SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES

THE

# RAY SOCIETY.

INSTITUTED MDCCCXLIV.



*This Part is issued to the Subscribers to the* RAY SOCIETY *for the Year* 1920.

LONDON:

MCMXXII.

PRINTED BY ADLARD AND SON AND WEST NEWMAN, LTD.,
LONDON AND DORKING.

88.4
15X
4, Pt. 1
MERT. ZOOL

104
a

A

# MONOGRAPH

OF THE

# BRITISH MARINE ANNELIDS.

VOL. IV, PART 1.

POLYCHÆTA—

HERMELLIDÆ TO SABELLIDÆ.

BY

**WILLIAM CARMICHAEL McINTOSH, M.D.Edin.,**

L.R.C.S.E., LL.D. (St. AND. & EDIN)., D.Sc.(Oxon.), F.R.S., F.R.S.E., F.L.S., C.M.Z.S., V.D., J.P., etc.,

PRESIDENT OF THE RAY SOCIETY; PROFESSOR EMERITUS OF NATURAL HISTORY IN THE UNIVERSITY OF ST. ANDREWS; LATELY DIRECTOR OF THE UNIVERSITY MUSEUM AND OF THE GATTY MARINE LABORATORY; SUB-COMMISSIONER AND SCIENTIFIC REPORTER TO THE TRAWLING COMMISSION UNDER LORD DALHOUSIE, 1883–1885; SCIENTIFIC MEMBER OF THE FISHERY BOARD FOR SCOTLAND, 1892–1895; MEMBER OF THE IRISH INLAND FISHERIES COMMISSION, 1899–1901.

LONDON:
PRINTED FOR THE RAY SOCIETY,
AND SOLD BY
DULAU & CO., LTD., 34–36, MARGARET ST., CAVENDISH SQUARE, W. 1.

1922.

SMITHSONIAN
MAY 3 1977
LIBRARIES

# CONTENTS OF VOL. IV. PART I.

## POLYCHÆTA (*continued*).


| | PAGE |
|---|---|
| Family XXVI.—Hermellidæ | 1 |
| Genus CXXXII.—Tetreres | 6 |
| *Tetreres murata*, Allen | 7 |
| Genus CXXXIII.—Sabellaria | 12 |
| *Sabellaria spinulosa*, R. Leuckart | 12 |
| *S. alveolata*, L. | 22 |
| Family XXVII.—Amphictenidæ | 33 |
| Genus CXXXIV.—Pectinaria | 37 |
| *Pectinaria belgica*, Pallas | 38 |
| Genus CXXXV.—Amphictene | 43 |
| *Amphictene auricoma*, O. F. Müller | 43 |
| Genus CXXXVI.—Lagis | 48 |
| *Lagis Koreni*, Malmgren | 49 |
| Genus CXXXVII.—Petta | 58 |
| *Petta pusilla*, Malmgren | 58 |
| Family XXVIII.—Ampharetidæ | 61 |
| Genus CXXXVIII.—Ampharete | 65 |
| *Ampharete acutifrons*, Grube | 66 |
| Genus CXXXIX.—Amphicteis | 70 |
| *Amphicteis Gunneri*, Sars | 70 |
| Genus CXL.—Sabellides | 74 |
| *Sabellides octocirrata*, Sars, var. *britannica* | 75 |
| Genus CXLI.—Samytha | 78 |
| *Samytha sexcirrata*, Sars | 78 |
| Genus CXLII.—Amage | 80 |
| *Amage auricula*, Malmgren | 80 |
| Genus CXLIII.—Melinna | 82 |
| *Melinna cristata*, Sars | 83 |
| *M. elisabethæ*, McIntosh | 86 |
| *M. palmata*, Grube | 88 |
| Family XXIX.—Terebellidæ | 90 |
| Sub-Family I.—Amphitritea | 106 |
| Genus CXLIV.—Amphitrite | 106 |
| *Amphitrite cirrata*, O. F. Müller | 106 |
| *A. groenlandica*, Malmgren | 111 |
| *A. affinis*, Malmgren | 112 |
| *A. gigantea*, Montagu | 114 |
| *A. figulus*, Dalyell | 117 |
| *A. scylla*, Savigny | 122 |
| Genus CXLV.—Polymnia | 125 |
| *Polymnia nesidensis*, Delle Chiaje | 126 |
| *P. nebulosa*, Montagu | 129 |
| Genus CXLVI.—Lanice | 137 |
| *Lanice conchilega*, Pallas | 137 |
| Genus CXLVII.—Loimia | 146 |
| *Loimia montagui*, nom. nov. | 147 |
| Genus CXLVIII.—Nicolea | 149 |
| *Nicolea venustula*, Montagu | 150 |
| Genus CXLIX.—Pista | 157 |
| *Pista cristata*, O. F. Müller | 158 |
| Genus CL.—Laphania | 162 |
| *Laphania Boeck*, Malmgren | 163 |
| Genus CLI.—Leprea | 165 |
| *Leprea lapidaria*, L. | 165 |
| Genus CLII.—Thelepus | 169 |
| *Thelepus cincinnatus*, O. Fabricius | 170 |
| *T. triserialis*, Grube | 177 |
| Genus CLIII.—Streblosoma | 180 |
| *Streblosoma Bairdi*, Malmgren | 181 |
| Genus CLIV.—Parathelepus | 183 |
| *Parathelepus collaris*, Southern | 184 |
| Genus CLV.—Proclea | 185 |
| *Proclea Graffi*, Langerhans | 185 |
| Sub-Family II.—Polycirridea | 187 |
| Genus CLVI.—Polycirrus | 187 |
| *Polycirrus medusa*, Grube | 190 |

PAGE

Family XXIX.—Terebellidæ (*cont.*)—
Sub-Family II.—Polycirridea (*cont.*)—
Genus CLVI.—Polycirrus (*cont.*)—
*P. aurantiacus*, Grube . . 193
*P. caliendrum*, Claparède . . 197
*P. hæmatodes*, Claparède . . 198
*P. denticulatus*, De St. Joseph . 201
Genus CLVII.—Hauchiella . . 201
*Hauchiella tribullata*, McIntosh . 201
Genus CLVIII.—Lysilla . . . 203
*Lysilla Loveni*, Malmgren . . 203

Sub-Family IV.—Trichobranchidea . 205
Genus CLIX.—Trichobranchus . . 205
*Trichobranchus glacialis*, Malmgren 205

PAGE

Family XXIX.—Terebellidæ (*cont.*)—
Sub-Family IV.—Trichobranchidea (*cont.*)—
Genus CLX.—Terebellides . . 209
*Terebellides Strœmi*, Sars . . 209

Family XXX.—Sabellidæ . . . 215
Genus CLXI.—Sabella . . . 222
*Sabella penicillus*, L. . . . 223
Genus CLXII.—Potamilla . . . 232
*Potamilla reniformis*, Leuckart . 232
*P. Torelli*, Malmgren . . . 239
"*Sabella, B.C.*" . . . . 243
Genus CLXIII.—Laonome . . 245
*Laonome Kröyeri*, Malmgren . 245
Genus CLXIV.—Branchiomma . . 247
*Branchiomma vesiculosum*, Montagu 247

The Council of the Ray Society desire to record, with gratitude, that substantial donations towards the cost of producing the first part of this volume have been made by—

The Royal Society.
The Carnegie Trust for the Universities of Scotland.
The Right Hon. Lord Rothschild, F.R.S.
Prof. W. C. McIntosh, F.R.S.

## LETTERS USED IN TEXT-FIGURES.

*b.* Branchial vessels.
*Be.* Nephridiopore.
*bo.* Building organs.
*br. gl.* Brown glands.
*cc.* Dorsal body-wall.
*cil. c.* Ciliated membranous channel.
*cm.* Circular muscle.
*d.* Alimentary canal.
*dm.* Dorsal longitudinal muscle.
*glv.* Ventral gland.
*hyp.* Hypoderm.
*int.* Intestine.
*lu.* Muscular and other tissues connected with hook-rows.
*mg.* Anterior stomach.
*mg'.* Posterior stomach.
*n.c.* Nerve-cords.
*n.p.* Posterior nephridia.
*nu. c.* Neural canals.
*oc.* Eye-spots.
*œs.* Œsophagus.
*om.* Oblique muscles.
*op.* Opercular lobes.
*p.* Palps.
*pb.* Pharynx.
*pc.* Cephalic plate.
*per.* Peristomium.
*pr.* Prostomium.
*pv.* Ciliated funnel, and, in Fig. 139, proventriculus.
*r.* Ridge.
*Spm.* or ♂. Spermatozoa.
*th.* Thoracic glands.
*ul.* Uncinigerous lamellæ.
*vm.* Ventral longitudinal muscles.
*vv.* Ventral blood-vessel.

# FAMILIES, GENERA, AND SPECIES OF THE BRITISH MARINE ANNELIDS.

(ANNELIDA POLYCHÆTA, *continued.*)

---

Family XXVI.—Hermellidæ (*De Quatrefages*), *Malmgren*, 1867.

This family has borne various titles, such as *Tubularia*, Ellis; *Psamatotus*, Guettard; *Tubipora*, Linnæus; *Sabella*, Linnæus and Gmelin; *Nereis*, Pallas; *Amphitrite*, Cuvier and Duméril; *Chrysodon*, Oken; *Sabellaria*, Lamarck, De Blainville, Thompson, Grube; *Amymone*, Savigny; *Hermella*, Milne Edwards; *Hermelliens*, De Quatrefages; *Hermellacea*, Grube; *Sabellariens*, De St. Joseph.

The anterior region (the prostomium being invisible) bears two great lateral lobes homologous with the first pair of feet, which have ventrally prehensile tentacles, and dorsally a crown of opercular bristles from the fused buccal lobe. Only in the remarkable type (*Cryptopomatus Geayi*, Gravier [1]) is there a distinct prostomium soldered to the great lateral lobes, and with a median tentacle inserted ventrally. The body is composed of three distinct regions. The buccal segment has a fascicle of bristles on each side; anteriorly is a large folded lamella, hollow inferiorly, with numerous lateral tentacles. Frontal margin provided with a crown of paleæ. The posterior (caudal) region is slender, smooth, non-segmented. Feet of the anterior (thoracic) and posterior (abdominal) regions provided with ligulate branchiæ. Inferior division of the foot similar throughout and armed with bristles. Dorsally, short, pectiniform hooks occur in transverse rows on lamellæ. Tubes in masses (colonial), rigid, composed of coarse sand, or minute pebbles.

This was the sixteenth family (Sabellariadæ) of Dr. Johnston (1865), and he gave the body two regions, with a disciform head having concentric circles of dissimilar and peculiar bristles. Branchiæ in pairs on all the segments, dorsal, ligulate and narrow. Feet biramous.

The body-wall in the anterior region of *Sabellaria spinulosa*, R. Leuckart (Fig. 136), has externally cuticle and a fairly developed hypodermic layer with basement-tissue and a circular coat internally. Special lateral processes of hypoderm, muscular and other tissues bearing the hooks occur in this region. The cœlom is occupied by the large pharynx, which presents a thick wall composed of concentrically arranged circular fibres, the central cavity having a coating of columnar epithelium of considerable thickness. The dorsal longitudinal muscles are larger and more massive than the ventral, and form a thick band, while through them at intervals pass muscular fibres, widely

[1] 'Ann. Sc. nat.,' 9e sér., t. ix, p. 288, pl. vii, 1909.

separated from each other, from the hook-rows. Internally is a thick coating of sarcolemma, but only a few distinct muscular fibres. The ventral longitudinal muscles form ovoid masses often pointed internally in transverse section, and have internally the sarcolemma and muscular fibres continued from the dorsal. A wide gap separates them in the middle line. The nerve-cords are placed in the substance of each near the upper and inner border. This position removes them from contact with both the circular coat and the hypoderm, and also from the influence of the oblique muscles, which are well developed, and in an example of *S. alveolata* observed by Mr. Arnold Watson a slip passed from one oblique muscle to the adjoining one.

In the posterior region (Fig. 137) of a ripe male the muscular system is considerably altered, for the entire cœlom is occupied on each side by a great mass of sperms which stretches from the lateral body-wall to the alimentary canal, and fills up the space between the latter and the ventral wall. The atrophied dorsal longitudinal muscles form a thin arch superiorly, each separated from its neighbour, and ending in a thicker lobe in the midst of the sperms in the dorso-lateral region. The ventral longitudinal muscles are

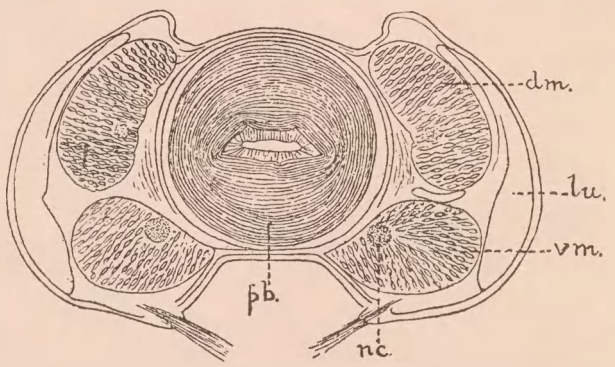



Fig. 136.—Transverse section of the anterior region of *Sabellaria spinulosa*, Leuck. *dm.*, dorsal longitudinal muscles; *nc.*, nerve-cord; *pb.*, pharynx; *vm.*, ventral longitudinal muscles; *lu.*, muscular and other tissues connected with the rows of hooks.

also considerably attenuated, and form a somewhat clavate mass in section with the narrow end innermost, but separated from the muscle of the opposite side by a long interval. The nerve-trunks lie at the upper and inner border with a large neural canal at the inner edge. The great thickness of the mucous coat of the alimentary canal is a prominent feature, since atrophy of the gut is not unusual in other polychæts when the reproductive elements distend the body-wall. The gut may have a respiratory function in this case.

In some species of *Pallasia* the neural canals are smaller in front than in the posterior region, and this raises the question as to the physiology of these structures.

Milne-Edwards[1] (1838) considered that in *Sabellaria alveolata* the centralisation of the chief vascular trunks was less complete than in the Eunicidæ, for instance, since there are two main trunks only connected posteriorly, situated laterally, and an analogous disjunction in the ventral vessel, which is single and median in the anterior fourth of the body, and a part of the posterior, but presents two parallel trunks in the median region. He corrects the view of Savigny that they were capitobranchiate annelids (the tentacles being interpreted as branchiæ). The figures illustrating the paper are excellent.

[1] 'Ann. Sc. nat.,' 2e sér., t. x, p. 208, pl. xi, fig. 3.

Fuchs (1907) describes in *Sabellaria alveolata* the blood-sinus round the gut as ending posteriorly in a thick dorsal vessel, and in front in the heart. The ventral vessel is median anteriorly, asymmetrical in the abdominal region. The vasa lateralia are largely developed, furnishing blood to the gills. The intersegmental ring-vessels are on the anterior face of the respiratory dissepiments.

Arnold Watson notes that in the fifth segment of *Sabellaria alveolata* a transverse muscle pulls the bristles closely to the side of the annelid, and another slip which crosses the cavity of the foot from front to rear acts in that direction.

This author has, with long-continued enthusiasm, observed the structure and functions of many organs in the tubicolar polychæts; thus he noted that the proventriculus (gizzard) in *Sabellaria* prepared the food for considerable periods, the grains being moved up and down by muscular contraction from end to end, even occasionally being forced into the dark part of the gullet or the commencement of the intestine, but always returned to the gizzard for further treatment. According to this observer, the blood from the intestinal sinus at the posterior end of the crop spreads out, passes over the organ (crop) in capillaries,

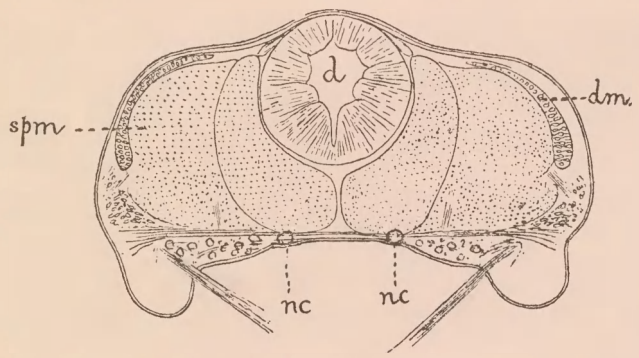



Fig. 137.—Transverse section of the posterior region (near tip of tail) of *S. spinulosa*, Leuck. *d*, alimentary canal; *dm*, dorsal longitudinal muscles; *nc*, nerve-cords; *spm*, sperms.

and collects in front of it in large lateral patches (re-forms vessels). The pear-shaped region in front of the crop has the two lateral trunks connected by transverse branches. The ventral trunk seems to fork at the tip of the caudal appendix and curve forward to form a lateral vessel on each side. He also saw a vesicle on the face of a septum (of the abdomen) which contracted horizontally, and so with the circular veins. The ventral trunk gives off lateral branches in each abdominal segment which go to the contractile bulbs. He thinks the same arrangement is continued in the caudal appendix without the "ring" mentioned by De Quatrefages at the junction of the caudal appendage and the "abdomen." The two lateral trunks or sinuses (one on each side) pass forward to the crop, giving off in each segment transverse trunks to the branchiæ, three being rather close together behind the crop, where they are lost. In front of the crop, round which a very fine blood-vessel runs, a lateral vessel again appears on each side, but soon joins into a median dorsal heart which has a heart-body, the vessel then going straight to the bases of the paleæ. Lateral trunks are given off to the branchiæ. Posterior abdominal (afferent) branches pass from the lateral trunks, which are in a line with the dorsal vessel, to the branchiæ for nine or ten segments in front of the caudal appendage. In the abdominal appendage of a translucent specimen the median vessel appeared to be

moniliform and to have a contractile bulb on each side at the origin of the transverse vessel, whilst the oblique trunks pass forward apparently internal to these, and may have no connection with the bulb.

Linnæus (1758) considered the annelid a *Teredo*.

Duméril (1806) ranged the Sabellarians under the genus *Amphitrite*, between what he calls l'Arrosoir (? *Sabella penicillus*) and the Terebellids, which were followed by the Sabellids, the Serpulids and Spirorbids being separately placed in front of *Amphitrite*.

The Hermellidæ were entered by Savigny (1820) under the Serpulids, yet his description of their general structure was fair.

This family was established by De Quatrefages in 1848, and he gives a summary of the chief characters in his Annelés (1865), placing the group between the Spionidæ and the Amphictenidæ. He arranged them according to the regions of the body, *Hermella* and *Pallasia* having three, but the former is distinguished from the latter by possessing an operculum with three rows of paleæ, whereas the latter has but two. The body in *Centrocorone*, again, has only two regions. The early memoirs of this author on the "Hermelliens" are of great interest.

Dr. Thomas Williams[1] (1851) placed the Hermellidæ along with *Amphictene* under his genus *Amphitrite*. He gives a detailed description of the function of the paleæ of the crown, of the hooks, of the "liver" which coats the intestine, and the supply of minute organisms carried to the mouth by the currents of water caused by the cilia of the "branchiæ" and other parts. He was of opinion that the water deposited these organisms in the stomach and passed onward to the vent.

Three species were described by Dr. Johnston (1865) in his Catalogue of the Worms, viz., *Sabellaria anglica* and *S. crassissima* (which probably belong to the same species, viz., *S. alveolata*) and *S. lumbricalis* (= *S. spinulosa*). His descriptions are both interesting and minute, and the figures of the bristles by his accomplished wife are easily recognized.

The family Hermellacea of Grube came between the Terebellids and Serpulids in his early classification (1851).

The segmental organs are stated by Cosmovici (1880) to occur throughout the greater part of the body. Each has the form of a trumpet, viz., the wide end at the diaphragm near the alimentary canal, and the tubular portion passing outward to open by a pore toward the dorsal division of the foot. The organs transmit the eggs. Re-investigation of these organs is necessary. The genital glands occur in pairs close to the diaphragms.

The Hermellidæ formed the only family of Levinsen's (1883) group *Hermelliformia*, and in his analytical table he placed them between the Spionidæ and the Maldanidæ, a position which does not seem to be an improvement on the classification of Malmgren.

Häcker (1896) mentions that the larva is an armed Monotrochous form (De Quatref.).

Cunningham and Ramage (1888) supposed that the so-called cephalic lobes were modified anterior feet, since in no other case in the group do bristles occur on the prostomium. They found the cerebral ganglia above the anterior end of the œsophagus, and in contact with the ventral integumentary surface of the base of the peduncles of the

[1] 'Rep. Brit. Assoc.,' 1851.

paleæ, the whole substance of which (paleæ) belongs to the body and not to the pre-oral region. Similar views have been mentioned by others and recently by Caullery. Cunningham found a large neural canal, similar to that of *Sabella*, on the inner side of each nerve-cord, as had previously been pointed out by the author.[1]

Ashworth[2] (1912) observes that large quantities of Hermellids are used for bait in the neighbourhood of Marseilles. The majority of the Polychæts, indeed, are eagerly eaten by the food-fishes.

The development of the Hermellidæ has been the subject of researches by De Quatrefages,[3] Horst,[4] von Drasche[5] and Caullery.[6]

One of the earliest investigators of the development of the Sabellarians was De Quatrefages,[7] who observed the ripe ova in the cœlomic cavity of the adults, but he did not notice the mode by which they were extruded. He followed the changes subsequent to fertilisation, as well as the extrusion of two bodies (polar bodies ?), the segmentation, early formation of the digestive system, and the assumption of cilia. His views about the similarity of the serous (external) layer in fertilised and unfertilised ova would not now be held.

Caullery[8] (1914) began where his predecessors left off, viz., the trochophore stage, in which the larva is pyriform (somewhat earlier than in Plate XCIV, fig. 9). The prostomial region is greatly developed, with an apical tuft of cilia, a red eye-spot, and an area with large touches of yellow pigment more or less disposed in three concentric belts. The pre-oral ciliated ring (prototroch) is well developed, with the mouth behind it, whilst on each side is a tuft of long, jointed and barbed bristles inserted into a differentiated region with muscles. At the posterior end are a few touches of yellow pigment. The accomplished French author points out that it is difficult to distinguish this early stage from larval Spionids, yet from his studies at Wimereux he clears up the subject by demonstrating that the development of the palps in the Sabellarian is much less rapid than in the Spionids, which also develop, as the larva elongates, simple capillary bristles in the segments behind (Plate XCIV, figs. 10 and 12), and which, like the jointed forms, are provisional bristles during the pelagic stage. Finally, the anal ring of cilia is much more conspicuous in the Sabellarian larva (Plate XCIV, fig. 11). As Caullery's species at Wimereux was in all probability *Tetreres* (*Pallasia*) *murata*, Allen, the figures in the Monograph (Plate XCIV) slightly differ, and apparently are those of *Sabellaria spinulosa*, Leuckart.

Caullery describes and figures four subsequent stages, the second (that already described being the first) showing more distinct segmentation, two eyes, increased pigmentation, and in the middle two violet rings. In the third stage there are three

[1] 'Proceed. R. S. E.,' 1876—7, p. 10 (sep. copy).
[2] 'Catal. Chætop. Brit. Mus.,' p. 100.
[3] 'Ann. Sc. Nat. Zool.,' 3e sér., t. viii, 1847, and t. x, 1848.
[4] 'Versl. Med. K. Akad. Vet. Amsterdam,' 2e R., 16 Th., 1881.
[5] 'Beitr. Entwickel. Polychæt.,' 2tes Heft, Wien, 1885.
[6] 'Bull. Soc. Zool. France,' t. xxxix, p. 168, with text-figs.
[7] 'Ann. Sc. Nat. Zool.,' 3e sér., t. viii, p. 99.
[8] *Op. cit.*, p. 169.

pigmented (violet) rings, and two behind in process of formation. The fourth stage has five to six segments; the prostomial region is notably enlarged so that the larva is mushroom-like. In the fifth stage the yellow pigment is greatly increased on the prostomium in concentric rings, two eyes are on each side, long cilia occur on the border of the prostomium and there are two palps with yellow pigment. The œsophagus has dense walls, whilst the intestine is wide. Each segment has a belt of violet pigment and touches of yellow surround the anal region. The buccal segment has glandular bands ventrally and developing tentacles; the following segment also has a glandular belt (in the fixed larva), latero-ventrally a minute cirriform lobe and laterally three others. Four segments are furnished with long and somewhat spatulate bristles corresponding with those pertaining to *Tetreres*, Caullery. Above each is a minute tubercle, indicating the future branchiæ. No ventral bristles have appeared. The posterior segments dorsally bear hooks of the Sabellarian type, and the anal ring of cilia is ornamented by touches of yellow pigment, and so with the anal cone.

Häcker[1] (1898) thought the *Mitraria*-larvæ from the "Plankton Expedition" pertained to the Hermellidæ since the remarkable bristles were paddle-shaped at the tip with a central spine like that seen in *Sabellaria* (*Pallasia*) *Johnstoni* of the "Challenger."

As noticed for centuries the Hermellids are conspicuous, both between tide-marks and beyond it, by the formation of masses of firmly cemented sandy tubes, those of *S. spinulosa* in the littoral region often covering large surfaces of rocks which have been bored by *Pholas*, and thus to some extent preventing their rapid disintegration. In the estuaries of English rivers entering the North Sea, as well as in certain Scotch bays, *S. alveolata*, on the other hand, occurs in masses which are brought up from the bottom by dredge or trawl, and called by the fishermen "Ross." Both species seem to range to deeper water, *S. spinulosa* especially abounding on shells in Scottish seas.

### *Genus* CXXXII.—Tetreres, *Caullery*, 1913.

*Nereis*, Pallas; *Terebella*, Gmelin; *Hermella*, Savigny, Schmarda; *Sabellaria*, De Blainville, Grube; *Pallasia*, De Quatrefages.

Cephalic lobes form two elongated pillars pointed at their anterior ends. Dorsal surface slightly concave, and each pillar has a row of more than twenty papillæ on the external margin, besides two rows of paleæ—external and internal. Paleæ of the external row more feeble and more numerous than those of the internal row, and both are sabre-shaped with smooth edges. Inner and ventral surfaces of the cephalic lobes covered with numerous tentacular filaments. Mouth ventral, between the cephalic lobes, surrounded by a large hood (of upper and lower lips—Arnold Watson), its posterior border having ten rounded cushion-like lobes, and laterally a much larger conical lobe, outside which is the dorsal cirrus of the first segment. Tentacles (palps of some) two, on the dorsum of the lip, D-shaped in section, grooved and crenate. Body of three regions, the anterior or "thoracic" region having four setigerous processes on each side. Bristles long, hair-like, furnished with

[1] 'Pelag. Polychæt. u. Achætenlarven, Plankton Exped.,' p. 16, Taf. i, figs. 6—10, and Taf. ii, figs. 11—13.

rows of spikes. Hooks long, narrow and serrated. Tube massive, of fragments of shells and pebbles.

Caullery[1] (1913) gives sound reasons for dividing De Quatrefages' genus *Pallasia* into two, viz. *Pallasia sensu stricto*, and *Tetreres*,[2] Caullery. The former has three anterior "parathoracic" segments. The paleæ of the external row of the crown are inflected and pennate at their extremity, whilst those of the inner row are smooth and fine. *Tetreres*, on the other hand, whilst agreeing with *Pallasia* in general characters, differs in having four "parathoracic" segments. Paleæ of the external row more feeble and more numerous than those of the internal row. Both are sabre-shaped with smooth edges.

The genus *Phalacrostemma* of Marenzeller, species of which come from the Azores and Madeira, is a closely allied one.

1. Tetreres murata, *Allen*, 1904. Plate CXVIII, figs. 1—1 *d*—body and tube; Plate CXXIII, figs. 1—1 *h*—bristles, paleæ, hooks; Plate CXXV, figs. 8 and 8 *a*—capillary bristles.

*Specific Characters.*—Cephalic region with twenty papillæ on the pillars. Paleæ of the outer row thirty-four to forty-five, thin, smooth, straight, translucent, flattened, with long tapering points. Paleæ of the inner row (about eleven visible) are stouter, stronger, bright yellow, straight, flattened, and directed forward. Behind the rows of paleæ are two stout, black hooks imbedded in fleshy papillæ. Tentacles attached directly to the surface of the lobes. Body about 130 mm. in length. Branchiæ dark olive-green, twenty to twenty-one on each side. Caudal tube dark green. Hooks with eight teeth.

Synonyms.

1904. *Pallasia murata,* Allen. Journ. M.B.A., vol. vii, p. 232.
1906. „ „ idem. Ibid., vol. vii, p. 299, pl. x.
1912. „ „ Crawshay. Ibid., vol. ix, p. 348.
1913. *Tetreres murata,* Caullery. Bull. Soc. Zool. France, t. xxxviii, p. 200.
„ *Pallasia murata,* McIntosh. Ann. Nat. Hist., ser. 8, vol. xii, p. 169.
1915. „ „ Allen. Journ. M.B.A., vol. x, p. 645.

*Habitat.*—Dredged in the neighbourhood of the Mewstone and Stoke Point, Plymouth, and in the English Channel. Dr. Allen states that the tubes are very common, and are widely distributed over the Channel on the rough grounds. It is rare, however, that the animals are secured, as the tubes appear to be buried vertically in the gravel and the inhabitant can retreat downward. Common at Plymouth (Crawshay).

The modification of the two great pillars or lobes (so-called peristomial lobes and feet of others) which carry the bristles of the crown is considerable, since on the dorsum a groove commences in the anterior branchial region, soon forms a broad sulcus (Fig. 137 *a*), which debouches at the point of separation of the two long grooved and obliquely

[1] 'Bull. Soc. Zool. France,' t. xxxviii, p. 198.

[2] τετρηρης, galley of four series of rowers.

bevelled divisions. Each of these lobes is a massive process which tapers in lateral view anteriorly, has a twisted sulcus dorsally, and the firm margins of which have the slender paleæ. Externally is a row of tapered papillæ, as in other forms, which, commencing on the edge behind the paleæ, cease at the rounded anterior end of the lobe. The external paleæ (Plate CXXIII, figs. 1 and 1′) form a single row of spatulate bristles which follow the curve of the margin, and are slender posteriorly, stronger in front. Moreover, the posterior bristles slope upward and forward, whereas the anterior are nearly proclivous. Each of the posterior bristles starts from a rounded sac at the base, is much tapered, then gradually dilates into a broad, flattened, translucent blade, after which it diminishes to the finely-pointed tip (Plate CXXIII, fig. 1 *a*). The anterior bristles are larger, and, as mentioned, they project nearly horizontally when the animal lies flat in a vessel. These join the still more powerful anterior series of the inner row, which, in some cases, extend boldly from the inner half of the anterior curve. The anterior end of the inner

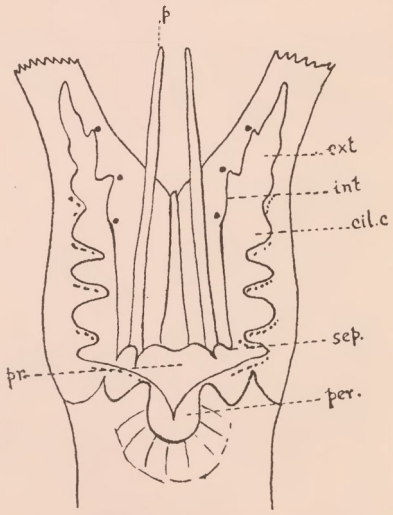



Fig. 137 *a*.—Diagram of the anterior region of *Tetreres murata*. *p*., palps; *cil.c*., ciliated channel formed of membrane; *ext*., external border; *int*., internal border; *sep*., separation from the prostomium *pr*.; *per*., peristomium (lower lip). After Arnold Watson.

row of paleæ has the strong bristles just mentioned which present stout and not very acute points (Plate CXXIII, fig. 1 *b* and 1 *b*′). When fractured long fibres hang from the interior. These powerful bristles project considerably from the surface, but behind the anterior edge the rest of them are deeply imbedded in the tissues, only the tip being visible. All are directed obliquely forward and slightly upward. Attached to these is a minute Campanularian with a ringed stalk, a comparatively large theca and a thick rhizome. Next these powerful bristles are less robust forms with a tapered base, flattened and pointed tip. Those deeply inserted in the tissues behind have the thickened chitinous tips of the larger forms in front, whilst their hold of the tissues will enable them to act as levers or protective organs. The base has a rim and abuts also on the rounded mass seen in the outer posterior paleæ.

Opposite the last and larger external papilla of the coronal row is, beneath the crest of the ridge on each side, a strong, sharp, dark brown, curved hook which is guarded by the flaps of a conical, fleshy papilla. The point of the hook in the preparations is directed inward, but it probably can be moved in various directions. The long straight bristles

found in the tissues in this region in *Sabellaria spinulosa* may be the homologues of these hooks. In the hollow in front of the hooks a series of symmetrical folds converge to the margin of the fork in front of the mouth, whilst the groove behind has transverse or curved furrows and much brown pigment.

The ventral face of each coronal lobe is slightly turned inward and densely covered with proportionally small tentacles, which in their firm attachment and general aspect resemble those of *Phoronis* rather than *Sabellaria*. These are attached directly to the surface of the lobes, and thus differ from the arrangement in *Sabellaria*. In some they form oblique rows slanting from behind forward and outward at their commencement on the external ridge posteriorly. After a short distance they spread to the inner border and thus cover the ventral surface with the exception of a belt internally, but the rows are not evident either on the inner border or on the outer after the middle. Those in front and internally do not present the same regularity in the rows; indeed, in one they were irregular. Both show a bare longitudinal stripe along the centre—that is, between the outer and inner series—till near the tip. The tentacles are richly ciliated along one surface, show an afferent and an efferent vessel, and are coloured of a deep brown. The great length of the "peristomial" lobes and the extended surface covered by the tentacles indicate a special function.

The mouth opens at the posterior end of the great lobes and behind the tentacles. In contraction it forms a puckered longitudinal slit with two overlapping flaps in front, whilst in partial dilatation it has a series of separate folds or "cushions" externally, and internally the posterior folds of the hood; whilst in front the hood is folded forward in the middle line like an epistome, and forms a collar at each side before joining the posterior folds. The whole would thus form a characteristic funnel leading to the mouth. The hood is fixed all round a little behind its margin. Mr. Arnold Watson, who at first thought that the frilled membrane which runs from the extremity of each peristomial lobe was an extension from the sides of the prostomium, has by careful examination of the living forms now (1916) found that though this membrane is in its lowest (most posterior) part united with the edge of the prostomium, yet it is distinctly and deeply separated at its free upper edge. Its origin, therefore, is the same as the outer edge of the channel, and both should be regarded as peristomial. On the dorsal aspect of the hood are the two long tentacles which have a smooth dorsal edge and a deeply grooved ventral surface with frilled margins—probably ciliated in life—and they occupy a smooth and pigmented area of the pillars to the inner edge of the outer tentacles.

Besides the two lateral tentacles (palps of some) a median subulate one springs from a slightly elevated and antero-posteriorly elongated base somewhat in front of the lateral. This may have a function in connection with the forward frill of the hood. The parts thus differ considerably from those of *Sabellaria*, especially in the great development of the hood. The lobes overlapping each other and the hood present evidences of transverse striation, so that the function is special. Externally is a large lanceolate lobe (Dr. Allen's neuropodial cirrus of the first segment) connected at its base by a frill with a small elevation bearing bristles (ventral, Allen), as in *Sabellaria*.

Allen thinks the two tentacles have the same structure as those of the Spionidæ and Disomidæ, being D-shaped in section with the grooved surface bordered by a crenate

membrane. This feature is common in the Terebellids and others. Meyer, like Cunningham and Ramage, again suggests that the peristomial lobes may represent the dorsal division of the foot of the first segment, and Allen says that in *Pœcilochætus* the feet of the first segment are much enlarged and directed forward. Meyer further thinks that the Hermellidæ are closely related to the Spionidæ.

The body behind the foregoing is divided into three regions, viz. the first, devoid of hooks, and with four bristled segments, the second of about forty segments (Allen) with bristles, hooks and gills, and lastly, the caudal tube with its crenate and frilled extremity. The dorsal surface anteriorly is somewhat flattened, or at first grooved, then rounded posteriorly, whilst ventrally it is rounded in the first region and grooved in the second. The first region is firm and rounded, then a slight dilatation occurs at the commencement of the second, and little tapering ensues till near the tail, where, after gently diminishing, it tapers somewhat abruptly to the caudal tube. The general colour of the body is buff, with dark chocolate-brown markings in the region of the thorax and peristomium. The branchiæ are dark olive-green, and the smooth caudal portion is also dark green (Allen). The first segment presents dorsally a pair of branchiæ somewhat less than the second, then a free lamella divided into two, viz., a truncated flap with a conical median papilla, followed by another with two papillæ, broadly conical, then the setigerous papilla, and lastly the ventral cirrus, which is conical on one side and bifid on the other. The bristles differ from the succeeding in being longer, simple, finely tapered and smooth (Plate CXXIII, fig. 1 *c*). They therefore correspond in structure with the enclosed bristles observed in *Sabellaria spinulosa*, and are usually, in the preparations, directed forward and inward toward the mouth.

The other bristles of the region, viz. on segments 2—5, consist of flattened spatulate forms with translucent tips—split like a brush and directed dorsally forward and slightly inward. Each (Plate CXXIII, figs. 1 *d* and 1 $d^1$) has a fillet or rim at the base, then the striated shaft slightly dilates all the way upward to the flattened faintly striated blade, which has a brush-like tip. When these bristles pierce the surface, the tip is pointed and entire, but it subsequently becomes frayed. In each tuft between these are slender tapering bristles (Plate CXXIII, fig. 1 *e*) with hair-like tips which are minutely spiked so that foreign structures readily adhere. These are shorter than the spatulate forms. The dorsal bristles of this region are powerful organs borne by four large flattened lamellæ, which increase from the first to the last, and have a direction obliquely outward and backward. Their structure is uniform throughout, each tuft having large flattened spatulate bristles arising from a bristle-sac or cell, the striated shaft dilating gently from the base to the oar-like tip where a more decided enlargement occurs, and then slightly narrowing distally.

The next region of the body is characterised by the great development of the branchiæ, and by the presence of the forty lateral lamellæ for the hooks. A typical foot consists of the branchial process dorsally, the thick lamellæ with the hooks on the free ridge, which has a rounded end dorsally, but ventrally the obliquity of the edge leaves a bluntly conical process followed by an acutely conical cirrus or flap behind the ventral bristles, and lastly, the edge of the latter is connected with the body by a free frill with a notch in its margin. Such is the condition in one of the large feet in front, but by-and-by

the bristles become more prominent and longer, the uncinigerous flap projects more laterally than ventrally, and the region of the conical cirrus becomes a flattened ridge with a small papilla ventrally—behind the prominent setigerous process. The ventral bristles are in front directed obliquely inward and forward, but as they become longer and more slender posteriorly they have a tendency to slope outward and forward, and lastly, in front of the caudal process, the long silky hairs are directed backward, as, indeed, Dr. Allen's figure indicates.

In structure the ventral bristles (Plate CXIII, fig. 1 *e*) have long smooth shafts with whorls of spikes on the tip, which is extremely attenuate. Moreover, in glancing at the fascicles it is apparent that two series of bristles are present, viz., the stronger kind just described, and a less robust series which are finely tapered and quite smooth. All have tapered bases with the fillet at the tip, and the shafts are translucent. The same structure prevails in those immediately in front of the caudal process, the whorls of spikes being very distinct, but the smooth bristles have now attained pre-eminence, and their finely tapered extremities stretch far beyond those with the whorls of spikes.

The branchiæ are twenty-one in number, including the rudimentary forms posteriorly, and are of a deep brown colour. The first is smaller than the second and has only a single frill. The second is flattened and has a double frill—that is, one along each edge. Those following have a single frill situated along the anterior and inner border. They reach their maximum size about the seventh or eighth segment of the third (abdominal) region, and thereafter diminish in bulk, the frill disappearing in three or four of the more slender terminal branchiæ.

The hooks, which form dense rows on the edges of the lamellæ, have an elongated form (Pl. CXXIII, fig. 1 *f*), the posterior outline being almost straight, a very slight convexity occurring in the middle. In the anterior hooks the crown is rounded, the outline being broken only by the slight notch for the attachment of the tendon. As a rule six recurved teeth are present, though a minute additional one is often seen at the crown. The prow is somewhat narrower than the crown and is also more or less rounded; minute incurvations for the attachment of the two tendons, however, occur. On the other hand the posterior hooks (Plate CXXIII, fig. 1 *g*) have a distinctly concave posterior outline and a more convex anterior edge usually with eight recurved teeth, the crown and base being similar to those in front.

The caudal appendix shows four or five transverse ridges and papillæ on each side at its commencement ventrally, as if such indicated a continuation of segments. On the dorsal surface rings only occur (Plate CXVIII, fig. 1).

The tubes (Plate CXVIII, fig. 1 *d*) are built of two layers, an internal layer of comparatively small pieces of shell or thin, flat stones, arranged with considerable regularity and forming a smooth internal surface, and an external layer of large pieces of gravel and shell forming a strong but rugged and irregular outer covering (Allen). Arnold Watson has found that the animals are social with gregarious tubes, "which are as smooth externally as can be expected since they are composed chiefly of small shells or other fragments attached by the flat surface, with here and there a larger shell at long intervals. Most of the pieces are evidently from the middle of the tube, both ends being absent, but the outer ends of the tubes are only half as thick as these, the diameter is

slightly larger, and the wall consists only of two layers, whereas there are four or five in the middle" (*in lit.*). It is possible that some of the very coarse tubes figured by the earlier authors, such as Martini, may represent those of this form.

Bernardi (1911) mentions the occurrence of a species at a depth of 555—235 m. in the Mediterranean. It would be satisfactory to ascertain if it is the same form as Allen's.

It is interesting to note how closely the bristles of Fauvel's *Phalacrostemma elegans*[1] approach those of this species, whilst differing in minute detail, the cephalic hook, for instance, being less curved.

## *Genus* CXXXIII.—Sabellaria, *Lamarck*, 1818.

Prostomium small, having in front of it the two moveable pillars, disc-like in front, and provided with three concentric rows of golden paleæ, whilst ventrally are numerous tentacles in several transverse rows. Mouth opens in the centre between the cephalic pillars. The second segment has a fascicle of two capillary bristles. Segments 3, 4 and 5 each with a lateral ramus of paleæ and capillary bristles and a ventral fascicle. The other segments have uncinigerous pinnules dorsally and tufts of capillary bristles ventrally. Body of three regions—including the caudal tube—the anterior broad, flattened, divided into segments, branchiferous; the second with branchiæ and lateral lamellæ for the hooks, and sometimes with bristles. The caudal tube is devoid of appendages. Branchiæ cirriform or ligulate, dorso-lateral, from the third segment backward, gradually diminishing and disappearing. Bristles of various kinds simple, paddle-like, brush-like and whorled, often minutely serrate. Hooks pectiniform, rather elongate, with five or six teeth. Tube of agglutinated sand-grains, solitary or in masses.

1. Sabellaria spinulosa, *R. Leuckart*, 1849. Plate CXII, figs. 1—1 *c*; Plate CXVIII, figs. 3 and 3 *a*—tubes and opercular crown; Plate CXXIII, figs. 2—2 *i*—bristles and hooks; Plate CXXIV, figs. 10—10 *b*—bristles.

*Specific Characters.*—Head with a bifid opercular crown carrying three rows of paleæ, the outer having broad paddle-shaped tips with a spiked median process and three strong spikes at each side, the middle shaped like a bill-hook or with long dagger-shaped points, and the inner having the tip bent at an angle, with a heel and long toe like a shoe. Cephalic, buccal, and first body-segments form a firm and muscular anterior region. Mouth with a transverse series of six ridges bearing purple tentacles at each side. First region of the body of three segments carrying branchiæ, short lamellæ with powerful spatulate dorsal bristles borne laterally, the tips of which are split like brushes, and rudimentary delicate spinous bristles between them. Ventrally are minute bristle-tufts of like arrangement and structure. Purplish-brown pigment on the dorsum, sides, and other parts. The second region (of about twenty-eight segments) has branchiæ and bristles dorsally, laterally lamellæ—deep in front, but long and cirrus-like in the posterior

[1] 'Camp. Scient.,' Fasc. xlvi, p. 270, pl. xxiv, figs. 1—16, 1914.

region, all bearing elongate hooks having five or six teeth in lateral view, and a distal and two basal tendons. Bristles of the first pair peculiarly modified, with short spinous tips and strong, smooth shafts, the rest having delicate shafts and finely tapered, long tips with whorls of spikes directed distally. Purplish-brown pigment is present.

Tail developed into a long tubular process with the anus at the tip. Aggregated tubes composed of coarse fragments chiefly of shell-gravel and lined by secretion, or of sand-grains neatly and firmly glued together. Masses occur on rocks, stones and shells between and beyond tide-marks. Single tubes are found on shells, stones and other sites. The tubes are closed behind.

Synonyms.

1767. *Sabella alveolata,* Linnæus. Syst. Nat., Edit. xii, p. 1268.
1805. „ *lumbricalis,* Montagu. Test. Brit., p. 549.
1807. „ „ Turton. Brit. Fauna, p. 203.
1817. „ „ Stewart. Elements, vol. ii, p. 423.
1812. „ „ Pennant. Brit. Zool., iv, p. 370.
1847. *Hermella ostrearia,* Frey and Leuckart. Beitr. Wirbell. Thiere, p. 152.
1848. „ *alveolata,* De Quatrefages. Ann. Sc. nat., t. x, p. 14.
1849. *Sabellaria spinulosa,* Leuckart. Archiv f. Naturges., Bd. xv, p. 178, note 3.
1851. „ „ ? Grube. Fam. Annel., pp. 85 and 139.
1853. *Sabella alveolaria,* Dalyell. Pow. Creat., vol. ii, p. 175, pl. xxv, figs. 1—3.
1865. *Sabellaria lumbricalis,* Johnston. Cat. Worms Brit. Mus., pp. 251 and 346.
„ *Hermella alveolata,* De Quatrefages. (Partim), Annel., ii, p. 314.
1867. *Sabellaria spinulosa,* Malmgren. Annul. Polych., p. 102, Tab. xi, fig. 66.
1872. „ „ Malm. Annul. Göteb., Kongl. vet. Samh., No. xiv, p. 94.
1874. „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 204.
1875. „ „ McIntosh. Invert. and Fishes St. Andrews, p. 128.
1876–7 „ „ idem. Proc. Roy. Soc. Edin., vol. ix, p. 379.
1879. „ „ Tauber. Annul. Danica, p. 125.
1884. „ „ Levinsen. Vidensk. Meddels., p. 180.
„ „ „ Von Drasche. Beitr. Entwickl. Polych., Hft. 2, pp. 1—7, pl. i, figs. 1—8, and pl. ii, figs. 1—7.
1888. „ „ Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 652, pl. xli, fig. 17.
1891. „ „ Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 260.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e ser., t. xvii, p. 154, pl. vii, figs. 200—203.
1897. „ „ Michaelsen. Polych. deutsch. Meere, p. 176.
1904. „ „ Allen. Journ. M. B. A., vol. vii, p. 232.
1908. „ „ Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 208.
1910. „ „ Southern. Proc. R. I. A , vol. xxviii, p. 243.
1912. „ „ Crawshay. Journ. M. B. A., vol. ix, p. 348.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 149.
„ „ „ Fauvel. Campag. Scient., Fasc. xlvi, p. 276.
„ „ „ idem. Arch. Zool. Expér., t. liv, p. 139.
1915. „ „ Southern. Irish Sc. Invest., No. 3, p. 49.

1915. *Sabellaria spinulosa*, Allen. Journ. M. B. A., vol. x, p. 645.
1917. „ „ Rioja. Annel. Poliq. Cantábrico, p. 43.
1919. „ „ var. *Intoshi*, Fauvel. Arch. Zool. Expér., t. lviii, p. 449.
„ „ „ idem. Bull. Mus. Hist. Nat., No. 6, p. 477.

*Habitat.*—Masses of the tubes cover rocks and shale about half-tide-mark near the commencement of the East Rocks, St. Andrews, and elsewhere. They also occur on the roots of tangles and on shells and stones from deep water. Berwick Bay (Dr. Johnston); Southport (Dr. Carrington); Luccomb Chine, Isle of Wight, between tide-marks; occasionally on oysters off St. Peter Port, Guernsey; Lochmaddy, North Uist, under stones near low water-mark, not common (W.C.M.); Plymouth (Allen and Crawshay); Dublin Bay (Southern). Whereas at St. Andrews it forms large spreading masses between tide-marks, its place is taken at Hilbre Island by *S. alveolata*, and *S. spinulosa* there is said to be a form from deep water. Southern states that it also is usually found in deeper water in Dublin Bay, whilst on the West Coast it is littoral as well as laminarian in distribution.

Abroad it is found in Sweden (Lovén), Heligoland (Leuckart), French coast (De St. Joseph), St. Thomas and Madagascar (Fauvel).

The cephalic region in *Sabellaria spinulosa* (Plate CXVIII, fig. 3 *a*) is divided dorsally into two great lateral lobes bearing the paleæ on pillars, the dorsal edge of the mouth being in the centre, whilst the lips slope obliquely backward ventrally; the two lobes, which appear to be homologous with the operculum of the Serpulidæ, can be widely separated ventrally, where they merge into the mouth and its tentacles. Arnold Watson found three sets of cilia on the tentacles: (1) A series of long cilia, arranged at intervals in pairs, driving particles into the longitudinal groove; (2) with these are palpocils which remain extended after the former cease [1]; (3) a shorter series of cilia in the tentacular groove. Each lobe forms a semicircle, which by apposition with its neighbour constitutes the opercular crown on the dorsal arch of the mouth, and between the tentacles is a tongue-shaped fold or process—richly ciliated.

The external series of golden paleæ which form a fringe to the crown are about twenty-five in number, the typical paleæ (Plate CXXIII, fig. 2) having a shaft, which tapers from the junction of the tip to the pointed base. The tip forms a broad, flattened, and somewhat spatulate process, one side of which bulges more than the other immediately on expanding above the shaft, whilst the tip is symmetrically narrowed to a blunt point, which is cut into three spikes on each side, the centre being produced as a long process with three lateral spikes directed distally. In the examples from Luccomb Chine, Isle of Wight, these lateral spikes are smaller and more numerous, and the process is larger. Striæ cross the flattened tip from side to side, and are slightly curved upward at each end, the bulged base of the tip often showing a differentiation of these and a more marked curvature. The paleæ at the extreme ends dorsally and ventrally are less neatly formed than those in the centre of the semicircle, the inner lateral spikes being long and powerful, whilst the central elongated process is more or less

[1] The cilia themselves often remain quiescent, so that it might be difficult to distinguish the one from the other.

rudimentary. All, however, have the asymmetrical base as in the other types of the second and third rows.

The second row consists of modified bristles with a slender shaft tapering to a point at its base, and of a proportionally massive tip shaped like a broad bill-hook (Plate CXXIII, fig. 2 *a*). The shaft tapers from its upper end to its pointed base and is comparatively slender. It curves posteriorly into the convex margin of the tip, whilst anteriorly it abruptly expands into a thin edge, which is concave in its progress to the pointed tip. Moreover, a second outline occurs within the foregoing, so as to simulate a double edge, as if a trace of a double wing were present. The thin edge beyond the inner line is boldly striated transversely throughout, and curved transverse striæ cross the greater part of the tip, but not the base. A shorter series of these bristles also occurs (Plate CXXIII, fig. 2 *b*).

A considerable number of the bristles in this (second) row present a further stage in the modification of the tip, which forms a long, curved, tapering structure with the double outline on the anterior face and the transverse striæ throughout the greater part of its extent. The two ridges on the anterior face are evidently modifications of wings, and the point is acute. The shaft is long and tapers from the upper part to a point at the base, whilst the posterior curve comes off distally before the anterior and is less abrupt. The anterior outline swells into the "heel" of the tip and is specially striated. In the St. Andrews forms these chiefly occur at the ventral edge. In those from Luccomb Chine, Isle of Wight, they occur all along the second or middle series.

In the variety *ensifera* from Lochmaddy and Guernsey several of the paleæ of the second row form long needle-like processes projecting far beyond the rest, and giving a character to the crown. Such occur in the young as well as in the adults from both places. Fauvel found a similar variety at St. Thomas.

The third or inner row has another modification, the tip leaving the thin shaft at an angle greater than a right angle, and resembling a long foot with a pointed toe, the resemblance being the closer since the heel and foot have a different axis from the shaft. The shaft is proportionally the most slender, and the bending of the tip backward causes the heel (anterior projection) to stand out prominently. Bold transverse striæ occur on the face between the ridges, so as to make a rasp-like surface to which mud adheres. Finer striæ are found on the heel and on the tip apart from the ridges. These bristles form a spiny guard to the oral aperture, and are often covered with muddy *débris*.

The crown is supported on a firm fleshy pillar, slightly bifid dorsally, and more distinctly so ventrally, its surface dorsally and laterally being variegated with purplish or madder brown pigment—often arranged in bands dorsally and at the sides of the tentacles ventrally. A circle of acute tapering and highly sensitive (Arnold Watson) papillæ pointing forward surrounds the base of the crown, and a brown pigment-band passes from the sides ventrally to the fissure.

Amidst the paleæ of two specimens from Southport are numerous examples of a parasite akin to *Udonella*.

In the Scottish forms variations in the length of the tips of the second row of paleæ are not uncommon, two or more of these on each side occasionally forming conspicuous

golden curved needles which project far beyond the others and so in one from Wales kindly sent by Arnold Watson. Fauvel specially alluded to this variety, which he has courteously termed var. *Intoshi* in his recent able memoirs on the Polychæts of St. Thomas and those of Madagascar, and he has given figures of the paleæ and hooks (Plate VIII, figs. 50—53). His diagnosis is: Paleæ of the external row of the operculum with large teeth, without the long median process; paleæ of the middle row short, hood-shaped. Other characters as in the type. This author [1] also describes another variety, viz. var. *Gravieri*, from the same island, in which the outer row of paleæ corresponds with the foregoing, but those of the inner row are alternately long and short. A curious variety was found in its tube attached to *Cellepora* off St. Peter Port, Guernsey, in which the external paleæ had the distal central process reduced, so that at most it is only bifid or rarely trifid. The blade is short and broad. The bill-hook series of the second row is also broader and shorter than normal, but the inner paleæ (third series) do not materially differ. This form shows that the paleæ are hollow, formed of two thin plates of a somewhat brittle chitinoid substance.

On separating the lobes of the crown the mouth opens in the centre, and it is marked by the same madder-brown pigment, sometimes showing longitudinal stripes on its dorsal edge. It forms a large antero-posterior opening ventrally, the extended sides of which bear six series of purplish tentacles, whilst posteriorly a deep groove lies between a smooth fold on each side. Each series of tentacles springs from a base, as if formed of a transversely folded sheet of tissue on each side, the purplish-brown pigment penetrating between the folds and rendering them more distinct. The folds are directed obliquely outward and forward, two on the pillars of the crown being more nearly longitudinal than the others, and, besides, a patch of tentacles closely abutting on the fissure lies to the inner side of these.

In a decomposing example Mr. Watson removed the superficial tissues of the tentacles with a camel's hair brush, leaving "the skeletogenous shaft, which then appeared as a transparent tube enclosing the muscular sheath of the central canal."

The tentacles are long and nearly cylindrical filaments which in life often twist and wriggle about. When stretched out they become attenuate, and distinct crenations directed toward the tip occur on their ciliated edges, giving the organ a transversely streaked aspect. Each contains two vessels, apparently a single trunk bent upon itself at the tip, the trunks looping together at the bases of the tentacles. The fluid in these vessels is perfectly translucent and free from granules. The matrix of the process is granular and pale (hypodermic), and seems to keep the vessels from undue pressure, yet retaining sufficient elasticity. Muscular fibres, both longitudinal and circular, are also present, but the latter were not distinctly made out. Under a power of 60 diameters the cilia of these organs are often seen to remain perfectly still, projecting from the sides like minute glassy spikes; then they suddenly are adpressed, the points directed toward the tip of the tentacle. Occasionally they are jerked in various ways, some vibrating rapidly a few times and again becoming rigid. In the quiescent condition they bear some resemblance to the spinous ray of a starfish or to some spine-clad stems like *Gleditschia*. The tip of the tentacle is more opaque than the rest, from its granules and

[1] 'Arch. Zool. Expér.,' t. liv, p. 142, pl. viii, figs. 42—49.

gland-cells, and now and then it assumes a clavate outline, and in the preparations a few show a slight constriction below the tip.

On each side of the posterior groove of the mouth with its glandular folds is a bifid process, the anterior rounded portion of which is applied to the soft external fold of the mouth, whilst the pointed and somewhat ligulate process projects, like a ventral branchia, downward and slightly forward. These organs probably act in conjunction with the posterior buccal groove in tube-formation.

The *body* (Plate CXII, figs. 1—1 *e*) is somewhat flattened, marked dorsally and ventrally by a red streak. The cuticle is delicate and iridescent dorsally between the branchiæ, and is ciliated, especially over the sites of the blood-vessels. The dorsal groove over the buccal region is also ciliated. Transverse rows of very long cilia also occur behind the stomach and produce currents directed anteriorly. The ventral surface is likewise ciliated and aids in the driving of the current forward, the water being expelled anteriorly by undulatory movements of the body. Ingoing and outgoing currents are visible at the mouth of the tube (Arnold Watson).

Arnold Watson has observed that the contents of the large muscular organ or gizzard (Fig. 139, *pv.*) at times receive careful treatment before passing into the intestine, sometimes being forced into the dark part of the adjoining œsophagus, or into the first part of the intestine, but returned to the gizzard for further treatment.

On the ventral surface opposite the second and third segments is a smooth ovoid area clearly differentiated from the surrounding parts by an elevated border.

Arnold Watson finds that the peristomial membrane is less developed than in *S. alveolata*, and thus the median cirrus is able to hold its own.

The firm cylindrical region, which splits in front to form the two pillars of the crown, has at its posterior border several processes, which apparently pertain to the next segment.

Dorsally (Plate CXII, fig. 1) is a pair of branchiæ of the normal shape, and from them a fold passes ventrally on each side, a space, however, intervening between it and the outer limb of the bifid postoral process. At the end of this ridge is a broad, flattened, pointed lobe or papilla, and sometimes two occur. Such would appear to indicate the first foot of the anterior or thoracic region of the body, more especially as on each side of the mid-dorsal groove a tuft of three long simple bristles (Plate CXXIII, fig. 2 *c*), with striated shafts and translucent tapered tips embedded in the tissues, passes forward to the anterior crown. The inner bristle on each side forms a pair with its neighbour, and the tips are slightly incurved towards each other; the second and third (outer) are smaller. These bristles pass forward in a nearly parallel manner, only very slightly widening in front. The most interesting feature, however, is the occurrence to the exterior of these, also embedded in the tissues, of several types of the modified bristles in the paleal crown. Thus the slipper-shaped kind with the shaft coming off at an angle, the form resembling a broad and short bill-hook, and the broad paddle-like external paleæ with the lateral spikes and special central process, are each represented on one side or the other.

Mr. Watson notes that in the first segment the bristles are on the dorsal side of the cirrus, the latter being between them and the building organ. In the second the

bristles are on the ventral side of the cirrus. He also met with a specimen having a double cirrus on the second segment, the bristles emerging between them. Another example had two sets of collar-bristles on the right, whilst the left was devoid of them and the process reduced in size.

The anterior ("thoracic") region of the body includes three segments with transversely elongated lamellæ, each, moreover, having a pair of flattened, ligulate, crenate branchiæ which taper to a point and somewhat resemble the horns of a goat or antelope, from their transverse ridges, the large cilia of which have a bold hook-like curve directed toward the tip of the organ. The branchiæ are supplied with long, powerful cilia on their ridges, which make a vortex in the water around them, and thus are in marked contrast to the delicately ciliated tentacles. Two vessels occur at their base, apparently afferent and efferent, and between these are a series of parallel transverse branches. They are less sensitive than the pale purple tentacles, since a more violent contraction takes place when the latter are touched with a needle. The first, viz., that in front of the anterior region proper, is a rather broad tongue-shaped process, shorter than the succeeding, which are elongated horn-shaped organs, the sixth apparently being the longest. They continue to the posterior end, but gradually diminish in size.

Each of the three prominent lateral lamellæ below the branchiæ carries a series of spatulate golden bristles (Plate CXXIII, fig. 2 *d*) arranged in a single line, the first having seven or eight, the second nine, and the third ten. They are generally directed straight outward, though in life the points are directed backward, and have a flattened translucent tip like the blade of a paddle, the upper end of the shaft gradually dilating into the broad blade, the dilated part, moreover, showing in some short oblique striæ on one side—as if a trace of the striæ so common in winged forms. Those of the first set have a narrower tip and longer fringes, the outer fringes, moreover, being split into finer processes on the margin. Those of the third series have broader tips and the brush-like filaments at the extremity are shorter. Each bristle diminishes in size from the tip to the base, and the shaft is striated. Mingled with the foregoing bristles are a few simple forms (Plate CXXIII, fig. 2 *c*), the curved slender tapering tips of which with their sparse spikes project from the skin between the stronger forms. If anything, the first series has slightly narrower tips and more slender shafts than the third, which sometimes shows truncated tips from wear.

A fold, marked by the purple-brown pigment from each of the dorsal setigerous lamellæ, continues the segment ventrally and ends in a papilla with a minute tuft of golden bristles (Plate CXII, fig. 1 *b*), which, although small, have a similar structure to the larger. They are translucent bristles with long shafts deeply inserted in the tissues, the dilatation of the shaft distally being more gradual, whilst the fringes at the tip of the blade pass much more deeply, so that the whole tip forms a more perfect brush. They are also accompanied by the simple spinous bristles, which are considerably shorter, but go more deeply into the tissues. The physiological importance of the two sets of bristles is unknown, but it may be conjectured that the oar-shaped forms, having performed their functions of fashioning the tube, could be slightly retracted, or the slender ones may be slightly protracted, so that both might act in a brush-like manner. The

anterior tuft is the largest and the third the smallest, the opposite condition occurring in the large dorsal bristles. The direction of these bristles is forward and slightly inward, the angle of inclination being thus different from that in the next series. The last (third) set shows faint serrations or striæ at the sides just below the flat tip.

Between the ventral edge of the lamella for the hooks and the ventral bristles in the second (abdominal) region of the body is a small filiform papilla, longest in front and diminishing to a minute process in the caudal region.

The succeeding region of the body is characterised by the increase in the depth of the lateral lamellæ, the first being about three times that of the next in front (Plate CXII, fig. 1); but they gradually diminish in depth in their progress backward, whilst they increase in prominence, those in the distal part of the region, for no dorsal bristles are visible, projecting like cirri. The bristles of the region are thus pushed ventrally, so that even the long posterior forms are not, as a rule, seen at the sides in a dorso-ventral view. They are situated to the inner side of the prominent, coloured lamellæ forming the dorsal region of each segment. The longest bristles in each tuft are in front, since, instead of being arranged in a transverse row, they form an oblique one. The typical bristles (Plate CXXIII, figs. 2 *f* and 2 *g*) are long and translucent with smooth shafts, which taper from the skin to the delicate and flexible tip covered with whorls of spikes directed distally. Their usual direction is forward and inward, and they fall smoothly under a needle carried from behind forward, but rise against it when passed in the opposite direction. As rudimentary bristles of the same kind appear in the first region of the body between the bases of the spatulate forms, their distribution is thus uniform throughout. Moreover, the bristles of the first series of this region present a transition stage, having stouter shafts and a broader and shorter spinous part at the tip, the latter, indeed, resembling a short villous region. Accompanying these is usually a slender tapering spinous bristle, and this is also a transition form. The posterior bristles form a conspicuous series ventally, but though longer their structure remains the same.

The prominent transverse or lateral lamellæ formerly alluded to bear the numerous hooks, their tendons and muscles. In shape the hooks (Plate CXXIII, fig. 2 *h*) are elongate, with a single tendon at the distal end and two at the rounded base. In lateral view five teeth usually characterise them, though when viewed from the front each represents only one of two or three in the row, of which six may occur in both anterior and posterior feet, the latter, however, having smaller hooks. The slender cirriform lamellæ of the posterior feet have the interior largely occupied by the bundles of tendons from the hooks, and to these muscular fibres are attached. At the base of each elongated lamella posteriorly is a deep brownish pigment-spot.

The narrow posterior end of the body is continued as a long tubular process (Plate CXII, fig. 1), which fits into the dorsal groove when the animal is quiescent in the tube, but which can be elongated or shortened at will, and forms a very efficient means for passing the fæcal matter out of the aperture of the tube without necessitating the turning of the annelid. At its tip is the vent with a more or less distinct rim, which in some is oblique. It is noteworthy that in the preparations this tube is generally dorsal, whereas that of *S. alveolata* is doubled forward in the ventral groove. The

aperture is richly ciliated, and Mr. Watson found that when severed from the body the anal aperture contracted at regular intervals of four or five seconds.

*Habits.*—This is one of the forms which aids in counteracting the effects of the borings of *Pholas* and other forms, and in resisting the erosion of the sea in every climate. It is agile in movement in its tube, to which it clings with great pertinacity, but is somewhat sluggish when removed, lying in the vessel with the tentacles ventral, and the branchiæ generally though not always dorsal.

Arnold Watson observed in a living example that the tail at times assumed a moniliform outline, and that the bristles posteriorly were in constant motion, apparently assisting in the circulation of the water and the expulsion of waste matter. The long hook-lamellæ were always in contact with the lining of the tube as the body moved forward or backward. The same observer (in MS.) considers that this species is that best fitted for study from its hardihood, living always under water, whereas *S. alveolata* prefers alternations of air and water. In Scotland, however, *S. spinulosa* covers considerable areas between tide-marks, so that it follows similar habits to *S. alveolata.*

Mr. Watson considers that rotation of the body on the long axis of the annelid is produced by the bristles on the third, fourth and fifth feet, which are so arranged that a cross-thrust can be obtained, the small ventral fascicles being directed forward at a right angle to the body, whilst the broad lateral fascicles of short bristles are directed backward as if to thrust the body out of the tube.

*Reproduction.*—Breeds in May at Plymouth (W. Garstang); September (Allen) mature specimens in September in Ireland (Southern). Arnold Watson found the ova collected in Wales in June of a deep pink hue, and a specimen only a quarter of an inch long discharged about sixty. They are larger than the ova of *S. alveolata.* Dehorne[1] observed that the number of the chromosomes in the spermatogenesis of this species was eight, so that it agrees generally with what Schriener found in *Tomopteris* and *Ophryotrocha.* The larvæ are abundant in the tow-nets during the summer months off the east coast of Scotland.

Fauvel[2] notices that the larvæ occurred at St. Vaast-la-Hougue in July.

The tubes are composed of coarse shell-gravel, or sand-particles more or less neatly cemented together, and forming as a rule at the East Rocks, St. Andrews, large masses, apparently having no very definite arrangement, though fracture reveals many tubes running in the same direction, yet they are often sinuous. Apparently each tube is closed posteriorly. Single tubes occur on shells and stones. The materials of which the tubes are composed show endless variety; fine sand-grains may form one part of the tube, coarse shell-gravel another, and larger fragments of shells, or *Balani,* may be on a third region. Internally the tube is lined by the secretion, and a fold of this sometimes occurs at the aperture, which is slightly dilated, the margin being inclined outward so as to make a firm hold for the paleæ. At Lochmaddy, North Uist, the tubes, composed of sand-particles, are met with singly as long, wavy diminishing tunnels, the posterior end being pointed. This locality was in strong contrast, for instance, with St. Andrews,

[1] 'Assoc. Française l'avancem. sc. Lille,' 1909, p. 124.

[2] 'Ann. Sc. nat. Zool.,' 9e sér., t. x, p. 208.

where the tubes as a rule formed masses. Amongst the tubes are many other forms which seek shelter in their grooves or cavities, such as Syllids, Nereids, *Ephesia*, *Pholoë*, etc.

When in its tube all the branchiæ are directed forward—sloping obliquely toward the middle line. The triangular lateral process in front of the first or thoracic region is directed forward. The dorsal bristles follow the direction of the branchiæ. On the other hand, the lateral lamellæ for the hooks are directed backward and flattened to the sides, even the cirriform terminal ones having this tendency. The crown and its paleæ form an effective operculum, and even in spirit the animal cannot be released by dragging it from behind.

The closure of the tube at the posterior end is an important feature in connection with the circulation of the water. When the closed end is fractured the animals fail in health and frequently abandon the tube (Arnold Watson).

On the French coast the tubes of this form are sometimes accompanied by those of *S. alveolata*, and thus De Quatrefages confused the structure of the two species.

*Varieties.*—Besides normal examples preserved on oyster-shells off St. Peter Port, Guernsey, two are peculiar in having irregular crowns. In one the dorsal fissure between the halves is enlarged; the pointed papillæ are present on the right, but are absent on the left, with the exception of a single large one, their places being taken posteriorly by an imperfect outer row of small flattened paleæ which cease about half way ventralward. Little regularity is observable in the left half of the crown except that a curved row of the second series occurs dorsally, and a fleshy bare pad occupies the position of the inner series. All the rest are irregular, but the various types of the three series are present amongst them. On the right the outer row is more regular, though not normal, and the individual paleæ show peculiarities, such as ending in a single blunt point, though a few are nearly normal. In the other example the row of pointed papillæ is present on the right and on the posterior half of the left. The outer paleæ on the right are nearly but not quite normal, the left are irregular, and the second and third series are irregular on both sides. In both the condition appears to be due either to injury or congenital defect.

A specimen in the British Museum is labelled *Psamatotus alveolatus*, Dr. Johnston.

Dalyell[1] (1853) appears to refer to this species under the name of *Sabella alveolaria*, and he gives an interesting account of its tube-making, reproduction, and general habits in confinement. It showed a decided preference for sand rather than pounded brick or glass.

Besides this form, Dr. Johnston (1865) described *Sabellaria crassissima* and figured one of the paleæ, but so far as can be observed it is a variety of *S. spinulosa*, or the author has confused the two British species (De St. Joseph). Dr. Johnston considered *Alveolaria lumbricalis* (Mus. Leach) this form.

De Quatrefages (1865) probably included this species under *S. alveolata*. The figures referred to in the synonymy pertain to *S. spinulosa*. The occurrence of the two species in company on the shores of France led the distinguished French author to confuse them.

[1] 'Pow. Creat.,' vol. ii, p. 176, pl. xxv, figs. 1—3.

Fauvel[1] (1914) mentions two varieties of *Sabellaria spinulosa*—one from Guernsey, which he has named *S. spinulosa*, var. *Intoshi*. It had been described without a name by the author in February, 1914.

Crawshay found the crustacean *Anthura gracilis* in a tube of this species from a depth of 42 fathoms off Plymouth, and he thought it was preying on the annelid. It may be a commensal or an accidental visitor.

2. Sabellaria alveolata, *L.*, 1767. Plate CXII, figs. 4, 4 *a*; Plate CXVII, fig. 3—body; Plate CXVIII, fig. 2—tubes; Plate CXXIII, figs. 3—3 *e*—paleæ, bristles and hooks.

*Specific Characters.*—Cephalic region with a less boldly bifid crown than in *S. spinulosa*, but with three rows of very regularly arranged paleæ, which are surrounded by a more highly developed series of filiform papillæ. The outer paleæ are shaped like a cricket-bat with a long tapering handle and unequal shoulder, the tip slightly bent and split into five or six teeth directed or curved to the front, the second the largest and most curved. The second row has paleæ resembling a large, heavy foot with a slender tapering leg. The third, or inner set, form an oblique palisade, and each has a long tapering terminal blade from which the shaft comes off at a large angle. Cephalic and buccal region shorter than in *S. spinulosa* and coloured brownish-purple. No long, simple bristles running longitudinally on each side of the dorsal median line. Body of two regions as in *S. spinulosa*, besides the caudal tube; three segments in the first region, about thirty-four bristled segments in the second. Length to the tip of the abdominal appendage $2\frac{1}{2}$ inches; breadth anteriorly at the peristomial lobes 6 mm. Branchiæ short, thick, and greenish, first three with broader, flattened bases and more slender tips than the rest. Bristles of the first region oar-shaped, slightly fringed, and with long shafts, a slender, finely spinous form occurring between each. In the second region no dorsal bristles occur. Ventral bristles of two kinds, viz. those having oar-shaped, long tips minutely spinous, and others with slender shafts and tapered tips bearing minute whorls of spikes. Hooks similar to those of *S. spinulosa*, with six teeth in lateral view, but the basal end is more distinctly truncate distally. Aggregated tubes of sand-grains forming larger masses than in *S. spinulosa*.

Synonyms.

1711. *Vers à tuyau*, Réaumur. Mém. Acad. R. Sc., p. 128, pl. ii, figs. 15—17.
1756. *Tubularia arenosa anglica*, Ellis. Corall., p. 104, pl. xxxvi, figs. *a*—*e*, and figs. A, B, C.
1758. *Tubipora* „ Linnæus. Syst. Nat., edit. x, vol. i, p. 790.
1767. *Sabella alveolata*, idem. Syst. Nat., edit. xii, p. 1268.
1774. *Psamatotus* à tuyau conique, un peu applati, et qui a un couvercle, Guettard. Mém., t. iii, p. 68, pl. lxix, fig. 2.
1777. *Sabella rudis*, Pennant. Brit. Zool., vol. iv, p. 147, pl. xcii, fig. 162.
1801. „ *alveolata*, Donovan. Brit. Shells, vol. iii, Tab. cxxxix.
1805. „ „ Montagu. Test. Brit., p. 540.

[1] 'Arch. Zool. Expér.,' t. liv, p. 139.

1806. *Sabella alveolata.* "Les amphitrites," Duméril. Zool. analytique, p. 296, Tab. clxxxix.
„ „ „ Turton's Linn., p. 610.
1812. „ „ Gmelin. Syst. Nat., i, 6, p. 3749.
1817. „ „ Stewart. Elements, vol. ii, p. 423.
1818. *Sabellaria* „ Lamarck. Anim. S. Vert., t. v, p. 352.
1819. *Sabella* „ Turton. Brit. Fauna, p. 136.
1820. *Hermella* „ Savigny. Syst. des Annel., p. 82.
1824. *Cistenides Pallasii,* Leach. Encycl. Brit., Suppl., p. 452, pl. xxvi.
1828. „ „ De Blainville. Dict. Sc. nat., t. lvii, p. 435, Atlas, pl. iv, fig. 1.
„ *Sabellaria alveolata,* Stark. Elements, vol. ii, p. 133.
1833. *Amphitrite alveolata,* Cuvier. Règne Anim. (Griffith's), vol. xiii, p. 15.
„ „ *ostrearia,* idem. Règne Anim. (Griffith's), vol. xiii, p. 15.
1836. *Sabellaria alveolata.* Templeton. Loud. Mag. Nat. Hist., vol. ix, p. 234.
1836–49. *Amphitrite alveolata,* Milne Edwards. Illust. Ed. Cuvier, pl. vi, fig. 2.
1843. *Sabellaria* „ Thompson. Rept. Brit. Assoc., p. 272.
1843–53. *Sabellaria crassissima,* Chenu. Illustr. Conch , 11e livr., pl. ii, figs. 7 and 8, and pl. viii, figs. 4 and 5.
1845. *Amphitrite plumosa,* Rathke. Rep. Zool. Ray Soc., p. 283.
1847. *Hermella ostrearia,* Frey and Leuckart. Beiträge, p. 152.
1848. „ *alveolata,* De Quatrefages. Ann. Sc. nat. Zool., 3e sér., t. x, p. 14, pl. ii.
„ „ *crassissima,* idem. Ibid., 3e sér., t. x, p. 20.
„ *Sabellaria anglica,* Grube. Arch. f. Naturges., p. 45, pl. iii, fig. 11.
„ „ *uncinata,* idem. Ibid., Bd. xiv, p. 48, figs. 6—8.
1850. *Cistenides Pallasii,* De Quatrefages. Ann. Sc. nat. Zool., t. xiii, pp. 37, 112 *et. seq.*
1851. „ „ Landsborough. Excurs. Arran, p. 49.
„ *Sabella alveolata,* Williams. Rept. Brit. Assoc., p. 186.
„ *Hermella* „ Maitland. Fauna Belg., p. 208.
„ *Sabellaria anglica,* Grube. Fam. Annel., pp. 84 and 139.
„ „ *alveolata,* idem. Ibid., pp. 85 and 139.
1853. *Sabella alveolata,* Williams. Ann. Nat. Hist., ser. 2, vol. xii, p. 396.
„ „ *alveolaria,* Dalyell. Pow. Creat., vol. ii, p. 175, pl. xxv, figs. 1—3.
1865. *Hermella crassissima,* De Quatrefages. Annel., t. ii, p. 318.
„ „ *alveolata,* De Quatrefages. Annel., t. ii, p. 314, pl. xiii, figs. 1—16.
„ „ *Savignyi* (Carus), idem. Ibid., pl. iv, fig. 1, pl. v, figs. 1—9.
„ *Sabellaria anglica,* Johnston. Cat. Worms. Brit. Mus., pp. 248 and 345.
„ ? *Sabellaria crassissima,* Johnston. Cat. Worms Brit. Mus., p. 250 (and of Pennant, Lamarck, etc.).
1867. „ *alveolata,* Malmgren. Annul. Polych., p. 102, Tab. xii, fig. 70.
„ „ *anglica,* Parfitt. Cat. Annel. Devon, p. 32.
1869. „ *alveolata,* Robertson, D. Proc. Nat. Hist. Soc. Glasgow, p. 31.
„ „ *anglica,* Grube. Mitt. St. Vaast, etc., p. 38.
„ *Sabella* „ idem. Abhandl. Schles. Gesell., 1868—9, p. 109.
1875. *Cistenides Pallasii,* Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 529.
„ *Sabellaria alveolata,* idem. Ibid., vol. xviii, p. 529.
1879. *Sabellaria* „ Tauber. Annul. Danica, p. 126.
1881. *Hermella* „ Horst. Versl. Meddel. Akad. Wetenssch., Ser. 2, vol. xvi, p. 207 and plate.
„ „ „ Horst. Bull. Sc. Nord., 4e année, p. 1.
1886. „ „ Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 156.

1887. *Hermella alveolata*, Mayer. Mitth. Zool. Stat. Neap., Bd. vii, pp. 723, 731, pl. xxii, figs. 15, 16, pl. xxiv, figs. 7—13, pl. xxvi, fig. 28.
1888. „ „ idem. Ibid., Bd. viii, pp. 481, 490, 494, 496, 507—9, 511, 527, 531, 536, 548, 562, 576, 579, 581, 590, 594, 635—655.
1890. *Sabellaria* (*Hermella*) *alveolata*, Malaquin. Annél, Boulon, p. 48.
1891. „ *alveolata*, Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 260.
1892. *Hermella* „ Jourdan. Ann. Sc. nat. Zool., 7e sér., t. xiii, p. 251, pl. vi, figs. 13—16.
1893. *Sabellaria* „ Lo Bianco. Atti Accad. Sci. Fis. Mat., vol. v, p. 45.
1894. „ „ De St. Joseph. Ann. Sc. nat. Zool., 7e sér., vol. xvii, p. 160.
1898. „ „ idem. Ibid., 8e sér., t. v, p. 405.
1904. „ „ Allen. Journ. M. B. A., vol. vii, p. 232.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 234.
1909. „ „ Fauvel. Ibid., 9e sér., t. x, p. 208.
„ „ „ idem. Bull. Inst. Oceanogr., cxlii, p. 20.
„ „ „ Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 586.
1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 243.
„ „ „ Elwes. Journ. M. B. A., vol. xi, p. 66.
1911. „ „ Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 66.
„ „ „ Fauvel. Bull. Inst. Oceanogr., No. 194, p. 33.
1914. „ „ Southern. Proc. Roy. Irish. Acad., vol. xxxi, No. 47, p. 149.
„ „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 276.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 645.
1917. „ „ Rioja. Annél. Poliq. Cantáb., p. 42.

*Habitat.*—Abundant in the estuaries of such rivers as the Tees, indeed, it stretches from Berwick Bay to the south of England, and occurs also on the west coast as at Southport (Dr. Carrington), Plymouth (Spence Bate and Brooking Rowe), and the Firth of Clyde (D. Robertson), Liverpool (Prof. Herdman), Plymouth (Dr. Allen), Luce Bay, Wigtownshire (Prof. G. S. Brady and D. Robertson),[1] between tide marks, Dublin Bay and West Coast of Ireland (Southern), Torquay (Elwes).

Abroad it extends to the Mediterranean, the shores of France (De Quatrefages, De St. Joseph, Fauvel), and the Mediterranean (Verany, Panceri).

The cephalic region (Plate CXII, figs. 4 and 4 *a*) differs from that of *S. spinulosa* in the more beautifully regular arrangement of the paleæ of the opercular crown, and in the greater development of the filiform papillæ, which form a graceful margin to it, and are even seen through its translucent marginal paleæ. The tentacles are richly ciliated, and the peristomial membrane has a folded anterior edge as it slants obliquely outward and forward from the ciliated blunt extremity of the prostomium, whilst its membrane fuses behind it in the pigmented median line (Arnold Watson). This observer also kindly sent a sketch indicating the currents caused by the tentacular filaments, which course obliquely inward and backward from the curves or loops on each side of the opercular pillars, and finally enter the mouth. As the tentacular filaments occur anteriorly on the inner as well as the outer border of each pillar a very effective series of currents is thus produced. Mr. Watson found the tips of the papillæ beneath

[1] 'Proc. Nat. Hist. Soc. Glasgow,' 1862.

the opercular paleæ furnished with numerous palpocils. Moreover, the shortness of the firm buccal region posteriorly distinguishes it from *S. spinulosa*. The sloping inner row of paleæ guard an elliptical central space, at the anterior end of which are the frilled dorsal margins of the mouth. Arnold Watson specially alludes to the two leaf-like anterior continuations of the lips which embrace the bases of the buccal tentacles on each side. He finds the processes beneath the opercular paleæ longer in the young than in the adult, and their tips have a brush of long hairs, less evident in the adult. The lateral tentacular filaments are eight or nine in number (in the adults ten), and the intervals between them gradually increase from before backward. The appearances of a young specimen in which the peristomial lobes were thrown back at a right angle to the body so as to make the mouth practically terminal suggested to Mr. Watson the view "that they may belong to the first and second segments." The crown is supported on two short and massive pillars, but they are connate at the dorsal margin, the only differentiation being a gap in the circle of papillæ and the central line separating the posterior paleæ. Looked at from the face, however, a slight incurvation of the margin is observed dorsally and a more distinct one ventrally, where the split between the pillars supporting the crown is very distinct. In this species the marginal papillæ surrounding the crown are larger, longer, and more numerous than in *S. spinulosa*, and are very conspicuous whether viewed from front or rear.

The outer paleæ form a pale golden, translucent, and regular margin to the crown, lying almost horizontally, or with a slight slope upward, and presenting a finely notched continuous edge under a lens. Each palea (Plate CXXIII, fig. 3) is shaped somewhat like a cricket-bat with a long tapering handle and unequal shoulders, the translucent and flattened blade being slightly bent at the tip and generally split into five or six strong curved teeth directed to the front, or that side of the blade with the higher shoulder and slight concavity in outline. The second tooth, which occupies nearly the middle of the blade, is longest, and is followed by three or four smaller. The blade is marked by transverse striæ, which are finest on the translucent tip, and a kind of keel occurs near the higher shoulder, for the shaft is more or less rounded or angular, whilst the blade is flattened. The blades at the dorsal edge are a little longer, and their tips show less friction. The middle paleæ have slightly shorter blades, the tips of which are sometimes frayed, and the curve in front differs, in so far as a tendency to slope backward distally is noticeable. Those at the ventral edge show the latter feature in a more pronounced manner, the tips are shorter, the teeth at the tip are longer, less curved, and show the effects of friction. The developing paleæ in the tissues have the teeth connected by a membrane. Arnold Watson notes that in very young examples the outer paleæ much resemble the stout bristles of the thoracic region of the adult.

The second row, which is nearly horizontal, consists of paleæ (Plate CXXIII, fig. 3 *a*), with an outline resembling a large heavy foot (the blade) and a slender tapering leg (the shaft), the heel being comparatively small. The double outline on the part representing the sole is less marked than in *Sabellaria spinulosa*, and this outline is nearly straight, the opposite one being slightly convex. Both slope a little toward the blunt tip, which is often frayed. The flattened tip is crossed by transverse striæ, and the tips

of the blades touch the bases of the outer paleæ and form a very regular second row, the two sides making an ovoid area.

The inner or third row of the pale golden paleæ forms an oblique palisade, which leaves only a narrow ellipse between them, and in lateral view, in Neapolitan examples especially, the palisade shows a high dorsal margin and diminishes gradually to the ventral edge. The typical palea (Plate CXXIII, fig. 3 *b*) has a long, flattened, tapering terminal blade, from which the shaft passes off at an oblique angle and tapers to a point, the heel or shoulder being at the front edge, the outline of which is very slightly concave, and with serrations on the margin. The dorsal outline presents a slight convexity in the region corresponding to the arch of the foot. The transverse or slightly oblique striæ pass from the inner outline to the free edge where the notches are. The rest of the tip is longitudinally striated.

By rendering the tissues transparent Arnold Watson[1] has shown that in each opercular lobe there are two setigerous sacs running longitudinally, the outer supplying the outer paleæ, the inner furnishing the median and inner paleæ which lie alternately in the sac. The developing paleæ originate as minute, angular particles (cells?), and the more advanced travel through the tissue in a somewhat spiral fashion to reach their positions at the dorsal end of each opercular crescent. Thus new paleæ take the places of those which are injured or shed. The same observer counted the paleæ in a large example about 2 inches in length; thus in the outer row on the left thirty-five occurred, besides one just coming into view, thirty-six on the right and one just visible; in the median row twenty-four on the left (three unpaired) and twenty-five on the right, whilst the inner series consisted of twenty-one on the left and twenty on the right.

The same author has carefully investigated the physiology of the lower lip, his building organ, as shown in the accompanying sketch, the strands of muscle radiating from the posterior border being noteworthy (Fig. 138).

The dorsal arch of the mouth (Plate CXII, fig. 4 *a*) is of a deep purplish-brown hue, and it passes backward till it meets with a buccal collar which joins its fellow of the opposite side ventrally in a slightly spout-shaped margin. From the dorsal edge of this collar springs a tapering buccal tentacle on each side. External to this collar ventrally another dark brownish-purple and frilled lamella, considerably thinner than the former, extends to meet that of the opposite side, so as to form another spout-shaped process—as it were ensheathing the former, and connected externally with the inner base of the bifid organ which guards the spout-shaped aperture ventrally. The bifid organ springs by a broad base from the peristomial region, the massive and larger division curving inward to meet its fellow in front of the external spout-shaped aperture, the chink of which is observed between them. The anterior end of each is blunt and rounded, and the dorsal surface is tinted brownish. The other process springs about midway from the outer edge, and passes forward and outward as a short conical process in the Neapolitan, but as a process with a longer filiform tip in the English examples, though its condition is subject to variation. Moreover, on a long papilla on the dorsal edge of the base (that is, behind the external pointed papilla), a row of fine bristles projects, the long axis of

[1] 'Rep. Brit. Assoc.,' 1910, p. 634.

the tuft being from the front slightly upward and backward. In structure these bristles differ from the ventral series in being comparatively stout, perfectly smooth, and with the tips apparently abraded from use.

Arnold Watson has found in some examples "a centrally situated ciliated cirrus at the outer edge of the membrane between the opercular lobes, as in *S. spinulosa*, whilst in others it is absent." He thinks, from observations on very young specimens, that this cirrus is an outgrowth from the upper lip, just in front of the posterior part, and connected to it by a ridge which widens as it approaches the lip. Moreover, on each side of this ridge are the eye-spots, which in young specimens are visible from the dorsum, and apparently rest on a pair of ganglia. They disappear or are hidden by pigment in older forms. As the animal grows the ridge lengthens, and simultaneously the peristomial membrane, which is continuous with it, increases, and apparently in some engulfs the cirrus.

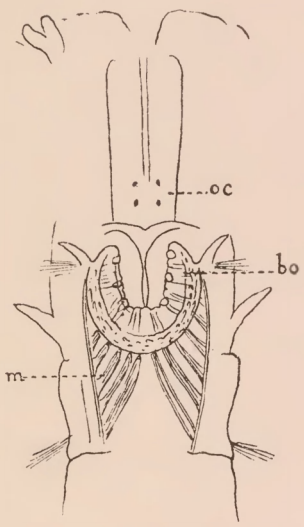



FIG. 138.—Oral region of a small example (¾ in.) of *Sabellaria alveolata* showing the building organ *bo.*, with its glandular apertures; *m.*, muscular bands. From a sketch by Arnold Watson.

In a young form kept by Arnold Watson under observation, and which had eighteen external opercular paleæ on each side and ten or twelve in the middle row, a distinct, unpaired, short ciliated cirrus, about twice as long as broad, occurred between the lobes terminating the ridge continued from the prostomium.

In the youngest stage, that is, with two long buccal tentacles and three others on each side, two black eye-spots occur on the ventral side just in front of the bases of the buccal tentacles, as well as two similar spots on the dorsal or inner side of the operculum in rear of the origin of the buccal tentacles, and they form a square with the ventral. In older stages the dorsal eye-specks disappear, but a series of specks is found on each side of the median line of the operculum (Arnold Watson). The same author observed a comma-shaped structure (ganglion ?) on each side of the central ridge at the end nearest the mouth.

The oral tentacles form a series of converging rows on each side to the number of about twelve, but the number is variable. Each basal lamella is concave in front, and

the filaments spring from the summit as a single row. The central axis is deeply stained by methylene-blue (Arnold Watson).

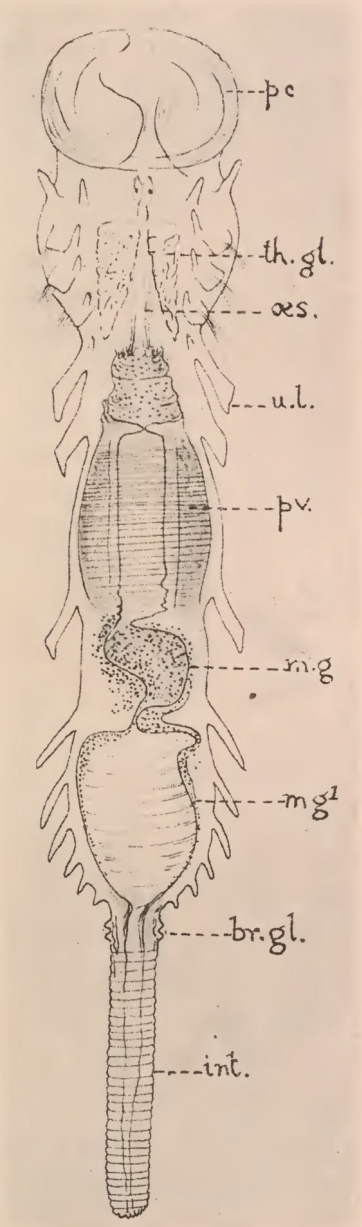



Fig. 139.—Sketch of the alimentary system of a young *Sabellaria alveolata*. *pc.*, cephalic plate; *th.gl.*, thoracic glands; *œs.*, œsophagus; *ul.*, uncinigerous lamellæ; *pv.*, proventriculus; *mg.*, anterior stomach; *mg'.*, posterior stomach; *br.gl.*, brown glands; *int.*, intestine (after Arnold Watson).

In spirit the buccal region still retains deep purplish-brown pigment on the sides, especially external to the tentacles and between their basal folds. It is terminated on each side posteriorly, as in *S. spinulosa*, by a fillet which has a branchia dorsally and a flattened and pointed lamella with a minute bristle-tuft below it ventrally, the bristles having proportionally stout shafts and tapering, closely spinous tops. They appear to belong to the ventral series.

The long dorsal bristles in the complex region of *Sabellaria spinulosa* are thus absent, only developing paleæ occurring towards its anterior margin. Whether the smooth bristles to the exterior of the ventral mouth-lobes represent their equivalent or otherwise is at present unknown, but their absence dorsally is noteworthy. Meyer's view that such represents the dorsal division of the first segment of the body is thus not without basis, more especially as the tuft of characteristic bristles shows that the ventral division is also present. The dorsal bristles seem to be well developed in *Tetreres murata*, Allen[1]; the first branchia with the fillet and the papilla on its anterior margin would thus appear to complete the parts of the first bristled segment.

The *body* (Plate CXII, figs. 4 and 4*a*) is massive, rather flattened, grooved both dorsally and ventrally, gently tapered, both when viewed dorsally and laterally, from the anterior to the posterior end, and divided into two regions, besides the long, flexible caudal tube, which appears to be invariably curved ventrally in the preparations. Numerous long cilia, set in transverse grooves, occur on the dorsal surface of the worm, and create the strong current which carries ova, sperms and other structures out of the tube, as well as aids in the respiratory process (Arnold Watson). The dorsum is occupied throughout by the branchiæ, the first three of which have broader flattened bases and more slender tips than the rest—which increase in length to the seventh or eighth, and then gradually diminish posteriorly. Their structure corresponds with that in *S. spinulosa*. The lateral region has the segment-ridges and the lamellæ for the hooks, the latter posteriorly projecting outward as long cuneiform processes, which Arnold Watson observed to be moved freely backward and forward, as well as retracted.

