediterranean and Cape Bojador ("Valdivia", stat. 28, 26° 17′ N.) The bathymetrical distribution is 0—1280 m. It is a true warm-water species, but the variety *norvegicus* is taken in the cold area by the "Voeringen" (stat. 267, 71° 42′ N. 37° 1′ E., 271 m., ÷ 1.4°, and stat. 275, 74° 8′ N. 31° 12′ E., 269 m., ÷ 0.4°).

Echinus alexandri Danielssen & Koren.

Echinus alexandri Danielssen & Koren, Nyt Mag. for Naturvidensk., vol. 27, 1883, p. 294, tab. 3 & 4.

18/7, stat. 88, 45° 26′ N. 25° 45′ W., 3120 m., sand and yellow mud, temp. 2.5° Cel. Very Common.

27/7, stat. 95, 50° 25′ N. 11° 44′ W., 1797 m., temp. 3.5° Cel. 18 specimens.

The test-diameter of the smallest specimen was 25 mm., of the largest 46 mm.

Echinus alexandri is indigenous to the great depths of the North Atlantic, where it has been found on the west as well as the east side. It ranges south to the Azores ("Princesse Alice", stat. 743, 37° 35′ 45″ N. 26° 26′ 15″ W., 1494 m.) There is no proof yet of its occurrence on the banks that separate the Atlantic from the Norwegian Sea, but it must no doubt occur there, as it has been taken by the "Voeringen" on their slope toward the Norwegian Sea (stat. 76, 69° 18′ N. 14° 33′ E., 980 m., ÷ 0.2°). The bathymetrical distribution is 790—3120 m.

Echinocyamus pusillus O. F. Müller.

Spatangus pusillus O. F. Müller, Zol. Dan. Prodr., 1776, p. 236.

20/5, stat. 38, 26° 3′ N. 14° 36′ W., 77 m., red sand and shingle. Several specimens.

Echinocyamus pusillus is an east Atlantic species ranging north to the Porsangerfjord and south to the Mediterranean, Cape Bojador and the Azores. Its bathymetrical distribution is 0—800 m. (Mortensen). According to Koehler it has, however, been taken at a depth of 1250 m.

Hemiaster expergitus Lovén.

Tab. 5, figs. 11 & 12.

Hemiaster expergitus Lovén, Kgl. Sv. Vet. Akad. Handl., vol. 11, no. 7, 1874, p. 13, tab. 5, figs. 46 & 46, tab. 11, figs. 93 & 94, tab. 13, figs. 114—120, tab. 26.

18/7, stat. 88, 45° 26′ N. 25° 45′ W., 3120 m., sand and yellow mud, temp. 2.5° Cel. One specimen which measured:

Length	53.5 mm.
Breadth	52.5 „
Height	30.5 „
Breadth of mouth	6 „
Breadth of anal area	5 „
Breadth in per cent of length	98.15 „
Height in per cent of length	57.01 „

The type specimen was 14 mm. long and the specimens described by Mortensen measured as much as 37 mm.,[1]) which has represented up to the present time the maximum size of this species. But as the foregoing measurements show *Hemiaster expergitus* may attain considerably larger size. The form of the spines and of the pedicellariæ agrees perfectly with the description given by Mortensen. I have therefore in spite of its large size referred the specimen to *Hemiaster expergitus*.

Hemiaster expergitus is a North Atlantic species, ranging from the Caribbean Sea to the Davis Straits on the west side and from Iceland to the Cape Verde Is. on the east side. The "Michael Sars" found it in 1902 on the banks north-east of the Faroe Is., "Tampen" (stat. 51, 61° 40′ N., 3° 11′ E., 400 m., 6.34°) but with this exception it is only known from the great depths of the North Atlantic. The bathymetrical distribution is 400—3120 m., but its main distribution seems to be at depths greater than 1000 m.

Spatangus raschi Lovén,

Spatangus raschi Lovén, Øfvs. Kgl. Vet. Akad. Førhandl. vol. 26, 1869, p. 733, tab. 13.

10/4. Stat. 4, 49° 38′ N., 11° 35′ W., 923 m., sand and mud, temp. 9.2° Cel Common. 7 specimens were preserved.

27/7. Stat. 96, 50° 57′ N., 10° 46′ W., 184 m., temp. 11° Cel. 8 specimens, of which one was preserved.

As may be seen from the following table, the form of the test is subject to considerable variations, particularly in regards its height. While thus in the specimens from stat. 4 the breadth of the test varies between 89.8 and 94.05 per cent of the length, the height varies between 47.92 and 62.5 per cent of the length.

Length	81	84	86.5 (stat. 96)	87	93	96	98	100
Breath	74	79	78.5	78.5	86	87.5	88	94
Height	45	52	45	49	57	46	55	58
Breadth of mouth	11	11	11.5	15	16	11	11	14
Breadth of anal area	8	8.5	8.5	8	8	9.5	9	10
Breadth in % of length	91.36	94.05	90.75	90.23	92.58	91.15	89.8	94
Height in % of length	55.56	62.5	52.02	56.32	61.29	47.92	56.12	58

All measurements are in millimetres.

Spatangus raschi is an east Atlantic species, ranging south to the Azores and north to the banks off Tromsoe ("Voeringen", stat. 173 B, 69° 18′ N., 14° 32′ E., 549 m.) It is a decided warm water species, which was only once

[1]) Mortensen: Echinoidea, part 1, 1903, p. 149.

[1]). Mortensen: Echinoidea, part 2, 1907, p. 97.

taken by the "Voeringen" in the cold area (stat. 96, 66° 8′ N., 3° E., 1472 m., ÷ 1,1°). The bathymetrical distribution is 179—1472 m., but its main distribution seems to be between 400 and 1000. m.

Brissopsis lyrifera Forbes.

Brissus lyrifer, Forbes, British Starfishes, 1841, p. 187.

10/4. Stat. 3, 49° 32′ N., 10° 49′ W., 184 m., fine sand, temp. 10.3° Cel. Very common.

5/5. Stat. 21, 35° 31′ N., 6° 35′ W., 535 m., yellow sand, temp. 11.52° Cel. Two smaller specimens.

Brissopsis lyrifera is an east Atlantic species ranging north to the banks off Meløy ("Voeringen" stat. 147, 66° 47′ N., 12° 8′ E., 260 m.) and south to the Mediterranean and the Azores. Its bathymetrical distribution is 10—535 m. According to Farran [1]) it has, however, been taken at depth of 878—1299 m. off the west coast of Ireland.

CRINOIDEA.

Bathycrinus recuperatus Ed. Perrier (?).

Bathycrinus recuperatus Ed. Perrier, Rev. Scient. vol. 35, 1885, p. 691.

7/5 stat. 25 A, 35° 36′ N. 8° 23′ W., 2300 m., yellow mud. One specimen, in which, however, the crown, the basals, the uppermost portion of the stem and the lowermost part of the roots were wanting. The remaining portion of it was 105 mm. long and consisted of 39 joints. The lowermost joint was 1.64 mm. in length and its breadth was 1.64 mm. at the lower and 0.92 mm. at the upper border. The uppermost joint was 2.3 mm. in length and 0.92 mm. in breadth. The joints, with the exception of the lowermost one, are cylindrical and remind one in their form and structure of those in *Bathycrinus carpenteri*. Among the *Bathycrinidae* of the Atlantic *B. recuperatus* seems to be most nearly related to *B. carpenteri* (cfr. Koehler & Vaney: Note preliminaire sur les Crinoides du "Talisman" et du "Travailleur")[2]). I have therefore, though doubtfully, referred the specimen under consideration to Perrier's species.

A mutilated specimen of *Bathycrinus recuperatus* was found in 1883 by the "Talisman" between Spain and the Azores (44° 20′ N. 19° 31′ W., 4255 m.).

Hathrometra dentata Say.

Alectro dentata Say, Journ. Acad. Nat. Sci. Philadelphia, vol. 5, 1825, p. 153.