[1] 'Journ. M. B. A.,' vol. vii, p. 301, pl. x, figs. 1 and 3.

The dorsal surface is marked by close transverse striæ and an ovoid area about the sixth and seventh branchiæ. Ventrally the groove at the same level has a similar depressed ovoid area, and the caudal tube lies in the groove posteriorly, whilst anteriorly the groove commences behind the first (or thoracic) region. Arnold Watson counted about thirty rows of long cilia on one of the longest branchial filaments. They arise from grooves like the dorsal cilia, and apparently shorter cilia occur in the intervals.

Behind the fragmentary segment just described is the first region of the body proper (thoracic *auctorum*), consisting of three segments, each with a dorsal branchia and a lateral setigerous lamella, which increases in length and breadth from the first to the third. The first is least, and has slightly smaller oar-shaped bristles (Plate CXXIII, fig. 3 *c*), seven in number, the pointed translucent tips of which are only a little fringed, and thus differ from those of *Sabellaria spinulosa* with their deep fissures. The second has a longer lamella than the first and a few bristles more, and the third exceeds both in these respects, and the bristles often show asymmetrical tips. The shafts of all these oar-shaped bristles are remarkably long, penetrating deeply into the tissues, and they also appear to be flat. Between each, as a rule, is a slender finely spinous form (Plate CXIII, fig. 3 *d*), only the tip of which projects from the surface, but it has a long, straight shaft almost as large as that of the oar-shaped kind. The bristles are stained in life by methylene-blue (Arnold Watson). The posterior margin of the first and second lamellæ is coarsely crenate, but that of the third is smooth, whilst a ridge from each lamella passes downward to the ventral bristles.

The ventral bristles, as in the previous species, conform to the type of the dorsal, being more slender forms with oar-shaped tips.

The posterior region of the body has about thirty-four bristled segments, and tapers gently from the anterior to the posterior end, but the latter is of considerable breadth and is gently rounded to join the caudal tube. The dorsal surface is more or less flattened and marked by a rather broad median band with transverse grooves, which are not opposite those between the lateral lamellæ—indeed, they alternate with these. The ovoid anterior area is opposite the first, second, and part of the third segments of the region, whilst posteriorly the median band rises into an elevated rounded ridge, continuous with the caudal tube. The branchiæ form conspicuous dorsal processes, the first seven or eight being noteworthy for their great length. Their structure corresponds with that observed in *S. spinulosa*. The ventral surface has a deep median groove, commencing with the first segment of the region and continuing to the last, for the reception of the caudal tube as it curves to this surface. Two transverse ridges cross the groove in front of the anterior area, the second being slightly bent forward, and the next (third) curved more boldly backward to suit the ovoid boss. As with the grooves on the dorsum, these transverse ridges are opposite the middle of each segment.

This region (second body-region) has no dorsal bristles. A ridge passes from each branchia laterally and ventrally, almost to the edge of the ventral groove. The upper third of the ridge is flat, then the torus for the uncini projects and ends ventrally in a papilla; lastly, the ridge is continued ventrally, and ends in a process for the ventral

bristle-tuft and a small subulate cirrus external to or behind it. The first has the longest and largest cirrus, and it is situated to the exterior of the bristle-tuft, and the next five or six, though less, are easily seen to the exterior of the bristles. By-and-by, in their progress backward, they diminish and fall to the rear of the bristle-tuft, and in the caudal region they form only flattened eminences behind the tufts. The first torus for the hooks is of great length, and so with the second, but the others gradually diminish, the last eight or nine being cirriform. The hooks (Plate CXXIII, fig. 3 *e*) are similar to those of *S. spinulosa,* presenting six teeth in lateral view; the basal end, however, is somewhat more truncate distally. Front views show at least a double series of teeth along the edge. Each has its distal and two proximal tendons, and the numbers are great, the tendons forming an asbestos-like mass of fibres in each case. The posterior hooks are smaller, but do not differ materially in outline.

The first bristle-tuft of the region is directed horizontally inward, and in structure it possesses intermediate characters, having about six or seven strong golden bristles with long flattened oar-shaped tips and elongated points, the surface of the tip being minutely spinous. There are, besides, about the same number of forms with more slender shafts and finely tapered tips, densely covered with minute whorls of spikes.

The second ventral tuft of pale golden bristles is directed inward and slightly forward, but it conforms to the ventral type of structure, some of the bristles having stouter longitudinally striated shafts, others more slender, but all having slender tapering tips clothed with whorls of spikes directed distally. The rest of the bristles of the region have their tips directed forward and inward, those in the caudal region being even more conspicuous than those in front, and they have proportionally shorter tips and longer shafts, the imbricated spikes forming a scale-like arrangement on the front of the bristle, whilst the back is smooth. A more or less alternating series of stronger and more slender bristles occurs in each tuft, which is antero-posteriorly spread, like a fan over the soft caudal tube in its ventral groove. Arnold Watson is of opinion that the function of the ventral bristles is largely connected with the passage of the waste matter forward, and they keep the caudal appendage in a central position. He met with an abnormality at the eighteenth abdominal foot which had an extra fascicle of bristles about half the size of the ordinary one and situated internally.

The caudal tube bends smoothly to the ventral groove, and extends more than half-way forward on the ventral surface, diminishing a little as it proceeds. A purplish-brown pigment patch marks its commencement. Two ridges (probably muscular) occur on the ventral surface, with a median groove between them and a lateral furrow at each side. The anal aperture at the tip is usually ovoid in the preparations, with the long diameter transverse.

Arnold Watson has found the intestine infested with *Selenidium* even in young worms only 2 mm. long. In another sickly young specimen a group of parasitic Nematodes (?) were waving out of the anus.

In a very young example with two eye-specks, Arnold Watson observed two light brown bodies at the junction of the caudal process with the trunk, and noticed that the peristaltic action of the gut was from behind forward. He also observed glandular pores

round the margin of the lower lip. The mucous ribs or folds sloped obliquely from the median ventral ridge and met at an angle in the mid-dorsal line. He evaginated the caudal tube, which showed a spiral or oblique arrangement of ribs internally with a ventral ridge apparently in connection with the expulsion of the excreta. The inner lining was infested by parasitic worms (Nematodes?)

Eye-spots occur in young forms (Fig. 140), after the disappearance of the central cirrus, at the V-shaped origin of the ridge anteriorly. The cirri at each side of the building organ appear to be proportionally larger in the very young forms (Arnold Watson).

Arnold Watson observes "that the position of the nephridiopores for the emission of ova is on the posterior face of the uncinigerous lobes, whilst the pores for the emission of sperms are on the dorsum just behind the base of the branchial processes." "The pores of the head-kidney are in the angle formed by the first pair of branchiæ with the body."

*Reproduction.*—Specimens from Naples (probably procured in summer) had ova of

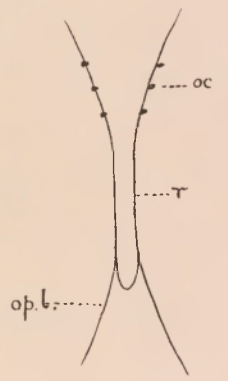



Fig. 140.—Sketch of the folds and eye-spots of a young example of *Sabellaria alveolata*. *oc.*, eye-spots; *r.*, ridge; *op.l.*, opercular lobes. After an outline by Arnold Watson.

considerable size in the cœlomic space. Lo Bianco (1893 and 1909) states that artificial fecundation was carried out at Naples between September and June. Arnold Watson mentions that the ova are cream-coloured, or, at any rate, much less tinged with pink, and smaller than those of *S. spinulosa*.

*Tubes.*—Considerable masses of the tubes (Plate CXVIII, fig. 2) are found in the estuaries of many English rivers, composed either of fine or coarse sand-particles sometimes dotted over with pure white Foraminifera, as if sparsely studded with pearls. The coarse tube figured by Chenu (1843–53) might pass for that of *Tetreres murata*, Allen, if indeed it is not that form.

An interesting variation in the form of the tube was procured by Arnold Watson at St. Mawes, in which the aperture of each tube had a broad flat projection like a shield over it, and composed of the same coarse grains of sand as the rest of the structure. He considers that this addition may have some relation to the intensity of the light in the situation chosen by the annelid, though it is possible that protection from certain enemies may also be a reason. In watching the building operations of a young example, Mr. Watson observed the grains of sand rotated and held in place by the "palps," the lips by their sucker-action meantime covering them with cement. After a number of grains had

been fixed the annelid by a to-and-fro motion appeared to rub the inner surface of the tube with the region just below the palps, where it is probable glands for secreting the lining of the tube may exist. He has studied the building organ in a young specimen 2 mm. in length (Fig. 138, p. 27), and two main apertures are present, one at each side of the organ.

Mr. Watson also noticed in a young example the ejecta discharged from the gut in a thread-like form, and worked forward by ciliary action and perhaps the movement of the bristles. The annelid then protruded its anterior region, and with a sudden jerk inward the refuse was dropped outside the tube. He also noted that where the tube was broken posteriorly the aperture was closed by a translucent brownish secretion, so that the respiratory and other functions could thus be efficiently carried on.

Ellis [1] (1755) gives fairly good figures of the annelid with its opercular crown, and observes that the tubes are interesting as showing a series of saucer-shaped enlargements, and this observation is correct, though such has not hitherto been observed in the Scottish specimens—it may be from their incompleteness. Ellis thought the animal made a cover of sand at these enlargements for protection, and when alarmed retired into the narrow part of the tube. Mr. Arnold Watson sent a fine example from the English coast in which these enlargements occurred at the ends of the tubes throughout the entire surface.

Guettard (1774), after Reaumur and Ellis, gives a description of this and another species under the title *Psamatotus*, with a brief historical account from Reaumur onward, and shows that Linnæus at first placed *Sabellarian* tubes amongst the tubiporous corals, and that Baker erroneously located a true polyp in the tube of the annelid. Guettard's examples of the annelids were chiefly attached to shells. His figure is quite recognizable. He termed it *Penicillus—Pinceau.*

Pennant's figure (1777) shows the tubes in mass, and he terms the species *Sabella rudis*, correcting in the subsequent edition the name to *Sabella alveolata.*

This is the *Alveolaria arenosa* of Leach in the British Museum, from Sandgate, Kent, and termed by Dr. Johnston *Sabellaria crassicornis.*

Donovan (1801), in his 'British Shells,' gives a bold figure of the funnel-shaped ends of the tubes, and specially refers to it. His figure represents even a more expanded condition than that on Plate CXXXIII, fig. 15.

Montagu (1805) noticed that the aperture of each tube is considerably expanded, and the whole has somewhat the appearance of a honeycomb. The length of some of the tubes was nearly 3 inches.

Cuvier terms it *Amphitrite alveolata*, and gives an enlarged coloured drawing of the animal protruding from its tube, and a coloured view of the operculum—more elongated (elliptical) than *S. spinulosa.*

De Blainville, again, figures the tubes with both cylindrical and dilated ends.

*Sabella alveolata* was included by Milne Edwards in the 1836—49 edition of Cuvier under the Amphitrites, along with Terebellids, Amphictenids and Chlorœmids.

[1] 'Nat. Hist. of the Corallines.' Ellis's figure, or one resembling it, has been copied by various authors, such as Chenu (11e livr., pl. ii, fig. 7).

Horst[1] (1881) investigated the development of *Sabellaria* (his *Hermella*) *alveolata* at Wimereux and corroborated some of the points, such as the formation of a perivitelline space, mentioned by De Quatrefages. He believed that more spermatozoids than one entered the ovum, that, in contradistinction to De Quatrefages, the first plane of segmentation occurs in the direction of the point where the polar globules appeared. He differs also in regard to the segmentation, and found that the "animal spheres" surround the vegetative part of the ovum, forming an "amphiblastula." When four days old the larva has a dome-like form with a cephalic tuft of long cilia and the peritroch, and there are a mouth and ciliated œsophagus separated by a constriction from the gut. There are four provisional setæ and two ocular patches. His figures are good, the latest (metachete) stage of the larva with its long spinous temporary bristles and reddish pigment being characteristic.

Giard[2] (1913) noted that *Axionice flexuosa* frequently occurred at Wimereux in masses of *Sabellaria alveolata*. He may refer to another form.

In the British Museum an example from Sandgate, Kent, has *Sabellaria crassissima* over the old label *Alveolaria arenosa*, Mus. Leach. It is further interesting that the *Sabellaria saxicava*, Baird, is only an ordinary example of the genus in the usual tube of coarse sand which has subsequently been coated with Lithothamnion. It came from Vancouver Island. So far as known there is no borer in the family.

Hornell (1891) mentions that a mite is frequently found parasitic on this species in the Liverpool district (Hilbre Island).

## Family XXVII.—Amphictenidæ, *Malmgren*, 1866.

*Amphitrite*, O. F. Müller; *Terebellum*, Denys de Montfort; *Pectinaria*, Lamarck; *Amphictenea*, Savigny, Grube.

Cephalic region obliquely truncate or semicircular, with two rows of powerful golden bristles (paleolæ) nine to seventeen in number which exactly fit the aperture of the tube, and which are compressed, tapered and arranged in contiguous series in two rows attached to the buccal (second) segment. Above the paleolæ is a firm region with a smooth or fimbriated border, whilst beneath them is the membranous fan-shaped veil with cirri on the margin (rarely entire). To the base of this on the dorsal arch of the mouth a group of contractile grooved tentacles is affixed on each side. Tentacular cirri two, the anterior springing from the side of the head, the second from the first segment. Body of comparatively few segments, and of several regions differently constituted, viz., a buccal, an anterior or thoracic region, large and devoid of hooks, a posterior (abdominal) region with prominent lamellæ for hooks, and lastly a short posterior appendicular or caudal region of about five to six segments (scapha), usually bent at an angle, excavated above and convex ventrally, the margin crenulate and with a valvular flap above the anus. Intestine longer than the body. Cœlom with one anterior

[1] 'Versl. en Meded. afd. Naturk. Amsterd.,' 2d R De xvi, pp. 207—214, and plate.

[2] Œuvres Div., p. 57.

dissepiment. Branchiæ two pairs, on the second and third segments,[1] pectiniform, lamellæ diminishing from within outward and attached to a tapered basal stem—often coiled, situated near the feet. Anterior heart connected with peri-intestinal sinus.

Bristles commence on the sixth segment, arranged in two series, viz., three in the first region and twelve to fourteen in the second, the latter stronger, and accompanied by lamellæ for hooks. The structure throughout is the same, viz., strong, simple, tapering bristles with traces of wings on the tips, and a shorter series with spear-like dilatations at the end of the shaft, and a tapering, hair-like tip. Some forms have hooks with long shafts anteriorly (Hessle). Pectiniform hooks, commencing on the ninth segment, and in a single row (Hessle). Bristle-like hooks (probably ventral, though in young dorsal—Hessle) on each side of the base of the caudal appendix (scapha). Tube free, tapered, nearly straight or very slightly curved, composed of neatly arranged sand-grains and secretion, or in one genus of fragments of shells. Feet reduced as in all tubicolar forms. Nerve-cords comparatively free. Tentacles innervated from the anterior ganglia (Nilsson), from the middle ganglion (Hessle), the former homologising them with the palps. Nerves for tentacular membrane from the middle ganglion. Nuchal organ, as in the Ampharetidæ, raised (Hessle). A groove between tentacles and mouth.

In the Amphictenidæ Schneider found a heart-body, and Cunningham[2] (1888) mentions that an anterior heart is present, and is connected with a blood-sinus on the walls of the intestine.

Some authors, like Eisig and Picton, think the heart-body equivalent to the chloragogenous coat of the vessel pushed in. Picton considered it mesoblastic in *Polymnia*, and analogous to the liver of vertebrates, but glycogen is absent so that its complete analogy is not proven, though other products may be present and stored. The functions of the pigment and the chitinous bodies are unknown. It has been suggested that waste products may be carried through the heart-wall and thence to the nephridia and leucocytes. Beddard and Horst, again, are of opinion that the heart-body is hypoblastic. Eisig views it as modified peritoneal tissue, though Schaeppi has found it of different chemical composition. It is in the blood-stream as the liver is, and hence Fauvel considers it hepatic in function, and that it has no connection with amœbocytes. Its occurrence in so many families of Polychæts is noteworthy, for besides the Amphictenidæ, it is present in the Opheliidæ, Chloræmidæ, Cirratulidæ, Ampharetidæ and Terebellidæ, whilst in the Arenicolidæ it is paired, and unites the gastric plexus with the ventral. Functionally some are inclined to the view that it prevents regurgitation.

In the anterior region of *Cystenides hyperborea*, Malmgren, the cuticle is tough, but the hypoderm is comparatively thin. A thin circular muscular coat lies beneath the basement-membrane. The dorsal longitudinal muscles are elongated in section, stretching from the feet at each side to the dorsal middle line, where they are connate. The ventral longitudinal muscles are thicker, but have a wide space between them occupied by the transverse muscle formed by the circular coat augmented by other fibres. The nerve-cords form an ovoid mass in section above the transverse muscular fibres, and there is

[1] According to Nilsson, the fourth and fifth segments.

[2] 'Quart. Journ. Micr. Sci.,' N.S., vol. xxviii, p. 261.

no neural canal. The oblique muscles pass by the blunt inner end of the ventral longitudinal muscles and thus are widely separated from the nerve-cords—a rare condition.

The apparent absence of neural canals in the group is interesting in connection with the supposed special functions of the so-called "giant-fibres."

Cunningham[1] (1888) describes three pairs of nephridia in *Pectinaria belgica*, the first the largest, each consisting of a tube bent on itself, and provided with a nephrostome and nephridiopore. The nephrostome of the first is on the anterior side of the septum separating the buccal from the next segment. The others occur on the fifth and sixth segments, the third and fourth being devoid of them. They are brown or black in colour. Between the nephridiopore of the first and the base of the branchia is the aperture of the special glandular organ of the species. The nephrostomes are simple, elongated funnels with the apertures directed forward, and the gonads (undifferentiated cells) are attached to their inner side.

Linnæus (1767) included *Pectinaria* along with the Terebellids, the forms he alluded to being *P. granulata* and *P. capensis*. Gmelin (1788) somewhat improved on the foregoing by aid of O. F. Müller's labours in the 'Zoologiæ Danicæ Prodromus,' and the 'Zoologia Danica' itself. He, however, did not render the position of the Pectinarians and the Terebellids clear, including for instance *P. belgica* under the genus *Sabella*.

Cuvier separated the Amphictenidæ from the Terebellæ and Sabellæ of Müller, Bruguière, Gmelin and Lamarck, and constituted the group *Amphitrite*, containing not only the *Amphictenidæ* but the Hermellidæ. Under this head he enters a protest, so needful in modern times, against the perpetual changing of names, rendering the study of nomenclature much more difficult than that of facts. In *Amphitrite* the head is furnished with two series of stout bristles having a metallic lustre and resembling combs, whilst above them are the tentacles. The plumose anterior gills do not exceed four.

The Amphictenidæ were relegated by Grube in 1851 to the Terebelliformia—the practice usually followed up to that date. In 1871[2] he reviewed the characters which linked *Terebella*, *Pectinaria* and *Amphicteis* together, but he followed Malmgren in making each a separate family. He divided the Amphictenea into two groups, the one including *Pectinaria*, Lam., having two pairs of comb-like branchiæ on the third and fourth segments, and *Scalis*, Grube, whilst *Petta* had three pairs. The number of bristle-bundles and the lateral processes differ in each.

This group followed the Hermellidæ, and was termed the "Pectinairiens" by De Quatrefages (1865). He regarded these annelids as only partly sedentary, since they can carry their tubes about like those of the Phryganidæ. He was at one time inclined to link them on to the Terebellidæ, but the disposition of their branchiæ and their definite anatomical characters caused him to separate them. Amongst other structural features he mentions that there are two dorsal blood-vessels, and that the chief trunks joining the dorsal with the ventral have pedicled sacculations on each side. He arranged them according to the number of the branchiæ, *Pectinaria* having two and *Scalis* three pairs.

Claparède (1868) thought that the separation made by Malmgren between *Pectinaria*

[1] 'Quart. Journ. Micr. Sci.,' N.S., vol. xxviii, p. 254.

[2] 'Schles. Gesell.,' 6th April, 1870.

and *Amphictene* rested only on secondary characters. *Pectinaria* was characterised by Malmgren as having an entire fleshy cephalic region and the tube straight.

Meyer[1] (1887) remarks that at Naples the Amphicteniens are normally hermaphrodite.

The Amphictenidæ formed, along with the Ampharetidæ and Terebellidæ, Levinsen's group *Terebelliformia* (1883), after the arrangement adopted by Malmgren and others, and there is some justification for this view. He included all the Amphictenidæ under the genus *Pectinaria*.

The circulatory and digestive systems of *Pectinaria belgica*, *Amphictene auricoma* and *Petta pusilla* were carefully described and figured by Wirén[2] (1885).

Fauvel[3] (1903) describes the form and structure of the tubes of the Amphictenidæ, the glands supplying the cement and the habits of the annelids. He subsequently (1907) gave an account of the circulation in *Lagis Koreni*. The account of the intestinal sinus, the large size of the ventro-pedal vessel of the first and second segments, and the occurrence of contractile ampullæ on them, the structure of the heart, and the indirect communication of the intestinal circulation with the ventral trunk are amongst the salient features of this paper.

The Amphictenidæ were placed after *Terebellides* at the end of the family Terebellidæ by Dr. Johnston (1865).

Three pairs of organs of Bojanus are described by Cosmovici (1880) in the anterior region of the body of the Amphictenidæ. The first pair have the form of closed glandular pouches. The other two are attached to the segmental organs, which are flask-shaped, with a posteriorly directed funnel-shaped internal opening and an external pore. The backwardly directed internal aperture is considered by the author to be related to the position of the genital products which lie on each side of the nerve-cord posteriorly.

D. Nilsson[4] (1912) gives a detailed account of the nervous system and sense-organs chiefly of this family, and he contrasts the arrangement of the cephalic ganglia of the Amphictenidæ and Ampharetidæ with those of the errant forms—all being essentially three-lobed, as Pruvot and Racovitza showed. Whereas, however, the ganglia in the free-living forms are arranged (diagrammatically) like an H or a K, those of the two families mentioned are in the form of a crescent. He describes in the branches of the nerve-cord of *Pectinaria belgica* a motor dorsal and a mixed ventral root, and he gives a figure showing both segmental and intersegmental nerves to illustrate this condition. The former (dorsal) root supplies the longitudinal muscles, the latter (ventral) the circular muscles and sensory structures. Further observations on this subject would be interesting. Nilsson's account of the nervous system and sense-organs specially deals with *Lagis Koreni*, *Pectinaria belgica*, *Amphictene auricoma* and *Petta pusilla*, and he points out that the scapha (with its eyes in *Petta*) has its nerve-supply from the posterior gastric just as the buccal region has its nerves from the stomato-gastric. The fine nerves on the veil, and the nerve-cells of the nuchal and side organs are figured and described. Finally he

[1] 'Mittheil. Zool. Stat. Neap.,' viii.

[2] 'Kongl. Sv. Vet. Akad. Handl.,' Bd., xxi, p. 22, etc., Taf. iii, figs. 1—5, Taf. iv, figs. 9, 10, Taf. v, Taf. vi, figs. 8, 9.

[3] 'Mem. Pontif. Accad. Romana N. Lincei,' vol. xxi, pp. 1—28, with text-figs.

[4] 'Zoologiske Bidrag Uppsala,' p. 85, Taf. iii—v, 1911—12.

discusses the homologies of the cephalic ganglia with the succeeding segmental ganglia of the main cord.

In his dredging expedition to Finmark, Canon Norman procured numerous Polychæts, which he kindly sent me for identification. They included many of those described in the present volume, such as Amphictenidæ, Ampharetidæ, Terebellidæ, Sabellidæ and Serpulidæ. The list was published in the 'Annals of Natural History,' 7th ser., vol. xii, p. 283 (1893). It has been deemed sufficient to note them under the head of "Distribution," and the same applies to Kükenthal's Polychæts from Spitzbergen as entered by Marenzeller and E. Mayer in the 'Arch. f. Naturgeschichte' for 1889, pp. 1 and 132.

C. Hessle[1] furnishes a detailed account of the Terebelliformia of Levinsen, with plates and text-figures, and in this the Amphictenidæ are included systematically and anatomically. His descriptions and figures are good, and he has illustrated by a series of diagrams the typical nephridia in each family. He treats not only of the European, but of the extreme northern and southern Polar types, those from Japan, the Swedish Expedition to Magellan, and the collections in various museums to which he had access.

The Amphictenidæ are dwellers in sand or fine gravel, though in deep water a few frequent the mud, making their tubes of sponge-spicules artistically and regularly arranged in a transverse manner. They are nocturnal in habit and widely distributed. The northern *Cistenides hyperborea*, so common in the Gulf of St. Lawrence, Canada, has not yet been met with in British seas. The group has affinities with the Ampharetidæ and the Terebellidæ, and Levinsen and others form these into Grube's division Terebelliformia.

## *Genus* CXXXIV.—Pectinaria, *Lamarck*, 1812.

*Cistenia*, Leach; *Amphictene*, Savigny.

Cephalic lobe rounded; frontal veil (tentacle-membrane of Hessle) cut into triangular fimbriæ. Tentacles short, covering the cephalic lobe. Two eyes over the ganglia. On the second segment is a cirrus. Buccal segment extending as a nuchal area with its paleæ. Body broad in front, tapered posteriorly and of two regions, the anterior much the longer—branchiferous and setigerous; segments about twenty; posterior region (scapha) of six short segments containing the anus, armed with minute paleæ and crenate or "toothed," on each side. Branchiæ two pairs, on the third and fourth segments, comb-like in form, with broad teeth (lamellæ). A pair of cement glands in the fourth segment. Nephridia in the fourth, seventh and eighth segments, the anterior longer than the posterior. Seventeen pairs of bristle-bundles, beginning on the fifth segment. Bristles capillary with narrow wings. Uncini pectiniform, with several large teeth, and with smaller below. They commence on the eighth segment and continue to the last. Tube composed of neatly arranged and minute fragments of shells, grains of sand, straight or slightly curved.

[1] 'Zool. Bidrag Uppsala,' Bd. v, 1917.

1. Pectinaria belgica, *Pallas*, 1766. Plate CXVIII, figs. 4 and 4 *a*—body and tube; Plate CXXIV, figs. 1—1 *c*—bristles and hook.

*Specific Characters.*—Paleolæ from ten to fifteen, large, flattened and tapered to a fine point; a large corrugated firm surface of the crown above them, the margin of which is deep and smooth, curves ventrally a little within the edge of the paleolæ, and ends at the long anterior cirrus. Two eyes over the brain. Veil (tentacle-membrane) restricted in area, fan-shaped, and with ten to eleven (seventeen, Lo Bianco) large tapering papillæ in front, and a few others on the lateral edges as they pass to the mouth (in all about twenty-five). The tentacles are fixed to its posterior border—which is smooth. Body about 70 mm. with the scapha in addition. Second cirrus arises a little behind the rim of the crown, and this segment with the two branchial segments makes a region of three; the first branchial segment has an incomplete glandular ridge ventrally, whilst that of the second is complete. Third segment with two ventral lobes (Hessle). Seventeen bristled segments anteriorly; thirteen with hooks, each with seven to eight teeth in profile. Dorsal surface smooth and rounded; ventral with glandular areas and ridges in front; flattened and grooved posteriorly. The next region consists of three bristled segments but hooks are absent. The first two have glandular ridges ventrally, whilst the third approaches the condition in the succeeding segments. The third region has fourteen bristled segments and prominent lamellæ for the rows of hooks, the largest lamellæ being in front. Bristles of two kinds—simple, stout, tapering forms, with finely-tapered tips having traces of wings, and those with a spear-head dilatation distally, a serrated edge, and long tapering hair-like tips. Hooks commence on the thirteenth segment, with seven to eight recurved teeth beneath the crown, then a group with minute serrations, and lastly the sinuous prow: the shaft is short. Two cement-glands. Caudal process tortoise-shaped, of five segments, bent at more than a right angle to the dorsum; dorsal surface flattened, with a median keel or process and symmetrically arranged transverse ridges; rim little elevated; two notches beyond the hooks and occasionally a minute papilla or two. Caudal hooks (six to twelve?) have stout straight shafts tapering toward the neck, which first bends a little backward, then gently forward to a strong point. General colour of the body yellowish-orange in females, whitish in males, and the branchiæ are reddish-yellow. Tube large, nearly straight, tapered, composed usually of small grains so that the surface is smooth, the separate joints not clearly visible. Often brownish.

Synonyms.

1766. *Nereis cylindraria*, var. *belgica*, Pallas. Miscell. Zool., p. 122, Tab. ix, figs. 3—13.
„ *Sabella granulata*, Linnæus. Syst. Nat., p. 1268.
1773. *Solen fragilis* Spec. 2, Klein. Descr. Tubul. Mur., p. 21, Tab. i, fig. 5.
1777. *Nereis cylindracea belgica*, Pennant. Brit. Zool., iv, p. 147.
„ „ *conchilega*, idem. Ibid., iv, p. 47.
„ *Sabella tubiformis*, idem. Ibid., iv, p. 148, Tab. xcii, fig. 163, and Edit., 1812, iv, p. 372, pl. xcv, fig. 2.

1791. *Sabella belgica*, Linnæus. Gmelin's Syst. Nat., i, p. 3749.
1805. „ *granulata*, Montagu. Test. Brit., p. 544.
1806. „ *belgica*. Turton's Linn., iv, p. 611.
1807. *Nereis pectinata*, Turt. Brit. Fauna, i, p. 134.
„ *Sabella granulata*, idem. Ibid., p. 202.
„ „ „ Pennant. Ibid., p. 134.
1812. *Amphitrite auricoma*, Pennant. Brit. Zool., iv, p. 91.
1817. „ „ Stewart. Elements, i, p. 389, pl. xii, figs. 1, 2.
„ „ „ Cuvier. Règne Anim. (Griffiths), t. xiii, p. 14 (*fide auctorum*).
1818. *Pectinaria belgica*, Lamarck. Hist. Nat. Anim. s. Vert., t. v, p. 350 (excl. syn. Mülleri), 2nd Edit., p. 602.
1819. *Cistenia Pallasii*, Leach. Encycl. Brit., i, p. 452, Tab. xxvi.
„ *Sabella belgica*, Martin. Conch. I., t. iv, f. 27.
1820. *Amphictene auricoma*, Savigny. Syst. Annel., p. 89, 2e Edit., t. xxi, p. 426 (excl. syn.).
1827. *Pectinaria* (*Amphitrite*) *belgica*, Bruguière. Encycl. méth., pl. lviii, figs. 10—15 (after Pallas).
1830. *Amphitrite belgica*, Bosc. Vers., 2nd Edit., vol. i, p. 198.
1836. *Pectinaria* „ Templeton. Mag. Nat. Hist., ix, p. 234.
1836–49. *Amphitrite auricoma*, M. Edwards. Règne An. Illust., pl. vi, fig. 1.
1843–53. *Pectinaria belgica*, Chenu. 11th livr., p. 1, pl. ii, figs. 1—3.
1845. *Amphitrite auricoma*, Rathke. Ray Soc. Repts., p. 283.
„ „ „ Williams. Ann. Nat. Hist., ser. 2, vol. xii, p. 396.
1851. *Pectinaria belgica*, Grube. Fam. Annel., pp. 82 and 138.
„ „ „ Landsborough. Excurs. Arran., p. 50.
1853. *Sabella* „ (*Amphitrite auricoma*), Dalyell. Pow. Creat., vol. ii, p. 178, pl. xxv, figs. 5 and 6.
1865. *Pectinaria* „ Johnston. Cat. Worms Brit. Mus., pp. 243, 345.
„ „ „ De Quatrefages. Annel., p. 332.
1866. „ „ Malmgren. Nord. Hafs.-Annul., p. 356, Tab. xviii, fig. 42.
1867. „ „ idem. Annul. Polych., p. 103.
1868. „ *neapolitana*, Claparède. Annél. Nap., p. 382, pl. xxviii, fig. 2.
1871. „ *belgica*, Grube. Schles. Gesell. (1870), p. 73, sep. abdr., p. 5.
1872. „ „ Malm. Annul. Göteb., p. 94.
1873. „ „ Kupffer. Jahresb. Komm. deut., p. 151.
1874. „ „ Encycl. Brit. Helminthol., p. 296, fig. 4, p. 68, figs. 11 and 12, and pl. cclxxv, figs. 6 and 7.
1878. „ „ Lenz. Jahr. Komm. deut. Anhang., p. 11.
1879. „ „ Tauber. Annul. Danica, p. 126.
1883. „ „ Levinsen. Vidensk. Meddel., p. 152.
1886. ? „ „ Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 349.
1889. „ „ Grieg. Bergens Mus. Aarb., p. 8.
1893. „ „ Lo Bianco. Atti R. Accad. Napoli, vol. v, no. 11, p. 47.
(= *Nereis cylindraria*, var. *belgica*, Pallas; *Cistenia Pallasii*, Leach; *Amphitrite auricoma*, Cuvier; *Pectinaria neapolitana*, Claparède.)
1894. *Pectinaria belgica*, Bidenkap. Christ. Vet.-Akad. Forhandl., p. 119.
1897. „ „ Michaelsen. Polych. deutsch. Meere, p. 162.
1900. „ „ Ehlers. Schwed. Magell. Annel, p. 15.
1901. „ „ idem. Polych. Magell. u. Chil., p. 204.
1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 238.

1912. *Pectinaria belgica,* Wollebæk. Skriv. Vid.-selsk. Krist., No. 18, p. 39, pl. iii, figs. 9—11.
„ „ „ A. H. Meyer. Inaug. Dissert. Kiel., p. 10.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 130.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 84.
1917. „ „ Hessle. Zool. Bidr. Uppsala, 5, p. 75.

*Habitat.*—Off the Hebrides, July, 1866 (Dr. Gwyn Jeffreys); Loch Linnhe, off Castle Walker; "Knight Errant," 1882 (Sir John Murray); Berehaven, Ireland, Royal Irish Academy's Expedition, 1885 (Prof. A. C. Haddon); large tube? off the Bell Rock, St. Andrews (W. C. M.); Dublin Bay and Killary Harbour (Southern); Plymouth (Spence Bate and Brooking Rowe).

Abroad it extends to Sweden; Finmark (Norman); Magellan (Ehlers); Belgium (Pallas?).

The crown in this species has ten to fourteen paleolæ, which are broader than those of *Lagis Koreni*, and, as *P. belgica* is often larger, they are stronger and more individualised, but their curves are similar, the convexity being ventral. They dilate a little above the base and then taper to a very delicate, hair-like tip, which from the lines at its sides would seem to indicate relationship with a winged bristle. Friction, however, removes the delicate extremity in some. The outer paleola is shorter than the adjoining one, whilst the two inner appear also to be smaller in most examples. In the largest example from British waters in the collection, viz., from Loch Linnhe, fourteen paleolæ occurred on the left and ten on the right. Above the paleolæ is the tough, firm and slightly corrugated surface of the crown, which has a proportionally broader rim than in *L. Koreni.* Having reached its greatest diameter laterally it curves ventrally a little within the edge of the paleolæ, and ends at the long anterior cirrus. The margin dorsally and laterally is smooth, but on the ventral curve to the paleolæ it has one or two small papillæ. After the cirrus the edge slopes backward to form the pillars at the sides of the mouth.

The veil is more restricted than in any of the allied forms, and its outline is fan-shaped, the anterior edge having ten or eleven rather large tapered papillæ or fimbriæ and the edges a few others as they pass to the anterior region of the mouth.

The tentacles arise immediately behind the veil, and form a considerable group on each side. They have the usual shape, and the extremities in the preparations, as in life, are often clavate. Numerous smaller forms occur posteriorly, and all are attached to a surface continuous with, and forming part of, the veil, and these are in front of the mouth dorsally. The small lateral fold of the veil to a certain extent forms a guard antero-laterally. A broad fillet occurs on each side of the mouth posteriorly, and a median fold completes it behind.

The second cirrus arises laterally a little behind the margin of the crown and is a long subulate tapering organ. A ridge passes ventrally from it on each side, meeting its fellow in the middle line behind the mouth, and may be taken to represent a segment. The next two are branchial segments, each having the typical branchia of the group, viz. a series of flat lamellæ largest internally and diminishing externally, attached to the basal and posterior stem. The second is smaller, but of similar structure. These

two segments are glandular ventrally, and in the centre of each is a median fold or boss.

The next region of the body, which is smoothly rounded dorsally, flattened and grooved ventrally, consists of three bristled segments devoid of hooks. The first two are highly glandular ventrally from side to side, and with the median fold, whilst the third is apparently only partly so, being continued ventrally as a transversely folded band with a slight median differentiation. The bristles in these are typical, viz. strong, with tapering tips (Plate CXXIV, fig. 1), which show traces of wings, and those with the spear-head dilatation and the long hair-like tips, the edge being serrated.

The succeeding region of the body still remains smoothly rounded dorsally, but ventrally it has throughout the five or six anterior segments a fusiform area in the centre, apparently a special glandular region. At each side ventrally in a line with the lamellæ is a short glandular patch, which diminishes as the segments go backward. The ventral surface generally is flattened and grooved posteriorly. This region has fourteen pairs of dorsal bristle-bundles attached to the dorsal edges of the lamellæ bearing the rows of hooks. The bristles are stout, simple, with tapering tips which have traces of wings (Plate CXXIV, fig. 1), besides those with spear-shaped dilatations, serrated edges, and long tapering tips. The tufts are smaller posteriorly, but do not differ in structure.

Each of the hooks (Plate CXXIV, fig. 1 *a*) presents seven teeth below the crown; then follows a process with minute teeth, the trend of which is from above obliquely outward, whilst the prow inferiorly is bluntly conical. The shaft of the hook is short and bent nearly at a right angle. In Malmgren's figure of the hook the minute teeth above the prow cover a longer space—that is, are more numerous than in the specimens from Britain. The prow, both in this species and in *Amphictene auricoma*, often presents a slightly double tip as if not smoothly rounded.

The tortoise-shaped caudal process is usually bent at more than a right angle to the dorsum, thus making a small angle with the ventral surface. The rudimentary feet pass obliquely upward to the dorsal keel, toward the end of which is on each side a considerable row of caudal hooks. The dorsal surface of the process is flatter than in allied forms, a median keel and symmetrically arranged transverse ridges being on this surface. The rim is not much elevated, and has two notches beyond the hooks and in some a minute papilla or two. The caudal hooks (Plate CXXIV, fig. 1 *b*) differ from those of any other form, having a comparatively straight shaft tapering toward the neck, which bends a little backward and then gently forward at the tip, so as to form a strong point. As usual the shaft is longitudinally striated.

The tube is large, nearly straight, and tapered to a small extremity. Moreover it is lined in some by a comparatively thick internal membrane which readily separates in the preparations from the firm wall. Its masonry as a rule differs from that of *Lagis* or *Amphictene* in so far as the grains are smaller, and even though in some the surface is rendered irregular by projecting larger grains, the general effect is characteristic. Typical examples on sandy ground are smooth and finely grained, no separate joints being distinguishable (Plate CXVIII, fig. 4 *a*).

On a large example dredged by the "Knight Errant" in Loch Linnhe off Castle

Walker on September 7th, 1882, numerous minute Loxosomæ occurred in the grooves of the three conspicuous glandular ridges (last branchial and first bristled segment) and a few behind the lamellæ for the anterior hooks.

Pennant (1777) observes that this form, his *Nereis conchilega*, is an inhabitant of the *Sabella tubiformis*, which he describes and figures in the same volume, the figure resembling the tube of this or *Lagis Koreni*. Of the animal he writes: "*Nereis* with a flat body, attenuated towards the tail; pellucid; about thirteen feet on each side; about the mouth a series of very fine filaments."

Chenu's (1843—53, pl. ii,, fig. 1) figure of the tube of this species somewhat resembles that of *Amphictene auricoma*.

So far as can be observed the *Sabella belgica* of Dalyell (1853) appears to be this species—both in regard to the account of the animal and the form and size of the tube. He found it nocturnal in habit.

Claparède (1868) reviews the structural features of the Neapolitan *Pectinaria*, the hooks of which differed from those of the Northern form, and finds that the blood, as Rathke states, moves from behind forward in the two large intestinal vessels, but this is also the direction of the blood in the ventral vessel, whereas the current in the two dorsal trunks is from before backward—a remarkable variation in the Polychætes. Rathke considered the whole series of glands in the anterior region assexual, those in front being ovarian and those posterior testicular. He thus agreed with Pallas.[1] Claparède points out that these are not sexual glands and that the Pectinarians are unisexual. These glands are ciliated externally and contain brownish-yellow concretions or cellular bodies, and that such are homologous with the excretory structures in the Chloræmidæ. He found a segmental organ at the base of the first branchia and in connection with the second pair of glands mentioned above, and he thought it probable that the others had a like function; further, that Rathke may have been correct in seeing ova in their interior at the time of reproduction—on their way to the exterior. He was uncertain as to the exact place of origin of the sexual elements, though he saw minute ovules in the interstices of the small muscles of the feet.

Leschke[2] (1902) describes a pelagic larval stage captured in October which shows prototroch and telotroch, pigment-specks in rows occurring over the snout in front of the former and along its line. The mouth opens on a projecting process anteriorly, and the shape in lateral view is peculiar.

Considerable confusion existed in the writings of the earlier authors between this species and *Lagis Koreni*, and such even held till the end of the nineteenth century. The frequent occurrence of the latter form and the comparative rarity of the former, as well as the paucity of reliable descriptions and figures, probably had this tendency. In the Scottish seas *Lagis Koreni* generally frequents shallow water on sandy beaches, whereas *P. belgica* has as a rule been only procured by the dredge.

[1] 'Miscellanea Zoolog.,' p. 130, and 'Dierkundig. Mengelwerk,' IV Stuk, p. 20.

[2] 'Wissensch. Meeresuntersuch.,' Bd. v, p. 127, Taf. vi, fig. 13.

*Genus* CXXXV.—Amphictene, *Savigny*, 1820.

Malmgren re-established the genus *Amphictene* of Savigny as distinct from *Pectinaria* on the grounds that the veil or lamella has its edges fringed with subulate processes or cirri, and that the tube is gently curved. Though the distinctions are not of great moment the name may be retained.

1. Amphictene auricoma, *O. F. Müller*, 1776.—Plate CXVI, fig. 6—portion of tube; Plate CXVIII, figs. 5—5 *b*, tubes; Plate CXXIV, figs. 2—2 *c*, bristles and hooks.

*Specific Characters.*—Paleolæ eleven to thirteen, tips tapered to a delicate point or boldly bent like a hook.[1] Dorsal collar of scabrous area above these has its margin fringed with subulate processes, and the edge passes to the base of the anterior long cirrus or tentacle. Veil comparatively small, its anterior edge fringed with long subulate processes. Branchiæ with large ovoid lamellæ internally, diminishing externally, basal stem short. Anterior region has three bristled segments, but is without hooks, the tufts of bristles being small. Seventeen bristled segments in the region behind. Bristles similar throughout, viz., stout simple bristles tapered at the tip and with traces of wings, and others with a spear-shaped flattening of the serrated tips and a long hair-like end. Hook-like bristles of the caudal process long, straight, rapidly diminished at the tip, which has a bold hook. Hooks (which are on thirteen segments) of the long rows on the lamellæ of the feet with six teeth from the curve downward, then a process with numerous minute spikes on the edge, and lastly a rounded prow nearly in a line with the armed face. Caudal process deeply grooved dorsally and the edge boldly and symmetrically notched, the ventral surface being convex and grooved by oblique furrows. Dorsal terminal lip prolonged as a somewhat conical process beyond the ventral lip. Caudal hooks about eight in average examples, though sometimes ten. Tube gently curved, pale brownish, and often tapered to a slender tip; composed of neatly cemented and fine grains of sand.

Synonyms.

1769. *Amphitrite auricoma*, Martini. Conch., vol. i, Tab. iv, fig. 27.
1776. *Amphitrite* „ O. F. Müller. Prodr. Zool. Dan., p. 216.
1780. „ „ Fabricius. Faun. Grœnl., p. 289, No. 272.
1788. „ „ O. F. Müller. Zool. Dan., vol. i, p. 26, Tab. xxvi.
1791. „ „ Gmelin. Linn. Syst. Nat., i, pt. vi, p. 3111.
1806. „ „ Turton's Linn., p. 82.
1815. „ „ Oken. Lehrbuch., Bd. ii, p. 377.
1817. „ „ Stewart. Elements, vol. ii, pl. xii, figs. 1 and 2, = *Sabella granulata*, p. 423.
„ *Sabella belgica*, Cuvier. Règ. An., t. ii, p. 521.
1818. *Pectinaria belgica*, Lamarck. Anim. s. Vert., t. v, p. 602.

[1] Seven to eight anterior paleæ sub-equal, four inner shorter and more slender (Carus).

1820. *Amphitrite auricoma,* Savigny. Syst. Annel., p. 89.
1828. *Pectinaria* „ De Blainville. Dict. Sc. nat., t. lvii, p. 436, pl. iii, fig. 1.
1830. *Amphitrite auricoma,* Bosc. Vers., 2e Edit., vol. i, p. 195.
1839. ? „ „ Bruguière. Encycl. Meth., pl. lvii, figs. 13, 14 (but tube straight).
1841. „ „ Delle Chiaje. Descrizione, Tav. xxxix, figs. 5 and 6.
„ *Pectinaria* „ idem. Ibid., vol. v, p. 95.
1842. *Amphitrite* „ H. Rathke. Neuste Schrift. Naturf. Gesellsch. in Danzig, Bd. iii, pp. 56—83, Tab. v.
1843. „ „ H. Rathke. Nova Acta Acad. C.L.C. Nat. Cur., Bd. xx, p. 219.
1844. „ „ Œrsted. Nat. Tidsk., 2e ser., i, p. 415.
„ *Amphictene* „ idem. Reg. Mar., p. 68.
„ *Amphitrite* „ Cuvier. Règ. An. Griffith's, p. 14.
1851. „ „ Maitland. Fauna Belg., p. 204.
„ „ „ Sars. Reise i Lofoten og Finm., 1849, Nyt Mag. Naturv., vi, p. 206.
„ ? *Pectinaria belgica,* Grube. Fam. Annel, pp. 82 and 138.
„ *Pectinaria auricoma,* idem. Ibid., pp. 82 and 138.
1852. „ „ Danielssen. Reise, 1858, Norske Vid. Selsk. i Trondhjem. Skt. i 19 de Aarh., 4, 2, p. 27.
1853. *Amphitrite* „ Sars. Nyt Mag., Bd. vii, p. 386.
1855. *Pectinaria* „ Stimpson. Invert. Rhode Is., etc., p. 146.
1857. „ „ Koren. Nyt Mag., ix, p. 94.
1859. „ „ Danielssen. Kgl. Norske Vid.-Selsk. Skrift., 4e Bd., p. 123.
1861. „ „ idem. Nyt Mag., xi, p. 55.
1864. „ „ Grube. Insel Lussin, p. 89.
1865. „ *granulata,* Johnston. Cat. Worms Brit. Mus., p. 245 (exclus. syn., L.).
„ *Amphictene auricoma,* Malmgren. Nord. Hafs.-Annul., p. 357, Tab. xviii, fig. 41.
„ *Pectinaria belgica* (pro parte), De Quatrefages. Annel., ii, p. 332.
„ „ *auricoma,* idem. Ibid., p. 335.
1867. *Amphictene* „ Malmgren. Annul. Polych., p. 103.
1868. „ „ Claparède. Annél. Nap., p. 382, pl. xxviii, fig. 2.
1871. „ „ Grube. Schles. Gesell., p. 74, sep. abdr., p. 5.
1873. *Pectinaria auricoma,* Kupffer. Jahres. Komm. deut., p. 151.
1874. *Amphitrite* „ Malm. Göteborg. Fauna, p. 94.
„ *Amphictene* „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 204.
1875. „ „ Panceri. Atti Soc. Ital., vol. xviii, p. 529.
„ „ „ Ehlers. Zeitschr. f. wiss. Zool., Bd. xxv, p. 27.
„ „ „ McIntosh. Invert. and Fishes St. Andrews, p. 128.
1879. *Pectinaria* „ Tauber. Annul. Danica, p. 126.
1883. „ „ Levinsen. Vidensk. Meddel., p. 151.
1885. „ „ Carus. Fauna Medit., i, p. 260.
1886. „ „ Harvey Gibson. Proceed. Lit. and Philos. Soc. Liverp., vol. xl, p. 156.
1889. *Amphictene* „ Grieg. Bergens Mus. Aarb., p. 8.
1891. „ „ Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 259.
„ „ „ Appellöf. Bergens Mus. Aarb., p. 8.
1893. *Pectinaria* „ Lo Bianco. Atti R. Accad. Sc. Napoli, vol. v, No. 11, p. 46.
1894. „ „ Bidenkap. Christ. Vet.-Akad. Forhandl., p. 118.
1896. „ „ Appellöf. Bergens Mus. Aarb., p. 12.
1897. „ „ Michaelsen. Polych. deutsch. Meere, p. 160.

| | | | |
|---|---|---|---|
| 1898. | *Pectinaria auricoma*, | Lönnberg. | Unders. rörande Öres. Meddel. Kungl. Landbruk., No. 1. |
| 1903. | „ | „ | idem. Ibid., 1902, No. 2. |
| 1904. | *Amphictene* | „ | Journ. M. B. A., vol. vii, p. 230. |
| 1907. | „ | „ | Fauvel. Bull. Inst. Ocean., No. 107, p. 31. |
| 1908. | *Pectinaria* | „ | Percy Moore. Proc. Acad. Nat. Sc. Philad., p. 353. |
| 1909. | *Amphictene* | „ | Fauvel. Bull. Inst. Ocean., No. 142, p. 21. |
| 1910. | *Pectinaria* | „ | Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 238. |
| 1911. | „ | „ | Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 63. |
| 1912. | „ | „ | Wollebæk. Skrift. Vid.-Selsk. Krist., No. 18, p. 37, pl. iv, figs. 1—5, pl. v, figs. 1—6. |
| „ | „ | „ | A. H. Meyer. Inaug. Dissert. Kiel., p. 8. |
| 1913. | *Amphictene* | „ | Giard. Œuvres Div., p. 57. |
| 1914. | *Pectinaria* | „ | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 129. |
| „ | *Amphictene* | „ | Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 278. |
| „ | „ | „ | McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 86. |
| 1915. | „ | „ | Allen. Journ. M. B. A., vol. x, p. 637. |
| „ | *Pectinaria* | „ | Southern. Irish Sc. Invest., No. 3, p. 47. |
| 1917. | „ | „ | Hessle. Zool. Bidr. Uppsala, v, p. 78. |

*Habitat.*—Off East Sands, St. Andrews, small; Plymouth (Spence Bate and B. Rowe); Bressay Sound, 7 fathoms, medium; St. Magnus Bay, 78—83 and 100 fathoms; off the Hebrides (Minch), large (J. G. Jeffreys); off the coast of Durham, large (Prof. G. S. Brady); coast of Kerry, large (A. G. Moore); Berehaven, Ireland (R. I. A., 1885), medium and good examples of tubes; 45 fathoms, S.W. Ireland; 48 fathoms, mouth of Kenmore River, small; log. 21 (A. C. Haddon, 1885); log. 22, S.W. Ireland (R. I. A., 1885), 40 fathoms, north of Bantry Bay; stat. 34 (S. F. B.), small; off St. Peter Port, Guernsey, tube large; Lochmaddy, North Uist, small (W. C. M.); Dublin Bay, Blacksod and Clew Bays (Southern); "Porcupine," 1869, 173 and 422 fathoms, tubes of sponge spicules; 15—20 fathoms off Peel, Isle of Man, small, in greyish mud.

Abroad it extends to the shores of Norway, Sweden and Finmark, as well as to the North Sea (Rathke, Ehlers, etc.); Mediterranean and Adriatic (Grube, Panceri, Verany, Marion, Stossich, Claparède, etc.). Claparède says it is comparatively rare at Naples; Newfoundland (Fauvel); American shores (Leidy).

The crown in this species bears from eleven to thirteen paleolæ, which in well-preserved examples are so brittle that few can be removed entire. They are flattened golden bristles which are a little narrowed at the base, remain of uniform diameter for some distance and then taper to a fine point, which is either slightly curved or boldly bent round like a hook (Plate CXXIV, fig. 2), thus differing, for instance, from those of *Lagis Koreni*, which are coiled after the manner of a watch-spring. The dorsal collar at the margin of the flattened scabrous area above the paleolæ is cut into rather long fimbriæ with a broad base and a tapered tip, the latter, however, not being acute, and the collar runs ventro-laterally almost to the base of the anterior cirrus or tentacle, after the manner of *Lagis Koreni*. The cirrus is of average length and is tapered from base to apex. From its base a ridge passes obliquely backward and inward on each side to the mouth. The great length of the rim of the dorsal scabrous plate circumscribes the area of the veil, which is

the smallest yet observed, but its disposition is similar, for it has a slight ventral fold on each side to aid in guarding the tentacles. The anterior or free edge is fringed with comparatively long subulate fimbriæ. The tentacles are perhaps less numerous than in allied forms, but their structure is the same, the distal ends being often flattened and with a median groove joining that proceeding along the column.

The folds at the sides of and behind the mouth in the main agree with those of other species.

The second cirrus or tentacle arises on the dorsal edge of a glandular ridge, which ventralward presents two divisions, viz., an outer transversely elongated rounded eminence, and a larger inner ridge which passes with slight obliquity to a median division. In front of this prominent ridge are two or three minor ones, the grooves of which converge toward the mouth. From the dorsal edge of the cirrus a small ridge runs dorsally, but soon disappears behind the fimbriated rim of the scabrous region.

The branchiæ occupy a similar position to those of *Lagis Koreni*, but are specially modified in so far as the lamellæ of the first branchia are proportionally larger, both broader and longer, and the basal axis to which they are attached is shorter. Thus the apparatus is more fan-shaped and less like the scorpioidal cyme. As in *Lagis* the larger lamellæ are internal, and they gradually diminish to the small external end. The second branchia is considerably less in all its parts, but it has the same abbreviation of the basal axis or stem. The first branchia would appear to belong to the segment behind the second long cirrus, and which sends a prominent glandular ridge to the mid-ventral line. The second pertains to the ridge immediately behind, and which also passes to the mid-ventral line, where, as in the previous form, a separate shield occurs. It is further distinguished by a considerable, flattened, glandular lobe immediately following the branchia, which would apparently act as a guard to the first branchia. So far as these parts show, three segments would thus seem to pertain to the collar-region, viz., that of the second long cirrus and the two branchial segments.

The next region of the body consists of three bristled segments devoid of hooks as in allied forms. The appearance of these, however, suggests a sub-division, for the two anterior have the thick glandular ridges, the first with a single central division and the second with two central divisions, whereas the third has only a long, slender, non-glandular ridge as in those which follow. The region appears to be on the whole considerably foreshortened in contrast with *Lagis*. The first two bristle-tufts are very small, and they arise from the non-glandular or dorsal part of the ridge. The third is considerably larger, and is usually closely applied to the surface of the dorso-lateral region. Each tuft has the stout, tapering simple bristles with traces of wings distally below the tapered point, and all have, in addition, a few in which the spear-like dilatation at the tip is present, with the hair-like point and serrated edge. All these bristles have a peculiar ring-like dilatation at the base.

The third region is characterised by the great development of the lateral lamellæ for the hooks, as well as for the long and strong bristles at the dorsal edge. All the latter are very powerful anteriorly, dilating from the base upward until full diameter is attained, and then tapering to a delicate hair-like tip (Plate CXXIV, fig. 2 *a*). Besides

these are the bristles with the spear-shaped enlargement and the finely-tapered tips, the shafts being also robust. The posterior bristles are considerably smaller, but they keep to the same type, those with the spear-shaped tips being proportionally longer.

The caudal hooks are situated on each side of a small keel (notched at its free end) which marks the median dorsal region of the caudal appendage. They are distinguished by their comparatively great length and straightness, by the rapid diminution at the neck, and by the abrupt curve and sharp condition of the hook at the tip (Plate CXXIV, fig. 2 *b*). The edge of the process is deeply and symmetrically notched, usually curved ventrally, and the dorsal lip of the vent is prolonged as a somewhat flattened conical process with a dorsal papilla on its surface which curves beyond the split ventral lip. The dorsal surface of the process is concave, forming a deep groove, whilst the ventral is convex and grooved by oblique furrows, directed outward and backward. It seems to be easily regenerated, even before the bristled segments necessary to complete the series are formed, and thus some examples are peculiarly short and broad, the tapered posterior region of the body not yet having been reproduced, whilst the caudal process is fully developed.

The lamellar hooks (Plate CXXIV, fig. 2 *c*) have six teeth from the crown downward; then follows a finely spinous process (like a large tooth with serrations), below which is a notch directed upward, and lastly the rounded prow which is nearly in a line with the face of the hook. The shaft is short and comparatively broad. The finely serrated part above the prow is slightly longer proportionally than in *Pectinaria belgica*, but in some positions the same double contour of the tip of the prow is visible.

The tube (Plate CXVIII, figs. 5—5 *b*) is gently curved and finely tapered, especially in the smaller specimens, and composed of finer sand-grains than in *Lagis Koreni*, neatly cemented together, the tubes of young forms especially having very minute grains, and in any case the tubes are perfectly rounded and apparently smooth, for the slight elevations caused by the sand-grains are only visible under a lens, and a certain amount of translucency is present, for the quartzose sand-particles are each fixed in its setting like a jewel, so that there is little interference with the light. Moreover, the tube has only the thickness of such grains, with a delicate coat of the secretion internally. The smaller end of the tube has grains considerably finer than the wider, but they blend into each other so insensibly that it is only by comparing the distant parts that the difference is observed. Like many others the annelid works at its tube only during the night. In the "Porcupine" Expedition of 1869 empty tubes occurred in deep-sea mud in which no sand-grains were present, the only convenient hard particles being fragments of the siliceous spicules of sponges, the animal constructing its tubes of these with the utmost neatness and regularity in horizontal rows from end to end, somewhat after the manner of close basket-work (Plate CXVIII, fig. 5 *a*). The fragments are short, and conduce to the perfect rotundity of the tube, which only presents the slight convexity of each spicule at the edge, the outline being minutely crenate under the microscope. The cement fixing the spicule is in small quantity, just sufficient to render the tube strong without interfering with its transparency and smoothness. The workmanship of these tubes, indeed, excites admiration, no less for the skill and perseverance of the architect than

for the unfailing accuracy and beauty of the result. No careless work betokens haste or weariness, but from the first translucent circle to the last the same uniform regularity is maintained. Moreover, on magnifying a portion of the tube[1] the beauty and complexity of the structure are more evident, for each of the fragments shows the central tube of the spicule as a clear lumen or filled with extraneous granular matter. In extremities a Nemertean (*Anopla*) will occasionally thrust itself into the mouth of the tube, driving the annelid before it and compressing it in the narrow region behind. In specimens from deep water, 80—130 fathoms in Hardanger Fjord and off Lervig in Norway, the tubes, at first formed of fine sand-grains, were for some distance afterwards made up of sponge-spicules placed transversely.

The alimentary canal contains fine mud in which sponge-spicules, Foraminifera, fragments of coccoliths, algæ, and other structures abound.

The preparation 65 . 3 . 9 . 7 in the British Museum labelled *Pectinaria granulata*, from Shetland, is *A. auricoma*, and the same with 67 . 1 . 7 . 26 from Cornwall and Berwick Bay.

This form was the subject of an elaborate structural description by H. Rathke[2] (1842) with excellent figures, and though he misinterpreted the segmental organs (which he regarded as testes and ovaries) his account is worthy of all respect.

As Claparède truly says, De Quatrefages did not profit by the distinctions Grube had made between *Pectinaria belgica* and this species, but attributed to *Pectinaria belgica* certain of the characters of *Amphictene auricoma*. The Swiss author, however, was doubtful about the contractile vascular cæcum described in the northern species by Rathke. The Neapolitan form showed no lateral cirri to the anal scoop, but it had four tongue-like processes, and it had a triangular appendix posteriorly and a short cirrus over the anus.

A young stage of this species from Kiel Bay in June is alluded to by Willemoes-Suhm,[3] but he gives no detailed description.

### *Genus* CXXXVI.—Lagis, *Malmgren*, 1867.

Smooth area behind the palmulæ slightly excavated, with an entire rim. Semicircular oral fold below the palmulæ with cirri along the margin. Fifteen pairs of sub-equal bristle-tufts along the sides. Bristles of two kinds—(1) strong bristles with tapered shafts, the pale striated flattened tip bent at an angle and tapered to a slender extremity, and (2) even stronger forms tapered toward the tip, which has rudimentary wings. Uncinigerous lamellæ commencing at the fourth segment, twelve in number. Pectiniform hooks with the armed region set at right angles to the short shaft, and with six to seven teeth curved downward. Caudal hooks with strongly curved tips and striated throughout. Tube slightly curved neatly made of sand-particles.

[1] Vide 'Ann. Nat. Hist.,' ser. 6, vol. xiii, p. 13, fig. 8.

[2] 'Neuste Schriften Naturforsch. Gesellsch. in Danzig,' Bd. iii, pp. 56—83, Taf. v, exclus. fig. 10, 1842.

[3] 'Zeitschr. f. w. Zool.,' Bd. xxi, p. 388, 1871.

1. Lagis Koreni, *Malmgren*, 1867. Plate CXII, fig. 2—entire animal from life; Plate CXVI, fig. 7 and 7 *a*—portions of pelagic tube; Plate CXVIII, fig. 6—anterior end and tube; Plate CXXIV, figs. 3—3 *c*—paleæ, bristles and hooks; Plate CXXXVI, fig. 21—nuchal organs.

*Specific Characters.*—Crown with fifteen paleolæ,[1] flattened, hollow, tapering to a delicate tip, often curved or coiled, and the concavity of the curve minutely crenulate as if from thinner tissue. The dorsal surface of the crown is firm, glabrous, with a smooth rim which passes ventrally to end in a subulate cirrus or tentacle. A notch separates the latter from the veil, which is rather broad and has anteriorly a series of long papillæ or fimbriæ. A firm, transversely elongated area separates the veil from the paleolæ, and the edges of the veil form a guard to the tentacles which are attached to its base. The second cirrus arises in front of the branchiæ, and a ridge passes from it on each side to a central boss. Branchiæ two in number, with a long coiled basal stem and lamellæ which diminish from within outward; under the last a small lamella[2] (Hessle). Body from $1\frac{1}{2}$ to 2 inches in length, gently tapered to a comparatively broad tail, which has an appendix rounded vertrally, flattened and grooved dorsally, where there is a valve to the anus, and with pale papillæ along its sides. Caudal appendix usually curved ventrally, though in the tube it may be straight. It is shaped like a *Mysostomum*, with a concave transversely striated dorsal surface resembling a sucker surrounded by a rim which is notched and papillose; ventral surface convex and obliquely striated. Caudal hooks (dorsal) with short, stout striated shafts and acutely curved tips. Anal cirrus club-shaped (Hessle).

Bristled segments fifteen. Behind the branchiæ are three bristled segments without hooks, forming the first region; then the succeeding division has twelve largely developed lamellæ for the hooks, with bristles dorsally. The bristles are stout, pale and golden, with finely tapered though rather stiff tips with traces of wings, and others which have a spear-tip flattening with a serrated edge distally followed by a long tapering hair-like tip. Hooks (which are on twelve segments) have a short horizontal shaft, a rounded crown and six teeth along the front edge in lateral view; beneath these is a tooth-like process minutely spinose, and then the keel shows a convexity, a hollow and a small knob at the edge. Caudal hooks generally four, of which three project. Tube slightly curved and tapering, neatly formed of sand-grains showing exquisite masonry.

Synonyms.

1731. *Solen fragilis*, Klein. Tab. mar., p. 21, t. xv.
1819. ? *Cistenia pallasii*, Leach. Ency. Brit. Suppl., p. 452, pl. xxvi.
1836–48. *Amphitrite auricoma*, M. Edwards. Cuvier Règne Anim., edit. Planches., Tab. vi, fig. 1.

---

[1] Hessle gives twelve.

[2] Two cement-glands (fourth to sixth segments) opening between the second branchia and the first bristle-tuft (Hessle).

1841. *Pectinaria auricoma*, Delle Chiaje. Descriz., t. v, p. 96.
1859. „ *grœnlandica*, Danielssen. Reise, 1858, Norske Vid.-Selsk. Skriv., i 19de Aarh., Bd. iv, Heft. 2, p. 123.
1865. *Lagis Koreni*, Malmgren. Nord. Hafs.-Annul., p. 360.
1867. „ „ idem. Annul. Polych., p. 104, pl. xiii, fig. 74.
1868. *Pectinaria Neapolitana* (partim), Claparède. Annél. Nap., p. 373, pl. xxviii, fig. 1.
1869. *Lagis Koreni*, Grube. Mitt. St. Vaast, p. 37.
1871. *Pectinaria Koreni*, idem. Schles. Gesell. (1870), p. 73, sep. abdr., p. 5.
„ „ *Malmgreni*, idem. Ibid. (1870), p. 74.
„ „ *neapolitana*, idem. Ibid. (1870), p. 73.
1873. „ *belgica*, Möbius. Wirb. Th. Ostsee, p. 109 (Kupffer), 1873.
1874. *Lagis Koreni*, Marenzeller. Verh. K. K. Zool.-Bot. Gesells. Wien., xxiv, p. 217.
„ „ „ idem. Sitzb. Akad. Wien, lxix, p. 68, pl. vii, fig. 5.
„ *Pectinaria belgica*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 204.
1875. „ *neapolitana*, Panceri. Atti Soc. Ital., vol. xviii, p. 530.
„ *Lagis Koreni*, Ehlers. Zeitsch. f. wiss. Zool., Bd. xxv, p. 27.
„ „ *belgica*, McIntosh. Invert. and Fish. St. Andrews, p. 128.
1878. „ „ Lenz. Jahrb. Deutsch. Meere., p. 11.
1883. „ *Koreni*, Levinsen. Vidensk. Meddels., 1883, p. 153.
1885. *Lagis Koreni*, Carus. Fauna Medit., p. 260.
1888. *Pectinaria belgica*, Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 656, pl. xlii, fig. 20.
1890. *Lagis Koreni*, Levinsen. Annel. "Hauchs" togter, 1883—6, p. 346.
„ ? *Pectinaria belgica*, Malaquin. Annél. Boulon., p. 48.
1891. „ „ Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 260.
1893. *Lagis Koreni*, Bidenkap. Annul. Polych. Hardangerfjorde, p. 9.
1894. „ „ McIntosh. Ann. Nat. Hist., ser. 6, xiii, p. 12.
„ *Pectinaria Koreni*, Bidenkap. Forh. Vidensk.-Selsk. Christ., No. 10, p. 119.
1896. „ „ Appellöf. Berg. Mus. Aarb., p. 12.
1897. *Lagis Koreni*, Fauvel. Comp. Rend., t. cxxv, p. 616.
„ *Pectinaria Koreni*, Michaelsen. Polychæt. Deut. Meere., p. 46.
„ „ „ idem. Ibid., p. 162.
1898. „ *belgica*, De St. Joseph. Ann. Sc. nat., 8e sér., v, p. 405, pl. xxii, figs. 209—222, and pl. xxiii, figs. 223—235.
„ „ *Koreni*, Lönnberg. Meddel. Kungl. Landbrat., No. 1.
1903. „ „ idem. Ibid., No. 2.
1904. *Lagis Koreni*, Journ. M. B. A., vol. vii, p. 230.
1909. „ „ Fauvel. Bull. Inst. Ocean., cxlii, p. 21.
„ „ „ idem. Ann. Sc. nat., 9e sér., t. x, p. 209.
1911. ? *Pectinaria belgica*, Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 63.
1912. „ *Koreni*, Wollebœk. Skriv. Vid.-Selsk. Krist., No. 18, p. 40, pl. v, figs. 7—9.
1913. „ (*Lagis*) *Koreni*, Arnold Watson. Rep. Brit. Assoc., p. 512.
1914. *Lagis Koreni*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 130.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 89.
1915. „ „ Southern. Irish Sc. Invest., No. 3, p. 47.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 637.
1917. *Pectinaria Koreni*, Rioja. Anél. Poliq. Cantáb., p. 44.
„ „ „ Hessle. Zool. Bidr. Uppsala, No. 5, p. 80.

*Habitat.*—Found abundantly—both living and dead—on the West Sands, St. Andrews, after storms, which evidently displace it from the sand beyond low water-mark (E. M.). In the Minch (J. G. J.). Stomach of flounder and plaice, St. Andrews Bay (E. M.). Montrose Bay (Dr. Howden). Blacksod Bay and Ballynakill Harbour (Southern). Extends along both shores of Britain from Shetland to Plymouth.

Abroad it occurs in Norway, on the Atlantic shores of France (De St. Joseph) in Finmark (Malmgren). Adriatic (Grube) and Mediterranean (Claparède). Calvados (Fauvel). Kieler Bucht (Michaelsen). St. Vaast-la-Hougue (Fauvel).

The cephalic region (Plate CXII, fig. 2, and Plate CXVIII, fig. 6) is provided with a transverse series of fifteen lustrous golden paleolæ on each side. Each is a flattened hollow chitinous process tapering to a delicate tip which is always more or less curved toward the dorsum (Plate CXXIV, fig. 3), the concavity of the curve or coil being minutely crenulate as if from a thinner tissue on that side. Moreover, the point of those in the middle of the series is continued as a long and delicate process, generally coiled. The outer in each series is short, broad at the base and with a long tapering tip, not coiled. The paleolæ are finely striated longitudinally and also marked by transverse lines. The second external paleola has its transverse lines arranged in distinct ringed belts, and not scattered indiscriminately. In viewing the paleolæ of each side as a whole the distal curve of the outer forms is more marked than that of the inner, and the inner are deeply set in the tissues and moved by powerful muscles, whereas the external paleolæ are less deeply implanted. The bases of the paleolæ have a slight obliquity, being directed downward and outward on each side. In transverse section the flattened, hollow condition of the paleolæ is apparent. Moreover, they became much thinner and more flattened toward the base. They are hard, though somewhat brittle, and the edge of the razor is often notched in making sections.

When withdrawing itself into the tube the two rows of golden paleolæ slightly and symmetrically overlap, for they can both be separated and approximated, and the firm smooth area in front of them forms a platform, the whole performing the part of an operculum. In the living condition in its tube the animal sometimes moves gently outward and inward, the paleolæ overlapping as it passes inward with a motion similar to what might be done if, with the wrists fixed, the hands be spread out, then the fingers brought together and one hand moved over the other.

The anterior dorsal edge above the paleolæ is smooth, firm and somewhat hollow, with a marginal rim which forms more than a semicircle externally and it ends in a subulate tentacle ventrally. A notch separates the latter from the veil or frilled membrane to the ventral surface of the paleolæ, and the edges of the muscular membrane bear a series of long papillæ or fimbriæ. This membrane is not attached dorsally to the ventral edge of the rows of paleolæ, a firm, transversely elongated area occurring at their base.

Below and attached to the foregoing veil is a dense series of red-streaked tentacles on each side of the mouth which has a dorsal fold in the middle line and a transverse one behind it. In the median line ventrally is a large central boss, and on each side is a fillet continued upward by a ridge to the long lateral cirrus in front of the branchiæ. The

cirrus or tentacle is crenulate, with a broad base, which tapers by-and-by to a long slender process with a slightly bulbous tip. In structure this shows externally the cuticle and hypoderm with fibrillation, whilst internally it has granules of various sizes—probably hypodermic. It may be penetrated by the perivisceral fluid. In life this and the anterior cirrus or tentacle move a little to and fro, or the tips are coiled and waved. When the animal is killed in formaline the pharynx (proboscis) occasionally protrudes as a dark mass at the upper and median region of the tentacles (Arnold Watson).

An interesting feature in the oral region is the presence of the nuchal organs, as demonstrated by Arnold Watson (Plate CXXXVI, fig. 21). These are frilled or folded organs with dark-brown edges situated on each side of the pale tentacles, lying, as it were, midway between these and the large papilla posterior to the long lateral cirrus. "The anterior and posterior lobes of the organ are directed (when viewed from the ventral surface) upward so as more or less to face each other, and the small lateral (inner) lobes are also bent upward" (Arnold Watson). Considerable variation occurs in the appearance from the simple condition in which they form erect plates with ventral face to ventral face to the complicated structure. The lateral lobes are only found on the inner side, *i. e.* nearest the mouth, not at both sides of the organ. The margin of the lobes is generally rounded, swollen, and varies in colour from dark grey to dark brown in contrast with the opaque or sometimes semitransparent white of the rest of the organ, which is always exposed—that is, above the general surface (Watson).

The tentacles form a dense mass, each marked by a longitudinal groove, the red blood-vessel running in the middle line, the blood now flowing distally and again proximally in the same vessel. They are mobile organs, and undergo constant contractions and elongations, the tip being often clavate or spatulate. The grooved surface of the tentacle is minutely tuberculated toward the tip, probably in connection with its tactile functions in building the tube; indeed such may perform the part of minute suckers. The blood seems to flow to the tip of the organ, which becomes deep red, remains there for a little, and then is sent backward. A single blood-vessel apparently with similar action occurs in the long cirri.

The *body* is from $1\frac{1}{2}$ to 2 inches in length, gently tapered to a comparatively broad tail, which has the anal appendix passing off at an angle posteriorly. It is rounded dorsally, flattened and somewhat grooved ventrally, whilst laterally are, from front to rear, the branchiæ immediately behind the long cirrus, a segment without bristles, and fifteen bristle-tufts with lamellæ for the hooks from the fourth bristle-tuft backward, or twelve in all.

The general hue of the dorsum is brownish pink, the dorsal blood-vessel and the gills being deep red. The first three body-segments have numerous brown specks (eyes ?) on their posterior edges. The tentacles are dull pinkish in mass. The caudal process is slightly yellowish. The intestine shines through the translucent iridescent skin as pale brownish, and a large blood-vessel is attached to it dorsally, below the more slender median dorsal trunk. This large trunk appears to end in the deep opaque reddish mass below the median fillet of the second bristled segment. The median dorsal (superficial) trunk commences at the tail, whereas the larger and deeper trunk on the gut appears about the

third hook-lamella posteriorly and the blood comes from below. The former contracts from behind forward, squeezing the vessel into a pale thread. The skin is minutely reticulated with red capillaries, and two large lateral trunks are seen on the ventral surface. The first two ventral ridges have a series of brownish-red grains scattered on their posterior surfaces. On the ventral surface is a lateral trunk on each side which carries the blood backward. The caudal process has pale papillæ along its sides.

In life the bright red branchiæ are most sensitive organs, now being gently extended so as to expose each lamella separately to the water, and again abruptly contracted into a mass. They are usually two in number, though occasionally the posterior on one side is absent. The anterior lies immediately behind the long lateral cirrus and has the form of a coiled process placed transversely, to which are attached many membranous leaf-like plates which gradually diminish in size toward the tip, the whole somewhat resembling the antenna of a lamellicorn beetle or the scorpioid cyme of Forget-me-not, or Borage. With the leaflets crowded so thickly, the coiling of the axis and the diminution of the lamellæ at the tip present special advantages for aëration. The second branchia arises from the dorsal edge of the segment-ridge behind the former, and its structure is the same. The organs are firmly attached to the skin, and in softened examples are removed with it.

Cement-glands with muscles occur in the body (not the cœlom) at the sides of four segments, with a duct which opens near the first branchia (Hessle).[1]

Dorsally segmentation is less evident, but on the ventral surface the median and lateral ridges give more definition in this respect. A flat papilla, from which a ridge and groove run to the mouth, lies within the long cirrus behind the veil. Then a median fold behind the mouth is continued laterally to the first branchia. This is followed by another median elevation or a boss with a ridge on each side to the second branchia. The parts, however, vary much according to the degree of contraction or extension, the first-mentioned median fold in extension becoming a boss, in front of which a groove with a fillet at each side passes to the mouth. Behind the second branchial ridge is a distinct and longer one on each side of a median elevation, and terminating laterally in the first bristle-papilla. The bristle-tufts are directed upward and backward, commencing with three smaller tufts, the first two of which spring from the outer ends of ventral ridges connected with median elevations, whilst the third has only a lateral lamella. No hooks occur on these anterior feet. The fourth foot presents a large lamella and stronger bristles, and the five or six following have also strong bristles, after which they diminish to the last, which is minute—that is, not half the size of the first tuft. The structure of all these tufts of somewhat brittle bristles is the same, though the anterior and especially the posterior show certain modifications. Each has two kinds of stout bristles, viz., (1) that in which after widening a little above the base the strong shaft tapers gradually to a somewhat rigid, sharp tip (Plate CXXIV, fig. 3 *c*), and (2) a shorter series in which the stout shaft tapers to the commencement of the translucent terminal portion in which a rudimentary double wing appears, and then it dilates into a flattened spear-head tapered to a fine point (Plate CXXIV, fig. 3 *b*). The broad, flattened tip is marked by fine striæ directed distally. The serrations are large at the base of the terminal region, rapidly

[1] 'Zool. Bidr. Uppsala,' p. 52.

become finer, then indistinct, and finally leave the delicate hair-like tip smooth. The shafts of all are striated longitudinally, and are also crossed at intervals by transverse bars, which, however, do not affect the outline. In the first tuft of bristles the two kinds are more nearly of equal length, and in the last tuft the tips of the simple forms are more gently tapered as well as often fractured, whilst the great length and tenuity of the tips of the second type cause them almost to equal the length of the stronger. In transverse section these bristles are rounded (not circular).

The hooks (Plate CXXIV, fig. 3 *a*) have a short horizontal shaft, a rounded crown, six teeth along the front edge in lateral view, then a broader part, which at first sight looks like a seventh tooth, but which really is a series of more minute teeth, as in the typical *Pectinaria belgica;* finally, the keel below shows a convexity, a hollow, and a small knob at the edge.

The caudal process recalls the condition in the Opheliidæ, just as the head, buccal region and the first body-region do those of the Hermellidæ. Two segments without bristles follow the last bristle-tufts, and then a constriction, the anal process sharply curving ventrally thereafter. In outline it is *Mysostomum*-shaped, having a convex, obliquely striated ventral surface, and a concave, transversely striated dorsal surface like a sucker, surrounded by a rim, which is notched and papillose, whilst it terminates distally in a differentiated flap ventral to the anus, and another freely moveable flap of the same length dorsally. At the origin of the caudal process three to four hooks (Plate CXXIV, fig. 3 *d*) occur on each side of the median dorsal groove. They have short, stout, striated shafts and acutely curved tips, a few transverse striæ also being present here and there on the shaft, especially at the base. One or two developing forms accompany the former. In a small variety from Norway (dredged by Canon Norman) the dorsal flap has a distinct papillose margin, a condition also seen in those from Naples.

The anal funnel is, when the animal is removed from the tube, carried at an angle, usually greater than a right angle, to the caudal region, is rounded ventrally, flattened dorsally, and with a spatulate valve hinged dorsally at the tip. The dorsal edges of the process are somewhat scalloped at the base, one deep fissure being present, and each edge has four small clavate papillæ. The dorsal surface of the organ is often expanded into a wide sucker with an obliquely ridged centre and a free crenated edge. The apparatus would seem to act as a powerful ejector, and the external parts also, according to Arnold Watson, as an instrument in repairing the tube when broken. He saw both the scapha and its bract at work, " the latter at times apparently pressing down the edge of the material which, mingled with mucus, forms a dome which closes in and diminishes the wide opening to a pin-hole " (*in lit.*). He thought that the internal structure of the scapha suggested a respiratory function.

Young examples apparently of this form occur frequently in the bottom nets at the end of June and in July in St. Andrews Bay. They occupy little transparent tubes about 1 mm. in length, nearly straight and tapered posteriorly, both ends being open. This areolated tube is composed solely of secretion and mimics the adult's tube of sand-grains; the free edge being formed of somewhat larger spaces, the double edge under pressure being seen to the right. The posterior end of the tube presents a clear, transparent margin, then a granular belt, which is followed by somewhat smaller reticulations than in

front. The tube is further chequered by a series of larger reticulations which cause it to resemble crocodile leather.

Mr. Watson mentions (*in lit.*) that Mr. Chadwick at the Port Erin Laboratory observed the metamorphosis of the larval form into the post-larval, viz., the settling down of the former on the bottom of a vessel; it rotated rapidly for an hour and a half and then was found to have secreted the membranous tube.

The perseverance and ingenuity of Mr. Arnold Watson have lately enabled him to observe the building of the sand-tube by a post-larval form in July. Thus one which had cast its membranous tube endeavoured to manipulate minute sand-grains toward what should have been the edge of the tube, and he subsequently was enabled to watch the early post-larval form, which has only two buccal tentacles, by means of which minute sand-particles ($\frac{1}{1000}$ to $\frac{1}{500}$ inch in size) are collected and passed to the mouth which opens at their bases. What is required for food is swallowed, but those grains suitable for building purposes are rolled over in the mouth and then deposited on the edge of the tube (Plate CXIII, fig. 6). The annelid then advances slightly in its tube, and for four or five seconds applies to that sand-grain the secretion of the cement-gland. The post-larval membranous tube is thus the structure to which the first sand-grains are attached, so that further use is made of this protection.

*Lagis Koreni* is one of the most skilful artificers in the family of the Amphictenidæ, fashioning a tube like a slightly curved horn, composed of minute pebbles or large grains of sand, carefully selected and dexterously fixed to each other by the usual secretion. In placing the grains together in the tube there is no haphazard, but angle fits angle, as in a skilfully built wall, and no excess of cement hides slovenly masonry. The tube is perfectly round and dilates from the narrow end to the wider, which is often the lower end in the sand, for the animal carries it thus, and its symmetry and workmanship are faultless; yet the architect is devoid of eyes, and depends on its exquisite sense of touch and remarkable instinct. The tubes harmonise with their surroundings, the wall being formed of similar proportions of pale sand-grains, of yellow, brown and black, probably because in such a selection the average colours are fairly represented. The tube is more or less transparent in life, so that the position of the occupant can be determined from the outside, the posterior end, however, being opaque from an accumulation of soft sand, with a screw-like tunnel leading to the posterior end. Rarely a coarse tube is observed at St. Andrews, the minute pebbles projecting from the surface like those of *Pectinaria granulata*, and to one a gelatinous capsule containing mucus was attached externally. Much, therefore, depends on the nature of the ground inhabited by the specimen.

*Habits.*—When weak the animal drops from its tube. A healthy example removed from its tube and placed in sea-water constantly extends and contracts its body, the tail moving more freely than the anterior end. It usually lives in the sand with the wide end of the tube inferior, as first pointed out to me by the late Mr. David Robertson, of Cumbrae (1889), who found the specimens between tide-marks, whereas at St. Andrews they are only tossed on shore by storms.

The great numbers of this species found in the stomachs of the cod and the haddock off St. Andrews Bay show that in all probability they are swept in thousands from their sites in the sand, and thus come in the way of fishes which feed on the bottom. Both

tubes and annelids occur together along with small sea-mice, mollusca and crustacea in the stomachs of the fishes mentioned. It is possible that some may be seized as they project their tubes from the surface of the sand during their movements.

In an example removed from its tube for some days a milky fluid was discharged posteriorly; this consisted of ovoid or rounded granular bodies having motionless protoplasmic processes attached. Similar bodies seem to be present in the narrow end of a tube of *Amphictene auricoma* from Norway, since the tube is too slender for the example of *Lagis* beside it. The whole mass formed a plug in the narrow end of the tube, and probably represented immature male elements. Arnold Watson has noticed similarly that sperms were discharged from the smaller end of the tube in a voluminous stream *per anum*, the specimen subsequently dying on the third day. He thinks that normally the sperms are emitted by the nephridia.

A small ascidian (*A. sordida*) had fixed itself on the wide end of a broken tube, filling up the entire aperture.[1]

As Dr. Johnston does not include this species in his list (1865) it is possible that it was confounded with *Pectinaria belgica*.

Marenzeller (1874), in a careful digest, showed the identity of *Pectinaria neapolitana*, Claparède, and *P. Malmgreni*, Grube, with this species.

Cunningham and Ramage (1888) describe the dorsal blood-vessel as formed by blood-sinuses on the gut—communicating with a ventral sinus, which at the commencement of the pharynx forms a circum-intestinal ring opening into the dorsal heart—with its cardiac body. There are three pairs of nephridia. The nephrostome of the first is on the anterior side of the septum behind the buccal segment. They mention a milk-white gland which opens by a duct between the nephridial opening and the first branchia. The second nephridium is in the fifth, and the third in the sixth segment. They saw sperms pass out by the nephridiopores. The species is termed *Pectinaria belgica* by Cunningham[2] in another communication.

There is no doubt that Hornell's (1891) *P. belgica* is this species, and as Malaquin (1890) also observes that his *P. belgica* is very common at Boulogne in all probability it is the same form.

Lo Bianco[3] (1893) observes that *Lagis Koreni*, Malmgren, is synonymous with *Pectinaria belgica*, Pall., and it is true some authors confused the two species, yet they are essentially distinct.

De St. Joseph (1898) gives a detailed account of this species externally and internally, including the alimentary canal, the circulatory system, with the "heart," nervous system, segmental organs, respiratory system, cœlom and glands. He also found an encysted Distome, besides Gregarines in the intestine and in the cœlom.

Arnold Watson[4] (1913) supplements Fauvel's observation that the water necessary for respiration and for stirring up the sand-grains beneath the surface is, by a kind of peristaltic action of the animal, drawn or pumped through the tube, entering by the upper

[1] 'Invertebrates and Fishes of St. Andrews,' pl. ix, fig. 1.
[2] 'Quart. Journ. Micr. Sci.,' vol. xxviii, p. 253.
[3] 'Atti Accad. Sc. Fis. Math.,' vol. v, p. 47.
[4] 'Rept. Brit. Assoc.,' 1913 and 1919.

or smaller end above the surface, and often escaping to the surface of the sand through fissures caused by the digging of the annelid. The French author also noticed that the current could be reversed at will. The object of this current was supposed to be mainly for the purpose of ejecting the sand passed through the alimentary canal. Arnold Watson, however, found that constant additions are made to the broad end of the tube, and space

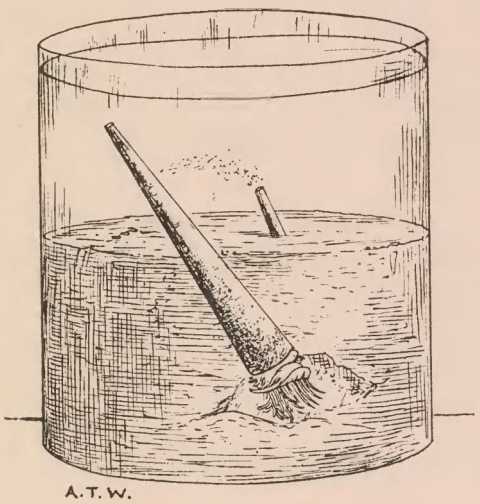



Fig. 141.—*Lagis Koreni* at work amongst sand. A current with sand and other particles is issuing from the tube in the rear. (After Arnold Watson.)

for this work is obtained by suction. After the sand has been traversed by the combs (paleæ) of the annelid, and the particles brought within reach of the tentacles, that not swallowed is carried away by a strong upward current caused by the peristaltic action above mentioned, passing between the wall of the tube and the dorsal surface of the

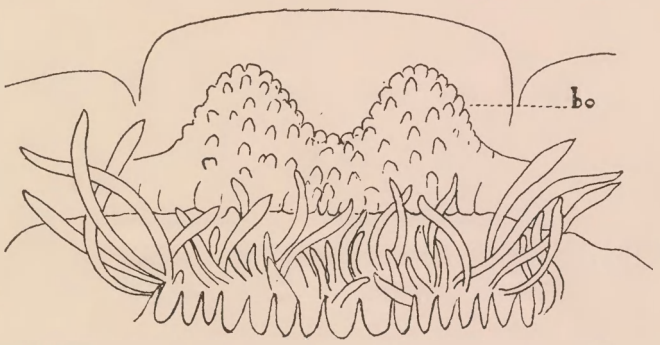



Fig. 142.—Papillose building-organs, *bo.* (cement-gland) of *Lagis Koreni.* (After Arnold Watson.)

annelid, and is ejected through the upper or smaller end, this forming the mounds usually observed on the surface of the sand (Fig. 141). In connection with the chamber thus formed at the broad end there is often a downcast shaft a short distance from the tube. Such currents are not the result of peristaltic action, but are due to two currents through the tube at opposite sides of the annelid, caused by the action of the body (Watson). This persevering observer also noticed the parts employed in the building of the tube, viz., a pair of dorsal "downwardly directed lobes" (Fig. 142) acting in connection with a lower lip just in front of ("above") the first ventral shield. Associated with these is a cement-gland, which, when the sand grain—carried by the papillæ to the building

organs, held in the hollow between the two lobes which apply it to the free edge of the tube—is accurately fitted, pours out the secretion that fixes it (Arnold Watson).

*Genus* CXXXVII.—PETTA, *Malmgren*, 1865.

Cephalic area above the palmulæ with an entire border; oral veil with a smooth margin. Anterior border of the first segment emarginate in the centre ventrally and crenulate, dentate at the sides. Row of eyes over brain. Nuchal organ folded as in *Lagis*. Branchiæ on the fourth and fifth segments (Nilsson). The ventral border of the second segment with three notches in the centre, making two rounded lobes. Cement-glands in fourth, fifth and sixth segments, opening between the second branchia and the first bristle-tuft. Seventeen fascicles of bristles and fourteen lamellæ for the hooks on each side. Hooks, which commence on the third segment, pectiniform; two large teeth in front, followed by a smaller, and a smoothly rounded prow. Bristle-like hooks of the caudal process with straight shafts and slightly hooked tips. Anterior nephridia not longer than the posterior. Tube very little curved, composed of minute fragments of shells, coarse and translucent sand-grains, or minute flattened black and brown fragments of rocks and shells.

1. PETTA PUSILLA, *Malmgren*, 1865. Plate CXXV, figs. 7—7 *g*—bristles, hooks, scapha.

*Specific Characters.*—Paleolæ nine to eleven on each side, base pale with slight trumpet-like enlargement, shaft flattened, a little dilated, and then tapered to a blunt rounded point. Four to five of the exterior paleæ stouter and broader than the others—Carus. Upper area of the crown slopes obliquely backward and has no rim. It curves round the ventral edge of the paleolæ and ends at the anterior cirrus, a smooth area (of the crown) occurring also below the paleolæ, between them and the veil, which has a high arch and a smooth border except at the highest point of the arch, where there are three papillæ. Ventral side of fourth segment has a plate with a knobbed lobe (Hessle). Body 15—24 mm. long, slightly tapered posteriorly so that the caudal appendix projects little beyond its area. Dorsal surface smooth, flattened; dorsal rim of first segment nearly straight, crenulate, or 5-dentate, and in the middle line a deep notch; a rather long row of hooks on either side, then a flattened lamella with a rounded posterior end and a cirrus; ventral rim follows with four fimbriæ between this and the vent, the lower edge of which is crenulate, with a subulate median cirrus. Eyes on scapha (fifth segment, Hessle); eight to eleven anal hooks on each side. Nephridia in fourth, fifth, sixth, seventh and eighth segments. A diaphragm occurs between the fourth and fifth segments.

Bristled segments seventeen, divided into three anterior without hooks and fourteen posterior with long rows of hooks. Bristles of two kinds—stout tapering bristles with traces of wings distally, and those with a spear-head expansion of the tip which ends in a hair-like point. Hooks on fourteen segments, with a short basal process or shaft, two teeth below the crown, then a modified tooth with a spinous edge, and a smoothly rounded prow beneath, the basal line from which is sinuous. Tube slightly tapered and curved,

formed of coarse but generally regular grains of sand neatly cemented; occasionally smoothly rounded and larger grains are used, or even entire shells (*e. g. Rissoa*), as well as fragments of others and stones.

Synonyms.

1865. *Petta pusilla,* Malmgren. Nord. Hafs.-Annul., p. 361, Tab. xviii, fig. 43.
1867. „ „ idem. Annul. Polych., p. 104.
1871. „ „ Grube. Schles. Gesell. (1870), p. 75, sep. abdr., pp. 4 and 8.
1874. „ „ Malm. Göteborg. Fauna, p. 94.
1878. „ „ Storm. Kong. Norske Vid.-selsk. Skrifter, p. 243.
1879. *Pectinaria pusilla,* Tauber. Annul. Danica, p. 127.
1885. *Petta pusilla,* Carus. Fauna Medit., vol. i, p. 261.
1893. „ „ Lo Bianco. Atti R. Accad. Sc. Napoli, vol. v, No. 11, p. 48.
1894. *Pectinaria pusilla,* Bidenkap. Christ. Vet.-Akad. Forhandl., p. 120.
1896. „ „ Appellöf. Berg. Mus. Aarb., p. 12.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 160.
1900. „ „ Gemmill. Fauna of Clyde, p. 359.
1909. *Petta pusilla,* Fauvel. Bull. Inst. Ocean., cxlii, p. 21.
1911–12. „ „ Nilsson. Zool. Bidrag Uppsala, Bd. i, pp. 138—9.
1912. „ „ Crawshay. Journ. M. B. A., vol. ix, p. 346.
„ *Pectinaria pusilla,* Wollebœk. Skrift. Vid.-selsk. Krist., No. 18, p. 35, pl. iii, figs. 1—8.
1914. *Petta pusilla,* McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 94.
„ „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 279, pl. xxv, figs. 22, 26.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 637.
1917. „ „ Hessle. Zool. Bidr. Uppsala, No. 5, p. 83.

*Habitat.*—Dredged in the "Porcupine" Expedition of 1869 off Ireland in 422 fathoms; dredged in 567 fathoms in the Atlantic "Porcupine" Expedition, 1870; S.W. Ireland, off Co. Kerry, and in the same region at 52½ fathoms during the Royal Irish Academy's Expedition of 1886; Firth of Clyde (Dr. David Robertson); Plymouth (Crawshay); Irish Sea (Arnold Watson).

It extends to Sweden (S. Lovén, Malm, Hessle) and Northern Seas; Mediterranean (Marseilles, Marion); Fayal, Azores and the Atlantic (Fauvel).

The crown has eleven paleolæ on each side, with a pale base which is expanded at the end, the shaft being flattened, little dilated, and then tapered to a blunt (rounded) point. In developing paleolæ a translucent process passes from the blunt tip. The blunt points of these and the coarser nature of the tube as compared with *Lagis Koreni* are interesting. The five outer paleolæ are larger than the others (Lo Bianco). The upper area slopes obliquely backward, and has a smooth edge without a rim. It extends to the ventral edge of the paleolæ, where it ends at the anterior cirrus, a smooth area occurring below the paleolæ—that is, between them and the veil. This process is clearly a development of the flattened area of the crown and is independent of the veil. The veil has a high arch and a smooth border, but in two examples the highest point of the arch had three papillæ close to each other, the rest of the margin being quite smooth. The veil is of moderate breadth, is attached to the roof of the oral region and gives origin to the tentacles, which form the usual lateral groups and have the typical structure.

From the second cirrus a ridge passes as in other forms ventrally on each side. In this species the anterior margin is 4—5-dentate, whilst in the centre is a deep hiatus. In small examples the processes are slender tapering papillæ. The branchiæ on the next two segments are typical. Large cement-glands, homologous with those of *Lagis Koreni*, occur in the fifth and sixth segments. The duct opens behind the second branchia and the first bristle-tuft. No muscle is present (Hessle).

The second region corresponds with that in other forms, viz., has more slender bristles in smaller tufts than the succeeding. Their structure, however, corresponds with the type common to all, including the posterior series (Plate CXXV, figs. 7—7 *c*). The stout simple bristles are tapered distally and have traces of wings (fig. 7 *a*). The others have a spear-head enlargement at the end of the shaft and a tapering tip (fig. 7 *b*), but the enlargement is proportionally broader and the tapered tip shorter than in allied forms. In the posterior region the fourteen pairs of bristle-bundles exhibit a gradation from the anterior to the posterior extremity. Moreover the region is only a little tapered posteriorly, the termination being comparatively broad. In consequence the caudal appendix projects little ventrally from the truncated end of the body, the last foot being modified into a rounded flattened lobe projecting beyond the truncated surface and with a subulate cirrus at its extremity, whilst the somewhat long row of caudal hooks is intimately associated with its dorsal edge. No other hook or bristle is connected with it.

The dense rows of hooks are situated on the edge of the prominent lamellæ. Each has a short base or shaft (Plate CXXV, fig. 7 *e*) with a well-marked rounded crown, a smaller and a larger fang beneath, the curve below the latter sloping to a modified tooth with a 4—6-spinous edge, then a gulf below, and a rounded prow, the basal line being slightly sinuous.[1]

The caudal appendix (scapha) presents dorsally an almost evenly truncated edge in a line with the general surface (Plate CXXV, figs. 7 *f* and 7 *g*), the margin, however, being minutely crenulate and projecting a little beyond the dorsal surface of the appendix. Then follows the line of caudal hooks, which abut at their ventral edge on the rounded and flattened lamella with the cirrus. A notch separates the ventral edge of the lamella from a series of four fimbriæ between it and the vent, the lower edge of which is crenate with a subulate median cirrus. Nilsson[2] has recently shown the structure of the eyes of this organ. The caudal hooks (Plate CXXV, fig. 7 *d*) are slightly narrowed at the base of the striated shaft, then dilate, continue for some distance with nearly parallel sides, diminish toward the neck, and end in a slight curvature at the point, which is somewhat blunt, probably from friction.

The tube is slightly curved, and in Malmgren's examples was composed of minute shells, viz., *Rissoa striata* and *Bulla truncata*. Tubes from the coast of Kerry are composed of comparatively large fragments of shells and stones with a minute *Rissoa*. Those from 422 fathoms off Ireland in the "Porcupine" Expedition of 1869 were formed of proportionally large translucent grains of quartz with here and there a yellow and black grain of other material. One fragment is composed of Foraminifera with a few grains of sand, but its

[1] Malmgren figures the spinous edge as a simple process, whilst Hessle gives it six to seven teeth.

[2] Beiträge Nervensyst. Polych. 'Zool. Bidrag Uppsala,' Bd. i, p. 137, 1912.

identity is uncertain. A tube from 567 fathoms in the Atlantic in the "Porcupine" Expedition of 1870 presents a uniform series of dull yellow grains throughout. The rounded and comparatively large yellow stones forming a tube from a depth of 52½ fathoms (log 33) off the south west of Ireland are noteworthy.[1]

## Family XXVIII.—Ampharetidæ, *Malmgren*, 1867.

Cephalic lobe (upper lip of some) covering the mouth, the median part separated by oblique grooves; tentacles long, smooth, pinnate or ciliated, arising from the mouth, and can be engulfed. Buccal segment surrounding the mouth and forming the lower lip, occasionally biannulate. Tentacular membrane is divided by two longitudinal grooves into three. A groove between tentacles and mouth. Body somewhat broad in front, tapered posteriorly and with a variable number of segments, generally twenty to forty, rarely about seventy, and of two regions, the anterior (or thoracic) having fascicles of capillary bristles and pinnules for hooks, the posterior (or

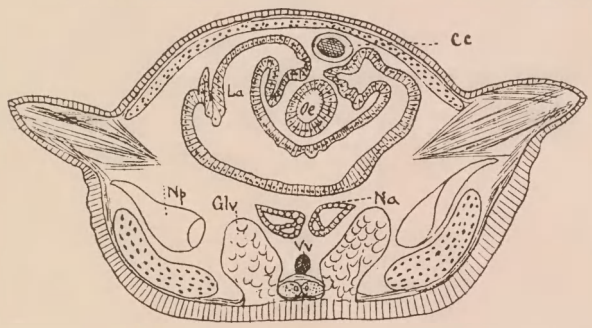



Fig. 143.—Transverse section of the body-wall of *Ampharete Grubei*, in the anterior region. *cc.*, cardiac body; *Gl.v.*, ventral glands; *La.*, anterior lobes; *Na.*, anterior nephridia; *Np.*, posterior nephridia; *Oe.*, œsophagus; *Vv.*, ventral vessel. (After Fauvel.)

abdominal) bearing only the pinnules for the hooks. Second segment provided with paleæ or capillary bristles as in the third and fourth. Anal segment with two cirri. Branchiæ filiform or subulate, seldom pinnate, four, rarely three, on each side, affixed to the anterior segments 2 and 3, and having in front the group of paleæ (palmulæ) on the second segment—sometimes absent. Anal segment naked or with two or more short cirri. The stomach is simple, as in the Amphictenidæ, the œsophagus having a lobe on each side. Diaphragm between the third and fourth segments with muscular sacs which Meyer thought were for the lodgment of the tentacles. Bristles capillary, tapered, with smooth extremities; shafts arising on a cylindrical or subconical tubercle (setigerous process). Reduced on the third segment. Hooks commence on the sixth segment except in *Melinna*, uniserial, pectiniform, multidentate, the anterior being absent in *Melinna* and *Isolda*. Posterior feet with dorsal cirri. Tube cylindrical, fragile, soft, longer than the animal, walls more or less thick, composed of mud, fragments of algæ, sand or minute stones.

In the structure of the body-wall (Fig. 143), after it is completely formed, *Ampharete Grubei*, as sketched by Fauvel, presents in the anterior region under the cuticle and hypoderm continuous dorsal longitudinal muscles (apparently fused in the middle

[1] Mr. Crawshay thinks Dr. Gemmill's note is the first in Britain, but such is not the case.

line), whilst the ventral longitudinal muscles are separated by a considerable interval in which the nerve-cords lie, each having a neural canal at the inner edge. The oblique muscles extend from the foot to the upper part of the cords, fibres apparently passing over them as well as joining the circular coat.

In the posterior region, again, the dorsal longitudinal muscles are thicker and still fused in the mid-dorsal line and the subjacent circular coat is thicker. The oblique muscles are short and powerful, as in the Opheliidæ, cutting off, as it were, the ventro-lateral projections, but apparently the chief factor is the circular coat—if these sketches are accurate. In the projecting areas are the ventral longitudinal muscles, which are circular in section, but as the author shows another muscular area at the extreme end there is doubt.

The nerve-cords lie beneath the transverse fibres, apparently from the circular coat, the oblique fibres touching their sheath laterally. A single neural canal now lies between them (Fauvel). In this group, as in the Amphictenidæ, the tentacular membrane is absent, the organ being represented by a raised band behind the tentacles, which are supplied by small nerves from the anterior part of the cephalic ganglia. Nuchal organ, as in the Amphictenidæ, raised posteriorly. The cephalic nerves are larger and more distinct than in the Amphictenidæ, probably because the region is more glandular. The representative of the tentacle-membrane is divided by two longitudinal grooves into three parts. The nerve supplies the mid-region and the inner parts of the two outer (Hessle).

The alimentary canal in *Ampharete Grubei* presents mouth, pharynx, œsophagus, stomach, with two reddish or orange diverticula in front, the rest being greenish brown, and followed by the intestine. In most of the family these sacs occur, and in some the œsophagus has two lobes. Wirén[1] has described and figured the blind sacs in *Amphicteis Gunneri* and *Melinna cristata*, whilst Fauvel has done so in *Ampharete Grubei*.[2]

In connection with the circulation of the greenish blood, the dorsal trunk terminates anteriorly in four main branches to the branchiæ, each of which has an afferent and an efferent trunk as well as a nerve, whilst the gut is surrounded by a sinus. The "heart" extends from the third to the eighth segment and has a cardiac body. The ventral trunk stretches from the posterior to the anterior end and carries the blood from front to rear. Its branches are the bifid "clypeal" in the abdominal region and twigs to the feet throughout. Other trunks are the lateral anastomotic connecting the branches to the feet (Fauvel).

The branchiæ in the genus *Isolda* of this group are interesting since the outer are thread-like, whilst the inner have lateral processes, making them feather-like.

Hessle (1917) observes that the nephridia of the fourth segment have long tubes, the rest have short, and that the nephridiopores in the fourth segment open dorsally in certain forms—behind or between the branchia.

Two pairs of segmental organs occur in *Ampharete Grubei* (Fig. 144). The anterior pair are of considerable length, but present the structure of a folded tube with two apertures,

[1] 'Kongl. Sv. Vet. Handl.,' Bd. xxi, No. 7.

[2] 'Bull. scientif. France et Belgique,' t. xxx.

the nephrostome opening into a thoracic chamber and the nephridiopore to the exterior a little behind the first bristle-tuft. This pair is purely excretory. The second pair are shorter, of a flask-shape, and have the typical structure (Fig. 145). These give exit to the sexual elements (Fauvel). In the majority of the group the opening of the segmental organs is on the dorsum behind the branchiæ. The nerve-cords are perhaps less free in this group than in the Amphictenidæ.

Sars (1835) first introduced this group to science by the description of "*Amphitrite Gunneri*" and *Sabella ? octocirrata*, though he placed the species under the Terebellids.

This family was instituted by Malmgren (1865, his *Ampharetea*), for the northern species, which he placed in two main groups according to the number of the segments and the condition of the frontal lobe. Thus, in the first group having from twenty to forty

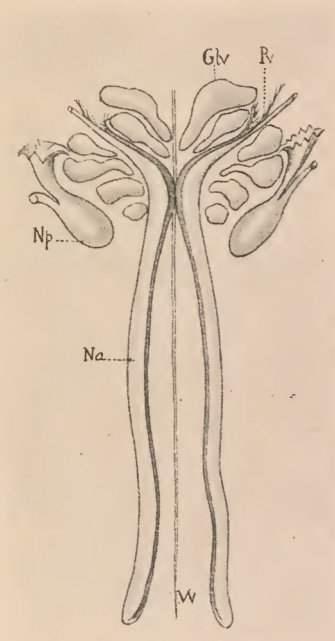



Fig. 144.

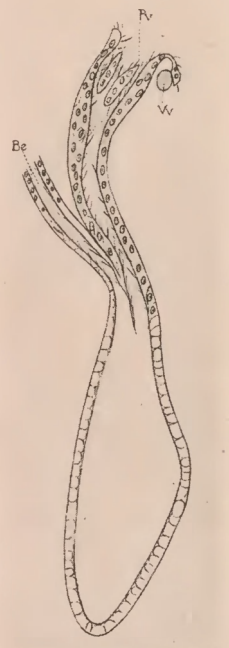



Fig. 145.

Fig. 144.—Nephridia and ventral glands of *Ampharete Grubei*. *na.*, anterior nephridia; *np.*, posterior nephridia; *gl.v.*, ventral glands; *pv.*, ciliated funnel. (After Fauvel.)
Fig. 145.—Structure of a posterior nephridium. *Be.*, nephridiopore; *pv.*, ciliated funnel; *vv.*, blood-vessel. (After Fauvel.)

segments and a conspicuous frontal lobe he had two divisions, viz., (1) those furnished with palmulæ, and (2) those without them. In the former were *Ampharete*, with fourteen bristled segments and ciliated tentacles, *Lysippe*, with sixteen tufts of bristles and smooth tentacles, *Amphicteis*, with seventeen bristle-tufts, and *Sosane*, with fifteen bristle-tufts, both with smooth tentacles. Of those devoid of palmulæ *Sabellides* had fourteen bristle-tufts, ciliated tentacles and four branchiæ, *Amage* fourteen bristle-tufts, smooth tentacles and four branchiæ, *Samytha* seventeen bristle-tufts, smooth tentacles and three branchiæ. Lastly, in the second great group the segments of the body are about seventy in number and the frontal lobe is absent. The single genus *Melinna* had eighteen bristle-tufts, smooth tentacles and four branchiæ. The species are on the whole northern, abounding, for instance, in the Gulf of St. Lawrence, Canada, and in the Arctic Seas.

The Ampharetidæ were included in the Terebellidæ by De Quatrefages (1865), the genera *Sabellides* and *Amphicteis* being separated by his *Apneumona* (Polycirridæ) and *Heteroterebellidæ*. He seems to have had little personal acquaintance with the representatives of the family.

The following representatives of this family were found by M. Sars[1] (1868) at a depth of 300 fathoms: *Amage auricula*, *Sabellides borealis*, *S. sexcirrata* and *Melinna cristata*.

Grube (1871) adopted Malmgren's family, arranging the groups similarly into (*a*) those with paleæ and branchiæ; (*b*) those with neither paleæ nor dorsal hooks behind them; and (*c*) those without nuchal paleæ, but with a large hook on each side behind the branchiæ. In 1878 (Philippine Annelids) the same author used the term "Ampharetea Mgrn." for the family with a revised grouping of the characters.

In a section of the anterior region of *Amphicteis foliata* Prof. Haswell (1882) gives the general position and proportions of the cutaneous, muscular and alimentary apparatus, the oblique muscles and the nerve-cords being somewhat indistinct,[2] though the author describes each of the latter as having a trigonal outline.

The Ampharetidæ formed with the Terebellidæ and Amphictenidæ Levinsen's (1883) group *Terebelliformia* (Grube). He arranged the genera thus: *Melinna*, *Glyphanostomum*, *Sabellides*, *Ampharete*, *Anobothrus*, *Amphicteis*, *Sosane*, *Lysippe*, *Amage* and *Samytha*. In grouping them with the Terebellidæ he simply followed the views of several previous authors.

An excellent historical summary of the family was given by Fauvel[3] in 1897 at the commencement of his systematic and structural treatise on the group, the type taken being *Ampharete Grubei*, which the author procured abundantly at St. Vaast-la-Hougue. This valuable memoir of Fauvel marks an era in the description of the group and is a credit to the author and to French science. He makes three regions of the cephalic ganglia—a palpary anterior, a central region of two fused ganglia, over which are the eyes, and a posterior or nuchal region—thus mainly following Pruvot and Racovitza. The nerve-cord has usually two neural canals. The stomato-gastric system is little developed and is attached to the palpary region. The food consists of diatoms, Foraminfera and similar minute organisms carried in by the currents. There is a peri-intestinal sinus. The blood is red in *Melinna*, green in the other genera. There is a cardiac body. The reproductive elements escape by the posterior nephridia.

In a recent paper[4] Prof. Stephenson (1913) devotes much attention to the peristaltic and antiperistaltic movements of the gut in the Oligochæts and Polychæts. He considers that the anti-peristaltic action is connected primarily with respiration and not with the circulation, the water entering at the anus being driven forward by ciliary action and the antiperistaltic contractions. Besides representatives of many of the families already dealt with, he describes this condition in the Ampharetidæ, Terebellidæ, Sabellidæ and Serpulidæ.

[1] 'Vidensk.-Selsk. Forhandl.,' 1868, sep. copy, p. 10.
[2] 'Proc. Linn. Soc. N.S.W.,' vol. vii, p. 635, pl. xii, fig. 14.
[3] 'Bull. Sc. France et Belgique,' t. xxx, p. 1, pls. xv—xxv.
[4] 'Trans. Roy. Soc. Edin.,' vol. xlix, No. 14. pp. 779—81 *et seq.*

Recently Hessle (1917) has given a classification of the Ampharetidæ in which he has used the nephridia along with the older features in all but *Melinna* and *Isolda* as aids in the arrangement. Thus the groups *Ampharete*, *Sabellides*, *Glyphanostomum*, *Neosabellides*, *Anobothrus*, *Sosane*, *Lysippe*, *Lysippides* and *Samytha* fall under the division in which the anterior nephridia (in the fourth segment) are larger than the posterior; whilst *Amphisamytha*, *Amphicteis*, *Amage* and *Phyllocomus* are placed under the second division in which the anterior nephridia are absent or smaller than the posterior. It would not appear, however, that this system does much more than corroborate the former classifications of Malmgren and others. It is doubtful, indeed, if this classification has any advantage over that of Malmgren, founded on the presence or absence of palmulæ and the condition of the tentacles and branchiæ. It further has the disadvantage of requiring dissection. It must be kept in mind, however, as a feature of importance.

### *Genus* CXXXVIII.—Ampharete, *Malmgren*, 1865.

*Amphitrite*, Sars; *Crossostoma*, Gosse; *Amphicteis*, Grube & Schmarda; *Ampharete*, Malmgren; *Isolda*, Fritz Müller; *Branchiosabella*, Claparède.

Cephalic lobe subquadrangular, smooth, without bands; anterior margin truncate or a little arcuate; frontal part separated by grooves as a trapezoidal or subrectangular area; no median sulcus. Nuchal organs in the form of grooves. Buccal segment a little shorter than the cephalic lobe. Tentacles not numerous, short, filiform ciliated. Second segment short, smooth; third segment under a transverse sulcus, bipartite (transversely), short and narrow. Rows of golden paleæ more or less expanded anteriorly on each side of the third segment. Branchiæ subulate or filiform, forming a transverse row on each side of the third and part of the fourth segment. Fourteen cylindrical setigerous tubercles, commencing at the fourth segment. Rows of hooks beginning at the sixth segment (third setigerous) continued to the anteanal segment. Capillary bristles with curved, winged apex. Hooks subquadrangular, in two rows, multidentate, five to ten long acute teeth. No abdominal cirri. Stomach with two anterior diverticula; ventral glands; two pairs of dissimilar nephridia (Fauvel). Diaphragm between the third and the fourth segments. Tube composed of mud, thick, with a membranous lining.

In the Ampharetidæ J. T. Cunningham[1] (1888) found large neural canals; in *Melinna* one on the inner side of each nerve-cord in the thoracic region. These canals also occur in the anterior region of *Ampharete*. Cunningham supposed these canals were for the support of the nerve-cords—an idea combated by Fauvel, who points out that they are present only anteriorly in *Ampharete*, where the cords are sunk most deeply in the tissues, but are absent posteriorly when the cords are near the surface.

[1] 'Quart. Journ. Micr. Sci.,' vol. xxviii, p. 274.

1. Ampharete acutifrons, *Grube*, 1860. Plate CXII, fig. 3—entire animal; Plate CXVI, fig. 8—anterior end; Plate CXXIV, figs. 4—4 *c*″—paleæ, bristles and hooks.

*Specific Characters.*—Cephalic lobe more or less pentagonal; at the posterior border is a minute, simple eye on each side. Buccal segment shorter than the cephalic lobe, its tentacles pennate. Paleæ have flattened, striated shafts and a tapered tip with a granular interior, whilst the concave edge of the slender tip is crenulate. About fifteen on each side.

Body measuring 60—80 mm., anterior end bluntly conical, only slightly tapered, then diminishing to a somewhat slender tail, which terminates in an anus with about twenty cirri around it. The dorsal surface is smooth and rounded, the ventral somewhat flattened, and with glandular transverse ridges on the wide part in front. The fourteen bristled segments are narrow, whilst the twelve hook-bearing posterior segments are antero-posteriorly elongated. Branchiæ on the third and fourth segments, four pairs, simple, subulate. Bristles with a nearly cylindrical shaft, and a finely tapered hair-like tip which has wings. Hooks have six to nine teeth, the anterior border forming a right angle with the axis, whilst the posterior border curves to the prow at the smaller end. Blood green; dichroic. Nephridia in the fourth and sixth segments.

Coloration—male pale greenish, female pale salmon. The brownish stomach is seen through the integument and surrounded by a greenish blood-sinus, whilst the anterior lobes of the stomach are brick-red (Fauvel). Tube membranous, covered with agglutinated sand.

Synonyms.

1843–53. ? *Pherusa Mulleri*, Chenu. Illust. Conch., 11e livr., pl. vii, fig. 7.
1860. *Amphicteis acutifrons*, Grube. Archiv f. Naturges, Bd. xxvi, p. 109.
1863. *Branchiosabella zostericola*, Claparède. Beobach., pp. 34—36, pl. xiv, figs. 32—37.
1865. *Amphicteis acutifrons*, De Quatrefages. Annel., t. ii, p. 394.
,, *Ampharete Grubei*, Malmgren. Nord. Hafs. Annul., p. 363, Tab. xix, fig. 44.
1867. ,, ,, idem. Annul. Polych., p. 104.
1869. ,, ,, Grube. Jahresb. Schl. Gesell., pp. 68, 69.
1871. ,, ,, idem. Ibid., p. 78, sep. abdr., p. 11.
1873. ,, ,, Möbius. Jahr. Comm. deutsche, 1871, p. 109.
1874. ,, ,, Malm. Annul. Göteborg, Kongl. Vet. Handl., vol. xiv, p. 95.
1875. ,, ,, Möbius. Jahr. Comm. deutsche, 1872, p. 163.
,, ,, ,, Marion. Rev. Sc. nat., iv, p. 308.
1879. ,, ,, Tauber. Annul. Danica, p. 127.
,, *Amphicteis* ,, Théel. Kongl. Svensk. Vet.-Akad. Handl., vol. xvi, p. 59.
1883. ,, ,, Wirén. Chætop. "Vega" Exped., p. 413.
,, *Ampharete* ,, Levinsen. Vidensk. Meddel., p. 162.
1889. ,, ,, Marenzeller. Arch. f. nat., lv, p. 132.
1891. ,, ,, Hornell. Liverp. Mar. Biol., vol. iii, p. 161.
,, ,, ,, idem. Trans. Biol. Soc. Liverp., vol. v, p. 258.

1894. *Ampharete Grubei,* Bidenkap. Christ. Vet.-Akad. Forhandl., p. 122.
1895. „ „ Fauvel. Bull. Soc. Linn. Normand., t. ix, pp. 329—348.
„ „ „ idem. Mém. Soc. Nat., etc., Cherbourg, t. xxix, p. 340.
1896. „ „ idem. Bull. Soc. Linn. Normand., 4e sér., vol. x, p. 70.
1897. „ „ Michaelsen. Polych. deutsch. Meere, p. 162.
„ „ „ Fauvel. Bull. Sc. de Fr. et Belg., t. xxx, p. 289, pls. xv—xxiv.
1901. „ „ Whiteaves. Mar. Invert. E. Canada, p. 74.
1907. „ „ Fauvel. Bull. Inst. Ocean., No. 107, p. 32.
1909. „ „ idem. Ann. Sc. nat., 9e sér., t. x, p. 209.
1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 239.
„ „ „ Skorikow. St. Petersb. Mus. Zool. Ann., xv, p. 233.
1912. „ „ Wollebæk. Skriv. Vid.-selsk. Krist., No. 18, p. 50, pl. x, fig. 6.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 129.
„ „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 282.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 96.
„ „ „ Ditlevsen. Polych. Annel. (Meddel. Grønl.), p. 720.
1915. „ „ Southern. Irish Sc. Invest., No. 3, p. 47.
1917. „ *acutifrons,* Hessle. Zool. Bidr. Uppsala, No. 5, p. 96.

*Habitat.*—Not uncommon in 80—100 fathoms in St. Magnus Bay, Shetland, where it was first dredged by Dr. Gwyn Jeffreys in 1867; in 20 to 40 fathoms in Dingle Bay, and at Bundoran, Donegal Bay, in the "Porcupine" Expedition of 1869. Large examples were procured in the stomach of the cod and haddock off St. Andrews Bay (E. M.); dredged off the coast of Durham (Prof. G. S. Brady); dredged in 11 fathoms amongst tangle-roots in Bressay Sound (W. C. M.); Irish Sea (Hornell), Lambay, Dublin, Blacksod and Clew Bays (Southern).

It occurs elsewhere in the Channel, Cattegat, Atlantic; Spitzbergen, Greenland, Sweden (Malmgren, Marenzeller, etc.), Nova Zembla and the Kara Sea (Théel). Extends to Canada, where it was dredged by Dr. Whiteaves in 220 fathoms, between Anticosti and the south shore. Siberian and Behring's Seas (Wirén). Kiel (Möbius).

The cephalic lobe (Plate CXVI, fig. 8) is, as Fauvel describes, more or less pentagonal, the two anterior lines of the pentagon sloping obliquely forward and inward so as to make a blunt cone. At the posterior border of this region is on each side a minute eye, generally indistinct in spirit-preparations.

The buccal segment is narrow and bears inferiorly the buccal tentacles, which Fauvel frequently found in life in the mouth. The tentacles taper from base to apex, which in the preparations is often slightly enlarged.

The base of each is smooth, then small papillæ appear laterally, and increase in length in the slender distal region of the organ, the tip, however, being bare. A typical papilla is a translucent, cylindrical process of the hypoderm covered with cuticle, and having microscopic palpocils at the tip, the space between the rows of papillæ being ciliated, whilst the convex dorsal surface has palpocils, and their cavities communicate with the cœlomic space (Fauvel). In structure these papillæ thus differ from those of *Sabellides*, which have the internal axis.

The mouth has, when closed, a puckered margin with a conical anterior fold, the tentacles with their plate of insertion being drawn inward, the parts in their respective

conditions being clearly shown in Fauvel's figures.[1] Some preparations thus indicate an outer and an inner folded collar.

The second segment is short and devoid of processes. The third bears dorsally the fan of flattened paleæ, and, with the next segment, the four branchiæ on each side (Fauvel). The paleæ form a more or less horizontal fan, with the longer bristles internal, the shorter external. Each of the larger paleæ (Plate CXXIV, fig. 4) has a flattened finely striated shaft and a tapered tip with a granular interior, and a slender curved tip ending in a fine point, the same minutely granular aspect being present in it as in the region below. The concave edge of the distal curve is crenulated, after the manner of similar structures in the Amphictenidæ.

The *body* (Plate CXII, fig. 3) reaches nearly an inch in length in spirit, and is slightly tapered anteriorly, the bristled region of fourteen segments being narrowed both anteriorly and posteriorly, and terminating in the narrower uncinigerous region of twelve segments, the caudal extremity having a series of slender filiform cirri. Generally speaking the segments of the anterior region are narrow, those of the posterior region are wider. The terminal segment is comparatively small, and the filiform tapering cirri, which Malmgren says are twenty in number, seem to surround the vent. The body is somewhat smoothly rounded dorsally, flattened and marked by a median band ventrally.

The branchiæ are smooth, or slightly crenulate, tapering organs of a greenish hue which arise, three in a transverse row on the third segment, and the fourth behind the middle one of the row.

The anterior region is distinguished by the ventral glandular belts, and by the presence of fourteen setigerous processes and fourteen lamellæ for the hooks. Whilst two or three of the anterior setigerous processes are smaller, the typical process is somewhat flattened and carries the row of bristles more or less vertically, the longer and stronger bristles being dorsal, the somewhat shorter ventral. Each bristle has a bulb at its origin, then the shaft dilates a little, remains of equal diameter for some distance (Plate CXXIV, figs. 4, 4 *a'*, 4 *b*), then shows a slight curvature at the commencement of the tip, which has wings and tapers to a hair-like point. About eight of the stronger forms are present in each tuft, besides a series apparently of developing forms, the slender tips of which project between the others at the level of the skin. A tendency of the upper tips to bend downward and of the inferior upward is often apparent.

The lamellæ or ridges for the hooks lie ventralward of the bristles and anteriorly form ridges with even margins, but by-and-by a papilla appears at the dorsal edge and forms toward the end of the region a cirrus with a slender tapering extremity, not shown by Fauvel. The anterior hooks (Plate CXXIV, fig. 4 *c*) differ from the outlines of Fauvel, having a broader body, about six teeth, and a rounded prow of a different curvature from that figured by the French author.

The posterior region has twelve segments, and is distinguished by the absence of bristles and the elongated nature of the lamellæ for the hooks and of the cirrus, as well as by the great antero-posterior diameter of the segments in relation to their transverse.

[1] Op. cit., pl. xix, figs. 57 and 58.

Each bears laterally the slender, tapering cirrus and beneath it the small elongated lamellæ for the hooks, which are considerably smaller than those in front, but have a similar structure. If anything they are shorter and broader than those of the anterior region and show five or six teeth and a rounded prow.

The general colour of a Zetlandic example is pale orange anteriorly from the wall of the gut, whilst the posterior region is pale with the brownish line of the intestine. The processes anteriorly are of a pale amber hue.

Fauvel found Gregarines in the alimentary canal. This author's account of the external and internal structure of *Ampharete Grubei* is both comprehensive and complete.

Cunningham and Ramage[1] (1888) enter *Ampharete gracilis* from the Forth, but a further investigation is necessary, and unfortunately all the specimens collected by these authors have disappeared.

A careful account of the tube of this species and its formation is given by Fauvel (1897). It is composed of shell-fragments and secretion and is placed vertically on the bottom, one half with thinner walls immersed in the sand and the other part with thicker walls projecting from the surface.

Prof. Fauvel[2] (1901) severely criticises the statements of M. Cosmovici concerning the segmental organs, especially his view that when the nephridia do not carry the reproductive elements externally they do not communicate with the cœlom by a ciliated funnel, and that when present the latter does not open into the preceding segment. Fauvel especially quotes his observations on the nephridia of *Ampharete Grubei*, in which only two pairs occur, viz., one piercing the anterior thoracic diaphragm, the other behind it. The former is solely excretory, the latter gives passage to the genital products.

Ehlers[3] (1875) mentions the occurrence of *Ampharete Goesi*, Malmgren, in the "Porcupine" Expedition of 1869 at a depth of 767 fathoms, 59° 35′ N., 9° 11′ W. It is a northern form, and may yet occur nearer the coast of Britain.

Besides the foregoing a form procured between tide-marks at St. Peter Port, Guernsey, offers certain differences, though it likewise has fourteen pairs of bristle-tufts anteriorly. Its hook has almost uniformly only five teeth, and its figure (Plate CXXIV, fig. 4 *c′*) is somewhat broader than that of *Ampharete acutifrons*, to the hook of which Malmgren assigned six to nine teeth, whilst Hessle gives five for the anterior and ten for the posterior hooks. Moreover, he states that the hooks of both *Ampharete Goesi* and *A. gracilis* have five teeth, whilst Malmgren gives seven for the former and five or six for the latter. A similar though minute form occurs in St. Magnus Bay, Shetland, with six teeth as a rule to each hook. Unfortunately all the specimens were injured and incomplete so that uncertainty at present exists, and it would seem that the specific characters of several species of *Ampharete* need revision. There are probably two or three to be added to the fauna.

[1] 'Trans. Roy. Soc. Edin.,' vol. xxxiii, p. 659, pl. xlii, fig. 20.
[2] 'Bull. Sc. France et Belgique,' t. xxxvi, p. 167.
[3] 'Zeitsch. f. wiss. Zool.,' Bd. xxvi, p. 27.

*Genus* CXXXIX.—Amphicteis, *Grube*, 1860. (Amphitrite, *Sars*, 1835.)

Shield-like cephalic lobe bounded by a prominent lobe (palp, Fauvel) on each side, which follows the shape of the shield posteriorly, median groove anteriorly. Nuchal organs cushion-like. Tentacles smooth. Body enlarged anteriorly, tapering posteriorly. Second segment (buccal) short, naked. Third segment large and prominent, with a transverse division inferiorly, and bearing at each side the fascicle of paleæ. Branchiæ subulate, four on each side, arising from the third, fourth, and fifth segments. Bristled segments seventeen, commencing on the fourth (third, Hessle). Uncinigerous pinnules begin on the seventh and extend to the segment in front of the anus. No distinct cirri on the feet. Anal segment with two cirri. Capillary bristles with curved and tapered tips arising from a subcylindrical base. Hooks commence on the sixth segment, uniserial, subtriangular, rounded, five to six long teeth. Stomach with internal diverticula. No ventral glands. Four to five pairs of similar nephridia, short and wide, the anterior smaller than the posterior; the apertures in the fourth segment do not open dorsally. Diaphragm between the fourth and fifth segments and between the fifth and sixth. Tube composed of mud.

1. Amphicteis Gunneri, *Sars*, 1835. Plate CXVIII, fig. 7—body; Plate CXXIV, figs. 5—5 *b'*—palea, bristles and hooks.

*Specific Characters.*—Palmulæ (eight to twenty) flattened, with a long tapering apex. Tentacles about twenty, smooth. Body 30 mm. long, and 3 mm. across feet. Segments 34—35, ventrally grooved. Branchiæ filiform, four on each side, on third and fourth segments. Posterior region with fifteen hook-laminæ, and terminating in two anal cirri. Feet with a clavate papilla at the ventral edge distally. Capillary bristles with curved tips and wings striated at the base. Middle part of hook broadest, with six teeth. Nephridia in fourth to seventh segments. Colour pale yellow, roseate ventrally, with the brown stomach and greenish blood-vessels shining through. The branchiæ are greenish, annulated with brown, white and yellow. The first four segments ventrally are marked with whitish and large brown touches. The dorsal surface has whitish touches, and the cephalic lobe has brownish spots (Fauvel). Tube of mud with fragments of algæ and other sea-weeds.

Synonyms.

1835. *Amphitrite Gunneri*, Sars. Beskrivel., p. 50, Tab. xi, fig. 30.
1844. „ „ Œrsted. Nat. Tidsk., 2 ser., i, p. 415.
„ „ „ idem. Region. Mar., p. 79.
1851. *Amphicteis* „ Grube. Fam. Annel., pp. 82 and 138.
1853. „ „ Sars. Nyt Mag., vii, p. 390, etc.
1855. *Crossostoma midas*, Gosse. Ann. Nat. Hist., vol. xvi, p. 310, pl. viii, figs. 7—12.
1857. *Amphicteis Gunneri*, Koren. Nyt Mag. f. Nat., ix, p. 94.
1858. „ „ F. Müller. Archiv f. Naturges., pp. 211—220, 2 plates.
1859. „ „ Danielssen. Kongl. Norsk. Vid. Selsk., p. 124.

1860. *Amphicteis grœnlandica,* Grube. Arch. f. Naturges., Bd. xxvi, p. 109, pl. v, fig. 3.
1861. „ *Gunneri,* Danielssen. Reise, 1857, and Nyt Mag., xi, p. 55.
1864. „ „ Sars. Vidensk. Selsk. Forhandl., pp. 6, 13.
1865. „ *grœnlandica,* De Quatrefages. Annel., t. ii, p. 393.
„ *Crossostoma midas,* idem. Ibid., p. 394.
„ „ *Gunneri,* Malmgren. Nord. Hafs. Annul., p. 365, Tab. xix, fig. 46.
1866. *Amphicteis* „ Kinberg. Ofr. Kongl. Vet. Akad. Forhandl., pp. 340—347.
1867. „ „ Malmgren. Annul. Polych., p. 105.
1869. „ „ McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 422, pl. xiv, fig. 14.
1870. „ „ Grube. Jahrb. Schles. Ges., pp. 68—84.
„ „ *curvipalea,* Claparède. Suppl. Annel. Nap., p. 132, pl. xiii, fig. 5.
1872. „ *Gunneri,* Marenzeller. Bremer Exped. (Zool. Jahrbucher), p. 429.
1873. „ „ Kupffer. Jahr. Comm. deut. Meere., 1871, p. 151.
1874. „ „ Malm. Göteb. Annul., Kongl. Vet. Handl., xiv, pp. 63—105.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 204.
1875. „ „ idem. Marine Invert. and Fishes St. Andrews, p. 129.
„ „ „ Möbius. Jahresb. Comm. deut. Meere., 1872.
„ „ *curvipalea,* Panceri. Atti Soc. Ital., vol. xviii, p. 532.
„ „ *Gunneri,* Marion. Rev. Sc. nat., iv, p. 307.
„ „ *curvipalea,* idem. Ibid., p. 307.
1877. „ *Gunneri,* Marenzeller. Denks. Math. Nat. Cl. K. K. Akad. Wiss., xxxv, p. 35, sep. abdr.
1879. „ „ Théel. Kgl. Svensk. Vet.-Akad. Handl., vol. xvi, p. 61.
„ „ „ Tauber. Annul. Danica, p. 128.
1880. „ „ McIntosh. Ann. Nat. Hist. (October), p. 271.
1882. „ „ Hansen. Nyt Mag. f. Nat. (Norske Nord.-Exped.), p. 46.
1883. „ „ Levinsen. Vidensk. Selsk., p. 163.
„ „ „ and *curvipalea,* Marion. Annales Mus. Hist. Nat. Marseilles, t. i, p. 60.
1885. „ „ McIntosh. Annel. "Challenger," p. 426.
„ „ „ Wirén. Svensk. Vet.-Akad. Handl., N.F., vol. xxi, p. 15, pl. i, figs. 1—11.
1886. „ „ Levinsen. Kara Havets, etc., p. 12.
1892. „ „ Marenzeller. Zool. Jahrb., Bd. vi, p. 429.
1893. „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 63.
1894. „ „ Bidenkap. Christian. Vidensk. Selsk. Forh., No. 10, p. 123.
„ „ „ De St. Joseph. Ann. Sc. Nat. Zool., 7e sér., t. xvii, p. 163.
„ „ *curvipalea,* idem. Ibid., p. 163.
1895. „ *Gunneri,* Fauvel. Mém. Soc. Nat. Cherbourg, 3e sér., t. xxix, pp. 345—6.
1896. „ „ idem. Bull. Soc. Linn. Normand, 6e sér., t. x, pp. 69, 76.
„ „ „ Appellöf. Bergens Mus. Aarb., p. 12.
1897. „ „ Fauvel. Bull. Sc. France et Belg., t. xxx, pp. 411—430, pl. xxiv, figs. 144, 167, pl. xxv, figs. 150—161.
„ „ „ Michaelsen. Polych. deutsch. Meere., p. 164.
„ „ *curvipalea,* Birula. Bull. Acad. Imp. St. Petersb., 5e sér., vol. vii, p. 14.
1904. „ „ Journ. M. B. A., vol. vii, p. 230.
1906. „ *Gunneri,* Augener. Westind. Polych., p. 175.
1907. „ „ Fauvel. Bull. Inst. Ocean., No. 107, p. 32.
1908. „ „ Ehlers. Deutsch. Tiefsee Exped., p. 141.
1909. „ „ Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 208.
„ „ „ idem. Bull. Inst. Ocean., No. 142, p. 22.

1911. *Amphicteis Gunneri*, Ditlevsen. Danmark Exped., p. 427.
1912. „ „ Meyer. Inaug. Dissert. Kiel., p. 19.
„ „ „ Wollebæk. Skrift. Vid.-selsk. Krist., No. 18, p. 55, pl. viii, figs. 1—11.
1914. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 98.
„ „ „ Fauvel. Campag. Sc. Monaco, Fasc. xlvi, p. 281, pl. xxvi, fig. 26.
„ „ „ Ditlevsen. Polych. Annel. (Meddel. Grønl.), p. 721.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 637.
1917. „ „ Hessle. Zool. Bidrag, Uppsala, p. 116, Taf. i, fig. 9.

*Habitat.*—Stomach of the haddock, St. Andrews Bay (E. M.) Dredged by Dr. Gwyn Jeffreys off the Hebrides, 1866, and in 80—100 fathoms in St. Magnus Bay, Shetland; 90–125 fathoms, 30—50 miles West of Valentia, Ireland (J. G. J.); "Knight Errant," Stat. 8, 640 fathoms (very large). Plymouth (Spence Bate and Rowe, Allen); S.W. Ireland, log. 19, 75 fathoms, 1885 (A. C. H.); Kenmare, S.W. Ireland, 1886; S.W. Ireland, log. 55, 1866, 23—38 fathoms (R. I. A.); Bay of Galway (E. P. Wright).

Abroad it has been found by the "Challenger" in 2750 fathoms in the middle of the Atlantic; Barentz Sea (McIntosh); Naples (Claparède); Greenland (Grube); Norway (Sars); Spitzbergen, Finmark (Norman). In 220 fathoms between Anticosti and the south shore, Canada (Dr. Whiteaves); Kerguelen (Ehlers). New England, U.S.A. (Verrill) and Atlantic Coast; Kara Sea (Levinsen); Arctic Sea (Marenzeller); Monaco (Fauvel); West Indies (Augener).

The *cephalic region* (Plate CXVIII, fig. 7) is somewhat shield-shaped dorsally, with a ridge running forward on each side anteriorly and a median groove. Each ridge diverges a little and projects in front. A prominent fillet of the buccal segment bounds them laterally, and converging to a median dimple guards them posteriorly as two oblique ridges, whilst in front of these a less prominent **V**-shaped fillet lies immediately behind the ridge marking the nuchal organs. On each side, at the commencement of the posterior slope, is a minute eye—indistinct in most spirit preparations. A dimple in the fillet opposite the eye-speck increases its range posteriorly, and represents the nuchal organ with pigment-specks in front. The buccal segment has an irregular border anteriorly, since, besides the two lateral fillets at the cephalic plate, a narrow rim passes in front of the mouth and a broader behind it, the margin of the lower lip being marked by five crenations, the three median and their four grooves being most distinct. Projecting from the mouth are the buccal tentacles, which are smooth. The second segment is narrower than the foregoing, and has a nearly straight anterior margin dorsally, whilst ventrally it is sinuous, having a forward curve in the middle, then a concavity, whilst the lateral border again slightly curves forward. The region containing the foregoing parts forms a blunt cone differentiated from the succeeding, which is wider, though the maximum transverse diameter is four or five segments behind.

The branchiæ are rather massive subulate organs springing from the third and fourth segments and the anterior edge of the fifth. Each has a short basal region, from which it readily separates, and a tapering distal part ending in a filiform tip. Two are anterior and two posterior. In the smaller examples variation in the origin of the stems exists, the outer anterior being sometimes nearly in a line with the origin of the posterior pair

of one side. In a large example, again, the outer anterior are external to a line from the outer posterior.

The stomach of this form has a blind sac which opens into the ventral aspect of the organ.

Behind the sixth bristled segment the body gradually diminishes to the tail, which terminates in a median anus with a lateral subulate cirrus on each side. The surface is rounded and smooth dorsally, slightly flattened in front ventrally, and marked by transverse glandular ridges, a distinct median groove running from the middle to the tip of the tail. The length of the body varies from 1 to more than 2 inches.

The third segment, from its greater width and prominent anterior border, indicates the commencement of the bristled region. Its dorsal margin is boldly concave forward, whilst its ventral edge is nearly straight, and there is little to separate it ventrally from the succeeding segment. It carries on the prominent lateral region the fan-like paleæ, which are more or less horizontal—that is, the concavity of the fan looks upward, the convexity downward, and the longest bristles are internal, their number being from fourteen to twenty. They are flattened golden bristles minutely striated longitudinally (Plate CXXIV, fig. 5), the striæ ending in granules distally, whilst the finely tapered tip is translucent. A few transverse bars occur here and there on the shaft, which dilates from the base to the surface of the skin, and then gradually tapers to the attenuate tip. They form two groups, an anterior longer and a posterior shorter, the former probably representing the dorsal division, the latter the ventral.

The anterior region has seventeen pairs of dorsal bristles, the first two of which are small, but the rest are conspicuous tufts projecting from setigerous processes which, when viewed from above downward, are nearly cylindrical, but antero-posteriorly are slightly tapered distally, and have at the ventral edge of the bristle-tuft a clavate papilla which seems to have escaped Malmgren. This clavate papilla is less developed in front than in the posterior setigerous processes, where it is much larger distally. The bristles (Plate CXXIV, figs. 5 *a*, 5 *a'* and 5 *a''*) have straight striated shafts which dilate a little from the base upward, continue of nearly equal diameter to the commencement of the wings, and then curve slightly backward and taper to a fine tip. The striæ of the shaft become oblique in the curved terminal region, and the wings themselves are striated for some distance upward. These bristles are evidently much used by the annelid, and the basal striated portion of the wings is often worn. A transverse ridge with a small dorsal cirrus—curved downward—represents the dorsal division behind the foregoing, and continues to the tip of the tail.

The hatchet-shaped lamellæ for the hooks commence on the ventral surface of the seventh segment at some distance from the setigerous process and at the posterior edge of the segment. A more or less distinct ridge, wider anteriorly and gradually diminishing posteriorly, connects them with the setigerous processes. The first are small and little elevated, but they increase in prominence, and gradually approach the setigerous process, so that at the twelfth or thirteenth bristle-bundle they are close to it; and the tip of the last is nearly as prominent. Thereafter the uncinigerous processes form conspicuous lamellæ on each side of the posterior region to the tail. The uncinigerous lamella has in the preparations a slightly irregular or crenulated edge to which the hooks are attached,

and a small lanceolate process at the dorsal edge (Plate CXXIV, figs. 5 *b* and 5 *b'*). The hooks have six prominent teeth, the distal region being tapered toward the crown, and the dorsal or posterior outline has a marked incurvation above the base, whilst a deep bay occurs below the lower tooth, and then a curved prow. In the largest example (over 2 inches) from deep water the hooks remained true to the type, five large upper teeth being followed by a smaller process above the prow. De St. Joseph mentions seven teeth in the anterior hooks and six in the posterior. The anterior rows are convex forward, but the posterior are nearly straight.

After the bristles cease a small papilla indicates the site of the setigerous process, and the papilla by-and-by projects posteriorly from a fused lamella which has a dorsal and a ventral ridge, the latter being a modification of the connecting-ridge. The uncinigerous lamella is bi-annulate, and remains so to the end. The last four or eight feet, however, are modified, so that only the bi-annulate uncinigerous process remains.

The posterior border of the caudal segment is either crenate or smooth—according to the conditions as regards reproduction. In those recently reproduced or in process of reproduction it is crenate, but in entire examples it appears to be smooth. The cirri are lateral in position and of considerable size.

The tube is composed of mud with a lining of secretion, and has various fragments of shells, spines of *Spatangus*, sand and minute pebbles adherent or mixed with the mud. The inner secretion, when first exuded, and before being coated with mud and *débris*, is very tough. The large example from 640 fathoms had its tube thickly coated with mud only. In the Irish examples (S. W. Ireland, 1885) the fragments of shells are embedded transversely in the thick muddy coating of the tube, giving it a heavy and dense character. The tube is placed vertically in its native site.

Gosse (1855) described this species as new, with interesting remarks on its habits in confinement, and gave good figures.

A careful and exhaustive description of this form is given by Fauvel (1897) both in regard to external and internal structure, and is accompanied by excellent figures.

The *Amphicteis curvipalea* of Claparède,[1] a form subsequently procured on the shores of France by De St. Joseph and at Plymouth by Allen,[2] is, so far as can be made out from the descriptions and an example sent for examination from Plymouth by Dr. Allen, an average specimen of *Amphicteis Gunneri*, and Fauvel had previously come to the same conclusion.

Michaelsen is probably right in thinking Malmgren's *Amphicteis sundevalli* synonymous with *A. Gunneri*.

### *Genus* CXL.—Sabellides, *M. Edwards* (*char. emend.*).

Cephalic lobe subquadrangular with or without furrows, frontal edge elevated, trapezoidal, anterior region arched, without grooves. Filiform tentacles with slender

[1] 'Annél. Nap. Suppl.,' p. 132, pl. xiii, fig. 5.

[2] 'Journ. M. B. A.,' N.S., vol. viii, p. 230.

processes on each side. No palmulæ. Body comparatively short, slightly attenuate posteriorly and ending in two anal cirri; segments not numerous; anteriorly both bristles and hooks, posteriorly only pinnules for hooks. Four slender subulate branchiæ on each side on the dorsum of the third segment. Setigerous processes fourteen, commencing on the third segment; the first process under the first branchia very small, but with conspicuous bristles. Uncinigerous pinnules commence at the sixth segment—that is, the fourth setigerous—and extend to the penultimate segment; the posterior segments (behind the eighteenth—the thirteenth uncinigerous) furnished with a small dorsal cirrus. Anal segment with two cirri. Neither œsophageal lobes nor stomachal sac. Nephridia in the fourth segment with long tubes, the rest with short tubes, those in the fourth segment opening dorsally. Capillary bristles with a curved and winged tip. Uncini uniserial with five to seven long sharp teeth. Tube smooth; composed of mud.

1. Sabellides octocirrata, *Sars*, 1835, var. *britannica*, *McI.* Plate CXVIII, fig. 11—body; Plate CXXIV, figs. 7, 7 *a*, 7 *b*—bristle and hooks; Plate CXXXVIII, fig. 2—body (after Malmgren).

*Specific Characters.*—Cephalic lobe conical. Tentacles ciliated, twenty, contractile, unequal, rectractile. Two simple eyes. Paleæ about five on each side. Body typical with fourteen pairs of bristle-bundles anteriorly; bristles short, translucent, with slightly curved, winged, and tapering tips. Branchiæ four on each side on the third segment. Uncinigerous tori commence on the fourth setigerous segment and are seventeen in number; hooks with four teeth. Posterior region with fifteen uncinigerous processes. Hooks also with four teeth.[1] Nephridia in the fourth, sixth and seventh segments.

Synonyms.

1835. *Sabella? octocirrata,* Sars. Beskriv. og. Iagtt., p. 5, Tab. xiii, figs. 32 *a*—*g*.
1843. *Sabella* „ Rathke. Nova Acta. Cur., Bd. xx, p. 222.
1843–53. *Sabellides* „ Chenu. Illust. Conch., 11e livr., pl. iv, fig. 9.
1851. *Sabellides* „ Sars. Nyt Mag., Bd. vi, pp. 132 and 205.
1853. „ „ idem. Ibid., Bd. vii, p. 370.
1859. „ „ Danielssen. Kgl. Norske Vid.-selsk. Skrift., Bd. 4de, p. 123.
1861. „ „ idem. Nyt Mag., xi, p. 55.
1863. „ „ Claparède. Beobach., p. 36.
1865. „ „ De Quatrefages. Annel., ii, p. 377.
1871. „ „ Grube. Schles. Gesell. (1870), p. 79, sep. abdr., p. 12.
1872. „ „ Malm. Annul. Göteb., p. 95.
1875. „ „ and *adspersa,* Marion. Rev. Sc. nat., t. iv, pp. 308 and 470.
„ „ *adspersa,* Panceri. Atti Soc. Ital., vol. xviii, p. 532.
1876. *Sabella octocirrata,* Oscar Grimm. Ann. Nat. Hist., 4th ser., vol. xvii, p. 176.
1879. „ „ Marion. Ann. Sc. nat., 6e sér., t. viii, p. 21.
1883. „ „ Levinsen. Vidensk. Meddel., p. 160.
1885. „ „ Carus. Fauna Medit., i, p. 268.
1887. „ „ Webster. Chætop. Eastport, Maine (U.S. Comm. F. and F.), p. 745.

[1] Five teeth (Carus); eight teeth posteriorly in two or three rows (Hessle).

1893. *Sabella adspersa*, Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 64, Tav. iii, fig. 3 (tube).
1894. „ *octocirrata*, Bidenkap. Christ. Vet.-Akad. Forhandl., p. 121.
1895. „ „ Fauvel. Mém. Soc. Nat. Cherbourg, t. xxix (3e sér., t. ix), p. 346.
1897. „ „ Birula. Bull. Acad. Imp. St. Petersb., 5e sér., t. vii, p. 15 (foot-note).
„ „ „ Michaelsen. Polych. deutsch. Meere., p. 166.
1903. *Sabellides* „ Norman. Ann. Nat. Hist., ser. 7, vol. xii, p. 283.
1906. „ „ var. *mediterranea*, De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 234, pl. v, figs. 104 and 105.
1914. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 101.
1917. „ „ Rioja. Annél. Poliq. Cantáb., p. 44.
„ „ „ Hessle. Zool. Bidr. Uppsala, No. 5, p. 113.

*Habitat.*—Dredged in St. Magnus Bay, Shetland (Dr. Gwyn Jeffreys, 1867). This form was dredged off Valentia by Dr. Gwyn Jeffreys in 50 to 60 fathoms in 1870; also off the Hebrides; dredged in Loch Portan, Lochmaddy, August, 1872, the loch being more or less mixed with fresh water, or at least brackish (W. C. M.).

The typical form is found in Norway (Sars, Rathke); Sweden (Malm); Mediterranean (Grube, Marion); var. *mediterranea*, Saint Raphael (De St. Joseph); Caspian Sea (O. Grimm[1]); Finmark (Norman).

The Hebridean example is small and presents anteriorly a bluntly conical snout from which the tentacles have been removed, but in the Irish specimen they are provided with long and proportionally thick papillæ or "cilia," which, however, are devoid of a central axis. The tip in the preparation has a "hairy" aspect as if from numerous palpocils, as in *S. borealis* (Plate CXVIII, fig. 11). Moreover, the papillæ extend nearly to the extremity, only a short granular portion projecting beyond them. The size of these papillæ seems to be a feature of the species. From the dorsal surface of the third segment eight somewhat stiff branchiæ project forward. They are proportionally longer than in *Sabellides borealis*, and more finely tapered.

The *body* (Plate CXXXVIII, fig. 2) is small and slender, a little more than half an inch in length, scarcely tapered anteriorly, with the exception of the short cone of the snout, and very gently tapered posteriorly till near the tip, when more rapid diminution occurs to the vent, on each side of which is a slender cirrus. So far as can be observed fourteen bristled segments occur anteriorly, distinguished by the absence of the long cirrus which is present in the sixteen posterior segments. The bristles are short and translucent, with slightly curved, winged and tapering tips, and they are borne on a prominent setigerous process. The anterior hooks have a rounded crown, the curve smoothly running into the convex dorsal (or posterior) outline, and the four teeth are characteristic, that next the crown being the largest, and the second, third and fourth regularly diminishing. The prow curves rather far forward and the tip is somewhat small.

The posterior hooks are prominently situated on the edges of the fillets and are free distally, a space separating the one from the other. They are very minute, and differ from the anterior in the sinuous curve of the crown and the slightly broader prow. They have, however, only four teeth as in front. The figure of the hooks in the var.

[1] 'Ann. Nat. Hist.,' February, 1876.

*mediterranea* of De St. Joseph unfortunately is so indistinct that little can be said about them, except that they have four teeth in lateral view, a single row occurring in the thoracic forms and a treble row in the abdominal.

The tube is a slender one to suit the small size of the species, is coated with fine mud and lined by secretion. In all probability the same species inhabited small hair-like tubes, composed of fragments of sand and spines of *Amphidotus*, procured in the stomach of a haddock at St. Andrews (E. M.).

*Reproduction.*—The example is a male with its body-cavity crowded with nearly ripe sperms (August). De St. Joseph (1906) found ova in the thorax, abdomen and feet, but the date is not indicated.

*S. adspersa*, Grube, has been entered under this species with a query. It is very closely allied.

A variety which was formerly described under the title of *S. malmgreni* deserves special notice were it only for its habitat. In this the cephalic region corresponds with the type. Body slender, elongated, having the normal number of the anterior segments with prominent setigerous processes bearing bristles with straight shafts and slightly winged tips. Segments of the posterior region with a subulate cirrus, and the lamellæ with the tori near the tail are longer. The terminal segment bears two filiform cirri. Hooks with a truncate posterior outline and four teeth on the anterior edge, diminishing from above downward. The posterior edge is nearly straight dorsally, but curves inferiorly to the prow, which forms a short, slightly variable process. Posterior hooks have a broader posterior edge which makes a larger angle with the outline of the base (for the edge slopes downward and backward), but they have the same number of teeth, and the prow is similar. Tube of secretion and fine mud.

*Habitat.*—Loch Portan, Lochmaddy, North Uist, a loch into which a considerable amount of fresh water mingles with the salt. The same form was dredged by Dr. Gwyn Jeffreys off Valentia, Ireland, in 50—160 fathoms. A single example was procured, measuring about half an inch in spirit. The tentacles were absent, and only three branchiæ remained. The body is slender, elongated, with the normal number of the anterior bristle-bearing segments, the setigerous processes being prominent and the bristles retracted (the specimen having been removed from its tube). It is little tapered in front but gently diminishes towards the tail. The translucent bristles (Plate CXXIV, fig. 7) have straight shafts and slightly winged tips. The segments of the posterior region have a subulate cirrus and the tori near the tail are longer. The terminal segment bears two filiform cirri.

The anterior hooks (Plate CXXIV, fig. 7 *a*) have a truncate posterior outline and four teeth on the anterior edge diminishing from above downward. The posterior edge is nearly straight dorsally, but curves inferiorly to the prow, which forms a short process. The posterior hooks have a somewhat broader posterior edge, which makes a larger angle with the basal outline (for the edge slopes downward and backward), but they have the same number of teeth and the prow is similar. The slope of the posterior margin brings its angle with the dorsal outline toward the middle of the hook.

The flexible tube of secretion and fine mud is cylindrical.

The hooks of the foregoing forms diverge from the type, as seen in *S. octocirrata*, and lean somewhat toward the type of an *Ampharete*. The hook certainly differs from *Sabellides borealis*, which has from five to six teeth. So far as observed neither has yet been detected in British waters, though *S. borealis* is common in Canada, Finmark and Norway.

Ehlers[1] (1875) describes a new species, *Sabellides fulva*, from the "Porcupine" Expedition of 1869, station 49° 1′ N., 11° 56′ W. in 557 fathoms, on a bottom of mud and shell-fragments. Its hook has a rudimentary tooth below the upper five.

*Genus* CXLI.—Samytha, *Malmgren*, 1865 (including *Amage*, Carus).

Cephalic lobe sub-quadrangular, without glandular bands; frontal region elevated, sub-rectangular, smooth, without a median groove. Buccal segment short. Filiform, smooth tentacles somewhat enlarged at the tip. No palmulæ. Three longer filiform branchiæ on each side, arising from the third and fourth segments in an interrupted row. Anal segment with two cirri. Setigerous processes seventeen—from the fourth backward. Bristles slightly curved and winged at the tip.

Uncinigerous pinnules from the fourth bristled segment backward to the posterior end. Uncini sub-triangular, with five long teeth.

Stomach without an anterior lobe or inner blind sac. Nephridia with comparatively short tubes, that in the fourth longer; they occur also in the fifth segment. The nephridiopores open dorsally (Hessle).

Malmgren instituted in 1865 the genus *Samytha* for the *Sabellides sexcirrata* of Sars, which had smooth tentacles, only three branchiæ on each side, seventeen pairs of setigerous processes and the characteristic hooks.

Hessle (1917) added further information concerning the nephridia.

1. Samytha sexcirrata, *Sars*, 1856. Plate CXVIII, fig. 8—body; Plate CXXIV, figs. 6 and 6 *a*—bristle and hook.

*Specific Characters.*—Head forming a somewhat broad central process with a lateral peristomial support on each side anteriorly. Beneath is the flap bearing the smooth and somewhat clavate buccal tentacles. Branchiæ subulate, filiform, in two groups. Body somewhat clavate with seventeen bristle-bundles in two series, a longer and a shorter, in each tuft, with slightly curved tips and narrow wings. Twelve to eighteen uncinigerous pinnules posteriorly. Hooks triangular, with a broad crown and four to five teeth anteriorly, about eight posteriorly. No dorsal cirri posteriorly.

Nephridia in fourth, fifth and sixth segments.

Synonyms.

1856. *Sabellides sexcirrata*, Sars. Fauna Lit. Norveg., ii, p. 23—24.
1865. ,, ,, De Quatrefages. Annel., t. ii, p. 378.

[1] 'Zeitschr. f. wiss. Zool.,' Bd. xxv, pp. 27 and 64, Taf. iv, figs. 18—23.

1865. *Samytha sexcirrata*, Malmgren. Nord. Hafs.-Annul., p. 370, Tab. xx, fig. 49.
1867. „ „ idem. Annul. Polych., p. 106.
1868. *Sabellides* „ Sars. Vidensk. Selsk. Forhandl., p. 10 (sep. abdr.).
1871. *Samytha* „ Grube. Schles. Gesell. (1870), p. 79.
1873. „ „ Verrill. Americ. Journ. Sc. and Arts, ser. 3, vol. v. Results of recent Dredgings on coast of N. England.
1874. „ „ Malm. Annul. Göteb., p. 95.
1879. *Sabellides sexcirrata*, Tauber. Annul. Danica, p. 129.
1882. „ „ Hansen. Norsk. Nord. Exped., 1876—78, vol. iii, p. 14, etc.
1884. „ „ Levinsen. Oversgt. norsk. Annel., p. 164.
1893. „ „ idem. "Hauchs" togter, p. 348.
1894. „ „ Bidenkap. Christ. Vet.-Akad. Forhandl., p. 124.
1896. „ „ Appellöf. Bergens Mus. Aarb. (1894—5), p. 12.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 166.
1909. „ „ Fauvel. Bull. Inst. Ocean., cxlii, p. 23.
„ *Samytha* „ Ditlevsen. Annul. Polych. Norw. Arct. Exped., vol. iii, No. 15, p. 16.
„ *Sabellides* „ Percy Moore. Proc. U.S. Nation. Mus., vol. xxxvii, p. 140.
1912. „ „ Meyer. Inaug. Dissert. Kiel., p. 22.
„ *Samytha sexcirrata*, Wollebæk. Skriv. Vid.-Selsk. Krist., No. 18, p. 60, pl. xi, figs. 1—9.
1914. „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 286.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 102.
1917. „ „ Hessle. Zool. Bidr. Uppsala, No. 5, p. 113.

Dredged in St. Magnus Bay in 100 fathoms by Dr. Gwyn Jeffreys in 1867. Extends to Canada, where it was dredged in 220 fathoms between Anticosti and the south shore (Whiteaves), and probably to the Antarctic seas. Norway and Sweden (Sars, Malmgren); New England and Atlantic Coast, U.S.A. (Verrill). Arctic Seas.

*Head* (prostomium) forms a somewhat broad anterior median process with a peristomial buttress on each side. Beneath is the flap bearing ventrally the buccal tentacles, which are smooth, and somewhat enlarged distally. The posterior lip is prominent, and passes upward at each side as a process separated from the cephalic border by a notch. When viewed laterally it forms a projecting spout-shaped frill. The segment behind the buccal has no processes. The third and fourth segments carry dorsally the branchiæ, which are three on each side, and comparatively long, tapering (subulate) organs. In the Canadian forms they are nearly half the length of the body in the preparations.

*Body* somewhat clavate in outline, though a slight narrowing occurs anteriorly from the eighth foot forward, and behind this it diminishes to the tail, which presents a single, thick, short, lateral cirrus on each side. The dorsum is smoothly rounded throughout, whilst the ventral surface is marked from the mouth to the tenth bristled segment by a thickened glandular layer in each segment. Then a groove appears in the middle line and is continued to the tip of the tail. In a large specimen the vent presented a notch dorsally with a crenate edge beneath, and in a perfect Canadian example in a tube a short cirrus occurred on each side. Malmgren's specimens had been imperfect. External to the branchiæ is the small first setigerous process, which bears a tuft of bristles. This and the next two are rather dorsal than lateral, but they soon become

lateral, and project from the region as long processes sloping outward and backward. Each bristle-tuft has a longer and a shorter series of translucent bristles with slightly curved tips furnished with somewhat narrow wings (Plate CXXIV, fig. 6). The shaft is minutely striated longitudinally, and widens a little as it approaches the tip.

The hooks (Plate CXXIV, fig. 6 *a*) have a somewhat triangular outline from the breadth of the slightly sinuous crown. The posterior outline curves to the rounded prow which is carried to the line of the teeth. The first tooth is as large as the second and the two following are similar, the last being slightly broader at the base from the curve of the gulf between it and the prow. Most of the hooks have five teeth, though occasionally the larger have six, whilst some in the centre of the row may have only four teeth. The posterior hooks are smaller, but they have the same form and structure. Moreover the papillæ or lamellæ on which they occur are the only processes posteriorly, and are twelve to thirteen in number.

The tube is not mentioned by Malmgren, but is composed of a lining of tough secretion with a few sand-grains and free shreds of mucus, which give it the aspect of being coated with minute algæ.

*Reproduction.*—The larger example from St. Magnus Bay in July appears to be a female with large ova.

The *Sabellides adspersa* of Grube [1] from Lussin Piccolo in the Adriatic seems to be a closely allied form.

*Genus* CXLII.—Amage, *Malmgren*, 1865.

Cephalic lobe sloping downward anteriorly, twice as broad as long, transversely truncate posteriorly, and with two prominent papillæ as if bifid, supported by glandular fillets of the peristomium. Tentacles filiform, smooth. Tentacular membrane trilobed, and with two glanular bands. Four subulate branchiæ fixed on each side of the third and fourth segments. Anal segment with two cirri; stomach has a blind sac. Nephridia with short, wide tubes, and the anterior are less than the posterior, which extend into the fifth segment.

Setigerous processes commence on the third segment (on which they are small), and are fourteen in number. Rows of hooks from the sixth segment to the penultimate segment. Oval papillæ above the hooks and bristles in the posterior segments. Capillary bristles with very narrow wings, and tapered, slightly curved tips. Hooks pectiniform, sub-triangular, 4—5 toothed.

1. Amage auricula, *Malmgren*, 1865. Plate CXVIII, fig. 10—body; Plate CXXIV, figs. 8—8 *b*—bristle and hooks; Plate CXXV—dorsal view, anterior end.

*Specific Characters.*—Cephalic region somewhat broad, and bent downward, the prostomium being bifid; supported laterally and posteriorly by the fillets of the

[1] 'Arch. f. Naturg.,' xxix, p. 57, Tab. vi, fig. 2, 1863; and 'Jahresb. Schles. Gesell.,' 1871, p. 80.

peristomium, which form a thick reflexed margin. Tentacles smooth. Branchiæ four on each side, affixed to the third and fourth segments (ten to twelve, Malmgren). Body 10—12 mm. long, 2·5 mm. at its widest part, gently tapered in front, somewhat flattened from above downward, and diminishing gradually to the tail. Fourteen bristled segments occur anteriorly and twelve in the posterior region, the last having two short subulate caudal cirri; anal papillæ small. Nephridia in the fourth, fifth, sixth and seventh segments. Bristles with slightly curved, winged, and tapering tips. Hooks have a sinuous crown, four to five teeth, and are present on eight segments (Hessle). Club-shaped dorsal cirri better developed anteriorly than posteriorly.

Synonyms.

1865. *Amage auricula,* Malmgren. Nord. Hafs. Annul., p. 371, Tab. xxv, fig. 72.
1866. *Sabellides brevicirrata,* Sars. Vid.-Selsk. Forhandl., 1865.
1867. *Amage auricula,* Malmgren. Annul. Polych., p. 106.
1868. „ „ Sars. Vid.-selsk. Forhandl., p. 10 (sep. copy).
1869. „ ? McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 423, pl. xiii, fig. 10.
1871. *Sabellides auricula,* Grube. Schles. Gesell. (1870), p. 80.
1872. *Amage* „ Malm. Annul. Göteb., p. 95.
1873. „ „ Verrill. Americ. Journ. Sc. and Arts, ser. 3, vol. v, p. 98, etc.
„ „ „ idem. Proc. Americ. Assoc. Sc. (1873), Salem (fide auct.).
1874. „ „ idem. Americ. Journ. Sc. and Arts, vol. vii, p. 411, etc.
1878. „ „ McIntosh. Trans. Linn. Soc., ser. 2, Zool., p. 508.
1879. *Sabellides* „ Tauber. Annul. Danica, p. 129.
1883. *Amage* „ Levinsen. Vidensk. Meddel., p. 164.
1884. „ „ Marenzeller. Denkschrift. der Mat.-Naturw. der K. Akad. d. wiss. Wien, Bd. xlix, p. 2, Taf. ii, fig. 6.
1894. „ „ Bidenkap. Christ. Vet.-Akad. Forhandl., p. 123.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 166.
1911. „ „ Fauvel. Bull. Inst. Oceanogr., No. 194, p. 34.
1912. „ „ Wollebæk. Skriv. Vid.-selsk. Krist., No. 18, p. 65, pl. xiii, figs. 1—6.
„ „ „ Meyer, A. H. Inaug. Dissert. Kiel, p. 23.
1914. „ „ Ditlevsen. Polych. Grønland, 3 Heft., p. 723.
„ *Sabellides* „ Treadwell. Polych. Pacif. Coast Univ. Califor., vol. xiii, p. 211.
„ *Amage* „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 290, pl. xxviii, figs. 13—16.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 103.
1917. „ „ Hessle. Zool. Bidr. Uppsala, No. 5, p. 120.

*Habitat.*—Procured by the "Knight Errant" in Trawl 2, Station 10, August 24th, 1882, in 576 fathoms.

"Valorous" Expedition, 1875; Atlantic Coast, U.S.A. (Verrill); Sweden (Malmgren, Malm, Hessle); Japan (Marenzeller); Norway (Fauvel); Lofoten, Finmark, Drøbak (Wollebœk); Spitzbergen (Hessle).

The *prostomium* is characteristically bifid, supported laterally and posteriorly by the folds of the peristomium, which form a thick, reflexed margin, the whole giving the cephalic region considerable breadth, and it is also bent downward. According to Malmgren the filiform tentacles are smooth.

The *body* is comparatively small, about 12 mm. in length and 2·5 mm. at its widest part, slightly diminished in front and gently tapering to the tail. As in Malmgren's figure, eight to twelve segments follow the bristled region, but in some examples two thick short subulate cirri occurred at the tip, and they seemed to be larger than the dorsal cirri in front of them and less clavate in outline, as when viewed from above the dorsal cirri are clavate, with a narrow base and rounded or bluntly ovoid tips. The last setigerous process is followed by a short dorsal cirrus, the succeeding cirri having a more elongated stalk and a more distinctly enlarged tip. The ventral uncinigerous processes are bluntly conical papillæ, a considerable ridge intervening between them and the dorsal cirri.

The bristles (Plate CXXIV, fig. 8 *b*) are pale golden, almost devoid of wings, and have long, finely tapered tips with a trace of a curve.

The hooks (Plate CXXIV, figs. 8 and 8 *a*) commence on the fourth segment, have a nearly straight posterior outline, a slightly sinuous ventral margin which curves upward at the prow anteriorly, and four to five teeth, the first being smaller than the second, the third and fourth larger than the second, the fifth stouter than the others, and separated along the anterior margin by a gulf from the rounded prow, the lowest tooth being the stoutest. The hook has a different shape from that of *A. Malmgreni* from the greater depth posteriorly—that is, from the angle to the front. The posterior hooks are smaller but of similar structure.

The tube consisted of secretion covered with soft, grey mud, and in some the secretion adhered firmly to the surface of the annelid.

*Reproduction.*—The Norwegian examples had large ova in July.

A form dredged by Dr. Gwyn Jeffreys off the Hebrides (Plate CXXIV, figs. 9 and 9 *a*—bristle and hook) in 1866 is devoid of palmulæ, and has about fourteen bristle-bundles on each side, but this number is uncertain, for the only example is pulpy and imperfect, the tentacles are smooth and club-shaped, and the ventral glandular bars of the segments very distinct. The bristles (Plate CXXIV, fig. 9) offer no feature of note, being the ordinary winged forms.

The hooks (Plate CXXIV, fig. 9 *a*)[1] lean in their outline rather to those of *Melinna* than to those of *Amage*, yet differ characteristically from both. They are somewhat triangular, with a narrow crown and five teeth, the fifth being shorter and broader from the form of the "bite" between it and the prow, which is somewhat abruptly rounded. The process for the ligament is carried nearly to the base posteriorly. The "bite" is somewhat larger than shown in the R.S.E. figures.

The *Amage adspersa* of Grube has hooks with only four teeth. It occurs at Madeira (Langerhans).[2]

### *Genus* CXLIII.—Melinna, *Malmgren*, 1865.

Cephalic lobe smooth, without an elevated frontal part, palpode rudimentary (Fauvel). Anterior margin transverse. Buccal segment produced longitudinally at the sides of the

[1] *Vide* also 'Trans. Roy. Soc. Edin.,' vol. xxv, pl. xiii, figs. 10 and 10 *a*.

[2] 'Zeitschr. f. wiss. Zool.,' Bd. xxxi, p. 261, Taf. xv, fig. 19.

cephalic lobe. Two groups of simple eyes ; nuchal organs ciliated grooves. Tentacles smooth, filiform. Four rather long, subulate branchiæ on each side. A single large curved hook on each side with two basal glands behind the branchiæ on the dorsum of the third segment (fourth, Hessle), three anterior bristled segments coalesced in the form of a vagina, free anteriorly, fixed posteriorly, partly ensheathing the mouth and the sides of the branchiæ. The fourth setigerous segment (sixth of body) has dorsally a free membranous edge regularly denticulated. The lateral borders of the first five segments elevated (Hessle). Eighteen fascicles of bristles commencing on the fifth segment, the three anterior sunk in the tissues, the following fifteen having subcylindrical setigerous processes. Bristles with slightly curved and winged tips. Feet with rudimentary cirri. The second, third, fifth and sixth segments have simple bristles ventrally. The anterior feet have dorsally no cirri, whereas the posterior have rudimentary cirri. Uncinigerous processes commence on the seventh segment and continue to the posterior end. Hooks subtriangular with few teeth (four) and in a single row. Minute subconical papillæ bearing capillary bristles above the uncinigerous pinnæ posteriorly.

Stomach without a diverticulum. Four pairs of long, tubular nephridia in segments 5—8. Diaphragm between the third and fourth segments with muscular sacs. Ventral glands. Branchial vessels arise from the heart by two ramified branches. Tube composed of mud lined by tough secretion.

1. MELINNA CRISTATA, *Sars*, 1851. Plate CXVIII, fig. 9—body ; Plate CXXV, figs. 1—1 *c*—bristle and hooks.

*Specific Characters.*—Head a short, bluntly rounded process, but in extrusion of the tentacles a flattened lamella. An eye-speck on each side. Body long (50 mm., Hessle), somewhat clavate, tapering to the slender tail with a terminal anus, which has two lateral flaps and a few short papillæ. Branchiæ four on each side, arising from a basal process on the third segment, and each process gives rise to an anterior and a posterior pair. Dorsal collar with regular conical processes on its edge—ten to twenty in number. A single large curved hook on each side behind the branchiæ, with a broad base and a terminal canal. Eighteen setigerous processes anteriorly, the first three less developed. Bristles with striated shafts and slightly curved and winged tips, and in a longer and a shorter series. They commence on the fifth segment (Hessle). Hooks appear on the fourth bristled segment, have a rounded crown, four teeth on the anterior edge, increasing in size from the first to the fourth. From fifty to fifty-five lamellæ for the hooks in the posterior region. Nephridia in the fifth, sixth, seventh and eighth segments. Tube of secretion coated with mud, cylindrical, and three times longer than the animal.

SYNONYMS.

1851. *Sabellides cristata,* Sars. Nyt Mag., vi, pp. 132 and 206.
1856. „ „ idem. Fauna Lit. Norweg., vol. ii, p. 19, Tab. ii, figs. 1—7.
1861. „ „ Danielssen. Nyt Mag., xi, p. 55.
1864. „ „ Sars. Forhandl. Vidensk.-selsk. Christ., p. 57.
1865. *Melinna* „ Malmgren. Nord. Hafs.-Annul., p. 371, Tab. xx, fig. 50.
„ *Phenacia* „ De Quatrefages. Annel., ii, p. 377.

1867. *Melinna cristata*, Malmgren. Annul. Polych., p. 106.
1868. *Sabellides* „ Sars. Vidensk.-selsk. Forhandl., p. 10 (sep. copy).
1871. *Melinna* „ Grube. Schles. Gesell. (1870), p. 80.
1873. „ „ Kupffer. Jahresb. Komm. deutsch. Meere., 1871, p. 151.
1874. „ „ McIntosh. Ann. Nat. Hist., 4th ser., vol. xiv, p. 204.
„ „ „ Malm. Fauna Göteb. (Kongl. Vet. Handl.), vol. xiv, p. 96.
„ „ „ Verrill. Invert. Vineyard Sound, Rep. U.S. Com. F. and F., I, 1871—72, pp. 432 and 613.
1875. „ „ Ehlers. Zeit. f. wiss. Zool., Bd. xxv, p. 27.
„ „ „ Lütken. Arctic Man., p. 174.
„ „ „ Marion. Rev. Sc. nat., t. iv, p. 307.
„ „ „ McIntosh. Invert. and Fishes St. Andrews, p. 129.
„ „ „ Möbius. Jahresb. Comm. deutsch. Meere. (1872).
1878. „ „ Marenzeller. Denks. Math. Naturw. K. Akad. wiss. Wien, vol. xxxv, p. 391.
1879. „ „ Tauber. Annul. Danica, p. 129.
„ „ „ Théel. Kgl. Sv. Vet.-akad. Handl., Bd. xvi, p. 63 (sep. copy).
1883. „ „ Levinsen. Vidensk. Meddel. Copenhagen, p. 160.
1884. „ „ Webster and Benedict. Rep. Com. F. and F., U.S.A., for 1881, p. 732.
1885. „ „ Wirén. Svensk. Vet.-Akad. Handl., N.F., vol. xxi.
1886. „ „ Levinsen. Kara-Havets, etc., p. 11.
1887. „ „ Ehlers. Mem. Mus. Comp. Zool. Harvard, vol. xv, p. 232.
„ „ „ Webster. Chætop. Eastport, Maine (U.S. Com. F. and F.), p. 748.
1888. „ „ Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 660, pl. xlii, fig. 22.
1889. „ „ Grieg. Bergens Mus. Aarb., p. 8.
1894. „ „ Bidenkap. Christ. Vet.-Akad. Forhandl., p. 120.
1896. „ „ Appellöf. Bergens Mus. Aarb., p. 12 (sep. copy).
1901. „ „ Whiteaves. Mar. Invert. E. Canada, p. 74.
1907. „ „ Fauvel. Bull. Inst. Ocean., No. 107, p. 34.
1908. „ „ Moore. Proc. Acad. Nat. Sc. Philad., p. 349.
„ „ „ Ehlers. Deutsch. Tiefsee-Exped., p. 44.
1911. „ „ Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 63.
1912. „ „ Wollebæk. Skriv. Vid.-selsk. Krist., No. 18, p. 65, pl. xiv, figs. 1—9.
„ „ „ Meyer, A. H. Inaug. Dissert. Kiel, p. 23.
1914. „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 291.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 104.
„ „ „ Ditlevsen. Polych. Annel. (Meddel. Grønl.), p. 723.
1917. „ „ Hessle. Zool. Bidr. Uppsala, No. 5, p. 92.

*Habitat.*—Abundant in the stomachs of the cod at St. Andrews (E. M.).
Forth (Cunningham and Ramage).

Elsewhere it was dredged in 220 fathoms by Dr. Whiteaves between Anticosti and the south shore in 1873; Bouvet Island (Ehlers), Greenland; Norway and Sweden, Finmark, Spitzbergen, etc. (Lovén, Ljungman, Malmgren, Norman, Fauvel and Hessle); a characteristic form in the Norwegian waters, 300 fathoms off Norway (Sars). New England, U.S.A., and Atlantic coast (Verrill). Kara-Havets (Levinsen). Barentz Sea (McIntosh). Arctic Sea (Marenzeller). North Pacific coast, North America (Moore).

The *head* varies in aspect according to the condition of the tentacles. In contraction when these are withdrawn within the mouth the anterior end presents dorsally a short,

bluntly-rounded process with (in some) a notch in the centre. In extrusion of the tentacles there is a flattened lamella, from the anterior edge of which the somewhat clavate tentacles project. The tentacular lobe is separated by a deep dorsal groove from the next segment, the groove passing laterally downward to the mouth in front of the posterior lip. Two basal processes arise from the third segment, each of which soon splits into two anterior and two posterior rather long tapering branchiæ, the larger being the inner of the anterior pair on each side, the two outer being considerably less than the inner posterior. The posterior lip forms a lamella with a free anterior edge which curves upward on each side to form a prominent collar at the angle (thus differing from *M. elisabethæ*), then it turns backward to the edge of the denticulated membrane of the fourth setigerous segment. The latter, the lower lip and the lateral folds thus form a kind of base or sheath for all the parts in front. The transverse and free fold just alluded to has about a dozen denticulations of nearly equal size on its free or anterior edge.

The *body* is somewhat clavate, broad at the branchial region and gently tapering to the slender posterior extremity, which is characterised amongst the Ampharetidæ by its great length, no less than about fifty segments occurring in it. The anus is terminal, comparatively large for the size of the region, and in the only example in which the part is apparently complete a few short papillæ occurred on the edge. Above or beneath the anus is a vertical slit with the lateral edge projecting on each side. The dorsal surface of the body is rounded and smooth, whilst the ventral surface is marked anteriorly as far as the fourteenth bristle-bundle by the glandular thickening in each segment; thereafter a median groove is continued to the slender region near the tip of the tail.

Hessle[1] found two glands at the sides of the hooks on the dorsal surface behind the branchiæ. He regards these hooks as representing a reduced fourth segment. The glands have a muscular investment and their duct communicates with the hollow hook.

The first three bristle-bundles are small, and form a slightly oblique row in the preparations along the edge of the flap between the mouth and the denticulated border on the dorsum of the fourth bristled segment. These have no evident setigerous process, since they are immersed in the tissues of the region, but the tips are occasionally modified, probably by friction, so that they are bent nearly at right angles and split, so as to resemble hooks. The following fifteen pairs have, when fully developed, a prominent and somewhat conical setigerous process from which the long pale golden bristles project, either transversely or in a slightly backward direction. The bristles (Plate CXXV, fig. 1) have long, finely striated shafts, and slightly curved and winged tips which taper to a delicate point. A shorter series occurs amongst the foregoing, their finely-tapered tips falling short of the longer by a considerable interval.

Between the basal region of the branchiæ on each side and the denticulated margin of the dorsal collar is a powerful hook (Plate CXXV, fig. 1 *a*), which in the preparations is generally conspicuous, the point being directed backward and downward. It has a broad flattened base and shaft; the latter widens as it proceeds upward from the base to about half its length, then narrows distally, the tip forming a sharp hook which curves to the front. Along the dorsal or convex edge of the curve a considerable thickening of the brittle chitinous tissue occurs, and this part is perforated by a canal containing

[1] Op. cit., pp. 53 and 54.

granular contents, and in connection with a gland, also granular, at the side of the shaft. The canal opens on the convex side of the organ a little short of the tip. The shaft is finely striated longitudinally, the striæ converging as the hook narrows distally and ceasing within the tip.

The ordinary hooks are arranged on small ridges beneath the bristle-tufts anteriorly from the fourth segment backward. The lamellæ which carry the hooks are at first minute, but by-and-by they project as small flaps with a tendency to a prolongation ventrally. The hooks (Plate CXXV, fig. 1 *b*) present a rounded crown with four teeth on the front edge, increasing in size from the first to the third, the fourth having a broad base but a shorter fang, for the gulf above the rounded prow is short. The posterior margin is sinuous and the base rounded. Behind the bristled region the lamellæ become more prominent and have a small papilla dorsally.

The tube is coated with greyish mud and lined with tough secretion. Attached externally in Norwegian examples are fragments of shells—it may be in considerable numbers—and occasionally globular arenaceous Foraminifera, with grains of sand in mud, and here and there a leaf of an alga.

This species was first described by M. Sars[1] (1851) under the title of *Sabellides cristata* as having eight tentacular cirri borne on a collar or crest with crenulations, fifteen thoracic segments bearing bristles (besides three anterior tufts without mamillæ).

J. Percy Moore[2] (1905) describes *Melinna cristata*, sp., nov., from the North Pacific (Alaska) as closely resembling Malmgren's species. It differs in the more finely denticulated post-branchial membrane, larger size and more numerous segments. The hooks are similar.

Augener's[3] *Melinna profunda* appears to be only a variety of *M. cristata*, and the hooks agree.

2. Melinna elisabethæ, *McIntosh*, 1914. Plate CXIX, fig. 1—dorsal collar; Plate CXXV, figs. 2—2 *b*—bristle and hooks.

*Specific Characters.*—Cephalic region similar to that of *M. cristata*, but with a slight notch anteriorly and two lateral eminences. The tentacular plate and tentacles often extend beyond it. Tentacles remarkably long. Body similar to that of *M. cristata*, the number of segments being variable. Branchiæ arise from two basal processes, but they do not divide into an anterior and a posterior pair. Dorsal collar shorter, with smaller conical processes than in *M. cristata*, and often in groups of three. In front of the collar a distinct conical process passes forward to the space between the branchiæ. Ventrally the lateral edges of the body-collar are less prominent. The post-branchial hooks have a broad, almost ovoid, flattened shaft, which abruptly narrows anteriorly and is boldly curved into a rounded and apparently solid terminal hook. Bristles as in *M. cristata*. Hooks usually present only four teeth, and differ slightly in curves, especially at the base. Tube of tough secretion coated with a little mud and occasional fragments of shells.

[1] Sars, 'Nyt Mag.,' Bd. vi, p. 205.

[2] 'Proc. Acad. Nat. Sc. Philadelphia,' December, 1905, p. 851.

[3] 'Westind. Polych. Bull. Mus. Comp. Anat., U.S.A.,' p. 181, Taf. vi, figs. 126, 127, Taf. vii, fig. 128.

Synonym.

1914. *Melinna elisabethæ*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xiii, p. 106.

*Habitat.*—In the stomach of the haddock and flounder, St. Andrews Bay (E. M.). Abundant in the Fjords of Norway, where it was collected by Canon Norman and Hessle.

The specimens of this species were first obtained in Britain by my mother in the stomachs of haddocks, and consequently the external configuration was altered. The presence of the same form in Norwegian waters (dredged by Dr. Merle Norman) enables a more satisfactory description to be made.

The head and anterior region, while formed on the general plan of *M. cristata*, have proportionally longer branchiæ and tentacles. The cephalic border anteriorly has a slight notch and two lateral eminences, the tentacular plate and the tentacles being often pushed beyond it. The tentacles are remarkably long, and the mouth forms a gaping aperture beneath them, at the end of the bluntly conical region.

The branchiæ arise from two basal processes where they are fused, and they are longer and more distinctly tapered than in *M. cristata*. Moreover they do not lend themselves to a transverse division into an anterior and a posterior pair as in *M. cristata*. The outer and more slender branchia separates readily to the base, and the next to it posteriorly nearly as far, but the two inner (the one in front of the other) are united for a considerable distance above the base. Their arrangement therefore differs from that in *M. cristata*. The dorsal collar stretches in the same manner as in the latter, but the free edges of the two differ, for instead of the very large, regular, conical processes of *M. cristata* this form has smaller conical processes often in groups of three (Plate CXIX, fig. 2), and there is less regularity. The edge of the collar thus differs under a lens, and the collar is often narrower from side to side. In front of the denticulated collar a distinct conical process passes forward to the space between the branchiæ. On the ventral surface again the body-collar has not the prominent lateral edges seen in *M. cristata*.

The post-branchial hooks are diagnostic, and their position is the same as in *M. cristata*. They have a broad, almost ovoid flattened shaft, the base of which is often oblique. Anteriorly it somewhat abruptly narrows, and is boldly curved forward as a rounded, tapering and apparently solid hook (Plate CXXV, fig. 2 *a*) with a sharp point. The broad shaft is marked by fine longitudinal lines which are continued beyond the curve and toward the tip of the hook, and also shows slightly curved cross striæ which pass forward to the neck of the hook and then cease, the tip being homogeneous and clear. It is moved by powerful muscles attached to the shaft. The concavity of the hook has a thick layer of chitin, but no canal could be made out. Such a hook differs from that of *Melinna cristata* in outline and structure as well as in the absence of the canal at the tip.

The bristles (Plate CXXV, fig. 2) have the same structure as in *M. cristata*, viz., translucent, striated shafts and winged, tapering tips, and they are accompanied by the shorter series as in the previous form. The hooks (Plate CXXV, fig. 2 *b*) resemble those of the other species, but whilst in *M. cristata* they often show five teeth, in *M. elisabethæ* four is the usual number, and the curves slightly differ.

The tube of this form consists of tough secretion coated with a little mud, and having fragments of shell attached here and there by the edges. The gastric juice of the fishes does not seem to affect the tubes much, though their inhabitants are rapidly softened.

The tubes of the Norwegian examples are of tough secretion coated with fine mud and here and there an arenaceous Foraminifer. It is curious that this species has never been tossed on shore at St. Andrews. It probably inhabits the deeper water. It is the common form in Norway.

3. Melinna palmata, *Grube*, 1869 (= M. adriatica, *Marenzeller*). Plate CXIII, fig. 1—body; Plate CXIX, fig. 2—edge of dorsal collar; Plate CXXV, figs. 3—3 *c*—bristles, hooks and setigerous process.

*Specific Characters.*—Cephalic region generally as in *Melinna cristata*, but differing in the minute size of the post-branchial hooks and in the conspicuously barred condition of the branchiæ, which are arranged as in *M. elisabethæ*—that is, are not placed one in front of the other. The membranous crest of the fourth segment has four to eight rounded teeth. Tentacles four. Anterior region of the body typical (with eighteen bristled segments). Bristles rather stronger than in *M. cristata* and the shorter series more distinctly curved. Anterior hooks with five teeth and a process between the last and the prow; thirty-six to forty-seven in single rows, except the first and the last. Of a dull or slightly purplish pink hue, the branchiæ varying from pink to pale pink. Tube rather friable, composed of secretion coated with mud.

Synonyms.

1869. *Melinna palmata*, Grube. Jahresber. nat. Schles. Gesell., p. 40.
1874. „ *adriatica*, Marenzeller. Sitzb. Akad. Wien, vol. lxix, p. 472, pl. vii, fig. 6.
1875. „ „ Panceri. Atti Soc. Ital., vol. xviii, p. 532.
„ „ „ Marion. Rev. Sc. nat., t. iv, p. 307.
1885. „ „ Carus. Fauna Medit., vol. i, p. 269.
1893. „ „ Marenzeller. Denkschrift K. Akad. wiss. Wien, Bd. lx, p. 34, Taf. ii, fig. 6.
„ „ *palmata*, Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 65.
1895. „ „ Fauvel. Mém. Soc. National des Sc. Nat. Cherbourg, t. xxix, p. 345, pl. xxiv, fig. 148.
1904. „ *adriatica*, Allen. Journ. M. B. A., vol. vi, p. 230.
1909. „ *palmata*, Fauvel. Bull. Inst. Ocean., No. 142, p. 22.
1910. „ *adriatica*, Elwes. Journ. M. B. A., vol. xi, p. 6.
1917. „ *adriatica*, Rioja. Anél. Poliq. Cantáb., p. 45.
„ „ „ Hessle. Zool. Bidrag. Uppsala, v, p. 94.

*Habitat.*—Common in soft mud in Plymouth Sound, on the shore and in deeper water (Allen); Torquay, amongst *Zostera* roots (Elwes).

Abroad it occurs in the Adriatic (Marenzeller); Monaco (Fauvel); St. Malo and Chausey (Grube and Fauvel); shores of Cantabria (Rioja).