30/6 stat. 70, 42° 59′ N. 51° 15′ W., 1100 m., temp. 3.7° Cel. Four mutilated specimens, one of them clinging to *Acanella arbuscula Johns. s. normani Verr.*

This species is found off the east coast of North America, where it is common according to Verrill[3]) at depths of 126—1171 m. It seems further to occur off the west coast of Europe, as the "Porcupine" specimen of *Antedontenella* depicted by Carpenter in the report on the "Challenger" crinoids[1]) accords perfectly with the specimens from Newfoundland under consideration. The range of *Hathrometra dentata* can not, however, be definitely determined at the present time, as the species has been confused with *H. tenella Retzius* and *H. sarsii* Düben & Koren.

Hathrometra prolixa Sladen.

Antedon prolixa Sladen, Duncan & Sladen: Memoir on the Echinodermata of the Arctic Sea to the West of Greenland, 1881, p. 77, tab. 6, fig.s 7—10.

9/8—10/8 stat. 102, 60° 57′ N. 4° 38′ W., 1098 m., dark sand and clay, temp. ÷ 0.9° Cel. Common.

Hathrometra prolixa is an Arctic species, ranging in the Norwegian Sea between the Faroe—Shetland Channel (60° 22′) and Spitzbergen (80°) and between the east coast of Greenland (about 20° W.) and the Kara Sea (64 52′ E.). It is further found off the west coast of Greenland between 63° 24′ and 81° 4′ N. The bathymetrical distribution is 46—1960 m. Bottom temperature 1.1—÷2.1°. Most of the localities belong to the cold area, and the few warm-water stations included in its range are all situated within the border-region adjacent to the cold area, where the hydrographical conditions may change. The species must therefore be considered a cold-water form.

Leptometra phalangium J. Müller.

Alecto phalangium J. Müller, Wiegmanns Archiv für Naturgesch., Jahrg. 7, Bd. 1, 1841, p. 142.

21/5 stat. 39 B, 26° 3′ N. 15° W., 267—280 m., fine grey sand. Four smaller specimens.

Leptometra plalangium is an east Atlantic species, ranging from the Hebrides to Madeira and the Azores. It is further found in the western part of the Mediterranean. Aust. H. Clark gives in "New Genera of Unstalked Crinoids" [2]) its bathymetrical range as 82 to 346 m. According to other reports it is 46—458 m. Bell[3]) states that *Leptometra phalangium* descends to a depth of 1281 m. I have, however, not been able to find any autority for this statement.

[1]) Fisheries, Ireland, Sci. Invest. 1912 no. 6, p. 63.
[2]) Bull. Mus. Nat. d'Hist. Natur., vol. 16, no. 6, 1910, p. 29.
[3]) Ann. Rap. Commis. of Fish and Fisheries 1883 (1885), p. 550.

[1]) Rep. Sci. Res. Voy. Challenger., Zool., vol. 26, 1888, p. 169, tab. 31, fig.s 1 & 3.
[2]) Proc. Biol. Soc. Washington, vol. 21, 1908, p. 120.
[3]) Bell: Cat. British Echinoderms, 1892, p. 60.

Bergen, December 20. 1918.

P. S.

During the printing of the present paper a sample of bottom-material from st. 70 was handed to me for examination. It contained three species of echinoderms which have not been mentioned in the foregoing description of the echinoderm-material from the expedition. The number of echinoderm-genera and species from the "Michael Sars" Expedition 1910 is thereby raised to 18 and 95 respectively.

Astrogonium parelii Düben & Koren.

Astropecten parelii Düben & Koren, Kgl. Vetensk. Handl., 1844 (1846) p. 247, tab. 7, figs. 14—16.

One young specimen, diameter 18 mm., radius of arm 10 mm., radius of disc 4 mm.

Calycaster monaecus Ed Perrier.

Calycaster monaecus Ed. Perrier, Mem. Soc. Zool. de France, vol. 4, 1891, p. 262.

One young specimen, diameter 8 mm., radius of arm 4 mm., radius of disc 2 mm. It agrees with the smallest of the four specimens described by Perrier[1]).

Calycaster monaecus is taken only once previously, by the Prince of Monaco, at the Azores, in 1557 mm.

Brissopsis atlantica Mortensen.

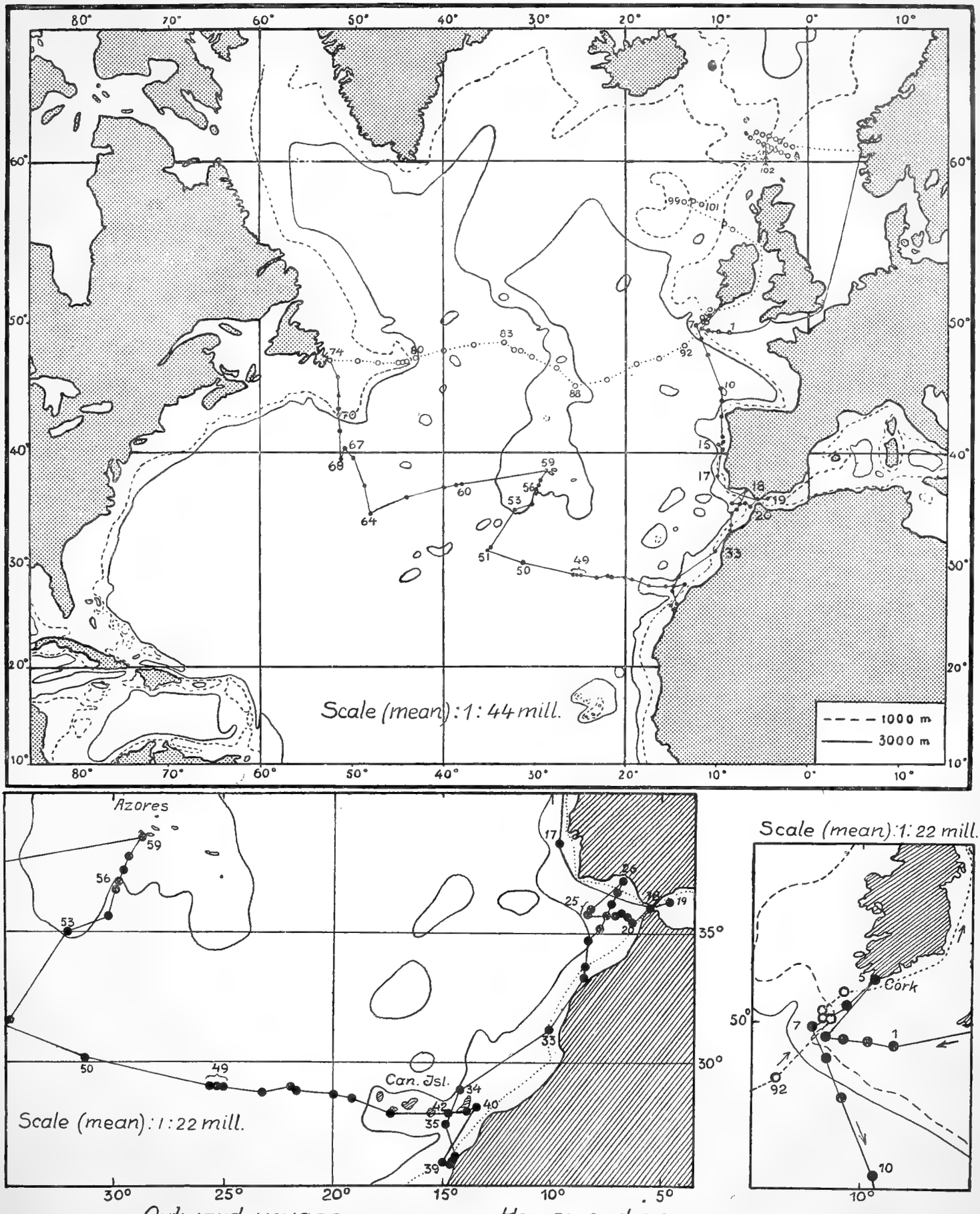
Brissopsis atlantica, Mortensen, Echinoidea, part 2, Danish Ingolf Exp., vol. 4, part. 2, 1907, pag. 160, tab. 3, figs. 6, 10, 17, tab. 18, figs. 5, 9, 10, 13, 19, 20, 24, tab. 19, figs. 1, 4, 5, 11, 13, 14, 16, 22 23, 25, 28, 30—33.

One specimen.

[1]) Ed. Perrier, *Stellerides*, Res. Camp. Sci. Monaco, Fasc. 11, 1896, p. 28. tab, 3, fig. 3 a.

Bergen, October 20. 1920.

Cruises of the "Michael Sars" 1910.



Portions of the voyage in larger scale in the two smaller charts. Figures denote station-numbers.

List of stations at which Echinoderms were collected.

Stat. 1. April 9. 49° 37′ N. 8° 36′ W., 146 m., fine sand temp. 9.57° Cel., trawl.
Astropecten irregularis.
Ophiura affinis (taken with Petersen bottom collector).
Echinus esculentus, E. acutus.

Stat. 3. April 10. 49° 32′ N. 10° 49′ W., 184 m., fine sand, temp. 10.3° Cel., trawl.
Stichopus tremulus.
Astropecten irregularis, Luidia ciliaris, Stichaster roseus.
Dorocidaris papillata, Echinus acutus, Brissopsis lyrifera

Stat. 4. April 10. 49° 38′ N. 11° 35′ W., 923 m., sand and mud, temp. 9.2 Cel., trawl.
Laetmogone violacea, L. wyville-thomsoni, Stichopus tremulus.
Plutonaster bifrons.
Dorocidaris papillata, Araeosoma hystrix, Phormosoma placenta, Echinus acutus, Spatangus raschi.

Stat. 10. April 19. 45° 26′ N. 9° 20′ W., 4700 m., yellow mud, temp. 2.56° Cel., trawl.
Oneirophanta mutabilis, Benthodytes janthina.
Paragonaster subtilis. Freyella sexradiata.
Ophiura convexa, Ophiocten latens, Ophiomusium planum.

Stat. 21. May 5. 35° 31′ N. 6° 35′ W., 535 mm., yellow sand, temp. 11.52 Cel., trawl.
Labidoplax digitata.
Dorigona arenata, Brisingella coronata.
Amphiura chiajei, A. duplicata.
Phormosoma placenta, Echinus acutus, Brissopsis lyrifera.

Stat. 23. Mai 5. 35° 32′ N. 7° 7′ W., 1215 m., yellow mud., temp. 10.17° Cel., trawl.
Laetmogone violacea.
Phormosoma placenta, Echinus acutus

Stat. 24. May 6. 35° 34′ N. 7° 35′ W., 1615 m., yellow mud., temp. 8° Cel., trawl.
Bathyplotes tizardi, Laetmogone violacea, L. wyville-thomsoni, Benthogone rosea.
Plutonaster bifrons, Pentagonaster dentatus, Zoroaster fulgens.
Ophiomusium lymani, Ophiactis abyssicola, Ophiacantha abyssicola.
Porocidaris purpurata, Phormosoma placenta.

Stat. 25 A. May 7. 35° 36′ N. 8. 25′ W., 2300 m., yellow mud., trawl.
Mesothuria verrilli, Benthogone rosea, Euphronides auriculata.
Plutonaster bifrons, Hymenaster rex.
Ophiomusium lymani, Ophiacantha abyssicola.
Sperosoma grimaldii, Hygrosoma petersii.
Bathycrinus recuperatus (?).

Stat. 25 B. May 8. 35° 46′ N. 8° 16′ W., 2055 m., yellow mud., trawl.
Plutonaster bifrons, Pentagonaster dentatus.
Pectinura elata, Ophiomusium lymani, Ophiacantha abyssicola.

Stat. 35. May 18. 27° 27′ N. 14° 52′ W., 2603 m., yellow mud.
Mesothuria verrilli, Benthodytes glutinosa.
Ophiomusium lymani.

Stat. 37. May 20. 26° 6′ N. 14° 33′ W., 30 m., shingle, temp. 15.6° Cel., trawl.
Holothuria tubulosa.
Luidia ciliaris, Echinaster sepositus.

Stat. 38. May 20. 26° 3′ N. 14° 36′ W., 77 m., red sand and shingle.
Ophiura affinis.
Echinocyamus pusillus.

Stat. 39 B. May 21. 26° 3′ N. 15° W., 267—280 m., fine grey sand.
Cidaris affinis.
Leptometra phalangium.

Stat. 41. May 23. 28° 8′ N. 13° 35′ W., 1365 m., yellow mud, temp. 6° Cel., trawl.
Mesothura verrilli. Laetmogone wyville-thomsoni, Benthogone rosea.
Plutonaster bifrons, Pentagonaster dentatus, Zoroaster fulgens, Cribrella abyssalis.
Ophiacantha aristata.
Porocidaris purpurata, Araeosoma hystrix, Sperosoma grimaldii, Hygrosoma petersii.

Stat. 48. Mai 31. 28° 54′ N 24° 14′ W., 2800—3000 m., trawl
Deima atlanticum, Peniagone ferruginea n. sp.

Stat. 53. June 8. 34° 59′ N. 33° 1′ W.
1. m. net, 100 m. wire.
Luidia sarsii.
2615—2865 m., yellow hard clay mud, temp., 3° Cel. trawl.
Pseudostichopus villosus, Peniagone wyvilli, Benthodytes typica.
Pteraster reductus.
Pectinura elata, Ophiura tessellata, Ophiomusium lymani, O. planum.

Stat. 56. June 10. 36° 53′ N. 29° 47′ W.,
1 m. net, 100 m. wire,
Luidia sarsii.

Stat. 64. June 24. 34° 44′ N. 47° 52′ W.,
1 m. net, 200 m. wire and young fish trawl, 300 m. wire.
Luidia sarsii.

Stat. 67. June 26. 40° 17′ N. 50° 39′ W.
1 m. net, 50 m. wire.,
Luidia sp.

Stat. 70. June 30.. 42° 59′ N. 51° 15′ W., 1100 m., temp. 3.7° Cel., young fish trawl. 1700 m. wire.
Benthodytes gigantea.
Benthopecten spinosus, Plutonaster agassizi, Psilaster andromeda, Mediaster stellatus, Astrogonium fallax, A. parelii, Calycaster monaecus, Zoroaster fulgens.
Ophiocten sericeum, Ophiomusium lymani, Ophiolebes claviger, Ophiacantha abyssicola, Astrochele lymani,
Phormosoma placenta. Brisopsis atlantica.
Hathrometra dentata.

Stat. 75. July 9. 47° 22′ N. 49° 16′ W., 120 m.
Zoroaster fulgens.

Stat. 88. July 18. 45° 26′ N. 25° 45′ W., 3120 m., sand and yellow mud, temp. 2.5° Cel., trawl.
Mesothuria maroccana, Peniagone azorica, Cucumaria abyssorum.
Dytaster agassizi, Solaster abyssicola.
Ophiura concreta, O. irrorata, O. tessellata, Ophiacantha crassidens.
Salenia profundi, Echinus alexandri, Hemiaster expergitus.

Stat. 92. July 23. 48° 29′ N. 13° 55′ W., young fish trawl, 200 m. wire.
Benthodytes glutinosa.

Stat. 94. July 26. 50° 13′ N. 11° 23′ W., 1 m. net surface and 1 m. net, 200 m. wire.
Luidia ciliaris.

Stat. 95. July 26—27. 50° 22′ N. 11° 44′ W., 1797 m., temp. 3.5° Cel., trawl.
Benthogone rosea.
Benthopecten spinosus, Plutonaster bifrons, Bathybiaster robustus, Pentagonaster dentatus.
Ophiomusium lymani, Astronyx locardi,
Phormosoma placenta, Echinus alexandri.

Stat. 96. July 27. 50° 57′ N. 10° 46′ W., 184 m., temp. 11° Cel., young fish trawl, 300 m. wire.
Ophiura affinis.
Echinus acutus, Spatangus raschi.

Stat. 98. August 5. 56° 33′ N. 9° 30′ W. 1 m. net, 200 m. vire.
Luidia sarsii

Stat. 101. August 6 –7. 57° 41′ N. 11° 48′ W., 1 m. net, 200 m. wire.
Luidia sarsii. L. ciliaris.
1823 m., hard clay, temp, 3.3° Cel., trawl.
Benthopecten spinosus, Plutonaster bifrons, Bathybiaster robustus, Psilaster andromeda, Psilasteropsis patagiatus, Zoroaster fulgens, Brisingella coronata.
Ophiochiton ternispinus, Ophiomysium lymani, Ophiactis abyssicola, Ophiacantha abyssicola.
Phormosoma placenta, Echinus acutus.