In general aspect this form approaches *Melinna cristata*, though it differs in the appearance of the branchiæ and the obscurity of the hooks. The *snout* bears a series of smooth tentacles, about twelve in number, the shorter forms being inferior. They occur on the dorsal base of a funnel-shaped process—apparently the homologue of the cephalic

plate of the Terebellids—which leads to the mouth. In his account of the species Marenzeller mentions only four tentacles, but they are easily removed in preparations. The shape of the anterior region of the body agrees with that of the typical forms, three bristle-tufts being borne by the oblique anterior part. The ventral collar behind the snout is prominent and smooth, the angle in front of the first bristle-bundle being conspicuous in a ventral view. Posteriorly the body terminates in an anus with a somewhat dilated rim.

The branchiæ resemble in general aspect those of *M. cristata*, though distinguished by their transverse bars and arrangement, for the four branchiæ on each side arise from a curved base and are all visible from the rear. The branchial hooks are minute and readily escape detection, and thus are in contrast with the two forms most abundant in the north. The shaft is broad and short (Plate CXXV, fig. 3 *a*), striated, and the sharp hook at the tip leaves the neck at more than a right angle, the whole being similar to that of *Melinna maculata*, Webster, which approaches Grube's form. Behind the foregoing region at the fourth bristled segment is the dorsal collar (Plate CXIX, fig. 1), which is somewhat narrower and less distinctly denticulated than in the two forms previously mentioned, the papillæ having a tendency to fuse with each other and thus lose the feature so characteristic of *M. cristata*. There are usually four to eight rounded fimbriæ.

The tip of the foot (Plate CXXV, fig. 3 *c*) is more distinctly differentiated than in *M. cristata* as a bluntly conical process marked off from the rest of the foot by a shoulder. Moreover, the bristles are proportionally larger and more deeply tinted yellow by transmitted light. The longer forms (Plate CXXV, fig. 3) have nearly straight shafts and finely-tapered tips with just a trace of a bend and with distinct but narrow wings, whereas the shorter bristles have boldly-curved tips which in some are much worn. The wings of these commenced a little beyond the cuticle. The number of the setigerous processes is the same as in the other forms, viz., eighteen, the first three being immersed in the tissues and the tips appearing beyond the surface.

The anterior hooks, which are in a single row (Plate CXXV, fig. 3 *b*), follow a similar arrangement to those of the other species but have five teeth besides a process above the prow, and thus a greater number as a rule than in the two previous forms. The posterior outline is inflected, whilst the inferior border of the base, after a slight inflection posteriorly, becomes convex as it approaches the anterior prow. The posterior hooks do not differ materially from the foregoing except in size. They are distinguished from those of *Melinna maculata*, Webster, by having a process between the prow and the first tooth.

The *tube* is composed of secretion covered with a layer of mud. It is friable.

Grube describes *Melinna palmata* from St. Malo, where he obtained a single specimen, as having a smooth (entire) margin to the dorsal collar on the fourth bristled segment instead of the fimbriated margin of *M. cristata* and *M. elisabethæ*. There are eight branchiæ which differ at their base from those of *M. cristata*, and in the spirit-preparation the anterior and the inner filaments of the posterior branchia are longer and more pointed than the rest. The frontal border is three-lobed as in *M. elisabethæ*. The hooks have four teeth. No mention is made of the two dorsal post-branchial hooks, and though Fauvel subsequently alludes to them as the homologues of the paleæ and transformed dorsal

bristles, there is nothing distinctive in either figure or description. It differs from *M. elisabethæ.*

Fauvel (1909) thinks Marenzeller's form (1874) closely allied to Grube's *M. palmata*, from which it differs by its smaller size, its coloration, and the hooks with only four teeth. He found Grube's *M. palmata* at the Isles of Chausey near St. Malo, where Grube procured his specimen, and he thus was able to compare it minutely with *M. adriatica.* He found uncini with four teeth amongst the others with five in the thorax, and so with the Neapolitan examples.

## Family XXIX.—Terebellidæ, *Malmgren*, 1867.

*Amphitrite*, O. F. Müller, Bruguière; *Nereis*, Pallas; *Terebella*, Linnæus, Grube, Cuvier, etc.; *Terebellacea*, Grube, Carus, etc.

Cephalic lobe (upper lip) more or less reduced, semicircular, usually an oval lobe above the mouth. Numerous grooved and ciliated tentacles (generally devoid of blood-vessels), usually collected in two fascicles and springing from the buccal segment, thus approaching the Amphictenidæ and the Ampharetidæ. A tentacular membrane is represented by a thick roll behind the tentacles. The free border of the buccal segment forms a lower lip. Eyes simple, with cup-shaped pigment-cells and a ganglion-cell; only two eye-spots on ganglion. Nuchal organs small. Body vermiform, more tumid anteriorly, tapering posteriorly; skin smooth; glandular scutes ventrally; anterior region differing from the posterior. The buccal segment is probably the second (Hessle). Upper lip best developed. Branchiæ in pairs on the second or following segment, ramose, rarely filiform, with or without pedicles; rarely confluent, or only one. Blood either in a system of vessels or in the cœlom. Anterior dissepiment between the fourth and fifth segments. Anterior heart and heart-body. Anterior bristles in two rows from the eleventh segment, the anterior stouter, borne on tubercles, capillary, and generally with wings; usually on the anterior region, though they may go to the posterior end. Anterior hooks on transverse tori or pinnules, arranged alternately and reversed, in a single or double row with long chitinous threads, pectiniform or avicular. In general the nephridia consist of a large funnel and a U-shaped tube ending in a nephridiopore. The posterior nephridia have large funnels ending in a kidney-chamber. They inosculate in *Lanice* and *Loimia*, whilst in *Terebella punctata* there is a long tube into which the nephridia open. In *Amphitrite* the posterior nephridia communicate with each other. Tube membranous, strengthened with mud, pebbles, sand, fragments of shells, and adherent to rocks, stones, shells, etc.

In *Polymnia nebulosa* (Fig. 146) the cuticle covers a highly glandular hypoderm, which in the preparations presents in various parts many circular granular cells toward the surface. Within the foregoing is a powerful circular muscular coat, from which the oblique comes off on each side at the lower edge of the dorsal longitudinal and passes to be inserted into the circular coat over the outer border of each nerve-trunk. The dorsal longitudinal muscles extend on each side from the mid-dorsal line, where the raphe for the mesentery of the alimentary canal separates them, to the origin of the oblique, where

the edge of the muscle is slightly curved inward. The ventral longitudinal muscle is about the same length, extending from the lower edge of the oblique to a point on each side of the mid-ventral line, where it is wedged between the oblique and the circular coat. A diaphragm occurs between the fourth and fifth segments, and has two

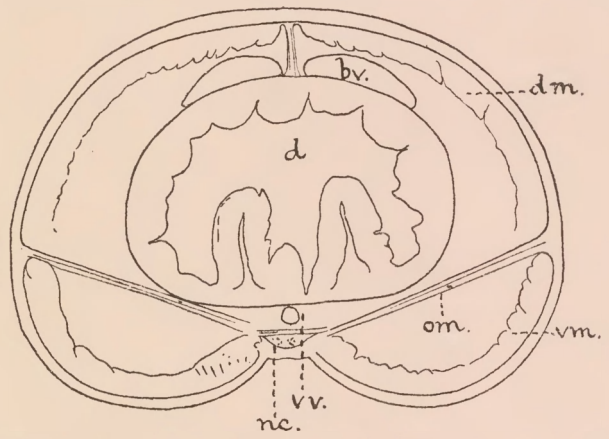



Fig. 146.—Transverse section of the anterior region of *Polymnia nebulosa*, Mont. Enlarged. *bv.*, branchial vessels; other letters as before.

muscular blind sacs. The nerve-cords lie immediately external to the circular muscular coat, protected externally by a thick layer of hypoderm, and anteriorly are generally carried inward by a ventral groove. No neural canal is present. The circulation in the Terebellids consists of a dorsal and a ventral trunk, with a sinus round the gut, and a

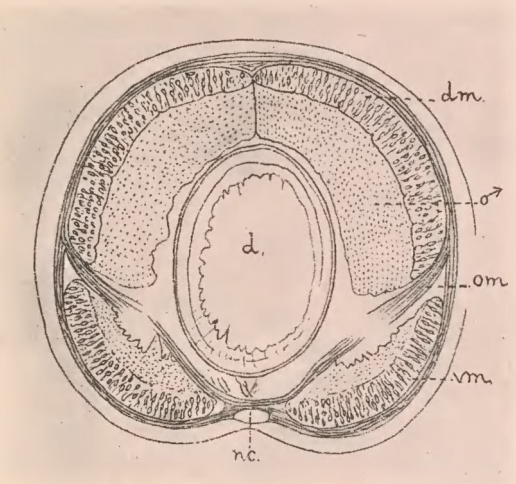



Fig. 147.—Transverse section of the posterior region of a male *Polymnia nebulosa*.

heart between the œsophagus and the stomach. A heart-body is present. Though the gills are absent in some, such as *Leæna*, the plan of the circulation is the same.

In the posterior region of the body the outline in section (Fig. 147) is more rounded and the dorsal and ventral longitudinal muscles proportionally thicker, even when the perivisceral cavity is filled with the reproductive elements.

Other structural features of note are the innervation of the tentacles by the anterior border of the ganglion.

In the Terebellids, as in the Amphictenidæ and Ampharetidæ, the stomach and intestine are surrounded by a blood-sinus, the ventral trunk receiving blood from the gills and the alimentary blood-sinus. In some Terebellids, *e. g.* the Polycirrids, the gills are absent and the blood is colourless or nearly so, but they have a circulatory system similar to that of the Terebellids proper with a heart, but only a few cells to represent a heart-body, and the current proceeds directly to the ventral trunk. Anteriorly the alimentary canal has a tough investment with a few longitudinal and circular fibres, whilst a thick coat of long gland-cells lines its interior, which is often thrown into numerous folds, two of which ventrally are conspicuous and form indeed a kind of typhlosole. In most Terebellids the stomach consists of two compartments, a muscular and a glandular cavity. The gut posteriorly is loaded with sand-particles, sponge-spicules, diatoms, Foraminifera, Radiolarians, and various organic structures amongst the mud. The cœlom in autumn is filled with the reproductive elements.

Claparède[1] (1868) mentions that the dorsal vessel in *Terebella multisetosa* contains a substance of a deep black colour distributed in irregular cords. In *Terebella flexuosa* "the brown substance forms two lobed masses, one applied to the superior part of the vessel, the other to the inferior. These two masses are not independent, but united at intervals by thick connecting cords." He considered these bodies similar to the chloragogenous tissue which surrounds the exterior of the ventral vessel, this tissue being absent when the heart-body is present. He thought the Polycirrids were devoid of a circulatory system.

Cunningham[2] (1888) observes that in *Amphitrite Johnstoni* "the intestinal blood-sinus is connected on the ventral side of the intestine with a large definite vessel, which at the level of the posterior end of the heart divides into two branches: these pass up, one on each side of the œsophagus, and unite to form the heart. Thus the paradox is here true that the typical dorsal vessel is in these families (Terebellidæ, Amphictenidæ and Ampharetide) chiefly represented by a ventral vessel. The usual subintestinal or ventral vessel is, of course, present in addition."

In *Amphitrite Johnstoni* (*figulus*)[3] the cardiac body "occupies nearly the whole cavity of the heart, the channels left for the passage of the blood being very small. It is composed of cylindrical cords which generally have a longitudinal direction, and they are a mass of cells with large spherical nuclei which stain deeply. In *Lanice conchilega* the body is proportionally smaller, the cords thinner, and confined to the immediate neighbourhood of the walls of the vessel, so that a large central space is left for the passage of the blood. In the cords a lumen is often, but not always visible. In *Terebellides strœmi* only a single cord occurs in the dorsal vessel, and it runs longitudinally and nearly fills up the cavity of the heart. The cord has a lumen with a radiate arrangement of the cells."

In *Lepræa lapidaria* (Fig. 148) the general arrangement of the cuticle, hypoderm and muscular layers of the body-wall agrees with that in *P. nebulosa*, and the alimentary canal is similarly slung dorsally, whilst inferiorly a double band of mesentery, apparently

[1] 'Annél. Chét. Nap.,' p. 399.
[2] 'Quart. Journ. Micr. Sci.,' N.S., vol. xxviii, p. 261.
[3] Ibid., p. 264.

containing contractile fibres, leaves the lower edge of the gut, and widening, is attached with the oblique muscle at the upper and outer angle of each nerve-area. In the space between the bands is the ventral vessel. Under the gut on each side is a large sub-intestinal. The oblique muscles have a tendency to pull the lateral wall and make the ventral wall on each side project as a rounded ridge with a deep median depression, and

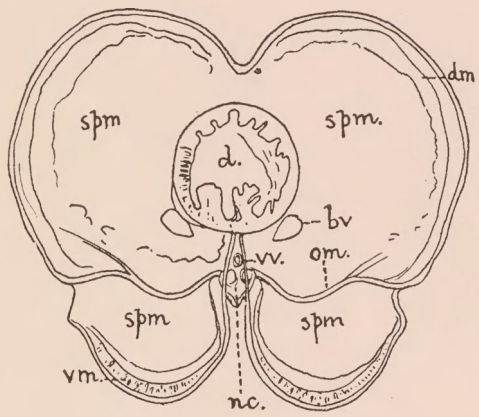



Fig. 148.—Transverse section of the anterior region of *Lepræa lapidaria*. The oblique muscles, *om.*, cause an indentation on each side. The lower folds of the intestine are prominent. The cœlomic cavity is distended with sperms (*spm.*); other letters as before.

having in ripe examples the reproductive elements in the interior and laterally the ridge of hooks. At the bottom of the median groove is a ridge in the preparations containing the nerve-area, which is cone-shaped, broad above and pointed below. It lies outside the circular muscular coat and is covered by neurilemma, hypoderm and cuticle. The alimentary canal shows ventrally two prominent folds like a typhlosole.

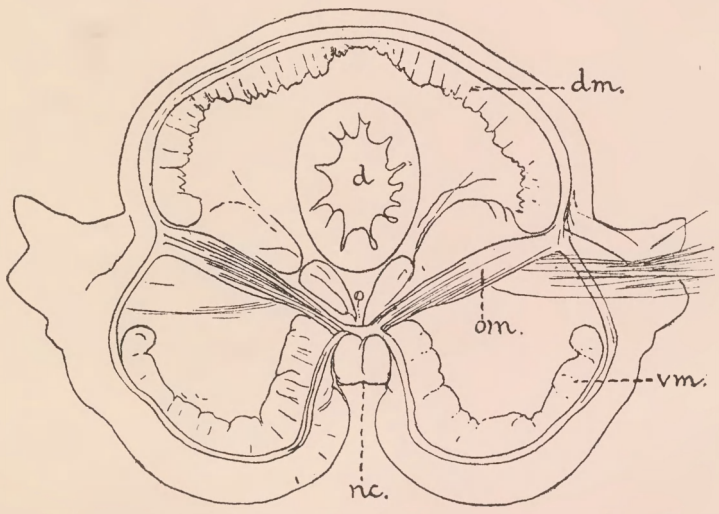



Fig. 149.—Transverse section of the anterior body-wall of *Polycirrus aurantiacus*, Grube, in the line of the feet. Letters as before.

The hypoderm in the anterior region of *Polycirrus aurantiacus* (Fig. 149) is largely developed, especially ventrally, and crowded with glands, this layer in the preparations being often thrown into foliate masses apparently from its softness. A strong circular muscular layer occurs within the basement-membrane. The oblique muscles are con-

siderably stronger than in *Terebella* and pull the lateral regions inward, so that the area of each ventral longitudinal muscle forms a rounded and prominent ridge on each side. The dorsal longitudinal and the ventral longitudinal muscles are about equally developed, though from the firm boundary of the ventro-lateral spaces the latter are occasionally thicker. Two strong muscular strands pass from the lower edge of the alimentary canal to the circular coat in the mid-ventral line. A noteworthy feature is the attachment of the oblique muscles (*om.*) above the feet, instead of the fibres leaving the foot at its lower border beneath the bristles. The nerve-cords lie outside the circular muscular coat as two large and prominent areas, the ventral groove being dimpled in transverse section. The hypoderm covering the prominent ventral ridges is remarkably thick till it is well within the deep median furrow, where it abruptly thins off at the sides of the nerve-cords, which appear to be covered only by a thin layer which forms a kind of modified cuticular covering. The cords are thus in close relation to the surrounding medium. The size of the trunks is of interest in connection with the brilliant phosphorescence of the species. The segmental organ seems to open below the upper attachment of the oblique muscle. The alimentary canal is typical.

In *Terebellides strœmi*, Sars, the hypoderm is somewhat firm and granular. The circular muscular coat is thin, though in the dorso-lateral regions its fibres are increased. The dorsal longitudinal muscles are much extended, and a lateral muscle is cut off by a powerful band which passes from the foot to the outer edge of the ventral longitudinal, the body thus having a rounded ridge on each side ventrally. The nerve-cords are small, and lie within the hypoderm and strong circular muscular coat between the somewhat flattened ventral longitudinal muscles. The slender oblique are attached on each side of the trunks, unless it be held that the strong band cutting off the lateral longitudinal corresponds to these muscles.

The nomenclature of the Terebellids in former years seems to have been peculiar. Thus, Dujardin's[1] *Sabellina brachycera* is a form with seven tentacles and eyes on the upper fold as in a young Terebellid. On the other hand, his *Sabellina tenuis*[2] in the same paper with ten filiform tentacles and four ocular points behind them and two on the tail resembles Ehrenberg's *Amphicora*.

Hessle (1917) does not think the distinctions into fore, middle and hind brain according to Nilsson's view hold in the Terebellimorpha, for the cephalic ganglia are reduced to a nervous band over the pharynx and the distinctive fusions between the parts are absent. In most of the Terebellidæ the nuchal organ is in abeyance, but in *Thelepus* and allied genera it is a small ciliated groove on each side.

Nilsson thought the tentacles derived their nervous supply from the posterior region of the fore brain, but Hessle doubts this interpretation.

The segmental organs in Terebellids occur as looped organs in the anterior region with internal and external openings, and ranging from four to sixteen or more in number. In *Lanice conchilega*, however, Cunningham[3] describes four functional organs in segments 6—9, besides traces of three others in front of these, and fused membranous

[1] 'Ann. Sc. nat.,' 2e sér., t. xi, p. 292, pl. vii, figs. 6—8.

[2] Ibid., p. 291, 1839.

[3] Quart. Journ. Micr. Sci., N.S., vol. xxviii, p. 250, pl. xviii, figs. 11—13.

nephridial sacs in segments 10—13. The wide internal openings of the four fully-developed organs are attached to the body-wall close behind the ventral "fascicles of somites 5—8, and are overhung dorsally by a longitudinal lip furnished with a series of small digitate processes; lower down the anterior and posterior lips of the opening are simple, thick-walled and ciliated. The aperture leads into a thin tube, which passes inward and backward, curving round the inner end of the fascicle of bristles behind the aperture, and then, crossing the continuous tube, passes up on the inner or mediad side of the loop, at the apex of which it is continued into the efferent wider limb of the loop, which passes down on the outer side to open into the longitudinal tube." He found nephrostomes attached to the anterior faces of the septa behind segments 2 and 3, but no external apertures in segments 3 and 4. Communications between successive nephridia were found—the only case in Invertebrates—and Cunningham thinks it approximates the condition of the nephridial system in Vertebrates. The gonads are in the form of small, indifferent cells attached to the exterior of the seven nephrostomata, and are early shed into the cœlom, where they undergo further development (Cunningham).

The segmental organs in the Terebellids have a well-developed nephrostome—and a longer or shorter U-shaped canal. The anterior organs with the opening of their funnels in the diaphragms differ from the posterior, which have larger funnels and their ducts lie in the nephridial mass (Hessle). Their variability was noticed by Meyer (1887), the anterior differing from the posterior in the relative length of their canals. Whilst in most genera the organs are free, they discharge into a longitudinal connecting duct in *Lanice* and *Loimia*, and a similar arrangement occurs in *Pista* and in *Lanicides*. In *Amphitrite*, whilst the anterior organs are free, the posterior lie very close to each other, but no communication has been observed. Hessle (1917) utilises the nephridia in his classification, but they do not seem to be of special service in this respect.

Amongst interesting structural features in the Terebellids are the occurrence of statocysts and statoliths near the cephalic ganglia in such as *Amphitrite Edwardsi*, for example, and the presence of cardiac bodies in many.

The genus Terebella was founded by Linnæus for a series of red-blooded worms sometimes embedded in sand, and at first forming a heterogeneous group from which subsequent naturalists withdrew many species. In the twelfth edition of his 'Systema Naturæ' (1767), amongst other forms he inserted *Terebella lapidaria*, which had been briefly described by Kähler, from Marseilles, in 1754.

Savigny's (1820) first tribe of the Terebellidæ under the general group of the Serpulids was *Terebellæ simplices*, in which the upper lip was not dilated into two lobes, the appendages of the first and third segments forming four lateral lobes directed forward. Branchiæ three pairs, ramified to the base and inserted on the second, third and fourth segments. Ex. *T. conchilega*, *T. medusæ*, *T. cirrata*.

His second tribe, *T. Phyzeliæ*, was characterised by having the superior lobe dilated at the base in two tentaculiferous divisions. No appendages to the first and third segments. Two pairs of branchiæ ramified to the base and inserted on the second and third segments. Ex. *Terebella scylla*, *T. cincinnata*.

The third tribe was the *T. Idaliæ*, in which there were no appendages to the first

and second segments. A single pair of branchiæ ramified at their extremity and attached to the third segment. Ex. *T. cristata*.

Cuvier distinguished the Terebellids by their having tubes composed of sand and fragments of shells, by their bodies possessing fewer rings, the mouth being surrounded by mobile tentacles, and the neck having gills in the form of arbuscles, of which most have three pairs. After Savigny he used these in classification, those with two pairs of gills being the *T. Phyzeliæ*, and with one the *T. Idaliæ*.

Milne Edwards[1] (1838) gave an account of the circulation in *Terebella nebulosa*, Montagu, and *T. conchilega*, Sav., which for the most part agrees with modern interpretations. He considered the anterior part of the contractile dorsal vessel a pulmonary heart since it sent blood to the branchiæ; whilst the ventral vessel chiefly performed arterial functions. The contractile gills also aid in the circulation. In *T. conchilega* he found that the lateral branches of the ventral vessel do not form rings on the upper surface of the gut, but go exclusively to a vascular "*locis rete*" situated on each side of the visceral cavity near the bases of the feet, other branches supplying the intestinal wall.

The same author[2] (1844) examined the development of *Terebella nebulosa*, Mont. The ova were yellowish brown and were immersed in a gelatinous mass in the tube. He followed the various stages in the mucus, the assumption of the ovoid form, the appearance of two eye-spots, the occurrence of the prototroch, and the perianal ring of cilia. Then the apodous larva acquired new segments in front of the pygidium and the segments were outlined. He noted the development of the alimentary system, and that in two or three days the cephalic lobe was distinct, with its eyes and a median appendage, whilst the cœlomic cavity had corpuscles in its fluid. By-and-by the natatory cilia disappeared, but the buccal and the anal region showed energetic ciliary action. The young thus differed from the adult and conformed to the general type of the Polychæts. They then secreted cylindrical transparent tubes, acquired additional bristles, and hooks were developed ventrally. On the eighteenth day the cephalic plate was enlarged, the eyes atrophied, and there were six pairs of feet. After a time a new cephalic appendage was formed—filiform, long, and furnished with "vésicules urticants," yet no blood-vessels had appeared. Other tentacles followed, and whilst the larval eyes had disappeared, a number of oculiform points occupied the frontal segment, and the ventral scutes were distinct. When the young Terebellid had about forty pairs of feet the branchiæ appeared, simple at first, but afterwards branched, and the blood-vessels were distinguishable. At the length of 10 or 12 mm. ova were shed into the cœlomic cavity. All the organs soon assumed the adult character.

In Griffiths' edition of Cuvier's 'Animal Kingdom' (1824—33) it is stated that the female part is composed of a single median ovary occupying the whole inferior face of the visceral cavity so far as the ninth ring, terminating behind, according to Pallas, in a bifurcation. It is composed of a great number of oviferous grains, and has a single opening posteriorly. The male organs consist of four pyriform vesicles placed on each side of the anterior moiety of the ovary. They open externally by minute orifices between the feet.

[1] 'Ann. Sc. nat.,' 2e sér., t. x, p. 199, pl. x, fig. 1.

[2] 'Comptes Rend. l'Acad. Sc. Paris,' p. 1411.

In *Terebella conchilega*, De Quatrefages[1] (1844) found the cephalic ganglia elongated fusiform, with connectives in the middle line, and giving off three or four pairs of nerves to the cirri. The œsophageal connectives are short and thick, and from their anterior part a small branch with a ganglion may represent the visceral system. The ventral chain is single in front (anterior region) with the usual ganglia. In the posterior region the chain is double, though the ganglia are united by commissures as in *Aonia* and *Malacoceros*.

Johnston[2] (1845) constituted the family Terebellidæ, which he separated from the Pectinarians and Sabellarians.

Grube (1851) placed the Terebellidæ between the Maldanidæ and the Hermellidæ, a position less convenient than subsequent investigations proved, and like some of his predecessors he included the Amphictenidæ and Ampharetidæ under the same head—Terebelliformia—distinguishing them by the presence of paleæ in the mouth-segment.

M. Sars did much to extend our knowledge of the northern species of Terebellids in his various papers, adding such interesting forms as *Terebellides*, *Amœa;* and in 1868 found the following forms at a depth of 300 fathoms, viz., *Terebella artifex*, *Terebellides strœmi*, and *Ereutho smitti*.[3]

Dr. Thos. Williams (1858) examined the segmental organs in the thoracic region of *T. nebulosa* and other species, one half being highly vascular, the other membranous and excretory, the former being connected with the ovary or spermary, the latter being the efferent channel. He held that the long glandular mass in front was a secretory organ in connection with tube-formation. This family and the Arenicolidæ were, he stated, the only two in which the reproductive elements were shed into the body-cavity—a statement which cannot now be made. He further observes[4] that "in the Terebellæ and Serpulæ, which are cephalo-branchiate, the anterior extremity of the great dorsal trunk enlarges fusiformly and propels the blood directly into the branchial appendages. In these genera therefore this vessel becomes the branchial heart; and the great ventral trunk, into which the efferent branchial vessels empty themselves, becomes the systemic aorta."

Malmgren (1865) grouped the Terebellacea under five sub-families, viz., Amphitritea, Polycirridea, Artacamacea, Trichobranchidea, and Canephoridea, and he gave a useful syllabus of the genera under each. The Amphitritea presented a truncated cephalic lobe with numerous canaliculated tentacles arising from a muscular lip, and behind them numerous ocular points. Blood-vessels conspicuous. Branchiæ generally present. Bristles capillary and winged, generally in the anterior region of the body, sometimes throughout the entire length. Avicular or rarely pectiniform hooks on tori, and of similar structure throughout. This author has the credit of placing the structure and arrangement of the bristles and hooks of the group on a proper footing. His classification is as follows:

[1] Ann. Sc. nat.,' 3e sér., t. xiv, pp. 368—9.
[2] ' Ann. Nat. Hist.,' vol· xvi, p. 447.
[3] ' Videnskr.-Selsk. Forhandl.,' 1868 (sep. copy), p. 10.
[4] ' Rept. Brit. Assoc.,' 1851.

- Capillary bristles only in the anterior part of the body.
  - Branchiæ ramose.
    - Three pairs.
      - Almost equally subfruticose. — No eyes. Avicular uncini and edge of bristles strio-serrulate . . . . . Amphitrite (O. F. M.).
      - Arborescent; post. smaller. Hooks
        - Pectiniform . . . . . Loimia, Mgrn.
        - Buccal segment
          - Avicular. Produced into a large lateral lip — Lanice, Mgrn.
          - Short and narrow. Bristles with tips smooth . Terebella, L.
    - Two pairs or one.
      - Two pairs. Capillary bristles
        - In fifteen segments. Branchiæ arborescent . . . Nicolea, Mgrn.
        - In seventeen segments. Branchiæ subclaviform . Pista, Mgrn.
      - One pair. Capillary bristles
        - In sixteen segments . . Scione, Mgrn.
        - In fifteen segments . . Axionice, Mgrn.
  - Branchiæ absent. Capillary bristles.
    - In ten segments . . . . . Lecœna, Mgrn.
    - In fifteen segments . . . . . Lanassa, Mgrn.
    - In seventeen segments . . . . . Laphania, Mgrn.
- Fasicles of capillary bristles throughout the entire body. Branchiæ
  - Ramose, arborescent, generally three pairs . . . . Lepræa, Mgrn.
  - Filiform in segments.
    - Two, forming a contiguous transverse series on each side . . . . . Thelepus (Leuck.).
    - Three. Fascicles of bristles beginning on segment
      - two branchiferous . Neottis, Mgrn.
      - one branchiferous . Grymæa, Mgrn.

After an interesting historical summary, De Quatrefages (1865), gives a brief account of the structure of the Terebellidæ, first investigated by Pallas, and subsequently by Milne-Edwards, Grube and himself. He points out the delicacy of the cutaneous tissues, the large size of the perivisceral cavity, the contents of which enter the tentacles (his cirri). He mentions three pairs of "salivary glands" connected with the digestive system anteriorly. The vascular system presents a dorsal and a ventral trunk, the latter continued to the posterior end of the body, but the former at the junction of the œsophagus with the intestine abuts on a large vascular ring surrounding the alimentary canal, and giving origin to a slender dorsal branch, and a larger ventral trunk which extends throughout the intestine. In the proboscidian region the superior branch furnishes trunks to the branchiæ. The blood is usually red, though Schmarda found it green in two from Jamaica and one from Chili. The branchiæ are the respiratory organs except in the abranchiate types, where the cutaneous tissues subserve this function. The nervous system shows a bilobed cephalic region. Anteriorly the ganglia are fused in the middle line, but thereafter the chain is simple. The cords are separate in the posterior region.

In his classification of the family into Branchiate, Abranchiate and Heteroterebellids, he starts with the primary distinction of a body divided into two regions or composed of one only, eight genera falling under the former, three under the latter, which he distinguishes as the Heteroterebellidæ. The first series (Branchiate) is divided according as they have or have not dorsal branchiæ, those having three pairs of arborescent dorsal branchiæ belonging to the genus *Terebella*, with two pairs to *Physalia*, and with one pair to *Idalia*. Of the others *Terebellides* has pectinate median branchiæ; whereas simple cirriform buccal branchiæ characterised *Phenacia*, and pinnate buccal branchiæ the *Sabellidæ*. On the other hand cirriform and pinnate branchiæ are both present in *Isolda*. The last of this series is *Apneumea* with no dorsal branchiæ, and which therefore forms the second tribe (Abranchiata). The third tribe, as mentioned, has the body composed of a single region, and two of the genera have arborescent dorsal branchiæ, viz., *Heteroterebella* with three pairs, and *Heterophyselia* with two pairs. *Heterophenacia*, again, has

cirriform branchiæ. This author therefore made a useful classification for the period, but it lacked the precision and breadth which the study of other structural features subsequently gave, and he included the Ampharetidæ in the family instead of separating them.

Dr. Johnston (1865) made the Terebellidæ his fifteenth family out of a total number of sixteen, but his description includes the characters of the Amphictenidæ as well as those of the Terebellidæ. Accordingly the presence or absence of a front armed with a row of stiff bristles constituted his main divisions. The Terebellidæ were arranged in three groups, the first having three pairs of branchiæ, the second two pairs, and the third one pair—a classification more or less on the lines of De Quatrefages.

Leon Vaillant[1] (1865), who had studied an imperfect example of a Polycirrid, thought that the tentacles indicated a series of buds. The error was noted at the time, and Ch. Gravier[2] has since fully explained the misinterpretation.

Claparède (1868) divided this family into two tribes, viz., Branchiate and Abranchiate, and he made special remarks about the *tori uncinigeri*, which he ranged under five heads according as their hooks pointed forward ("rangée progressive"), backward ("r. rétrogressive"), alternated ("r. alterne"), similar to the last but wider apart ("r. engrenantes"), and lastly an anterior and posterior row with opposite points connected by a curved series at one end ("r. parabolique"). He found young forms at Naples easily discriminated by this method. He also alludes to the tendinous processes attached to the hooks under the title "soies de soutien" or "soies-tendons" in the posterior region. In his later publication (1870) the author corrects A. Costa and others, who insisted on the presence of vessels in the tentacles of this family. Only the cœlomic fluid penetrates into these organs.

In Claparède's posthumous work on the structure of the sedentary Annelids (1873) many interesting remarks occur on the Terebellids, especially in connection with *Terebella flexuosa*, a few of which may be summarised. He lays great stress on the supporting functions of his clypeal tissue in Terebellids. It not only furnishes the external shield-like thickenings in the mid-ventral region, but passes internally and forms a mass in the perivisceral chamber supporting the nerve-trunk and vessels. The connective tissue, again, is amorphous, with nuclei. The new hooks are formed at one extremity of the torus only, and the torus is hypodermic. He states that the dorsal longitudinal muscles are united in the Terebellids and that there is a lateral dorsal muscle. The circular muscle forms only an isolated cordon in each segment in the thoracic region, and by this he refers to the lateral region below the bristles; yet in his figure (Plate IX, fig. 7) it is seen that he really means the circular or transverse fibres outside the nerve-cord. He considers the oblique muscles as of minor importance in the Terebellids, yet they are largely developed in sedentary annelids. The nuclei of the muscular fibres are external as in Oligochæts.

The cœlom is divided into two chambers by a longitudinal median mesentery enclosing the dorsal and the ventral vessels. Moreover, no communication exists between the perivisceral chamber in Polychæts and the exterior as in *Lumbricus*. A large part of the body in Terebellids is devoid of dissepiments. In certain forms a diaphragm

[1] 'Ann. Sc. nat.,' t. iii, pp. 242—250, pl. iii.

[2] 'Bull. Soc. Philomath. Paris,' 1906, pp. 1—14, with text-figs.

separates the branchial segments from the succeeding and thus the respiratory chamber is free from the contents of the cœlom.

The vessels on the alimentary canal send jets into the dorsal and also into the sub-œsophageal plexus which communicates with the vessels of the collar. From the latter arise the vessels which carry blood to the branchiæ. The trunk conveying oxygenated blood joins the ventral. There are heart-bodies in *Terebella flexuosa* and *T. multisetosa*. In *Terebella Meckelii* he found two folds in the intestine like a typhlosole. The reduction of the cerebral ganglia to a simple transverse commissure without trace of division occurs in *Terebella flexuosa*. In Terebellids he asserts that tubular fibres in the nervous system are absent, yet in *T. flexuosa* a homogeneous substance resembling the contents of the tubular fibres is seen on each side of the middle line (Plate X, fig. 1), as in *Audouinia filigera*. In *Terebella Meckelii* the nerve-cords are in the circular coat in Claparède's figure, since fibres are outside them, but in the text he observes that they are hypodermic. In *Terebella flexuosa* the cords are so united in the thorax that the halves are indistinguishable. He thinks, therefore, it is an exaggeration to say that the Annelids have a double nerve-cord and the Gephyreans a single one.

Ray Lankester[1] (1873) detected hæmoglobin in the blood of *Terebella*.

Grube (1878) in his 'Philippine Annelids,' gave a description of the genus *Terebella*, L., s. str. Sav., in which, whilst furnishing nothing new, he puts the characters in an orderly manner. He adds that segment 1 is bare, and the next, 3 or 2, rarely 1, branchiferous. The branchiæ are three pairs, two pairs, or rarely one pair, ramose, arborescent, or now and then bifurcate at the base or in the form of cirri.

Cosmovici (1880) furnishes a general description of the structure of the Terebellidæ, especially in connection with the segmental organs and organs of Bojanus, a term applied to the glandular part of the segmental organs. His description of the parts is confusing.

The Terebellidæ formed the first family in Levinsen's (1883) group *Terebelliformia*, the others being the Ampharetidæ and Amphictenidæ. Perhaps little advantage is to be gained by such grouping other than Malmgren obtained by placing them *seriatim* in his series. He arranges the genera as follows: *Lysilla*, *Amœa*, *Leucariste*, *Terebellides*, *Artacama*, *Thelepus*, *Amphitrite*, *Pista*, *Lanice*, *Terebella*, *Nicolea*, *Axionice*, *Scione*, *Trichobranchus*, *Streblosoma*, *Grymœa*, *Thelepodopsis*, *Laphaniella*, *Leœna* and *Laphania*.

Marenzeller (1884), in an important discussion in connection with the Adriatic forms, states that in the Terebellidæ the following holds in the arrangement of the rows of hooks:

I. Hooks alternate, uniserial—*Pista cristata*, *P. cretacea*, *Nicolea venustula*, *Polymnia nesidensis*.

II. Hooks opposite, biserial—*Amphitrite gracilis*, *Lepræa lapidaria*.

III. Hooks turned inwards (*inverse*), biserial—*Lanice conchilega* and *Loimia*.

Between I and II.

IV. Hooks semi-opposite, incompletely biserial—*Amphitrite cirrata*, *A. variabilis*, *A. rubra*, *Polymnia nebulosa*.

Between I and III.

Hooks semi-inverted (inversi), imperfectly biserial.

Moreover, he placed under the genus *Nicolea* both *Scione* and *Axionice*,

[1] 'Proc. Roy. Soc.,' No. 140, 1873, p. 3.

Malmgren; under *Polymnia*, *Terebella* and *Polymnia*, Malmgren; under *Leœna*, both that genus and *Lanassa*, Malmgren, and included under *Thelepus* both *Neottis* and *Grymœa*, Malmgren.

Finally he arranges the Mediterranean forms thus:

A. Bristles with the end flattened and serrated.

I. Bristle-tufts in seventeen to twenty-four segments, appendage to the bristles—*Amphitrite*.

II. Bristle-tufts on all the segments from the fourth, the tip short, slightly curved.

B. Bristles with simple tips.

I. Seventeen setigerous processes beginning at the fourth. Hook-rows double from the eleventh to the twentieth. Ex. *Lanice*, *Pista*, *Polymnia*.

II. Seventeen setigerous processes beginning at the third segment. Hook-rows single—*Thelepus*.

The careful descriptions of the species and the reliable figures make this paper valuable to all students of the group.

Meyer[1] (1886) contributes many important features in the structure of the Terebellids, such as the nephridia, the circulation and the heart-body, and his paper is illustrated by excellent drawings. Amongst the forms specially treated are *Amphitrite rubra*, *Polymnia nebulosa*, *Lanice conchilega* and *Loimia medusa*.

Cuénot[2] (1891) deals with the lymphatic glands, amœbocytes, blood (hæmatines), the development of the genital organs and other features of invertebrates, including the Polychæta. Special remarks are made on *Polycirrus hæmatodes*, *Lepræa lapidaria*, *Spirographis spallanzani*, *Nicolea venustula*, and *Myxicola infundibulum*.

After an elaborate consideration of the grounds on which previous classifications of the Terebellidæ were based, and the difficulties which had been encountered, De St. Joseph (1894) promulgated a new classification, having for its basis the arrangement of the hooks in the rows, the condition of the branchiæ, the structure of the hooks and bristles and other features. The main divisions are as follow:

I. Transverse rows of denticles on the vertex of the avicular hooks.

A. Branchiæ absent.

(*a*) Hooks with a short base and elevated crest with a large number of teeth (seven to eleven), three transverse rows of teeth.

(*a*) Hook with a posterior prolongation—*Pherca*, n.g. (*b*) Without a posterior prolongation—*Bathya*, n. g. and *Proclea*, n.g.

(*b*) Base of the hooks long, and the vertex relatively little elevated. Bristles commencing on the fourth segment—*Leœna*, Mgrn., with bristles of one kind, and *Phisidia* with bristles of two kinds. Bristles commencing on the third segment—*Laphania*, Mgrn.

B. Branchiæ ramose, cirriform or rarely subulate.

1. Bristles commencing on the fourth segment and with serrated points; hooks with six rows of denticles; numerous setigerous segments—*Amphitrite*, O. F. M. Three to four rows of denticles—*Terebella*, L.

[1] 'Mitt. Zool. St. Neap.,' Bd. vii, pp. 592—748, Taf. xxii—xxvii.

[2] 'Archiv Zool. Expér.,' 2e sér., t. ix.

(*a*) Bristles with a simple point. Hooks having a rounded base which is prolonged in the anterior segments or throughout; three to five rows of denticles on the vertex.

Rows of hooks alternate, or double; two to three pairs of branchiæ—*Pista*, Mgrn.

Two pairs of subulate branchiæ—*Eupista*, McIntosh.

(*b*) Hooks clustered or thick-set with moderately long base, a ligament for fixing, three to five teeth on the vertex and from three to twelve denticles (teeth) in all. Rows of hooks alternating in a certain number of segments. One pair of branchiæ with few branches—*Scione*, Mgrn.

(*c*) Two teeth and two transverse rows on vertex of hook; two pairs of ramose branchiæ—*Nicolea*, Mgrn.

(*d*) Hooks with elevated crest, and base of moderate length. Two teeth and two transverse rows of two to three denticles. Two rows of hooks; three pairs of finely branched branchiæ; seventeen setigerous segments—*Lanice*, Mgrn.

(*e*) Hooks not clustered, with a long base; two teeth on the vertex; two transverse rows of one to three denticles. Double row of hooks facing each other, rarely simple and alternate; three pairs of arborescent branchiæ; seventeen setigerous segments—*Polymnia*, Mgrn.

2. Bristles commencing on the second or third segment, with simple points.

Hooks with a long base and a button; two teeth on vertex, two transverse rows of denticles or more. Hooks in a single row, retrogressive.

(*a*) Bristles beginning on the third segment; two or three pairs of cirriform branchiæ—*Thelepus*, Leuckart.

(*b*) Bristles commencing on the third segment; three pairs of cirriform branchiæ—*Grymæa*, Mgrn.

Two or three pairs of subulate branchiæ as in the Ampharetidæ—*Euthelepus*, McIntosh.

II. Hooks pectiniform, without transverse rows of denticles on the vertex; four to six teeth. Double row of hooks in certain segments. Three pairs of arborescent branchiæ; seventeen bristled segments—*Loimia*, Mgrn.

This classification does not seem to facilitate rapid work, and the variations in the rows of denticles on the crest of the anterior and posterior hooks are considerable. The form of the hook would appear to be of greater moment than the number of these teeth.

Other authors have increased our knowledge of this group, such as Ehlers, Gravier, Fauvel and Wirén.

The presence of otocysts in the Terebellidæ was first pointed out by Claparède in the larval *Lanice conchilega*, and in the young of another Terebellid by Agassiz, whilst Giard and Nordenskiöld worked at the same form as the first mentioned, considering it a special form which Giard termed *Wartelia*. Meyer and Andrews also added to the knowledge of the subject, whilst Fauvel (1909) carefully investigated it by serial sections,

and found only two Terebellids, viz., *Lanice conchilega* and *Loimia medusa*, possessing otocysts.

An account of the circulatory and digestive systems in several species was given by Wirén (1885), accompanied by excellent figures.

Goodrich[1] (1900) observes that in the Terebellidæ the nephridium opens internally, and that the genital funnel becomes connected with the nephrostome and loses its primitive opening to the exterior. He considers these organs in this group as cœlomoducts.

Cunningham[2] found a median neural canal in *Lanice conchilega*, but none in *Amphitrite Johnstoni* or *Terebellides strœmi*.

Ssolowiew[3] (1899) gave an account of the Terebellids of the White Sea, the species on the whole resembling the Norwegian, though he adds *Solowetia Malmgreni*, a new genus and species, and *Amphitrite birulai*, a new species, and makes various changes in the synonymy. His figures, though fairly accurate in most cases, are somewhat deficient in finish. He places the Terebellids under nine heads, founding the separation of the groups chiefly on the structure of the cephalic lobe, that of the branchiæ, and on the arrangement and structure of the bristles and hooks, the genera having the following order: *Polycirrus*, *Terebellides*, *Trichobranchus*, *Artacama*, *Solowetia*, *Amphitrite*, *Laphania*, *Pista*.

Wollebæk (1912) makes six groups of the Terebellidæ, the first containing *Hauchiella* and *Lysilla;* the second, *Amœa;* the third, *Terebellides* and *Trichobranchus;* the fourth, *Ereutho*, *Polycirrus*, *Leucariste*, *Streblosoma*, *Grymœa* and *Thelepus:* the fifth, *Lecœna*, *Artacama*, *Scione*, *Nicolea*, *Terebella*, *Pista*, *Amphitrite* and *Lanice;* whilst the sixth includes only *Laphania*, with, perhaps, *Solowetia* near it. No exception can be taken to the first group, both being devoid of hooks, yet the one genus has and the other has not bristles. The second group is sharply separated from those in front and behind. The third group is a natural one. The fourth might well be subdivided and the same may be said of the fifth. *Laphania*, which constitutes the sixth group, does not appear to require isolation.

Hessle[4] (1917) replaces Malmgren's classification of the Terebellids, which has been in use for fifty years, by one of his own in which the nephridia play a prominent part, but the results do not seem to be commensurate with the trouble, and the grouping of the genera, *e. g. Amphitrite* and *Artacama*, is in some cases unsatisfactory. Most of the characters are of old standing, but the introduction of the nephridia in the series is new. His first division has the anterior nephridia smaller than the posterior, or absent, and here fall *Pista*, *Lanicides*, *Lanice*, *Loimia*, *Nicolea* and *Polymnia*, *Neo-amphitrite*, *Neolepræa*, *Terebella*, *Amphitrite* and *Artacama*. He thus more or less reverses the arrangement of Malmgren, and the foregoing representatives differ materially amongst themselves as to the details of nephridial arrangement, whilst, as regards the old character of bearing branchiæ, they all agree. They certainly could all be recognised and separated without

[1] 'Quart. Journ. Micr. Sci.,' vol. xliii, N.S., p. 740.

[2] Ibid., vol. xxviii, p. 264.

[3] 'Annuaire Musée Zool. de Acad. Imp. des Sc. de St. Pétersbourg,' t. iv, p. 179, Taf. x—xiii.

[4] 'Zool. Bidrag Uppsala,' No. 5, pp. 149—151.

the additional item of the nephridia, however interesting these may be as corroborative distinctions.

In his second division, in which the branchiæ are absent, all the nephridia are free, though the anterior may vary in size from the posterior. Here are *Leœna, Proclea, Laphania, Lanassa, Phisidia* and *Spinosphæra*. The first four and probably all form a natural series.

In the third group, which has branchiæ, nothing is entered about nephridia, but the hook-rows are single or absent and the branchiæ are filamentary. In this division are *Thelepus, Streblosoma* and *Parathelepus*.

The fourth group is devoid of branchiæ and the nephridial characters are not entered. It contains *Amœa, Polycirrus, Lysilla* and *Hauchiella*, the last (the *Polycirrus tribullata* of the author) having neither bristles nor hooks.

The Terebellidæ have various ectoparasites, generally Protozoan. Thus *Cothurina* was met with by Schmarda on *Terebella macrobranchia; Rhabdostyla sertularium* on the branchiæ and feet of the Amphitritea and on *Lepræa lapidaria* from Naples by De St. Joseph; and *Rhabdostyla arenicolæ*, Fabre-Domergue, has also occurred, and on the tentacles of *Nicolea venustula* De St. Joseph records *Ophryodendron annulatorum*. Crustacean parasites are rare in the Amphitritea, but Sars mentions *Terebellicola reptans*, a female of which was fixed to a Terebellid[1] and Levinsen *Crypsidomus Terebellæ*, which with its egg-sacs lived in the intestine of *Amphitrite cirrata*.

Busch[2] (1851) describes and figures a pelagic Terebellid larva in its tube, similar to that formerly recorded by Milne Edwards, and subsequently by Giard, E. Nordenskiöld and others.

Several stages of *Terebella Meckelii* are given by Claparède and Mecznikow (1868). They show the segmenting egg, the trochophore, the larva of two segments, and lastly one of six bristled segments in the pelagic stage (so-called *Wartelia*) in its transparent tube, with its complete alimentary canal, viz., proboscis, œsophagus, stomach, intestine and vent, on each side of which is a papilla. A pair of segmental organs occur opposite the first two bristle-tufts. They thus supplement the previous stages described in *Terebella conchilega* by Claparède (1863).

Willemoes-Suhm[3] (1871) found the larva of *Nicolea* in April in Kiel Bay, the early forms being pear-shaped and ciliated; then they become more elongated, being cylindrical and tapered at each end. The next stage has a conical snout and four eyes, with three bristled segments and two papillæ posteriorly. He describes the ova of *Terebellides strœmi* as attached to sea-grass by a stalk, and gives an account of the early stages (trochophores) with two reddish eyes and an otocyst.

Häcker (1896) thought the Terebellids and Arenicolidæ had not pelagic larvæ, for they only rotated in their galleries. *Terebellides strœmi*, however, has pelagic young (Willemoes-Suhm). The same author[4] (1898) mentions a Terebellid larva from the Sargasso Sea which had formed its tube of Radiolarian skeletons. As it was included

[1] 'Christ. Vidensk.-selsk. Forhandl.,' 1861, p. 46 (sep. copy).

[2] 'Beobach. Anat. u. Entwickel. Wirb. Seeth.,' p. 73, Taf. xi, fig. 7.

[3] 'Zeitsch. f. w. Zool.,' Bd. xxi, p. 388, Taf. xxxiii.

[4] 'Plankton Exped. Polych., etc., Larvæ,' p. 31, Taf. iv, fig. 39.

in the "Drift-Larvæ" it was probably pelagic. Those captured in British waters have hitherto had transparent tubes of secretion.

Erik Nordenskiöld[1] (1901) gives a careful account, with a plate, of the structure of a larval Terebellid (*Wartelia*) which he found at St. Andrews.

Some remarks on fossil Terebellids comparatively recently (1911) made by Dr. Bather[2] are of special interest, since certain tubes originally described by W. Davies are partly composed of the bones and scales of various species of fishes—a feature apparently unknown in living forms, though the composition of the tubes is sufficiently varied. The slender fin-rays are arranged in the long axis of the tubes, just as the linear leaves of the pines are in the Japanese forms of the "Challenger" and in those from the cretaceous beds of Bohemia. Tubes composed entirely of secretion occur both in these fossil types and now. Whilst tubes of the same species are generally speaking similar, it may happen that a widely distributed species removed from its ordinary surroundings in sand to a muddy bottom in deep water is compelled to fashion its tube of neatly arranged sponge-spicules placed transversely.

Terebellids abound on sandy shores, especially beyond low water, though many fine species occur between tide-marks and in fissures of rocks. Others inhabit deep water, even to great depths, viz., 2750 fathoms. They are strictly tubicolar, though some, as *Nicolea venustula*, when free were found by Michaelsen to swim freely, and others do the same. In size they range from 40 cm. downward, and their colours are often both varied and bright, the rich red branchiæ, the roseate tentacles and the speckled body of certain forms being noteworthy.

Young Terebellids are abundant in the pelagic condition, especially in the bottom tow-nets from May to September, in their transparent tubes shaped somewhat like a post-horn, and they are accompanied during the warmer months by young examples of *Clione*. A post-larval Terebellid, *Amphitrite præcox*, of De St. Joseph, possesses long bristles like an epitokous form, and develops ova.

Their food consists of the forms in their immediate neighbourhood, such as Diatoms, Foraminifera, Radiolarians, spicules of sponges, and fragments of Polyzoa, molluscs and hydroids.

As mentioned, external crustacean parasites (*e.g. Terebellicola*) are rarely present, but Distomes occur anteriorly in the gut (De St. Joseph), a Nematode (*Lyorhynchus*, Rud.) in *Loimia medusa*, and another and a Tetrarhynch in *Polycirrus*, whilst Protozoan parasites, such as *Cothurnia*, *Rhabdostyla* and *Ophryodendron* are more common.

Terebellids are by no means sluggish animals. When freed from their tubes they swim actively with a quick, wriggling movement, the tentacles being in front; the jerks are rapid and vigorous, and they make considerable progress.

The tubes of the Terebellids comprise many and varied structures, from the fringed anterior processes of *Lanice conchilega* to the remarkable spinose tube of the "Challenger" species, or the more delicately hirsute tube of the British Terebella B (Plate CXIX, fig. 7). The compact spiral tube of Caullery's *Streblosoma longiremis* is another curious form,

[1] 'Ofversigt Finsk. Vet.-Soc. Förhandl.,' B. xliii.

[2] "Upper Cretaceous Terebelloids from England," 'Geol. Mag.,' dec. v, vol. viii, p. 481, pl. xxiv.

yet the tubes of the common *Thelepus cincinnatus* are likewise more or less spiral in certain circumstances.

The abundance of the Terebellids on the beach at St. Peter Port, Guernsey, is a notable feature, and they are common in fissures of the gneiss rocks, especially from the Battery to St. Sampson's.

The classification of the Terebellidæ, including the condition of the nephridia, is not free from uncertainty, since the presence or absence of branchiæ, their form and number, the number of segments furnished with conspicuous setigerous processes, the form of the hooks and other features are subject to variation either from age or surroundings. Yet there are certain main features which, with the minute structure of bristles and hooks, are of service in discrimination and arrangement.

Most authors subdivide this large family into sub-families, and to this there is no objection. The first sub-family is that of the *Amphitritea*, Malmgren, in which the cephalic lobe is short, provided with numerous grooved tentacles, eye-spots and branchiæ. The setigerous processes occupy the lateral regions, especially anteriorly, whilst the hooks occur throughout.

### Sub-Family I.—Amphitritea.

### *Genus* CXLIV.—Amphitrite, *O. F. Müller*, 1771.

Cephalic lobe typical, with numerous sulcate tentacles ; narrow vertical margin behind these produced on each side into a lobe, and under the tentacles forming a membranous lip above the mouth. Buccal segment naked. Branchiæ fruticose (or simple filaments), sparingly branched, equal, three pairs, fixed to segments 2, 3 and 4. Setigerous lobe beginning at the fourth segment, under the third branchia, and occurring in segments 16—24. Tori for the hooks commencing on the fifth segment (second setigerous), and borne behind the bristled region on short subrectangular pinnules. Capillary bristles from the fourth backward with the tips striate and serrulate. Hooks short, avicular, biserial in the bristled segments with the exception of the first six, in the rest uniserial, and having three to four teeth. Ventral scutes conspicuous. This genus belongs to the first large group of the Terebellids, in which the anterior and posterior hooks do not materially differ, the cephalic region is short and eyes often behind the tentacles. Anterior and posterior nephridia present, the former smaller and with narrow, the latter with wider tubes (Hessle).

Malmgren (1865) first drew attention to the confusion connected with the generic name from O. F. Müller to Cuvier, Oken and Lamarck, but as Claparède subsequently approved he conserved the old title for the species of O. F. Müller, viz., *Amphitrite cirrata*.

1. Amphitrite cirrata, *O. F. Müller*, 1771. Plate CXXV, figs. 5—5 *a*—bristle and hook.

*Specific Characters.*—Cephalic fold behind the tentacles not produced into lateral lobes. Eyes absent. Three pairs of branchiæ each arising by a single short base, and consisting of simple filaments tapering a little distally and slightly spiral. Body from 87 to 200 mm. in length, and having about eighty-five segments. Seventeen pairs of

bristle-bundles. A small papilla under the setigerous lobe from the third to the ninth, the largest is the first (in segment 3).[1] Side-lobes on second, third and fourth segments, and a small flap of the ridge for the hooks immediately beneath in the anterior segments. Ventral shields ten to twelve, subrectangular. Bristles with serrated margins to wings. Hooks in a double row in segments 11 to 20. They have a long and oblique basal plate and four teeth above the main fang (in lateral view). Colour of the body pale carmine, brownish posteriorly. Nephridia from the third to the eleventh segments.

SYNONYMS.

1766. *Nereis cirrosa,* Linnæus. Syst. Nat., edit. xii, i, p. 1085.
1771. *Amphitrite cirrata,* Die buschigte Amphitrite, O. F. Müller. Von Würmern, p. 188, Tab. xv.
1775. „ Besenförmige, Martini. Allg. Gesch. Nat., vol. ii, p. 478, Tab. figs. 1, 2.
1776. „ *cirrosa,* O. F. Müller. Prod. Zool. Dan., p. 216, No. 2617.
„ *Teredo arenaria,* Forskål. Icones Rer. Nat., p. 8, Tab. xxvi, figs. 1 and $1_2$.
1777. *Ver-medusæ,* Dicquemare. Journ. Phys., p. 215.
1780. *Amphitrite cirrata,* O. Fabricius. Fauna Grœnland., p. 285.
1789–92. *Terebella* (*Amphitrite*) *cirrata,* Bruguière. Encyclop. Méthod., p. 53, pl. viii, figs. 16 and 17.
1800. *Die buschigte amphitrite,* O. F. Müller. Naturgesch. Wurm-Arten, p. 188, Tab. xv.
1803. *Sabella cirrata,* Montagu. Test. Brit., Part. II, p. 541.
1806. *Terebella* „ Turton's Linnæus, p. 83.
1807. *Sabella* „ idem. Brit. Fauna, vol. i, p. 550.
1808. *Amphiro* „ Montagu. MS. Linn. Soc., pl. xxviii, fig. 1.
1812. *Sabella* „ Pennant. Brit. Zool., vol. iv, p. 111.
1817. *Terebella* „ Cuvier. Règ. An., i, p. 519.
„ „ *conchilega,* idem. Ibid., p. 520.
1818. „ *cirrhata,* Montagu. Trans. Linn. Soc., vol. xii, p. 342, Tab. xi, fig. 1.
1820. „ *cirrata,* Savigny. Syst. Annel., p. 86.
1828. „ *cirrhata,* De Blainville. Dict. Sc. nat., t. lvii, p. 438.
1830. *Amphitrite cirrata,* Bosc. Vers., 2nd edit., vol. i, p. 195.
1838. *Terebella* „ Milne Edwards. Ann. Sc. nat., 2e sér., t. v, p. 203.
1843. „ „ Rathke. Fauna Norweg. (Nova Acta Nat. Cur.), t. xx, p. 220.
1843–53. „ „ Chenu. Illust. Conch., pl. vii.
1844. „ „ Œrsted. Region. Marin., p. 79, fig. 9.
„ „ „ idem. Nat. Tidsk., 2 ser., i, p. 415.
1849. „ „ Leuckart. Archiv f. Naturges, Bd. xv, p. 171, Tab. iii, fig. 5.
1851. „ „ Sars. Nyt Mag., Bd. vi, p. 206.
„ „ „ Grube. Fam. Annel., pp. 80 and 138.
1853. „ „ Sars. Nyt Mag., Bd. vii, p. 390.
1855. „ *ornata,* Leidy. Invert. Rhode Is. and N. Jersey, p. 14, pl. xi, figs. 44 and 45.
1859. „ (*Amphitrite*) *cirrata,* Danielssen. Kgl. Norske Vid.-Selsk. Skrift., 4d Bd., p. 122.
1861. „ *cirrata,* idem. Nyt Mag., xi, p. 55.
1864. *Amphitrite* „ Grube. Insel Lussin., p. 88.
1865. „ „ Johnston. Cat. Worms. Brit. Mus., p. 237.
„ „ „ Malmgren. Nord. Hafs.-Annul., p. 375, Tab. xxi, fig. 53.
„ *Terebella* „ De Quatrefages. Annel., t. ii, p. 361.
„ „ *Montagui,* idem. Ibid., p. 361.

[1] Marenzeller states that 4 and 5 are without these.

1867. *Terebella cirrata*, Parfitt. Cat. Devon. Annel. (Trans. Devon. Assoc. Sc.), p. 32.
„ *Amphitrite* „ Malmgren. Annul. Polych., p. 107.
„ „ „ Packard. Mem. Boston Soc. Nat. Hist., vol. i, p. 292.
1873. „ „ Kupffer. Jahresb. Komm. deut., p. 152.
1874. „ „ Verrill. Americ. Journ. Sc., p. 101, etc.
„ „ *ornata*, idem. Invert. Vineyard Sound, p. 613, pl. xvi, fig. 82.
„ „ *cirrata*, Malm. Annul. Göteb., p. 96.
1875. „ „ Ehlers. Zeitsch. f. wiss. Zool., Bd. xxv, p. 28.
„ *Terebella* „ Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 230.
1877. *Amphitrite* „ Marenzeller. Denkschrift. Kaiserl. Akad. Wiss. Wien, Bd. xxxv, p. 35 (sep. abdr.).
1878. „ „ McIntosh. Trans. Linn. Soc., ser. 2 Zool., p. 508.
1879. „ *ornata*, Webster. Annel. Virgin. Coast, p. 262.
„ „ *cirrata*, Tauber. Annul. Danica, p. 129.
1880. „ „ McIntosh. Ann. Nat. Hist. (October), p. 271.
„ „ *ornata*, Webster. Chætop. N. Jersey, p. 127.
1881. „ *cirrata*, Horst. Niederl. Archiv Zool. Suppl, Bd. i.
1882. „ „ Hansen. Norske Nord.-Exped., p. 16.
1883. „ „ Levinsen. Vidensk. Meddel., p. 174.
„ „ „ Wirén. Chætop. "Vega" Exped., p. 419.
1884. „ „ Marenzeller. Sitz. K. Akad. Wiss. Wien., Bd. lxxxix, p. 20 (sep. abdr.).
„ „ „ Webster and Benedict. Rep. Com. F. and Fish., U.S.A. (1881), p. 732.
1885. „ „ Carus. Fauna Medit., i, p. 261.
1887. „ „ Webster. Chæt. Eastport, Maine, U.S. Com. F. and F., p. 748.
1888. „ „ Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 663, pl. xliii, fig. 24.
1889. „ „ E. Meyer. Arch. f. Naturges., Bd. lv, p. 133.
1890. „ „ Marenzeller. Annalen K. K. Naturhist. Hofmus., Bd. v, p. 2.
1893. „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 49.
1894. „ „ Bidenkap. Christ. Vid. Selsk. Forhandl., p. 126.
1896. „ „ Appellöf. Berg. Mus. Aarb., vol. xiii, p. 12.
1897. „ „ Vanhöffen. Fauna u. Flora Grönlands., Bd. ii.
„ „ „ Michaelsen. Polych. deutsch. Meere, p. 166.
1898. „ „ idem. Grönland. Annel., p. 129.
1899. „ „ Ssolowiew. Ann. Mus. St. Petersb., t. iv, p. 201.
1901. „ „ Whiteaves. Mar. Invert. E. Canada, p. 73.
1909. „ „ Fauvel. Bull. Inst. Ocean., No. 142, p. 26.
1911. „ „ Ditlevsen. Sœrtryk. Meddel. Grönland, No. 45, p. 428.
1912. „ „ Meyer, A. H. Inaug. Dissert. Kiel., p. 31.
„ „ „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, p. 100, pl. xxxi, figs. 1—5, pl. xxxii, figs. 1—3, and pl. xxxiii, figs. 1, 2.
1913. „ „ Augener. Zool. Anzeig., Bd. xli, p. 268.
1914. „ „ Fauvel. Campag. Sc. Monaco, Fasc. xlvi, p. 293, pl. xxvii, figs. 13—32.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 4.
1917. „ „ Hessle. Zool. Bidrag Uppsala, Bd. v, p. 185.

*Habitat.*—South Devon (Montagu); small examples in 8—10 fathoms, Bressay Sound; var. East Rocks, St. Andrews (R.M.); Coast of Durham (G. S. Brady); Forth near Inchkeith (Cunningham and Ramage).

Abroad it occurs at the following: Greenland (Michaelsen); Lussin (Grube); Norway (Rathke and Appellöf); Sweden, Finmark and Spitzbergen (Lovén, Norman); Iceland (Leuckart, Forell); Greenland (Forell, Ditlevsen and Amondsen); Nova Zembla, Gulf of St. Lawrence (McI.); Godhavn Harbour, Disco., "Valorous," 1875 (McI.); Adriatic and Mediterranean (Grube, Panceri, Verany, Marenzeller); White Sea (Ssolowiew); New England and Atlantic Coast, U.S.A. (Verrill); Barentz Sea (McIntosh); Siberian and Behring's Seas (Wirén); Spitzbergen and the Mediterranean (Fauvel); Franz-Joseph Land (Augener); Canada (Whiteaves).

The *cephalic plate* is comparatively adherent, for the dorsal collar is restricted, and the edge externally bends over into that of the supraoral fold, the whole plate being more limited than usual. A sub-oral fold occurs within, and externally is the lower lip on the ventral border; the dorso-lateral continuation of the lip bears the first group of branchiæ. The tentacles have the normal structure and a deep groove. The segment following the foregoing has no distinct shield, the anterior edge ventrally forming a free border and ending laterally on each side in a rounded free flap. A second free anterior rim follows, also ending laterally in a rounded flap opposite the second branchia. In the middle line is a large shield which sometimes indents the segment behind it. Opposite the third branchia and the first bristle-tuft is a third rounded external flap, which passes further dorsalward than the other two. It abuts on a narrower shield than the one in front.

The branchiæ are three in number, arising from the second, third and fourth segments, and each forms a series of long, simple filaments which are attached to a single basal process. The tufts on each side are separated transversely by a considerable space.

The *body* is enlarged anteriorly, and gradually tapers posteriorly to the terminal anus. Dorsally it is rounded; ventrally are about ten to twelve shields anteriorly, and then a median groove passes to the posterior end. Seventeen pairs of vertical, flattened setigerous processes occur anteriorly, the first being in a line with the last branchial tuft. The bristles (Plate CXXV, fig. 5) are dull golden and in two series, a longer and shorter; the former are deeply inserted, have shafts nearly of uniform diameter throughout, and have comparatively short tapering tips with wings which are broad at the commencement, but taper distally. The condition of the tip, however, is variable, apparently from injury, since many are short with short and broad wings and tips that taper little—the result in all probability of injury. The shorter series has winged and tapering tips, though a few at the edge present short (broken?) tips with broad wings. A minute papilla occurs on the ventral side of the setigerous process from the second to the eighth bristled segment. Moreover, just below the papilla a little flap is developed at the dorsal end of each hook-row, and sloping backward behind it from the first bristled segment (which has no hooks) to the last, where, however, it is less distinct. No hooks occur opposite the first bristle-bundle; a single row is present on the next foot, and for several feet thereafter, but the eighth has two rows.[1] The hooks (Plate CXXV, figs. 5 and 5 *a*) have in lateral view about four teeth above

[1] From the eleventh to the twentieth segment the hooks are in a double row and semi-opposite (Lo Bianco).

the main fang, and the posterior outline curves forward to the crown, and has a projecting process of the base inferiorly. The base has a gentle curve, slopes from behind downward and forward, and an eminence occurs on the anterior curve below the main fang. Striæ pass from the teeth on the crown to the posterior border of the neck. The broad ridges for the hooks are large in the bristled region, but thereafter they diminish to short lamellæ, and then low ridges toward the tail. The posterior hooks have smaller (shorter) bases and the posterior outline is less curved toward the crown.

There are several varieties of hooks. Thus (1) in those from South Devon the curve of the back of the hook and the base forms a semicircle, as Malmgren shows; this is A with four teeth above the main fang. The anterior ligament is considerably within the tip of the main fang. (2) B, in which the posterior curve differs, the base being shorter, the posterior projections greater and the curve more abrupt. This resembles Malmgren's *groenlandica*. The outline of the hook differs.

A variety of *Amphitrite cirrata* occurred in the "Porcupine" Expedition of 1870, Station No. 3 in 690 fathoms, in which there is a tendency to the shortening of the line from the anterior process (below the main fang), and a distinct hollow immediately beneath the process, thus approaching *A. affinis*. Its branchiæ are unbranched, or perhaps only a single one is split.

The small size of specimens from Bressay Sound is in contrast with that of those from the south.

This species was entered by Linnæus (1767), along with *Terebella lapidaria*, but it was O. F. Müller (1771) who gave the name *Amphitrite cirrata*. Considerable confusion existed in connection with the Terebellids and the Amphictenidæ until the labours of O. F. Müller, Fabricius (1780), Savigny (1820), Montagu (1818) and Risso (1826) rendered it possible to place them on a more satisfactory footing: indeed Lamarck's classification (1812) rather increased the complexity, since the Pectinarians and Sabellarians were joined with the Terebellids.

Montagu's specimens from South Devon reached the length of 12 inches, and he describes them as gregarious in tubes of sand and clay, half an inch projecting from the surface. The branchiæ in the figure are ramose, but probably this was due to the artist. His *Amphiro cirrata*[1] as figured by Miss D'Orville is probably the same form though the branchiæ are somewhat confused. It has seventeen pairs of bristles. This author's *Amphiro fœtida*[2] has branchiæ apparently unbranched, but differs from *A. cirrata* in having bristle-tufts almost to the posterior end.

Chenu (1843—53) figures this species, but he shows only nine pairs of bristles anteriorly, so that there is doubt.

The form which Dalyell (1853) describes as *Terebella conchilega*, the shell-binder, appears to be an *Amphitrite*, and probably this species, though his artist has given it bristle-tufts from front to rear. He found the reddish ova discharged from September to December. His form made its tube of comminuted shells, though in confinement one used sand.

[1] MS. vol. 'Linn. Soc.,' 1808, pl. xxviii, fig. 1.

[2] Ibid., pl. xl, fig. 3.

The *Terebella gelatinosa* of Keferstein[1] is probably an *Amphitrite*.

Panceri[2] (1875) enters *Amphitrite cirrata*, O.F.M., as a distinct form from *A. cirrata*, Savigny.

Levinsen[3] (1877) describes and figures a remarkable crustacean parasite (*Crypsidromus terebellæ*) from the outer wall of the intestine of this species from Queensland. The body of the female has the aspect of two wings, from the junction of which posteriorly depend the egg-sacs, whilst at the opposite side is the mouth.

2. Amphitrite grœnlandica, *Malmgren*, 1865. Plate CXIX, fig. 3—body; Plate CXXXVIII, figs. 6 and 6 *a*—hooks.

*Specific Characters.*—Closely resembles *Amphitrite cirrata* in general structure, but has slightly branched branchiæ on a short stem, nineteen pairs of bristles and hooks, which have a more erect character than in *A. cirrata*, and the slope made by the base more nearly approaches a right angle, whilst five or six teeth occur in lateral view above the main fang. Ten ventral scutes. Segments ninety to one hundred.

Synonyms.

1865. *Amphitrite grœnlandica*, Malmgren. Nord. Hafs.-Annul., p. 366, Tab. xxi, fig. 52.
1867. „ „ idem. Annul. Polych., p. 107.
1883. „ „ Levinsen. Vid. Meddel. Forh. Copenhagen, p. 175.
1894. „ „ Bidenkap. Vid.-selsk. Forh. Christ., p. 127.
1912. „ „ Wollebæk. Skrift. Selsk. Krist., 1911, No. 18, p. 102, pl. xxxv, fig. 4.
„ „ „ Meyer. Inaug. Dissert. Kiel, p. 36.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 8.
1917. *Neoamphitrite* „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 181.

*Habitat.*—Dredged in the "Porcupine" Expedition of 1869 in 164 fathoms on greyish sand, stones and corals off Ireland, and in 808 fathoms on very soft, sticky mud off the Irish coast in the same expedition; in 690 fathoms in the Atlantic (No. 3) in the "Porcupine" Expedition of 1870.

Abroad it extends to Canada, Norway and Finmark.

The *body*, which apparently ranges from 2 to 6 or 7 inches in length, is enlarged anteriorly and tapered posteriorly, ending in a papillose terminal anus. The large lower lip occupies the centre, behind which is a "segment" with a double ring, though the posterior moiety is interrupted in the centre by a pair of small separate areas. The next is the first ventral scute, which is short and supported on each side by a cushion which extends to the mid-branchial region. This is followed by a narrow though somewhat long scute. The next three are slightly broader (that is, antero-posteriorly) and diminish a little in transverse diameter. Then follow four large and broad scutes, behind which only a median trace is indicated and they disappear. There are nineteen pairs of bristle-tufts, the first being opposite the last branchia, and placed on low pads above the hook-rows. The two series of bristles, the longer and shorter,

[1] 'Zeitsch. f. wiss. Zool.,' Bd. xii, p. 126, Tab. xi, figs. 19—22 (1862).
[2] 'Atti Soc. Ital. Sc. Nat.,' vol. xviii, p. 231.
[3] 'Videnskab. Meddel. Naturhist. For. Kjöbenhavn,' p. 25, Tab. vi, figs. 19, 20.

are well marked, the former showing a slight dilatation of the shaft at the commencement of the wings and a long, curved, tapering, serrated tip. The shorter bristles have a proportionally stouter shaft, with a distinct twist or bend in the flattened blade after the wings cease, the tips thereafter being finely tapered.

The branchiæ arise from a short stem, and split up into a number of branches, each dividing into two, the whole forming a dense tuft.

The anterior hooks (Plate CXXXVIII, figs. 6) have a more erect character than those of *A. cirrata*, and the slope made by the base comes nearer a right angle, whilst the hollow in the posterior outline is median, not near the inferior angle as shown by Malmgren, so that the Canadian form may differ, whereas that procured in the "Porcupine" more nearly corresponds. There are five or six teeth above the main fang. The posterior hooks (Plate CXXXVIII, fig. 6 *a*) have a more erect figure, with a shorter and more massive base.

Hessle (1917) places this under his genus *Neo-amphitrite*, but the distinctions do not appear to be such as to warrant the complication.

3. Amphitrite affinis, *Malmgren*, 1865. Plate CXX, fig. 10—branchia; Plate CXXV, figs. 6—6 *b*—bristles and hook.

*Specific Characters.*—Body typical. *Anterior region* presents a transverse shield behind the mouth, passing dorsally to join the smooth area in rear of the collar. Eleven shields follow besides several rudimentary. The dorsal edge of the second segment extends to the base of the first branchia, whilst the dorsal edge of the third falls short of its branchia. A still longer gap separates the first bristle-tuft of the next segment from the third branchia. Behind the shields a deep groove occupies the ventral median line. Branchiæ three, on second, third and fourth segments, small, and with rather short and thick terminal divisions. Seventeen pairs of setigerous processes, the first opposite the third branchia. Bristles pale golden, the tip having narrow wings, which soon cease, the translucent region beyond being flattened like a long knife-blade, serrated on the edge, and tapered into a very long hair-like extremity. Hooks in a double row, each having a small base and a large neck and crown, with three teeth above the main fang, in lateral view, and a process in the gulf below it. It is distinguished from the hook of *A. cirrata* by the fact that the posterior outline more nearly forms a right angle with the base, the angle being more obtuse in *A. cirrata*.

Synonyms.

1865. *Amphitrite affinis*, Malmgren. Nord. Hafs.-Annul., p. 375, Tab. xxii, fig. 55.
1867. „ „ idem. Annul. Polych., p. 107.
1883. „ „ Wirén. Chætop. "Vega" Exped., p. 419.
„ „ „ Levinsen. Vid. Meddel. Nat. Forh. Copenhagen, p. 174.
1894. „ „ Bidenkap. Christ. Vid. Forh., No. 10, p. 128.
1912. „ „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 101, pl. xxxiv, figs. 1—7.
1913. „ „ Augener. Zool. Anz., Bd. xli, p. 268 (Franz-Joseph Land).
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 121.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, pp. 9 and 44.
1917. *Neoamphitrite affinis*, Hessle. Zool. Bidrag Uppsala, Bd. v, p. 179.

*Habitat.*—Dredged in the "Porcupine" Expedition of 1869, at 808 fathoms at Station 11, off the Irish coast, in sticky mud. Dredged by the "Knight Errant" at Station 11, 28th August, 1880, in 535 fathoms; Clew Bay (Southern).

Abroad it has been found in Spitzbergen (Malmgren); Norway (Danielssen, Wollebæk); Iceland and Siberia.

The *cephalic region* presents a broad horse-shoe fold over the mouth, continuous at its outer and inferior edge, with the larger collar which bounds the tentacular area posteriorly. A deep groove, wide in the middle and tapered at each side, is thus formed. Below the mouth is a short fold bounded by the first-mentioned horse-shoe arch at each side, and ventral to this a broader band or lip.

The *body* is typical, so far as it goes, is rounded dorsally, whilst ventrally are twelve distinct shields and several rudimentary ones posteriorly. Behind the mouth is a transverse shield which dorsally joins the smooth region behind the collar. Two segments with ventral shields follow, the dorsal edge of the first passing to the base of the first branchia, whilst the dorsal edge of the second falls short of its branchia. In all twelve shields are present. A still larger gap separates the first bristle-tuft of the next segment from the third branchia. Behind the shields a deep groove occupies the ventral median line. A ridge (marking the nerve-cord) is continued from the last ventral plate or shield along the groove to the posterior end of the body.

Marenzeller describes the colour of the body as reddish grey, brownish in front and pale posteriorly. Tentacles streaked and punctated with brown. In the examples from the "Porcupine" brownish pigment still remained anteriorly at the cephalic folds and between the ventral shields.

The branchiæ are three in number, proportionally small and with short and rather thick terminal divisions. The first (Plate CXX, fig. 10) has a short stem which splits; each branch consists of a few short, slightly curled filaments, some with bifid tips. The second is a little less, and the third is again smaller. Both sides are alike, and on the whole the organs seem to be somewhat shorter than in *A. cirrata*.

There are seventeen pairs of bristle-tufts, the first commencing opposite the third branchia. The bristles (Plate CXXV, fig. 6) are pale golden, the shaft being deeply inserted in the tissues, only a short free portion occurring below the wings, which are narrow and soon cease, the translucent tip beyond being flattened like a long knife-blade, boldly serrated at the edge, and tapered to a very long hair-like tip. One or two shorter forms occur amongst the others, but apparently no regular series as in other genera, and some may be developing long bristles. In these little of the winged region projects beyond the surface, and the flattened blade is occasionally split into spikes. Amongst the bristles are long curved forms with narrow wings (Plate CXXV, fig. 6′) and finely tapered tips. The bristles issue from an elevation at the dorsal edge of the ridge for the hooks, and they form a vertical series in each tuft. Moreover, six small papillæ (third to ninth segments) occur immediately beneath them, situated at the posterior border of the ridge for the hooks.

The hooks (Plate CXXV, figs. 6 *a* and 6 *a*′), when fully developed, form a double row, the large fang facing that of the opposite hook. The base is comparatively small and the crown and neck large (Plate CXXVI, fig. 2 *b*). The crown presents in lateral

view three teeth above the main fang, which is long and sharp. The posterior border is convex and a marked heel occurs as it joins the base. The curve below the main fang has a median process, and beyond it is an abrupt bend, whilst the anterior process or prow is rounded and blunt. Striæ pass from the small teeth on the crown along the posterior part of the neck.

The posterior hooks (Plate CXXV, fig. 6 *b*) are smaller and more compact.

This species further differs from *A. cirrata* in the position of the papillæ at the anterior setigerous processes, and in the absence of the adjoining flap at the dorsal end of the rows of hooks.

No tube accompanies it, but as the intestine is filled with whitish mud containing a few sponge-spicules, minute Foraminifera and Radiolarians, many fragments of silex and crustacean hairs, it is probable that the tube is likewise of the same nature.

*Reproduction.*—The cœlom had numerous small ova, so that the example is a female.

The hook of this form has certain resemblances to *Amphitrite Birulai*, Ssolowiew,[1] and if his drawing is faulty it might prove to be a variety.

Southern (1914) states that the hooks are in two rows in segments 11—20, but in the others in a single row. He thinks it closely approaches *A. variabilis* of Risso. An examination of an example kindly sent by Mr. Southern shows that it is a small one, with the characters less boldly marked than in larger forms.

Wollebæk's[2] figure of the hook, whilst evidently pertaining to *A. affinis*, has certain differences, such as the size of the process on the anterior outline (below the main fang), and the depth of the blunt prow.

This species was also placed by Hessle under his genus *Neoamphitrite*.

4. AMPHITRITE GIGANTEA, *Montagu*, 1818. Plate CXX, fig. 11—branchia; Plate CXXV A, figs. 10—10 *b*—bristles and hook.

*Specific Characters.*—Cephalic region as in *A. cirrata*, though the lateral processes of the tentacular plate seem to be larger proportionally. Two statocysts near the cephalic ganglia. Body more than a foot long, 15—18 mm. in diameter in the anterior region, and tapered posteriorly to a crenate or papillose anus. The number of segments ranges from 100 to 160. Seventeen pairs of bristle-tufts occur anteriorly, the tips having wings and a translucent, serrated blade beyond them. The shaft dilates a little about the commencement of the wings. The hooks have a longer base than in *A. cirrata*, five or six teeth above the main fang, and the outlines on each side of the process on the anterior border are more distinctly concave. Nine pairs of segmental organs anteriorly (De St. Joseph). The body is of a uniform chamois (buff) colour, the setigerous processes and hook-rows being paler. The branchiæ are deep red and the tentacles orange, whilst the dorsum is of a greyish blue anteriorly. Tube a gallery in the sandy mud.

[1] 'Ann. Mus. St. Pétersb.,' t. iv, p. 198, Taf. xii, fig. 10, 1899.

[2] Op. cit., pl. xxxiv, fig. 6.

Synonyms.

1808. *Amphiro gigantea,* Montagu. MS. Vol. Linn. Soc., pl. xx, fig. 2.
1818. *Terebella* „ idem. Trans. Linn. Soc., vol. xii, p. 341, Tab. xi.
1843–53. „ „ Chenu. Illust. Conch., 11e livr., pl. iv, fig. 2.
1845. „ „ idem. Bibl. Conch., 2e sér., t. i, p. 265, pl. xxii.
1851. „ „ Grube. Fam. Annel., p. 81.
1865. „ *Edwardsi,* De Quatrefages. Annel., t. ii, p. 354, pl. xix, fig. 1.
„ „ *gigantea,* idem. Ibid., p. 355.
„ „ „ Johnston. Cat. Worms Brit. Mus., p. 237.
1867. „ „ Parfitt. Trans. Dev. Assoc. Sc., p. 32 (sep. c.).
1870. „ „ Grube. Archiv f. Naturges., p. 323.
1894. *Amphitrite Edwardsi,* De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 186, pl. vii, figs. 207, 208, pl. viii, figs. 209—223.
1909. „ „ Fauvel. Ibid., 9e sér., t. x, p. 209.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 633.
1917. „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 184.

*Habitat.*—In the *Zostera* banks near the mouth of Salcombe Harbour, with *Lepidasthenia argus* as a commensal (Allen).

Abroad it has been found on the shores of France by De Quatrefages at St. Vaast; at and near Dinard (De St. Joseph), accompanied by *Lepidonotus squamatus* as a commensal. It is curious that this Polynoid has not hitherto been found as a commensal in Britain.

The *cephalic region* resembles that of *A. cirrata* though the dorsal lamella for the tentacles appears to be fuller, especially the lateral fold on each side of the lower lip, these being prominent in the large examples. The tentacles form a huge mass, coiling and stretching in life in every direction.

The *body* is comparatively large, stretching from 6 to 15 inches or thereabout, enlarged anteriorly and tapering gently posteriorly to the crenate or slightly papillose anus. The skin of the rounded dorsum varies in the preparations, some being comparatively smooth except for the longitudinal bands of the dorsal muscles, others being tessellated like *Scalibregma*, and though modified, the same tendency is noticeable in the smoother posterior extremity. The number of segments ranges from 100 to 160. There are eleven ventral scutes, the first being the largest, the last scute being followed by a narrower median glandular belt, which by-and-by diminishes as the ventral groove becomes more pronounced, though toward the tip of the tail it again becomes indistinct. The second, third and fourth segments have in each a free lamella laterally at the anterior border, probably in connection with the functions of the branchiæ. A diaphragm between the fourth and fifth segments divides the thoracic region into two unequal portions, and it presents two dorsal and two ventral sacs, which De St. Joseph associates with the propulsion forward of the cœlomic fluid. In the posterior region diaphragms occur from the second backward to the tail. Nine pairs of segmental organs anteriorly are described by De St. Joseph.

The branchiæ form three dense arbuscles on each side on the second, third and fourth segments. Each has a stout pedicle, which by-and-by splits up into several

main branches, these again sub-dividing more or less dichotomously into a series of terminal filaments. The first is the largest, though all form conspicuous tufts. In life they keep up a constant movement like masses of worms (De St. Joseph).

The anterior region has seventeen pairs of bristle-bundles which arise from vertically elongated lamellæ, the first being opposite the last branchia. A large papilla takes the place of these opposite the second branchia, and a smaller papilla occupies the space between the hook-row and the setigerous process in the following eight segments. The sixteen hook-rows of the region have a glandular belt in front and behind, and the majority show a dimpled or interrupted hook-line, as if cut into sections.

The longer bristles have straight shafts and well-developed wings, a slight curvature marking the tip, which, moreover, shows a dilatation of the shaft or axis just after the commencement of the wings. Then the wings cease, and a translucent, flattened, serrated, tapering blade forms the extreme tip (Plate CXXV A, figs. 10 and 10 *a*). The shorter bristles have the same character, but the terminal blade beyond the wings is broader at the base (projecting more distinctly in lateral view, like a knife-blade).[1]

The anterior hooks (Plate CXXV A, fig. 10 *b*) are characterised by the great length of the base, and by its marked curvature from the posterior ligament to the prow. The posterior outline presents a slight convexity superiorly and a slight concavity above the ligament. Bold striæ occur on the upper and posterior part of the neck. The main fang is large, and five or six teeth appear above it in lateral view. The gulf under the main fang is large, curving to the process for the ligament, and again slightly hollowed as it passes below it to the prow. In the first six segments the hooks are in a single row, but in the following ten they are in a double row facing each other.

The posterior hooks differ in the shorter and broader basal region, the increase in the posterior outline, and the diminution of the anterior curves on each side of the process for the ligament.

This appears to be the *Terebella gigantea* of Col. Montagu (1818), for the discrepancies are readily explainable. He rightly gives seventeen pairs of bristles, and his capillary appendages are the tentacles, 5 or 6 inches in length, and the three pairs of branchiæ are much ramified. By the first eight joints, which have a broad plate on the back, he evidently means the ventral scutes. He gives its length as 16 inches, and states that it is the longest of the species (British): "It inhabits the soil at the bottom of the sea, and seems to be destitute of any case. We found one specimen in the estuary of Kingsbridge at low water; it discharged an orange-coloured fluid from its mouth in great abundance."[2] His figure for the most part represents the ventral surface and is incomplete posteriorly. It has been supposed that the *Terebella constrictor* of this author is the same species, but an examination shows that it is not.

This species was also described and figured by De Quatrefages (1865), under the title of *Terebella Edwardsi*. The French author considered it the giant of the race on the shores of France.

[1] In De St. Joseph's figure the serrations are at right angles to the axis, and the dilatation of the shaft and other points diverge somewhat from nature.

[2] 'Trans. Linn. Soc.,' vol. xii, p. 342.

An extended and careful account was given by De St. Joseph (1894), and he entered into various structural features.

5. Amphitrite figulus, *Dalyell*, 1853. Plate CXIII A, fig. 1—body; Plate CXXV, figs. 10 and 10 *a*—bristles; Plate CXXV A, figs. 1 and 1 *a*—bristle with double expansion and hook.

*Specific Characters.*—Median dorsal collar of the cephalic fold narrow, but the oral arch and the lateral folds are larger than in *A. cirrata*. Tentacles with a red streak.

The *body* is 6 to 8 inches long, enlarged in front, tapered posteriorly and ends in an anus. Segments ninety to one hundred, and of these twenty-four bear bristles commencing at the last (third) branchia. Dorsal surface anteriorly in the preparations somewhat tessellated. Each segment anteriorly shows dorsally two rings, which by-and-by have transverse furrows. Then as the space between the bristles increases a larger number of rings are present, whilst posteriorly the narrow transverse furrows show less regularity. Ventral scutes fifteen. Various shades of flesh colour, some of the larger being brownish, other pinkish, and marked by the orange intestine posteriorly. Nephridia from the third to the ninth segment (Hessle).

Branchiæ three on each side on segments 2, 3 and 4, the first the largest, each having a cylindrical stem which soon divides dichotomously, the terminal branches long and tapering, colour dull red. A small conical papilla at the second branchia marks the commencement of the setigerous processes, though it has no bristles. Bristles of two kinds, a longer and shorter series, the shafts of the former long, straight, slightly diminished upward to the winged tip, which is finely tapered. Shorter series with an accessory terminal blade carried at an angle to the region beneath it, and tapered to a slender, slightly curved tip. The rows of hooks commence at the second bristle-tuft, and continue to the posterior end. The third ridge bears the first double row of hooks. These differ from those of *A. cirrata* in the less oblique base and in the curves of the anterior outline below the great fang; four teeth occur above the latter in profile. Tube either earthy and friable, or of fragments of shells, minute stones and sandy mud lined by secretion.

Synonyms.

1808. *Amphiro constrictor*, Montagu. MS. vol. Linn. Soc., pl. xxxv, fig. 3.
1843–53. *Terebella constrictor*, Chenu. Illust. Conch., 11e livr., p. 266, pl. xxiv, fig. 1.
1853. *Amphitrite brunnea*, Stimpson. Fauna Grand Manan, p. 31.
„ *Terebella figulus*, Dalyell. Pow. Creat., vol. ii, p. 191, pl. xxvii, figs. 1 and 2.
1865 ?. „ *nebulosa*, Johnston. Cat. Worms. Brit. Mus., pp. 237 and 345 (partim ?).
„ *Amphitrite Johnstoni*, Malmgren. Nord. Hafs.-Annul., p. 377, Tab. xxi, fig. 51.
1867. „ „ idem. Annul. Polych., p. 107.
1869. „ „ Grube. St. Vaast., p. 38.
„ *Terebella figulus*, McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 423.
1870 ?. *Amphitrite nana*, Claparède. Suppl. Annél. Nap., p. 129, pl. xiii, fig. 6.
1873. „ *Johnstoni*, Möbius. Exped. Ostsee Comm. deutsch., p. 109.
1874. „ *figulus*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 204.
„ „ *Johnstoni*, Malm. Göteborg Fauna, p. 96.
„ „ *brunnea*, Verrill. Check List, p. 10 (U.S. Com. F. and F.).

1875. *Amphitrite figulus*, McIntosh. Invert. and Fishes St. Andrews, p. 129.
1879. „ *Johnstoni*, Tauber. Annul. Danica, p. 130.
1883. „ „ Levinsen. Vidensk. Meddel., p. 175.
1884. „ *brunnea*, Marenzeller. Sitzb. Akad. wiss. Wien., Bd. lxxxix, p. 24.
„ „ „ Webster and Benedict. Rep. Com. F. and F. U.S.A., p. 732.
1888. „ *Johnstoni*, Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 661, pl. xliii, fig. 23.
1891. „ *figulus*, Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 257.
1894. „ *Johnstoni*, Bidenkap. Christ. Vid.-selsk. Forhandl., p. 127.
1896. „ „ Orlandi. Atti del Soc. Ligustica di Sc. nat. e geogr., t. vii, p. 157.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 168.
1898. „ „ De St. Joseph. Ann. Sc. nat., 8e sér., v, p. 421.
1899. „ *brunnea*, Ssolowiew. Ann. Mus. St. Pétersb., t. iv, p. 202, Tab. xii and xiii, fig. 12.
1904. „ *Johnstoni*, Journ. M. B. A., vol. vii, p. 239.
1909. „ „ Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 209.
1911. „ „ Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 63.
1912. „ „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 103, pl. xxxvi, figs. 1—3, pl. xxxviii, fig. 2.
„ „ *Stimpsoni*, Meyer. Inaug. Dissert. Kiel, p. 34.
1914. „ *Johnstoni*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 122.
1915. „ *figulus*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 6.
„ „ *Johnstoni*, Southern. Irish Sc. Invest., No. 3, p. 46.
1917. *Neoamphitrite figulus*, Hessle. Zool. Bidr. Uppsala, Bd. v, p. 182.

*Habitat.*—Not uncommon in various parts of the British shores, as at Berwick Bay (Johnston); from tangle-roots, and also from deeper water outside the bay; under stones on sand near low water, St. Andrews, and in *débris* of the fishing boats from deeper water (E. and R. M.); in sandy creeks at Lochmaddy (W. C. M.); off Inverary (J. G. J.); Joppa (Cunningham and Ramage); Isles of Arran (E. P. Wright); "Porcupine" Expedition of 1869 in 165 fathoms in muddy sand; Blacksod Bay and other parts on the West Coast of Ireland, usually in wide deep tunnels in *Zostera*-beds, lining the tunnel with mud (Southern).

Elsewhere it is found in Sweden, Norway and Finmark (Malmgren, Malm, Wollebæk); Canada (coll. Dr. Whiteaves); Mediterranean (Orlandi, etc.); New England, U.S.A. (Verrill); White Sea (Ssolowiew); North Sea (Pryde)[1]; St. Vaast-la-Hougue (Fauvel).