Stat. 102. August 9—10. 60° 57′ N. 4° 38′ W., 3/4 m. net, 400 m. wire.
Luidia sarsii.
1098 m., dark sand and clay, temp. +0.9 Cel., trawl.
Pontaster tenuispinus, Plutonaster bifrons, Bathybiaster vexillifer, Psilaster andromeda, Zoroaster fulgens, Solaster papposus v. septentrionalis, S. squamatus, Lophaster furcifer, Hymenaster pellucidus.
Ophiopleura borealis, Ophioscolex glacialis.
Hathrometra prolixa.

Explanation of the Plates.

Plate I.

Fig. 1. *Mesothuria maroccana,* R. Perrier from stat. 88, abactinal view.

„ 2, 3. *Deima atlanticum,* Herouard from stat. 48. 2 actinal view, 3 abactinal view.

„ 4—6. *Peniagone ferruginea,* n. sp. from stat. 48. 4 actinal view, 5 from the right side, 6 abactinal view.

Plate II.

Fig. 1, 2. *Oneirophanta mutabilis,* Théel from stat. 10. 1 abactinal view, 2 actinal view.

Plate III.

Fig. 1, 2, *Benthodytes glutinosa,* R. Perrier from stat. 35. 1 actinal view, 2 abactinal view.

„ 3—5. *Peniagone wyvilli,* Théel from stat. 10. 3 actinal view, 4 from left side, 5 abactinal view.

„ 6, 7. *Benthodytes typica,* Théel from stat. 53. 6 abactinal view, 7 actinal view.

Plate IV.

Fig. 1. *Benthopecten spinosus,* Verrill from stat. 101. abactinal view.

„ 2—4. *Plutonaster agassizi,* Verrill from stat. 70. 2 actinal view, 3 abactinal view, 4 adambulacral and marginal plates from middle portion of arms.

„ 5—8. *Dorigone arenata,* Edv. Perrier from stat. 21. 5 abactinal view, 6 actinal view, 7 adambulacral plates, 8 two pair of marginal plates with pedicellariæ from the interbrachial arc.

Plate V.

Fig. 1. *Astrogonium fallax,* Ed. Perrier from stat. 70. Adambulacral- and marginal plates from middle portion of arms.

„ 2—4. *Solaster abyssicola,* Verrill from stat. 88. 2 abactinal view, 3 adambulacral papillæ from middle portion of arms, 4 skeleton from abactinal surface.

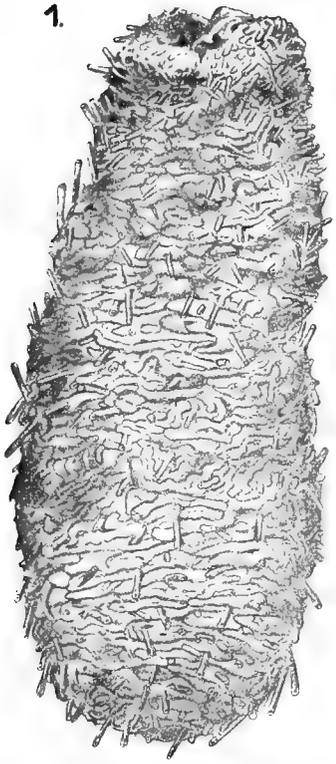
„ 5. *Solaster endeca,* Retzius from Bergen. Skeleton from abactinal surface,

„ 6, 7. *Pteraster reductus,* Koehler from stat. 53. 6 abactinal view, 7 actinal view.

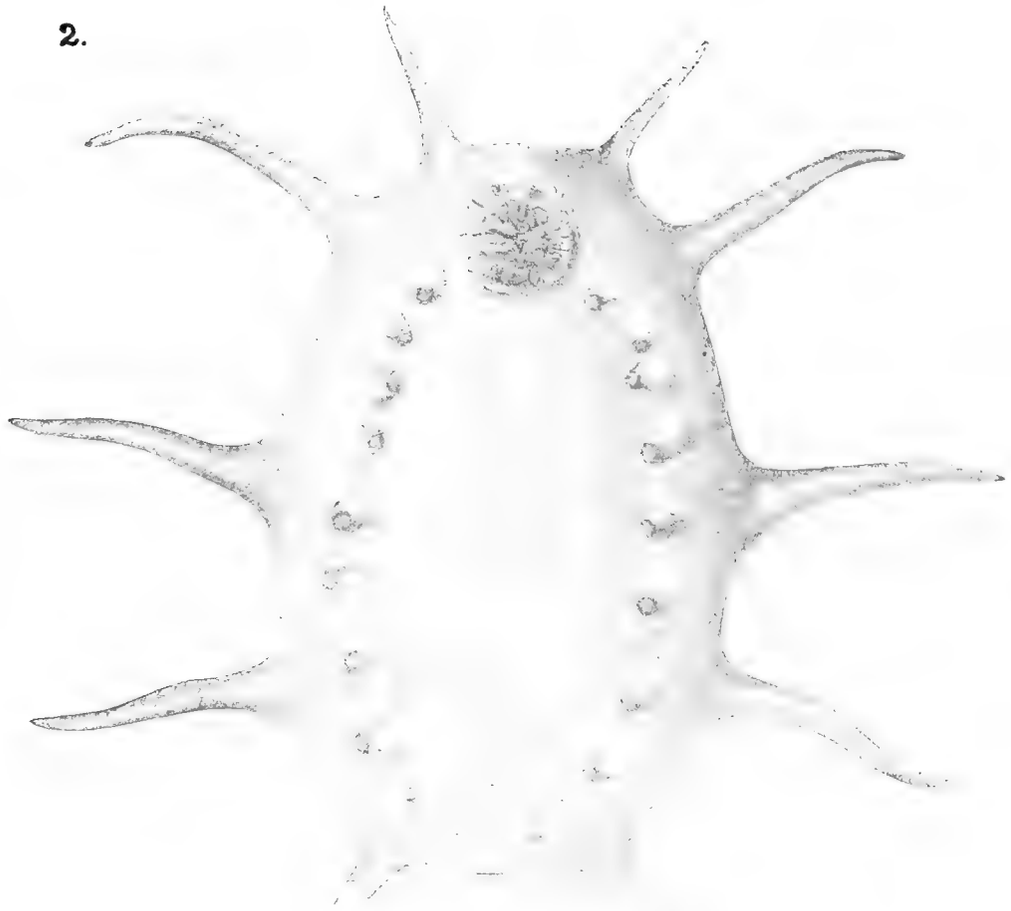
„ 8—10. *Ophiomusium lymani,* Wyville Thomsen from stat. 70. Abactinal view. 8 disc-diameter 2 mm, 9 disc-diameter 4 mm., 10 disc-diameter 5 mm.

„ 11—12. *Hemiaster expergitus,* Lovén from stat. 88. 11 abactinal view, 12 actinal view.

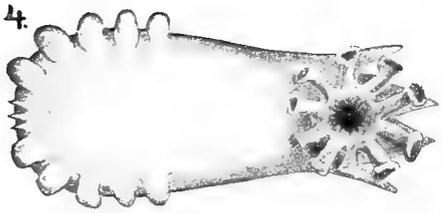
1.



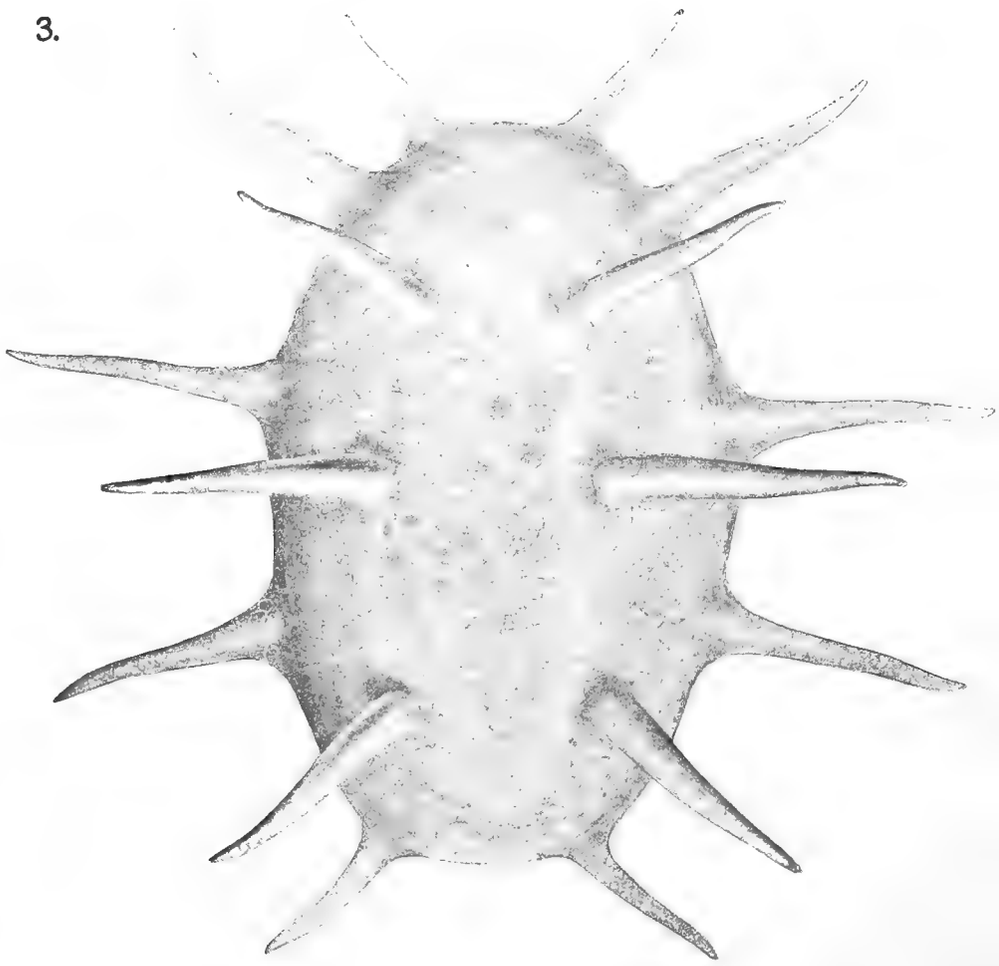
2.



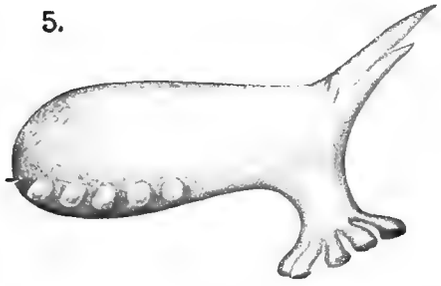
4.



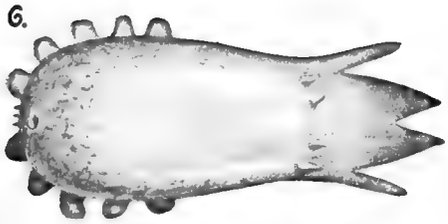
3.



5.

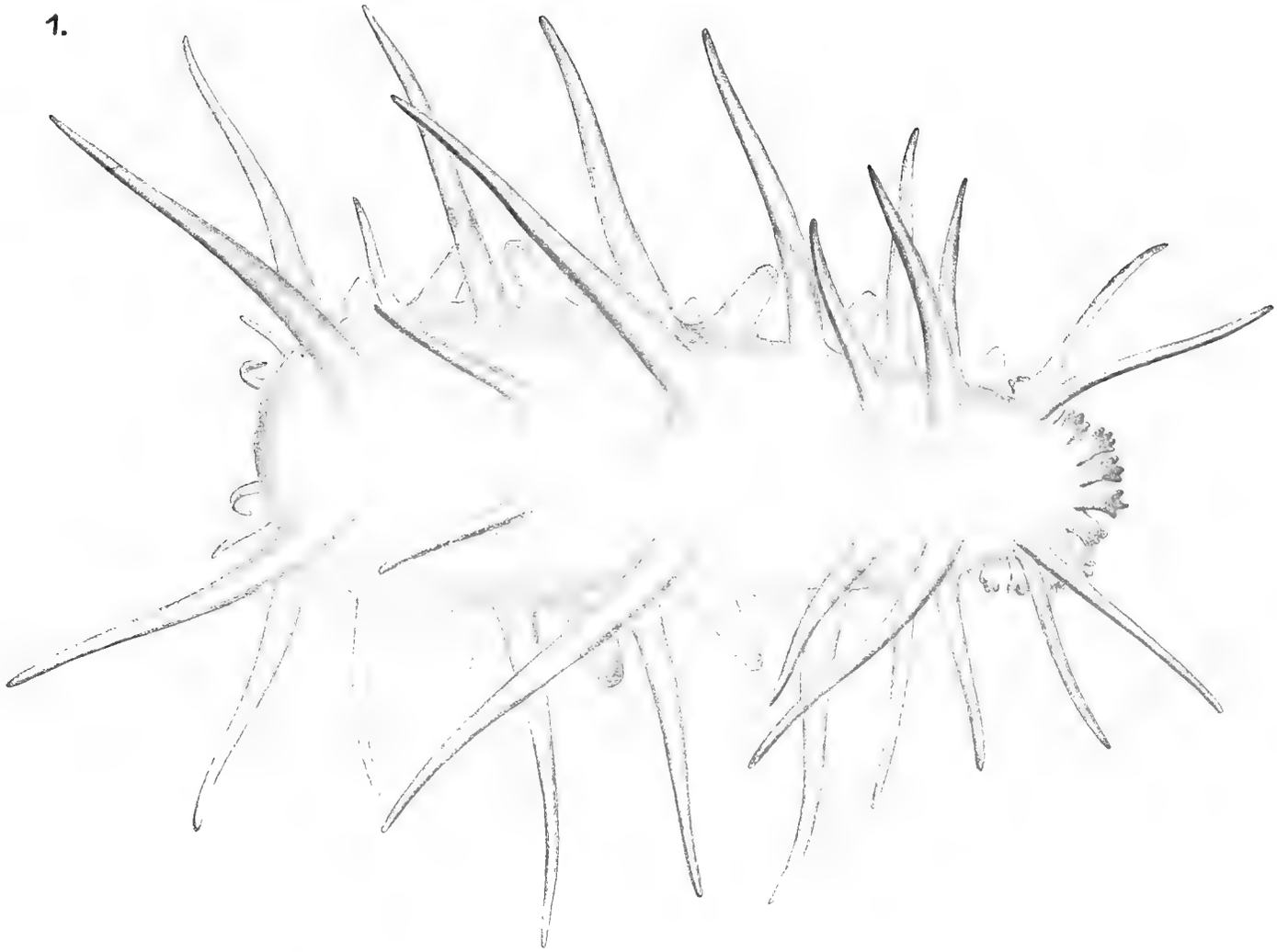


6.