The *cephalic region* differs from that of *A. cirrata* in the great development of the fold in front of the tentacles, and which forms an arch over the mouth. At its outer edges it bends backward to become continuous with the broad, dark, brownish fold behind the tentacles, which, however, in this form is limited in extent, for the median portion is narrow. This structure of the posterior fold is characteristic. The mass of grooved and frilled tentacles springs from the hollow between these arches, and forms a centre of very active functions during the life of the animal, their colour then being pale orange or pink. The projecting dorsal portion of the arch or lip is dark brown inferiorly. Many cells and granules occur in the interior of the tentacles. Below the dorsal arch is the mouth, and

[1] This talented young zoologist fell in the last battle with the Germans in East Africa—as he led the King's African Rifles.

beneath is a globular process followed by the lower lip, which is separated by a groove on each side from the folds or arches. Behind the lower lip ventrally is a well-marked collar with a crenated anterior border stretching completely across the ventral surface in the line of the first branchiæ. It has a rounded, free edge dorso-laterally, and a median and two smaller crenations at its posterior border, and these probably usher in the change seen in the next ring, which has a distinct, though small median scute or pad.

The *body* is 6—8 inches in length, enlarged in front and tapering toward the posterior end, as usual in the family. The segments number from ninety to one hundred, and of these twenty-four bear bristles, the first being opposite the third or last pair of branchiæ. The dorsum anteriorly is tessellated in the preparations somewhat as in *Scalibregma*, each of the two rings in the segments being crossed antero-posteriorly by folds which cut the ring into narrow spaces. On the ventral side of the second branchia is a papilla, the forerunner of the setigerous process which follows in the next segment. Moreover, below each setigerous process is a small papilla, as in *A. cirrata*, but these are continued for sixteen segments instead of the few in *A. cirrata*. The bristle-tuft is situated at the posterior part of one ring, whilst the following ring lies between the bristle-tufts. This arrangement, however, extends only throughout thirteen or fourteen rings, viz., from the interval between the second and third branchiæ backward. Then the rings are marked by transverse furrows, each being thus divided into two, whilst further backward, as the space between the bristles increases, into a larger number of rings. In some cases the posterior lamellæ for the hooks are asymmetrical, an intermediate lamella occurring on one side only. The posterior segments show less regularity in their narrow transverse dorsal furrows. The body diminishes and ends in a terminal anus. The colour of the body is pale orange.

Behind the first distinct scute, or ventral shield, already mentioned in connection with the mouth, is a narrow elongated one, followed by thirteen others, those immediately succeeding the very narrow one gradually, though slightly, increasing in antero-posterior diameter to the eleventh or twelfth, whilst the last three or four are rudimentary, being rounded or shield-shaped median elevations, which gradually end in a moniliform and somewhat elevated ventral ridge, by-and-by lost in the groove posteriorly.

The branchiæ are three in number, of a fine dark red colour and slightly mottled under a lens. They coil and twist actively under examination. The first is the largest, the third the smallest. Each springs from a cylindrical base, which soon divides dichotomously, though occasionally a small tuft of three short filaments may be found on the main stem of the first branchia. The terminal branches are long and tapering, and in life these give the aspect of gills formed of simple filaments. Each filament is enveloped in a transparent structureless cuticle, whilst the centre is marked by coherent granular tissue arranged in a close series of transverse rows so as to give the whole a finely barred aspect. No distinct longitudinal fibres are apparent, though in some a longitudinal canal is seen. In the basal region are many large compound bodies—the "blood-globules" of Williams.

A small conical papilla situated in the groove close to the exterior of the second pair of branchiæ marks the commencement of the setigerous processes, though it has no bristles, and it is in a line with the second post-oral fold, in the centre of which

is the first small shield or scute. The first bristle-tuft is opposite the last branchia, only a short interval separating it from the base of the organ. It springs from a setigerous papilla at the dorsal edge of the ridge for the hooks. The bristles form a vertical row of considerable depth, and in structure agree with the succeeding tufts, no rudimentary forms marking the commencement of the series, as in various groups. Each tuft consists of a longer series with stout, straight and long shafts, the free portion of which is slightly diminished in diameter toward the commencement of the winged, finely tapered and curved tip (Plate CXXV, figs. 10 and 10 *a*, and Plate CXXV A, fig. 1). The tips of the bristles are directed upward and backward in their normal condition. The shorter series consists of those with shorter and less tapered winged tips, which have an accessory terminal blade carried at an angle to that beneath, and is broad at the base and tapered to a slender, slightly curved tip. Such a bristle approaches that of certain Acœtidæ, such as *Panthalis*. The structure of these bristles remains the same from the first tuft to the last, but the setigerous processes increase in prominence in their progress backward. The serratures at the tip cause them to cling tenaciously to the cuticle.

No hooks or their homologues occur in the ridge running downward from the first bristle-tuft and the ridge itself is intermediate in character. The ridge from the second pair of bristles presents a lateral border and a median linear elevation containing the single row of hooks, the ridge terminating ventrally in a rounded border at some distance from the ventral shield; the ridges which follow gradually approach the ventral scutes or shields until at the eighth they touch. The third ridge has a double row of hooks, but they appear to be less regular than those which follow. As a rule the ridges for the hooks are longest in front, and diminish a little toward the twenty-fourth bristle-bundle. Each leaves the setigerous process as a slightly flattened ridge with an anterior, a median, and a posterior fillet, the median bearing the rows of hooks. On the cessation of the bristles the thick and rather long ridge for the hooks increases in prominence and presents a free edge dorsally and ventrally. It diminishes in depth, while increasing in prominence posteriorly. The rows of hooks in life are terminated ventrally by a brownish speck. In the posterior processes the hooks are in a single row.

The hooks, which commence at the second bristle-tuft and continue to the posterior end (Plate CXXV A, fig. 1 *a*), differ from those of *A. cirrata* in the less oblique base and in the curves of the anterior outline below the main fang. Usually four teeth occur in lateral view on the crown above the fang, but when examined in front the crown appears to have several transverse rows. These hooks are very similar to those of *Amphitrite variabilis*, Risso, as figured by Marenzeller, but the latter has only seventeen pairs of bristles.

The cœlomic corpuscles immediately after extrusion in spirit are ovoid or elliptical bodies, reddish in mass, the larger of a certain uniformity of size, filled with rather coarse granules and with a nucleus. Amongst these are many smaller rounded bodies, some with two large nuclei—it may be in process of fission—and, indeed, the process of division is seen in others. The smallest are minute, translucent, elliptical bodies, though some are fusiform with a nucleus in the centre, and a number may be strung together in a small coagulum. From these the larger corpuscles seem to be developed, numerous divisions

apparently taking place during their growth, groups of three after division occasionally occurring. On reaching the full size division seems to be rare. Each large cell has a cell-wall which sometimes is ruptured or dissolved, and the coarse granules form a botryoidal surface.

*Reproduction.*—In May the pale salmon-coloured ovaries occurred in the anterior region, extending to the seventh or eighth bristle-tuft as a series of lobate folds crowded with very minute ova. The nephridia are large and numerous. In the same month (May) a large example had in the cœlomic cavity a quantity of a dull purplish gelatinous fluid, the colour being apparently due to the minute granules of purple oil in the ova, which measured ·046 mm. in long and ·037 mm. in short diameter. There were besides numerous cœlomic corpuscles, elongated or spindle-shaped bodies, which by-and-by disappeared from the fluid.

*Habits.*—It is less active than *T. nebulosa*, and lies rolling in a vessel moving branchiæ and tentacles. Dalyell says it is phosphorescent, but this has not been observed at St. Andrews.

The tube in a Hebridean example is earthy and rather friable. In confinement it rapidly forms a membranous tube in the vessel of sea-water, both ends of the tunnel being open. From this shelter it stretches its attenuated tentacles along the bottom. In tangle-roots the tube is formed of mucous lining with sandy mud externally. A tube from Bantry Harbour (R. I. A. Expedition, 1885) consists of mud and dark fragments like peat, the whole forming a thick friable coating. At St. Andrews the tubes are composed of sand-grains and mud (and they retain their shape), part being attached to stones and part to the mud beneath. In one instance the tube was a foot and a half in length, and contained in addition the commensal, *Gattyana cirrosa*.

*Commensals.*—The ordinary commensal at St. Andrews is *Gattyana cirrosa*, though at least on one occasion large examples of *Sthenelais boa* were obtained near the mouth of their tubes at low-water mark. De St. Joseph found the former also in the tubes on the shores of France (Croisic).

If Montagu's *Terebella constrictor* proves to be this form, then his title has priority.

Dalyell's (1853) description and figure are perfectly clear, so that there is no dubiety as to the species which he called the potter from its predilection for mud in the construction of its tube. He pointed out the thick, heavy and friable nature of the tube in contrast with that of *Lanice conchilega*, and the fondness of the annelid for empty shells in deep water. A small specimen which from injury had only twelve bristle-tufts, regenerated its body in five or six weeks. The versatility of the annelid, he noted, was surprising. "Many tentacula are searching for materials, many in collection, many bearing them to the edifice, some quitting their hold, others recovering the load, while the architect itself seems occupied in kneading masses in its mouth, disgorging them successively, or in polishing the rude workmanship resulting from its labours."

So far as can be gathered from Claparède's description and figures (1870), his *Amphitrite nana* would not appear to offer substantial differences from this species.

Cunningham and Ramage (1888) state that there are fifteen to seventeen pairs of nephridia in the first fifteen to seventeen post-buccal segments, and that there are median

vessels passing from the ventral vessel to the intestine. In the anterior region the dorsal vessel is represented by a perienteric sinus, and this anteriorly opens into a free dorsal contractile heart with a cardiac body.

Ssolowiew (1899), in his "Terebellids of the White Sea,"[1] makes *Amphitrite johnstoni* fall under *Amphitrite brunnea* of Stimpson, as also does Marenzeller.

In the collection in the British Museum, *Terebella constrictor*, according to Malmgren, is *T. debilis*, = *figulus*, = *Johnstoni*, but the title is on several bottles containing other forms, such as *Nicolea*, *Leprea* and *Amphitrite scylla*.

6. Amphitrite scylla, *Savigny*, 1820. Plate CXIII, fig. 2—body; Plate CXXV A, figs. 2—2 *c*—bristles and hooks.

*Specific Characters.*—Cephalic collar forms a small rim posteriorly, and passes to join the edge of the supra-oral arch. Tentacles numerous, of a pale cream colour. Front edge ends in a prominent spout-shaped arch over the mouth. Lower lip formed by a transverse fold, and within it is a small tongue-like eminence. Body proportionally long and slender, segments 115—150, pale cream-coloured enlivened by blood-vessels, and the brownish-red specks posteriorly. The enlarged anterior region has a close series of transverse ridges minutely tessellated from isolated glandular masses. The anus has marginal papillæ. Scutes occupy about twelve segments in front with several narrow rings; the posterior region is marked only by the segment-junctions. Branchiæ two pairs, the first and larger pair on the second segment. Each springs from a short stem, which rapidly gives off four main divisions, splitting up into a dense arbuscle with short terminal branches. The second pair is on the next segment. Occasionally a specimen has three branchiæ on one side and two on the other, the third being a small independent stem behind the second. Setigerous processes twenty pairs (Von Marenzeller gives seventeen to nineteen), and in addition a small conical papilla under the second branchia, and conspicuous papillæ on segments 6—13. The longer bristles have winged tips with a characteristic expansion at the base, and are narrow distally. The shorter bristles have peculiarly curved tapering tips without distinct wings. Hooks commence at the third setigerous process, the first being distinguished by the large size of the main fang and the comparatively small size and oblique nature of the base. By-and-by they form a double row and become typical, the great fang being proportionally smaller, the base less elongated, and the lower edge more convex. In a double row from segment 11, in a single row posteriorly. Body in front of a dull reddish colour, becoming paler behind the anterior region and ventrally; posteriorly of a pale straw or almost whitish hue marked by the dull grey contents of the intestine. The branchiæ, which have tapered tips, are bright red, and are in constant movement with the tentacles when the animal is removed from its tube. The tentacles are pale yellow (straw colour), the tips being more opaque. By flattening out at any part of their length they can attach themselves to the surface of the glass. Some specimens have brownish-red pigment-specks toward the posterior end; others are dull orange anteriorly, pale and translucent posteriorly. Inhabits tunnels in fissures of rocks.

[1] 'Ann. Musée Zool. St. Petersb.,' p. 202.

Synonyms.

1820. *Terebella scylla,* Savigny. Syst. Annel., p. 87.
1826. „ *variabilis,* Risso. Hist. nat. L'Europe Merid., vol. iv, p. 408.
1828. „ *scylla,* De Blainville. Dict. Sc. nat., t. lvii, p. 438.
1836–49. „ *variabilis,* Cuvier. Règ. An., Illust. Edit., p. 25.
1843–53. „ „ Chenu. Illust. Conch., 11e livr., pl. iv, fig. 6.
1851. „ *scylla,* Grube. Fam. Annel., pp. 80 and 138.
1860. „ *gracilis,* idem. Arch. f. Naturges., Bd. xxvi, p. 99.
1862. „ *gelatinosa,* Keferstein. Zeitschr. f. w. Zool., Bd. xii, p. 126, Taf. xi, figs. 19—22.
1865. *Physelia scylla,* De Quatrefages. Annel., tom. ii, p. 369.
„ „ *gracilis,* idem. Ibid., p. 372.
1868 ?. *Terebella lævirostris,* Claparède. Annél. Nap., p. 139, pl. xi, fig. 5.
„ *Nicolea gelatinosa,* Grube. Abh. Schles. Ges., 1868—69, p. 128.
1875. *Terebella lævirostris,* Panceri. Atti Soc. Ital., vol. xviii, p. 530.
1884. *Amphitrite gracilis,* Marenzeller. Sitzb. der K. Akad. wissensch. Wien, sep. abdr., p. 26, Taf. i, fig. 3.
1885. „ „ Carus. Fauna Medit., i, p. 262.
1893. „ *variabilis,* Lo Bianco. Atti R. Accad. Sc. Napoli, vol. v, No. 11, p. 50.
1894. „ *gracilis,* De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 198, pl. viii, fig. 234.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 168.
1900. „ *variabilis,* Ehlers. Magell. Annel., p. 15.
1901. „ „ idem. Polych. Magell. u. Chil., p. 208.
1904. „ *gracilis,* Journ. M. B. A., vol. vii, p. 228.
1906. „ „ Bohn. Ann. Sc. nat., 9e sér., t. iii, p. 121 (movements).
1909. „ *variabilis,* Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 576.
1914. „ *gracilis,* Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 122.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 9.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 633.
„ „ „ Southern. Irish Sc. Invest., No. 3, p. 46.
1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 49.
„ „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 190.

*Habitat.*—Abundant in fissures of the gneiss rocks amongst sandy mud and gravel at St. Peter Port, Guernsey, and also between tide-marks in Herm. Polperro, Cornwall (Dr. Baird); Southport (Dr. Carrington); several examples in the Collection of the British Museum unnamed; Falmouth; Plymouth (Allen); Blacksod Bay (Southern).

Abroad it is found in the Red Sea (Savigny); Sicily (Grube, V. Carus); shores of France (De Quatrefages, Keferstein, De St. Joseph); Mediterranean and Adriatic (Claparède, Von Marenzeller); Cantabria (Rioja).

The dorsal cephalic collar, in this really the border of the *cephalic plate,* forms a small crenated rim posteriorly, and passes downward at each side to join the lower edge of the supra-oral arch. The tentacles which take origin from the plate are numerous and have the typical grooved structure. They are of a pale cream colour and partly translucent. Its front edge terminates in a prominent spout-shaped arch over the mouth, the sides inferiorly sloping obliquely to their attachment. The lower lip is formed by a transverse fold, and within it is a small tongue-like fold or

eminence probably associated with tube-formation. No eyes are visible in the preparation behind the cephalic collar.

The *body* has 120—150 segments, and is characterised by its great proportional length and slenderness posteriorly, as well as by its pale cream-colour, here and there enlivened by the blood-vessels and the brownish-red specks posteriorly. The enlarged anterior end has, further, a close series of transverse ridges which have a minutely tessellated appearance from isolated glandular masses arranged transversely. These glands have, besides the granules, clear refracting cells and globules. The separation of the longitudinal dorsal muscular fibres in this region also increases its tessellated aspect. Behind the bristled region the body gradually narrows, and ends in a slender tail with a terminal anus surrounded by marginal papillæ. The dorsal surface is convex, the ventral flattened anteriorly and grooved posteriorly. The glandular shields or plates in front are about twelve in number, with a few (three or four) additional small median processes. Behind the region of the shields is a median groove with a prominent ridge on each side. At first lateral, these ridges gradually pass to the mid-ventral line, forming posteriorly a raised belt with a median fissure, then widen a little toward the tail, where the papillæ for the hooks occur in the line of each moniliform ridge, and gradually diminish as the tip is reached.

Whilst the segments in front have several narrow rings dorsally—giving a finely ribbed aspect to the surface—the narrow posterior region has only the segment-junction separating each smooth segment. The Mediterranean forms appear to be similar in colour to those from the Channel Islands, viz., yellowish-grey.

Behind the lower lip is apparently a segment with a narrow ventral shield. The next bears the first, and larger, pair of branchiæ, each springing from a short stalk and rapidly giving off four main divisions, which split up, after a brief course, into a sub-dichotomously divided tuft with comparatively short terminal branches, the whole forming a dense arbuscle. The second, and smaller, pair is on the next segment and has a similar structure. Occasionally a specimen has three branchiæ on one side and two on the other, the third being a small independent stem behind the second.

Ventralward of the second branchial stalk is a small conical papilla which represents the first setigerous process, though it has no bristles. The next setigerous process has a well-developed tuft of bristles, which are pale, translucent, rather brittle, and in two groups, the longer forms (Plate CXXVA, fig. 2) have long, straight, deeply inserted shafts, which are nearly cylindrical to the commencement of the wings from which they taper to a delicate point. The wings have a characteristic expansion at the base, are narrow distally, and show no serrations. The shorter bristles (Plate CXXVA, fig. 2*a*), have peculiarly curved, tapering, serrated tips without distinct wings. Whilst the two setigerous processes behind the branchiæ remain isolated and simple, the third presents two processes, viz., the setigerous, and an antero-ventral papilla, and these continue in the six subsequent feet, the following (from the tenth) setigerous processes, which are somewhat conical, though antero-posteriorly flattened, remaining simple, and the first (tenth) of the (posterior) series having a small papilla below it, at the end of the hook-row. There are twenty pairs of bristle-tufts. The glandular cushions between the

bristle-tufts in front assume the form of papillæ. Marenzeller mentions that the setigerous processes are crenate at the convex tip, but this was not evident in those examined.

The first hooks occur opposite the third setigerous process—that is, the second behind the branchiæ—and they occupy the summit of the elevated ridge which extends from the bristle-tuft downward to the ventral grove, and cover, in short, the external aspect of the ventral longitudinal muscles. They are in a single row in the first six segments, but the rest are in a double row, and this continues to the commencement of the last thirty. After the cessation of the bristles the uncinigerous processes form transverse crescents in each segment, gradually, however, becoming smaller, until on the slender terminal region in front of the tail they form a series of papillæ, so that the ventral ridge on each side is moniliform. The first hooks are distinguished (Plate CXXVA, fig. 2 *b*) by the great size of the main fang, which has a crown of small hooks above it, about three being usually visible in lateral view, and by the comparatively small size and oblique nature of the base, which has above its dorsal angle an abrupt incurvation, whilst on its anterior edge it has a sharp point, for the attachment of a tendon, and a gentle incurvation beneath it. The modified form of these early hooks is indicated by the imperfect condition of those at the end of the row. By-and-by they form a double row and assume the typical condition in which the great fang is proportionally smaller (Plate CXXVA, fig. 2 *c*), the base less elongated, its lower edge more convex, and the curve below the point on the anterior edge less pronounced. About four small hooks are visible above the great fang in lateral view.

The *Amphitrite Tondi* of Delle Chiaje[1] (1828) is a form having two branchiæ, but the description is so brief, and the figure so indefinite, that it is uncertain whether it refers to *A. scylla* or not.

This species was entered by De Quatrefages (1865) under two titles, viz., Savigny's, and again as the *Physalia gracilis* of Grube.

A form with three branchiæ, but otherwise closely resembling the above in the cephalic region, intersetigerous papillæ, bristles and hooks, occurs occasionally between tide-marks in Guernsey and Herm. It would appear to be another instance of the variability of these organs (branchiæ) in a common species.

De St. Joseph (1894) describes a single pair of segmental organs in the third segment, with a ciliated funnel internally, and a reddish-brown outer region which opens between the setigerous process and the row of hooks.

Two preparations from Polperro in the British Museum, labelled "*Terebella constrictor*," contain *Amphitrite scylla*, Nos. 62.7.12.50, and 62.7.12.46.

### *Genus* CXLV.—Polymnia, *Malmgren*, 1865.

Cephalic lobe with a large collar, and at its junction with the body a series of eye-specks, whilst a frilled inward curve occurs at each lower edge. Second, third and fourth segments with small lamellæ. Anterior ventral shields larger than the

[1] 'Memorie,' vol. iii, p. 169, tav. xlv, fig. 2.

posterior. Lateral lobes on the anterior segments. Branchiæ, three. The (smooth) bristles begin on the fourth segment. Hooks, which commence on the fifth segment, with one or two teeth above the main fang; the basal region elongated and convex inferiorly. The nephridia are separate from each other, and are somewhat short and wide, those of the fifth segment having a longer tube (Hessle).

1. Polymnia nesidensis, *Delle Chiaje*, 1828. Plate CXIV, fig. 6—body; Plate CXXVa, figs. 5–5 *b*—bristles and hook.

*Specific Characters.*—Cephalic collar less developed than in *T. nebulosa*. Upper lip large and frilled, and lower lip prominent, with a tongue-like process internal to and above the latter. Eyes are absent in many preserved examples, but others show numerous eyes behind the dorsal collar. Body rather small (40 mm. in length), terminating posteriorly in the vent, which has two longer median and two lateral cirri on the ventral surface. Segments 50—80 two-ringed; two or three behind the buccal have lamellæ at their outer edges ventrally and opposite the first and second branchiæ. Fifteen to sixteen ventral shields.[1] Branchiæ three, the first the larger, dichotomously branched with short terminal divisions, so that the tips appear to be evenly truncated. Setigerous processes seventeen, the first close to the last branchia. Bristles in two series, a longer and shorter, the former with broader wings. Rows of hooks commence on the second bristled segment, a single row anteriorly, but a double row in segments 11—20. The hooks are distinguished from those of *T. nebulosa* by the presence of a second tooth above the great fang. Body and tentacles yellowish, dorsum brownish, or occasionally dull greenish. Nephridia occur from the third to the eighth segment. Tube fragile, covered with sand-grains and minute stones.

Synonyms.

1826. *Terebella lutea*, Risso. Hist. nat. l'Europe merid., t. iv, p. 409.
1828. *Amphitrite nesidensis*, Delle Chiaje, Mem., vol. iii, pp. 169, 179, Tav. xliii, figs. 2, 3.
1841. „ „ idem. Descriz., vol. iii, p. 69, vol. v, p. 94, Tav. cv, figs. 2, 3.
1843–53. *Terebella* „ Chenu. Illust. Couch., 11e livr., pl. v, fig. 4.
1848. *Terebella lutea*, Grube. Archiv f. Naturg., xiv, p. 114, Taf. iv, figs. 9, 10.
1851. „ *nesidensis*, idem. Fam. Annel., p. 81.
1855. „ *lutea*, idem. Arch. f. Naturges., Bd. xxi, p. 116.
1861. „ „ idem. Ausflug. Triest., pp. 85, 128.
1864. „ „ idem. Insel. Lussin., p. 87.
1865. „ *Danielsseni*, Malmgren. Nord. Hafs.-Annul., p. 379, Tab. xxi, fig. 54.
„ „ *abbreviata*, De Quatrefages. Annel., t. ii, p. 363.
„ „ *nesidensis*, idem. Ibid., p. 365.
1867. *Polymnia Danielsseni*, Malmgren. Annul. Polych., p. 108.
1868. *Terebella flavescens*, Claparède. Annél. Nap., p. 396, pl. xxiii, fig. 6.
1869. „ *Danielsseni*, Grube. Abhandl. Schles. Gesell., 1868—9, p. 105.
1870. „ *abbreviata*, idem. Arch. f. Naturges, 36 Jr., p. 334.

[1] Fifteen ventral scutes, the first eight being short and wide, and the last triangular (Lo Bianco).

1871. *Terebella lutea et Danielsseni,* idem. Jahresber. Schles. Gesell., p. 50.
1873. „ *Danielsseni,* Kupffer. Jahresb. Komm. deut., p. 152.
1874. *Polymnia* „ Malm. Annul. Göteb., p. 97.
1875. *Terebella lutea,* Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 230.
1879. „ *Danielsseni,* Tauber. Annul. Danica, p. 131.
1883. *Amphitrite Danielseni,* Levinsen. Vidensk. Meddel., p. 175.
1884. *Polymnia nesidensis,* Marenzeller. Sitzb. K. Akad. Wissensch., p. 51, Taf. i, fig. 5 (sep. abdr.).
1885. „ „ Carus. Fauna Medit., i, p. 265.
„ *Terebella* (*Polhymnia*) *Danielsseni,* Wirén. Köngl. Sv. Vet. Akad. Handl., Bd. xxi, p. 18, etc.
1887. *Polymnia nesidensis,* Meyer. Mitth. Zool. Stat. Neap., t. vii, pp. 634 and 636.
1888. *Terebella Danielsseni,* Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 663, pl. xliii, fig. 25.
1893. *Polymnia nesidensis,* Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 56.
1894. „ „ Bidenkap. Forhandl. Vidensk.-selsk. Christ., No. 10, p. 129.
„ „ „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 225, pl. x, figs. 256—258.
1896. *Terebella Danielsseni,* Appellöf. Berg. Mus. Aarb., xiii, p. 12.
1897. *Polymnia nesidensis,* Michaelsen. Polych. deutsch. Meere., p. 170.
1903. „ „ Moore. Proc. Acad. Nat. Sc. Philad., p. 475.
1904. „ „ Journ. M. B. A., vol. vii, p. 229.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 238.
1909. „ „ Fauvel. Bull. Inst. Ocean., No. 142, p. 29.
„ „ „ Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 584.
„ „ „ Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 209.
1910. „ „ Elwes. Journ. M. B. A., vol. ix, p. 63.
1912. „ „ Crawshay. Ibid., vol. ix, p. 343.
„ *Terebella Danielsseni,* Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 97, pl. xxix, figs. 1—6.
1913. *Polymnia nesidensis,* Ehlers. Deut. Südpol. Exped., p. 560.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 124.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 11.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 634.
1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 57.
„ „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 175.

*Habitat.*—Dredged in 110 fathoms 30 miles west of the Blasquet, S.W. Ireland, 1869 (J. G. J.). Not infrequently in Bressay Sound, in 8—10 fathoms amongst tangle-roots; in 6—8 fathoms, West Voe of Scalloway (W. C. M.). Plymouth (Spence Bate, B. Rowe and Crawshay). Dredged amongst oysters, scallops and mussels in the Great Roussel, Guernsey (W. C. M.) Common in Laminarian roots, Torquay (Elwes); coast of Durham (G. S. Brady). Blacksod Bay and other parts on West Coast of Ireland (Southern). A very attenuate fragment about 4 inches long amongst examples of *Notomastus latericeus* from Plymouth (1908). Elsewhere it is found in Japan (Moore); French coast (De St. Joseph). Extends to the Mediterranean and Adriatic (Delle Chiaje, Grube, Claparède, Marenzeller, Fauvel) as well as to Sweden and Finmark (Malmgren); shores of the North Sea and Baltic (De Quatrefages, Grube, Marenzeller); South Polar waters (Ehlers).

The *cephalic* region has a less developed dorsal collar than in *P. nebulosa*, and

it is not usually folded backward as in that species; moreover, no eyes are present in many of the preparations. The upper lip in front of this forms a large frilled process, and the lower lip is also prominent. A median tongue-like process lies above and internal to the latter. In extreme protrusion of the mouth-parts some have the lower lip folded backward ventrally with a smaller and a larger fold above it, whilst in others the lower lip projects downward and outward as a cyathiform process marked by a fold at each side.

The *body* is comparatively small in comparison with *P. nebulosa*, is convex and smooth dorsally, deeply grooved ventrally from the ventral shields almost to the tip of the tail, which in perfect examples has two longer median and two lateral cirri on the ventral surface, the rest of the vent being crenated or with short papillæ. Two segments following that bearing the lower lip have a lamella at their outer edges ventrally, and are opposite the first and second branchiæ. The anterior, indeed, often stands out as a frill on the front edge of the shield. In all, about sixteen shields are present ventrally, and they bear traces of the two-ringed condition of the segments generally. They are narrow and transversely elongated in front, broad and transversely shortened posteriorly. The ventral groove abuts on two rounded lateral ridges (probably marking the ventral longitudinal muscles), and bearing the elevations or lamellæ for the hooks. The segments are two-ringed. It is a smaller species than *Polymnia nebulosa*, and of a firmer consistence. Colour yellowish, with brownish grains, ventral surface dull yellow (chamois, Marenzeller).

The branchiæ are three in number, the anterior being the largest, the second and third regularly diminishing. In proportion to the size of the body they are somewhat larger than in *P. nebulosa*, and they have a stiffer outline. They are dichotomously branched, and have very short terminal divisions—a distinctive feature when contrasted with *P. nebulosa*. A variety (?) from the West Voe of Scalloway, in 6—8 fathoms, has longer tips to the branchiæ, but the hooks appear to be identical.

The setigerous processes are seventeen in number, the first occurring close to the base of the last branchia. The bristles are long, translucent, slightly yellowish and finely tapered (Plate CXXVA, figs. 5 and 5*a*), and, as usual, in two series, a shorter and a longer. In the latter the wings are narrow and indistinct; in the former they are broader and easily recognised, but they do not proceed to the finely tapered extremity of the bristle. A curvature of the tip occurs at the winged region. Little difference exists between the first bristles and the last except in the fewer number as contrasted with the middle and anterior groups.

The rows of hooks commence on the second bristled segment, and they are comparatively short to the seventh bristle-bundle, the last ten of the region being longer. Moreover, whilst they form a single row in front they are arranged in a double row from the eleventh to the twentieth segments, the main fang in each pointing to a median line between the rows. Behind the bristles the hooks are borne on an uncinigerous process or lamella, and form shorter rows than in front. The lamellæ have a concave distal margin anteriorly, but posteriorly the tip is bifid, and the processes diminish toward the tip of the tail.

The hooks (Plate CXXVA, fig. 5*b*) somewhat resemble those of *Polymnia nebulosa*,

in general form, but are readily distinguished by the presence of a second tooth above the main fang and the somewhat shorter base. The posterior incurvation is below the middle, and the process on the anterior outline is prominent.

*Reproduction.*—This species, according to Lo Bianco (1909), is ripe in spring. Southern found it mature from February to May.

The *tube* is fragile, covered with grains of sand and small stones.

Malmgren thought that *Terebella lutea* from the Mediterranean was allied, yet distinct. Moreover, he considered that *T. debilis* and *T. nebulosa*, Grube, should form a distinct genus (*Polymnia*), since their branchiæ and hooks are so characteristic.

De St. Joseph (1894) found in this species Gregarines pertaining to the genus *Polyrabdina*, Mangazzini,[1] also *Gregarina terebellæ*, Kölliker, and encysted Distomes of the same kind as in *Nicolea venustula* and *Polymnia nebulosa*.

Examples of *Polymnia* have been found by Orton[2] (1914) to attain a good size in much less than a year, so that their development is somewhat rapid.

A variety, of small size, procured at various parts of the British coast, at first sight resembling Malmgren's *P. arctica*, shows finer divisions of the branchial filaments, which are proportionally long. Two teeth as a rule are present in the hooks above the main fang, a trace of a process occurs midway along the curve below the latter, and the ventral outline (of the base) is more convex.

2. Polymnia nebulosa, *Montagu*, 1818. Plate CXIV, fig. 6—body; Plate CXXVa, figs. 3 and 3 *a*—bristles and hook.

*Specific Characters.*—Cephalic region with a large collar or upper arch, at the junction of which with the body posteriorly is a dense series of eye-specks, whilst it has a frilled inward curve at each lower edge. The upper arch folds inward to form the upper lip. Tentacles pale orange and spotted with white. Below the mouth is a transversely elongated tongue-like fold, and then the lower lip extends to the dorsal fold on each side. Body 70—100 or more mm. in length, as thick as a man's little finger, and having ninety or more segments, soft in consistence, fragile, of the typical shape, tapering posteriorly and ending in an anus with a crenate margin. Segments two-ringed. Orange-red, sometimes inclining to brown or paler and speckled all over with white. First segment massive ventrally; second, third and fourth with small lamellæ. Ventral shields fourteen or fifteen, the anterior narrow and broad, the posterior wider and shorter from side to side. Seventeen pairs of bristle-bundles. Segments in a line with the second and third branchiæ have a free lamella. The tentacles have the same hue as the body. Branchiæ three, on segments 2, 3 and 4, the first the largest, sub-dichotomously divided, the terminal processes numerous so as to give the organs a dense arbuscular aspect, or like a corymb. Nephridia from the third to the eighth segment. Setigerous processes with two sets of bristles, long, minutely striated forms with curved, tapering and winged tips, and a shorter series with translucent tapering

[1] 'Atti Acad. Lincei,' 4e sér., t. vii, p. 229, 1891; see also Schneider, 'Arch. Zool. Expér.,' t. iv, 1875, p. 598, pl. xxii, figs. 85 and 86.

[2] 'Journ. M. B. A.,' vol. x, p. 316.

tips either devoid of wings or with these rudimentary. Hooks with an elongated, convex base, a process for a ligament on the anterior margin, a main fang, and only one tooth above it in lateral view; in a double row in segments 11—20. Tube of shell-fragments, stones, fragments of Echinoderm tests, spines and other hard structures and secretion. Usually fragile, and sometimes with the rock for part of its circumference.

Synonyms.

1808. *Amphiro nebulosa,* Montagu. MS. Vol. Linn. Soc., pl. xxxix, fig. 1.
1818. *Terebella* „ idem. Trans. Linn. Soc., vol. xii, p. 343, Tab. xii, fig. 2.
1828. „ *Meckelii,* Delle Chiaje. Mem., vol. iii, pp. 169, 180, Tav. xlv, fig. 10.
1836–49. „ *nebulosa,* Cuvier. Rég. An., Edit. illust., p. 25, pl. i *b*, fig. 1.
1838. „ „ Milne Edwards. Ann. Sc. nat., 2e sér., t. x, p. 198.
1841. „ *Meckelii,* Delle Chiaje. Descrizione, vol. iii, p. 70, vol. v, p. 94, Tav. lxxx, fig. 10.
1842. „ *nebulosa,* Chenu. Bibl. Conch., t. ier, p. 266, pl. xxiii, fig. 2.
„ „ „ De Quatrefages. Souven., i, p. 46.
1843–53. „ „ Chenu. Illust. Conch., 11e livr., pl. iv, fig. 4.
„ „ *Meckelii,* idem. Ibid., pl. v, fig. 3.
1845. „ *nebulosa,* Milne Edwards. Ann. Sc. nat., sér. 3, tome iii, p. 147, pl. viii.
1848. „ „ Grube. Archiv f. Naturg., xiv, p. 116, Tab. iv, fig. 14.
1851. „ „ idem. Fam. Annél., pp. 80 and 138.
„ „ „ Williams. Rept. Brit. Assoc., 1851, pp. 170 and 183.
1853. „ „ idem. Ann. Nat. Hist., xii, p. 408, pl. xiv, figs. 1—3.
„ „ *tuberculata,* Dalyell. Powers Creator, vol. ii, p. 197, pl. xxvi, fig. 8, pl. xxvii, figs. 1 and 2.
1855. „ *nebulosa,* Grube. Arch. f. Naturges., 21 Jahrg., p. 115, Taf. iv, fig. 14.
1858. „ „ (segmental organs), Williams. Philos. Trans., p. 121.
1861. „ „ Grube. Ausflug nach Triest., p. 128.
1862. *Amphitritoides rapax,* A. Costa. Ann. Zool. Univ. Napoli, p. 32.
„ *Pallonia rapax,* idem. Ibid., p. 89.
1864. *Terebella nebulosa,* Grube. Die Insel. Lussin, p. 87.
1865. „ *debilis,* Malmgren. Nord. Hafs.-Annul., p. 378, Tab. xxii, fig. 57.
„ „ *nebulosa,* De Quatrefages. Annel., t. ii, p. 359.
„ „ *Meckelii,* idem. Ibid., p. 365.
„ „ *tuberculata,* Johnston. Cat. Worms Brit. Mus., p. 239.
1867. „ *nebulosa,* Costa. Ann., iv, p. 54.
„ „ „ Parfitt. Annel., Trans. Devon. Assoc., p. 32.
„ „ *debilis,* Malmgren. Annul. Polychæt., p. 108.
1868. „ *Meckelii,* Claparède. Annél. Nap., p. 391, pl. xxviii, fig. 3.
1869. „ *nebulosa,* McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 423.
1872. „ „ Grube. Abh. Schles. Ges. nat. Cult., 1869—72, p. 68.
„ „ *viridis,* Malm. Berg. Mus. Aarb., p. 97, Tab. i, fig. 7.
1873. „ *debilis,* Kupffer. Jahresb. Komm. deut., p. 152.
1874. „ „ Malm. Annul. Göteb., p. 96.
„ *Polymnia nebulosa,* Orlandi. Atti Soc. Ligust. Sc. Nat., vol. vii, p. 157.
1875. *Terebella Meckelii,* Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 230.
1879. „ *debilis,* Tauber. Annul. Danica, p. 131.
1883. „ „ Levinsen. Vidensk. Meddel., p. 175.

1883. *Terebella Meckelii,* Salensky. Arch. Biol., t. iv, p. 221, pls. viii and ix.
1884. *Polymnia nebulosa,* Marenzeller. Sitzb. der K. Akad. Wissensch., Wien 1884, p. 199, Taf. i, fig. 4, sep. abdr., p. 49.
1885. „ „ Carus. Fauna Medit., i, p. 265.
„ *Terebella debilis,* Wirén. Köngl. Sv. Vet.-Akad., Bd. xxi, p. 17, etc., Tab. ii, figs. 3—5, pl. iv, fig. 7, pl. vi, figs. 6 and 7.
1886. „ *nebulosa,* Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xv, p. 158.
1887. *Polymnia* „ Meyer. Mitth. Zool. Stat. Neap., Bd. vii, pp. 634—637, 639, 654—662, pl. xxvii, figs. 11—27.
1891. *Terebella* „ Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 257.
1893. *Polymnia* „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 56.
1894. *Terebella debilis,* Bidenkap. Christ. Vet. Akad. Forhandl., p. 128.
„ *Polymnia nebulosa,* De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 219, pl. ix, figs. 246—255.
1896. *Terebella viridis,* Appellöf. Bergens Mus. Aarb., xiii, p. 12.
1897. *Polymnia nebulosa,* Michaelsen. Polych. deutsch. Meere., p. 172.
1904. „ „ Journ. M. B. A., vol. vii, p. 229.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e ser., t. iii, p. 237.
„ „ „ Bohn. Ibid., 9e sér., t. iii, p. 120 (movements).
1909. „ „ Fauvel. Bull. Inst. Ocean., cxlii, p. 29.
„ „ „ Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 584.
„ „ „ Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 209.
1910. „ „ Elwes. Journ. M. B. A., vol. ix, p. 63.
1911. *Terebella* „ Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 63.
1912. *Polymnia* „ Crawshay. Journ. M. B. A., vol. ix, p. 343.
„ *Terebella debilis,* Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 96, pl. xxviii, figs. 1—6, and text-figs. 11 and 12.
„ *Polymnia nebulosa,* Meyer, A. H. Inaug. Dissert. Kiel, p. 45.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 124.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 298.
1915. *Terebella* „ Allen. Journ. M. B. A., vol. x, p. 634.
„ *Polymnia* „ Southern. Irish Sc. Invest., No. 3, p. 46.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 12.
1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 55.
„ „ „ Fauvel. Arch. Zool. Expér., t. lvi, p. 267.
1918. „ „ idem. Bull. Mus. Hist. Nat., No. 5, p. 12.
1919. *Terebella* „ idem. Ibid., No. 5, p. 341.
„ „ „ idem. Arch. Zool. Expér., t. lviii, p. 450.

*Habitat.*—Tenby (Goodall); Falmouth (Cocks); Berwick Bay (Johnston); Shetland (Dalyell). Large examples are found in the creek to the south of the jetty at Lochmaddy, and at various parts of the Loch at extreme low water, under stones, and especially where the bottom is composed of shell-gravel; dredged in Fermain Bay, Guernsey, attached to the interior of an old valve of *Pecten;* not uncommon in old valves of Lamellibranchs in the laminarian region (6—8 fathoms) in Bressay Sound, and more frequently in 8—10 fathoms amongst horse-mussels in the West Voe of Scalloway. It is abundant at Herm under stones near low water-mark, and dredged in various shells off this island in 12—20 fathoms. Dredged off Peel, Isle of Man, 10—12 miles from shore

in valves of *Pecten opercularis* (W. C. M.). Dredged off the Hebrides in considerable numbers; 9 miles off Balta (J. G. J.); Valentia Harbour in 2 fathoms amongst soft mud (J. G. Jeffreys and A. C. Haddon); Torquay (Elwes); Plymouth (Spence Bate, B. Rowe and Crawshay); Blacksod and Clew Bays, etc. (Southern).

It is elsewhere found in the Mediterranean (Delle Chiaje, Milne-Edwards, Grube, da Costa, Panceri, Claparède, Fauvel); Adriatic (Grube), amongst stones and nullipores as well as in a brown sponge; shores of France (Milne-Edwards, Grube, De St. Joseph); Azores and Gibraltar, Isles of Gambia (Fauvel); Finmark (Norman); North Sea; Gulf of St. Vincent, Australia (Fauvel).

The *cephalic region* is distinguished by the great size of the upper collar or arch, and by its frilled inward curve at each lower edge. Its upper surface is somewhat flattened, that is to say, only a shallow groove is present, the mass of tentacles springing from the posterior half near the rim. These tentacles are pale orange in life, and spotted with white so as to give them a barred appearance, and their movements are remarkable, for not only do they aid in the construction of the tube, but hoist the animals up the perpendicular side of a glass vessel or in any direction, and are continually moving as a series of complex threads. All are deeply grooved. When the annelid is hidden amongst shells and tufts of *Ceramium* the long spreading tentacles resemble independent Nemerteans, and in large examples stretch nearly a foot from the body. Below the mouth is a transversely elongated fold, and then follows the broad lower lip, which ceases at the dorsal fold on each side.

Behind the dorsal collar are a large number of dark pigment-spots—the so-called eyes. These are generally concealed by the posterior fold of the collar. In a small variety met with under stones between tide-marks at St. Peter Port, Guernsey, they are both numerous and distinct, and, moreover, remain in spirit. They form in a large Irish example a conspicuous brown band below the collar.

*Body* 9—10 inches or more in length, and as thick as the little finger behind the bristles, soft and mobile, with numerous (sixty to ninety) narrow segments, the anterior region being enlarged, and the posterior tapered to a comparatively large terminal anus with a crenate margin. Though the dorsum as a rule is convex, the preparations are generally marked by a slight median groove anteriorly. Ventrally, a deep median groove runs from one end to the other. In large examples the swollen anterior end is tessellated, whilst in the smaller posterior region this is less evident.

Each segment consists of two rings, one at the bristle-tuft and one in front of it dorsally, and these are continued ventrally, the groove in the ridge for the hooks being opposite the bristle-tuft, and only a narrow space occurring between them (the ridges). Posteriorly the segments are more definitely marked, the broader division containing the lamella for the hooks, a narrow ring being in front of it. Then the two rings are only indicated laterally above the lamellæ for the hooks, and finally for some distance at the tail each segment is undivided, and moreover, the segments become more and more minute as they approach the last, which is broader than those in front of it and has a minutely crenate margin. The ventral surface in this region is considerably diminished whilst the dorsal arch is increased. The ventral glandular shields are narrow and long in front, broader and shorter from side to side from the fifth backward, and they often

present a median process laterally in front of the point of contact of the hook-row. They are usually fourteen or fifteen in number, the anterior narrow shields being ridged (two-ringed), the posterior flattened. Occasionally an abnormality occurs in the arrangement of the two rings anteriorly, the broad posterior ring ceasing like a fold in the middle line. Reproduction of the tail is common.

The mucous glands form a dense series of orange tufts in the thoracic region on each side of the middle line and extend forward to the anterior end. They are long and much folded and frilled anteriorly, and the contents tinge the long anterior ones white with the exception of the orange tips. The contents consist of granular cells, granules and protoplasmic threads and vesicles. In the small forms from the Channel Islands the five posterior ventral shields in well-preserved examples present a symmetrical arrangement, each being broadly fan-shaped in front, constricted posteriorly, and sending out a spur on each side in front of the succeeding shield.

The Hebridean forms are orange-red, sometimes inclining to brown, speckled all over (tentacles, body and branchiæ) with white (on tubercles, Dalyell), and the larger examples are darker than the smaller. The oral region is purplish-red, also spotted with white. Those from the Channel Islands are paler than the foregoing, but also speckled with white on both body and branchiæ. The tentacles in the latter are irregularly barred with white, and in young specimens from Herm they are milk-white. The specks rapidly disappear in spirit.

The branchiæ are three in number on each side, and have a dull red colour spotted with white. The first pair are about 1 inch long in large specimens, and arise from the second body-segment, which has a spout-like fold at each side. The main stem is often unbranched for some distance, whilst in others (large) a small branch or two occur close to the base. The whole organ is sub-dichotomously divided, the short terminal divisions giving a character to the mass which appears to form a dense arbuscle. In many of the divisions the branches spring from one side only, but this does not appear to hold in the distal divisions. The ring at the base of the first branchia trends evenly away from it to the frill near the external margin of the mouth. A small papilla sometimes occurs close to the base of the second branchia—it may be only on one side—whilst ventralward the anterior fillet of the segment has a free process like a flat papilla. Close to the outer base of the third branchia is the first setigerous papilla, and a short distance ventralward is a similar free flattened process to that described in the previous segment.

In young examples the branchiæ are comparatively simple, though the terminal divisions correspond in general structure with that of the adult, and in a small littoral variety from St. Peter Port, Guernsey, the branchiæ are likewise less bushy, though the terminal branches are typical.

The setigerous processes are seventeen in number, commencing, as indicated, at the third branchia and continuing for sixteen segments thereafter. Each is a somewhat flattened papilla with the bristles arranged in a vertical row in the centre. The first tufts of bristles are smaller, the bristles themselves shorter, but they show two groups, as in the posterior, viz., a shorter series in this case without evident wings, and a longer series also without evident wings, and with slightly curved and tapered tips. In the

middle of the bristled region the longer pale golden bristles have stout striated shafts (Plate CXXVA, fig. 3) of nearly equal diameter, and tapering tips with wings. Many of these seem to have been broken in life, and show modified tips. The striæ at the commencement of the wings are oblique. The shorter bristles are more translucent and have either no wings on the free portion or very narrow ones.

The hooks commence on the segment behind that described as having the triangular fold in a line with the last branchia—that is they occur in the segment behind the branchiæ. At first they are in a single row, but by-and-by they form an alternate double row along the centre of the ridges which pass in front from the bases of the setigerous papillæ to the edge of the ventral scutes, and behind these almost to the mid-ventral line. With the cessation of the bristles a change ensues, for the hooks are now borne on a prominent lamella—slightly crescentic or scoop-shaped, and placed laterally at the posterior edge of each segment—which still consists of two rings. These lamellæ diminish in size posteriorly, becoming minute towards the tip of the tail. On these lamellæ the hooks form a close series in a single row. The hooks (Plate CXXVA, fig. 3 *a*) are distinguished by their elongated basal region, which has a median convexity, then curves upward at the anterior edge, which has a small process for the ligament. A process also occurs on the anterior margin about its middle, a double curve meeting at this point. The large fang is well developed and has only a single tooth above it in lateral view. The posterior margin has a deep incurvation. The hooks vary chiefly in the shape of the basal region.

The alimentary canal consists of mouth, muscular gullet, which is firm, narrow and dull greyish in colour, with many blood-vessels on its walls. It joins the dilated orange region, with its highly rugose glandular walls and the longitudinal bands of muscles. This terminates in the pale and wide gut which leads to the vent.

*Food.*—The muddy sand in the gut was loaded with sponge-spicules, diatoms, Foraminifera and organic particles of various kinds.

*Reproduction.*—In June amongst the perivisceral corpuscles were numerous ova which were much larger than the former by one to three diameters, and which varied considerably in size. Each had a zona, granular contents, a clear nucleus, and one or more nucleoli. The ova are developed in the paired, long strap or tongue-shaped ovaries, which arise ventral of the bristle-bundles in the anterior region. They are longest in front, and extend as far forward as the branchiæ. The long anterior organs appeared to be empty, only the cilia occurring internally. They soon, however, had ova in their interior and many of the posterior were laden with them. These posterior processes were shorter, broader, and more plume-like. They are attached to the body-wall inside but close to the bristle-bundle, and probably represent those nephridia which transmit the reproductive elements.

*Perivisceral fluid.*—This is coloured of a reddish hue and consists of a vast series of ovoid corpuscles filled with yellowish granules, and may possess in addition one or more larger clear circular vesicles, which, however, may be connected with katabolic changes. The corpuscles altered their outline by pressure against each other, and broke up into smaller cells with protoplasmic processes projecting from their surfaces.

The muscular fibres of the body-wall form a series of strands, both longitudinal and

circular, anteriorly over the swollen thoracic region. Two circular bands occur in each segment, whilst the longitudinal are in numerous separate strands, which give the dorsum a corded appearance.

Two varieties occur, viz., the large littoral form from Lochmaddy, and those from deep water, which are smaller.

*Commensals.*—In North Uist, as at Lochmaddy, *Polynoë scolopendrina* of large size is frequently met with in the tubes of this Terebellid. It is hard to conjecture how the soft—almost semi-gelatinous—annelid tolerates the stiff, hard-spined *Polynoë*, but it shows no signs of uneasiness or injury, and the *Polynoë* must supply itself with food either independently or from the catering of the *Terebella*. Very rarely was this commensal found in the numerous examples procured from the Channel Islands (Guernsey and Herm), and thus they were in contrast with those from Lochmaddy. Nor was a *Polynoë* found in those from Scalloway.

The tube of this form is composed of small stones, fragments of shells, or in certain cases, as in Ireland, fragments of slate with secretion, and it is loosely bound together, the cement readily giving way on attempting to remove it from its site. Some of the tubes are three-quarters of an inch in diameter, and they may be in the form of a long arch on a stone or rock; the annelid, taking advantage of the surface of the stone, thus saves both labour and materials. The tubes occur in some cases in groups or small colonies on congenial sites. The tube of one from Valentia Harbour is composed of fragments of leaves and other vegetable structures and fibres, the whole forming a soft tube.

An excellent account of the formation of the tube in confinement is given by De St. Joseph (1894). This author also states that in dredged examples the general colour is cinnamon with numerous white points, and thus corresponds with the so-called *Terebella Meckelii*. He mentions the occurrence of a papilla under the second pair of branchiæ, and the same on the five succeeding segments between the setigerous process and the torus.

*Habits.*—When seized in its tube it often breaks itself behind the bristled region, the "suicidal mark" of the Terebellids. Few species, indeed, are more irritable, for when touched it breaks off the posterior region, and almost always does so, even when cautiously lifted. Yet it swims actively when placed in water. It is not luminous.

*Reproduction.*—Ray Lankester[1] (1873) during the winter at Naples found the eggs in abundance, and observes that "a delicate chorion forms round the egg after segmentation, on the surface of the cleavage-cells, which are densely ciliated," and that "the cilia were really processes of the protoplasm of the cells" and could be drawn through the chorion, which they perforated.

Lo Bianco (1909) found that the period of reproduction at Naples, where the species is termed "Terebelle," was between August and May, most, however, occurring between January and April. The yellowish-orange ova are enveloped in a gelatinous matrix 2—4 cm. in diameter (fissato sull' orlo del tubo).

A careful account of the development of this species was given by Milne Edwards in 1844.[2]

[1] *Vide* p. 100.

[2] *Vide* p. 96.

Montagu's description (1818) is characteristic, and in his examples the branchiæ were likewise speckled with white. His specimens from Devonshire appear to have been about the size of those from the Outer Hebrides, viz., 6 or 7 inches and ½ inch in diameter. He thought the ventral shields were dorsal. The example figured had a reproduced tail. He describes the tube as composed of slimy matter covered with gravel and broken shells.

Dalyell (1853) procured his examples from Shetland. He gives no details of structure, though seventeen pairs of bristle-bundles are represented in his plate. He noted regeneration of the posterior extremity, the new region being grey at first, but gradually darkening and becoming finely speckled in five months.

Claparède (1868) had doubts about the identity of *Terebella Meckelii*, Delle Chiaje, and *T. nebulosa* of Montagu, but the differences in size (the northern form being much larger) and the colour of the tentacles cannot be depended on, and so far as can be judged these forms are the same. He draws special attention to the rounded gland-capsules in the pads or tori for the hooks, and considers them peculiar to the species.

Salensky (1883) gives a careful account of *Terebella Meckelii* with excellent figures, He describes the various stages, and the derivation of the various organs from the epiblast, mesoblast and hypoblast (his *entoderme*).

The *Terebella viridis*, n.s. of Malm[1] (1872), has three thinly branched branchiæ somewhat after the condition in *Nicolea*, and is held to be a variety of the present form.

De St. Joseph (1894) describes six segmental organs, two small in the third and fourth segments, a third in the fifth, and the last three in the sixth, seventh and eighth segments. He found an encysted Distome in this species anteriorly. He does not allude to any commensalistic form in its tube. This author[2] (1906) found many specimens of the Gregarine *Doliocystis*, some free without the epimerite, others fixed by the latter to the wall of the intestine and having posteriorly a diaphanous membrane. He also records Gregarines of the genus *Ulivina*, Ming. (*Sycia*, Léger), and of the genus *Selenidium*, free stages of *Gregarina terebellæ* of Kölliker.

Paton[3] (1899) describes the heart-body in *Polymnia* as a cylindrical rod over which the blood flows on its way to the gills, and attached to the wall of the heart by fine processes. It is mesoblastic in origin in this form, and, as Eisig suggests, it may be of the nature of intra-chloragogen, or modified peritoneal tissue, since "the tissues included under that designation" differ chemically. The heart-body being situated in the stream of blood from the alimentary to the respiratory organs, Paton concludes that its functions may be similar to the liver of the higher forms.

Fauvel considers the small *Terebella Grubei* procured by the "Challenger" in Australian waters this species, and the hooks certainly show little difference.

In the British Museum preparation 62.5.7.43 (labelled *T. conchilega*) is *Polymnia nebulosa* from Polperro, where it lives in chinks of rocks.

[1] 'Annul. Göteb.,' p. 97, Tab. i, fig. 7.

[2] 'Ann. Sc. nat.,' 9e sér., t. iii, p. 176, pl. iii, fig. 56.

[3] 'Quart. Journ. Micros. Sc.,' vol. xli, p. 288, pl. xxi, figs. 33, 35 and 36.

*Genus* CXLVI.—Lanice, *Malmgren*, 1865.

Cephalic region with small dorsal collar, the sides expanding into great lateral flaps which almost or completely meet in the mid-ventral line. The anterior margin of the tentacular plate forms a spout-like border surrounding the mouth. Body typical. Branchiæ three finely-branched tufts on each side, more or less whorled toward the tip, and situated on the first, second and third segments. Seventeen pairs of bristle-bundles from the fourth segment backward. Hooks commence on the second bristled segment, and range from eleven to twenty, biserial; they continue to the posterior end. Ventral scutes distinct.

Marenzeller (1884) placed *Lanice* after *Pista*, which followed *Leprea*; that again, in turn, came after *Amphitrite*.

1. Lanice conchilega, *Pallas*, 1766. Plate CXIIIa, figs. 2 and 2 *b*—body; Plate CXIX, figs. 8—8 *e*—structure and tubes; Plate CXXVa, figs. 4—4 *c*—bristles and hook.

*Specific Characters.*—Cephalic region as in the genus, the meeting of the lateral flaps of the dorsal collar in the mid-ventral line perhaps being normal. Statocyst on each side in the second segment. Body 270 mm. long, of a salmon-pink hue, except where the vessels give a deeper red or the intestine a dull greenish tint. Ventral surface anteriorly is deep red or brown, the tentacles pale pink, and the branchiæ dull red. Anus with marginal papillæ. Ventral shields (fourteen to seventeen, Marenzeller) extend from the lower lip almost to the termination of the bristles, each segment having its shield generally divided transversely into two. A glandular belt occurs on each side in the line of the bristle-bundles, and it extends considerably behind the bristled region. The third segment has a greatly developed anterior lamella stretching from the edge of the ventral shield almost to the second branchia. Anterior nephridia three on each side, the funnels opening in the second, third and fourth segments. The posterior nephridia occur in the sixth to ninth segments. Bristles with striated shafts, and a double serrated wing on each side of the tapering tip. From the sixth to the ninth segment a small papilla exists behind the bristle-tuft. Hooks present a stout base which narrows upward to the curved neck, above which are the main fang and two teeth above it in lateral view; biserial from the eleventh to the twentieth segment. Tubes lined by secretion, covered by fragments of shells, Foraminifera, gravel, fragments of Echinoderms, Balani and Serpulids, with a dendritic free end, the fimbriæ often being attached to two flattened basal plates or laminæ.

Synonyms.

1766. *Nereis conchilega,* Pallas. Miscell. Zool., p. 1311, Tab. ix, figs. 14—22.
1767. *Sabella chrysodon,* Linnæus. Syst. Nat., edit. xii, p. 1269.
1791. *Terebella conchilega,* Bruguière. Encycl. Méth., pl. lvii, figs. 5—12.
1803. *Sabella chrysodon,* Montagu. Test. Brit., vol. ii, p. 546.
„ „ *conchilega,* idem. Ibid., p. 547.
1806. *Terebella* „ Turton's Linn., p. 84.

1807. *Terebella conchilega* and *chrysodon*, Turton. Brit. Fauna, vol. i, p. 132.
1812. „ „ Gmelin. Syst. Nat., i, pt. vi, p. 3113.
1817. *Sabella* „ Stewart. Elements, vol. ii, p. 423.
1818. *Terebella* „ Lamarck. Anim. s. Vert., t. v, p. 363.
„ „ „ Schweigger. Handb. Nat., p. 599.
1820. „ „ Savigny. Syst. Annel., p. 85.
1828. „ „ De Blainville. Dict. Sc. nat., t. lvii, p. 438, pl. iv, fig. 2.
„ *Amphitrite Tondi*, Delle Chiaje. Memorie, vol. iii, p. 180, Tav. xlv, fig. 2.
„ „ *flexuosa*, idem. Ibid., pp. 169, 180, pl. xliii, fig. 5.
1830. „ *conchylega*, Bosc. Vers. (2nd Edit.), i, p. 195.
„ „ „ Cuvier. Règ. An., t. iii, p. 193.
1836. *Terebella conchilega*, Templeton. Mag. Nat. Hist., ix, p. 233.
1841. *Amphitrite Tondi*, Delle Chiaje. Descrizione, Tav. lxxx, fig. 2 (multilans).
„ „ *flexuosa*, idem. Descriz. e not., t. iii, p. 70, and t. v, p. 94, pl. cv, fig. 5.
1843–53. *Terebella borealis*, Chenu. Illust. Conch., 11e livr., pl. iii, fig. 1.
„ „ *flexuosa*, idem. Ibid., 11e livr., pl. v, fig. 5.
1844. *Terebella conchilega*, Thompson. Fauna Irel., p. 272.
1849. „ „ Milne Edwards. Règ. An., pl. v, fig. 1.
1850. „ „ De Quatrefages. Ann. Sc. nat., 3e sér., t. xiv, p. 368, pl. x, fig. 4.
1851. „ „ Maitland. Fauna Belg., p. 205.
„ „ „ Grube. Fam. Annel., pp. 80 and 138.
1853. „ *littoralis, seu arenaria*, Dalyell. Pow. Creat., vol. ii, p. 183, pl. xxvi, figs. 1—7.
1857. „ *conchilega*, Koren. Nyt Mag., ix, p. 94.
1862. „ „ Keferstein. Zeitsch. f. wiss. Zool., Bd. xii, p. 128.
1863. „ *artifex*, Sars. Nyt Mag. Naturvid., xii, p. 310.
1865. „ *conchilega* and *littoralis*, Johnston. Cat. Worms Brit. Mus., pp. 235 and 345.
„ *Physelia Tondi*, De Quatrefages. Annel., t. ii, p. 355, pl. xix, fig. 2.
„ *Terebella prudens*, idem. Ibid., p. 357.
„ „ *pectoralis*, idem. Ibid., p. 358
„ *Lanice conchilega*, Malmgren. Nord. Hafs.-Annul., p. 380.
1867. „ „ idem. Annul. Polych., p. 108, Tab. xiii, fig. 73.
„ *Terebella* „ Parfitt. Cat. Devon Annel., p. 31.
1868. „ *flexuosa*, Claparède. Annél. Nap., p. 394, pl. xxxi, fig. 1.
1869. „ (*Lanice*) *conchilega*, Grube. Mitt. St. Vaast, etc., p. 38.
1870. „ *conchilega*, idem. Archiv für Naturges., 36 Jahr., p. 327.
1873. „ *flexuosa*, Claparède. Annél. Sédent., pl. ix, figs. 1—15, pl. x, figs. 1—5, pl. xi, fig. 12, pp. 16, 36, 92, 95, 100, 123, 128.
1874. *Lanice conchilega*, Ehlers. Zeitsch. f. wiss. Zool., Bd. xxv, pl. i, fig. 201.
„ „ „ McIntosh. Ann. Nat. Hist., 4 ser., vol. xiv, p. 205.
1875. *Terebella flexuosa*, Panceri. Atti Soc. Ital., vol. xviii, p. 530.
„ *Lanice conchilega*, McIntosh. Invert. and Fishes St. Andrews, p. 129.
1879. *Terebella artifex*, Storm. Kongl. Norske Vid.-Selsk. Skrift. Trondhjem for 1878, p. 35.
1879. „ *conchilega*, Tauber. Annul. Danica, p. 131.
1880. „ „ Cosmovici. Archiv Zool. Expér., t. viii, p. 288, pl. xxiv, figs. 1—9.
„ *Lanice* „ Langerhans. Zeitsch. f. wiss. Zool., Bd. xxxiv, p. 106, pl. v, fig. 20.
1881. „ „ Leslie and Herdman. Proc. Roy. Phys. Soc. Edin., vol. vi, p. 66.
1883. „ „ Levinsen. Vidensk. Meddels. Copenh., p. 175.
1884. „ „ von Marenzeller. Sitzb. der K. K. Akad. der wiss. Wien, lxxxix, p. 1911, sep. abd., p. 41.

1885. *Lanice conchilega*, Carus. Fauna Medit., i, p. 264.
1886. *Terebella* „ Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 158.
1887. *Lanice* „ Cunningham. Quart. Journ. Micr. Sc., vol. xxviii, pp. 248, 264, 274, pl. xviii, figs. 10—14.
„ „ „ Meyer. Mitth. Zool. Stat. Neap., Bd. vii, pp. 618—625, 634, Taf. xxii, figs. 1, 4 and 5, pl. xxiii, fig. 3, pl. xxv, figs. 14–24, pl. xxvii, fig. 28.
1888. „ „ Cunningham and Ramage. Trans. Roy. Soc. Edinb., vol. xxxiii, p. 664, pl. xliii, fig. 26.
1890. *Terebella littoralis*, Arnold Watson. Journ. Roy. Micros. Soc., p. 685, pl. xiv, figs. 1—8.
„ *Lanice* (*Terebella*) *conchilega*, Malaquin. Annél. Boulon., p. 48.
1891. „ *conchilega*, Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 257.
1893. „ „ Lo Bianco. Annel. tubicola di Nap., p. 54.
„ *Terebella littoralis*, Watson. Sheffield Lit. and Philos. Soc., p. 2.
1894. *Lanice conchilega*, Bidenkap. Christ. Vet.-Akad. Forhandl., p. 128.
„ „ „ De St. Joseph. Ann. Sc. nat., 8e sér., t. xvii, p. 211, pl. ix, figs. 241—245.
1896. „ „ Orlandi. Atti Soc. Ligustica di Sc. Nat., vol. vii, p. 157.
1897. „ *conchylega*, Michaelsen. Polych. deutsch. Meere., p. 170.
1904. „ *conchilega*, Journ. M. B. A., vol. vii, p. 229.
1906. *Terebella* „ Bohn. Ann. Sc. nat., 9e sér., t. iii, pp. 122 and 124 (movements).
1907. *Lanice conchylega*, Ehlers. Abhandl. Königl. Gesell. Wiss. Göttingen, Bd. v, p. 27.
1909. „ *conchilega*, Fauvel. Bull. Inst. Ocean., cxlii, p. 31.
„ „ „ Benham. Records Canterbur. Mus., vol. i, p. 10.
„ „ „ Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 209.
1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 237.
„ „ „ Elwes. Journ. M. B. A., vol. ix, p. 63.
1911. *Terebella* „ Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 63.
1912. *Lanice conchylega*, Meyer, A. H. Inaug. Dissert. Kiel, p. 40.
„ „ *conchilega*, Crawshay. Journ. M. B. A., vol. ix, p. 343.
„ „ „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 105, pl. xxxvi, figs. 1—8.
1913. „ „ Giard. Œuvres Div., p. 57.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 123.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 302.
1915. *Terebella* „ Allen. Journ. M. B. A., vol. x, p. 634.
„ *Lanice* „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 15.
„ „ „ Southern. Irish Sc. Invest., No. 3, p. 46.
1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 54.
„ „ „ Hessle. Zool. Bidr. Uppsala, p. 168.

*Habitat.*—Abundant on many parts of the sandy shores of Britain, east, west, north and south, the tubes being immersed in the sand near and beyond low-water mark, so that in certain instances, when the tide is out, the surface is hispid with them. They are accompanied by *Amphidotus cordatus*, *Ceratisolen legumen* (on the western shores of England, as at Southport), by *Arenicola marina* and swarms of shrimps. Moreover, such regions are characterised by multitudes of young flat fishes. Hence after storms, when the sand is shifted, myriads of the tubes, generally empty, are occasionally tossed on shore, as at St. Andrews, forming a soft coating several inches in depth for hundreds of yards along the beach. They also occur in numbers under stones resting on sand near low water-mark. At Southport, where the tubes are common within tide-marks, the branched

extremities are rare, probably because the shrimpers have removed them. Plymouth (Spence Bate and R. Rowe); not uncommon between tide-marks in Guernsey and Herm; Dublin Bay (Southern); on rocky shores, as at Lochmaddy, North Uist, this species is found under stones amongst sponges and other structures; Firth of Forth (Leslie and Herdman); Torquay (Elwes); abundant in the stomachs of plaice, and abundant in St. Andrews Bay (E. M.); Southport (Carrington and W. C. M.); Shetland (tubes) (Dr. Gwyn Jeffreys); Bournemouth, Mus. Leach (British Museum); Polperro (British Museum); West Coast of Ireland, Blacksod Bay, etc. (Southern).

Abroad it extends from the Mediterranean (Delle Chiaje, Claparède, Marenzeller, etc.) to the shores of the North Sea, the Kattegat, Scandinavia, and to Madeira (Langerhans, Fauvel); New Zealand; shores of Cantabria (Rioja); St. Vaast-la-Hougue (Fauvel).

The *cephalic region* (Plate CXIX, fig. 8) is distinguished by its comparatively small dorsal collar, the rim, however, expanding at each side into a great lateral flap which in some almost meets its fellow of the opposite side in the mid-ventral line behind the lower lip, the outline in this region thus forming a **V**. In others the union of the lateral regions is more complete ventrally, some fusing so as to form a continuous band with only a slight concavity in front, thus probably indicating the normal condition as a continuous ventral web, the median gap being due to accidents. A marked characteristic is the disposition of the anterior margin of the tentacular surface, for it is contracted into a frilled spout-like border surrounding the mouth except in violent protrusion. Within the aperture are two folds—an outer smaller, and an inner larger, tongue-like fold. Cunningham and Ramage consider the large lower lip and the absence of eyes characteristic of *Lanice* as contrasted with *Terebella*.

The tentacles have the usual grooved structure and form a dense mass of mobile organs. In the centre of the living tentacle under pressure a pale band of muscular fibres proceeds from the base to the tip. The other parts of the wall appear to consist of an inextricable series of muscular fibres, longitudinal, transverse, or circular and oblique. In the interior of the tentacles are numerous cells, but whether free (cœlomic) or adherent is not evident, though they do not separate on laceration of the wall. They are slightly yellowish, and to some extent refract the light. When in its native habitat the tentacles are partially protected in extrusion by entering the hollow processes of the fringe of the tube.

The three branchiæ form conspicuous and finely branched tufts on each side, the first pair being the largest. All are sub-dichotomously divided, and the terminal divisions are fine, so as to give the arbuscles a characteristic appearance. Moreover, they also have a whorled aspect toward the tip. The ultimate divisions are translucent, and have obscure longitudinal striæ with cells and granules in the wall. The first pair are situated on the narrow segment immediately behind the collar, a trace of which is seen in front of the glandular ventral shield.

The long *body* is moderately dilated anteriorly, and gently tapered to the tail, at the tip of which is the terminal anus surrounded by a series of marginal papillæ. The segments are numerous, viz., from 200 to 280. The dorsum is rounded, the ventral surface grooved throughout, often with a central ridge, except at the anterior shields,

which extend from the lower lip almost to the termination of the bristles. The glandular surface is divided into rings by transverse furrows, generally two in each body-segment. Posteriorly it becomes narrow and ends in the median groove about the last bristle-bundle. Besides, a glandular belt occurs at each side in the line of the bristles, after the manner of the corresponding belt in the Maldanidæ, and it is continued backward considerably behind the bristles.

Immediately within the lips is a rugose internal surface, then a membranous fold slightly posterior to a line drawn between the third branchiæ.

The œsophagus (*a*, Plate CXIX, fig. 8 *a*) is pale, of considerable length, and terminates in an enlarged region (stomach) posteriorly. At this point is an elongated glandular organ, *f*, which commences in front as a double duct with fatty granules and yellow pigment, and enters the alimentary canal dorsally at the termination of the œsophagus. The sac in spirit is filled with a whitish pulpy secretion. In some it appeared to have two ducts opening into opposite sides of the tract. The duct seems to run a short distance along the muscular coat before entering the canal, as in the case of the human gall-bladder. Behind the foregoing is a delicate membranous region, *g*, somewhat wide in calibre, and containing fatty flakes, followed by *h*, which has a tesselated yellowish appearance from the chloragogenous coat. Then comes *i*, a rounded, muscular portion of the gut, and *m*, the intestine, marked by longitudinal lines ending in the terminal vent.

The microscopic appearances of the intestinal tract at *g* and *h* do not indicate much difference in function. Dr. Williams thought the anterior region had a salivary function, but he does not allude to the long cæcum, *f*. The smooth muscular portion, *i*, has a glandular lining of columnar cells closely arranged. The external wall of this part consists of a mass of non-striated muscular fibres, circular and longitudinal.

In front the ventral wall of the body is covered with a dense series of glands, *b*, secreting the mucus for the tube, and the five segmental organs, *c*, which have a clavate outline. They are filled with granules of various sizes. Each is connected with a tough thread emerging from the glandular masses on the ventral surface of the cavity. The ventral blood-vessel, *p*, lies below the gut, and a branch, probably from the dorsal, runs down the middle of the region in front of the œsophageal collar. Two detached glandular pinkish bodies, *o*, hang by their ends to the body-wall about the posterior third, and apparently send ducts backward—indeed, a double glandular structure seems to extend to the posterior end. The contents are minute granules. Here and there the glandular structures are connected by a finely reticulated network of vessels with curved, fusiform pinkish sacs attached by the ends to the wall of the body.

The intestine behind the muscular portion is marked externally by yellowish striæ apparently of a fatty nature, and these peel off readily like similar tissue in the muscular region of the intestine.

The first segment is very narrow, and is enveloped laterally by the free collar of the next segment. It bears the first pair of branchiæ, and forms a narrow rim in front of the glandular ventral shields. The next has a greatly developed anterior lamella or collar which stretches from the edge of the ventral shield almost to the second branchia, thus forming the second process of this kind on each side. The following segment has the third branchia and the first bristle-tuft, but bears no hooks. The bristles

(Plate CXXVA, figs. 4, 4*a*, 4*b*) are bound firmly together in flattened fascicles, slope outward or obliquely upward and outward, and have a pale golden hue. They have a pale base, a shaft with fine striæ internally, and a tapering tip with a double wing, the latter being obliquely striated (Figs. 4 and 4*a*) and serrated on the edge. Moreover, in old preparations the distal ends of these bristles break up into tufts of fine fibres. The first tuft is smaller and the translucent tips less definitely formed than those which follow, but the structure is essentially the same. The second series of bristles in each tuft is considerably longer than in the previous forms (*e. g. P. nesidensis*), the tips almost reaching the commencement of the wings of the distal series. Dr. Williams states that the number of bristle-bundles on each side is sixteen, but he had probably omitted the first. In transverse section the central region of the bristle presents the aspect of severed fibres. Marenzeller and De St. Joseph mention a small papilla below each setigerous process in segments 6, 7, 8 and 9. Such is observed in some examples from the second bristle-tuft backward to the third or fourth.

From each setigerous process an elongated and somewhat elliptical eminence having a double row of golden hooks along the centre passes ventrally. Each hook (Plate CXXVA, fig. 4*c*) has a stout base which narrows upward to the curved neck, above which are the chief fang and two teeth on the crown, in a diminishing series in lateral view. Curved striæ extend downward from the small teeth on the crown. The basal part of the hook is marked by radiating striæ. In the anterior hooks the third tooth on the crown is less distinct than in the posterior. In front view two teeth occur in the middle. The double rows are so arranged that the hooks lie back to back with the fangs pointing outward. The one set may by fixing arrest the egress of the animal, and the other may in the same way stop ingress. In some of these rows sixty-six hooks occur on one side and sixty-seven on the other, and in a second sixty-two and sixty-four respectively, so that the combined effect must be considerable. The rows are somewhat longer in front, and the first (opposite the second bristle-tuft) has only a single series of hooks. The anterior rows also have the glandular wedge which dorsally envelopes the bristle-tuft, and has its apex about the middle of each interspace. By-and-by, however, this glandular tissue diminishes to a narrow longitudinal belt between the last six bristle-tufts, the shortened eminence for the hooks touching the base of the bristles. With the cessation of the bristles the rows of hooks are confined to the lateral uncinigerous lamellæ, which continue to the posterior end, gradually diminishing in size as the slender tail is reached. The lateral glandular belt is also continued from the bristled region backward between the hook-lamellæ, but stops short of the tail. On these uncinigerous processes the hooks form a single row along the anterior edge, and at one end of the row a series of imperfect hooks make a curve, those least developed having only a striated main fang, whilst those touching the complete series show a crown above the fang, the base of the hook being absent. The minute processes on the tail have few hooks.

The hooks of specimens from the Channel Islands show the two teeth above the great fang very distinctly, and so with those from Shetland. The anterior hooks of those from Lochmaddy have considerably shorter necks than those from St. Andrews. The striæ on the neck of the hook are well shown in those from Cornwall. De St. Joseph observes that the first six thoracic rows have a single row of ninety to one hundred hooks.

*Reproduction.*—The development of this species has been worked out by Claparède (1863) from a larval form 0·26 mm. long to a fairly late stage with two branchiæ, whilst the same author and Mecznikow filled in the earlier stages in what is probably the same form (their *Terebella Meckelii.*) Neapolitan examples are mature in August and September (Lo Bianco). Southern (1914) dredged young specimens in May on the west coast of Ireland.

Pallas examined the anatomy of this form and his account was fairly accurate, though in regard to the reproductive organs he thought that the ovary terminated by a medial orifice at the edge of the first abdominal band.

Claparède's [1] (1863) youngest stage in the development of *Lanice conchilega* occupied its pelagic tube, and had seven segments, but was only 0·26 mm. in length. It showed a horse-shoe-shaped anterior end with mouth and lower lip, a clavate median tentacle and an eye on each side. The two segments succeeding the cephalic plate were devoid of appendages, but the fourth had a process on each side with two bristles, and, moreover, contained a circular sense-organ (his Gehörblasen). The next segment had a setigerous process and two bristles as well as a flask-shaped ventral cirrus, and the following (sixth) had only the latter. The terminal segment had palpocils and cilia at the vent. The œsophagus, stomach and intestine were distinct. He followed the development through various stages up to one with fifteen pairs of bristle-bundles, but still in the transparent tube. The median tentacle of this was very long, and three others were developing at each side. The statocyst had advanced forward and the two segmental organs were in front of it, the author considering these were glandular organs for secreting the tube. The flask-shaped ventral cirri extended from the third bristle-tuft for twenty segments. Between this stage and a young form of 5 mm., in which most of the adult characters except the third branchia were present, there is a gap, for the four eyes of the younger form have disappeared, and a series in a row behind the collar have taken their places. In the same way the flask-like ventral cirri with a hook at the tip have vanished and *tori* are in position. Many segments are present, and the tentacles stretch beyond the posterior end of the body.

At St. Andrews young forms occur in tubes on the blades of *Laminaria digitata* at low water, and they keep up a wavy series of contractions of the body. The same were met with on the laminarian blades in Lochmaddy.

The tubes vary considerably in composition according to locality, and the fimbriated anterior end is not always present. Some are covered with diverse fragments of bivalve shells which often have the pearly surface exposed, thus blending the lustre of *Nucula* and *Trochus*, the white of the cockles, the pink of *Tellina*, the purple of *Donax*, the brown and purple of mussels and other sea-worn fragments with entire but minute univalves and many Foraminifera. These are mingled with pieces of gravel, fragments of the spines of sea- and heart-urchins, fragments of the tests of the two latter, and of Balani and Serpulæ. Other tubes are mainly composed of the hyaline secretion with few sand-particles, or are chiefly made up of fine grains of gravel mixed with the tests of Foraminifera, whilst a third series are curiously thatched with fragments of the spines of *Amphidotus* mixed with minute Foraminifera and fragments

[1] 'Beobach. Anat. Entwickl.,' p. 72, Taf. viii, figs. 12 and 13, Taf. ix and Taf. x, figs. 1—8.

of bivalves. The coarser tubes show large fragments of shells, half a *Cardium* or other shell conspicuously projecting here and there, and the nacreous (or it may be the purple) surface of the mussel and the nacreous surface of such as *Nucula*, already mentioned, is exposed. These fragments often slant from before backward, but with frequent interruptions, so as to render the tube as difficult to draw by front as by rear through the sand. All these shelly-fragments and particles of gravel would appear to be placed and cemented in position after the thin inner lining of the tough secretion is formed. The lining of secretion keeps the channel smooth so long as no bending occurs. A tube with moderately coarse grains is still translucent here and there so as to give the annelid light, if that is of importance to it. The locality in which the tube is situated, of course, has an influence on its structure, those from sandy regions being fine, those from gravel or shell-gravel are coarse. Those from deep water generally have more of the membranous and less of the shelly materials—it may be from their scarcity. The coiled tubes situated in the valves of *Mytilus modiolus* present considerable patches of membrane, and one surface is glued to the shell, the protective structures being fragments of heart-urchins, entire green-pea urchins, spines of sea-urchins, and heart-urchins and small shells of *Dentalium*. At Lochmaddy the tubes are often composed of minute fragments of gneiss and quartz, whilst at Connemara fragments of Lithothamnion are common, the coarser fragments being posterior, and the finer, with Foraminifera and other minute particles, forming the branched termination.

In some the anterior aperture has two flattened plates composed of scale-like fragments of bivalves or of entire valves, the fimbriæ being attached to the margins, and the two plates, by the elasticity of the secretion, are closely applied except on the issue of the annelid. Moreover, much finer fibres are sometimes attached to one end of the flattened anterior aperture.

Occasionally the ordinary tube is again continued beyond the branching anterior end, and a new arborescent termination constructed.

The arborescent anterior end of the tube is formed by cementing such elongated bodies as the spines of the heart-urchin, elongated fragments of shell or gravel, which are placed parallel to the long axis of the fibre or its branches. Moreover, where the tubes are composed of fine grains the fibres are correspondingly delicate. In some a large fragment of shell is utilised in the arborescent tuft, apparently for strength, or in the case of a limpet-shell for protection. The arborescent tuft has a transversely flattened form, and the large aperture is protected by a basal web at each side (Plate CXIX, figs. 8 *c* and 8 *d*). Occasionally the annelid avails itself of the neighbouring branches of zoophytes or Polyzoa. The arrangement of the branches at the anterior end of the tube is apparently connected with the safety of the delicate tentacles and branchiæ. As the advancing tide covered the tubes at Lochmaddy a cloud of mud was thrown out by the annelids.

Mr. Arnold Watson, who has done such excellent work by observing tubicolar forms constructing tubes in his aquaria, was good enough to send a copy of a photograph of a newly-constructed branched process at the end of a tube showing graceful curves of the filaments formed of single grains of sand and minute particles of shells. Subsequent

strengthening of the filaments by larger particles renders the whole coarser and less graceful.

After a severe storm, as, for example, on October 15th, 1863, the West Sands, at St. Andrews, from the bridge at the Swilcan Burn outward were covered with vast multitudes of the tubes of *Lanice conchilega*. They especially abounded at the lines of mid-tide and low water, where the ebbing tide threw them into broad ridges with intervening grooves. They ranged from the very rough to the membranous, and almost all were empty. It was thus chiefly a loss of home, and not a loss of life. So vast were the masses that a civic authority thought they might be utilised as manure, but their composition gave slight basis for such a view, although they might be useful when applied to a clayey soil.

The absence of definition in Delle Chiaje's figures (1828 and 1841) and the brevity of his descriptions make the diagnosis of his *Amphitrite Tondi* somewhat uncertain, but it is probably the present species.

Dalyell (1853) gives an interesting account of the habits of this species in confinement, especially in connection with the formation of its tube and the action of the tentacles. It is for the most part nocturnal. He termed it the sand-mason.

De Quatrefages (1865) included this species under the titles of *Terebella conchilega* and *T. prudens*.

Claparède (1868) gave the species only sixteen pairs of bristle-bundles, and considered that Delle Chiaje's *Amphitrite Tondi* was only a ripe form of this species. He found a greenish hue present at the period of sexual maturity due to a multitude of fatty cells in the cœlom.

On May 6th, 1878, Giard communicated to the French Academy a note on an annelid which was formerly considered as a young *Terebella*, and which he termed *Wartelia*, thus conferring on the young stage of a Terebellid a separate title.

Cosmovici (1880), mentions two pairs of segmental organs and organs of Bojanus in this species, one pair of the latter situated in front and the other behind the cephalic diaphragm. In shape the segmental organs, which are separated from the organs of Bojanus and lie behind them, are like urns with a crenate and much ciliated mouth, and he figures the ova attached to the narrow end of the funnel whilst the inner edge of the funnel is prolonged as a narrow process toward the nerve-cords. He held that the reproductive elements were discharged through the funnel. The organ of Bojanus has no external aperture. The genital glands have, he observed, a close association with the segmental organ and its vessels. He states that he has noticed *T. conchilega* depositing eggs in May at Roscoff, and the ova were very numerous. This author, therefore, is at variance with the results of those who have examined the structure of the nephridia in the Polychæts, and J. T. Cunningham's subsequent observations are more in accordance with the actual structure.

Langerhans (1880) gives frontal outlines of the hooks, showing that anteriorly five teeth occur above the main fang, whilst posteriorly three rows are above it, no less than fourteen points being shown.

Marenzeller (1884) included the *Terebella gigantea* of Montagu[1] under this species

[1] 'Linn. Trans.,' vol. xii, p. 341, Tab. xi.

from the structure of the anterior border, the arrangement of the ventral shields, their lateral pieces and the coloration. The *Terebella gigantea* of De Quatrefages, however, belongs to another species, whilst his *T. prudens* and *T. pectoralis* agree with *T. conchilega*.

Cunningham[1] describes four long, double nephridial tubes as occurring in segments 6—9; their internal openings are behind the fascicles of bristles in 5—8. Membranous nephridial sacs are also present in segments 10—13, and they are inseparable from one another. He found both series in communication, forming a wide, continuous longitudinal tube from segments 6—13. Openings to the exterior were found in segments 6—9. The author draws attention to the fusion of the nephridia as approaching the condition in the vertebrates.

A careful account of this form is given by De St. Joseph (1894). He states that the intestine is fixed dorsally by a single mesentery, but two occur inferiorly, the blood contains minute corpuscles (hématies), and that the heart holds a cardiac body. The ventral nerve-cord has a neural canal containing a brownish fluid in the thoracic region. In the anterior thoracic chamber are three pairs of segmental organs, first to third segment, and two in the fourth, the canal opening on the fourth segment. Through these the generative elements do not pass, for they do not enter the anterior chamber. There are, however, four pairs of larger greenish segmental organs in the posterior thoracic chamber in segments 6, 7, 8 and 9. Their ciliated funnels communicate with the cœlom, and join the nephridial canals, which open on the papillæ below the bristle-bundles in these segments. This author[2] found a Polynoid (*Harmothoë picta*, De St. Jos.) commensalistic in the tube of *L. conchilega*.

Dr. Elrington[3] (1908) describes the larva of this form (formerly termed *Wartelia* by Giard and Nordenskiöld), and he corrects various misinterpretations, such as that the dorsal organ, which the two authors just mentioned supposed to be ova, is in reality a glandular structure for secreting the temporary transparent tube of the annelid. The bilobed buccal organ he found to be muscular, not glandular. It is interesting that so long ago as 1851 Busch[4] figured this stage.

Arnold Watson[5] (1916) furnishes an interesting account of a small *L. conchilega*, which ingeniously added a large fragment of gravel on its tube by supporting it with its tentacles whilst it was fixed by sand and cement manipulated by the lips, and this though the gap was too large to admit the fragment.

### *Genus* CXLVII.—Loimia, *Malmgren*, 1865.

Cephalic lobe with inconspicuous dorsal collar; large post-oral lamella. Body typical. Branchiæ three pairs, the first the largest, arborescent, with numerous short ultimate divisions. Seventeen pairs of setigerous processes; bristles with winged tapering

[1] 'Quart. Journ. Micr. Sci.,' vol. xxviii, p. 248, pl. xviii, figs. 10—14.

[2] 'Ann. Sc. nat.,' 7e sér., t. v, p. 172, pl. viii, figs. 44—47, and ibid., 8e sér., t. v, p. 233.

[3] 'La Cellule,' t. xxv, p. 103, 1 plate.

[4] 'Beobach. u. Anat. u. Entwickl. einiger Wirbell. Th.,' Taf. xi, fig. 7.

[5] 'Journ. Roy. Micros. Soc.,' June, 1916, p. 253, with two text-figures.

tips. Rows of hooks commence on the second segment and extend throughout the body. Hooks pectinate with a long anterior border with five or six teeth; opposed back to back in the double rows (Fauvel). Statocysts in the second segment (Fauvel). Nephridia as in *Lanice*.

1. Loimia montagui, nom. nov. Plate CXIX, fig. 5—body; Plate CXXVI, figs. 1 and 1 *a* —bristle and hook, and 1 *b*—hook of *L. medusæ*, Sav.

*Specific Characters.*—Cephalic lobe has a small dorsal collar which does not join the fan-like supra-oral arch. A large lamella, with a slight median excavation, forms a great post-oral platform, which is differentiated into a median, more flexible region and two stiffer lateral regions. Immediately behind is the first pair of gills; a broad fan-shaped flap occurs midway between the second pair and the ventral scute. The fourth segment bears the third pair and the first bristle-bundle. Ventral scutes not separated by deep furrows, and end in a narrow ridge about the eleventh bristle-bundle. Segments marked by narrow rings. General colour yellowish, ventral scutes rufous, shaded with purplish black (Montagu). Seventeen pairs of setigerous processes, commencing on the fourth segment; bristles commencing on the fifth segment, pale, smooth, golden, with tapering winged tips. Hooks pectiniform, with a long anterior border and five to six teeth, and no process exists on the edge of the base beneath the great fang as in *L. medusæ* from the Mediterranean. Posterior region has from 80 to 130 segments.

Synonyms.

1818?. *Terebella constrictor*, Montagu. Linn. Trans., vol. xii, p. 344, Tab. xiii, fig. 2.
1915. *Loimia gigantea*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 17.
„ „ *medusæ*, Allen. Journ. M. B. A., vol. x, p. 636.

*Habitat.*—Devon coast, as *Terebella constrictor* (Montagu); Plymouth (Baird); Plymouth (Spence Bate and B. Rowe); Yealm shore, Plymouth (Allen).

The *cephalic lobe* presents a small and inconspicuous dorsal collar which at each side bends down to disappear in the general plate, and without joining the supra-oral arch, which is fan-shaped and projects little. The space between the latter and the cephalic collar is occupied by the grooved tentacles. From the outer border of the cephalic region a large lamella arises, and passes with a slight median excavation to the other side, forming thus a great post-oral platform. A differentiation on each side occurs in the form of a curved line which extends from the segment-junction posteriorly obliquely forward and outward, thus marking off a central and more flexible region and two stiffer lateral regions. The great development of this post-oral flap is characteristic of the species.

The *body* has the typical Terebellid outline, enlarged in front, and tapering gradually to the posterior anus. It is rounded dorsally, flattened ventrally in front, and slightly so posteriorly.

The segment succeeding that bearing the post-oral lamella bears the first pair of branchiæ, but is not distinguishable in the sole example available from the next segment

either dorsally or ventrally, though it may represent in the dorsal region part of the segment in front.

The following segment carrying the second pair of gills has a broad fan-shaped flap at each side about midway between the gill and the ventral scute, whilst the following or fourth segment bears the third branchia and the first setigerous process. The ventral scutes in the example are not separated by the deep furrows so characteristic in other forms, but appear to be nearly continuous from the anterior broad scute to the narrow median ridge about the eleventh bristle-tuft. All the segments are marked by narrow rings. The general colour is yellowish, the ventral scutes rufous brown shaded with purplish black (Montagu). Gravier describes the forms from the Red Sea as greenish grey, with bold bars of brown on each thoracic segment, and white at the insertion of the dorsal bristles. The ventral tori are underlined by dark bands with a touch of the same colour at the cushions. The latter are reddish. The abdominal tori are white, set like pearls in a base of grey pigment. The tentacles have brown rings. The branchiæ are comparatively small, distinctly separated, and with short stems, the usual gradation occurring from the first to the third. They are distinguished from all the others by their very finely branched terminal divisions. The main stem and its subdivisions are short so that the entire organ in each case projects proportionally little. It is dichotomously divided. The branchiæ of the Mediterranean *L. medusæ*, though also furnished with fine terminal ramuscules, are more lax in branching, the separate divisions being longer.

Seventeen pairs of prominent setigerous processes occur anteriorly, and the bristles are directed outward and backward. Each consists of a flattened brush, with the edges dorsal and ventral, of pale golden bristles, the tips of which are in two series, a longer and a shorter. Each bristle (Plate CXXVI, fig. 1) slightly dilates above its pale bulb to near the origin of the wings, then tapers to a fine point. The wings are of moderate breadth, and cease before reaching the delicately tapered tip. The bristles of the shorter series have the same structure, but their shafts are more slender. They extend about as far as the commencement of the wings of the longer series. No noteworthy difference between the first and the last tuft occurs.

The rows of hooks commence at the second bristle-tuft, and are long in front, diminishing in length backward to the ninth or tenth, and again increasing at the fourteenth setigerous process, that is, behind the median frill which succeeds the scutes, only a brief space separating the long rows in the mid-ventral line, and the same condition is found at the fifteenth. At the sixteenth and seventeenth setigerous process the rows are shorter, as also is the mid-ventral space between them. The uncinigerous lamellæ which succeed are almost ventral in position, being separated only by the narrow ventral surface (Montagu's dorsum), and they continue to the posterior end (absent in the example). Double rows of hooks occur from the seventh to the sixteenth (*fide autor.*).

The hooks (Plate CXXVI, fig. 1 *a*) have a long anterior border with four or five teeth in diminishing series above the chief fang, making five or six in all, and there is no process on the edge of the base beneath the main fang. The posterior outline is boldly convex (opposite the teeth), curving inward to a notch which separates the irregularly

convex base. Several striæ pass obliquely from the upper teeth to the posterior border. The posterior hooks are somewhat less and the curves of the posterior outline and base slightly vary. The foregoing hooks differ from those of the Mediterranean species, which have a process on the edge of the base beneath the main fang (Plate CXX VI, fig. 1 *b*), and the curvatures also differ. If this form represents Savigny's *L. medusæ* then the British species should be called *L. Montagui.*

The tube of *Loimia medusæ*, Sav., is comparatively short, composed of grains of sand and fragments of shells. Gravier found the longest to be 15 cm., and the diameter 8—9 mm. The tube of the British species is probably similar.

Most of the older authors, such as De Blainville,[1] refer to Savigny's species. It is doubtful if Montagu's *Terebella constrictor* refers to the present form, yet this careful observer could scarcely have overlooked so fine a southern species as the present.