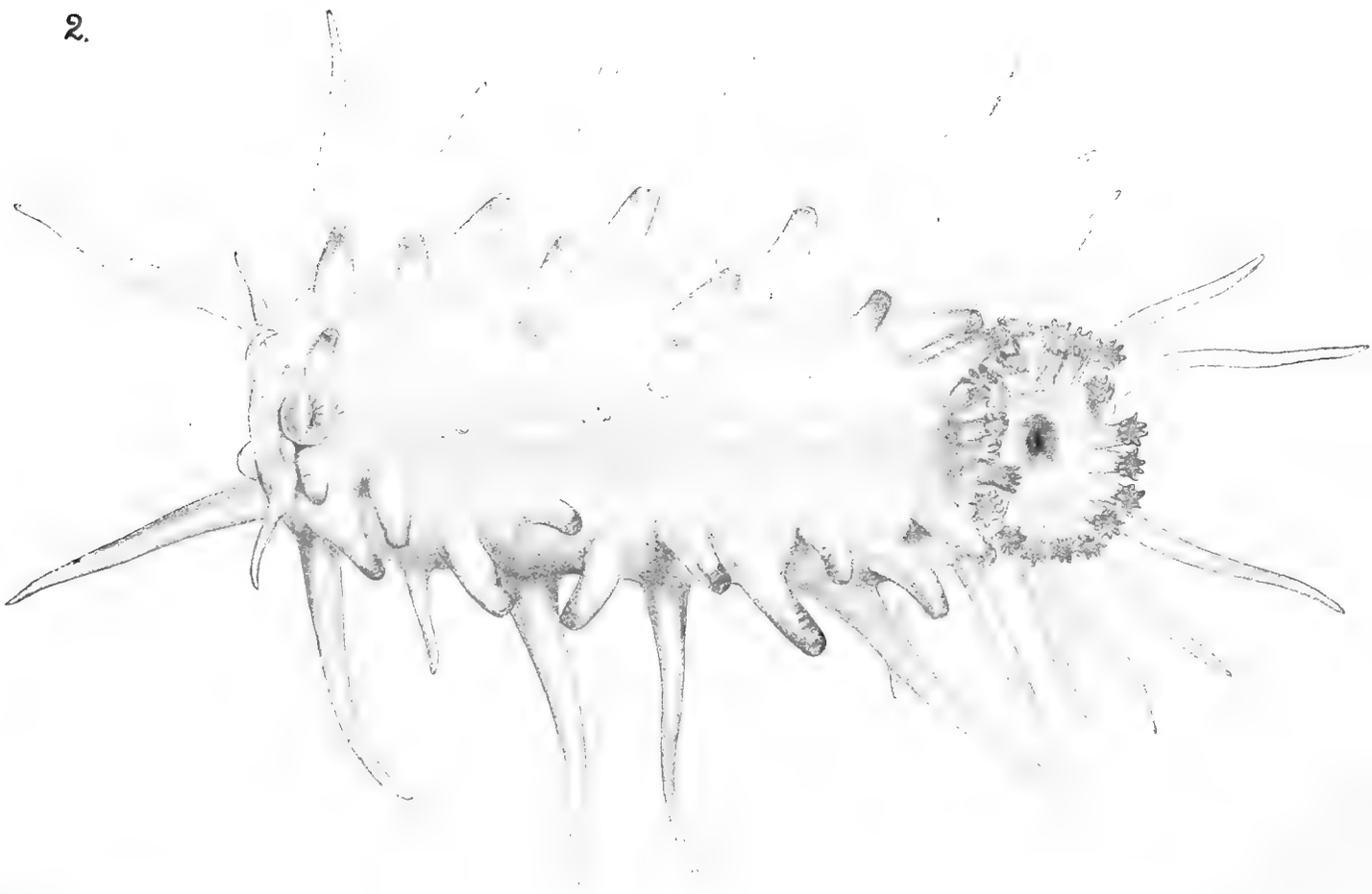


Thorolv Rasmussen del.

1.

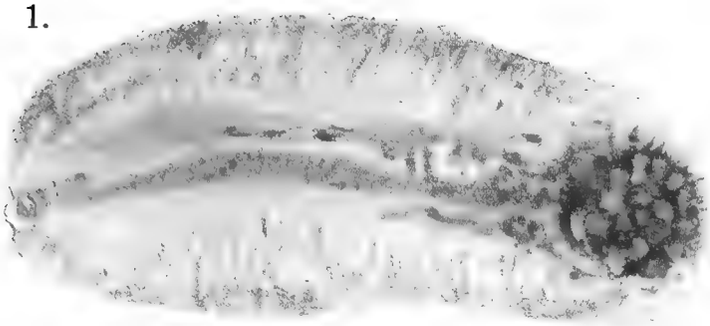


2.



Thorolv Rasmussen del.

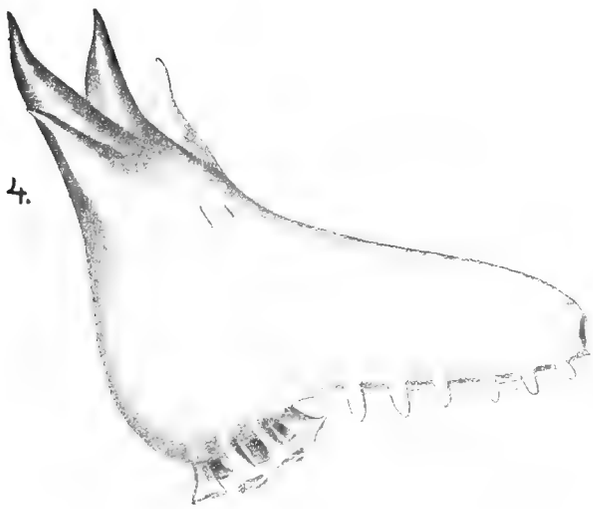
1.



2.

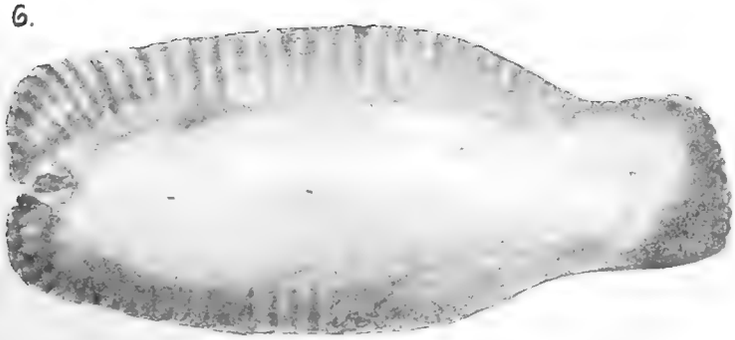
3.

4.



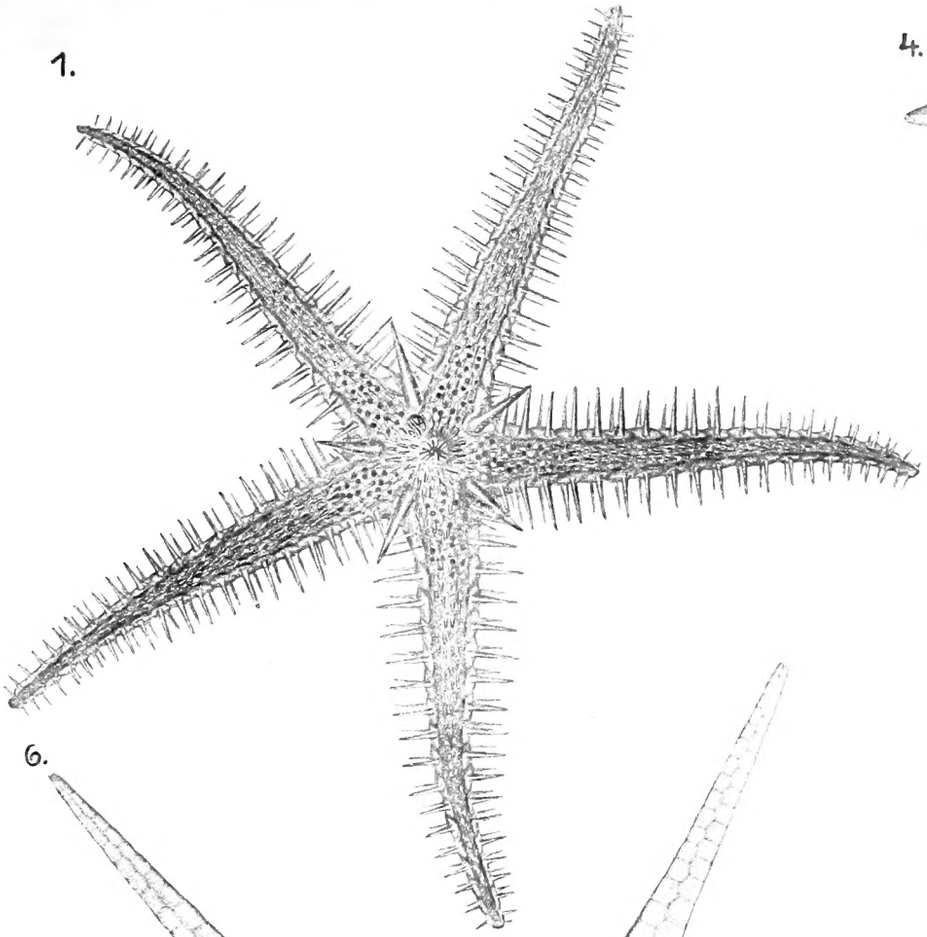
5.