C. Gravier[2] describes interesting variations in the young examples of *Loimia medusæ*, Sav., in which the first and second segments differ, and the third has a lobe which disappears in the adult, the branchiæ are less finely ramose at the tip, and the hooks, instead of having the teeth on the crown in a single row, have them double. It is possible, however, that there may be allied forms which show these distinctions, for even in *Arenicola*, to which the able French author alludes, friction will account for many of the changes between the hooks of the young and those of the old.

*Genus* CXLVII.—Nicolea, *Malmgren*, 1865.

*Scione* and *Axionice*, Malmgren; *Physelia* and *Heterophyselia*, De Quatrefages.

Cephalic collar small, with a row of distinct eyes behind it, the anterior border forming a spout-shaped arch over the mouth. Body typical. Branchiæ two, attached to the second and third segments, the anterior being the larger, dichotomously divided with short terminal branches. Sometimes a third pair of branchiæ. Fifteen to seventeen setigerous processes, the first behind the second gill on the fourth segment; the bristles have narrow wings on the long and finely tapered tips; no shorter series occurs in the tufts. A short cirrus in males over the fascicles of bristles in the third and fourth segments: none in females.[3] The avicular hooks commence on the second setigerous segment, (fifth) uniserial at first, then at seventh biserial for seven segments, afterwards uniserial. Ventral scutes conspicuous. The anterior nephridia are a little less than the posterior. Tubicolar.

[1] 'Dict. Sc. Nat. Vers. et Zooph.,' pl. v, fig. 1.

[2] 'Nouv. Arch. Mus. Paris,' 4e ser., t. viii, p. 224, with text-figs. 396—399.

[3] A rather thick cirrus over the bristles of the fourth and fifth segments occurs in *N. zostericola* and *N. venustula* from Plymouth, so that there is no difference in this respect. The processes were larger in the small *N. zostericola* than in the adult *N. venustula.* Allen says Crawshay gives *N. venustula* seventeen pairs of bristle-tufts, whereas in *N. zostericola* there are fifteen. Fauvel gives *N. venustula* fifteen to seventeen pairs of bristles and states that the two forms belong to one species. Tauber found three pairs of branchiæ and sixteen to seventeen bristle-tufts in *N. zostericola,* and Leuckart, in this form, describes three pairs of branchiæ and fifteen bristle-tufts.

1. Nicolea venustula, *Montagu*, 1818. Plate CXII, fig. 5—body; Plate CXIX, figs. 6 and 6 *a*—branchia and ovum; Plate CXX, fig. 12—branchia, and 12 *a* and 12 *b*—branchia, var. *zostericola*; Plate CXXVI, figs. 2—2 *d*—bristles and hooks, and 2 *b*″ and 2 *b*‴ *a*—bristle and hook of variety.

*Specific Characters.*—Cephalic collar forms a small rim dorsally, and behind it is a row of distinct eye-spots. Tentacles numerous and grooved. Body typical, forty to fifty (seventy-four, Marenzeller; one hundred, Hessle) segments, terminating in an anus posteriorly. Ventral shields thirteen (seventeen, Marenzeller), of a pale brown throughout, sparsely speckled with white spots.[1] Branchiæ, two pairs variable in length, sometimes with a short, at others with a long stalk, then dichotomously divided with few short terminal branches; the first is considerably the larger. Fourteen glandular plates ventrally. Seventeen setigerous processes on each side (fifteen in young and in those from Scandinavia). Bristles in single series, with narrow wings on the somewhat long and tapered tips. The first occurs behind the second branchia (fourth segment). The avicular hooks begin on the fifth segment (seventh, Carus), have a single tooth above the chief fang; base somewhat small, the lower edge evenly convex, and the process on the anterior edge curves upward. Nephridia in segments 3—7; in the male the nephridial papilla in the sixth and seventh segments cirriform. Colour reddish brown with white spots. Frequents soft tubes of sand and mud.

Synonyms.

1818. *Terebella venustula,* Montagu. Trans. Linn. Soc., vol. xii, p. 344, Tab. xiii, fig. 2.
1829. „ *longicornis,* Sars. Bidrag., p. 28.
1843–53. „ *venustula,* Chenu. Illust. Conch., 11e livr., pl. iv, fig. 3.
1844. „ *zostericola,* Œrsted. Region. Mar., p. 68.
1845. „ *venustula,* Chenu. Bibl. Conch., t. ie, p. 266, pl. xxiv, fig. 2.
1849. „ *parvula,* Leuckart. Arch. f. Naturges., 15 Jahrg., p. 175, Taf. iii, fig. 6.
1851. „ *venustula,* Grube. Fam. Annel., p. 81.
„ „ *zostericola,* idem. Ibid., p. 81.
1853 (?). „ *textrix,* Dalyell. Pow. Creat., vol. ii, p. 206, pl. xxvii, figs. 15—18.
1860. „ *zostericola,* Grube. Arch. f. Naturges., Bd. xxvi, p. 98.
1865. *Nicolea* „ Malmgren. Nord. Hafs.-Annul., p. 381, Tab. xxvi, fig. 76.
„ *Physelia* „ De Quatrefages. Annel., tom. ii, pp. 372 and 397.
„ *Terebella venustula,* Johnston. Cat. Worms Brit. Mus., p. 238.
„ „ *textrix,* idem. Ibid., pp. 239 and 345.
1867. *Nicolea zostericola,* Malmgren. Annul. Polych., p. 109.
„ *Terebella venustula,* Parfitt. Cat. Devon Annel., p. 32.
1868 (?). „ *vestita,* Claparède. Annél. Nap., p. 397, pl. xi, fig. 4.
1869. „ *zostericola,* McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 423, pl. xv, fig. 15.
1873. „ „ Mœbius. Exped. Ostsee, pp. 109 and 152.
„ ?. *Nicolea* „ and *arctica,* Kuppfer. Ibid., p. 152.
1874. „ „ Malm. Annul. Göteb., p. 97.
„ „ „ McIntosh. Ann. Nat. Hist., 4 ser., vol. xiv, p. 205.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 129.

[1] First segment with two lateral spines (Carus). Papilla under branchia 2, and behind the setigerous tubercle of 6 and 7, then pinnules to segment 21.

1878. *Nicolea zostericola,* McIntosh. Trans. Linn. Soc., ser. 2, Zool., p. 508.
„ *Terebella* „ Lenz. Jahrb. Comm. deut. Anhang., p. 11.
1879. *Nicolea* „ Tauber. Annul. Danica, p. 132.
„ „ „ Théel. Kongl. Sv. Vet.-Akad. Handl., Bd. xvi, p. 63.
1883. „ „ Levinsen. Vidensk. Meddel., p. 176.
„ „ *arctica,* Wirén. Chætop. "Vega" Exped., p. 420.
1884. „ *venustula,* Marenzeller. Sitzb. K. Akad. Wien, Bd. lxxxix, p. 85, Taf. ii, fig. 2.
1885. „ „ Carus. Fauna Medit., i, p. 264.
1886. „ „ Marenzeller. Polarforsch., p. 14.
1887. „ *zostericola,* Webster. Chæt. Eastport, Maine, U.S. Com. F. and F., p. 749.
1889. „ *venustula,* E. Meyer. Arch. f. Nat., lv, p. 133.
1890. „ „ Marenzeller. Annul. Beringsmeers, p. 2.
1891. „ „ Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 258.
1893. „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 55.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e ser., xvii, p. 207, pl. ix, figs. 235—240.
„ „ „ Bidenkap. Christ. Vet.-Akad. Handl., p. 129.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 170.
1898. „ „ idem. Grönland Annel., p. 129.
1899. „ „ Ssolowiew. Ann. Mus. St. Pétersb., t. iv, p. 214, Taf. xi, fig. 9.
1904. „ *zostericola,* Journ. M. B. A., vol. vii, p. 229.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 236.
1908. „ *venustula,* Ehlers. Denksch. Medic.-naturwiss. Gesellsch. Jena, Bd. xiii, p. 48.
„ „ *zostericola,* idem. Deutsch. Tiefsee-Exped., p. 145.
1909. „ *arctica,* Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 209.
„ „ *venustula,* idem. Bull. Inst. Ocean., cxlii, p. 30.
„ „ *zostericola,* Percy Moore. Proc. U.S. Nat. Mus., vol. xxxvii, p. 141.
1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 237.
1911. „ *venustula,* Fauvel. Bull. Instit. Oceanogr., No. 194, p. 38.
1912. „ *arctica,* Meyer, A. H. Inaug. Dissert. Kiel, p. 41.
„ „ *venustula,* Crawshay. Journ. M. B. A., vol. ix, p. 343.
„ „ *zostericola,* Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 95, pl. xxx, figs. 6—10.
1913. „ *venustula,* Augener. Zool. Anz., Bd. xli, p. 269.
„ „ „ Ehlers. Deutsch. Südpol. Exped., p. 559.
„ „ *zostericola,* Giard. Œuvres Div., p. 57.
1914. „ *venustula,* Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 123.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 298.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 19.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 635.
„ „ *zostericola,* idem. Ibid., p. 635.
„ „ *venustula,* Southern. Irish Sc. Invest., No. 3, p. 46.
1917. „ *zostericola,* Rioja. Anél. Poliq. Cantáb., p. 53.
1920. „ *venustula,* Chamberlin. Canad. Arctic Exped., vol. ix, B., p. 22.

*Habitat.*—Those with longer stalks to branchia from the fishermen's lines off St. Andrew's Bay (E. M. and R. M.); West Sands after storm (W. C. M.); West Rocks near the Pole, St. Andrews (R. M.).; Pier Rocks, St. Andrews. Numerous examples occurred in tubes in the tissue of *Alcyonidium hispidum* attached to stones beyond the pole at the West Rocks in May and many in tangle-roots (E. and R. M.). Somewhat common between tide-marks, where the young forms occur in numerous colonies. One of the

largest examples was procured by the "Porcupine" in 1869 twenty-five miles off shore (Ireland); off Fermain Bay, Guernsey; Plymouth (Spence Bate and B. Rowe, Crawshay); Kingstown and various stations on the West Coast of Ireland (Southern). The species ranges to deep water off the various shores of Britain, *e. g.* off the Hebrides in its tube inside a valve of *Pecten opercularis* (J. G. J.); Firth of Forth (Cunningham and Ramage). Abroad it is found at Behring's Sea (Marenzeller); Spitzbergen (Fauvel, Meyer); Christiana Fjord, Norway (Malmgren and Norman); Denmark and Sweden (Grube and Malmgren); North Sea, Mediterranean (Claparède, Grube, Marenzeller); shores of France (De St. Joseph); shores of Cantabria (Rioja); Red Sea (Boutan); Greenland (Michaelsen); Franz-Joseph Land (Augener); White Sea (Ssolowiew); Antarctic Sea (Ehlers); N.E. America (Moore).

The *cephalic* collar forms a small rim dorsally and behind it is a row of distinct eye-spots. The anterior border makes a spout-shaped aperture by forming an arch over the mouth, and which, seen from the dorsum, narrows a little in front, whilst in lateral view it slopes from above downward and backward. The tentacles are numerous and have the median groove so characteristic of such organs. Ventrally the dorsal collar terminates in spirit-preparations in a narrow edge at each side, the central region being occupied by an independent bilobed and often spout-like flap, making a kind of lower lip.

The *body* (Plate CXII, fig. 5) is enlarged in front, though in the small specimens this is slightly marked, and tapers to a moderately slender tail, at the tip of which is the anus surrounded by blunt papillæ. The segments vary from forty to fifty-five. The dorsal surface is rounded, the ventral has thirteen or more shields in front, and the median line thereafter is marked by a deep groove. Of a pale brown throughout, sparsely speckled with white spots, except on the ventral scutes. Tentacles pale reddish.

The branchiæ are two on each side, and vary much according to the age of the specimen, young forms having only short stalks without divisions, whereas adults have the branchiæ well developed and more or less dichotomously divided, with short terminal branches. The anterior gill is the larger and is in the adult densely arbuscular. All intermediate forms occur between the one stage and the other. The best developed branchiæ occur in those from deep water, *e. g.* 80 fathoms off North Unst, Shetland, and from the "Porcupine," the first pair having a comparatively long stalk before splitting into the terminal tuft. The disproportion between this and the second pair is marked, the latter being a short process with only a few divisions. In the blood are hæmatin-corpuscles which emit pseudopodia (Cuénot, De St. Joseph).

On each side are seventeen bristle-bundles (Plate CXXVI, figs. 2, 2*a* and 2*a'*) consisting of translucent bristles with shafts which slightly diminish towards the upper end, where the narrow wings commence and continue on the somewhat long and finely tapered tips for a considerable distance, disappearing, however, on the hair-like extremity. The tufts differ from those, *e. g.*, of *Amphitrite gracilis*, in being single, no shorter series occurring as in other types. The first bristle-bundle is found behind the second branchia and it has no special appendage, but the two following have on the dorsal side of the setigerous process, and continuous with it, a lanceolate appendage like the branchia of *Aricia*. The pinnules characteristic of the posterior region commence about the twenty-first segment.

The hooks (Plate CXXVI, figs. 2 *b* to 2 *b'''*) present a single tooth above the main fang, though in some traces of a second appear in lateral view. The base is somewhat small in proportion to the crown and neck, and its lower edge is evenly convex. The process on the anterior edge curves upward so as to make a narrow gulf below the main fang, and the edge beneath it is concave. The posterior or dorsal edge has only a slight indentation before joining the base. A series of striations pass from the crown down the posterior part of the neck. The basal region is deep and comparatively short in contrast with *Polymnia nebulosa*—another form possessing only a single tooth above the main fang. The inferior outline is convex with a slightly sinuous tendency at each end. The posterior hooks in many (Plate CXXVI, fig. 2 *c'*) show two distinct teeth above the main fang. In an example from Christiana Fjord (Canon Norman) the posterior indentation above the base is deeper, but the hook is otherwise similar to that of the British form.

*Habits.*—Those inhabiting the tubes in the tissue of *Alcyonidium* (E. M. and R. M.), attached to stones at extreme low water, had their tentacles thrust out into the surrounding water. The anterior end with the tentacles protruded from the apertures and thus facilitated extraction. Many had their body-cavities filled with ova (May 20th). De St. Joseph found that it left its tube and swam in a serpentine manner through the water.

The tubes often occur amongst algæ and small mussels, and are formed of secretion and minute grains of sand or fragments of shells, the masses sometimes being further encrusted by sponges. In the deep water forms the tube is composed mainly of fragments of shells, an occasional small stone and fragments of *Balani* and *Ditrypa*, cemented by a tough secretion. Occasionally it is placed inside a broken valve of *Pecten*, and thus one area of the circumference is sufficiently protected. Mr. Arnold Watson found one from Llanfairfechan in April wove a cobweb, and he suggests this may be the *Terebella textrix* of Dalyell.

*Reproduction.*—A small female from the East Rocks, St. Andrews, with only one or two divisions of the single pair of branchiæ, had numerous ova (Plate CXXIX, fig. 9) in the cœlom on June 21st. De St. Joseph gives their colour as orange. There are three pairs of segmental organs, the first in the third segment, the second at the sixth, and the third at the seventh (De St. Joseph). In the males as figured and described by Malmgren in *Nicolea arctica* (*Nicolea zostericola*, Œrsted, according to Levinsen, Wirén and Marenzeller) there is a small cirrus above the third and fourth setigerous segments, but such is only the papilla of the segmental organs, which is better developed in the male than in the female.

The species of the genus *Nicolea* have long been a source of dubiety to zoologists, and remained so up to date. This was due as much to variation as to misapprehension, for branchiæ as well as bristles and hooks varied, and young forms differed considerably from the adult. Indeed its representatives were placed under different genera such as *Axionice* and *Scione*, and much confusion has resulted. Marenzeller showed that *Scione* and *Axionice* fell under the same genus, and that *Nicolea parvula*, *N. zostericola* and *N. vestita* were synonyms of the original *Nicolea venustula* of Montagu. It is doubtful if even *Nicolea lobata*, Malmgren, and *Nicolea flexuosa*, Malmgren, are not in need

of further examination, though but a single pair of branchiæ occurs in each with sixteen and fifteen bristle-tufts respectively in the first and second. Whatever may be the result in regard to these northern forms, the British species of *Nicolea* now define themselves more clearly, notwithstanding all the variations in branchiæ, bristles and hooks.

Two varieties of the species are found, viz., those from deep water, with the anterior pair of large branchiæ on long stalks, and the littoral forms with short branchiæ. Some might be inclined to make two species, but the general structure and especially the hooks of the two forms so closely agree that for the present they may be united. In this connection the figures of Malmgren are not diagnostic. It is interesting that all the smaller forms (his *N. zostericola*) kindly sent by Dr. Allen from Plymouth had small branchiæ and fifteen pairs of bristles, whilst all the larger (his *N. venustula*) had seventeen pairs of bristles. The hooks of the two were identical, and it has to be remembered that whilst the anterior hooks have but a single tooth above the main fang in lateral view, or at most indistinct traces of a third, the posterior hooks have two teeth above the main fang.

So far as present experience goes it seems to be unnecessary to separate *Scione lobata*, Malmgren, from the foregoing, even though examples are found with only a single pair of branchiæ. At least no basis for this view has been satisfactory.

Montagu's account (1818) is brief, and there is nothing distinctive in the figure, to which the artist has given an eye on each side of the anterior region. He dredged it on the south coast of Devon at Torcross. It had seventeen pairs of bristles, an orange-red body, thickly and minutely marked with red spots.

Dalyell[1] (1853) gives a description and figure of *Terebella maculata*, a form about $1\frac{1}{2}$ inches long, and the "lower" extremity of which ends in points. A single pair of sparsely divided branchiæ only occur, the tentacles have spots of brown, and he mentions "a row of short, obtuse teeth" on each (probably referring to crenations). It is mottled, patched, or speckled with various colours, wherein brown, green and yellow predominate. Its tube is composed of grains of sand attached to corallines. This may refer to another species of *Nicolea*.

The *Polymnia viridis* of Malm[2] (1874) approaches *Nicolea* in general appearance and in the branchiæ.

A critical survey of the genus and species is given by von Marenzeller (1884), who points out that the number of the branchiæ and the number of the bristle-tufts vary, the former from two to three and the latter from fifteen to seventeen. The southern examples would appear to form a distinct variety, in which the three branchiæ and seventeen pairs of bristle-bundles are common.

Cunningham and Ramage[3] (1888) describe a *Scione maculata* (*Terebella maculata*, Johnston) with sixteen pairs of bristle-tufts anteriorly and a lateral semicircular lobe on each side from the third segment. The anus has six to seven conical papillæ. They

[1] 'Power's Creat.,' vol. ii, p. 203, pl. xxviii, figs. 10—19.

[2] 'Göteborg Fauna,' p. 97.

[3] 'Trans. Roy. Soc. Edin.,' vol. xxxiii, p. 665, pl. xliv, fig. 27.

consider it to be the same form as Dalyell's *T. maculata*. The bristles are winged, and the hook figured resembles that of a *Nicolea*.

Marenzeller in a later paper (1890) included *Nicolea arctica*, Malmgren, and *N. zostericola*, Grube, under this species, and he found occasionally only fifteen bristle-bundles in some typical representatives.

De St. Joseph (1894) gives the colour as brick-red, and he notes that Michaelsen found it also at Kiel. The œsophagus extends to the ninth setigerous segment, the glandular stomach to the sixteenth, the "chitinous" stomach to the first abdominal segment, and then the intestine ends at the tip of the body. Gregarines occurred in the intestine, and two encysted Distomes similar to those in *Nerine longirostris* were present in the cœlom. This author subsequently (1906) mentions the occurrence of *Ulvinia elliptica*, Ming. (which Siedlecki found in *Terebella nebulosa*),[1] also of *Selenidium costatum*. Both occur in *P. nebulosa*.

Ssolowiew (1899) includes, after Levinsen and Marenzeller, *N. zostericola* and *N. arctica* as synonyms of this species.

Leschke[2] (1902) alludes to the larval form as first mentioned at Kiel by Willemoes-Suhm. The species is ripe from April to June. The earliest larvæ are found on the sea-grass, and have three bristled segments in front and three naked posteriorly. The colour is ochreous. Rudiments of the tentacles appear, and bristles on all the segments, and it forms a mucous tube. The development is similar to that of *Terebella nebulosa* as described by Milne Edwards.

Southern's (1914) examples from Clare Island all had seventeen pairs of bristles.

Dr. Allen and Mr. Crawshay, from their observations at Plymouth, consider *Nicolea venustula*, Mont., distinct from *N. zostericola*, Œrst. and Grube, and the former kindly sent the type-specimens for examination. In glancing at them it is apparent that the sizes of the two forms differ, but whether this is due to race or to age is unknown, both being mature. The first pair of branchiæ in *N. venustula* form a much denser arbuscle than in *N. zostericola*, but the branchiæ of the latter vary amongst themselves and the differences may be due to age. *N. zostericola* has fifteen pairs of bristles as a rule, *N. venustula* has seventeen pairs, yet Prof. Fauvel has found the latter with only fifteen pairs. In both the males have the cirrus over the third and fourth bristle-tufts, and in these examples the cirri were more conspicuous in *N. zostericola*, but this is a variable character. There is nothing else distinctive in external appearance. Both have bristles of the same structure, *N. zostericola*, the smaller form, having paler shafts and tips, but precisely the same slight bend and the same narrow wings on the finely tapered extremities, which seem to be of similar proportions in each. The hooks of *N. zostericola* are also alternately arranged in the rows, and each has a dorsal outline nearly straight till it reaches the projection at the base, this projection or heel being more distinct in the Norwegian forms, the outline of the latter in the normal position sloping downward and forward to a smoothly rounded prow, whilst the anterior outline has a process for a ligament about its middle, the concave curve on each side of this being nearly symmetrical, viz., upwards to the main fang and downward to the prow. Most of the hooks present only a single tooth in

[1] 'Ann. Instit. Pasteur,' July, 1903, p. 430, pl. viii, figs. 1 and 2.

[2] 'Wiss. Meeresuntersuch.,' Bd. v, p. 127.

lateral view above the main fang, and pressure occasionally causes the second to project, whilst others in the same position show two teeth above the main fang—even in the same row with those having only the main fang and a single tooth above it. In one male most of the hooks showed this third tooth, but it does not appear to be a sexual character. Many examples of the species (*N. venustula*) show a single tooth above the main fang in front, and two in the posterior hooks.

Malmgren distinguished what appears to be a variety of the foregoing as *Nicolea arctica* from Spitzbergen and Greenland, but so far as recent examinations go it seems to be unnecessary to give it specific distinction, and this is also the view of Levinsen and Marenzeller, though Wirén follows Malmgren. In this variety the structure of the collar agrees with *N. venustula*. The body has from forty to seventy segments, with about fourteen ventral shields, the last three being rudimentary.

The colour of the male variety (*N. zostericola*) is whitish, of the female reddish with a white lateral line. Branchiæ two, apparently with finer branches than in *N. venustula* and more widely spread. The setigerous processes number fifteen pairs, the bristles in two groups with golden shafts, short, tapered tips with narrow wings. The hooks have two teeth above the great fang (Plate CXXVI, figs. 4 and 4 *a*). The tube is composed of mud. This variety was dredged in deep water off Shetland and at Station 8 to the west of Ireland in the "Porcupine" Expedition of 1869. It is probable that the *Terebella longicornis* of M. Sars[1] (1829) is a *Nicolea*.

Hessle (1917) found most of those on the Scandinavian coast had fifteen pairs of bristles.

In the British Museum, prep. 62 . 7 . 12 . 47 from Polperro, labelled "*Terebella constrictor*," appears to be *Nicolea venustula*.

A variety of this widely distributed form was procured by the "Knight Errant" in the trawl at 640 fathoms at Station 8, 22nd August, 1880, and it was from certain peculiarities considered at first to belong to a different type. Further examination, however, demonstrates that it may more fitly be placed as a marked variety of *Nicolea venustula*, Montagu. It was originally described as *Melinella Macduffi*.[2] The cephalic lobe agrees with that in the genus, and ventrally the buccal segment forms a rim behind the mouth. Ten glandular scutes occur anteriorly on the ventral surface instead of thirteen in the ordinary form and the ten anal papillæ are longer than usual. There are eighteen pairs of bristles anteriorly instead of the ordinary seventeen. Two branchiæ only occur on the first segment as two slightly branched organs supported on pedicles. The tip is dichotomously divided in some parts, whilst in others it is irregular. Not more than a dozen filaments occur in each branchia. The setigerous processes, which commence on the third segment, are minute and appear to be about eighteen in number. Each bears a small tuft of translucent bristles with delicately tapered slightly curved tips with narrow wings (Plate CXXV, fig. 4) and arranged in two series, a longer and a shorter, the shorter, however, being only a little within the tips of the longer.

[1] 'Bidrag. Söedyrenes Naturhistorie,' p. 28, Tab. i, figs. 7—9, Bergen, 1829. This is a noteworthy production for a theological candidate.

[2] 'Ann. Nat. Hist.,' ser. 8, vol. xiii, p. 109, 1914.

The rows of hooks commence with the bristles, and in a single series. Each hook (Plate CXXV; fig. 4*a*) generally agrees with the type of *Nicolea*, having two distinct teeth above the great fang, a somewhat narrow space inferiorly, as the process on the anterior outline is high and an excavation exists below it. The posterior outline has a deep dimple, the inferior margin of the base is convex and the prow rounded. The posterior hooks have the same structure but are smaller, and the hispid crowns are proportionally large. After the cessation of the bristles the uncinigerous processes become more distinct, and posteriorly they form in front of the tail a conspicuous series of serrations.

The tube is of moderate length and composed of secretion strengthened by glittering sponge-spicules and minute Foraminifera, so that it forms a somewhat thick or rough, hirsute tunnel. They seemed to have formed groups. These sponge-spicules constitute a large part of the wall of the tube and form a very efficient protection. The inner secretion is somewhat tough.

It is probable that such a form as the foregoing would stand for Malmgren's *Scione lobata*.

### *Genus* CXLIX.—Pista, *Malmgren*, 1865.

*Terebella*, Linnæus, Cuvier, etc.; *Terebellæ Idaliæ*, Savigny, De Blainville, Grube.

Cephalic plate with a thick dorsal collar, the margin externally and ventrally joining, after a notch, the anterior fold. Supra-oral fold short. Slender, grooved tentacles. Behind the mouth is a tongue-shaped process. Body rather short, tapered posteriorly to a slender tail with four large anal papillæ. Ventral scutes seventeen, besides four or five small terminal scutes. Anteriorly behind the dorsal collar the setigerous processes approach the median line. Behind and above the third and fourth bristle-tufts is a long papilla, and occasionally two are found behind the fourth. Branchia arises on the dorsum of the third segment on each side by a long stem (sometimes two are present), and the distal region is finely branched, the whole forming an arbuscle. Setigerous processes commence on the fourth segment and are seventeen in number; bristles curved, tapered and distinctly winged. The avicular hooks commence on the fifth segment, are in a single row anteriorly, double from the seventh to the sixteenth. Each has a deep basal region, a short, stout main fang with three or four teeth (in lateral view) above it, and a nearly straight posterior outline till it reaches the point of attachment of the powerful shaft. The first six tori have hooks with a long posterior process. The anterior nephridia are small or absent, the posterior with long ducts.

Marenzeller (1884) reviewed the history of the genus and rectified the synonymy.

In a careful note on the genus *Pista*, illustrated by excellent text-figures, Caullery[1] (1915) rightly uses both the anterior and the posterior hooks in diagnosis, and shows that the great size of the posterior inferior process really corresponds to the shaft of an ordinary bristle, as had been pointed out in such Sabellids as the Jasmineira-group, thus homologising the parts in both bristle and hook. He places the known forms under two genera,, viz., *Pista*, Malmgren, and *Eupista*, McIntosh, the type of the former being

[1] 'Bull. Soc. Zool. France,' t. xi, p. 68.

the British *Pista cristata*, O. F. Müller, and of the latter *Eupista Darwini*, McIntosh, dredged by the "Challenger" in the Pacific. The forthcoming treatise on the annelids of the "Siboga" expedition by this accomplished author will be full of interest.

Hessle (1917) arranged the Terebellidæ so that this genus followed *Trichobranchus* and *Terebellides*, on the ground that it, too, had anterior hooks with long shafts, but in other groups, such as the Polycirridea and Maldanidæ (e. g. *Rhodine*), there is a tendency to a similar condition, so that it appears to be unnecessary at present to break up the old arrangement.

1. Pista cristata, *O. F. Müller*, 1776. Plate CXIX, figs. 9 and 9 *a*—body and valvular end of tube; Plate CXXVa, figs. 8—8 *c*″—bristles and hooks.

*Specific Characters.*—Cephalic plate with a thick dorsal collar without eyes (in preparations). Anterior fold often symmetrically sinuous. Tentacles of moderate length and grooved. Body 120—150 mm. long, rounded dorsally, with twelve (Marenzeller gives seventeen, about twenty, Hessle) ventral shields anteriorly with reddish margins, and a deep groove throughout the rest of its extent, moderately enlarged anteriorly, and tapering posteriorly to a slender tail with a valvular anus at the tip. Papillæ in segments 6 and 7 behind the setigerous process. Segments 2, 3 and 4 with lateral lappets. Body of a uniform reddish orange, with a deep orange bar at each scute inferiorly. Lips reddish and the tentacles pale orange. A deep red patch occurs at the anterior part of the second region. The continental examples are greyish-red or brownish-red anteriorly, yellowish-grey posteriorly. Two branchiæ with long stems, much and dichotomously divided filaments, forming a dense and whorled bush. They arise from the anterior border of the fourth segment. Seventeen pairs of setigerous processes, which in front converge towards the dorsal median line. Hook-rows double from the eleventh to the twentieth segment (Marenzeller), and the tori are cinnamon-coloured. Hooks with a main fang and three or four teeth above it in lateral view, and with long shafts as in the Lanicides.

Synonyms.

| | | | |
|---|---|---|---|
| 1776. | *Amphitrite cristata*, | O. F. Müller. | Zool. Dan. Prod., p. 216, No. 2620. |
| 1788. | „ | „ | idem. Zool. Danic., vol. ii, p. 40, Tab. lxx. |
| „ | „ | „ | Linnæus. Syst. Nat., p. 3111. |
| 1789–92. | *Terebella* | „ | Bruguière. Encycl. Method., pl. lvii, figs. 1—4. |
| 1806. | *Amphitrite* | „ | Turton's Linn., iv, p. 83. |
| 1808. | *Amphiro* | „ | Montagu. MS. vol. Linn. Soc., pl. xl, fig. 2. |
| 1812. | *Amphitrite* | „ | Gmelin. Syst. Nat., i, pt. vi, p. 3111. |
| 1818. | *Terebella* | „ | Lamarck. Anim. s. Vert., t. v, p. 353. |
| 1820. | „ | „ | Savigny. Syst. Annel., p. 87. |
| 1828. | „ | „ | De Blainville. Dict. Sc. nat., t. lvii, p. 438, pl. v, fig. 2. |
| 1830. | *Amphitrite* | „ | Bosc. Hist. Vers., 2nd edit., vol. i, p. 194. |
| 1836. | *Terebella* | „ | Templeton. Mag. Nat. Hist., ix, p. 233. |
| 1840. | „ | „ | Grube. Actin. Echin. u. Würmer, p. 65. |

1843–53. *Terebella cristata,* Chenu. Illust. Conch., 11e livr., pl. iii, fig. 2.
1845. „ „ idem. Bibl. Conch., t. ier, p. 266, pl. xxiii, fig. 1.
1851. „ „ Grube. Fam. Annel., p. 80.
1853. „ *maculata,* Dalyell. Pow. Creat., vol. ii, p. 203, pl. xxviii, figs. 10—19.
1856. „ *cristata,* Thompson. Fauna Irel., p. 273.
1859. „ „ Danielssen. Reise, 1858, p. 122.
1860. „ *turrita,* Grube. Archiv f. Naturges., 26 Jahrg., p. 96, Taf. iv, fig. 6.
„ „ *cristata,* Sars. Reise, 1859, Nyt. Mag., xi, p. 258.
1861. „ *turrita,* Grube. Insel. Lussin., pp. 85, 128 and 148, Taf. iv, fig. 6.
„ „ „ idem. Ausflug. nach Triest., p. 148, Taf. iv, fig. 5.
1865. *Pista cristata,* Malmgren. Nord. Hafs-Annul., p. 382, Taf. xxii, fig. 59.
„ *Idalia* „ De Quatrefages. Annel., t. ii, p. 373.
„ „ *vermiculus,* idem. Ibid., p. 372.
„ *Terebella viminalis,* idem. Ibid., p. 364.
„ „ *cristata,* idem. Ibid., p. 658.
„ „ *maculata,* Johnston. Cat. Worms. Brit. Mus., p. 240.
1867. *Pista cristata,* Malmgren. Annul. Polych., p. 109.
1868. *Scione maculata,* Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 665, pl. xliv, fig. 27.
1869. *Pista cristata,* McIntosh. Ibid., vol. xxv, p. 423, pl. xv, fig. 20.
1870. *Idalia vermiculus,* Grube. Arch. f. Naturges., Bd. xxxvi, p. 334.
1873. *Thelepus cincinnata,* Kupffer. Jahresb. Komm. deut., p. 152.
1874. *Pista cristata,* Malm. Annul. Göteb., p. 97.
1875. „ „ Marion. Revue Sc. nat., p. 9.
1877. *Terebella* (*Pista*) *cristata,* var. ?, Grube. Monatsb. Königl. Akad. wiss. Berlin, Aug., p. 511.
1879. „ *cristata,* Tauber. Annul. Danica, p. 133.
„ *Pista cristata,* Webster. Trans. Albany Instit., p. 63.
„ „ „ Théel. Kgl. Sv. Vet.-Akad. Handl., Bd. xvi, p. 63.
1883. „ „ Levinsen. Vidensk. Meddel., p. 176.
„ „ „ Wirén. Chætop. "Vega" Exped., p. 420.
1884. „ „ Marenzeller. Sitzb. K. Akad. wiss. Wien, Bd. lxxxix, p. 36 (sep. copy).
1885. „ „ Carus. Fauna Medit., i, p. 263.
1889. „ „ Grieg. Bergens Mus. Aarb., Art. ii, p. 8.
1893. „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 52.
1894. *Scione maculata,* De St. Joseph. Ann. Sc. nat., 7e sér., xvii, p. 205, pl. ix, figs. 232—234.
„ *Pista cristata,* Bidenkap. Christ. Vet.-Akad. Forhandl. Christ., No. 10, p. 129.
„ „ „ Appellöf. Bergens Mus. Aarb., No. 11, p. 10.
1896. „ „ idem. Ibid., xiii, p. 12.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 168.
1899. „ „ Ssolowiew. Ann. Mus. St. Pétersb., t. iv, p. 207, Taf. xiii, fig. 14.
1900. „ „ Ehlers. Schwed. Magell. Annel., p. 16.
1901. „ „ idem. Polych. Magell. u. Chil., p. 213.
„ „ „ Gourret. Mem. Soc. Zool. Fr., p. 373.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 238.
1908. „ „ Moore. Proc. Acad. Nat. Sc. Philad., p. 351.
1909. „ „ Gravier. Exped. Antarct. Française Annél. Polych., p. 53.
„ „ „ Fauvel. Bull. Inst. Ocean., cxlii, p. 32.
1911. „ „ idem. Ibid., No. 194, p. 36.
1912. „ „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 99, pl. xxx, figs. 1—5.

1912. *Pista cristata*, Gravier. 2nd Exped. Antarct. Fr., p. 133.
„ „ „ Meyer, A. H. Inaug. Dissert. Kiel, p. 36.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 123.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 302.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 20.
1917. „ „ Hessle. Zool. Bidr. Uppsala, v, p. 154.

*Habitat.*—Dredged in 4—5 fathoms in Ardmaddy Bay, Lochmaddy, amongst shelly mud and grey clay (W. C. M.). Dredged in St. Magnus Bay, Shetland, in 80 fathoms; 50 miles west of Valentia in 160 fathoms; Outer Haaf, Skerries, Shetland, in 70—80 fathoms (J. G. J.); usually in deep water; Plymouth (Spence Bate and B. Rowe); Berehaven, Ireland, and S.W. Ireland, R. I. Acad. Exped., 1885; Blacksod and other bays on west coast, Ireland (Southern).

Abroad it occurs off Sweden, Norway and Finmark (Malmgren); Canada (dredged by Whiteaves); Mediterranean (Grube, Marion, Marenzeller, Lo Bianco); North America and Congo var.? (Grube); New England and Atlantic coast, U.S.A. (Verrill); Magellan (Ehlers); Antarctic Seas (Gravier); amongst *Posidonia*, Isle of St. Marguerite, Cannes, and at St. Raphael amongst *Zostera* (De St. Joseph); Virginia coast (Webster); Siberia and Behring's Sea (Wirén); White Sea (Ssolowiew).

The cephalic plate has a thick dorsal collar and the margin passes externally and ventrally to join the anterior fold, though it does not run evenly into it, a notch or a fold separating it from the raised anterior fold, which sometimes has a median projection with symmetrical lateral curves or in others slight frills. This anterior or supra-oral fold does not project so far forward as in many Terebellids, and it sometimes shows an inner fold over the mouth. The pale orange tentacles seem to be of moderate length and grooved, but are somewhat more slender and tapered than in ordinary Terebellids. Below the mouth is a well-developed tongue-like process which pushes the rim of the first segment backward when it projects, and ventrally it has a narrow rim.

The body is comparatively short and in the preparations is less dilated anteriorly than in the ordinary Terebellid. It tapers posteriorly to a slender tail with a terminal anus, which has four large rounded papillæ, two dorsal and two, slightly more prominent, ventral. Dorsally the body is rounded, ventrally flattened at the shields in front, and then grooved throughout the rest of its extent. Anteriorly behind the dorsal collar the setigerous papillæ approach the median line, where a bifid process occurs in front of them, and from the sides of the divisions the branchial stem originates—not always in the same place, for in some the right branchia springs antero-laterally in regard to the right process, whilst the left branchia arises behind and to the left of the left process. The free margin of the first segment forms a continuous fold ventrally which ends dorso-laterally in a rounded free flap, and a process is continued dorsally beneath its edge to the representatives of the setigerous process, which lies immediately behind the bifid cone formerly mentioned. The next segment has ventrally a large free lateral flap on each side whilst the median is differentiated into a narrow scute. The following segment has a still larger lateral flap which stretches further outward and upward and almost touches the base of the branchial stalk in the preparation. It thins off toward the narrow scute in the mid-ventral line. Laterally it ensheaths the lamella in front of it.

The ventral scutes are about seventeen in number. Vesicles four or five small terminal median scutes, and after them a median groove with a raised line continuous to the posterior end. Behind and above the third and fourth bristle-tufts a smoothly rounded process or long papilla occurs, and in some two are found behind the fourth. In the Irish examples they are clavate. Occasionally a smaller papilla appears behind the fifth.

In the Hebridean forms the tentacles are pale orange, the body of a uniform reddish orange with a deep orange bar at each scute inferiorly. The lips are reddish, and a deep red patch occurs at the anterior part of the second region. The posterior part of the body is pale orange. De St. Joseph states the colour is greyish rose with pale tentacles.

The branchia on each side arises by a long trunk in the line of the second large lateral flap (third segment) and quite on the dorsum. The distal region is finely branched, the whole forming a whorled arbuscle so characteristic of the genus. Occasionally a third and smaller stem springs from the segment in front, and its branches have the same arrangement. In an example from Shetland two large branchiæ of different sizes arose from the second segment, and two smaller, also of different sizes, arose from the third. In some the whorled condition is conspicuous, tier after tier leading to the somewhat truncate tip. It is noteworthy that the branchiæ cling to segments 2 and 3.

The next segment (fourth) bears a setigerous process and a ridge but no hooks. As indicated, the anterior setigerous processes are dorsal in position, but they soon become lateral. Sixteen are present. Those in front and rear are less prominent than the intermediate processes. The pale golden longer bristles have nearly cylindrical shafts, the proximal ends being narrowed only for a short distance, and they are finely striated, whilst the distal ends are curved, tapered, and soon end in a fine point, the sides of the tip having well-marked wings. The tip is curved and directed dorsally and posteriorly—that is, the convexity is in front. The shorter bristles have little more than the tips projecting uniformly beyond the surface of the skin, and they show the same form and curvature of the tip.

The hooks commence opposite the second setigerous process—that is, the fifth segment—as a single row, and the ridges leave a considerable interval between them and the scutes. The rows remain uniserial till the ninth or tenth when a biserial arrangement occurs to the twentieth. The hooks (Plate CXXIV, fig. 9) have a rather short, stout main fang with three or four teeth above it in lateral view, and oblique striæ pass from these to the posterior outline of the neck. The outline below the main fang is slightly angular and wide, whilst the median process on the anterior outline forms a short cone with a broad base, the line then trending at a different angle downward. The posterior outline is nearly straight (very slightly convex); then it bends outward at the point of attachment of the ligament, which passes off above the lower margin of the base, and thus the appearance of the hook is diagnostic. The basal region is comparatively deep and has a process at its anterior and inferior angle. The long ridges for the hooks cease with the bristles, and thereafter uncinigerous processes project from the posterior border of each segment, the glandular tissue forming a belt between them. Posteriorly the processes bear a single row of hooks. In connection with the development of these hooks Hessle figures one (Plate III, fig. 3) in its capsule,

but the hook seems to differ from that of the species mentioned if one may judge from the British examples.

The posterior hump of the hook seems only to be fully developed in adult specimens, as in a small example from Norway the posterior outline of the hook was straight except at the lower end where the ligament was fixed, and this seemed to be less fused with the base than in the adult. The posterior hooks did not show noteworthy differences from those of the adult. In this example the body was terminated posteriorly by a large rounded papilla budding out on each side from what apparently was a ruptured tail.

The tube is massive, composed of a thin lining of secretion and a thick coating of mud interspersed with minute stones and fragments of shells, generally arranged transversely. The translucent fragments permit a certain amount of light to pass into the tube. In some localities the tubes are formed of a thick layer of secretion and mud, amongst which the small stones are carefully imbedded, and in several the smaller stones are selected for the area near the transverse slit or valvular aperture. This end is elastic, the slit forming a curve convex on one side and with a concave slope on the other, and the symmetrical arrangement of the ends of the slit is noteworthy, a short fold at right angles to the main slit occurring at each side. It is not yet proved that these tubes found by the "Porcupine" of 1869 are those of *Pista*, since no trace of the inhabitant was present. De St. Joseph found the tubes frequently on *Rytiphlœa pinastroides* in deep water, and composed of a transparent secretion covered with clear grains of sand and pieces of algæ. His species, however, differs.

O. F. Müller's description and figures of this species are easily recognisable, especially the figures.

Montagu's figure of the annelid (by Miss D'Orville, 1808) shows two narrow tufts of branchiæ, but is probably intended for this species.

The *Terebella maculata* of Dalyell[1] (1853) somewhat resembles *Pista cristata*, but as he does not refer to the minute structure of the branchiæ, which rather agree with those of *Nicolea venustula*, especially if the "two pellucid stumps" represent traces of developing branchiæ, there is doubt, more especially as his *Terebella pecten*[2] agrees in regard to the branchiæ with a young *Pista cristata*.

The *Terebella flexuosa* of Grube,[3] from Greenland, has only a single pair of branchiæ, but they have a series of comparatively simple branches, and there are fifteen pairs of setigerous processes instead of seventeen, as in *Pista*.

De St. Joseph (1906) thought this form approached *Thelepus setosus*, De Quatrefages, and gives reasons.

Fauvel's[4] *Eupista dibranchiata* has a hook very like that of *P. cristata*.

### *Genus* CL.—Laphania, *Malmgren*, 1865.

Cephalic lobe truncated, with a horse-shoe-shaped plate over the mouth; grooved tentacles of moderate length. No eyes or branchiæ. Buccal segment a little elongated

[1] 'Pow. Creat.,' p. 203, pl. xxviii, figs. 10—13.

[2] Op. cit., p. 208, pl. xxvi, fig. 9.

[3] 'Archiv f. Naturges.,' Bd. xxvi, p. 102, Taf. v, fig. 2.

[4] 'Campag. Monaco,' p. 303, pl. xxviii, figs. 1—12.

and separated from the vent by a groove. Body slender, somewhat enlarged in front, gently tapered to the posterior end, where the segments are longer. Seventeen pairs of capillary bristles, commencing on the third segment. The smooth bristles have winged tips, and some with shorter tips are almost geniculate. Avicular hooks commence on the seventh (Hessle ninth) setigerous segment in a single row; then a double row between the eleventh and twentieth, continue to the posterior end, and show four teeth above the main fang. Distinct ventral scutes. Anterior nephridia reduced, the first of the posterior in the fifth segment, and opening through the diaphragm, the rest nearly equally developed, with long tubes.

1. Laphania bœcki, *Malmgren*, 1865. Plate CXXVI, figs. 4—4*b*—bristles and hooks.

*Specific Characters.*—Cephalic lobe as in the genus; buccal segment somewhat elongated[1]; the second the largest, and separated from the third by a groove and sometimes a ridge. Body 50—70 mm. long, and fifty segments, enlarged in front, and gently tapered to the posterior end; about two inches or more in length. It is rounded dorsally in front, but by-and-by the lateral regions form prominent fillets which cause a moniliform condition posteriorly. About ten to twelve conspicuous ventral scutes. Tail unknown. Bristles on seventeen segments, pale golden, with tapering, winged tips, those with shorter tips being winged and almost geniculate. Hooks avicular with four teeth above the main fang in lateral view. Nephridia in the fifth, sixth, seventh and eighth segments, a rudimentary one (Fauvel) between the third and fourth segments. Tube of mucus and sand.

Synonyms.

1865. *Laphania Bœcki,* Malmgren. Nord. Hafs.-Annul., p. 386.
1867. „ „ idem. Annul. Polych., p. 110, Tab. xii, fig. 68.
1873. „ „ Willemoës-Suhm. Zeitschr. f. wiss. Zool., Bd. xxiii, p. 349.
1883. „ „ Levinsen. Vidensk. Meddel. nat. For. Kjøbenhavn, p. 178.
1893 ?. *Amæa trilobata,* Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 60.
1894. *Laphania Bœcki,* Bidenkap. Christ. Vet.-Akad. Handl., p. 131.
1899. „ „ Ssolowiew. Ann. Mus. Zool. Acad. Imp. St. Pétersburg, t. iv.
1912. „ „ Ditlevsen. Danmark Eksped. Grönl., Bd. v, p. 428, pl. xxix, figs. 10—15.
„ „ „ Wollebæk. Vidensk. Skrift. Krist., 1911, p. 108, pl. xxiii, figs. 1—5.
1915. „ „ var. *hystricis,* McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 25.
1917. „ „ Hessle. Zool. Bidr. Uppsala, No. 5, p. 204.

*Habitat.*—Dredged off Shetland by Dr. Gwyn Jeffreys in 1867; "Porcupine" Expedition, 1870, Station I (Entrance to British Channel), in 567 fathoms.

Abroad it is found in the Gulf of St. Lawrence, Canada (W. C. M.); Finmark (Malmgren); Greenland (Ditlevsen, Hessle); White Sea (Ssolowiew).

The cephalic lobe is so developed that at first sight this form has some resemblance to a Maldanid. The dorsal collar, however, is present, and the plate passes obliquely forward to make a fairly firm arch over the mouth. From the surface of the plate spring

[1] As long as the three following (Hessle).

a series of moderately elongated grooved tentacles. A small tongue-like process lies in the pit below the mouth, whilst the lower lip is thick and curved. Ditlevsen describes the cephalic lobe as provided with a somewhat prominent margin, which has a straight edge and is beset with eight small rounded papillæ.

The *body* is slightly dilated anteriorly, remains for some distance of nearly the same diameter, and then gently tapers to the tail. In the preparations the anterior end is generally curved ventrally so as to resemble a Maldanid, as indeed the firmness, the ventro-lateral ridges and the posterior segmentation also do. It is rounded dorsally, flattened ventrally anteriorly, and grooved posteriorly, where the segments are marked by deep dorsal furrows. Following the buccal are two somewhat narrow segments, each having a setigerous process, and a glandular ventral scute or belt. Ten scutes follow, the last separated by an interval. Then the median ventral groove continues to the posterior end. Ditlevsen mentions that from the second to the fifth bristled segments are rudimentary ventral processes without armature. The hooks begin on the seventh bristled segment.

Seventeen setigerous processes occur on each side carrying pale golden bristles, and they are conical when viewed from the dorsum, obliquely truncated at the tip when viewed laterally. They commence on the third segment. The bristles are in two series—a longer and a shorter. The former are long, slender, translucent bristles, the free part being apparently cylindrical to the commencement of the wings, but the shaft is actually slightly enlarged till it almost reaches the base in the tissues. The tip is comparatively short, finely tapered, and the wings are distinct. The shorter forms (Plate CXXVI, fig. 6) have shafts very slightly less than the foregoing, and only their ends project beyond the skin, the wings commencing at once and dilating into broad expansions, whilst the short but finely-tapered tip is curved at an angle.

The rows of hooks commence on the seventh setigerous segment, though in one examined it was on the eighth counting from the first (small) setigerous papilla. The anterior hooks have, in lateral view, three or four teeth above the main fang (Plate CXXVI, fig. 6 *a*), a posterior outline curved toward the crown, then a hollow, and a projection above the posterior long ligament. The deep base is convex inferiorly, and the anterior outline has a process under the main fang. The figure of Malmgren is incomplete, though it is correct as far as it goes; that of Ssolowiew is not well finished.

The crowns of the posterior hooks (Plate CXXVI, fig. 6 *b*) are higher than those in front, and are more nearly in accordance with Malmgren's figure, five or six small teeth being above the main fang, and the posterior basal process is represented only by a short fragment.

*Reproduction.*—An example procured in the Gulf of St. Lawrence in July had well-developed ova in the cœlomic space.

*Tube.*—The tube is lined by tough secretion, and has externally coarse or fine grains of sand, minute shells and Foraminifera.

The distribution of this species appears to be extensive, since it occurs on both shores of the North Atlantic as well as the northern oceans.

A variety with narrow wings to the bristles (Plate CXXVI, fig. 5) was dredged.

*Genus* CLI.—Leprea, *Malmgren*, 1865.

*Heteroterebella*, De Quatrefages; *Terebella*, Hessle.

Cephalic plate with a well-marked dorsal collar which joins the highly arched supra-oral fold on each side. Ocular points conspicuous. Body typical, with setigerous processes throughout. Twelve ventral scutes followed by a median glandular stripe. Branchiæ three pairs, the first the largest; each with a short stem, the terminal branches both dichotomously and pinnately divided. Bristles commence on the fourth segment and continue to the end of the body, have distinct wings minutely serrated; the tip after tapering ends in a translucent knife-blade which again diminishes to a fine hair-like extremity. Setigerous processes closely associated with the ridges for the hooks, which commence at the first bristle-tuft. Hook has a large main fang and three teeth above it. Anterior nephridia with long tubes; the posterior nephridia are shorter and open into a long canal terminating blindly posteriorly.

1. Leprea lapidaria, *Linnæus*, 1767 (1754 *Kähler*). Plate CXIII, figs. 3 and 3 *a*—body; Plate CXXVI, figs. 8—8 *b*—bristles and hook.

*Specific Characters.*—Cephalic plate produced anteriorly, thin, with eyes behind dorsal collar. Tentacles pale yellow. Body 30—45 mm. long; 100—124 segments, with narrow rings and tessellated dorsally in front. Twelve ventral scutes followed by a deep groove with a median raised line to the tail. Three branchiæ on the second, third and fourth segments, first largest, each arising from a short stem which divides dichotomously; terminal processes dichotomously and pinnately divided, forming a finely ramose bush. Setigerous processes with bristles on every segment from the fourth backward. Small papilla (not always distinct) under each between the fourth and the tenth (eight in all). Bristles in the anterior segments (11—15) with long, finely striated shafts and winged tips, at the end of which is a slight spur or thickening followed by a finely serrated blade which tapers to a hair-like point. The posterior bristles have very slender shafts, no wings, and the tip appears as if bifid, since the two spurs are longer than in front and support a serrated web, broad at the base and having no hair-like tip.

Hooks in a single row in front, double row from the eleventh, and again in a single row posteriorly (about twenty-five to forty segments, Marenzeller).[1] Each hook has three teeth above the main fang. Colour reddish brown, inclining to purplish or violet on the dorsum. Ventral shields and glandular plates red; tentacles yellowish. Posteriorly the body is orange or brownish orange.

Synonyms.

1754. *Eine neue Art Wasserpolypen,* Kähler. Der K. Schwed. Akad. d. Wiss., etc., Aus d. Schwed. übers. v. Kästaner, Bd. xvi, p. 143, Tab. iii, figs. A—F.
1767. *Terebella lapidaria,* Linnæus. Syst. nat., edit. xii, t. i, pt. ii, p. 1092.
1806. „ „ Turton's Linn., p. 83.

[1] Lo Bianco states hooks commence on the fifth segment.

1808. *Amphiro constrictor,* Montagu. MS. vol. Linnean Soc., pl. xxxv, fig. 3.
1812. *Terebella lapidaria,* Gmelin. Syst. nat., i, pt. vi, p. 3113.
1817. „ „ Cuvier. Règ. An., ii, p. 520.
1818 ?. „ *constrictor,* Montagu. Trans. Linn. Soc., vol. xii, p. 343, Tab. xiii, fig. 1.
1825. „ *lapidaria,* Leach. Encyclop. Brit. Suppl., p. 452.
1828. *Amphitrite neapolitana,* Delle Chiaje. Mem., iii, p. 169, Tav. xliii, fig. 4.
1836–49. *Terebella constrictor,* Cuvier. Illust. Edit., p. 25.
1841. *Amphitrite neapolitana,* Delle Chiaje. Descriz., iii, p. 70, v, p. 94, Tav. cv, fig. 4.
„ *Terebella misenensis,* Costa. Ann. Sc. nat., sér. ii, t. xvi, p. 271, pl. xi, fig. 3.
1843–53. „ „ Chenu. Illust. Conch., 11e livr., pl. vii, fig. 8.
1851. „ *constrictor,* Grube. Fam. Annel., p. 81.
1855. „ *corallina,* idem. Arch. Naturges., 21 Jahrg., p. 119, Taf. iv, fig. 17.
„ „ *pectinata,* idem. Ibid., p. 120, Taf. iv, fig. 20.
1860. „ *rosea,* idem. Ibid., 26 Jahrg., p. 100.
1861. „ „ idem. Ausflug. n. Triest., pp. 86 and 149.
1864. „ *corallina* and *T. pectinata,* idem. Die Insel Lussin, p. 88.
1865. *Idalia lapidaria,* De Quatrefages. Annel., ii, p. 373.
„ *Heterophyselia Bosci,* idem. Ibid., p. 386.
„ (?) *Leprea textrix,* Malmgren. Nord. Hafs.-Annul., p. 389.
1867 (?). „ „ idem. Annul. Polych., p. 111, Tab. xii, fig. 69.
1868. *Heteroterebella sanguinea,* Claparède. Annél. Nap., p. 388, pl. xxix, fig. 3, and pl. xxx, fig. 1.
„ *Terebella sulcigera,* idem. Ibid., p. 400, pl. xviii, fig. 5.
1870. *Heterophyzelia Bosci,* Grube. Arch. f. Naturges., 36 Jahrg., p. 334.
1871. *Terebella rosea,* idem. Jahresber. Schles. Gesell., p. 51.
1872. „ *constrictor,* idem. Abhandl. Schles. Gesell., 1869—70, pp. 7 and 36.
1875. „ *misenensis,* Panceri. Atti Soc. Ital. Sc. nat., vol. xviii, p. 530.
„ *Heteroterebella sanguinea,* Marion and Bobretzky. Ann. Sc. nat., 6e sér., t. ii, p. 90.
1884. *Leprea lapidaria,* Marenzeller. Sitzb. K. Akad. Wissensch. Wien, p. 180, sep. copy, p. 29.
1885. „ „ Carus. Fauna Medit., i, p. 263.
1893. „ „ Lo Bianco. Atti Acad. Sc. Napoli, 2e sér., t. v, p. 51.
1894. *Terebella* „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 202, pl. viii, figs. 225—229, pl. ix, figs. 230, 231.
1904. „ „ Journ. M. B. A., viii, p. 229.
„ „ „ ibid., vol. vii, p. 229.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9e sér., t. iii, p. 236.
„ „ „ Bohn. Ibid., 9e sér., t. iii, p. 120 (movements).
1909. „ „ Fauvel. Bull. Inst. Ocean., cxlii, p. 28.
„ „ „ idem. Ann. Sc. nat., 9e sér., t. x, p. 209.
1911. „ „ idem. Bull. Inst. Ocean., No. 194, p. 41.
1914. *Leprea* „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 122.
1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 23.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 633.
1917. *Terebella* „ Rioja. Anél. Poliq. Cantáb., p. 50.
„ „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 188.

*Habitat.*—Abundant in cracks of rocks (gneiss) filled with mud and sand near St. Sampson's, Guernsey, and at other parts of the same island, as well as common in Herm (A. and R. M.); on a gravelly bottom and in fissures of rocks, Polperro, Cornwall, and

two examples on a *Pinna* (Laughrin); west coast of Ireland, rare (Southern); in crevices of shale, Plymouth (Spence Bate and B. Rowe, Allen and Todd).

Extends to the Mediterranean and all its bays; channel shores of France (De Quatrefages); shores of Cantabria (Rioja, De St. Joseph).

The *cephalic plate* has a well-marked dorsal rim which curves laterally to become continuous with the highly-arched supra-oral fold, often thin anteriorly. It bears numerous slightly grooved tentacles, which also differ from those of many other forms in firmly adhering after preparation. They are pale yellow in life, with the red blood-vessel in the centre. The buccal process or "tongue" inferiorly often projects as a smoothly rounded mass obscuring the rim of the segment behind it. Eyes not always visible. The structure of the cephalic region of this inhabitant of fissures in rocks does not differ materially from those which dwell in more or less free tubes, except that the lingual process or boss is large and that the tentacles show only a slight groove at the base, and it seems to disappear from the rounded distal region, which is tapered and ends in a slight knob.

The *body* (Plate CXIII, figs. 3 and 3 *a*) is comparatively short and firm, has the typical shape—enlarged in front and tapered posteriorly—whilst the dorsal surface is smoothly rounded to the level of the ridges for the hooks, and the ventral surface is marked by a deep groove behind the twelve to thirteen scutes. Anteriorly the dorsum is minutely striated transversely, and behind the branchiæ it is finely tessellated after the manner of *Scalibregma*. On the ventral surface are about twelve central shields which are of a brighter red than the rest of the body, and behind them a white median stripe (marking the nerve-cord) is continued to the tip of the tail, where it blends with the pale hue of the region. The first segment with its rim behind the lower lip is whitish, and each scute has a transverse whitish streak at its posterior border. The ridges for the hooks are somewhat paler than the general surface, and five of the anterior ridges have a glandular white patch between them and the bristle-tufts—indeed, each setigerous process has a glandular patch in front and behind. The dorsum throughout is dull brownish, inclining to purple, in its native site, and merging into orange brown near the tip of the tail, at which the anus is surrounded with small but distinct papillæ (six to eight, De St. Joseph).

The perivisceral fluid contains reddish corpuscles, and corpuscles containing hæmatin also occur in the vessels. The intestine harbours numerous gregarines (De St. Joseph). The branchiæ are three in number on each side, the first the largest and the third the least. Each arises by a short stem which divides somewhat dichotomously, but the terminal divisions are both dichotomously and pinnately divided, the whole having the aspect of a finely branched bush. In life they have a pale whitish-pink hue.

Two ridges run from the ventral scutes toward the first branchia, but they are devoid of hooks and bristles. The first bristle-tuft is borne by the setigerous processes opposite the second branchiæ (fourth segment). The pale golden bristles (Plate CXXVI, figs. 8, 8′ and 8 *a*) form two groups, a shorter and a longer. The longer (Plate CXXVI, fig. 8 *a*) have cylindrical shafts up to a slightly narrowed region behind the wings, which are minutely serrated at the edge, followed by a visible enlargement as the wings arise. After tapering considerably the slightly curved axis ends in a translucent knife-blade tip, the base of which is thickened into a process or spur representing the termination

of the axis, and the rest is flattened out to form the terminal blade, which tapers somewhat suddenly from the broad base to a fine hair-like extremity, the edge opposite the process having a thickened rim, whilst the other is minutely serrated. Malmgren's artist has not very accurately interpreted the basal part.[1] The second series of translucent bristles is shorter and often shows a slight curvature of the shaft, the process or rib at the tip of which is considerably longer than in the former series, the serrated blade passing off with a broad basal web to the hair-like tip. The rib or process in both longer and shorter would appear to stiffen the terminal web.

The posterior bristles are brittle, and few remain after capture. They consist of long, slender, translucent shafts bifid at the tip—that is to say, the web at the tip is stiffened by two spur-like thickenings, which support the serrated web between them. They show no long, tapering extremity as in front.

From first to last the setigerous processes are closely associated with the ridges for the hooks, and indeed form part of them, finishing as it were the dorsal end by a pointed process. Anteriorly the process is nearly transverse, but by-and-by it slopes backward, especially posteriorly, where the bristles pass from its posterior and upper angle. From the second branchia backward eight papillæ occur above the rows of hooks.

The hooks (Plate CXXVI, fig. 8 *b*) commence on the ridge passing from the first bristle-tuft ventrally toward the shields (fifth segment, De St. Joseph), and the succeeding ridges gradually increase in prominence until they are conspicuous latero-ventrally. The first row is single, but at the eleventh a double row occurs, and this continues a considerable distance, but on the small posterior ridges only a single row is found. The typical hook has a large main fang and three teeth above it, the posterior margin is nearly straight, its distal end curving to the crown, and its basal bending outward to form a process of the base. The latter is of moderate length, convex inferiorly, and with a sinuosity in front. The curve beneath the chief fang is abrupt and ends in a prominent process, and below it a curve goes to the anterior prow. Although only three teeth are observed above the great fang in profile, numerous teeth appear when the crown is viewed from above. In the first row of hooks the bases are altered, the anterior prow being prolonged, and the sinus above the base posteriorly being more pronounced than in the typical hook. Anteriorly the outer edge of the groove for the hooks is free, so that it sometimes resembles a papilla.

The body, the tentacles and the branchiæ occasionally swarm with *Rhabdostyla sertularium*, Sav. Kent (De St. Joseph).

*Reproduction.*—Dalyell (1853) describes the ova as red and embedded in albuminous matter. He does not give the date. De St. Joseph found an example with ripe eggs in August.

*Habits.*—Like *Marphysa sanguinea* and *Cirratulus cirratus*, *Leprea* has a habit of forming a siphonal bend in its tunnel in the fissure of the rock so that both head and tail can be thrust out at the free edge. It is rare, according to De St. Joseph, on shores bordered by granite at Dinard.

This species was first described and figured by H. Martin Kähler (1754) as a polyp

[1] 'Annul. Polych.,' Tab. xii, fig. 69 B.

which perforated stones, though Linnæus subsequently placed it under the Terebellids. Its habit of occurring in fissures of rocks with its siphonal tunnel had misled Kähler.

Dalyell's (1853) small examples constructed cylindrical sheaths of sandy or muddy particles and insufficient to cover the body. The sheath was frequently abandoned. They also, he narrates, produce a "real cobweb" of mucous threads with which they cover themselves and support the spawn.

The laxity of De Quatrefages' arrangement (1865) and the subsequent confusion is illustrated in this species, which was included under the genus *Idalia*, and afterwards described as a new form under the title *Heterophyselia Bosci*.

Malmgren's account (1865) was probably drawn from specimens in the British Museum, and his description refers to *Leprea lapidaria*, which had been confounded with Dalyell's *L. textrix* in the collection.

Marenzeller (1884) gave a careful digest of the literature of this species, and corrected the synonymy up to date.

Gravier [1] (1906) thinks that this species perhaps secretes an acid, which enables it to attack the calcareous masses amongst which it lives. It is nowhere more abundant than in the gneiss of Guernsey in fissures and crevices of the rocks, where the secretion of an acid would not be effective, so that the secretion is not always of service in this respect.

De St. Joseph [2] (1906) found a Rotifer, *Discopus synaptæ*, on the skin of this form at St. Jean-de-Luz.

In the British Museum, preparation 66 . 8 . 20 . 14, attached to the shell of a *Pinna* from Polperro, and labelled *Terebella constrictor*, is *Leprea textrix*.

## *Genus* CLII.—Thelepus, *Leuckart*, 1849.

*Lumara*, Stimpson, 1855; *Neottis*, Malmgren, 1865; *Phenacia, Heterophyselia* and *Heterophenacia*, De Quatrefages, 1865; *Thelepodopsis*, Sars, 1871; *Venusia*, Johnston, 1855; *Heteroterebella*, Panceri.

Cephalic lobe with a well-marked dorsal collar, the external rim passing to the ventral surface, and joining the lower edge of the supra-oral arch, the intervening space being occupied by the inner tongue-shaped process and the fillet of the post-oral segment. Anterior surface of cephalic plate occupied by the tentacles. Numerous ocular specks. Body typical, though the ventral scutes are often indistinct. The dorsal surface frequently has rounded glandular furrows. Branchiæ a filiform transverse series (two or three on each side, rarely one) on the second and third segments. Setigerous processes commence on the third segment, and extend to the posterior end. The avicular hooks begin on the fifth segment and also continue to the penultimate segment in a single row, and in some the row ends in a loop or circle. Nephridia increase in size from front to rear.

Tube long and membranous, with fragments of shells, zoophytes, and other foreign structures externally.

Grube (1878) adopts the title *Phenacia* of De Quatrefages for this group.

[1] 'Nouv. Archiv. Mus. Paris,' 4e sér., t. viii, p. 210.

[2] 'Ann. Sc. nat.,' 9e sér., t. iii, p. 175.

In a preliminary account of a species of *Streblosoma* from the "Siboga" Expedition, Caullery[1] reviews the genera of the Thelepinæ, concluding with the following arrangement: Fam. Terebellidæ; sub-fam. Amphitritea; trib. Thelepinæ; with four genera, viz., *Thelepus*, Leuckart, *Streblosoma* (Malmgren 1867, Sars 1871), *Euthelepus*, McIntosh, 1885, and *Parathelepus*, Caullery (= *Thelepides*, Southern). *Streblosoma* he substitutes for *Grymæa*, Malmgren, since the name has been preoccupied in the Protozoa. He separates the four genera thus:

| | | | |
|---|---|---|---|
| Branchial filaments more or less numerous. Bristles commencing on | segment 2 (first branchiferous), hooks commence on segment 5 | | *Streblosoma.* |
| | segment 3 (second branchiferous), hooks begin on | segment 5 | *Thelepus.* |
| | | segment 11 | *Parathelepus.* |
| Branchial filaments, few, cirriform. Bristles begin on segment 3, hooks on segment 5 | | | *Euthelepus.* |

An interesting feature is the tendency in some species of *Streblosoma* to form a spiral tube.

So far as can be noticed in examples of *Thelepus cincinnatus*, Fabr., from Greenland and Canada, the branchiæ seem to arise on the second segment in both, a single clear segment occurring between the collar and the first row of branchiæ. Only two pairs of branchiæ are present in each.

1. THELEPUS CINCINNATUS, *O. Fabricius*, 1780, var. *Andreanæ*, var. nov. Plate CXX, fig. 1—reproduced tail; Plate CXXVI, figs. 6—6 *d*—bristles and hooks.

*Specific Characters.*—Dorsal cephalic collar with eye-specks; supra-oral arch and ventral fillet small. Tentacles long, powerful, deeply grooved and crenate. Body about 6 or more inches long, typical in outline, and ending in a slender tail with the terminal anus, which has about a dozen papillae at its margin. Segments about 100. Dorsal surface rugose, glandular, with scattered papillæ and often reddish-brown dots. Colour reddish or pale orange inclining to yellow. Branchiæ two on each side and consisting of simple filaments often wavy from a slight spiral arrangement, the anterior forming a longer transverse row than the posterior. Papilla on segment 4 under the setigerous process and on 5, 6 and 7 between the latter and the torus.

Setigerous processes numerous, commencing on the third segment, but ceasing a considerable distance in front of the anus. Bristles of moderate length, in two series, a longer and shorter, the tapering tips having narrow wings. Rows of "retrograde" hooks begin at the posterior border of the fifth segment, comparatively short at first, then increase in length anteriorly, remain nearly uniform for a considerable distance and gradually become elevated, so that at the twenty-fifth a prominent uncinigerous process is formed. Posteriorly as the bristles diminish these processes increase in prominence, and finally as the uncinigerous processes diminish, they slant to the ventral surface and cease at the anal segment. The hooks present a main fang and two teeth above it

[1] 'Bull. Soc. Zool. France,' t. xl, p. 44, with text-figs.

in lateral view, a long base and a prow with a strong stud-shaped process. Segmental organs from fourth to seventh segment. Tube of secretion with fragments of shells and other structures attached to it.

This differs from the northern *T. cincinnatus*, since the bristles always cease a considerable distance in front of the anus, whilst the hooks have a wider and more convex base, and an additional tooth in lateral view on the crown.

Synonyms.

1780. *Amphitrite cincinnata,* O. Fabricius. Faun. Grönland., p. 286.
1820. *Terebella* „ Savigny. Syst. Annel., p. 87.
1826. „ *lutea,* Risso. Hist. nat. l'Europe, t. iv, p. 409.
1847. „ *madida,* Frey and Leuckart. Beiträge Wirb. Thiere, p. 154.
1849. *Thelepus Bergmanni,* Leuckart. Archiv f. Naturges., xv, p. 169, Taf. iii, figs. 4 A—C.
1851. *Terebella cincinnata,* Grube. Fam. Annel., pp. 80 and 138.
1853. *Lumara flava,* Stimpson. Marine Invert. Grand Manan, p. 30.
1858. *Terebella conchilega,* Dalyell. Pow. Creat., vol. ii, p. 199, pl. xxviii, figs. 3—8.
1860. „ *pustulosa,* Grube. Arch. f. Naturges., Bd. xxvi, p. 100, Taf. iv, fig. 7.
1865. *Venusia punctata,* Johnston. Cat. Worms Brit. Mus., pp. 241 and 345.
„ *Thelepus circinnata,* Malmgren. Nord. Hafs.-Annul., p. 387, Tab. xxii, fig. 58.
„ *Heterophyselia cincinnata,* De Quatrefages. Annel., t. ii, p. 387.
„ *Phenacia terebelloides,* idem. Ibid., p. 375.
„ *Lumara flava,* idem. Annel., t. ii, p. 397.
1867. *Thelepus circinnatus,* Malmgren. Annul. Polych., p. 110.
„ *Venusia punctata,* Parfitt. Cat. Devon Annel., p. 32.
„ *Phenacia pulchella,* idem. Ann. Nat. Hist., 3 ser., vol. xliii, pp. 1, 2, pl. i.
1868. *Heterophenacia nucleolata,* Claparède. Annél. Nap., p. 401, pl. xviii, fig. 1.
„ *Phenacia ambigrada,* idem. Ibid., p. 142, pl. xviii, fig. 6 (young).
„ „ *retrograda,* idem. Ibid., p. 143, pl. xviii, fig. 7 (young).
1870. „ *terebelloides,* Grube. Arch. f. Naturges., 36 Jahrg., p. 332.
1872. *Thelepodopsis flava,* Sars. Förh. Vidensk. Selsk. Christ., p. 415.
1874. *Thelepus circinnatus* McIntosh. Ann. Nat. Hist., 4 ser., vol. xiv, p. 205.
„ „ „ Malm. Annul. Göteb., p. 98.
„ „ *cincinnatus,* Verrill. Americ. Journ. Sc., ser. 3, vol. vii.
1875. „ *circinnatus,* McIntosh. Invert. and Fishes St. Andrews, p. 129.
„ *Phenacia pustulosa, ambigrada* and *retrograda,* Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 531.
„ *Terebella lutea* and *Heterophenacia madida,* idem. Ibid., p. 530.
1877. *Thelepus cincinnatus,* Marenzeller. Denkschr. Kaiserl. Akad. Wissensch. Wien, Bd. xxxv, p. 36, sep. abdr.
1878. „ *circinnatus,* McIntosh. Trans. Linn. Soc., ser. 2, Zool., p. 508.
1879. *Terebella circinnata,* Tauber. Annul. Danica, p. 133.
„ *Thelepus circinnatus,* Théel. Kgl. Sv. Vet.-Akad. Handl., Bd. xvi, p. 64.
1880. *Phenacia terebelloides,* Langerhans. Zeitschr. f. w. Zool., Bd. xxxiv, p. 107, fig. 21.
„ *Thelepus circinnatus,* McIntosh. Ann. Nat. Hist., ser. 5, vol. vi, p. 271.
1881. „ „ Leslie and Herdman. Proc. Roy. Phys. Soc., vol. vi, p. 67.
1882. „ *circinnatus,* Ar. Hansen. Norske Nord. Exped., p. 11.
1883. „ „ Levinsen. Vidensk. Meddel., p. 174.
„ „ *cincinnatus,* Wirén. Chætop. "Vega" Exped., p. 420.

1884. *Thelepus cincinnatus*, Marenzeller. Sitzb. K. Akad. Wien, t. lxxxix, p. 205.
1885. „ *circinnata*, Wirén. Köngl. Sv. Vet.-Akad. Handl., Bd. xxi, p. 21, Taf. ii, figs. 1, 2.
„ „ *cincinnatus*, Carus. Fauna Medit., i, p. 265.
1886. „ *circinnatus*, Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 158.
„ „ *cincinnatus*, Marenzeller. Polarforsch., p. 15.
1887. „ „ Webster. Chæt. Eastport, Maine, U.S. Com. F. and F., p. 749.
1888. „ *circinnatus*, Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 665.
1889. „ *cincinnatus*, E. Meyer. Arch. f. Nat., lv, p. 133.
1891. „ *circinatus*, Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 257.
„ „ *cincinnatus*, Appellöf. Berg. Mus. Aarb., p. 8.
1893. *Thelepodopsis flava*, Levinsen. "Hauchs," p. 350.
„ *Thelepus cincinnatus*, Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 57.
1894. „ *circinnatus*, Bidenkap. Christ. Vet.-Akad. Forhandl., p. 126.
1896. „ *cincinnatus*, Roule. Camp. "Caudan," p. 458.
„ „ *circinnatus*, Appellöf. Berg. Mus. Aarb., p. 12.
1897. „ *cincinnatus*, Michaelsen. Polych. deutsch. Meere., p. 172.
1898. „ „ De St. Joseph. Ann. Sc. nat., 8e sér., v, p. 427, pl. xxiii, fig. 240.
1899. „ „ Ssolowiew. Ann. Mus. St. Pétersb., t. iv, p. 216.
1901. „ *circinnatus*, Meyer. Arch. f. Naturg., Jahrg. 55, p. 12.
„ „ „ Whiteaves. Cat. Mar. Invert. E. Canada, pp. 14 and 73.
1902. „ „ Percy Moore. Proc. Acad. N. Sc. Philad., vol. liv.
„ „ *crassibranchiatus*, Treadwell. Bull. U.S. F. Com. (1900), pt. ii, p. 206.
„ „ *antarcticus*, Willey. "Southern Cross," p. 278.
1905. „ *circinnatus*, Graeffe. Arb. Zool. Stat. Trieste, Bd. xv.
1906. „ *cincinnatus*, Augener. Westind. Polych., p. 182.
1907. „ „ Norman. Mus. Norm., p. 10.
1908. „ „ Ehlers. Deutsch. Tiefsee-Exped., p. 146.
1909. „ „ Percy Moore. Proc. U.S. Nat. Mus., vol. xxxvii, p. 141.
„ „ „ Fauvel. Bull. Inst. Oceanogr., cxlii, p. 36.
„ *Telepus* „ Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 588.
1910. *Thelepus* „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 238.
1911. „ „ Fauvel. Bull. Inst. Oceanogr., No. 194, p. 36.
1912. „ *circinnatus*, Wollebæk. Skrift. Vid.-selsk. Krist., No. 18, p. 89, pl. xxiv, figs. 1—3, pl. xxv, figs. 1—7, pl. xxix, fig. 1.
„ „ „ Ditlevsen. Danmark-Eksped. Grönl., Bd. v, p. 428.
„ „ *cincinnatus*, Crawshay. Journ. M. B. A., vol. ix, p. 344.
„ „ „ Meyer. Inaug. Diss. Kiel, p. 46.
1913. „ *circinnatus*, Augener. Zool. Anz., Bd. xli, p. 269.
„ „ „ Fauvel. Bull. Mus. Hist. Nat., p. 91.
1914. „ *circinnatus*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 125.
„ „ *cincinnatus*, Fauvel. Campag. Scient. Monaco, xlvi, p. 306.
1915. „ „ Southern. Irish Sc. Invest., No. 3, p. 47.
„ „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 26.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 635.
1917. „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 212.

*Habitat.*—Generally from deep water on the eastern coast of Scotland, the tubes being coiled inside bivalves, sometimes fixing the valves in their coils; in the interstices of

laminarian roots tossed on shore by storms; under stones at extreme low water, Lochmaddy, as well as in the Loch itself; sometimes amongst masses of *Serpulæ* from deep water; dredged in 50 fathoms off Balta, Shetland (J. G. Jeffreys); Firth of Forth (Leslie and Herdman); Isle of Arran (E. P. Wright); Dublin Bay; west coast and other parts of Ireland (Southern); Plymouth (Spence Bate and B. Rowe).

This form is widely distributed abroad, but has probably been confused with other species. Taking, however, the literature as it is, it probably ranges from the Mediterranean to Spitzbergen, Greenland, Finmark, Iceland, Jan Meyen, Canada, the United States and Japan. Shores of France. Dredged by the "Knight Errant" at 987 metres; by the "Caudan" at 400 metres in the Gulf of Gascoigne; Azores (Fauvel); White Sea (Ssolowiew); Gulf of Mexico; Madeira (Langerhans, Fauvel); Siberia and Behring's Sea (Wirén); Franz Joseph Land (Augener); South Antarctic Seas, N.E. America (Moore).

The dorsal *cephalic* collar is well marked, and has posteriorly a series of eye-specks, whilst the external rim passes downward to the ventral surface and joins the lower edge of the supra-oral arch. A comparatively short space thus intervenes between the two sides ventrally, a space which is occupied by the inner tongue-shaped process, and the short fillet of the post-oral segment. The supra-oral arch is moderately prominent, but limited in extent, and often forms a small spout-shaped process. It is of a deep orange colour with a pale border, and a belt of minute brownish dots just below the pale rim. The anterior surface of the cephalic plate is occupied by the tentacles, which are of a pale flesh colour or orange with or without red specks. They are long, powerful, and marked here and there with whitish opacities, probably from the peritoneal corpuscles, which roll backward and forward in their interior. In some examples they are of a deeper hue than those of *Polymnia nebulosa*, probably from the presence of the reddish specks. These mobile organs are grooved throughout, and are sometimes flattened in a spatulate manner and again contracted and richly crenate. Under the structureless cuticle is the cellulo-granular hypoderm; then follow the fine but tough non-striated muscular fibres, circular and longitudinal. In life the slender vermiform tentacles coil and twist in every direction, now showing nodular enlargements and again extending into a uniform thread as before, or actively wriggling as if endowed with independent life. Each granular tentacle when separated from its attachment to the cephalic plate coiled itself in spasmodic jerks or gently unfolded. By their aid, as in other Terebellids, the annelid pulls itself upward on the perpendicular wall of a glass vessel. The tentacles at the ventral angle of the cephalic plate are small and short. The plate itself can be shortened or extended at will.

The body is typical of the Terebellids, viz., enlarged anteriorly and tapered gently therefrom to the posterior end, where the anus is terminal and surrounded by about a dozen papillæ. It is rounded dorsally, and more or less rugose or warty in old and large specimens anteriorly, rounded also anteriorly on the ventral surface, then flattened and slightly grooved, the groove continuing almost to the posterior end. The segments are distinctly marked throughout, the anterior presenting dorsally four transverse lines, and the longer and narrower posterior segments a larger number. The ventral scutes (glandular thickenings) are well developed, and can be distinguished

as such as far back as the thirtieth bristle-bundle. Moreover, a thick glandular coat invests the body laterally, enveloping the tori and the setigerous processes in each segment. In large examples the anterior scutes are rugose transversely, and cut into various folds in each segment. In *Thelepus cincinnatus*, Fabr., between the setigerous process and the hooks from the fourth to the seventh segment a papilla occurs at the dorsal end of the hook-row, the first being smaller than the rest. These are not readily seen in the British form, in which the glandular cushions running outward from the ventral scutes anteriorly are much more prominent. In several from Balta (50 fathoms), however, these small papillæ were present.

In many the posterior region is absent, and it is evident that the fragility of this part is great, for reproduced tails are common. In a specimen about $1\frac{3}{4}$ inches in length the regenerated tail (Plate CXX, fig. 1) had a regular series of rounded papillæ externally and a smaller series internally, the anus being in the centre. Slight grooves pass forward for a short distance from the intervals between the papillæ.

The body is of a reddish orange or pale orange inclining to yellow with the tints deeper anteriorly, and dorsally either pale or dark toward the posterior end. The ventral "scutes" are white. Most of the specimens from Lochmaddy are without dots; indeed, only a single example showed a series of reddish-brown specks scattered over the dorsum, none occurring on the under surface. The first segments are paler than the succeeding—both dorsally and ventrally, and slightly striated longitudinally. The tentacles are pale rose; the branchiæ pale yellowish.

The cœlomic fluid is abundant in this species.

The intestinal tract consists of a muscular œsophagus with strong circular and longitudinal non-striated fibres, followed by the more flexible portion with a yellow glandular coat, then the gizzard, and finally comes the wrinkled intestine with its "chlorogogenous" sheath. The œsophagus is generally empty; the flaccid region behind, when the animal has recently fed, has usually three or four large swellings so as to be moniliform. The contents of these are muddy sand containing organic particles such as diatoms. In one example the last swelling was partly bounded by the anterior part of the gizzard, which, however, throughout the rest of its extent was of the normal size. Dr. Williams states of this "gizzard-like part": "It is generally found on examination to be devoid of contents; the alimentary substance does not stop or lodge in it." In this case the gizzard contained a small quantity of the same muddy sand as the tract in front. In the normal condition it is unlikely that over-distension of the main part of the gizzard ensues, since its function is probably to triturate the muddy sand and render the organic particles available for absorption, and such would also be facilitated by the limited quantity in it.

*Segmental Organs.*—These are characterised by their greater length than those of *Lanice conchilega*, and in the normal condition lie flatly along the ventral wall with the free ends directed backward. They contain cellulo-granular structures and oil-globules, and often assume a peculiar moniliform aspect in spirit. In some rounded bodies like cells occur in masses.

The feet are represented by setigerous processes and tori uncinigeri. The first setigerous process arises dorso-laterally below the second series of branchiæ, and the

others follow in succession at the posterior part of each segment. The glandular investment of the region passes above it, and forms a finished edge dorsally. The succeeding processes gradually incline to the lateral region, and, posteriorly, to the ventro-lateral region. The bristles form a vertical fan in each process, narrow at the base and spreading out distally. Moreover, they are arranged in two alternating series, a longer and a shorter, the tips of the latter only projecting beyond the surface. They are shorter than those of *Lanice conchilega* and less slender, and the wings are more distinct. Each bristle has a pale base, gently dilates into the widest part of the shaft, then forms a nearly cylindrical and slightly narrower region to the wings, after which it tapers to a slender, curved tip. The wings are narrow, both anteriorly and posteriorly —the latter having shorter bristles. As Grube and Marenzeller point out, the bristles do not, as Malmgren observes, go to the posterior end, a considerable number of the terminal segments being devoid of them. Thus in an example from Balta about forty of the posterior segments had no bristles. As the tufts of bristles decrease, the uncinigerous processes become more distinct. In imperfectly preserved specimens the cuticle falls off and the bristles cling to it by their tips, probably from the enlargement caused by the wings, but the edges of the wings may also be concerned.

The branchiæ form two tufts of simple filaments arising from a transverse ridge on each side on the second and third segments, the anterior ridge being the longer, passing also further down the side (ventrally), and with more numerous filaments, which are often prettily waved in a spiral manner when the animal is at rest. They are of a pale straw or deep orange colour with a red streak in the centre from the blood-vessel, which is most distinct immediately after a contractile wave of the body drives the fluid forward. As they arise from two segments they can scarcely be called "one pair" as in the 'Catalogue of Worms' in the British Museum. In a young example, half an inch in length, these organs formed two distinct groups on each side, the first containing two or three filaments of different lengths, the posterior only one. They are enveloped in a transparent structureless cuticle, and the hypoderm has finer cells and granules than the tentacles. Longitudinal and circular muscular fibres are also present. The branchiæ seem to vary in the genus, and some of the largest examples of *T. cincinnatus* from the Arctic Seas have short, thick filaments. As regards origin and structure, the British form corresponds generally with the northern type just mentioned.

The bristle-tufts range from thirty to forty-one, and in transverse section the bristles are somewhat ovate, sometimes approaching a short or blunt ellipse. The anterior bristles have smooth straight shafts with curved, winged tips which taper to a fine point (Plate CXXVI, fig. 6). The wings are of moderate width and disappear before reaching the tip. The winged tips of the shorter series alone project beyond the setigerous process, and they have a more or less alternate arrangement with the longer series.

The posterior bristles are much reduced in size and the greater part of the shaft is deeply imbedded in the tissues, the translucent free portion having the shaft somewhat dilated at the commencement of the wings, which are rudimentary, and almost reach the surface of the setigerous process. In the most posterior forms the slender shaft

shows no enlargement, and the tip is hair-like. No regular series of short bristles occurs in these tufts, though one or two are observed at the edges.

The first row of hooks is on the fifth segment, the first two elevations being devoid of them. On the fifth the row is at the posterior part of the segment at some distance ventrally from the setigerous process. They increase a little in length after the first, and remain nearly equal for a considerable distance, gradually, however, becoming elevated, so that about the twenty-fifth, prominent uncinigerous processes are formed, and posteriorly they stand out like the "legs" of caterpillars. Toward the tip of the tail they diminish on the narrow segments and incline ventrally, so that those of opposite sides approach, and they cease at the last segment. In an example from St. Andrews the uncinigerous processes were irregular posteriorly, being crowded on one side, and scantily distributed, even with blanks, on the other—probably from injury. The hooks are arranged in a single row throughout and are smaller than those of *Lanice conchilega*, but more numerous, no less than 137 occurring in a row anteriorly, but posteriorly the number diminishes. Each hook (Plate CXXVI, figs. 6 *a*—*d*) in lateral view presents two teeth above the main fang. The posterior outline is short and has a dimple, whilst the base is elongated and convex inferiorly. The anterior outline (below the main fang) is smooth, often slightly convex, and merges into the prow (anterior part of the base), which is prolonged as a stout process with a slightly dilated tip, so as to resemble a stud, whilst below this the prow curves a little forward, and the inferior outline is slightly convex. In some a smaller process of the prow (less than that shown in fig. 6 *b*) occurs beneath the stud, as, for instance, from the south-west of Ireland. The occasional occurrence of a second tooth above the main fang brings the *Heterophenacia Renouardi* of Marion,[1] from Marseilles, nearer this species.

The *tube* is generally attached inside bivalves from deep water, and contains more of the tough membranous secretion and fewer shelly elements than that of *Lanice conchilega*; moreover, its anterior end is not branched. The anterior glands and the many glandular bodies which give a variolous appearance generally may also aid in the secretion, and in some the body is surrounded by a milky secretion before death. When in vigour the animal rapidly constructs a tube. In many the tube shows a tendency to assume a spiral form. The forms attached to the secretion are spines of *Amphidoti*, fragments of shells, corallines, masses of mud and Foraminifera. ' In Greenland the tubes of the arctic type are sometimes made of sand and Foraminifera (Ditlevsen). In the Mediterranean they are formed of coralligenous algæ, leaves of *Posidonia*, vegetable fibres and other *débris* (Lo Bianco).

*Reproduction.*—In an example captured on the 16th October numerous ova were found in the cœlomic space. Lo Bianco (1909) observes that individuals carried ova from August to October at Naples.

A distinct variety of *Thelepus cincinnatus*, if not a separate species, was dredged by the "Knight Errant" at Station 8, lat. 68° 4′, long. 7° 37′, in 305 fathoms on mud. Only the hook is at present available, but it differs from that of the ordinary form in the depth and proportional shortness of the base, which is boldly convex inferiorly. It agrees with the northern *Thelepus* in having only a single tooth above the main fang.

[1] 'Revue des Sc. nat.,' t. iv, March, 1876.

No member of the family has been the subject of more ambiguity or of a greater expenditure of time and labour than this form, a result perhaps partly due to the variability of its characters and the fineness of the distinctions between it and neighbouring species. It agrees with the northern *Thelepus cincinnatus*, Fabr., in having two pairs of simple branchiæ and in occasionally presenting the minute papillæ at the dorsal end of the hook-rows 4—7, but it shows an additional tooth above the main fang of the hook, and the base is somewhat shorter and broader, the stud above the prow projecting nearly in a line with the trend of the anterior outline, whilst the stud in *T. cincinnatus* makes a smaller angle with the anterior outline. The process beneath the stud is generally larger. *T. cincinnatus*, var. *andreanæ*, is distinguished from *T. triserialis*, Grube, a southern form characteristic of the Channel Islands and the Mediterranean, by the occurrence of three sets of gills in the southern type, by its hooks having a longer base and often only a single tooth above the main fang, though a second is occasionally seen. *Streblosoma Bairdi* differs in having much longer setigerous processes, three pairs of gills, hooks which have the stud set at a different angle, and with a prolongation of the anterior outline in a line with that above the stud. Two conspicuous teeth occur above the main fang. From *Thelepus setosus*, De Quatrefages, *T. cincinnatus*, var. *andreanæ*, is separated by its two pairs of gills, and by the commencement of its hook-rows on the fifth segment, whereas those of *T. setosus* begin on the third segment.

Yet after all these distinctions the feeling remains that the precise degree of variability in each has never been fully studied, and that the environment of each may be the cause of its special divergencies. All that can be done at present is to define such variations around each centre or supposed species. The variations of the hooks of the widely distributed *Thelepus setosus*, De Quatrefages, as recently shown by Prof. Fauvel[1] (1916), afford an excellent argument for caution in dealing with forms so intricate. Future work may show that the northern *Thelepus cincinnatus* of Fabricius may be the centre of the various forms hitherto described as species, for the presence or absence of a pair of gills, or the curves and processes of a hook or even the modifications of the nephridia are not necessarily in themselves features of fundamental value.

Von Marenzeller (1884) mentions that he has found, as Grube previously noted, specimens in which the bristles did not reach the posterior end. He also observes that *Phenacia ambigrada* and *P. retrograda* of Claparède refer to young examples. He appears to group all the varieties under this species. In all probability the author refers to the same form as here described, both from the structure of the hooks and other particulars.

Crawshay (1912) gives an account of the structure of the hooks and their variations at Plymouth, and he probably refers to this form, which differs from the northern *T. cincinnatus*.

2. Thelepus triserialis, *Grube*, 1885. Plate CXXV A, figs. 7—7 *b*—bristles and hook

*Specific Characters.*—General aspect of the cephalic region and body similar to that of *T. cincinnatus*, but three pairs of branchiæ occur, viz. on the second, third and fourth

[1] 'Arch. Zool. Expér.,' t. lv, p. 465, text-figs. 3—6.

segments, the first in a line with the first bristle-bundle. Eye-specks as in the former species. Ventral scutes 15. Lateral papillæ as in *T. cincinnatus*. Setigerous and uncinigerous processes similar to *T. cincinnatus*, but the former bears somewhat stouter bristles with slightly broader wings, and in the hooks the stud-like process on the prow (anterior end of the base) has a different angle, and a different process beneath it, whilst the posterior indentation is perhaps better defined. The upper teeth and the crown are much larger than in *T. cincinnatus*, though such may be a variation.

Brownish-violet or orange in colour.

Synonyms.

1855. *Terebella triserialis*, Grube. Arch. f. Naturges., 21 Jahrg., p. 118, Taf. iv, fig. 16.
1864. „ „ idem. Insel Lussin, pp. 85 and 128.
1865. *Phenacia setosa*, De Quatrefages. Annel., t. ii, p. 376 (only 2 branchiæ on second and third segments).
„ *Terebella triserialis*, idem. Ibid., t. ii, p. 364.
„ *Neottis* „ Malmgren. Nord. Hafs.-Annul., p. 388.
1869. *Phenacia setosa*, Grube. Schles. Gesell., 1868—69, p. 110.
1870. „ „ idem. Arch. Naturges., 1870, p. 332.
1871. *Terebella triserialis*, Grube. Jahresb. Schles. Ges. f. Vaterl. Cult., p. 49.
1875. *Phenacia* „ Panceri. Atti Soc. Ital., vol. xviii, p. 531.
1884. *Thelepus* „ Marenzeller. Sitzb. der K. Acad. Wiss., Wien, Bd. lxxxix, p. 58, Taf. ii, fig. 3.
1885. „ „ Carus. Fauna Medit., *i*, p. 266.
1894. „ *setosus*, De St. Joseph. Ann. Sc. nat., 7e ser., t. xvii, p. 230, pl. x, figs. 259—262.
1896. ? „ *cincinnatus*, var. *profundus*, Roule. Camp. "Caudan," p. 459.
1900. „ *triserialis*, Ehlers. Schwed. Magell. Annel., p. 16.
1901. „ and *Neottis spectabilis*, Pratt. Proc. Lit. and Philos. Soc. Manchester, p. 14.
„ „ *triserialis*, Ehlers. Polych. Magell. u. Chil., p. 212.
1904. „ *setosus*. Journ. M. B. A., vol. vii, p. 229.
1906. „ *thoracicus*, Gravier. Nouv. Arch. Mus., sér. 4, t. viii, p. 218, pl. iv, figs. 228, 229.
1909. „ *triserialis*, Fauvel. Bull. Instit. Ocean., cxlii, p. 37.
„ „ *setosus*, idem. Ann. Sc. nat., 9e sér., t. x, p. 209.
1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 238.
1914. „ „ idem. Ibid., vol. xxxi, No. 47, p. 125.
1915. „ „ idem. Irish Sc. Invest., No. 3, p. 47.
1916. „ „ Fauvel. Arch. Zool. Expér., t. lv (Fasc. 10), p. 466, figs. 3—6.
1917. „ „ Rioja. Anél. Poliq. Cantáb. p. 57.
„ „ *triserialis*, Hessle. Zool. Bidr. Uppsala, Bd. v, p. 217.
1919. „ *setosus*, Fauvel. Arch. Zool. Expér., t. lviii, p. 455.

*Habitat.*—Between tide-marks, under stones in Guernsey and Herm, and also dredged off St. Peter Port. Dredged in 10 fathoms in Lough Foyle, Ireland, in the "Porcupine" Expedition of 1869. Dublin Bay (as *T. setosus*); in laminarian roots and amongst Zostera in Blacksod and Clew Bays (Southern).

In the Mediterranean near Sicily, Villafranca and Lussin Piccolo, etc. (Grube and Marenzeller). Atlantic coast, N. America (Verrill). Shores of France, Madagascar, Australia (Fauvel). Shores of Cantabria (Rioja). Magellan (Ehlers). Falkland Islands (Fauvel). Red Sea (Gravier).

The cephalic collar and the arrangement of the parts of the anterior end are similar to those of the foregoing species, but no pigment-specks remained in the preparations behind the collar, though in life they were present. A distinction, however, immediately appears in the branchial region, the surface of which is more extensive, the filaments more numerous and more slender. Moreover, they arise from three segments, viz. the second, third and fourth. The first and largest forms a transversely elongated row of filaments on segment 2, its outer edge passing ventrally considerably below the first bristle-tuft behind it. The second springs from the dorsum of the third segment within (*i. e.* dorsal to) the first bristle-tuft and is smaller, whilst the third, which is somewhat longer, arises on the dorsum opposite the second bristle-tuft. The first pair is widest apart, the third nearer each other.

The body generally resembles that of the foregoing form, but is often smaller, and the dorsal and ventral surfaces, glandular scutes and plates do not materially differ. The bristle-tufts range from thirty to forty, the posterior region in one having about forty segments devoid of them, as in *T. cincinnatus*. It tapers posteriorly to a slender tail, and the uncinigerous processes seem to go on to the tip, thus differing from those of *T. cincinnatus*. The anus appears to have a papillose margin.

The first bristle-tuft arises opposite the second branchia, and as mentioned, is above the level of the first branchia, and the setigerous processes are continued along the dorso-lateral region to the posterior region, as in *Thelepus cincinnatus*, where they cease. They are vertically flattened in front and throughout the greater part of their course, but posteriorly they diminish to conical papillæ. The anterior bristles (Plate CXXVI, fig. 9, and a curved one in fig. 9 *a*) appear to be somewhat shorter than in *T. cincinnatus*, but are similarly arranged in two series, a longer and a shorter. The wings in both are slightly broader than in *T. cincinnatus*, both sets of bristles being proportionately shorter and thicker. They increase in length in the middle of the body, but posteriorly diminish both in size and number, especially before ceasing, yet retaining the same arrangement as regards shorter and longer series. The wings in the terminal bristles are narrow. All the bristles have a pale golden hue, and whilst the first few sets of bristles are directed outward, the majority slope outward and backward, the terminal tufts, however, in the preparations, projecting outward or even slightly forward.

The rows of hooks commence on a fillet at the fifth segment, that is, opposite the third bristle-tuft at the posterior part of the segment, and they slightly increase in length to the fifteenth series, when a gradual diminution occurs; the rows, moreover, by-and-by are elevated on processes, and instead of being nearly straight they are convex forward about the twenty-fourth, and this arrangement appears to be retained in the longer posterior uncinigerous processes, where they occur on the anterior face of the tip. As the bristles diminish and disappear the uncinigerous processes increase in prominence and are ventro-lateral in position. Finally, they are minute toward the tip of the tail. The hook (Plate CXXVI, fig. 9 *b*) is similar (generally) to that of *T. cincinnatus*, yet differs in detail. Thus it is proportionally larger, the base longer, the stud at the anterior end of the base (prow) has a different angle with the outline, is truncated at the tip, and the process beneath is more prominent, though there are variations in this respect; moreover, traces of a second tooth on the crown above the main fang are common. Marenzeller's

figure of the hook has a very long base and shows only a single tooth above the main fang (and resembles that of *T. cincinnatus*).

The tube is composed of secretion to which fragments of shells or entire uni- and bivalves, pieces of heart-urchin, fragments of *Cellepora*, and numerous other structures are attached, and it much resembles that of *Thelepus cincinnatus*, var. *andreanæ*. *Lepidonotus squamatus* occurred as a commensal in the tube of an example dredged in 81 fathoms by the "Porcupine" off Cape Finisterre; and Mr. Southern mentions another commensal, viz., *Polynöe scolopendrina*, in Clew Bay.

*Reproduction.*—An example from Lussin in the Adriatic forwarded by Prof. Grube had its cœlom crowded with large ova. It was probably procured in summer. Mature specimens (as *T. setosus*) are found with pale salmon-coloured eggs in August (Southern).

*Thelepus setosus*, De Quatrefages (1865) and other authors, seems to be allied in the closest manner to this species. Descriptions do not enable a definite distinction to be made, and the same result ensues on the examination of specimens kindly forwarded by Mr. Southern from Blacksod Bay. No clear separation could be made.

Fauvel recently has studied numerous specimens of *Thelepus spectabilis*, from the Falkland Islands, and found them identical with the *Thelepus setosus* of De Quatrefages, so common near Cherbourg. He queries if the latter is not *T. triserialis*, although the hooks are slightly different. The conclusion had already been drawn from descriptions that they could not be separated. This author, further, is of opinion that the *Neottis antarcticus*, McIntosh, is the same form, but the marked shortness and depth of the base of the hooks, the different outline below the stud near the tip, as well as the frequent presence of a larger spine on the crown in lateral view in *Thelepus setosus* are noteworthy, though a margin is necessary for variation.

This form occurs from Polperro in preparation 62 . 7 . 12 . 45 in the British Museum. It is labelled "*Terebella nebulosa*."

## *Genus* CLIII.—Streblosoma, *Sars*, 1871.

Cephalic lobe truncate anteriorly, and the dorsal collar is devoid of eye-specks in the preparations. Supra-oral arch flat, and the post-oral lip longer than in *Thelepus*. Body enlarged anteriorly, but gradually diminishing to a slender tail. Branchiæ three pairs of simple filaments on the second, third and fourth segments, but their position and relationship to the setigerous processes differ from those of *Thelepus*. The bristles commence on the second segment, and differ from those of *Thelepus* by their great length, and more lustrous condition. Hooks commence on the fifth segment, are smaller than in *Thelepus*, uniserial, with two prominent teeth above the main fang; a process for the ligament occurs on the anterior outline and the prow is prolonged downward and forward beyond it. The anterior nephridia (in the fifth segment) are smaller than the posterior, which appear to increase from the diaphragm backward. Tube of muddy sand in fine grains. The genus extends to America (Verrill).

Verrill[1] (1900) observes that the title *Grymæa* is preoccupied, and that therefore

[1] 'Trans. of the Connect. Acad.,' vol. x, p. 661.

*Streblosoma*, Sars, is the only tenable name for the genus. In this he was followed by Treadwell.[1]

1. Streblosoma bairdi, *Malmgren*, 1865. Plate CXXVI, figs. 7—7 *a*—bristle and hook.

*Specific Characters.*—Cephalic lobe as in *Thelepus*. Three pairs of simple branchiæ Body 2½ inches or more in length, with about thirty-two flattened and lobate setigerous processes, the region behind having only uncinigerous processes. The flattened rows of bristles are twisted like a screw propeller. Nephridia in the third, fourth, fifth, sixth and seventh segments. Bristles about ninety pairs, very long, striated, gently tapered beyond the skin, and with narrow wings. The shorter forms are more slender and alternate with the others; though on the dorsal edge long bristles and on the ventral edge slender bristles occur. Hooks distinguished by having two distinct prongs above the great fang, and the stud on the anterior outline leaves it at an obtuse angle, the prow being produced below it. Tube rather thick, of grey mud and sand. Malmgren named it after the genial and distinguished Dr. W. Baird of the British Museum.

Synonyms.

1865. *Grymæa Bairdi*, Malmgren. Nord. Hafs.-Annul., p. 388, Tab. xix, fig. 69.
1867. „ „ idem. Annul. Polych., p. 219.
1869. „ „ McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 424.
1871. *Streblosoma cochleatum*, G. O. Sars. Vid. Selsk. Skrift. Kristiania, p. 414.
1874. „ „ Malm. Annul. Göteb., p. 99.
1876. *Neottis antarctica*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xvii, p. 321.
„ „ „ idem. Transit. Venus Exped., p. 4, pl. xv, figs. 14 and 15.
1877. *Thelepus McIntoshii*, Grube. Monatsber. Königl. Akad. Wiss. Berlin, p. 544.
1879. *Terebella Bairdii*, Tauber. Annul. Danica, p. 134.
„ „ *cochleatum*, idem. Ibid., p. 133.
1883. *Grymæa Bairdi*, Levinsen. Vidensk. Meddel., p. 177.
„ *Streblosoma cochleatum*, idem. Ibid., p. 177.
1885. *Neottis antarctica*, McIntosh. Rep. "Challenger," vol. xii, p. 472, pl. lii, fig. 1.
1894. *Streblosoma cochleatum*, Bidenkap. Christiania Videnskab.-Selsk. Forhandlinger, No. 10, p. 131.
1896. „ „ Appellöf. Bergens Museum, Aarbog, No. 13 (1894—96), p. 12.
1897. *Grymæa Bairdi* and *Streblosoma cochleatum*, Michaelsen. Polych. deutsch. Meere, p. 174.
1901. *Thelepus spectabilis*, Pratt. Mem. Manchester Lit. and Philos. Soc., vol. xlv, No. 13, p. 14.
„ *? Grymæa spiralis*, Whiteaves. Mar. Invert. E. Canada, p. 73.
1902. *Thelepus antarcticus*, Willey. "Southern Cross," p. 278.
1906. „ *thoracicus*, Gravier. Nouv. Arch. Mus. d'Hist. Nat., sér. 4, t. viii, p. 218, pl. iv, figs. 228 and 229.
1912. *Grymæa Bairdi*, Wollebæk. Vid. Selsk. Skrift. Christiania, No. 18, p. 88, pl. xx, figs. 8 and 9, pl. xxix, fig. 2.
„ „ „ Meyer. Inaug. Dissert. Kiel, p. 49.
1914. *Thelepus spectabilis* and *thoracicus*, Augener. Fauna S.W. Australia, Bd. v, Jena p. 98.
1915. *Grymæa Bairdi*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 31.
„ *Thelepus triserialis*, idem. Ibid., ser. 8, vol. xv, p. 29.

[1] 'Bull. Amer. Mus. Nat. Hist.,' vol. xxx, p. 11, 1911.

1915. *Streblosoma cochleatum,* Caullery. Bull. Soc. Zool. France, t. xi, 1—3, p. 52.
1917. „ *Bairdi,* Hessle. Zool. Bidr. Uppsala, Bd. v, p. 211.

*Habitat.*—Dredged in 80—90 fathoms in Busta Voe, St. Magnus Bay, by Dr. Gwyn Jeffreys in 1867 and 1868. Dredged at Station No. 6 (Atlantic) in the "Porcupine" Expedition of 1870. Elsewhere it occurs in Sweden (Malmgren, Malm).

The *cephalic lobe* is truncate in lateral view—a feature due to the flattened arch of the supra-oral fold, which in many Terebellids forms a spout- or hood-like projection. The surface of the cephalic plate from which the tentacles arise is thus nearly vertical. The dorsal collar presents no eye-specks in the preparations, and curves downward to join the supra-oral fold externally and ventrally. The tentacles agree with those of *Thelepus*, being well developed and having a deep groove with frilled margins.

The general outline of the body agrees with that in *Thelepus*, though the details differ. It is enlarged anteriorly and tapered posteriorly, no example, however, being complete. The dorsal surface is rounded and smoother than in *Thelepus*, the ventral surface flattened, and posteriorly slightly grooved. Anteriorly are ten to eleven glandular ventral shields, which may be wrinkled in the preparations, and the outer edges of which touch the rows of hooks. A glandular belt accompanies the setigerous region, but it is not so pronounced dorsally as to form anteriorly the definite edge as in *Thelepus*, though posteriorly it is well defined. The ventral surface behind the shields is more thinly coated with the glandular tissue, and a thickened median ridge continues for some distance backward. The Norwegian examples appear to be smaller than the British.

Though *Thelepus triserialis* agrees with *Streblosoma bairdi* in having three pairs of branchiæ, yet their arrangement in connection with the bristle-tufts differs. In the present form a branchial tuft of several filaments occurs on the anterior edge of the second segment, but its attachment is above the line of the first setigerous process, which is likewise on the second segment. Behind is a second tuft of branchiæ with fewer filaments, and which is in a line with the first setigerous process of the left side; whilst on the right it is opposite the second setigerous process. The third is a prominent group of about six filaments opposite the third bristle-tuft. The individual filaments are similar to those of *Thelepus*, though in some they are longer; and the first set arise from a transverse ridge, which, however, does not pass externally below the line of the bristles as in *Thelepus*. On the whole the area covered by the branchiæ is longer antero-posteriorly than in *Thelepus*.

No more distinctive feature between *Streblosoma* and *Thelepus* exists than the great size of the setigerous processes and the length of the bristles. The first setigerous process occurs on the second segment, and it is slightly shorter than those which follow, and in the region of the shields the processes form long lamellæ with slightly expanded tips set obliquely like the blades of a series of oars, the ventral edges of which are curved and split for the extended line of pale golden bristles. Moreover, when the process is removed a distinct twist like the blade of a propeller occurs in all the pencils of bristles—a condition closely connected with the functions of the bristle-tufts. As in *Thelepus* the setigerous processes spring from the posterior part of each segment and are dorso-lateral in position. Two ranges of bristles occur in each tuft,

a longer and a shorter, the latter alternating with the former. The longer bristles (Plate CXXVI, fig. 7) have nearly cylindrical shafts inserted deeply in the tissues, but they taper from the cuticular surface distally so that when the narrow wings commence considerable diminution has occurred, and they taper to very fine hair-like curved points. The shorter forms are much more slender, but they also taper to hair-like points and have narrow wings. The dorsal edge of each fascicle is bounded by three or four strong bristles without the intervening shorter and more slender forms, whereas the ventral edge has shorter and more slender bristles.

The number of bristle-tufts is about thirty-two, and the region behind has only uncinigerous lamellæ. The posterior bristles are also inserted deeply in the tissues, are stout and comparatively short and have considerably broader wings, but they likewise taper to a fine hair-like point. They retain the same arrangement of the three or four strong bristles without the intervening slender forms on the dorsal edge of the tuft. As the shorter, slender forms do not present traces of wings it is doubtful if they represent reserve-bristles.

The first row of hooks commences opposite the fourth bristle-tuft, that is, in a corresponding position to that of *T. triserialis*, though in the latter it is the third setigerous process. The rows are somewhat shorter than in *Thelepus*, and they are sooner elevated on ridges; indeed, at the eighth or ninth a distinct lamella is apparent, and at the twenty-fifth it forms a fan-shaped flap with the single row of hooks in a curved line on the anterior face of the edge. The hooks of the first are distinguished by the apparent length of the base, but this is due to its narrowness. The typical hook (Plate CXXVI, fig. 7 *a*) has two distinct teeth above the main fang, the crown above it being thus elevated; the posterior outline is deeply indented, the anterior outline (below the main fang) has a peculiar stud which leaves it at an obtuse angle, whilst the prow is continued beyond it to end in a process for a ligament; the base is evenly convex inferiorly, and has a process at the end of the posterior outline.

The tube is soft, rather thick, and composed of grey, muddy sand in fine grains. In that dredged by the "Porcupine" the soft, translucent, yet fairly tough secretion had minute grains of sand attached to it at intervals. Thus the tube is readily distinguished as a rule from that of *Thelepus cincinnatus*.

Sars[1] (1871), in the characters of the genus, gave the hooks only two teeth, but in the British examples there are three.

Ehlers[2] (1875) describes from the "Porcupine" Expedition a species termed *Grymæa brachiata*, n.s., but the figures, for instance, of the hook are so indefinite that some doubt remains as to its exact nature, for the slight differences noted by the author, such as the occurrence of the hooks on the sixth segment, may yet be otherwise explained.

### *Genus* CLIV.—Parathelepus, *Caullery*, 1915.

Cephalic region with a frilled lobe around the mouth, the sides separated ventrally and partially dorsally; an independent small lamella behind the mouth. Tentacles

[1] 'Videnskab-Selsk. Forhandl. Christ.,' p. 10.

[2] 'Zeitsch. wiss. Zool.,' Bd. xxv, p. 74, Taf. iv, figs. 24—27.

arising as a group on each side of the frilled lamella. Dorsal eyes. Body similar to that of *Thelepus*, but with rows of glands encircling the second and third segments. Branchiæ on the second and third segments, simple, rather stiff, lateral in position. Bristle-tufts 15, commencing on the third segment; simple, capillary, bristles with narrow wings and in two groups. The avicular hooks commence on the eleventh segment.

1. PARATHELEPUS COLLARIS, *Southern*, 1914. Plate CXXV A, figs. 6—6 *b*—bristles and hooks.

*Specific Characters.*—Cephalic region as in the genus, the first segment having two lateral groups of dark brown eyes, and extending ventrally as a shield-shaped area with a smooth margin. Body about an inch or more in length, somewhat rounded dorsally and slightly flattened ventrally, the segments increasing in antero-posterior diameter from before backward. As it tapers anteriorly and posteriorly it is somewhat spindle-shaped. Branchiæ, as in the genus, 4 rather longer pairs on the second segment, two pairs on the third; slightly grooved. Bristles pale, the longer with more tapered, slender tips and slightly convex posteriorly, the shorter with less elongate tips. They commence on the third segment and continue for fifteen segments. Third and fourth segments have rows of glands in line with the bristles. Hooks minute, with two teeth above the main fang, a crown convex posteriorly, the outline again dipping inward above the posterior process of the base, which is rather long and has a curved inferior border. The anterior margin from the main fang to the prow has a spicular process directed outward and downward. The hooks bear a resemblance to those of *Streblosoma bairdi*, though much smaller. They begin on the eleventh segment (ninth setigerous), and are in a single row.

SYNONYMS.

1914. *Thelepides collaris*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 125, pl. xiii, fig. 30.
1915. *Parathelepus* (*Thelepides*) *collaris*, idem. In lit.
„ „ *collaris*, Caullery. Bull. Soc. Zool. France, t. xl, Nos. 1—3, p. 47.
1917. „ „ Hessle. Zool. Bidr. Uppsala, p. 219.

*Habitat.*—Dredged in 15 fathoms in Clew Bay on stony ground (Southern).

The *cephalic region* has a frilled lamella surrounding the mouth, and this is partly cleft dorsally and completely ventrally, where a small independent process occurs, as in *Proclea*. On the dorsum of the first segment are on each side two conspicuous groups of eyes which remain in the spirit-preparation, whilst ventrally is a shield-shaped area with a smooth margin. The tentacles arise in a group on each side of the frilled oral lamella.

The *body* is somewhat spindle-shaped, being slightly enlarged in the anterior region, diminished toward the head, and more distinctly tapered posteriorly. It is about an inch in length. Anteriorly the segments are four times as broad as long, then they gradually increase till in the posterior region they are much longer than broad. On the third and fourth segments is a conspicuous line of glands with elongated cells. The sole fragment had twenty-nine segments, twenty-seven of which were armed.

The branchiæ spring from the second and third segments as stiffish simple filaments, which project outward from the dorso-lateral region. They are faintly grooved and comparatively few in number, four (somewhat larger) pairs occurring on the second segment, two pairs on the third, and Mr. Southern thus likens them to those of *Euthelepus* of the "Challenger," where only a single pair occurs in each segment.

The bristle-tufts commence on the third segment, are fifteen in number and pale golden in colour. The longer have slender cylindrical shafts with a slight backward curvature at the slender, gently tapered tip, and narrow wings (Plate CXXV A, fig. 6). The shorter forms have less elongate and perhaps less finely tapered tips, but differ little.

The anterior hooks (Plate CXXV A, fig. 6 *a*) are avicular, minute, commencing on the eleventh segment (ninth bristled), with a row of 9 hooks, on the tenth with 20, on the eighteenth 93, and on the twenty-sixth 86 (Southern) in a single row without alternation. Each is Thelepoid in character, with an elongate base which has a uniformly convex inferior margin, the outline between the main fang and the simple conical prow having a process directed downward and forward, whilst a larger and a smaller tooth occur above the main fang. The posterior outline shows a convex crown and a well-marked dimple above the posterior projection of the base. The posterior hooks (Plate CXXV A, fig. 6 *b*) do not materially differ, though in some the prow is more pointed.

These hooks, though minute, have much of the facies of those of *Streblosoma bairdi*, yet according to the description of Mr. Southern the species differs in having only fifteen pairs of bristles whereas *Streblosoma* has thirty-two. The hooks in *Parathelepus* commence on the eleventh (ninth setigerous) segment, whereas in *Streblosoma* they begin on the fourth bristled segment.

### *Genus* CLV.—Proclea, *De St. Joseph*, 1894.

Cephalic region witb a frilled lamella on each side of the mouth, and in front of it is the plate for the tentacles. Behind the mouth is a lamella divided in the middle. Body like that of *Terebella*, and the anterior segments have side-lobes. No branchiæ. Bristles of two kinds—smooth and serrated, commencing on the fourth segment, and few in number. The shorter forms are whip-like or pectiniform. Hooks begin on the sixth segment, in a double row in some segments. Both anterior and posterior free nephridia—all with long tubes equally developed in both.

1. Proclea graffi, *Langerhans*, 1884. Plate CXXVI, figs. 10—10 *c*—bristles and hooks.

*Specific Characters.*—Cephalic region has ventrally a frilled lamella on each side of the mouth; above this is the flattened surface for the grooved tentacles. Buccal segment has behind the mouth a small semicircular lamella split in the middle. Body about an inch long, of typical Terebellid shape. Ventrally are ten glandular scutes, with the uncinigerous rows at their sides. Smaller scutes occur in the median groove a

considerable distance behind these. Sixteen setigerous processes with bristles. Second, third and fourth segments have side-lobes, the second and third best developed.

First bristle-tuft is on the fourth segment. The anterior bristles in two series, the longer with straight shafts, which at the commencement of the wings have a slight curvature. The shorter series show translucent, flattened tips, not differentiated into wings. The succeeding bristles have only the flattened, translucent tapering tip—sometimes with a longitudinal streak. In the last eight the shorter tufts show pectinate tips. The outline of the hook approaches that of *Leæna*, the crown being large, with about seven distinct teeth above the main fang. The prow is minute and conical, and a similar small conical process exists posteriorly with a deep notch above it. The posterior border is convex. All the rows of hooks behind the bristles are single. Nephridia in the third, sixth, seventh and eighth segments.

Synonyms.

1884. *Leæna Graffii*, Langerhans. Zeitschr. f. w. Zool., Bd. xl, p. 262, Taf. xv, fig. 21.
1894. *Proclea* „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 180.
1899. *Solowetia Malmgreni*, Ssolowiew. Ann. Mus. Acad. Imp. St. Petersburg, t. iv, p. 195.
1912. „ „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, p. 74.
1914. *Proclea Graffi*, Southern. Proc. Roy. Irish. Acad., vol. xxxi, No. 47, p. 120.
1917. „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 199, Text-fig. 53.

*Habitat.*—Dredged in Clew Bay in 10—11 fathoms on a sandy bottom (Southern).

Abroad it has been met with in the White Sea and Franz Joseph Land (Ssolowiew); shores of France (De St. Joseph); Norway (Wollebæk); Swedish West Coast (Malm); Finmark (Hessle).

The *cephalic* region presents ventrally two frilled lamellæ—one on each side of the mouth instead of the usual continuous lamella, though a rupture of the base may have taken place. Above this is the flattened surface from which the grooved tentacles arise. The buccal segment has behind the mouth a small semicircular lamella split in the middle.

The *body* is about an inch in length, enlarged anteriorly and tapering to the posterior end, which is imperfect, and has a characteristic Terebellid aspect. It is rounded dorsally, slightly flattened ventrally, on which surface is a median groove. Anteriorly the ventral surface has about ten scutes, the first four being, however, very narrow, almost linear. To the exterior of these are the rows of hooks, which are of considerable breadth, and at the dorsal edge are the sixteen setigerous processes with the bristles. Smaller scutes occur in the median groove a considerable distance backward. Behind the anterior region the uncinigerous lamellæ and the setigerous processes are separated by considerable intervals, the former continuing as prominent papillæ to the posterior end (fragmentary).

The first bristle-tuft commences on the fourth segment (Southern). The pale golden anterior bristles (first eight) consist of a longer series with nearly cylindrical straight shafts, which at the commencement of the wings have a slight curvature and taper to a fine, hair-like tip (Plate CXXVI, figs. 10 and 10′). A shorter series projecting little beyond the surface shows translucent, flattened and slightly curved tips, which are not

differentiated into wings, but taper to a delicate tip. The setigerous processes bearing them are, in those best developed, lamellar, so that they form a broad brush.

The succeeding bristles are in smaller pairs, and consist of a series having long straight shafts which dilate into a flattened translucent blade, slightly convex dorsally and tapered to a delicate tip (Plate CXXVI, fig. 10 *a*). The translucent blade has fine striæ and serrations. The tips of shorter forms project from the surface. The flattened tips of the posterior series appear to be modifications of the shorter series in front, the shaft ceasing at their bases, and only a longitudinal streak occupying the centre of the blade.

The anterior hooks approach those of *Leæna*, the crowns being large and the bases small. Each (Plate CXXVI, fig. 10 *b*) shows an acute main fang of moderate size, above which the high crown rises, its anterior edge having about seven distinct teeth. Below the main fang is a small smooth gulf, with a minute conical prow below, the inferior border being convex and rising to a similar small conical process posteriorly, above which is a deep notch, and then the convex posterior border goes to the crown. The posterior hooks do not differ in structure, though less in size, and therein they diverge from many ordinary Terebellids.

*Reproduction.*—A mature female occurred in August (Southern).

## Sub-Family II.—Polycirridea.

The second sub-family of Malmgren's Terebellidæ is the *Polycirridea*, which he characterises as having an entire and large cephalic lobe, rarely tripartite, the grooved tentacles arising from its upper surface. The bristles are not winged, and, as a rule, occur only anteriorly. Hooks elongate, sublinear or absent. No branchiæ or eyes. No visible blood-vessels. The genera are thus characterised by Malmgren :

| | | |
|---|---|---|
| No hooks. Bristles in six segments . . . . . | | *Lysilla*, Mgrn. |
| Avicular hooks. Fascicles of capillary bristles . . . . . | in thirteen segments . . | *Ereutho*, Mgrn. |
| | in nineteen to twenty-two segments . . . . | *Leucariste*, Mgrn. |
| | in forty or more segments . | *Polycirrus*, Grube. |
| Acicular elongate hooks. Fascicles of bristles in ten segments . . | | *Amæa*, Mgrn. |

Formerly the group was included under the *Aphlebina*, De Quatrefages, Grube, Claparède; *Polycirrus*, Grube, Schmarda; *Apneumea* and *Térébellides abrauches*, De Quatrefages; *Ereutho*, Malmgren; *Leucariste*, Malmgren; *Cyaxares*, Kinberg, and *Dejoces*, Kinberg.

### *Genus* CLVI.—Polycirrus, *Grube*, 1851.

Cephalic lobe with a slight dorsal collar, which in extension forms a frilled margin to the funnel-shaped oral region; when folded ventrally it has two lateral flaps with a median furrow. From the surface of this cephalic plate a dense series of grooved and often clavate tentacles springs. Body of the typical Terebellid outline, often coiled in

preservation, swollen anteriorly, and tapering posteriorly to the anus. Median tongue-shaped ventral scute behind the mouth, and seven to eight pairs of closely-arranged scutes immediately behind. Ventral surface grooved throughout. Colourless blood, but with heart (fourth to fifth segments). Setigerous processes commence on the second or third segment and number thirty to sixty, but cease before reaching the posterior end. Bristles long, translucent, and tapering from the base to the slender, curved, and finely serrated tip, devoid of wings, and in two series—longer and shorter. Uncinigerous processes either absent anteriorly, or begin on the ninth bristled segment (fifteenth segment—Ssolowiew) and continue to the end. Hooks avicular, with elongated base, slightly curved, with a process beneath the main fang and a single tooth above it. Anterior nephridia larger than the posterior. Tubicolar, often in fissures of rocks. The genus is widely distributed.

De Quatrefages[1] (1844) found no circulatory organs in this Group (his *Apneumea*), the fluid in the cœlomic cavity performing the function of this system, driven, as he supposed, by a system of "palettes microscopiques," composed of a series of vibratile cilia on the wall of the perivisceral cavity at the base of each foot. Though this explanation needed subsequent correction, the author for the first time described the absence of blood-vessels, as in the Glyceridæ and Capitellidæ.

Claparède[2] (1864), in his remarks on the genus *Aphlebina* of De Quatrefages, pointed out that the interpretation of that author as to the movement of the cœlomic fluid was erroneous, for no cilia could be observed in the living forms. He was of opinion that the movement of the fluid was due to the remarkable muscular contractions and dilatations of the body as in other anangian forms, such as *Glycera* and *Capitella*. The Swiss author further gave a general account of the structure of the group, mentioning two new species, viz. *A. hæmatodes* and *A. pallida*, the latter, however, probably pertaining to a known form. Notwithstanding the foregoing statement concerning the movement of the perivisceral fluid, Claparède[3] at a later date (1868) describes the perivisceral cavity of *Polycirrus caliendrum* as covered with cilia.

The same author subsequently (1868) gave the following classification of the group :

A. With setigerous processes and tori uncinigeri.

*a*. Uncini avicular.

α. Dorsal bristles throughout the body—*Aphlebina*, De Quartref.; *Apneumonea*, De Quatref.; *Polycirrus*, Mgrn.

β. Dorsal bristles in the anterior region only—*Polycirrus*, Grube (non Mgrn.).

*b*. Hooks sublinear, aciculiform—*Amæa* (Mgrn.).

B. With dorsal bristles; no hooks—*Lysilla*, Mgrn.

The only species of *Polycirrus* mentioned is *P. caliendrum* from Naples.

Gravier,[4] who founded a new genus *Anisocirrus*, for a Polycirrid from the Red Sea, thus distinguishes the genera :

[1] 'Ann. Sci. Nat.' (3) I, 1844, p. 18.

[2] 'Glanures Zoot.,' pp. 24 *et seq.*

[3] 'Annél. Chét.,' Naples, p. 406.

[4] 'Nouv. Arch. Mus. Paris,' 4e sér., t. viii, p. 231.

| | | | |
|---|---|---|---|
| Hooks | Avicular | Present in general in a certain number of thoracic segments. No tentacular collarette | *Polycirrus*, Grube. |
| | | Absent on the thorax; a large tentacular collarette . . . . . | *Anisocirrus*, Gravier. |
| | Aciculiform, absent on the thorax . . . . . | | *Amæa*, Malmgren. |
| | Completely absent on the thorax and abdomen . . | | *Lysilla*, Malmgren. |

De St. Joseph (1894), while following the classification of this group by Malmgren, inclines to the subdivision of the genus *Polycirrus* into two genera or sub-genera, as indicated by Langerhans, the one devoid of the thoracic hooks (without the accompanying bristles), and having the abdominal hooks with the bristles, the other having the hooks of both kinds. He mentions that even the parasites of the Polycirridea differ from those of the Amphitritea, since Nematodes are frequent in the former, and he has also found a scolex of a *Tetrarhynchus* in the intestine. He points out that the alimentary canal agrees with that of the Amphitritea, viz. a pale œsophagus, a yellowish glandular stomach, followed by a chitinous stomach and a yellowish intestine.

One of the most recent classifications of the Polycirrids is that of Prof. Caullery[1] (1916), who arranges them in two main groups, thus:

A. Species without uncini in the segments with capillary bristles. Ex *Ereutho smitti*, Mgrn.; *Polycirrus medusa*, Grube.

B. Species with uncini in the region provided with bristles, and this is split into two subdivisions, viz.:

$B_1$. Those with dimorphic uncini, appearing in segments 7—10. Ex. *Polycirrus aurantiacus*, Grube; *P. caliendrum*, Clap.; *P. denticulatus*, De St. Joseph.

$B_2$. Those with uncini of one type, appearing in segment 13, and to which are attached tendinous threads. Ex. *Polycirrus hæmatodes*, Clap.

To the foregoing have to be added the genera *Lysilla*, Mgrn., and *Hauchiella*, Levinsen, thus:

| | | |
|---|---|---|
| Uncini long . . . . . | | *Amæa*, Mgrn. |
| ,, short, avicular . . . . . | | *Polycirrus*, Grube. |
| Commencing | seventh to tenth segment . . . . . | *Polycirrus*, Mgrn. |
| | at the thirteenth segment . . . . . | *Leucariste*, Mgrn. |
| | after the setigerous segments . . . . | *Ereutho*, Mgrn. |
| No uncini | Some setigerous segments . . . . . | *Lysilla*, Mgrn. |
| | No bristles . . . . . | *Hauchiella*, Levinsen. |

Fuchs[2] (1907), in his description of the blood-systems of the Chætopods, describes the Polycirrids as devoid of branchiæ and blood-vessels. The thorax has two unequal chambers (a diaphragm occurring between the cephalic region and the second segment), the anterior being the smaller. In the posterior chamber are the genital glands and three pairs of segmental organs.

In the Red Sea Dr. Crossland finds a species living without a tube amongst sponges with a slight accumulation of fine mud.

[1] 'Bull. Soc. Zool. France,' t. xl, p. 239.

[2] 'Jenaische Zeitsch.,' 42 N.F., Bd. xxxv.

1. Polycirrus medusa, *Grube*, 1855. Plate CXIII A, fig. 3—body; Plate CXXVI, figs. 9—9 *b*—bristles and hooks.

*Specific Characters.*—Cephalic lobe without dorsal collar, the plate passing forward as a hollow hoof, the sides of the vertical slit leading to the mouth spreading out as two rounded lamellæ, which externally and dorsally sharply fold and end in a prominent fillet on each side. Tentacles numerous, ciliated, the smaller clustering on the sides of the vertical slit. Body 1 to 4 inches long, enlarged in front and tapering to a moderately slender tail with a terminal anus. Segments from fifty to eighty-eight. First ventral scute large and single, narrow in front, broad and rounded posteriorly, followed by a narrow belt also single, and then a series (six to eight) split by a median groove into pairs in each segment. Thirteen pairs of bristle-tufts (eleven to fourteen, Grube), each setigerous process being prominent and dorsally bifid, with a longer and a shorter limb. Lamellæ for the hooks commence behind the last bristle-tuft (sixteenth segment, Hessle), and continue to the end. The hooks have the basal outline convex, and two teeth above the main fang. No visible striæ at base. Nephridia from the third to the eighth segment. Colour golden or pale yellow, the same tint appearing on the tentacles. Some have the anterior region of a deep orange, the posterior half being paler. Bristles in two series, long, slender, with shafts slightly narrowed above the origin, tapered and curved distally. No wings. The shorter series similar in structure, but more attenuate. The first tuft is on the third segment (Hessle). Uncinigerous processes commence as slight ridges; by-and-by become prominent bosses or papillæ. Hooks in a single row with elongate bases, which are convex both in front (below the main fang) and behind the middle inferiorly, with a single tooth above the main fang as a rule, though a second is seen occasionally posteriorly. Tube, a tunnel in mud or of soft sand.

Synonyms.

1855. *Polycirrus medusa,* Grube. Arch. fur Naturges., p. 120.
1861. „ „ idem. Ausflug. Trieste u. Quarnero, p. 78.
1865. *Ereutho smitti,* Malmgren. Nord. Hafs.-Annul., p. 391, Tab. xxiii, fig. 63.
„ *Apneumea medusa,* De Quatrefages. Annel., t. ii, p. 383.
1867. *Ereutho smitti,* Malmgren. Annul. Polych., p. 111.
1868. „ „ Sars. Vidensk.-Selsk. Forhandl., p. 10 (sep. abdr.).
1869. „ „ McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 424, pl. xv, fig. 17.
„ „ „ Sars. Vidensk.-Selsk. Forhandl., p. 253.
1871. „ „ Ehlers. Ann. Nat. Hist., ser. 4, vol. viii, p. 57.
1874. „ „ McIntosh. Ibid., ser. 4, vol. xiv, p. 205.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 130.
„ *Polycirrus medusæ,* Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 231.
1879. *Ereutho smitti,* Tauber. Annul. Danica, p. 134.
„ „ „ Théel. Kgl. sv. Vet.-Akad. Handl., Bd. xvi, p. 64.
1881. „ „ Horst. Niederl. Arch. Zool., Suppl., Bd. i.
1882. „ „ Ar. Hansen. Norske Nord. Exped., p. 22.
1883. *Leucariste smitti,* Levinsen. Vid. Meddel. Forh., p. 173.
1885. *Polycirrus medusa,* Carus. Fauna Medit., i, p. 267.

1886. *Ereutho smitti*, Marenzeller. Polarfarsch., p. 15.
1887. „ „ Webster. U.S. Com. F. & F., p. 749.
1888. „ „ Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 666.
1889. *Polycirrus smitti*, E. Meyer. Arch. f. Nat., lv, p. 133.
„ *Leucariste* „ Levinsen. "Hauchs" Annel, p. 351.
1894. „ „ Bidenkap. Christ. Vet.-Akad. Forhandl., p. 125.
1897. „ „ Michaelsen. Polych. deutsch. Meere, p. 176.
„ „ „ Appellöf. Bergens Mus. Aarb., No. 13, p. 12.
1899. *Polycirrus medusa*, Ssolowiew. Annuaire Mus. Acad. Imp. St. Pétersbourg, t. iv, p. 188, Tab. x, figs. 1, 2.
1912. *Ereutho smitti*, Wollebæk. Skrift. Vid.-selsk. Krist., pl. xx, figs. 1—4.
„ „ „ Meyer, A. H. Inaug. Dissert. Kiel, p. 54.
1913. *Polycirrus medusa*, Augener. Zool. Anz., Bd. xli, p. 271.
1914. „ *Smitti*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 127.
„ *Leucariste smitti*, Ditlevsen. Polych. Grönland., Heft 23, Abt. 3, p. 726.
„ *Polycirrus aurantiacus*, Fauvel. Campag. Scient. Monaco, xlvi, p. 309.
1915. *Ereutho Smitti*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 36.
„ *Polycirrus aurantiacus*, idem. Ibid., ser. 8, vol. xv, p. 33.
„ „ *smitti*, Southern. Irish Sc. Invest., No. 3, p. 47.
1917. „ *medusa*, Hessle. Zool. Bidr. Uppsala, p. 220.

*Habitat.*—Not uncommon near low water-mark at the East Rocks under stones and between layers of rock, St. Andrews (E. & R. M.); on a coralline dredged in the Minch; amongst tangle-roots in 6—8 fathoms, Bressay Sound, Shetland (W. C. M.); in similar places in the Forth (Cunningham and Ramage); Blacksod Bay, in gravel, and in sand in Galway Bay, between tide-marks (Southern). Elsewhere it has been found at Spitzbergen and Greenland (Malmgren, etc.); 300 fathoms off Norway (Sars); Franz Joseph Land (Augener); White Sea (Ssolowiew); Bergen (Wollebæk); Mediterranean (Grube). Cosmopolitan.

The *cephalic region* is characterised by the absence of a distinct dorsal rim, the smooth spout-like supra-oral fillet passing forward in the median line, and each side, bending downward, forms a broad rounded flap at the ventral edge, the arrangement being symmetrical. The external margin curves outward and upward, almost to the dorsal edge, then doubles sharply backward as a fillet and ceases. When the neck is viewed from the dorsum these fillets are conspicuous on each side. From the entire surface of this cephalic plate arise the dense mass of bright yellow tentacles which form inextricable coils both in life and in spirit, whilst from the edges of the lateral flaps are many small filaments. The tentacles are mobile, grooved organs capable of endless changes, now flattened and again rounded, coiled and twisted in various ways, or again corrugated and wrinkled. The body is pulled along by these organs, which move like linear planarians over the glass. The small tentacles at the margin of the cephalic lobes keep constantly coiling, and the animal soon covers itself in a glass vessel with *débris* of various kinds, and through the meshes of its cover the long delicate tentacles everywhere emerge. These tentacles in life show a pale central streak, their sides are dotted with minute yellow granules, and the ridges are ciliated. Their muscular fibres form meshes, and though no circular coat is apparent the oblique and connecting fibres would to a large

extent supplant them. From the nature of the parts no prominent ventral lip is present, but the narrow part of the first glandular ventral scute glides under the ventral flaps of the cephalic plate and runs into the smooth surface, which trends as a shallow groove forward to the mouth.

The *body* reaches 2 to 4 inches in length, is more or less dilated anteriorly, sometimes being largely distended, and it tapers posteriorly to the tail, which in the preparations is by no means slender, though in life it is often much more attenuate. It is rounded dorsally, grooved ventrally, and has numerous segments, fifty to eighty-eight or more. Posteriorly it terminates in a crenate anus, the central papilla ventrally being the most prominent. Occasionally the anus is carried outward on a small process or appendix, but such may be due to regeneration. Anteriorly are thirteen pairs of setigerous processes, and behind these about seventy or more uncinigerous processes which occupy the ventro-lateral region.

The muscular fibres of the intestine are curiously reticulated, spaces being left between the fibres, and apparently there are no evident circular fibres, though the oblique and connecting fibres would suffice for constriction.

The segment behind the mouth has a single large granular ventral scute, narrow in front and broad and rounded posteriorly. Then a narrow belt follows, its lateral regions expanding to include the second setigerous processes. Thereafter a median band with a central line passes longitudinally backward, cutting the scutes into pairs in each segment, and of these seven or eight are distinct, each marked by transverse lines. The segments of the posterior region have a deep furrow in the preparations dividing them into two, and each of these is again subdivided into three narrow rings.

Viewed from the dorsum each setigerous process is dorsally bifid—a feature better marked in the smaller than in the larger examples, and the bristles issue between the limbs. The first setigerous process has a considerably longer anterior cirrus than those which follow, the posterior process being smaller. In the middle of the body the anterior process is shorter and thicker, and the posterior process is more distinct, whilst the last setigerous process in some has a rounded boss on the tip of the thick, short, anterior process, and the posterior is at a greater distance from it and smaller than in the middle of the series. From this bifid region the tip is curved downward and inward.

The bristles (Plate CXXVI, figs. 9 and 9 *a*) are in two groups, a longer and a shorter series. The former are pale golden slender bristles with shafts more attenuate than their pale bases, and which taper distally to the curved, almost wingless tip. In the shorter series only the curved tips, which are more slender than the foregoing, project beyond the surface. The margin from which the bristles issue slopes inward as it passes ventrally, and the fascicle has a twist as in *Streblosoma*.

The first uncinigerous process occurs as a slightly elevated ridge at the posterior part of the segment following the last bristle-bundle, and the succeeding processes gradually increase in prominence until they form bosses or papillæ like the "feet" of caterpillars along the ventro-lateral region of the body to the tail, the terminal processes being small and closely arranged. The single row of hooks lies on the anterior face of the tip. The anterior hooks (Plate CXXVI, fig. 9 *b*) have a base considerably longer than

shown in Malmgren's figure, the anterior outline below the main fang having a slight convexity about its middle, whilst at its junction with the posterior outline a distinct shoulder occurs. The main fang is large and acute, and the tooth above it is of considerable size, though not so large as in Malmgren's figure. The inferior outline of the base is slightly convex behind the middle, but generally shows an inflection toward the prow. The hooks retain the main features just mentioned posteriorly, though the base is somewhat shorter and a trace of another tooth occurs in some on the crown.

There are six pairs of nephridia.

*Habits.*—This species is not phosphorescent at St. Andrews.

So far as the description goes this form does not appear to differ from De Quatrefages' *Apneumea pellucida* from Bréhat. The identification of this widely distributed form by Ssolowiew with the *Polycirrus medusa* of Grube cleared up much ambiguity. It is possible that the *Ereutho antarctica* of Willey ("Southern Cross," 1902), may be a variety.

2. Polycirrus aurantiacus, *Grube*, 1860, *char. emend.* Plate CXX, fig. 4—ventral aspect of a portion of the body; Plate CXXVII, figs. 1—1 *b*—bristles and hooks.

*Specific Characters.*—Cephalic lobe with a slight dorsal collar, and when opened forming a frilled margin to the funnel-shaped oral region; but when folded ventrally it has two lateral flaps with a median fissure as in *P. medusa*. From the surface of this cephalic plate a dense series of grooved tentacles springs. Body of the typical Terebellid shape, sometimes enlarged dorsally in the region of the anterior scutes or immediately behind them. Length 3—4 inches, and with eighty-four to a hundred segments. Of a dull or pale yellow colour, the intestine appearing through the skin as an orange or dull reddish tube; the median tongue-shaped ventral scute is followed by seven to eight pairs closely arranged, then smaller scutes (about twenty) on the longer segments behind. Setigerous processes begin on the second segment and continue to the number of thirty-five to sixty. Uncinigerous processes commence on the ninth bristled segment and continue to the end. Anterior hooks differ but slightly from the posterior. Anus terminal with a crenate margin, and often a prominent ventral papilla, or occasionally a less distinct dorsal papilla. Setigerous processes bifid dorsally, the posterior being the longer division. The margin curves inward ventrally. Bristles in two series, long and short, the former translucent, tapering from the base, with finely attenuate and curved tips devoid of wings, and others with just a trace of wings; the shorter bare capillary forms much more slender, their tips only projecting beyond the surface. The uncinigerous processes which bear the hooks in a single row on the anterior face of the tip are less prominent than in *P. medusa*, and continue to the end. Hooks with a long base, a slightly upturned prow, a slight process on the anterior outline below the main fang, a marked indentation above the posterior basal process, and a single tooth above the chief fang. They commence on the sixth or seventh segment. Segmental organs three pairs in one, two and three armed segments after the sixth (Lo Bianco). Tube composed of sand.

Synonyms.

1860. *Polycirrus aurantiacus*, Grube. Arch. f. Naturges., Bd. xxvi, p. 110, Tab. iv, f. 8.
1861. „ „ idem. Ausfl. Triest, pp. 78, 128, 149, Taf. iv, fig. 8.
1864. „ „ idem. Insel Lussin, p. 89.
„ *Aphlebina pallida*, Claparède. Glanures, p. 25, pl. ii, fig. 2.
1865. *Apneumea aurantiaca*, De Quatrefages. Annel., t. ii, p. 383.
1869. *Polycirrus aurantiacus*, Grube. Mitt. St. Vaast, etc., p. 38, Abhandl. Schles. Gesell., p. 105.
„ „ „ McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 424, pl. xv, figs. 18 and 19.
1875. „ „ Panceri. Atti R. Accad. Sc. Napoli, p. 7, Tav. ii, figs. 4—7.
1880. „ „ Langerhans. Zeitsch. f. wiss. Zool., Bd. xxxiv, p. 108, Tab. v, fig. 23.
1884. „ „ idem. Ibid., Bd. l, p. 266.
1885. „ „ Carus. Fauna Medit., i, p. 267.
1893. „ „ Marenzeller. Polych. Grund., p. 34.
„ „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 60.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 239.
1897. „ „ Brumpt. Compt. Rend. Acad. Sc. Paris, 21 June, 1897 (Crust. Parasite).
1904. „ „ Journ. M. B. A., vol. vii, p. 229.
1909. „ „ Fauvel. Bull. Inst. Ocean., cxlii, p. 38.
„ „ „ idem. Ann. Sc. nat., 9e sér., t. x, p. 209.
1916. „ „ Caullery. Bull. Soc. Zool. France, t. xl, p. 242.
1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 60.
„ „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 226.

*Habitat.*—Abundant under stones and in crevices of rocks between tide-marks and also dredged on the oyster-beds at St. Peter Port, Guernsey ; occasionally in a tube of sand inside the valves of *Tapes*. It sometimes occurred in masses of *Cellepora* dredged in 15 fathoms in the same region, but it does not appear to bore. Not uncommon in similar regions in Herm. Both this and *P. hæmatodes* haunt the mud under stones in the Channel Islands. Dredged in the Minch off Lochmaddy, and abundantly amongst the tangle roots obtained by the "dreg" in Bressay Sound, Shetland; St. Magnus Bay; Symbister Harbour ; in 50 fathoms off Balta (J. G. Jeffreys).

Mediterranean and the Adriatic (Grube) ; common in colonies amongst littoral *Balani* at Naples (Lo Bianco) ; shores of France, De Quatrefages, De St. Joseph ; shores of Cantabria (Rioja) ; Madeira (Langerhans).

The *cephalic region* has even more voluminous folds than in *P. medusa*, the plate being frilled anteriorly as well as forming the two broad folds posteriorly. Moreover dorsally is an indication of a collar in the shape of a smoothly rounded ridge. The whole is occasionally spread as a wide border to the oral region, which thus assumes the form of a shallow funnel. When viewed from the dorsum the slight dorsal collar runs on each side and bends downward behind the projecting fold of the anterior arch, and it sometimes happens that a median fold in front divides the tentacles into two symmetrical series after the manner of *Phoronis*. The entire outer surface gives origin to the dense series of dull yellow tentacles which form a seething mass of threads—slender, flattened and fusiform. Each tentacle extends even to a greater degree than in *P. hæmatodes*, becoming paler when stretched though still retaining a trace of the

yellow hue. Their extensibility and elasticity are remarkable, and the thinnest strand presents a minutely cellular appearance with a central streak. The smaller and shorter tentacles occupy as usual the edges of the posterior lobes, so that when the flaps are adpressed they are close to the fissure leading to the mouth. As in *P. hæmatodes* the tentacles form an inextricable mass in a vessel, enclosing other annelids, fragments of shells, *Balani* and mud. When much stretched, the tip, which is generally the widest part, is yellowish, the attenuate region below it being pale, and the intermingling of these hues, especially against a dark background, is striking.

A specimen of moderate size can stretch its tentacles 3 or 4 inches, the processes being dilated at the tip but of extreme tenuity toward the base, and the corpuscles of the cœlomic fluid are observed in the centre. Moreover, besides those in a straight line many tentacles form curves, a coil or two or a series of coils like a corkscrew, and then suddenly these are drawn rapidly towards the cephalic region as if they were sliding along one of the attenuated tentacles in the line of retraction. By aid of these organs the annelid pulls itself along the bottom of a vessel, its body meanwhile remaining in various coils, and apparently taking no part in progression. Having reached the corner of a glass vessel it seemed to be contented—keeping up a constant movement of body and tentacles, apparently for respiratory purposes, the tail being frequently thrust beyond the central mass as a finely tapered region with a slight swelling at the tip, whilst waves of dilatation occured at intervals, and the numerous and closely arranged uncinigerous processes projected like lateral spines or serrations. In retracted tentacles the grooves were evident.

Instead of the single large first oral scute of *P. medusa*, this species has a tongue-shaped median glandular process, the edges of which are free, and the anterior border runs smoothly forward to the mouth. In one example this process was bifid posteriorly whilst a small area was cut off anteriorly, the whole being symmetrical. It may represent the first scute.

The *body* resembles that of *P. medusa*, and like it is in the preparations almost always coiled; only the tail is generally more tapered than in the species mentioned. It is rounded dorsally and often dilated anteriorly, grooved ventrally, and terminating posteriorly in the anus, which may have a simple crenate margin, though it generally shows a more prominent ventral papilla, occasionally a smaller dorsal papilla or both a dorsal and a ventral. Probably much depends on the condition of the region with regard to reproduction. In the preparations dilatations occur dorsally both in the region of the scutes, and, when this part is contracted, in the region behind.

The ventral scutes commence with the large median tongue-shaped one already mentioned, and laterally are two small scutes each of which abuts on a bristle-process (first and second). Each of these has its inner edge bevelled by the encroachment of the median scute. Six pairs of scutes follow, for the deep median furrow separates the respective sides. A rounded glandular scute of small dimensions is conspicuous on several of the succeeding segments, which have a longer antero-posterior diameter than those in front. A glandular belt also envelops each bristle-tuft anteriorly, and is continued, though less distinctly, posteriorly (Plate CXX, fig. 4), where the uncinigerous processes are more evident than the setigerous. In the large

northern variety from the Hebrides and Shetland the glandular thickening at each bristle-tuft is in some developed ventrally (in the preparations), so that four rows of scutes appear to be present. The ventral surface is often thrown into prominent transverse rugæ, which do not correspond with the processes for the long hooks.

The body is dull yellow and semitranslucent, the intestine being visible as an orange canal. Anteriorly the ventral scutes are pale, the uncinigerous processes are pale yellow, the lateral glandular belt deep yellow.

The pale golden bristles slope outward and backward from setigerous processes of considerable length anteriorly, and which are bifid dorsally, the longer process being posterior, and the margin curves inward ventrally. The setigerous processes become smaller in their progress posteriorly, and cease before reaching the tail, the process itself showing only the longer posterior papilla, the shorter being indistinguishable. The number of the setigerous processes seems to be variable, ranging from thirty-five to sixty, and, whilst the anterior are conspicuous, the posterior are not easily observed. The bristles (Plate CXXVII, fig. 1) are in two groups, a longer and a shorter. They are widest at the pale base, and gradually diminish distally, where they taper to a fine point, which is curved. The longer and stronger bristles are dorsal, the shorter and less robust ventral. The shorter forms are much more slender, their tapering tips alone projecting beyond the surface. A simple bristle with a faintly serrated edge is figured in Plate CXXVII, fig. 1 *a*. In some of the stronger traces of wings are just visible.

The uncinigerous processes commence on the ninth setigerous segment as a low elevation with a short row of hooks, which in outline differ from the typical forms in the middle of the body, in so far as the base is shorter and proportionally thicker, and a considerable elevation occurs on the anterior outline beneath the main fang. The typical forms (Plate CXXVII, fig. 1 *b*) have an elongated base slightly turned up at the prow, a posterior outline deeply indented above the basal process, an anterior outline with a slight projection below the chief fang, and a somewhat convex inferior (basal) outline. The main fang is proportionally large in comparison with the neck, and the tooth above it is of moderate size. A feature of these hooks is that whilst in lateral view the prow is narrowed toward the point, in a view from above the end of the prow is flattened and chisel-shaped. The uncinigerous processes, which are somewhat prominent posteriorly, continue to the end. The row of hooks is on the anterior face of the tip (Plate CXXVII, fig. 1 *c*). In the large northern variety from Shetland and the Hebrides the base of the hook is somewhat thicker posteriorly.

*Habits.*—Two occasionally thrust their bodies and tails into a fragment of the tube of a *Serpula*, the anterior region and tentacles being free at the opposite end. When lifted or irritated and often when put in spirit it breaks its body about the ninth bristled segment, that is, behind the anterior glandular scutes, and in sea-water it pulls this fragment actively about by aid of its tentacles. As Grube pointed out, it is brightly phosphorescent, and by simply blowing on the water in the shallow vessel containing it phosphorescent streaks appear on all the tentacles, and the corner of the vessel is so illuminated that its edge can be seen. On touching a Zetlandic example brilliant bluish phosphorescence gleams on every one of the tangled tentacles—spreading in a stellate manner around.

*Reproduction.*—A large example from Plymouth on March 11th had small ova in its cœlom.

Grube (1860), in his original description, gave this form ten pairs of setigerous processes with capillary bristles and commencing on the second segment, but he added that behind them were twenty-one pairs of short bristle-tufts—scarcely distinguishable. The rows of hooks commence on the twenty-first segment and are about seventy-two in number on each side. In his excursion to Trieste he at once observed the distinction between this form and *P. medusa*.

In 1864 Claparède made a note on this group, which was brought into prominence first by Milne Edwards in his Report of M. De Quatrefages' observations to the Academy of Science, Paris (on the *Aphlébines*). In this communication the Swiss author described two forms, viz. *Aphlebina hæmatodes* and *A. pallida* distinguished by coloration, the structure of the hooks, and, as he thought, by the number of the bristle-tufts.

In 1875 Panceri gave a short description with figures of this species, the figure of the anterior region and the tentacles representing the luminosity, though the purple is perhaps too deep. He locates the phosphorescent elements in unicellular glands in the tentacles and along the body.

Considerable variety seems to occur in the commencement of the tori; thus Langerhans (1880) gives a range from the fifth to the ninth, the latter referring to a specimen with seventy segments. The segments with dorsal bristles range from twelve to thirty-seven, also following mainly the size. The number with stout bristles (Stützbursten) is apparently always thirteen. He (1880) gives a recognisable figure of the anterior hooks, though the posterior outline is rather long in proportion to the posterior projection, and he has not noticed the slight eminence on the anterior outline just below the throat—a process better marked in the posterior hooks. It occurred at Madeira chiefly in the deeper water and in fish-baskets. He gives twelve segments to the thoracic region and forty-four in all, and three pairs of segmental organs, whilst the bristles are from twelve to nineteen pairs.

*Parasites.*—Brumpt[1] (1897) found a curious Crustacean (*Saccopsis Alleni*) parasitic on this species at Plymouth, and which is closely allied to *Saccopsis Terebellidis*, Levinsen. Caullery and Mesnil[2] also describe a remarkable form, *Xenocœloma brumpti*, which is attached to another species of *Polycirrus* (*P. arenivorus*), but has a communication with the cœlome of the annelid, and a process from the intestine exists at its base. The authors consider that Brumpt's form has a similar connection.

3. Polycirrus caliendrum, *Claparède*, 1868. Plate CXXVII, figs. 8 and 8 *a*—hooks.

*Specific Characters.*—Cephalic region and tentacles as in *P. aurantiacus*, and show the same colour and bluish or violet phosphorescence. Tentaculiferous surface often elegantly pigmented. Body terebelliform, 3—10 cm. long, with a breadth of 2—4 mm. Setigerous segments 34—70, and non-setigerous 28—75. Ventral scutes eight pairs, besides the large anterior median one. Six pairs of orange segmental organs in the six

[1] 'Comp. Rend. Ac. Sc. Paris,' June 21st, 1897.

[2] 'Compt. rend.,' t. clxi, p. 642, 1915.

anterior setigerous segments. Terminal anus papillose. Colour more or less orange, inclining to yellowish saffron. Capillary bristles without wings. Hooks commence on the ninth segment,[1] the anterior being somewhat shorter than the posterior and the base deeper, a single tooth occurring above the main fang, the gulf below showing a very slight, if any, elevation of the outline on the anterior part of the hook. The posterior basal process is larger and less rounded than in *P. aurantiacus*. The posterior hooks have longer bases, which are obliquely striated at the lower edge. The posterior basal process is larger than in *P. aurantiacus*. Colour of the male yellowish, of the female darker.

Synonyms.

| | | | |
|---|---|---|---|
| 1868. | *Polycirrus caliendrum*, | Claparède. | Annél. Chét. Naples, p. 406, pl. xxx, fig. 2. |
| 1875. | „ | „ | Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 231. |
| 1885. | „ | „ | Carus. Fauna Medit., i, p. 267. |
| 1893. | „ | „ | Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 59. |
| 1894. | „ | „ | De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 237, pl. x, figs. 263—269. |
| 1907. | „ | „ | Soulier. Acad. Sc. Montpell., ser. 2, t. iii. |
| 1909. | „ | „ | Fauvel. Bull. Inst. Oceanogr., p. 38. |
| 1914. | „ | „ | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 127. |
| 1915. | „ | „ | Allen. Journ. M. B. A., vol. x, p. 636. |
| „ | „ | „ | Southern. Irish Sc. Invest., No. 3, p. 47. |
| 1916. | „ | „ | Caullery. Bull. Soc. Zool. France, t. xl, p. 242. |
| 1917. | „ | „ | Hessle. Zool. Bidr. Uppsala, Bd. v, p. 227. |
| „ | „ | „ | Rioja. Anél. Poliq. Cantáb., p. 59. |

*Habitat.*—Plymouth (Allen); Blacksod Bay, Clew Bay, Ballynakill Harbour, and Bofin Island, Ireland (Southern).

Abroad it occurs at Naples in rather deep water (Claparède, Lo Bianco, etc.); shores of Cantabria (Rioja); shores of France (De St. Joseph).

This species is so closely allied to *P. aurantiacus* that much time may be absorbed in discriminating preserved specimens, especially if a minute comparison of the hooks is made. The presence of six segmental organs anteriorly is the only easily recognised distinction.

*Reproduction.*—Mature in March and May (Southern).

### 4. Polycirrus hæmatodes, *Claparède*, 1864. Plate CXXVII, figs. 2—2 *d*—bristles and hooks.

*Specific Characters.*—The cephalic plate, supra-oral arch and tentacles similar to those in *P. aurantiacus*, but the lateral folds are further forward. Body generally as in the species mentioned; segments 75—80. The first (post-oral) segment has ventrally a prominent median scute, lozenge-shaped or rounded, according to its condition, and seven or eight pairs of closely arranged scutes behind it, followed by a series of

[1] Lo Bianco gives the sixth setigerous segment.

smaller more widely separated. Setigerous processes (22) have the posterior papilla larger than in *P. aurantiacus*. Bristles simple, capillary or slightly winged, and they begin on the second segment. Uncinigerous processes commence about the ninth segment (thirteenth, Caullery), have few hooks in a single row, and they are smaller than in *P. aurantiacus*, have a wedge-shaped base tapering abruptly forward to the prow, a marked process at the junction of the base with the posterior outline, and a small process beneath the main fang on the anterior outline. At least two teeth on the crown above the main fang. The anterior hooks slightly differ from the posterior. Colour blood-red. Tube of fine sand attached to shells, or in crevices of rocks.

Synonyms.

1864. *Aphlebina hæmatodes*, Claparède. Glanures, p. 25, pl. ii, figs. 1α to ψ.
1865. *Apneumæa leoncina*, De Quatrefages. Annel., t. ii, p. 414, pl. xiv, figs. 10—11.
1884. *Polycirrus hæmatodes*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xl, p. 265, pl. xvi, fig. 26.
1885. „ „ Carus. Fauna Medit., i, p. 267.
1891. „ „ Cuénot. Archiv Zool. Expér., 2e sér., t. ix, p. 414.
1893. „ „ Lo Bianco. Atti. R. Accad. Sc. Nap., vol. v, No. 11, p. 60.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 241, pl. x, fig. 270.
1909. „ „ Fauvel. Bull. Inst. Oceanogr., p. 39.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 128.
1915. „ *elisabethæ*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 35.
„ „ *hæmatodes*, Southern. Irish. Sc. Invest., No. 3, p. 47.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 636.
1916. „ „ Caullery. Bull. Soc. Zool. France, t. xl, p. 242.
1917. „ „ Rioja. . Anél. Poliq. Cantáb., p. 60.
„ „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 227.

*Habitat.*—From the deeper water off the Bay of St. Andrews (*débris* of fishing boats (E. M.) In tube on egg-capsule of skate, Lochmaddy; Fairlie Channel, Scotland; dredged in 50 fathoms off Balta, Shetland; in 100 fathoms, St. Magnus Bay, Shetland; in a sandy tube on a *Pecten*, Shetland (J. G. J.). Procured between tide-marks, under stones in rock-pools, Herm; in a hole in a thick form of *Flustra* beside *Potamilla reniformis* off Fermain Bay, Guernsey; on old shell along with *Polydora*, Guernsey; in cracks of rocks in the same locality. Plymouth (Allen). Blacksod Bay and Clew Bay (Southern).

The Mediterranean (Claparède). Shores of France (De St. Joseph). Shores of Cantabria (Rioja). Madeira (Langerhans).

Dorsally the *cephalic plate* arises in front of a prominent ring somewhat crescentic anteriorly and apparently continuous with the post-oral segment. The supra-oral frill is similar to that of *P. aurantiacus*, but its lateral folds differ, the boss or projection caused by them being further forward and more conspicuous, and in the preparation the median fissure runs to the anterior border and forms a spout-like projection there. The tentacles have a similar structure and form a mass like that of the common species. When extended the cephalic plate makes a wide, frilled margin to the funnel-shaped oral region, and the median scute is smoothly rounded ventrally.

The *body* has a similar outline to that of *P. aurantiacus*, but the species is smaller and the posterior region finely tapered, the edges being serrated by the uncinigerous processes, whilst the anus has two dorsal papillæ and a more prominent midventral papilla. The surface is rounded dorsally and grooved ventrally. Anteriorly the first mid-ventral shield is proportionally larger than in *P. aurantiacus*, and is somewhat lozenge-shaped, the anterior angle being carried forward to the mouth. Behind it is a narrow fillet followed by 7 pairs of conspicuous glandular scutes succeeded by a series of smaller. Glandular extensions occur laterally at each setigerous process. The segments are marked by narrow rings as in the former species. The colour is deep red, in others the body is translucent, with a faint tinge of brick-red, and the intestine throughout is pale red, but as it dilates widely during the various movements this tint is interrupted by pale (dilated) areas, or the narrow reddish tube is twisted on itself in the translucent cœlom. In some the variegated aspect of the body is due to the bright red cells (perivisceral corpuscles), which alter the tint as they roll to and fro. The ventral scutes have the same reddish hue as the rest of the body. When sickly the colour fades—becoming pale brownish-red.

The anterior setigerous processes, which commence on the second segment, appear to have a slightly longer posterior papilla dorsally than in the former species, but the bristles are similarly arranged in a longer and shorter series, the letter being more numerous ventrally. The bristles have very narrow wings, are translucent, pale golden, and in lateral view present a slight enlargement before tapering to the delicate tip, which is slightly curved (Plate CXXVII, figs. 2 and 2 *a*). The shorter forms have a more attenuate, hair-like tip, and also present a trace of an enlargement below it. The posterior bristles are shorter, more slender and fewer in number in the small tufts. Some of the bristles present a brush-like tip (Plate CXXVII, fig. 2 *b*), apparently from friction.

The uncinigerous processes commence about the ninth bristled segment, and the hooks occur in a single row. Anteriorly the hooks (Plate CXXVII, figs. 2 *c* and 2 *c'*) are small, have a much shorter base than in *P. aurantiacus*, and the inferior outline rises into a convexity behind the slender prow, while posteriorly it juts into a process. Two or three teeth occur above the main fang, and a distinct process projects from the anterior outline just beneath it. The depth of the base posteriorly and its abrupt slope to the prow give a character to the hook. Comparatively few seem to be in each row. Posteriorly the hooks are considerably smaller (Plate CXXVII, fig. 2 *d*), but still have two teeth above the main fang. The curves anteriorly and posteriorly are less defined than in front.

*Reproduction.*—Mature in August (Southern).

De St. Joseph observes that *Polycirrus hæmatodes* is not phosphorescent, and thus differs from *P. aurantiacus*, so that the *Polycirrus phosphoreus* of Verrill,[1] which is bright red or blood-red, with ova of the latter tint, is apparently another species.

Hessle (1917) includes *P. elisabethæ*, McIntosh, under Wollebæk's *P. norvegicus*, but on the whole it rather falls under *P. hæmatodes*, of which species it is probably a northern variety.

[1] 'Proc. U.S. National Mus.,' vol. ii, p. 181, 1879.

5. Polycirrus denticulatus, *De St. Joseph*, 1894. Plate CXXVII, figs. 7—7 *c*—bristles and hooks.

*Specific Characters.*—Cephalic region typical, but the tentacles are not phosphorescent. Body 8 mm. or more in length, with fourteen setigerous and forty-six non-setigerous segments. Eight pairs of ventral scutes, and six pairs of segmental organs of a greyish hue. Bristles winged and serrate, commencing on the second segment. Hooks generally begin on the ninth, and they number about five on the anterior (thoracic) region, though in one none were present.[1] At the thirteenth setigerous segment the posterior series of hooks commence. Their structure agrees with that of *P. hæmatodes*. Ova roseate.

Probably young of *P. hæmatodes*. Hooks of the anterior region may drop out with age and segmental organs may vary.

Synonyms.

1894. *Polycirrus denticulatus*, De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 242, pl. x, figs. 271—274.
1907. „ „ Soulier. Mém. Acad. Sc. Montpell., sér. 2, t. 3, p. 370.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 128.
1915. „ „ Idem. Irish Sc. Invest., No. 3, p. 47.
1916. „ „ Caullery. Bull. Soc. Zool. France, t. xl, p. 242.
1917. „ „ Hessle. Zool. Bidr. Uppsala, Bd. v, p. 228.

*Habitat.*—Blacksod Bay in roots of Laminariæ on shore, and dredged in Ballynakill Harbour (Southern).

Abroad it occurs at Dinard, France (De St. Joseph).

Southern (1914) attaches little importance to the serrate wings of the capillary bristles as mentioned by De St. Joseph, since this may be due to abrasion.

## *Genus* CLVII.—Hauchiella, *Levinsen*, 1893.

Body anteriorly polycirrid in outline, often with an enlarged middle region, but devoid of both bristles and hooks. Nephridiopores on disc-like processes on each side of the anterior region. The anterior nephridia are longer than the posterior.

1. Hauchiella tribullata, *McIntosh*, 1869. Plate CXXXVIII, figs. 13, 13 *a* and 13 *b*.

*Specific Characters.*—Cephalic region as in *Polycirrus*. No eyes. The ventral sides of the first segments form a lower lip. Body somewhat fusiform, 30 mm. long, rounded dorsally and grooved ventrally, segments about eighty, two-ringed anteriorly. Three elevated disc-like processes with a nephridial papilla in the centre on the sixth,

[1] An interesting fact in connection with Prof. Caullery's classification.

seventh and eighth segments and traces of small papillæ in the same situation on the two preceding and some of the succeeding segments. Nephridia in the third, fourth, fifth and seventh segments. Neither bristles nor hooks. The small ventral shields are continued to the posterior end. Dorsally in the anterior segments are small glandular papillæ. Appears to be an inhabitant of sand.

Synonyms.

1869. *Polycirrus tribullata,* McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 424.
1893. *Hauchiella Peterseni,* Levinsen. Annel., etc., "Hauch's" togter, Kjøbenhavn, p. 351.
1896. ,, ,, Appellöf. Bergens Mus. Aarb., 1896, No. 13, p. 12.
,, ,, ,, Michaelsen. Polych. deutsch. Meere, p. 176.
1912. ,, ,, Wollebæk. Skrift. Vidensk. Kristiania, Bd. ii, p. 74, pl. xv, figs. 1—5, and pl. xvi, fig. 5.
1913. *Lysilla inermis,* Ehlers. Polych. Südpolar-Exped., p. 567, Taf. xliv, figs. 14—16.
1915. *Polycirrus tribullata,* McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 38.
1917. *Hauchiella Peterseni,* Hessle. Zool. Bidr. Uppsala, No. 5, p. 233.

*Habitat.*—Dredged in 90 fathoms off North Unst, Shetland, in July, 1867 (Dr. Gwyn Jeffreys).

Abroad it has been found in the Kattegat (Levinsen), off Bergen, in 30–300 m. (Appellöff, Wollebæk and Hessle), Kattegat and Kaiser Wilhelm-II-Land (Ehlers), Falkland Islands, and South Georgia, Moränenfjord (Hessle).

The *cephalic region* (Plate CXXXVIII, fig. 13 *a*) presents a deeply folded lobe split ventrally, and bearing numerous grooved tentacles, short, thick and club-shaped.

The *body* (Plate CXXXVIII, fig. 13) is somewhat fusiform, the middle being swollen, whilst the ends taper, especially posteriorly. It measures in spirit about $\frac{3}{4}$ of an inch, the Norwegian examples being about $1\frac{1}{4}$ inches, and anteriorly has two-ringed segments, is rounded dorsally, grooved ventrally, and marked by two latero-ventral ridges (ventral longitudinal muscles). The skin has a minutely granular aspect under a lens, and neither bristles nor hooks are present. Three well-marked, circular, flattened processes with a papilla in the centre occur (Plate CXXXVIII, fig. 13 *b*) on the sixth, seventh and eighth segments, and a minute papilla is visible on each side of the two segments in front, but only a trace of an elevation in those behind these circular processes. No ventral plates are present, only a raised central line.

The *Hauchiella Peterseni* of Levinsen seems to be this species, the author noting that the three circular, flattened processes with the papilla in the centre are the nephridial papillæ. It is also entered by Appellöf in his faunistic paper. The same form is described by Wollebæk with good figures.

Ehlers (1913) mentions what probably is the same form from the Antarctic Sea, the nephridial processes and the papillæ of the segments behind being regarded as rudimentary feet. The terminal anus presents two papillæ.

*Genus* CLVIII.—Lysilla, *Malmgren*, 1865.

Cephalic lobe forming a wide frill to the oral region and assuming various outlines according to the degree of expansion or contraction, its edges being somewhat thinner than in *Polycirrus* and prolonged ventrally. A slight dorsal collar. The surface of the cephalic plate has numerous clavate, grooved tentacles along the dorsal and lateral regions, but with a cluster of tangled filiform ones on each side ventrally. Neither eyes nor branchiæ. The buccal surface is prolonged ventrally as a tongue-shaped process fixed anteriorly but free posteriorly, and with a thickened glandular area (scute) in the centre. The body is enlarged anteriorly with a convex dorsal region, and two projecting and rounded ventro-lateral regions. The whole of the anterior dorsal surface as well as that of the swollen ventro-lateral regions is minutely tuberculated, the tubercles on the swollen ventro-lateral regions being larger, the papillæ, moreover, from intervening lines, having a transverse arrangement, but posteriorly the body appears to have only smooth rings, and it tapers to the caudal extremity. Segments indistinct. Six pairs of small setigerous processes in the groove between the dorsum and the ventro-lateral projections. Bristles simple and short. No uncinigerous processes or hooks; the anterior nephridia are larger than the posterior.

1. Lysilla Loveni, *Malmgren*, 1865. Plate CXX, figs. 13 and 13 *a*—lateral and ventral views of body; Plate CXXVII, fig. 3—bristle.

*Specific Characters.*—Cephalic region as in the genus. Body 30—60 mm. long, with indistinct segmentation, though posteriorly twelve deeper sulci indicate segments, dilated and papillose or tubercular anteriorly, the largest tubercles being on the ventral surface of the lateral ridges (nephridial papillæ). Six pairs of setigerous processes, beginning on the third segment, with curved ends anteriorly, each containing a simple closely arranged fascicle of pale bristles, the tips of which are curved and terminate in the tissues.

Nephridia occur in the six bristled segments (Hessle), and their pores are on short cirriform papillæ.

Synonyms.

1865. *Lysilla Loveni*, Malmgren. Nord. Hafs.-Annul., p. 393, Tab. xxv, fig. 71.
1867. „ „ idem. Annul. Polych., p. 111.
1869. „ „ McIntosh. Rep. Brit. Assoc. (1868), p. 338.
„ „ „ idem. Trans. Roy. Soc. Edin., vol. xxv, p. 424.
1873. „ „ Kupffer. Jahresb. Komm. deutsch. Meere, p. 152.
1874. „ „ Malm. Annul. Göteb., p. 99.
1879. „ „ Tauber. Annul. Danica, p. 134.
1883. „ „ Levinsen. Vidensk. Meddel., p. 172.
1897. „ „ Michaelsen. Polych. deutsch. Meere, p. 176.
1912. „ „ Wollebæk. Skrift. Vid.-selsk. Krist., No. 18, p. 75, pl. xvi, figs. 1—4.
„ „ „ Meyer, A. H. Inaug. Dissert. Kiel, p. 54.
1917. „ „ Hessle. Zool. Bidr. Uppsala, Bd. 5, p. 230.
„ „ „ var. *Macintoshi*, idem. Ibid., p. 231.

*Habitat.*—Dredged in St. Magnus Bay, Shetland, by Dr. Gwyn Jeffreys.

Malmgren's examples came from the Koster Islands; Vardo (Danielssen); Bergenfjord (Wollebæk). Sweden (Malm). Atlantic and northern waters (Hessle).

The *cephalic plate* passes forward from a small dorsal collar and is thrown into various folds, the edges of which appear to be somewhat thinner than in *Polycirrus*, and hence show a more elegantly frilled margin. Ventrally the plate forms a broad flap fixed laterally but with the inner edge free. The surface is covered with numerous clavate and grooved tentacles, but the ventral flaps have clusters of more minute filiform organs. The mid-ventral region behind the mouth has a large and prominent tongue-shaped process, smoothly continuous with the oral surface anteriorly, where it is fixed; it is free and somewhat conical posteriorly. In lateral view it forms, indeed, a spout-like process at right angles to the body, with an elevation (glandular) in the centre.

The *body* is enlarged anteriorly, marked by the two lateral rounded bands minutely tuberculated and ringed, the largest tubercles or papillæ being on the ventral surface of the longitudinal bands. The segments are not distinctly defined except by the setigerous processes in front, but Malmgren states that the posterior region (absent in the British example) presented about twelve deep sulci. He gives the length of 30—50 mm. and the width of the tumid anterior region as 5—6 mm., that of the posterior part 2—2·5 mm., and the latter, though minutely ringed, is smooth.

Six setigerous processes occur anteriorly in the groove, though no bristles are visible under a lens. Each consists of a slightly conical process with a curved tip and presenting a white streak in the interior due to the bristles (Plate CXXVII, fig. 3), which consist of a single closely arranged fascicle of simple translucent bristles, which curve distally in conformity with the outline of the process, and end within the tissues at the tip. Except for stiffening the setigerous processes these bristles are thus devoid of function. In the foregoing segments are the nephridia. It is curious that in a variety of this species, var. *macintoshi*, from the Antarctic seas, Gravier found the tips of the bristles spatulate.

Sub-family III: No representative of Malmgren's Sub-family III, Artacamacea, occurs in Britain unless the fragment described below pertains thereto, but the fourth sub-family has two examples.

A fragment of the posterior end of a small annelid procured from a specimen of *Cellepora* dredged off St. Peter Port, Guernsey, in 1868, presents certain features of interest. It is apparently a tubicolar form, of firm consistence, and measuring scarcely a quarter of an inch in length, rounded dorsally and with a distinct mid-ventral groove from end to end. It tapers from the anterior to the posterior end, the pygidium being smooth, with a slight swelling on each side in front of it. The segments are numerous for so minute a form, no less than between 60 and 70 occurring on the fragment, those in front being considerably wider than those near the tip of the tail. The feet in the anterior part of the fragment bear prominent lamellæ armed with hooks on the free edge and it was the structure of these (Plate CXXVA, fig. 9*a*) which first drew attention to the animal. They have four teeth above the main fang, so that the crown is high, thus approaching those of *Artacama proboscidea*. A hook of the latter is shown in Plate CXXVA, fig. 9.

### Sub-Family IV.—Trichobranchidea, *Malmgren*, 1866.

The cephalic lobe as in the Amphitriti. The branchiæ are filiform. Rostrate hooks (that is, with long shafts) occur in the anterior, avicular in the posterior region. The stomachs of the three genera, viz. of *Trichobranchus*, *Terebellides* and *Actobranchus*, are complex, dorsal folds being developed. No ventral shields are present.

Hessle (1917) makes a separate family for the genera *Trichobranchus* and *Terebellides* instead of the sub-family of Malmgren, and they certainly show considerable divergence. He makes them intermediate forms between the Ampharetidæ and Terebellidæ, and he gives the characters as follows: Tentacle-membrane (cephalic lobe?) reduced; tentacles not invaginated; branchiæ simple or pectinate; ventral shields absent; posterior region not shortened; paleæ absent; hooks with elongated shafts anteriorly, short shafts posteriorly, and in a single row. As shown elsewhere the presence of shafts to the hooks is seen in other forms, such as *Rhodina*, but, in any case, the advantages of this change of classification are not obvious.

### *Genus* CLIX.—Trichobranchus, *Malmgren*, 1866.

Cephalic lobe reduced and bifid, having on each side anteriorly a prominent rounded boss and a flattened fan-like plate. No distinct cephalic collar, though the lobe is ensheathed by the first segment. Pigment-spots (eyes) occur behind the tentacles. The lobe gives origin to a dense series of grooved tentacles, filiform and fusiform, the two being intermingled in front, but posteriorly the filiform are predominant. Both the longer and the shorter are grooved. Nuchal organs two ciliated flat surfaces (Hessle). Body terebelliform, enlarged anteriorly and tapered posteriorly. Buccal segment large and turgid posteriorly (lateral lobe). The body terminates in an anus with two papillæ. Branchiæ filiform, on segments 2, 3 and 4. The lateral lobe of the stomach provided with deep folds. Setigerous processes on each side bearing simple bristles with wings, and commencing on the sixth segment. Unicinigerous processes (on the tori), from the sixth to the last setigerous lobe, and bear long hooks; the posterior, on the pinnules, bear minute avicular hooks with short bases and spinous crowns. All are uniserial. Nephridia occur in the fifth segment and are large at the diaphragm, smaller behind, the latter probably transmitting the reproductive elements (Hessle). Tube membranous, coated with mud.

1. Trichobranchus glacialis, *Malmgren*, 1866. Plate CXV, figs. 5 and 5 *d*—dorsal and lateral view of body; Plate CXX, figs. 2 and 2 *a*—body and anterior end; Plate CXXVII, figs. 4—4 *c*—bristles and hook; figs. 4 *d* and 4 *e*—anterior end.

*Specific Characters.*—Cephalic lobe with the characters of the genus, and numerous ocular points occur at its posterior part. Buccal segment roll-like and transversely grooved. Sides of the second and third segments with small lappets. Three pairs of

branchiæ, the posterior nearer each other than the anterior. Body enlarged anteriorly, tapered posteriorly, sometimes spindle-shaped, the anus having two cirri. Length ¾ to 1 inch and with sixty-five to seventy segments. General colour blood-red, darker anteriorly, paler posteriorly. The lip is rich red, lateral flaps translucent. Three pairs of filiform branchiæ on segments 2, 3 and 4, often contorted and spiral. Setigerous processes fifteen, commencing on the sixth segment. Bristles simple, of moderate length, and with narrow wings on the tapering curved tips. The same segments bear hooks with elongated and curved shafts. Uncinigerous processes only are present behind the bristled region. They are flattened and slightly enlarged at the tip. Avicular hooks of this region minute, with short bases, a moderate main fang and four to five large teeth above it. Posterior segments forty to fifty. Nephridia in third, fourth, fifth, sixth and seventh segments. Tube fragile, delicate, formed of minute grains of sand.

Synonyms.

| | | | |
|---|---|---|---|
| 1866. | *Trichobranchus glacialis,* | Malmgren. | Nord. Hafs.-Annul., p. 395, Tab. xxiv, fig. 65. |
| 1867. | „ | „ | idem. Annul. Polych., p. 112. |
| 1869. | „ | „ | McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 425, pl. xvi, figs. 6—8. |
| 1874. | „ | „ | Malm. Annul. Göteb., p. 99. |
| 1875. | „ | „ | Marion. Rev. Sc. nat., t. iv, p. 309. |
| 1878. | „ | „ | McIntosh. Trans. Linn. Soc., ser. 2, Zool., p. 508. |
| 1879. | „ | „ | Tauber. Annul. Danica, p. 135. |
| „ | „ | „ | Verrill. Proc. U.S. Nat. Mus., vol. ii, p. 181. |
| „ | „ | „ | Théel. Kgl. Svensk. Vet.-Akad. Handl., Bd. xvi, p. 64. |
| 1881. | „ | „ | Langerhans. Canarische Annel., p. 117. |
| 1883. | „ | „ | Levinsen. Vidensk. Meddel. for 1883, p. 176. |
| 1884. | „ | „ | Webster and Benedict. Rep. U.S. Com. F. & F., p. 735. |
| „ | „ | „ | Langerhans. Zeitschr. f. wiss. Zool., Bd. xl, p. 262. |
| 1887. | „ | „ | Meyer. Mitth. Zool. Stat. Neap., Bd. vii, pp. 634, 636. |
| „ | „ | „ | Webster. Chæt. Eastport, Maine, U.S. Com. F. & F., p. 750. |
| 1893. | „ | „ | Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 58. |
| 1894. | „ | „ | De St. Joseph. Ann. Sc. nat., 7e sér., xvii, p. 244, pl. x, figs. 275—278. |
| 1896. | „ | „ | Appellöf. Bergens Mus. Aarb., p. 12. |
| 1897. | „ | „ | Michaelsen. Polych. deutsch. Meere., p. 174. |
| 1898. | „ | „ | idem. Grönland. Annel., p. 130. |
| 1899. | „ | „ | Ssolowiew. Ann. Mus. St. Pétersb., t. iv, p. 192, Tab. x, fig. 4. |
| 1900. | „ | „ | Ehlers. Schwed. Magell. Annel., p. 16. |
| 1901. | „ | „ | idem. Polych. Magell. u. Chil., p. 214. |
| 1909. | „ | „ | Fauvel. Bull. Inst. Oceanogr., cxlii, p. 40. |
| 1912. | „ | „ | Wollebæk. Skrift. Vid.-selsk. Krist., No. 18, p. 79, pl. xix, figs. 1—8. |
| 1913. | „ | „ | Ehlers. Deut. Südpol. Exped., p. 566. |
| 1914. | „ | „ | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 129. |
| 1915. | „ | „ | McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 39. |
| 1917. | „ | „ | Hessle. Zool. Bidr. Uppsala, Bd. v, p. 131. |

*Habitat.*—Dredged on a muddy bottom in 9 fathoms, Lochmaddy, and also procured under a stone amongst sandy mud at extreme low water of a spring-tide. Its occurrence

in Loch Portan in the same locality is noteworthy, as the water there has a considerable admixture of fresh water. St. Magnus Bay, Shetland, in 80 and 100 fathoms; in 90 fathoms 25 miles west of the Blasquet, S.W. Ireland (J. G. Jeffreys), 30—40 fathoms in Dingle Bay, Ireland, "Porcupine," 1869. At 690 fathoms in the Atlantic, No. 3, "Porcupine," 1870 (small); 358 fathoms in the Atlantic Station No. 6 in the same expedition; W. Coast Ireland, Clew Bay, etc. (Southern).

It elsewhere occurs off Bergen, Norway (Canon Norman, Wollebæk); Greenland ("Valorous," and Michaelsen); Spitzbergen (Fauvel); Sweden (Malmgren and Hessle); shores of France (De St. Joseph); Canary Islands and Madeira (Langerhans); Magellan and Antarctic Seas (Ehlers); Mediterranean; Atlantic Coast of America (Webster and Benedict); White Sea (Ssolowiew).

Caullery found none in the collections of the Siboga Expedition. It also occurs at the South Pole.

The *cephalic lobe* differs from that of *Polycirrus* in its reduced condition. Dorsally it has a groove separating it from the first segment, and is provided with two eye-spots, the lobe then projecting forward as two symmetrical rounded bosses flanked on each side by a translucent free flap. From the surface springs a dense series of tentacles, filiform, and fusiform. The filiform are pale pink in colour, and like the larger clavate, grooved, red-streaked tentacles, keep up a continuous movement. The translucent lateral flaps are devoid of tentacles. The distinction between the three groups of appendages is distinct in some preparations. The branchiæ are coiled, the posterior small tentacles filiform, whilst the larger are clavate and grooved. The mouth opens in the centre above a line joining the attachments of the translucent lateral flaps and in a groove between the two prominent anterior bosses.

The *body* (Plate CXV, figs. 5 and 5 *a*) is terebelliform in appearance, about an inch in length, enlarged anteriorly and tapered posteriorly to terminate in an anus with two cirri. It is rounded dorsally, grooved ventrally, and has about seventy segments. The mouth opens anteriorly at the furrow between the bosses, the translucent lateral flaps curving inward to be attached on each side. Ventrally is the tumid and streaked lower lip which forms the conspicuously truncated anterior end. The grooves generally show a symmetrical arrangement, a broad median belt passing down the centre, flanked by two or three stripes on each side, the ventral end being split. The second segment forms a continuous ring dorsally and ventrally, and sometimes projects forward dorsally so as to ensheath the posterior cephalic edge and the eyes. It bears dorsally the first branchia, on each side—a single thick and proportionally long filament tapered distally, distinguished by the bright red central vessel and often by the spiral condition. The third and fourth segments also bear a pair of gills, which readily fall off in the preparations. The general colour is blood-red, darker anteriorly, paler posteriorly. The lip is rich red, whilst the lateral flaps are translucent. The cœlomic corpuscles (and ova ?) are pale red, and appear through the transparent skin as they roll about. A red blood-vessel runs along the centre of the ventral surface.

The short setigerous processes, which have oblique tips, commence on the sixth segment, and are fifteen in number. Each tuft has two series, a longer and a shorter (Plate CXXVII, figs. 4 and 4 *a*). The larger bristles are pale golden, one half more or less free,

and one half inserted in the tissues, the shafts dilating a little from the base, then remaining cylindrical till the commencement of the very narrow wings, which have minute striæ directed outward and upward, after which they taper to a fine hair-like curved tip. They thus appear to represent the first stage of the development of wings on a bristle. The bristles slope outward and backward in the preparations, but are directed forward in life, the convexity of the terminal curve being in the same direction. The shorter forms often alternate with the longer, and their number corresponds nearly with that of the longer, viz. six in each tuft. There is also a slight gradation in the size of the longer bristles from the dorsal to the ventral edge. Below each bristle tuft is a row of hooks with elongated curved shafts (Plate CXXVII, fig. 4), which increase from the base upward to the shoulder, above which the neck is distinctly narrowed, the head again expanding so as to resemble with the main fang a bird's head. Above the main fang the rounded crown has a series of four to five smaller teeth. This kind of hook is characteristic of the bristle-bearing segments.

A series of vertically flattened uncinigerous lamellæ occur on the succeeding segments, and some are broader at the tip than the base. They bear at their apices a row of minute avicular hooks (Plate CXXVII, fig. 4 *a*), having short, broad basal processes with a convex inferior outline, a posterior outline in which a deep sinus occurs above the basal process, and an anterior outline which in some has a trace of a process beneath the main tooth. The latter is of moderate size, but the teeth above it are proportionally large, so that this hook does not present the same disproportion between the first and succeeding teeth present in the long anterior hooks. In lateral view four to five teeth occur above the chief fang, and in reality they form a rounded crown with their points curved obliquely downward. Malmgren, while noting the distribution of the hooks from front to rear, does not sufficiently define the structure of the posterior hooks.

*Habits.*—It has the appearance and habits of a tubicolar species, yet no tube was ever found with it on the West Coast. It is possible that there it lives in a tunnel in the mud. In other localities the tube consists of tough mucus, often with external shreds, or minute grains of sand attached to it.

The *T. massiliensis* of Marion from Marseilles has only three teeth in the posterior hooks, and the rostrate hooks extend to the sixteenth setigerous segment. Possibly this is only a southern variety of *T. glacialis*. Then, again, the *Octobranchus Giardi* of Marion and Bobretzky[1] would appear to be closely allied to *T. glacialis*, except for the four pairs of branchiæ, which occur as simple processes from the segment bearing the eyes and the three following. The hooks are similar. This form would appear to be an intermediate type, especially in branchiæ, between *Trichobranchus* and *Terebellides* (Hessle). The *Filibranchus roseus* of Malm has two pairs of simple branchiæ and seventeen bristled segments.

De St. Joseph (1894) describes twenty eye-spots on each side, and he found three pairs of segmental organs respectively in segments 3, 4 and 5, the second pair being larger than the others. He could not make out the three posterior pairs mentioned by Meyer. The alimentary canal agreed with that in *Amphitrite*. His example, however, was young and incomplete.

Hessle (1917) distinguishes *Trichobranchus glacialis* from *T. roseus* by the fact that

[1] 'Ann. Sc. nat.,' 6e sér., t. ii, p. 87, pl. x, fig. 21, and pl. ii, fig. 21 A and B.

the latter has no eye-specks, and only two pairs of branchiæ, whilst the nephridia occur in the third, fourth, fifth and sixth segments.

Malmgren instituted the sub-family Canephoridea for *Terebellides*, in which a single quadripartite branchia occurs. The hooks are rostrate in the anterior region, pectiniform in the posterior region.