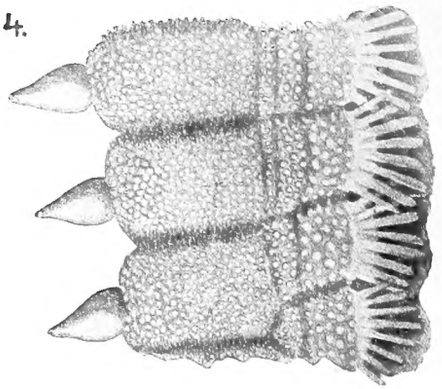
6.

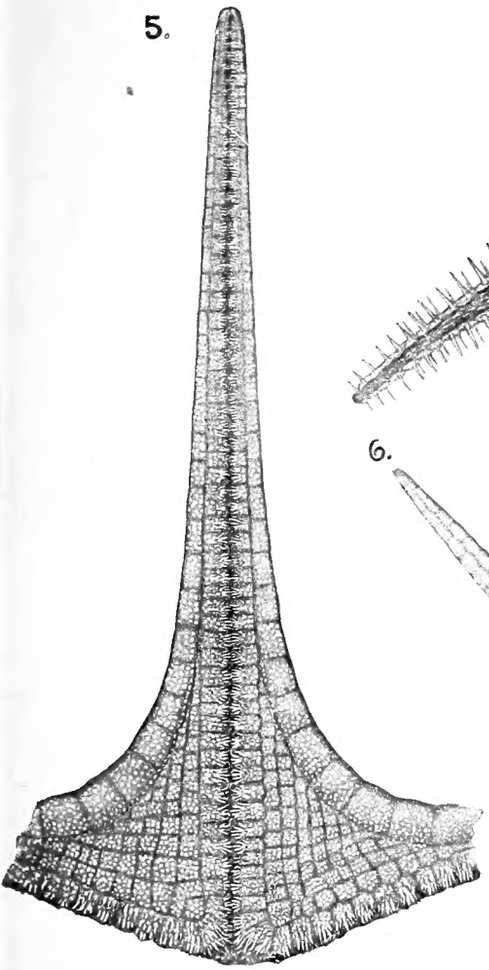


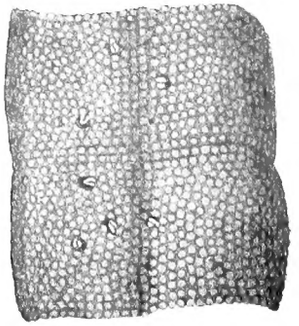
7.

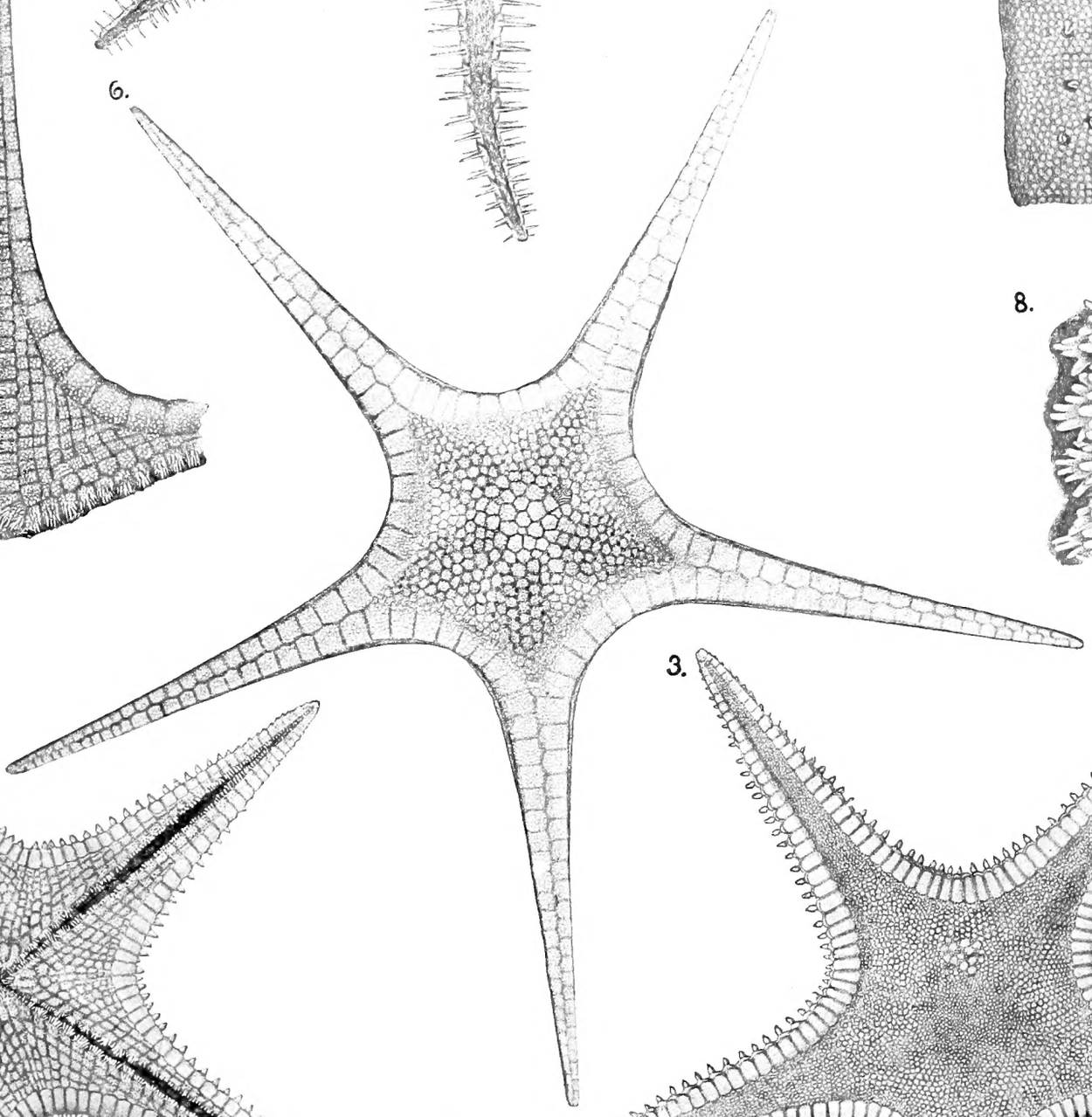
Thorolv Rasmussen del.

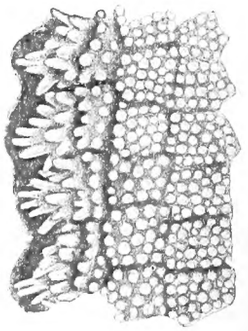




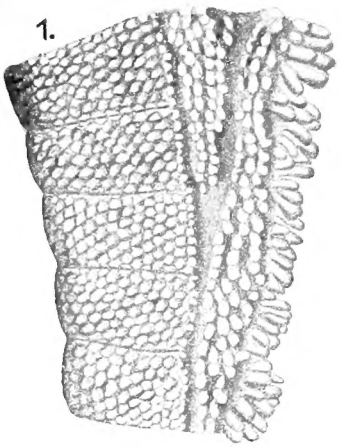


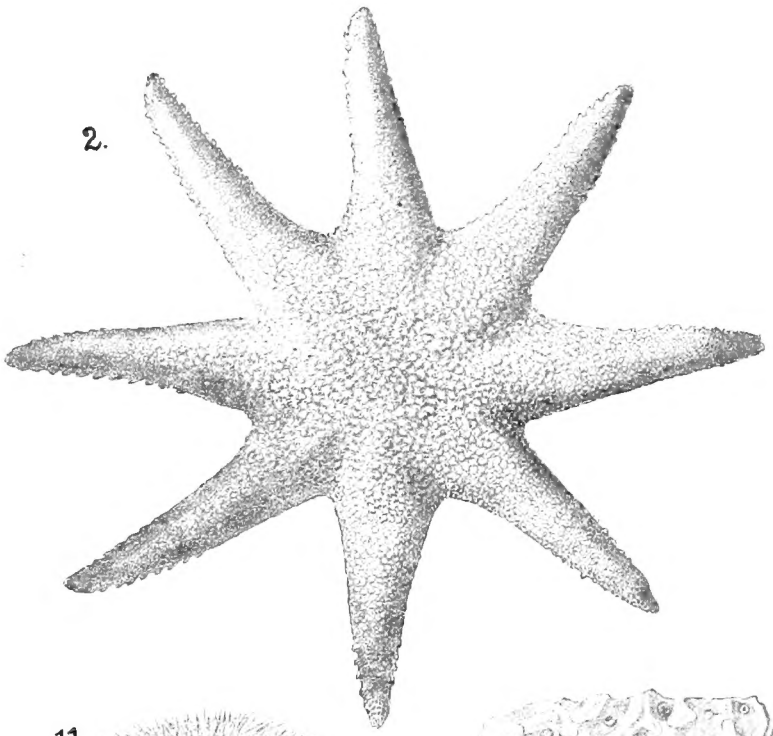


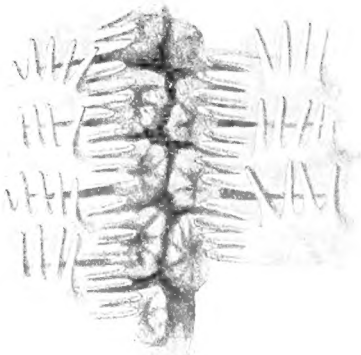


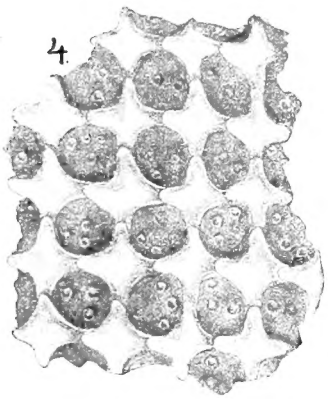


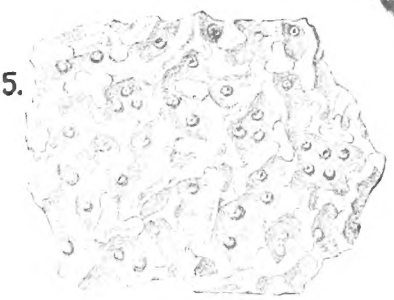
Thorolv Rasmussen del.


1.


2.

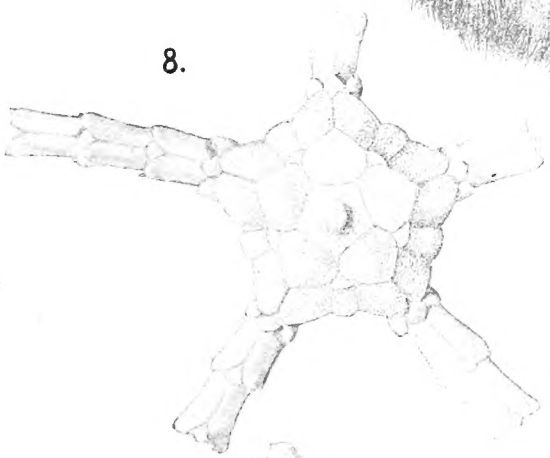

3.

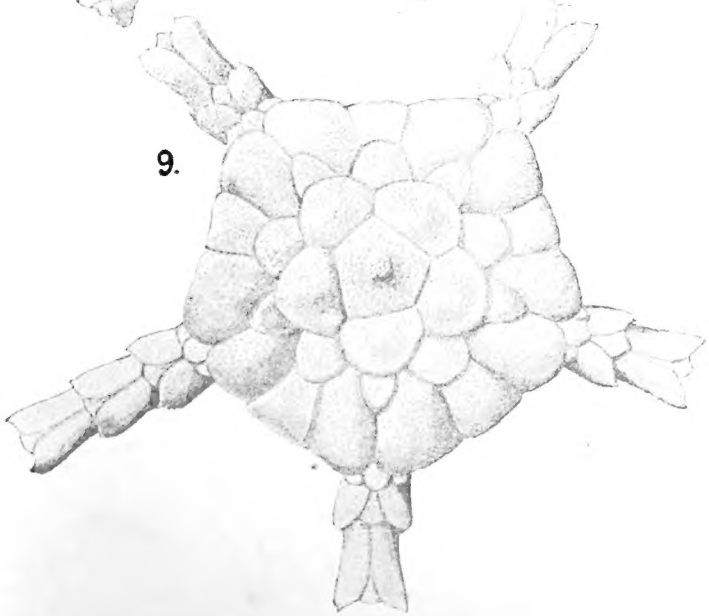

4.

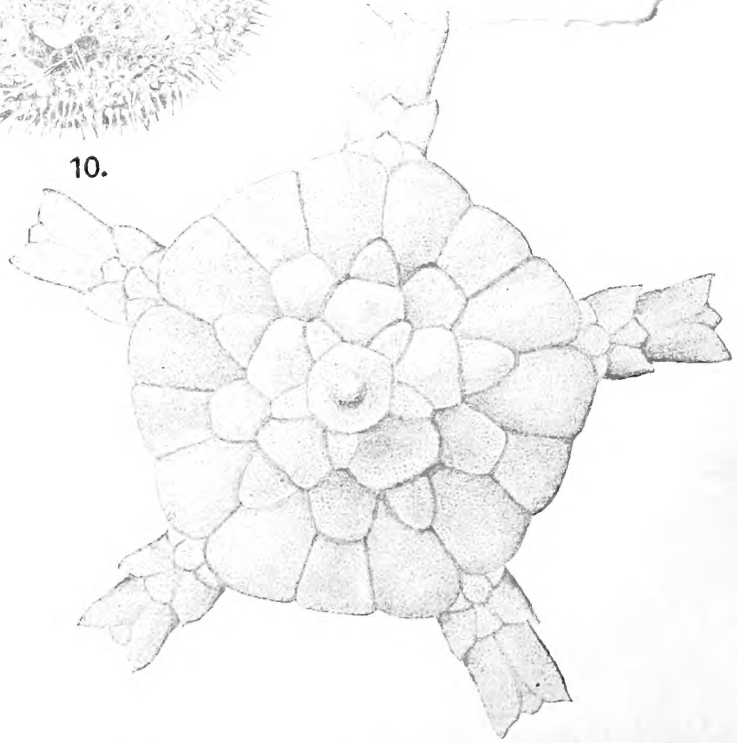

5.

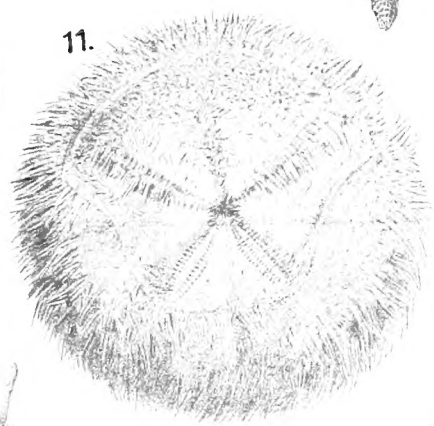

6.

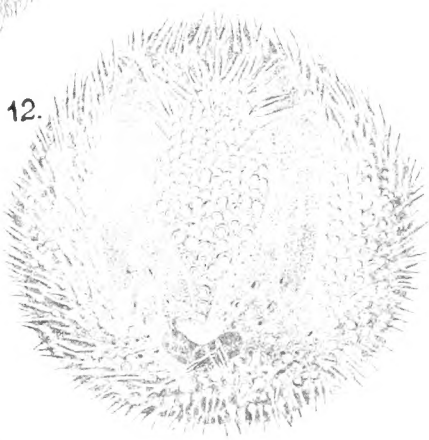

7.


8.


9.


10.


11.


12.

Thorolv Rasmussen del.