### *Genus* CXL.—Terebellides, *Sars*, 1835.

Cephalic lobe rounded-ovate, the plate being deeply frilled, and having a long and smooth dorsal surface arising from a groove marking it from the first segment, and ventrally being continuous so as to surround the mouth. The surface is covered by a dense series of grooved tentacles. It is fused with the buccal segment.[1] Under the mouth is a large bilobed plate. Body enlarged anteriorly, tapering gently backward and terminating in a moderately slender tail with the crenate anus at the tip. Dorsal surface smoothly rounded; ventral surface is less rounded and posteriorly is flattened. Behind the mouth and the cephalic plate which bounds it is a large semicircular flap or lamella passing from side to side. Five distinct glandular belts on the ventral surface anteriorly, and a belt in the line of the setigerous and uncinigerous processes. Branchiæ arising from a single powerful stem on the second and third segments, and having four divisions—two larger dorsal and two smaller ventral. Each has a smooth basal process or arm above which are a dense series of lamellæ, which in the case of the dorsal project forward in front of the basal stem. Gizzard present; glandular stomach, muscular and folded. Setigerous processes eighteen pairs, commencing on the second segment (third, Hessle). Bristles simple, long, tapering and winged. Hooks on slight lateral ridges in the bristled region (from segment 7; 8, Hessle), and with long curved shafts (rostrate); thereafter pectiniform on uncinigerous lamellæ, and minute, the outline short and broad with two or more teeth above the main fang. Anterior nephridia with long and well-developed tubes, the posterior are small. They occur in the third, sixth and seventh segments. Tubicolar in mud or muddy sand.

1. Terebellides Strœmi, *Sars*, 1835. Plate CXX, fig. 3—body; Plate CXXVII, figs. 5—5 *b*—bristles and hooks.

*Specific Characters.*—Frilled cephalic plate elevated above the dorsal outline, and the margins meet in the middle line ventrally to form a spout-shaped channel behind the mouth. Cephalic plate directed anteriorly and posteriorly instead of dorsally and ventrally as in *Polycirrus* and other forms. The posterior edges of the plate give origin to the tentacles, which are of a pale flesh colour and often spatulate. Body 60 mm. long, enlarged in front and gently tapered to the tail, which is by no means slender. Segments fifty to fifty-six, of which eighteen are anterior. Ventral surface with bold glandular belts (Hessle). Third, fourth and fifth segments have ventrally free anterior borders. The

[1] Coalesced (Grube).

posterior region has from thirty-five to forty segments. Colour reddish or pale orange anteriorly, marked with red laterally. Posteriorly it is greyish yellow from the colour of the mud in the intestine. Males are paler; females roseate. Branchiæ are of a deeper red. Each of the upper pair arises by a rather thick, fluted stem from the second and third segments, the main divisions being dorsal, each having a basal process directed backward and a fusiform dorsal region composed of vascular lamellæ. The inferior divisions are much smaller. The stomach is remarkable for the complexity of its folds, the lateral chambers presenting a series of rings. In *Octobranchus* the stomach has two lateral chambers. The first setigerous process commences on the second segment (third, Hessle), and it and the second are smaller than those which follow. Bristles in a single series, the stouter dorsal and the more slender ventral in position. Anterior hooks commence on the sixth segment, and have a long, slightly curved, finely striated shaft which diminishes after the shoulder, the neck being bent a little backward and with a main fang and four teeth in lateral view above it. The posterior hooks are avicular, with a deep dimple above the base posteriorly and three large teeth above the chief fang. Base convex inferiorly and the anterior prow is short. Tube of soft grey mud or of sand, friable.

Synonyms.

1835. *Terebellides Strœmii*, Sars. Beskriv. og Iagttagelser, p. 48, Tab. xiii, fig. 31 *a—d*.
1843–53. „ *strœmi*, Chenu. Illust. Conch., 11e livr., pl. iv, fig. 8.
1846. *Corephorus elegans*, Grube. Arch. f. Naturgesch., Bd. xii, p. 161, Taf. v, fig. 1.
1851. *Terebellides Strömii*, Sars. Nyt Mag., Bd. vi, pp. 131 and 206.
„ „ *strœmi*, Grube. Fam. Annel., pp. 81 and 138.
„ *Terebella pecten*, Dalyell. Pow. Creat., vol. ii, p. 208, pl. xxvi, fig.
1853. *Terebellides Strömii*, Sars. Nyt Mag., Bd. vii, pp. 386 and 390.
1859. „ *strœmi*, Danielssen. Kgl. Norske Vid.-Selsk. Skrift., 4de Bd., p. 123.
1861. „ *strœmii*, idem. Nyt Mag., xi, p. 55.
1863. „ *strœmi*, Lovén. Foredrag Skandin. Nat. Sallsk. för. Offen., p. 6 (sep. c.).
1864. „ „ Grube. Insel Lussin, p. 89.
1865. „ „ De Quatrefages. Annel., t. ii, p. 374.
„ „ „ Johnston. Cat. Worms Brit. Mus., pp. 242 and 345.
1869. „ *Strömii*, D. Robertson. Proc. Nat. Hist. Soc. Glasgow, i, p. 84.
1871. „ *strœmi*, Ehlers. Ann. Nat. Hist., ser. 4, vol. viii, p. 57.
1873. „ „ Verrill. Rep. Fish Com., p. 613.
„ „ *stroemii*, Kupffer. Jahres. Kom. deutsch., p. 152.
„ „ *strœmi*, Mœbius. Exped. Ostsee, pp. 109 and 152.
1874. „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 205.
„ „ „ and *gracilis*, Malm. Göteborg Fauna, p. 100.
1875. „ „ McIntosh. Invert. and Fishes St. Andrews, p. 130.
„ „ „ Ehlers. Zeitschr. f. w. Zool., Bd. xxv, p. 23.
1877. „ „ Grube. Monatsb. Königl. Akad. Wiss. Berlin Aug., p. 511.
„ „ *strömi*, Marenzeller. Denksch. Kaiserl. Akad. Wiss. Wien, Bd. xxxv, p. 36, sep. abd.
1878. „ *Strœmii*, McIntosh. Trans. Linn. Soc., ser. 2, Zool, p. 508.
„ „ *strœmi*, Lenz. Jahresb. Com. deutsch. Meere., p. 11.
1879. „ „ Théel. Kgl. Sv. Vet. Akad. Handl., Bd. xvi, p. 64.

1879. *Terebellides Strœmii,* Tauber. Annul. Danica, p. 135.
1881. „ *strœmi,* Horst. Annel. "Barents," Niederl. Arch. Zool. Suppl., Bd. i, p. 24.
1882. „ „ Hansen. Norske Nord. Exped., No. 7, p. 15.
1883. „ *strömi,* Wirén. Chætop. "Vega" Exped., p. 421.
„ „ „ Levinsen. Vidensk. Meddel., p. 173.
1885. „ *strœmi,* Carus. Fauna Medit., i, p. 268.
„ „ „ Wirén. Köngl. Sv. Vet. Akad. Handl., Bd. xxi, p. 18, Taf. iii, figs. 5—10, Taf. iv, figs. 1—6, Taf. vi, figs. 3 and 5.
1886. „ *strömi,* Levinsen. Kara-Havets, etc., p. 13.
1887. „ *stroemi,* Webster. U.S. Com. F. & F., p. 750.
„ „ *strömi,* idem. Chæt. Eastport, Maine, U.S. Com. F. & F., p. 750.
1888. „ *stroemii,* Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 667, pl. xliv, fig. 29.
1889. „ *strœmi,* Grieg. Bergens Mus. Aarb., Art. 2, p. 8.
„ „ *strömi,* E. Meyer. Arch. f. Naturges., lv, p. 133.
1890. „ *strœmi,* Marenzeller. Ann. K. K. Naturhist. Hofsmus. Wien, Bd. v, p. 2.
1892. „ „ idem. Polych. Bremer Exped., p. 402.
1893. „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 61.
„ „ „ Levinsen. Annul. "Hauchs," p. 351.
1894. „ „ Bidenkap. Christ. Vet.-Akad. Forhandl., p. 125.
1896. „ „ Appellöf. Bergens Mus. Aarb., No. 13, p. 12.
1897. „ *Strœmii,* Ehlers. Hamb. Magel. Sam., p. 134.
„ „ *strœmi,* Michaelsen. Polych. deutsch. Meere, p. 174.
„ „ „ Vanhöffen. Grönland Exp., Bd. ii.
1898. „ *strœmii,* Michaelsen. Grönland Annel., p. 130.
1899. „ *strœmi,* Ssolowiew. Ann. Mus. St. Pétersb., t. iv, p. 190, Tab. x, fig. 3.
„ „ *strömi,* Wollebæk. Skrift. Vid.-selsk. Krist., No. 18, p. 78, pl. xviii, figs. 1—9.
1900. „ *strœmi,* Ehlers. Schwed. Magell. Annel., p. 16.
1901. „ „ idem. Polych. Magell. u. Chil., p. 213.
„ „ *strömi,* Gourret. Mém. Soc. Zool. France, t. xiv, p. 376, pl. viii, fig. 2.
„ „ „ Whiteaves. Mar. Invert. E. Canada, p. 72.
1902. „ *strœmi,* Marenzeller. Denkschr. Math. Nat. Cl. Kaiserl. Akad. wiss. Wien, Bd. lxxiv, p. 22.
1903. „ „ Moore. Proc. Acad. Nat. Sc. Philad., p. 478.
„ „ *strömi,* Norman. Ann. Nat. Hist., ser. 7, vol. xii, p. 283.
1904. „ *strœmi,* Journ. M. B. A., vol. vii, p. 229.
1906. „ *strœmi,* Augener. Westind. Polych., p. 181.
„ „ *strömi,* Levander. Meddel. Soc. Fauna Fennica, Hft. 34, p. 212.
1908. „ *strœmi,* Ehlers. Deutsch. Tiefsee-Exped., p. 154.
„ „ „ Moore. Proc. Acad. Nat. Sc. Philad., p. 352.
1909. „ „ Fauvel. Bull. Inst. Oceanogr., No. 142, p. 39.
„ „ „ Lo Bianco. Mitt. Zool. Stat. Neap., Bd. xix, p. 588.
1910. „ *strömi,* Skorikow. St. Petersb. Mus. Ann., xv, p. 213.
1912. „ *strœmi,* Ditlevsen. Danmark-Eksped. Grönl., Bd. v, p. 428.
„ „ „ Meyer, A. H. Inaug. Dissert., p. 50.
1913. „ „ Augener. Zool. Anz., Bd. xli, p. 270.
1914. „ „ Fauvel. Ann. Polych. "Hirondelle," p. 309.
„ „ *strömi,* Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 128.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 309.

1915. *Terebellides strömi*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 41.
„ „ „ Allen. Journ. M. B. A., vol. x, p. 636.
„ „ *strœmi*, Southern. Irish Sc. Invest., No. 3, p. 47.
1916. „ *strömi*, McIntosh. Ann. Nat. Hist., vol. xvii, p. 59.
1917. „ *strœmi*, Hessle. Zool. Bidr. Uppsala, Bd. 5, p. 137.

*Habitat.*—Stomach of haddock, St. Andrews (E. M.); dredged in 4—5 fathoms, Ardmaddy Bay, Lochmaddy, in tenacious grey mud (and clay); Plymouth (Allen), Loch Long (D. Robertson); dredged in the "Porcupine" Expedition, 1869, in 30—40 fathoms, Dingle Bay, Ireland; young example in 422 fathoms, No. 15, "Porcupine," 1869 (54° 1′ N., 12° 14′ W.); West Coast of Ireland, Clew Bay, etc. (Southern). A cosmopolitan form. Abroad it has been found off Kerguelen (Ehlers), Japan (Hessle), North Pacific Coast of North America (Moore), Behring's Sea (Marenzeller), Atlantic (Grube, etc.), Greenland (Michaelsen, Ditlevsen, etc.); Northern regions, such as Greenland, Spitzbergen, Norway, Iceland, etc. (Sars and Malmgren); off Cape Guardia and in 31 fathoms off Cape Finisterre and in Bono Bay, "Porcupine," 1870; Siberian and Behring's Seas (Wirén); Norway, Sweden and Finmark (Malmgren and Norman); Kerguelen, "Challenger"; Spitzbergen (Meyer); Kara-Havet (Levinsen); Adriatic (Grube); Mediterranean—Naples (Lo Bianco); 300 fathoms off Norway (Sars, Wollebæk); Franz Joseph Land (Augener); New England and Atlantic coast, U.S.A. (Verrill); Strait of Magellan (Grube, Ehlers, McIntosh); Arctic Sea (Marenzeller); White Sea (Ssolowiew); West Indies (Augener).

The *cephalic region* is almost as blunt as in *Trichobranchus*, though the great elevation of the frilled cephalic plate is characteristic, since it rises from a slight collar high above the dorsal outline and has a boldly folded margin, the two sides meeting in the middle line inferiorly and forming a spout-shaped channel, the sides of which behind the mouth in some are thickened. The cephalic plate thus has the surfaces directed anteriorly and posteriorly instead of dorsally and ventrally as in *Polycirrus* and other forms. The edges of the plate posteriorly give origin to the tentacles, which are of a pale flesh colour, grooved, often spoon-shaped, and, though not stretching much, coil actively in every direction.

The *body* is enlarged in front and gently tapers to the tail, which is by no means slender. It is smoothly rounded on the dorsum, and only in well-preserved examples are the lines of the segments indicated. On the other hand the ventral surface presents anteriorly bold glandular belts—the representatives of the scutes of other members of the family. Besides, a great glandular semicircular lamella is placed immediately behind the spout-shaped fold of the cephalic plate, separates the oral from the succeeding region, and is evidently of great physiological importance. A narrow glandular ring follows, the convex central region, being in some separated by a furrow from the lateral regions, which diminish as they go outward. A broader ring, the second body-segment, which bears the branchiæ dorsally, then follows, the central region, likewise marked off by two furrows from the lateral regions. This is partly overlapped by the broad glandular belt which stretches from side to side of the next segment, and gives off the setigerous process at each side. Four similar ventral belts follow—diminishing as they go, and

then the succeeding belts are narrow, separated by increasing breadths of non-glandular tissue. Further, an almond-shaped area beneath each setigerous process is differentiated, and on this the hooks appear on the sixth bristled segment and thereafter it becomes the uncinigerous process, whilst between each a lateral glandular belt is continued backward behind the bristled region on each side to the tail.

The general colour of the body is reddish or pale orange anteriorly, marked with red laterally. Posteriorly it is greyish yellow (from the grey mud in the intestine). The snout is pale, the branchiæ are of a deeper red or have pinkish lamellæ, and a red blood-vessel.

In this form the dissepiments are only developed posteriorly (Hessle).

The first setigerous process commences on the second segment, at the upper or lateral edge of the ventral glandular belt, and below it is a slightly curved elevation with the convexity anterior. Seventeen setigerous processes follow. Each is short and stout, with a slightly bevelled tip grooved for the bristles. The first and second are smaller and they slightly diminish posteriorly. The pale golden bristles (Plate CXXVII, figs. 5, 5′ and 5″) have long and nearly cylindrical shafts, a little narrowed at the proximal end, and distally tapering to a somewhat stiff curved tip, which ends in a hair-like point. The tip has narrow but distinct wings. The bristles appear to be in a single series, the stouter dorsal and the more translucent and slender ventral in position. Some present a stout shaft finely striated, and a peculiar and rather abrupt curvature at the tip (Plate CXXVII, fig. 5″), and apparently have a special function.

The rows of hooks commence on the sixth segment and continue to the posterior end. In the bristled segments anteriorly they occur on slightly elevated ridges a short distance below the setigerous processes with the exception of the first, which is close to the base of the process. The ridges become more prominent before the bristles cease. The rows are often conspicuous from their brownish colour. The golden hooks of the first row not only diverge in position but in structure, for they are larger and longer, have translucent shafts which dilate a little above the base, and again gradually diminish to the neck, which is curved backward, the tip being bent at a little more than a right angle and tapered to a sharp point—slightly turned up in some. The second series shows hooks of the normal outline, besides others imperfectly formed—with shorter shafts, and slightly curved, bifid tips, a distal longer and another shorter process at a distance below it. The typical hook (Plate CXXVII, fig. 5 *a*) has a long, slightly curved, finely-striated shaft which is slender at the base, dilates gradually in its progress to the shoulder, near which it diminishes, the neck then being bent a little backward, the enlarged crown having four teeth above the main fang, which is powerful and sharp.

The uncinigerous processes become more prominent behind the bristled region, on slightly flattened lamellæ with wider truncated tips, and attain their maximum about the twentieth from the end, and gradually diminish backward. In this region the hooks are all of one kind and essentially different from those in the anterior region. Each hook (Plate CXXVII, fig. 5 *b*) has a convex posterior region with a deep dimple above the base, three large teeth above the main fang, the anterior outline having a slight process below the main fang, whilst the base is convex inferiorly and short, the somewhat

abrupt anterior outline making but a short prow. The importance of the form and of the functions of hooks are well illustrated in this species, which has no less than three kinds.

The branchiæ arise from the second and third segments by short and somewhat bulky and fluted stems, which are flattened antero-posteriorly. The two main divisions are dorsal, each having a smooth basal process directed backward and a fusiform dorsal region composed of lamellæ, which from the stem backward abut on the smooth basal process, whilst the lamellæ of the portions in front of the stem are fixed to a median ventral band. These lamellæ are highly vascular, the vessels or channels forming a close series of arches from twelve to eighteen in number along each leaflet, the free margin of which is crenate. The posterior branchiæ are much smaller, but they also have a basal trunk to which the lamellæ are attached. The lamellæ are more or less conical, having a distinct apex to which the vascular channels point, and thus they are more or less straight and nearly vertical. A coagulated fusiform mass occurred in the basal trunk of one. In the tube the branchiæ are turned forward with the basal region of the smaller pair uppermost, and the lamellæ next the dorsum.

*Reproduction.*—Willemoes-Suhm[1] (1871) describes the eggs of this form attached to sea-grass in May, at Kiel, and followed its development up to the late trochophore stage with two large red eyes and a long tuft of cilia in front, besides prototroch and telotroch, Leschke[2] also refers to the same species at Kiel. Lo Bianco (1909) found at Naples both males and females in full sexual maturity from May to November.

*Tube.*—Small examples occurred in rather friable tubes of soft grey mud and sand ("Porcupine," 1869, 422 fathoms). Larger forms from Norway have thick tubes of dark grey mud. In the Canadian examples the friable tube consists of brownish sand. The internal secretion is scanty.

*Habits.*—It generally frequents a muddy bottom, as for instance in 18 fathoms towards the southern end of Bressay Sound. It can wriggle about when disturbed, and rolls along the vessel in captivity, boring its snout into a muddy mass and completely hiding itself, the great branchial lobes apparently offering no obstacle. It readily leaves its tube, and as that is of friable mud and sand it frequently disappears in the dredge. The body is generally more or less coiled. The dorsal blood-vessel is large, and waves of contraction drive the contents forward, a dilatation occurring just behind the tips of the branchiæ. The contractions take place about thirty-six times per minute.

This was one of the many new species of marine animals which the elder Sars, then a clergyman at "Floröe Præstegaard," added to science in his remarkable 'Beskrivelser og Iagttagelser,' published when he was sixty miles from the nearest zoological library. It was but an earnest of a life of zoological discovery which no surroundings could alter and no vicissitudes could quench; moreover, his skill in pourtraying the forms which came under his notice kept pace with the ardour and accuracy of his observations.

Fritz Müller[3] seems to have found a similar form off the Coast of Brazil.

[1] 'Zeitschr. f. w. Zool.,' Bd. xxi, p. 391, Taf. xxxii.
[2] 'Wiss. Meeresuntersuch.,' Bd. v, p. 128.
[3] 'Archiv f. Naturges.,' Bd. xxxiv, p. 218, 1858.

Steen[1] (1883), in his account of the structure of the species, designates the thoracic glands as salivary glands. The segmental organs are situated in the fifth and sixth segments, a pair in each, and the funnel opens into the body-cavity in the middle of the segment, projecting, not through a diaphragm, but according to his interpretation, standing at right angles to the body-wall.

*Parasites.*—Levinsen[2] describes a crustacean parasite (*Saccopsis terebellidis*) of this species from Greenland, the body of the female of which is somewhat pear-shaped and without apparent segmentation. Behind the eighth bristle tuft on the right a reddish-brown mass with processes passing internally occurred in a large example from Berehaven, Ireland. It is probably one of the Rhizocephala.

M. Sars[3] (1861) described a parasitic female Copepod which he termed *Terebellicola reptans* in this species. The body is pear-shaped, the broad end being in front, with eleven segments. The head is joined to the first thoracic segment, and has a rostrum. Maxillipedes and five pairs of feet are present, the fifth, however, being rudimentary (biarticulate).

Wirén (1886) gives an account of a Lumbrinereid commensal, *Hæmatocleptes terebellidis*, living in the œsophagus of this species.

Cunningham and Ramage (1888) mention that there is but one pair of nephridia in the first bristled segment.

The sub-family *Canephoridea* of Malmgren contains Grube's genus *Canephorus*, which seems to be closely allied to *Terebellides*, having twenty anterior segments and thirty-two posterior. Branchiæ sinuous quadrilobate (arising from segment 2), and on a short basal process. Colour greyish, a little iridescent.

## Family XXX.—Sabellidæ.

The body is somewhat rounded or slightly flattened, of two regions, an anterior (often called the thoracic) embracing from five to twelve segments with bristles of two kinds, and hooks of two kinds in a double row, either long or short, and a posterior (so-called abdominal) region of numerous segments. The ventral longitudinal sulcus is continued on the dorsum anteriorly. The bristles and hooks of the posterior region are each of one type.

The first segment has a collar more or less adpressed to the branchiæ. Branchiæ forming a funnel surrounding the mouth by the apposition of the fan on each side, the rays having only pinnæ internally in Sabellids proper, and externally occasionally processes arranged in pairs, and eyes in other forms. A pair of muciparous glands (modified segmental organs) opening by a single orifice anteriorly. Posteriorly

[1] 'Jenaische Zeitschr. f. Nat.,' Bd. xvi, p. 232, Taf. xi—xiii.

[2] 'Videnskab. Meddel. Naturhist. For. Kjøbenhavn,' p. 24, Tab. vi, figs. 21—22, 1877.

[3] 'Forhandl. Vid.-selsk. Christ.,' 1861, p. 139.

segmental organs of the ordinary type with ventral nephridiopores. Neural canals largely developed. Neither thoracic membrane nor operculum.

Tube cylindrical, of mucine, leathery, or membranous, coated with dark mud, rarely with sand or other material.

The general structure of this and several of the succeeding genera has been given in the 'Annals of Natural History' lately,[1] so that it will only be briefly alluded to under the species dealt with.

The term "Sabella" was employed by Linnæus in the tenth edition of the 'Systema Naturæ' to designate a form similar to the Nereides with a tube of grains of sand, and two thick tentacula behind the head.

Cuvier noted that the members of the group rarely possessed a calcareous tube, whilst they had the same fan-like gills as the Serpulæ, and in many the same thoracic membrane.

The Sabellids were ranged under his comprehensive group "Annelides Serpulées" by Savigny (1820)—along with Amphictenids, Arenicolids and other forms. The special genus *Sabella* (Genus XXI) was, however, described with considerable minuteness and care. He made three tribes, viz. (1) Sabellæ Astartæ, (2) S. Simplices and (3) S. Spirographes.

The circulation of the Sabellids was stated by Milne Edwards[2] (1838) to be akin to that of *Nephthys* and the Nereids. A dorsal and a ventral trunk are present, whilst the inner aspect of the integument is supplied with a multitude of vascular filaments for the secretory organs, and the bases of the feet present also a capillary rete which probably aids in respiration, but the main respiratory organs are the cephalic fans in front.

The elder Sars did much to place the genera of this group on a proper footing by giving carefully revised characters.

It is difficult to distinguish the *Clymeneis stigmosa* of H. Rathke,[3] in his "Fauna Norwegens" (1843). It is apparently a Sabellid, and at first sight might pass for *Chone infundibuliformis* without branchiæ, but the author was familiar with that species, and would not have omitted reference to the elongated anterior hooks. It is, at any rate, a Sabellid.

According to De Quatrefages (1850), the cephalic ganglia of *Sabella flabellata* form two pairs connected by a large commissure. Branches from these go to the branchiæ and to the eyes. The œsophageal connectives are extremely short. The visceral system seems to arise from the ganglia as a small twig on each side and furnished with two ganglia. The ventral cords are separate throughout, though nearer each other posteriorly, and the first ganglion is close to the cephalic ganglia, the others following in each segment and on each cord. Fine connecting trunks occur between each ganglion, whilst branches from the latter pass to the muscles and other organs. He mentions that in the branchiæ of the Sabellidæ and Serpulidæ are venous and arterial twigs which mingle in a system of vessels, the walls of which cannot be distinguished from the surrounding tissues, and in which respiration is carried on through the thin covering tissues and

[1] 'Ann. Nat. Hist.,' ser. 8, vol. xvii, 1916, p. 1.

[2] *Op. cit.*, p. 212.

[3] 'Nova Acta Cur.,' Bd. xx, p. 228, Tab. ix, figs. 10—14.

their cilia.[1] He describes what he terms a cartilaginous skeleton in these branchiæ, composed of cells, with a tough fibrous investment like a periosteum. He refers to the chondroid tissue of the organs.

This family was united with the Eriographididæ and the Serpulidæ, under which latter title the whole were ranged by De Quatrefages (1865), but it is difficult to see what was gained by this method, which, if anything, increased the complexity of the subject. It is true it led to certain interesting homologies of the organs of the two families, such as that of the tentacles of the Sabellidæ with the opercula of the Serpulidæ. In his arrangement of the large family thus constituted De Quatrefages employed the operculum, the regions of the body, the branchiæ, the tentacles, the feet and the tubes in separating the genera, of which he made twenty-one. Under his first tribe, the Serpulea sabellea, were ranged the Sabellids proper, *Oria*, *Fabricia*, *Amphiglena*, and *Protula*, whilst in the second division, the Serpulea heterosabellea, were *Anamæbæa*, *Amphicorina* and *Myxicola*. He distinguished these from the former by the supposed indistinct separation between the thoracic and abdominal regions—a misapprehension corrected by Claparède.

Following De Quatrefages Dr. Johnston (1865) included the Sabellidæ under the Serpulidæ. Grube (1878), like various previous authors, placed the Sabellidæ along with the Serpulidæ in his Family Serpulacea, Blainville. This author in 1838 showed that the vessel to the branchial filaments was single.

Claparède (1868), following Burmeister and De Quatrefages, included the Sabellidæ under the Serpulidæ as the first tribe of that group, and distinguished from the other tribe by the fact that they have no thoracic membrane whereas the Serpulids have. Moreover, the Sabellids are characterised by the presence of a ciliated median ventral groove, which, passing between the right feet at the posterior part of the thorax, becomes dorsal in that region. This "sillon copragogue" of the Swiss author carries fæcal matter to the front, and discharges it from the tube without contact with the mouth. In those species in which the groove is ventral throughout it becomes less and less deep anteriorly and disappears in front, so that when the animal projects its anterior region from its tube at the usual angle the fæcal matter is dropped at a distance from the mouth. He corroborated Grube's observation that the blood-vessel to each branchial filament was single, and that the skeletogenous support was independent of the perivisceral prolongation.

Langerhans (1880) groups the Sabellids under his Serpulacea, but readily distinguishes them from the Serpulids by the absence of the thoracic membrane. He arranges the genera of the Sabellidæ thus:

I. Tori on the thorax with two rows of bristles.

A. With a collar.

*a*. Branchiæ spiral . . . . . *Spirographis*.

*b*. Branchiæ simple.

*α*. Sub-terminal branchial eyes. . . . . *Branchiomma*.

*β*. No sub-terminal eyes.

[1] Grube and Claparède, on the other hand, pointed out that in the Sabellids the trunk to the filament was single.

(1) Dorsal bristles on the thorax of one kind (einerlei Art) . . . . . *Sabella.*
(2) Dorsal bristles on the thorax of two kinds . *Potamilla.*

B. Without a collar . . . . . *Amphiglena.*

II. Tori on the thorax have no double rows.

A. Uncini on the abdomen as in *Sabella.*

*a.* Thoracic hooks elongated . . . . . *Jasmineira.*

*b.* Hooks on the thorax short.

α. Branchiæ with dorsal appendages . . . . *Dasychone.*
β. Branchiæ without dorsal appendages . . . . *Laonome.*
γ. Branchiæ spiral . . . . . *Bispira.*

B. Abdominal hooks as in *Serpula* and *Terebella.*

*a.* Branchiæ with a web.

α. Without a collar.

(1) Thorax without uncini . . . . . *Myxicola.*[1]
(2) Thorax with uncini . . . . . *Leptochone.*

β. With a collar.

(1) No anal groove . . . . . *Chone.*
(2) Anal groove . . . . . *Euchone.*

*b.* Branchiæ without a web.

α. Branchial filaments do not end in a process . . *Dialychone.*
β. Branchial filaments end in a process.
(1) With a collar . . . . . *Oria.*
(2) Without a collar . . . . . *Fabricia.*

Levinsen[2] (1883) chose the old method of grouping the Sabellidæ and Serpulidæ together under his title *Sabelliformia.* The arrangement of his genera was:—*Amphicora, Notaulax, Euchone, Chone, Laonome, Dasychone, Sabella, Potamilla.*

De St. Joseph (1894) followed Claparède and others in grouping the Sabellidæ under the Serpulidæ and uniting with them the Eriographididæ and the Amphicoridæ. The presence or absence of a thoracic membrane did not appear of sufficient importance to separate the groups. Accordingly he ranged all in a single family—Serpulidæ—under which he made two tribes, viz., (1) Sabellidæ, in which the tube is formed of mucine and coated with *débris* of shells and sand, and either free or sunk in the sand. No thoracic membrane and no operculum.

(2) Serpulidæ: Tube of mucine combined with calcareous matter, or rarely with a crystalline translucent substance like chalcedony. Generally a thoracic membrane and an operculum.

He classifies the Sabellidæ mainly according to the arrangement of the hooks and bristles, taking the nature of the collar and the branchiæ also into account.

I. Thoracic hooks avicular with oar-shaped bristles.

I *a.* A single row of avicular hooks on the abdominal processes.

1. With a collar.

[1] This is inaccurate as regards the common species.
[2] *Op cit.,* p. 180.

A. Basal lamellæ of the branchiæ always in a spire.

*a*. The two divisions of the branchiæ unequal; dorsal bristles of one kind—*Spirographis*, Viv.

*b*. The two divisions of the branchiæ equal; dorsal bristles of two kinds on the thorax—*Bispira*, Kr.

B. The basal lamellæ of the branchiæ are not spiral.

*a*. No sub-terminal eyes on the branchiæ.

*α*. Dorsal bristles on the thorax of one kind—*Sabella*, L.

*β*. Dorsal bristles of two kinds on the thorax.

$\beta^1$. Abdominal bristles of one kind—*Potamilla*, Mgrn.

$\beta^2$. Abdominal bristles of two kinds.

Bristles of the first thoracic segment in a linear series—directed towards the head. The posterior base of all the avicular hooks short—*Hypsicomus*, Grube.

Bristles of the first thoracic segment forming an ordinary fascicle. Posterior base of the thoracic hooks very long—*Potamis*, Ehlers.

*b*. Sub-terminal eyes on branchiæ.

Dorsal bristles of one kind on the thorax—*Branchiomma*, Köll.

2. Without a collar.

Dorsal bristles of two kinds on the thorax—*Amphiglena*, Clap.

I *b*. Two rows of hooks and bristles on the abdominal tori.

Bristles of the first thoracic segment disposed in two oblique rows. Thoracic and abdominal bristles of two kinds—*Protulides*, Webster.

II. Thoracic hooks avicular or with a long shaft and in a single row. A single row of avicular hooks on the abdominal tori.

A. Avicular hooks on the thorax. Avicular hooks on the abdomen.

*a*. Branchiæ with dorsal appendices. Thoracic dorsal bristles of one kind—*Dasychone*, Sars.

*b*. Branchiæ without dorsal appendices.

*α*. Thoracic dorsal bristles of two kinds.

*a'*. Absent on the first segment. Posterior base of all the hooks truncate—*Laonome*, Mgrn. (non Kbg.).

*a''*. Disposed in an angular double row on the first segment. Posterior base of all the hooks ordinary—*Notaulax*, Tauber, Lev.

*β*. Thoracic dorsal bristles of one kind.

1 *a*. Branchial lobes forming on each side a double concentric half-circle—*Sabellastarte*, Kr.

2 *a*. Branchial lobes do not form a double concentric half-circle—*Eurato*, St.J.

B. Thoracic hooks with a long shaft

1 *a*. Abdominal hooks with a long manubrium; thoracic dorsal bristles of one kind—*Haplobranchus*, Bourne (*Manayunkia*, Leidy).

2 *a*. Abdominal hooks avicular; thoracic dorsal bristles of two kinds—*Jasmineira*, Langerh.

3 *a*. Abdominal hooks resembling the flattened plates of the Terebellids or Serpulids.

*a*. Branchiæ forming two divisions on each side united by a thin membrane throughout the greater part of their extent.

*α*. Without prominent uncinigerous tori. Almost complete ring of minute hooks on the abdomen. Thoracic dorsal bristles of one kind, *Myxicola*, Koch (*Eriographis*, Grube, *Arippasa*, Johnst.), including *Leptochone*, Clpd.

*β*. Prominent tori uncinigerous. Hooks do not form a ring on abdomen.

1 *a*. No ventral groove in the posterior segments. Thoracic dorsal bristles of two kinds—*Chone*, Kr.

2 *a*. Ventral groove in the posterior segments. Dorsal thoracic bristles of two kinds, rarely of one—*Euchone*, Mgrn.

*b*. Branchiæ not united by a membrane throughout the greater part of their length.

*α*. Branchial barbules not terminated at the same level. Dorsal thoracic bristles of two kinds—*Dialychone*, Clpd.

β. Branchial barbules all terminating at the same level. Dorsal thoracic bristles of one kind.

1. With a collar—*Oria*, Quatref.
2. Without a collar—*Fabricia*, Blv.

*Parasites.*—Amongst the external crustacean parasites of this family discovered by Sars,[1] are *Sabelliphilus elongatus*, Sars, on *Sabella penicillus* (*S. sarsi*, Kröyer), *Chonephilus dispar*, Sars, on *Chone papillosa*, and *Sabellacheres gracilis*, Sars, on *Myxicola Sarsii* (probably *M. infundibulum*), the former from Norway, the two latter from Finmark.

An interesting commensalistic form is *Lar sabellarum*, a Gymnoblastic hydroid, which was originally found by Gosse growing on the edge of the tube of a Sabellid in his aquarium. This peculiar hydroid has only two tentacles and a mobile bilabiate "proboscis." Hincks, Browne, Dick and Gemmill have since found the same species, the three last-mentioned in the estuary of the Clyde, and reproductive individuals and gonozoids have been described.

Moseley[2] and Ray Lankester[3] found chlorocruorin in Sabellidæ from both deep (600 fathoms) and shallow water. MacMunn subsequently met with the same substance in the greenish blood of *Sabella*.

[1] 'Christ. Vidensk. Selskab. Forhandl.,' 1861, p. 46 (sep. copy).

[2] 'Quart. Journ. Micr. Sc.,' N.S., vol. xvii.

[3] Ibid., November, 1867.

M. Sars[1] (1868) included *Chone infundibuliformis* and *Euchone* sp.? amongst those found at a depth of 250—300 fathoms.

*Reproduction.*—Miss Gregory observes that examples of *Sabella microphthalma* are pure females in April and May, but that in August they are hermaphrodite or female.

Benham[2] follows Pruvot and Mayer in regarding the branchial apparatus of the Sabellids and Serpulids as "greatly subdivided and enormously elongated palps." The cœlom enters the cephalic appendages in both.

Fuchs[3] (1907) included the Sabellidæ under the Serpulimorpha, with a biregional body consisting of thorax and abdomen. The anterior region has a pair of excretory organs ending in a single aperture, the genital organs in the posterior region being in pairs.

It is sometimes difficult to get the Sabellids to leave their tubes, into which they retreat on the slightest alarm. Mr. Crossland, however, mentions that a very common small form in the Red Sea readily leaves its tube, crawls on the side of the vessel, and makes a new tube of secretion in a short time. Bohn again characterises their swimming movements as "natation hèlicoidale oscillatoire."

Orton[4] (1914) observed that *Dasychone* and others attained a good size in much less than a year.

One member of the Sabellids, viz. *Spirographis spallanzani*, has been found by Dr. Gaskell[5] to have no nerve-cells giving the chromaffine reaction—which he had detected in *Aphrodita aculeata* and *Eunice gigantea*. So far as his observations go the chromafine reaction is not common in the Polychæta.

The British Sabellids number more than twenty, exclusive of some forms not yet fully investigated from lack of good material. In this respect, therefore, they compare favourably with those from othea areas. Thus, for example, Sars[6] in 1861 gave ten species of Sabellids, including one of *Myxicola*, as occurring in the prolific Norwegian waters. De Quatrefages in his 'Annelés' mentions about a dozen of the forms which have been found in Britain, including double entries like *Sabella penicillus* and *S. pavonina*, *Sabella reniformis* and *S. saxicava*, *Fabricia amphicora* and *F. Johnstoni*. In Malmgren's 'Annulata Polychæta' of Spitzbergen, Greenland, Iceland and Scandinavia nineteen Sabellids (including *Myxicola*) are entered, and some of these appear to be purely northern in distribution, and do not occur in our waters. Only six are entered by Dr. Johnston in the 'Catalogue of Worms in the British Museum,' and two of these represent one species, *Sabella penicillus*, and another, *S. savignii*, is doubtful.

Six species, including *Myxicola Steenstrupi*, are recorded by Théel[7] (1879) from Nova Zembla.

Langerhans (1880) found ten species at Madeira.

[1] 'Videnskab.-Selsk. Forhandl.,' 1868 (sep. copy), p. 10.
[2] 'Camb. Nat. Hist.,' 1896, pp. 260 and 261.
[3] 'Jena. Zeitschr. f. Naturw.,' Bd. xlii, 1907.
[4] 'Journ. M. B. A.,' vol. x, p. 316.
[5] 'Philos. Trans.,' ser. B., vol. 205, p. 157 (1914).
[6] 'Forhandl. Videnskabs-Selsk. Christiania,' 1861, pp. 116—131.
[7] 'Kongl. Sv. Vet. Akad. Handl.,' Bd. xvi, No. 3, p. 65.

The tubes in this group appear to be formed by the secretion of the glands of the body generally, and Brunotte[1] states that an example deprived of the anterior (thoracic) region secreted a tube of the ordinary structure. The ventral shields anteriorly specially aid in this function.

As a rule Sabellids are marine in habitat, but several species have been found in fresh water, such as *Manayunkia speciosa*, Leidy, in N. America, *Caobangia biletti*, Giard, in Tonquin, and *Dybowscella*, Nusbaum, in the Baikal Sea.

About twenty-seven species of Sabellids occur in the laborious memoir of Miss Katherine Bush[2] from the vast area of the Pacific.

A. Hofsommer[3] (1913) furnishes an account of the Sabellids obtained by the "Poseidon" and those of Kiel Bay, and he links on the Eriographididæ of Malmgren as the second division of the group, characterised mainly by the absence of the collar and the union of the branchial filaments by a membrane. He describes two new species of *Chone* and places much reliance on the thoracic glandular belts in his discrimination.

Fifteen species occur in the careful survey of Clare Island, on the rich west coast of Ireland, by Mr. Southern (1914), several not having hitherto been found in Britain. Thirteen species of Sabellids are entered by Prof. Fauvel (1914) in his fine work on the Polychæta procured during the voyages of the Prince of Monaco in his yachts "Hirondelle" and "Princess Alice." In the recent (1915) list of the Polychæta procured at Plymouth by Dr. Allen thirteen species are entered and a few are exclusively southern forms. Comparatively few species (*e. g.* from two to five) pertaining to this family as a rule occur in local catalogues in the British area. These will be elsewhere alluded to. Moreover, it is perhaps more difficult to separate the Sabellids by their bristles and hooks than, for instance, the Terebellids, and coloration disappears as a rule in spirit-specimens.

Mr. Crossland mentions that in the Red Sea a Sabellid grows on massive colonies of *Porites*, the tube of the annelid lengthening as fast as the coral grows, so that its aperture is always at the surface of the coral. This species is gorgeously beautiful, for its branchiæ form a double spire (*Bispira ?*), and the tubes are dotted over the coral 6 inches to a foot apart, and their colours contrast with the yellowish or brown background of the coral. Moreover the colours of no two are alike. In one group he saw white, bright yellow, brown, red and deep violet blue.

### *Genus* CLXI.—Sabella, *Linnæus*, 1758.

Cephalic region with a deep median groove dorsally and two lateral flaps; ventrally with two flattened reflected conical lobes. The mouth opens in the centre of two membranous flaps prolonged upward. The branchiæ spring from a firm curved base on each side of the cephalic plate and form a semicircle of long axes with pinnæ devoid of dorsal appendages, but occasionally with ocular points and spirally arranged. The tentacles, which are about one-fourth the length of the branchiæ, arise from the dorsal edges of the mouth by a flattened base, and are attenuate distally.

Body of two regions, elongated, flattened, little attenuated posteriorly and ending

[1] 'Recher. Anat. Branchiomma,' p. 10.

[2] 'Harriman Exped. to Alaska,' New York, 1905.

[3] 'Wissensch. Meeresunter.,' Bd. xv, Kiel, 1913, pp. 307—361, pl. i and a map.

in a rounded tip. Ventral groove conspicuous posteriorly as well as in front, not continued on the dorsum anteriorly. Fascicles of bristles dorsal in front, ventral posteriorly, hooks ventral anteriorly, dorsal posteriorly. Anus at the tip, occasionally dorsal. Setigerous processes commence at the buccal segment and continue to the posterior end. Bristles anteriorly either with long narrow wings and slightly curved tips or with shorter and broader tips and wings.

Uncinigerous ridges from the second segment backward to the posterior end, with dissimilar biserial rows (two) in front; only the avicularian rows (hooks) posteriorly.

1. Sabella penicillus, *Linnæus*, 1766. Plate CXIV fig. 1—body; Plate CXX, fig. 5—reproduced tail; Plate CXXVII, figs. 6—6 *i*—bristles and hooks.

*Specific Characters.*—Cephalic plate deeply split into two lateral pillars, which carry in each case 35–45 branchial filaments attached to a firm basal ring, the filaments

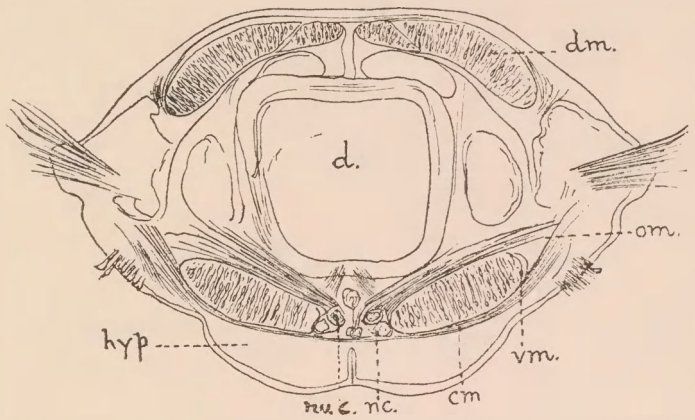



Fig. 150.—Transverse section of the body-wall of the anterior region of *Sabella penicillus*. The neural canal is larger than the nerve-trunk on each side.

elongate, slender, tapered only at the extremity, which is smooth, the rest having a series of short, delicate pinnæ. No ocular points on the branchiæ, which show white with purple bands at regular intervals. Collar narrow behind, and passes ventrally to expand into the large reflected lamellæ on each side of the median line. Tentacles flattened at the base, canaliculate, subtriangular in section and tapered to a delicate point, about a fourth the length of the branchiæ. Body flattened, 12—15 inches long, tail rounded and little tapered, segments 150—200 or more (600); 8—12 thoracic. In an example of 150 segments, breadth 6 mm., branchiæ 45 mm. Brownish flesh-colour with the ventral scutes pale. Anterior bristles arranged in a longer and shorter series, the longer having tips with narrow wings, the shorter with broader wings tapered to a fine point. In the second region the bristle-tufts form narrow cones and all of one length, with somewhat short tips and broad wings. Longer and finer bristles of two kinds, the longer without a visible wing, the shorter with longer tips and striated wings, the whole forming a cylindrical column with a lanceolate head enlarged at the base. Avicular hooks anteriorly in a single row, with a bold forward curve of the crown, and a single acute main fang, the free edge being serrated, each being accompanied by a paddle-shaped bristle. Posterior hooks smaller, also in a single row, of similar structure

except that the base is more elongated posteriorly. Tube of tough secretion and mud, 150—200 mm. long and 3 or more mm. in diameter.

The general structure of the body-wall in the anterior region is indicated in Fig. 150 after the nerve-cords have approached more closely to each other. The large size of the neural canals (*nu.c.*) containing the coagulable substance is noteworthy.

Synonyms.

1555. *Penicillus marinus,* Rondel. Hist. Poiss., pt. ii, p. 111, and fig.
1606. „ „ Aldrovandus, p. 561, with fig.
1755. *Fucus maritimus,* Ellis. Corall., p. 88, Tab. xxxiii.
1758. *Serpula penicillus,* Linnæus. Syst. Nat., Edit. x, vol. i, p. 788.
1762. *Scolopendra major tubularia,* Baster. Opusc. Subsec., ii, p. 77, Tab. ix, fig. 1.
1766. *Serpula penicillus* and *Nereis lutaria,* Pallas. Misc. Zool., p. 116, Tab. x, fig. 1.
1767. *Sabella* „ Linnæus. Syst. Nat., ed. xii, p. 1269 (excl. syn. Rond. Ellis & Syst. Nat., x).
1776. *Tubularia penicillus,* O. F. Müller. Zool. Danica Prodr., p. 254 (No. 3063).
1780. „ „ Fabricius. Fauna Grœnland, p. 438.
1789. „ „ O. F. Müller. Zool. Danica, iii, p. 13, Tab. lxxxix, figs. 1 and 2.
1803. *Sabella* „ Montagu. Test. Brit., vol. ii, p. 541.
1806. *Ampharete* „ Turton's Linn., p. 82.
„ „ *ventilabrum,* idem. Ibid., p. 82.
1807. *Sabella* „ Turton. Brit. Fauna, vol. i, p. 136.
„ „ *penicillus,* idem. Ibid., p. 202.
1808. *Amphitrite ventilabrum,* Montagu. MS. vol. Linn. Soc., pl. iv, fig. 3 and pl. xix.*
1811. *Sabella pavonina,* Jameson. Wern. Mem., i, p. 558.
1812. *Amphitrite ventilabrum* and *penicillus,* Gmelin. Syst. Nat., xiii, I, pt. vi, pp. 3110 and 3111.
„ *Sabella penicillus,* Pennant. Brit. Zool., vol. iv, p. 369.
1815. *Spirographis penicillus,* Oken. Lehrbuch, Bd. ii, p. 380.
1817. *Amphitrite ventilabrum,* Cuvier. Règ. An., t. ii, p. 519.
„ *Sabella alveolata,* idem. Ibid., p. 521.
„ „ *penicillus,* Stewart. Elements, i, p. 389.
1818. *Amphitrite penicillus,* Lamarck. Anim. s. Vert., t. v, p. 356, Edit. 2, p. 610.
1820. *Sabella pavonina,* Savigny. Syst. Annel., p. 79.
„ „ *ventilabrum,* idem. Ibid., p. 81.
1823. *Tubularia penicillus,* Fleming. Edin. Philos. Journ., viii, p. 295.
1826. *Amphitrite* „ Risso. Europ. Merid., t. iv, p. 410.
„ „ „ Payraudeau. Annel. and Mollusc. Corse, p. 20.
1828. „ „ and *pavonina,* De Blainville. Dict. Sc. nat., t. lvii, p. 434.
1830. „ *penicillus,* Bosc. Vers., 2nd Edit., vol. i, p. 199.
1834. „ *ventilabrum,* Dalyell. Edin. New Philos. Journ., xvii, p. 415.
1835. *Sabella penicillus,* Sars. Beskr. og Jagt., p. 47.
1839. *Amphitrite ventilabrum,* Bruguière. Encyclop. Méthod., pl. lix, figs. 1—4.
1841. *Sabella* „ Delle Chiaje. Descriz., t. iii, p. 71.
1843. „ *penicillus,* H. Rathke. Nova Acta Acad. C. L. C. Nat., Bd. xx, p. 225, Tab. xii, figs. 5—7.
1843–53. ? *Amphitrite Mulleri,* Chenu. Illust. Conch., 11e livr., pl. v, fig. 8.
„ „ *ventilabrum,* idem. Ibid., 11e livr., pl. vi, fig. 5.
1844. *Sabella penicillus,* Œrsted. Nat. Tidsk., ser. 2, i, p. 415.

1844 *Sabella pavonia*, idem. Region. Mar., p. 79.
1845. „ *penicillus*, Johnston. Ann. Nat. Hist., vol. xvi, p. 449.
1846. „ *pavonina*, Grube. Arch. f. Naturges., xii, p. 57.
„ „ *penicillus*, idem. Ibid., p. 55, Taf. ii, fig. 2.
1848. *Amphitrite ventilabrum*, Dalyell. Anim. Scot., ii, p. 280.
1850. *Sabella flabellata*, De Quatrefages. Ann. Sc. nat., 2e sér., t. xiv, p. 369, pl. x, fig. 3.
1851. „ *penicillus*, Sars. Nyt Mag., Bd. vi, p. 202 (Bergen).
„ „ *pavonina*, Maitland. Fauna Belg., p. 205.
1853. *Amphitrite ventilabrum*, Dalyell. Powers Creat., ii, p. 212, pl. xxx, figs. 9—11.
„ *Sabella pavonina*, Stimpson. Grand Manan, p. 30.
1856. „ *Sarsi*, Kröyer. Danske Vid.-selsk. Forh., p. 23.
1857. „ *ventilabrum*, Koren. Nyt Mag., ix, p. 94.
1859. „ *sarsi*, Danielssen. Reise, 1847, p. 56, and 1848, Kgl. Norke Vid.-selsk. Skrift., 4de Bd., p. 124.
1861. „ *penicillus*, Sars. Forhandl. Vid.-selsk. Christ., p. 121.
1865. „ „ and *S. pavonina*, Johnston. Cat. Worms Brit. Mus., pp. 254 and 346.
„ „ *pavonina*, De Quatrefages. Annel., ii, p. 446.
„ „ *longibranchiata*, idem. Ibid., ii, p. 445.
„ „ *penicillus*, idem. Ibid., t. ii, p. 446.
„ „ *pavonina*, Malmgren. Nord. Hafs-Annul., p. 398, pl. xxvii, fig. 82.
1867. „ *penicillus*, Parfitt. Cat. Annel. Devon., p. 34.
„ „ *pavonina*, Malmgren. Annel. Polych., p. 112.
1869. „ *pavonina*, Grube. Mitt. St. Vaast, etc., Abhandl. Schles. Gesellsch., 1868–69, p. 108.
1870. „ „ idem. Arch. f. Naturges., p. 346.
1873. „ *penicillus*, Möbius. Jahresb. Comm. wiss. deutsch. Kiel, p. 165.
„ „ *pavonia*, Kupffer. Ibid., p. 152.
1874. „ *pavonina*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 205.
„ „ „ Malm. Annel. Göteb., p. 101.
„ „ *alveolata*, Panceri. Atti Soc. Ital. Sc. Nat., vol. xvii, p. 529.
1875. „ *pavonia*, var., Ehlers. Zeitschr. f. wiss. Zool., Bd. xxv, pp. 29 and 76.
„ „ *pavonina*, McIntosh. Invert. and Fishes St. Andrews, p. 130.
1879. „ *pavonia*, Tauber. Annul. Danica, p. 135.
1881. „ *pavonina*, Leslie and Herdman. Proc. Roy. Phys. Soc. Edin., vol. vi, p. 67.
1882. „ *penicillus*, Macé. Arch. Zool. éxper., 1e sér., x, p. 9.
1883. „ *pavonina*, Levinsen. Vidensk. Meddels., Kjøbenh., p. 187.
1884. „ *flabellata*, Viallanes. Ann. Sc. nat., 6e sér., t. xx, art. 2, p. 2, *et subseq.*
„ „ *variabilis*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xl, p. 269.
1885. „ *pavonina*, Pruvot (nervous system). Arch. Zool. éxper., 2e sér., iii, p. 312, pl. xi, fig. 11, pl. xv, figs. 12, 13, pl. xvi, figs. 1—4.
1886. „ *penicillus*, Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 159.
1888. „ *pavonina*, Cunningham and Ramage. Trans. Roy. Soc. Edin., xxxiii, p. 669, pl. xliv, fig. 31.
„ „ *penicillus* (neural canals), Cunningham. Quart. Journ. Mic. Sc., vol. 28, p. 270.
1889. „ *pavonia*, Grieg. Bergens Mus. Aarb., p. 8.
1890. „ *pavonina*, Malaquin. Annél. Boulon., p. 48.
1891. „ *pavonia*, Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 261.
1893. „ *pavonina*, Lo Bianco. Atti Accad. Sc. Napoli, vol. v, p. 66.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e sér., xvii, p. 267.
„ „ *pavonia*, Bidenkap. Christ. Vid.-selsk. Forhandl., p. 135.

1896. *Sabella pavonina*, Roule. Camp. "Caudan" (Ann. Univ. Lyon), p. 161.
1897. „ *pavonia*, Michaelsen. Polych. deutsch. Meere., p. 182.
1898. „ „ Idem. Grönländ-Annel., p. 130.
1901. „ *pavonina*, Whiteaves. Mar. Invert. E. Canada, p. 72.
1902. „ „ Marenzeller. Denkschr. Mat.-Nat. Cl. Kaiserl. Akad. Wiss. Wien, Bd. lxxiv, p. 23.
1904. „ „ Journ. M. B. A., vol. vii, p. 231.
1906. „ „ Bohn. Ann. Sc. nat., 9e sér., t. iii, p. 129 (movements).
1909. „ „ Fauvel. Bull. Inst. Oceanogr., cxlii, p. 41.
„ „ „ Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 586.
„ „ „ Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 209.
1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 241.
„ „ „ Elwes. Journ. M. B. A., vol. ix, p. 65.
1911. „ *pavonia*, Riddell. Proc. Liverpool Biol. Assoc., vol. xxv, p. 64.
1912. „ *pavonina*, Crawshay. Journ. M. B. A., vol. ix, p. 346.
1913. „ „ Giard. Œuvres Diverses, p. 57.
„ „ *pavonia*, Hofsommer. Wiss. Meeresunters. Kiel, Bd. xv, p. 317, Taf. iv, figs. 1 and 2.
1914. „ *pavonina*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 138.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 312.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 641.
„ „ „ Southern. Irish Sc. Invest., No. 3, p. 49.
1916. „ *penicillus*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 2.
1917. „ *pavonina*, Rioja. Anél. Poliq. Cantáb., p. 63.

*Habitat.*—Tossed on shore in great numbers after storms on the West Sands, St. Andrews, and the tube is often encrusted by *Alcyonium digitatum*. It was a common accompaniment of other forms from deep water entangled in the lines of the fishermen; Moray Firth; Orkneys (Fauvel); Dingle Bay, Ireland, 50 fathoms; Shetland (J. G. J.); Plymouth (Spence Bate and P. Rowe, Allen, Crawshay); Dublin Bay, Blacksod Bay and West Coast, Ireland (Southern); Torquay Harbour (Elwes); off Forth (Cunningham and Ramage). In the river Roach, near Burnham, Essex, the tubes are usually small (Punnett), whereas in the Channel they are the size of block-tin gaspipes (British Museum). It is common on the south coast and all along the eastern and western shores. Norway (H. Rathke); North Sea (Kröyer); Greenland (Michaelsen); in 81 fathoms (326 metres?) off Cape Finisterre, "Porcupine," 1870; Sweden (Malmgren); shores of France (De Quatrefages, De St. Joseph); shores of Cantabria (Rioja); Canada (Whiteaves); Atlantic coast, U.S.A. (Stimpson, Verrill); Naples, in a depth of 25—100 metres in a colony with *Aglaophenia myriophyllum* (Lo Bianco).

When the branchiæ of this species are thrown off the *cephalic region* presents a truncated surface, in the centre of which is a frilled eminence which, when carefully inspected, shows two lateral membranous wings, which unite in the middle line below and send a process ventrally between the two great ventral laminæ, whilst the upper edges pass above the mouth in a series of short frills. In the mid-dorsal line over the mouth is a triangular flap with an acute apex, the base of which is grooved dorsally, the whole resembling an epistome. Dorsally the cephalic plate is deeply grooved by the dorsal

furrow, the firm and thick edge of the rim which carries the branchiæ being severed and neatly curved on each side; the rim then passing ventrally to the base of the great flaps is folded inward and upward, and is fused on each side with the firm median mass over the mouth. In the perfect condition with the branchiæ attached the pedicle between the ventral flaps passes upward as a bifid process, then expands on each side into a lateral flap or wing, which after a short progress bends backward and upward, makes a kind of frilled knee, and becomes continuous with the investing membrane of the branchiæ of its side, its outer border inferiorly passing into the basal semicircle of the branchiæ, to which it is fixed throughout. Such is the arrangement connected with the floor of the mouth and the lower lip. Dorsally the membrane forming the roof of the mouth splits considerably in front of the median fissure of the lower lip into two limbs, each of which at the base has an axis with a narrow ventral web, and a thinner and broader dorsal web which tapers distally and goes much further along the axis than the former, the axis finally tapering to a long, delicate tip. The whole forms the so-called tentacle, which in the preparations is concealed in each branchial semicircle. Viewed from the inner surface of each branchial fan the "tentacle" has the web on its dorsal edge connected with the dorsal edge of the fan, whilst its ventral web passes ventrally to the central region dorsad of the mouth. The inrush of water along the inner surface of the branchial fan would thus be swept toward the mouth, the tentacles and their webs probably aiding in this function, and keeping the stream in each fan to its own side as it rushes down the groove by the outer border of the smaller anterior web into the mouth.

The branchial fan arises on each side from the firm base formerly mentioned, a spiral twist being evident dorsally and more especially ventrally at its commencement. Each, in preservation, has the ventral edge curved inward, and a narrow membranous web passes from the frill of the inferior oral membrane for some distance along its edge. This ventral border is the thickest and gives origin to the majority of the branchial stems, the rest springing from the middle and posterior parts of the basal semicircle. The number of these filaments varies, the two sides seldom being equal; thus, for instance, thirty-eight may occur on the right and forty-one on the left. The fan on each side is long and graceful, banded with regular markings of dull red and white. The circles of colour do not go evenly round the expanded fan, but start from the ventral fissure. Dorsally a greenish hue occurs in some at the base of the fan. In others green or purple predominate, and the fluid in which the animals lie is always tinged with green (Dalyell).

Each filament has an elastic chordoid and camerated axis, the cameræ being after the fashion of the bristles of *Nereis* or *Aricia*. The filaments are united by a web inferiorly (about the level of the first pigment-band), but free throughout the rest of their extent, and are somewhat flattened processes with a smooth external edge, near which the axis lies, whilst the inner edge is fringed with a dense series of slender pinnæ, which likewise have a translucent axis jointed at intervals like the bristles of the Chlorœmidæ. The filaments and their translucent axis gradually diminish distally, but the axis can be traced almost to the extremity. Toward the tip of the filament the pinnæ gradually diminish in length, finally forming mere papillæ, and thereafter the tapering tip is smooth and of moderate length. When the branchiæ have lost their distal ends and regeneration has

considerably advanced, the long filamentous processes projecting from the tips give a novel character to the organs.

Anteriorly the buccal segment lies in a hollow between the two pillars of the dorsal fan, a more or less separate fan-shaped lamella, tinted of a deep reddish brown, occurring on each side. From this the marginal collar passes ventrally to expand into the prominent and generally reflexed lamella on each side of the median fissure, where it is distinctly thickened. A band on each side of the median oral process joins it to the fold a little higher. The first shield on the ventral surface behind the collar is continuous from side to side, and is the largest of the series of glandular scutes, though it is opposite the first bristle-bundle the latter would seem to pertain to the segment behind it.

The mouth leads into a simple alimentary canal, which, when seen from the dorsum, forms a moniliform tract from end to end—wider anteriorly and narrower posteriorly. The septum in each segment retains it firmly in position. The contents can be seen through the transparent walls of the canal, and in one consisted of pale granules anteriorly and posteriorly of muddy sand. At each side of the gut anteriorly is a long granular sac (segmental organ).

The *body* shows little or no narrowing anteriorly, remains of similar diameter for a considerable distance, then in preservation may increase in breadth behind the anterior third, and thereafter gradually tapers to the tail, ending in the anus, which is often bilobed. In lateral view the margin of the vent slopes from above downward and backward, the ventral edge thus projecting considerably. Seen from above the aperture is bifid inferiorly, and a triangular area is differentiated on the dorsum in front of the aperture. Both dorsal and ventral surfaces are plano-convex, thus in transverse section being more or less elliptical, the dorsal, however, being generally more smoothly rounded, with a pale streak in the middle line from the dorsal vessel. The ventral surface has a continuous series of scutes from one end to the other, and with the exception of the first all are divided by the median groove—giving a right and a left scute to every segment. The number of segments varies from 200—270 or more.

The first region of the body (the so-called thoracic region) is distinguished by the direction of the bristle-tufts, which slope upward and backward, and by the presence of ventral rows of hooks. The setigerous processes vary from seven pairs to eleven, one side occasionally having nine or ten and the other eleven. The first setigerous process arises immediately behind the dorso-lateral lamella, and is smaller than those following; moreover, it has no row of hooks dorsally. The bristles (Plate CXXVII, fig. 6 *d*) are arranged in a rather dense group and show a longer and a shorter series. The longer forms (Plate CXXVII, fig. 6) have cylindrical striated shafts slightly narrowed toward the origin of the wings which are narrow, the bristle thereafter ending in a translucent and somewhat strong though flexible tip. No serrations on the edges of the wings have been seen in these though striæ go to the edge. The bulk of the group of bristles is made up of those with shorter shafts and broader wings (Plate CXXVII, fig. 6 *a*), the whole tip being rather broad until near its extremity, where it is abruptly tapered to a fine point. In the cluster of bristles in the tuft various stages occur in the developing bristles, some resembling a long, narrow knife-blade, others a deep-bellied shorter blade.

In lateral view a forward curve of the shaft at the origin of the wings is seen, the tip then gently curving backward to a nearly straight tip. The succeeding tufts are of similar shape—that is, somewhat flattened—but they are longer and stronger, and the edges have distinct serrations (Plate CXXVII, fig. 6 *b*). The anterior setigerous processes form a somewhat flattened cone, the base ventrally being prolonged into a prominent ridge bearing the hooks, which lie between two raised margins, constituting a narrow flap posteriorly in each segment. Moreover, a distinct papilla occurs on the anterior edge of the tip.

The setigerous processes of the second region form stiff narrow cones, which project nearly straight outward, the bristles only being visible at the tip. A soft and rather swollen process bearing the hooks lies above their dorsal edges. The bristles form a kind of pillar, narrow at the base and enlarging at the tip to about double the diameter at the base of the wings, which give to the distal end a characteristic lanceolate enlargement, from which the tapering tips slope slightly inward. These differ from the anterior groups in being all of one length, and appear to be ranged round a central papilla. The tips are comparatively short, with somewhat broad wings, which are obliquely striated and serrated along the wide or lower edge. The setigerous processes and bristle-tufts remain of the foregoing structure till near the posterior end, where longer and finer bristles project from the small, modified processes. The bristles are fewer, and of two kinds, viz., a long, slender series (Plate CXXVII, fig. 6 *h*), without visible wings, which have long, gently tapered and slightly curved tips; and secondly, of a shorter series (Plate CXXVII, fig. 6 *i*), with rather longer tips than those in front and with striated wings.

The anterior hooks (Plate CXXVII, fig. 6 *f*) are typical avicularian forms with a marked forward curvature of the crown and a single acute main fang, the free edge of which is minutely serrated throughout the greater part of its extent, leaving little more than a third smooth, and the tip is often slightly turned up. The anterior outline has a wide gulf under the fang and a boldly rounded prow, whilst the posterior outline is convex, and the base is considerably prolonged in this direction and abruptly finished. Curved striæ occur at the throat, longitudinal striæ in the body, and horizontal striæ in the base of the hook. The hooks form a single row. Accompanying each hook in this region is a paddle-shaped or flag-like bristle (Plate CXXVII, fig. 6 *e*), the wings and tip of which are membranous and translucent. The hooks in the middle and posterior regions likewise form a single row, and have almost the same structure as those above mentioned, except that the prolongation of the base posteriorly is less, and no paddle-shaped bristles occur. The posterior hooks, moreover, are considerably less (Plate CXXVII, fig. 6 *g*).

In a small specimen $\frac{4}{10}$ inch long only three rows of ventral hooks are present, so that the number increases with age. Six brown pigment-specks occur behind the branchiæ. The tube of this example is leathery and brownish, with minute mud-particles on its surface and clear granules here and there. Another young form was in a tube projecting from a mass of *Alcyonidium parasiticum* growing on *Sertularia rugosa* and Ascidians tossed on shore at St. Andrews.

A young example procured at the West Sands, after an October storm, measured

after preservation $\frac{8}{10}$ inch, and it had about sixty-six segments. The first two bristle-tufts are somewhat short, the third to the sixth are long, and these corresponded to the first region of the body; consequently only five pairs of dorsal hook-rows are present. The seventh pair of bristle-tufts is slender and small, so that the outline is narrowed, the adjoining tufts being longer. Toward the tip of the tail elongated, slender simple bristles occur as in the adult. The bristles correspond in arrangement and structure with those of the adult. The anterior hooks differ in having a shorter posterior basal process, but they are accompanied by the same paddle-shaped bristles. The anal segment is bilobed, and has a peculiar series of dark pigment-specks. Four pairs of setigerous processes bearing short bristles occur behind the last hooks, which are small and only three in number. The bristles increase in length at the sixth from the tip. The opaque glandular tissue splits at the termination of the rows of dorsal hooks at the second ring from the latter, since the first has a bar obliquely bevelled at the lower edge. The splitting continues to the tip of the tail and gives a regular arrangement to the parts. Both anteriorly and posteriorly the bristles commence before the hooks. Four pairs of bristles occur before hooks appear, the first hooks being between the fourth and fifth bristle-tufts, and their bases are undeveloped. The first five pairs of bristles are short, but the sixth are decidedly longer.

*Reproduction.*—Lo Bianco (1909) found that at Naples the rose-coloured ova were deposited in April. At St. Andrews ova occurred in the cœlom in October.

*Parasites.*—M. Sars found a parasitic Copepod on this form, viz. *Sabelliphilus elongatus.* The body is elongated, somewhat rounded, attenuated posteriorly, and has ten segments. In the female the head is fused with the first thoracic segment, but in the male it is separate. Rostrum bifurcate. First pair of antennæ with seven articulations, the first two in the female much dilated, in the male less dilated. A second pair of antennæ quadriarticulate, the terminal joint with three hooks and the penultimate with one hook. Maxillipedes triarticulate, terminal joint with a hook. First four limbs triarticulate, fifth rudimentary, simple, uniarticulate. Ovigerous sacs elongate, subcylindrical. The same parasite occurred in examples from St. Andrews and the West Coast of Ireland, and in both cases attached to the left edge of the branchiæ at the dorsal fissure.

*Habits.*—*S. penicillus* is fond of a muddy bottom at some depth. When sickly it leaves its tube, apparently for better aëration. It is most active at night, and is exceedingly shy and sensitive. The posterior end, like the anterior, can be regenerated. Thus in a large example (Plate CXX, fig. 5) the new segments form a conical appendix with a streaked purplish spot of pigment near the tip.

The *tube* may reach the length of 2 feet, and is fixed to stones on the bottom. The elasticity of the distal end closes the aperture, the rest of the tube being composed of secretion and mud, and so smoothly rounded as to resemble a tube of caoutchouc (Dalyell) of considerable firmness, and some are nearly $\frac{3}{8}$ inch in diameter. Many are coated with patches of, or entirely sheathed in, *Alcyonium digitatum*, so that the tube must stand more or less erect, and have free aëration. In connection with the muddy surroundings from which the animal forms its tube, further light is thrown on the azoic-mud theory of

the late distinguished Dr. W. B. Carpenter. As formerly indicated[1] this theory would not stand criticism. The lining of the tube is tough and well fitted for strengthening it. Orton[2] found that this species formed a tube 12·6 cm. long in less than thirty-one weeks, and at this age contained well-developed, but not quite ripe ova.

Ellis (1755) terms this form "Turkey feather," though parts of the description do not apply to the plate (33). He figures both tubes and animals in and out of the tubes. He further cites it as "Fungus auricularis."

It is probable that the *Serpula penicillus* of Linnæus (1758) refers to this species.

Pallas[3] (1766) gives a fairly good figure of this form under the title of *Serpula penicillus* in a vessel of sea-water. Moreover, his acquaintance with the literature of the subject is evident by his references to Rondeletius, Ellis and Baster.

In this and in many other instances O. F. Müller's (1799) figures of the animals are in advance of Delle Chiaje's in minute accuracy and general pose.

Dalyell (1853) records a series of interesting observations on the living animal in confinement in regard to the branchiæ, the tube-building organs, and their action with mud as well as regeneration of lost parts. He expresses wonder at the faculty by which the annelid communicates its purpose to one, ten or one hundred of its infinite parts whilst all the rest remain inactive. He secured young specimens with few branchiæ (six) and watched their increase and the enlargement of the tube, as well as the attachment of the end of the latter to glass or other bodies.

Pruvot (1885) demonstrates the massive condition of the great nerve-trunks as they leave the cephalic ganglia and the large size of the anterior commissures immediately behind the ganglion (Plate XV, figs. 12 and 13). The great trunks have neural canals. He notes and figures the chlorogogenous tissue around the ventral blood-vessel between the ganglia. He figures four cephalic ganglia—two small anterior median sending twigs to the tentacles (his antennæ) and two large ovoid lateral ganglia.

De St. Joseph (1894) gives an account of the variations in the number of the thoracic segments and the "sillon copragogue" (ventral groove), and he concludes that the differences are to be attributed only to the size of the animal or its age. He enters into a detailed account of its structure.

Cunningham[4] (1888) could find no connection between the neural canals and the cephalic ganglia. The canals reached the œsophageal commissure, and he found a single transverse connection between the canals in the first commissure, but no more. He noticed the coagulable substance (formerly described by the author)[5] in these canals.

Hornell (1891) describes a variety from Hillbre Island with unequal tufts of branchiæ, viz., sixty-one filaments on one side and thirty on the other, and as the form is a large one, the branchial fan being about 4 inches in diameter, the condition is conspicuous, and he imagines such may be mistaken for *Spirographis*.

[1] 'Ann. Nat. Hist.,' January, 1872.
[2] 'Journ. M. B. A.,' vol. x, p. 316, 1914.
[3] 'Misc. Zool.,' pl. x, fig. 1.
[4] 'Quart. Journ. Micr. Sc.,' vol. xxviii, p. 271.
[5] 'Proc. Roy. Soc. Edin.' 1876–77, p. 380.

A small variety (it may be a different form) was found by Roule[1] at a depth of 950 metres.

### *Genus* CLXII.—Potamilla, *Malmgren*, 1865.

Dorsal collar bilobed, the rim passing at each side ventrally to a notch, and the ends curve forward. Body as in *Sabella*. Ventral sulcus conspicuous, not continued dorsally in the anterior region. Setigerous processes commencing at the collar-segment. Bristles of two kinds, the longer having tapered tips, the shorter sub-spatulate with unequal wings. Hook-rows begin on the second segment, and the hooks are of two kinds, the one avicular, the other with a short shaft and spatulate tip. Only the avicular hooks posteriorly. Branchiæ forming a half-fan on each side connected at the base; no dorsal processes; occasionally eye-specks. Two short, compressed, tapering tentacles. Tube of a tough secretion with sand-grains and other foreign particles.

1. Potamilla reniformis, *Leuckart*, 1849. Plate CXIV, figs. 2—2 *b*—body; Plate CXXVIII, figs. 2—2 *f'*—bristles and hooks. Compare with Plates CXXVII, fig. 7, and CXXVIII, fig. 1—varieties.

*Specific Characters.*—Cephalic plate with a bilobed white collar dorsally; then the rim passes on each side to a ventral notch separating the ventral ends, which curve forward. The truncated cephalic surface has a projecting transverse fold at the upper end of the ventral incurvation, and two folds meet above it so as to make a triradiate aperture. Branchiæ comparatively short, about ten in each fan, the tips short, slender and filiform. Most of the filaments have two conspicuous and elevated brown or reddish-brown or dark violet ocular specks separated by an interval from each other.[2] Tentacles short, but the membranous web is like that of *S. penicillus*. Body comparatively small, about $\frac{3}{4}$ inch, and having 60—100 segments, but the southern examples are larger, De St. Joseph giving 12 cm. and 290 to 300 segments, of which 9—12 or more are anterior; rounded dorsally, flattened ventrally, where a groove at the tenth segment bends inward to the mid-ventral line and continues to the tail, which is tapered and ends in an anus with three papillæ and several violet pigment-specks. Anterior region of 12 segments (11 setigerous processes). Anterior setigerous processes bear two kinds of bristles, about three longer dorsal having straight shafts and tips with moderate wings bent backward, and a double series of spatulate forms with a short process at the tip. The posterior bristles have narrow wings and long tips. Anterior hooks with a finely serrated crown above the main fang, a ridge below the crown, a somewhat long, longitudinally striated neck and a long base. Each hook is accompanied by a short thick bristle with a spatulate tip. The posterior hooks are smaller, have a longer neck, a more pointed crown, and a shorter base, with a tendency to slope downward. Tube of a tough horny secretion of an olive

[1] Camp. "Caudan," p. 164.

[2] Carus, 'Fauna Medit.,' gives five to eight.

brown hue, the exposed parts covered with minute sand-particles, and one end elastic so as to close or roll up on the withdrawal of the annelid.

Synonyms.

1790. *Amphitrite reniformis,* Linnæus. Syst. Nat., ed. xiii (Gmelin), i, pt. vi, p. 3110.
1800. *Die nierenformige Amphitrite,* O. F. Müller. Naturges Wurm.-Arten., p. 194, Tab. xvi.
1806. *Amphitrite reniformis.* Turton's Linn., p. 82.
1815. *Spirographis* „ Oken. Lehrbuch, Bd. ii, p. 381.
1830. *Amphitrite* „ Bosc. Vers., vol. i (2nd Edit.), p. 199.
1839. „ „ Bruguière. Encyclop. Méthod., pl. lviii, figs. 18—20.
1843–53. „ „ Chenu. Illust. Conch., 11e livr., pl. vii, fig. 6.
1849. *Sabella* „ Leuckart. Archiv f. Naturges,, Bd. xv, p. 183, Tab. iii, figs. 8 A—8 F.
1855. „ *oculifera,* Leidy. Marine Invert. Rhode Island, Journ. Acad. Nat. Sc. Philad., p. 145, Tab. xi, figs. 55—61.
1856. „ *aspersa* and *oculata,* Kröyer. Oversigt Kgl. danske Vid.-selsk. Forh., pp. 19 and 22.
1861. „ *reniformis,* Sars. Forhandl. Vid.-selsk. Christ., p. 123.
„ „ *saxicola,* Grube. Ausflug Triest. u. Quarnero, p. 151.
1863. „ *stichophthalmus,* idem. Archiv f. Naturges., Bd. xxix, p. 62, Taf. vi, fig. 3.
1864. „ *saxicola,* idem. Insel. Lussin, p. 91.
„ „ *oculata,* idem. Ibid., p. 91.
1865. „ *reniformis,* De Quatrefages. Annel., t. ii, pp. 450, 666.
„ „ *saxicava,* idem. Ibid., p. 437, pl. xv, figs. 1—7.
1867. *Potamilla reniformis,* Malmgren. Annul. Polych., p. 114, Tab. xiii, fig. 77.
1868. *Sabella saxicava,* McIntosh. Ann. Nat. Hist., 4th ser., ii, p. 286, pl. xx, figs. 5—8.
1869. *Potamilla reniformis,* Grube. Mitt. St. Vaast, etc., p. 38.
1870. *Sabella saxicava,* idem. Arch. f. Naturges., p. 349.
1873. *Potamilla oculifera,* Verrill. Rep. U. S. Comm. F. & F., i, pp. 322 and 617, pl. xvii, fig. 86.
1875. „ *reniformis,* Marion and Bobretzky. Ann. Sc. nat., 6e sér., ii, p. 91, pl. xi, fig. 22.
„ „ *stichophthalmus,* idem. Ibid., p. 92, pl. xi, fig. 23.
„ *Sabella oculata, stichophthalmus* and *saxicola,* Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 532 (err. pro 232).
„ *Potamilla reniformis,* Marion. Rev. Sc. nat., t. iv, p. 470.
1879. „ „ idem. Ann. Sc. nat., 6e sér., viii, p. 26, pl. xvi, fig. 6.
„ „ *tortuosa,* Webster. Trans. Albany Instit., ix, p. 285.
1880. „ *reniformis,* Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 112.
1883. „ „ Levinsen. Vidensk. Meddels. Kjøbenh., pp. 187 and 285.
1884. „ „ Webster and Benedict. Rep. Comm. F. & F. U.S.A. for 1881, p. 736.
„ *Sabella* (*Potamilla*) *reniformis* var. *polyophthalmus,* Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxi, p. 266, Taf. xvi, fig. 28.
1885. „ *reniformis,* Carus. Fauna Medit., i, p. 271.
1887. *Potamilla* „ Webster. U. S. Comm. F. & F., p. 750.
1890. „ „ Marenzeller. Ann. K. K. Naturhist. Hofsmus., Bd. v, p. 2.
1891. „ „ Andrews. Journ. Morphol., v, pp. 271—279, pl. xx, figs. 1—14.
„ „ „ Watson. Nature, vol. xliv, p. 507.
1892. „ „ idem. Ibid., vol. xlvi, p. 7.
„ „ *neglecta,* Marenzeller. Zool. Jahr. Jena, Bd. v, p. 429.

1893. *Sabella reniformis,* Lo Bianco. Atti Acad. Sc. Nap., 2e sér., v, p. 67.
1894. *Potamilla* „ Bidenkap. Christ. Vid.-selsk. Forhandl., p. 136.
„ „ „ De St. Joseph. Ann. Sc. nat., 7e sér., xvii, p. 292, pl. xi, figs. 296—298.
1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 182.
1904. „ „ Journ. M. B. A., vol. vii, p. 231.
1905. *Pseudopotamilla reniformis,* Bush. Tubic. Annel. Pacific, p. 203, pls. xxxiii, xxxiv and xxxvii.
1906. *Potamilla reniformis,* De St. Joseph. Ann. Sc. nat., 9e ser., t. iii, p. 241.
1907. „ „ Soulier. Trav. Acad. Sc. Montpel., 2e sér., t. iii, p. 121.
1908. *Pseudopotamilla reniformis,* Moore. Proc. Acad. Nat. Sc. Philad., p. 359.
„ *Potamilla neglecta,* Ehlers. Deutsch. Tiefsee Exped., p. 154, Taf. xxii, figs. 5—17.
1909. „ *reniformis,* Fauvel. Bull. Inst. Oceanogr., cxlii, p. 42.
„ ? „ *neglecta,* Moore. Proc. U.S. Nat. Mus., vol. xxxvii, p. 145.
„ „ *reniformis,* Fauvel. Ann. Sc. nat., 9e sér., t. x, p. 210.
1910. „ „ Elwes. Journ. M. B. A., vol. ix, p. 65.
1911. „ „ Fauvel. Bull. Inst. Oceanogr., cxciv, p. 37.
„ „ „ Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 65.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 138.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 314.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 642.
„ „ „ Southern. Irish Sc. Invest., No. 3, p. 49.
1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 7.
1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 63.

*Habitat.*—Procured at extreme low water in fissures of rocks at Guernsey and Herm; also dredged in grooves in *Pecten,* and in tunnels in oysters; in swarms in the Gouliot Caves, Sark, where their tubes project from almost every chink, and occasionally they are in groups, besides perforating the *Balani* on the floor and ledges. It spreads its tubes through sponges and ascidians, bores the masses of *Cellepora* and various shells such as limpets; tubes from Connemara (A. G. Moore) were crowded with the tubes of a sessile-eyed crustacean. Plymouth (Allen); Torquay (Ehlers); West Coast of Ireland, Blacksod Bay, etc. (Southern).

*Distribution.*—The distribution of this form is wide, viz. from the Arctic Seas to the Mediterranean; Norway (Sars); Behring's Sea (Marenzeller); Finmark (Norman); Iceland (Leuckart); Greenland and Finmark (Malmgren); shores of Cantabria (Rioja); St. Lawrence, Canada (W. C. M.); Atlantic Coast, North America (Leidy and Verrill).

North Pacific Coast of North America (Moore); shores of France (De Quatrefages, De St. Joseph, Fauvel); Mediterranean and Adriatic (Grube, Panceri, Marion and Bobretzky); Madeira and Teneriffe (Langerhans, Fauvel); Naples at considerable depth (Lo Bianco).

The *cephalic plate,* when the branchiæ are shed, presents dorsally a bilobed collar or lamella, the deep dorsal furrow terminating in the centre. The outer edge of each flap is continued as a broad rim nearly to the mid-ventral line, where a notch separates the two sides, which curve forward. The truncated surface has a projecting transverse fold at the upper end of the ventral incurvation, and two folds meet above it so as to make a triradiate aperture.

The branchiæ are about ten or eleven (twelve to fifteen, De St. Joseph, Leuckart)

in number on each side and comparatively short, whilst the pinnæ are long. Each filament has the transversely barred or camerated chordoid axis, and tapers to a short filiform tip, which, however, is usually enveloped by the long pinnæ or is in screw-like coils. The pinnæ have the translucent axis as in *S. penicillus* with long joints, and are richly ciliated. In life the branchiæ are of a pale green marked with white touches, so that they form a whitish ring around the collar, within which they are attached. The pinnæ are variegated with pale greenish and white and show vermiform movements when cast off. In some the branchiæ are of a pale buff hue with a little yellow at the tips of the filaments. In contraction they are generally of a dull stone colour. Leuckart's examples had whitish branchiæ with brownish touches, and De St. Joseph describes his examples as vinous-brown. Sars states that his specimens had yellowish-white branchiæ with four or five orange bands. Just above the whitish ring at the base most of the filaments have externally two boldly marked and elevated brown or reddish-brown ocular specks separated by an interval from each other. De St. Joseph states that in his specimens each contained about thirty ovoid "crystallins" in a mass of brownish pigment. Moreover, the eyes of those from the Mediterranean are more numerous than those from the north, whilst Marion considered that those from deep water had fewer eyes than the littoral forms. They are absent in a few of the filaments. The longest filaments are dorsal, those at the ventral edge being considerably shorter and slightly reflexed. The ocular pigment in some fades in spirit. The tentacle is comparatively short, but its membranous web on each side appears to agree with that in *Sabella penicillus*.

The branchiæ of this species are more translucent and feathery than those of *P. Torelli*, the pinnæ more delicate and longer, and the coloration of the two forms diverges. The terminal processes of the branchiæ are short, whereas those of *P. Torelli* are long and opaque whitish. In an example of *P. reniformis* the bases of the branchiæ were reddish brown with a pale band, whilst the rest of the filaments were pale. In *P. Torelli* the branchiæ are boldly blotched with brownish red and white and the long terminal filament is opaque white. The ocelli in *P. reniformis* are also diagnostic, and in some they are confined to the base of the filament. The white specks on the body of *P. Torelli* also differentiate.

The *body* is comparatively small, about three-quarters of an inch in length, and has from sixty to a hundred segments. It is rounded dorsally, slightly flattened ventrally, and marked by a groove, which at the tenth segment bends from the side inward to the middle line and divides all the scutes which follow into two. The ten scutes in front of these are split transversely. The ventral scutes are conspicuous by their whitish or pinkish colour, and are even visible through certain parts of the tube. Anteriorly the brownish dorsum is marked with dark brown pigment at the bases of eleven setigerous processes, the succeeding region of the dorsum being reddish brown. The surface is paler in the median line dorsally and ventrally. The body is slightly tapered posteriorly, and ends in a papillose anus, three papillæ being distinct, and the colour of the tip is orange rather than brown.

An interesting variety was procured by Arnold Watson at Llanfairfechan, Wales, in which the anterior region consisted of no less than twenty-six segments, the first eight

bristle-tufts, perhaps, being more conspicuous than those which followed. The ventral groove turned to the right behind the twenty-fifth scute. The two kinds of bristles, viz., those with winged, tapered tips and those with broad paddle-tips, are present throughout the series, though best developed in the first eight. The hooks and their attendant short penniform or beaked bristles occur throughout the entire anterior region. The branchiæ have the usual structure and their ocelli remain in the preparation. This example demonstrates the wide range of segments in the anterior region of Sabellids, as, indeed, various figures of previous authors show; thus Chenu[1] gives one with eleven pairs of thoracic bristles.

The setigerous processes are ranged along the lateral regions from the second segment backward, a differentiation occurring anteriorly by the inflection of the groove which often passes behind the tenth bristle-tuft to the mid-ventral line, though in others it is further back. Each of the setigerous processes anteriorly has dorsally three longer bristles with straight shafts, tips bent backward and moderate wings (Plate CXXVIII, fig. 2). The edges of the wings appear to be minutely serrated. Following these is a double series of comparatively stout bristles with short and broad wings, making a spatulate tip with a filament in the centre (Plate CXXVIII, figs. 2 *a* and 2 *b*). These bristles also have a dorsal curve, the filament trending in that direction, so that they would brush an opposing structure with the convex surface. From the nature of the parts the shafts are somewhat abruptly tapered at the tip. Some of the bristles have modified tips so that they resemble a short and broad knife-blade, as in certain forms in *Chætopterus*, the shaft not being continued along the centre as in the ordinary winged types.

In the posterior segments the bristles alter, being shorter, fewer in number, and with modified (geniculate) tips (Plate CXXVIII, fig. 2 *c*) which have moderately wide wings at the base, but they soon diminish, and the long central tapering tip projects far beyond them, thus performing the functions of the simple bristles of this region in other forms.

The anterior rows of hooks are below the setigerous processes, and consist of a long series of the avicular forms (Plate CXXVIII, fig. 2 *e*) with serrated crowns sloping to the sharp main fang, a rather long, slightly striated neck with straight sides, the anterior outline curving forward into the rounded prow and the posterior into the well-marked basal process. Accompanying each is a bristle (Plate CXXVIII, fig. 2 *d*), the shaft of which has a curvature toward the distal end, and the tip has a region with short wings so modified as to resemble a hook with a long shaft and a main fang.[2] Two forms of accompanying bristles thus are present in this species, viz., those with broadly spatulate tips, and those with a slightly enlarged posterior crown and a beak-like point anteriorly nearly at right angles to the shaft. In a small example from Perelle Bay the latter was large and with distinct wings (as in fig. 2 *d*). The book has a larger space between the main fang and the prow than in *Sabella penicillus*.

The hooks behind the foregoing region are above the setigerous processes, and they become fewer and fewer as well as smaller, and with a longer base in their progress toward the tail (Plate CXXVIII, figs. 2 *f*, 2 *f*[1]).

[1] 'Illust. Conch.,' 11e livr., pl. vii, fig. 6.

[2] So far as can be seen at present certain specimens do not have the very broad paddle-like bristles, though their hooks cannot be differentiated from those which have these broad bristles.

The *tube* is a tough horny secretion of an olive-brown hue, and the exposed parts are covered with minute sand-particles, whereas the sheltered portions are hyaline and more delicate. In withdrawing its branchiæ it not only rolls the filaments together, but the elastic anterior end of the tube doubles over or is rolled into a coil (Plate CXIX, figs. 11 and 11 *a*). In the Gouliot Caves of Sark the tubes occur in numbers under the coating of *Balani* so abundant there, and their devious windings are characteristic.

*Habits.*—It bores a hole through as well as passes along between the layers of *Balani* and lines the interior with its tough secretion. It further invades the cracks and fissures of the rocks near low water-mark. It is also partial to bivalves of various kinds, such as *Pecten pusio*, and pierces masses of *Cellepora*, besides either piercing ascidians and sponges or being coated with them. In the same oyster-shells are found the boring sponge and the boring mollusk *Gastrochœna*. The perforations in the calcareous masses are circular, and though more or less curved and coiled, are not to be confounded with those of *Dodecaceria* and *Polydora*. Large ascidians also surround the tube, but probably they were developed round it instead of being perforated. No trace of acidity is found in the body except at the tip of the tail, where a distinct acid reaction occurs, but whether this is connected with tube-formation or boring is unknown.

It is possible that the *Amphitrite* Flächerförmige (Nierenförmige) of F. H. W. Martini[1] refers to this species. His A. Besenförmige (Pinsel des Kolumnus of Naples) is less easily discriminated.

R. Wagner[2] (1832) gives the synonymy of this species from Nizza as *Sabella ventilabrum*, and describes the alimentary canal as having two sacs in front, probably referring to the anterior nephridia or "muciparous" glands. He likewise shows a portion of the ventral ganglionic chain with its lateral branches and commissures.

Sars (1861) found in the northern forms six or seven bristles with longer tips in the anterior tufts instead of the three usually present in the British examples, and in the same way a larger number of spatulate forms (twelve to twenty), whilst posteriorly the number was ten to sixteen. He gives the number of branchial filaments as ten to fourteen pairs, their length as one-sixth that of the body, and with purple ocular points five to eleven in number distributed on the dorsal base of the filaments. He states that the collar has a lateral as well as a dorsal and ventral fissure—"lateraliter profunde incisum seu bilobum." This differs from the condition in the British forms. His examples ranged from $1\frac{1}{2}$ to 2 inches in length, and they frequented water 10 to 30 fathoms in depth amongst *Nullipores*, *Balani* and *Pecten Islandicus*.

Leuckart (1849) was the first to recognise that Müller's "nierenförmigen Amphitrite" was probably distinct from *Sabella penicillus*, when examining three examples from Iceland, and he gave a careful account with figures which show that

---

The broadly spatulate belong to the typical form, and no eyes are present. Those with narrower wings come from Berehaven, Ireland, and show no eyes. Other varieties are AB from Herm, and W from Guernsey. *Potamilla Torelli* has rather broad wings to its spatulate bristles, and may yet be linked on to this form.

[1] 'Allg. Geschichte der Natur,' vol. ii, 1775, p. 483, Taf. lv, fig. 3.

[2] 'Isis,' 1832, p. 655, Taf. x.

his interpretation was warranted. He noticed the peculiar curved spatulate bristles in the anterior hook-rows.

The *Sabella stichophthalmus* of Grube[1] (1863) does not seem to differ materially from a variety of this species, though the author's figure of the first bristles must have led to misinterpretations. He represents them as long, blunt hooks, and it was left to Marion and Bobretsky[2] (1875) to give a more satisfactory representation and description, and thus to connect it with the present form.

Langerhans (1884) found a large variety bearing from seven to ten eyes on its filaments amongst old coral at Madeira.

*Reproduction.*—De St. Joseph (1894) states that the eggs are greyish. He thought the *Potamilla tortuosa* of Webster, which makes its galleries in shells, very similar to *P. reniformis*, and he found small examples of the latter species with the cephalic region in process of reproduction. This author[3] (1906) mentions that it occurs in *Oculina*, and he thinks it approaches the condition of a commensal like *Aspidosiphon* (a Gephyrean) which frequents Madrepores.

Arnold Watson's observations on regeneration were conducted on a form which he thought distinct from *P. reniformis*, *P. Torelli* and *Potamis*, as no eye-specks occurred on the branchial filaments, though just below the base of these on each side there are eye-spots as in *P. reniformis* and other Sabellids. He counted twenty-two filaments in one and twenty-four in another. The diameter of the detached plumes was 18—19 mm. He called it the blushing Sabella, as its blood was red. The tube is peculiarly rugged —constricted at the entrance to the burrow in the rock. An examination of this form, kindly sent by Mr. Watson, shows that it appears to be a variety of *Potamilla reniformis*.

A variety (AB) occurred under stones between tide-marks both in Guernsey and Herm with only five pairs of anterior bristles, and shows certain differences from both *Potamilla reniformis* and *P. Torelli*. The cephalic plate of var. AB has a narrower collar than in *P. reniformis*—a feature well marked in the small, pointed ventral lobes. The edge is smooth at and near the mid-dorsal groove, then at each side is a lateral flap which trends to the lamellæ on the ventral surface. These lamellæ are smaller than in *Sabella penicillus*, and besides the small lamellæ which project ventrally their margin is incurved at the middle line.

The body is comparatively small, about $\frac{3}{4}$ inch in length, and the number of segments is between sixty and seventy. It is rounded dorsally with the exception of the region of the dorsal groove anteriorly, slightly flattened ventrally, where a median furrow runs from the middle of the sixth scute backward to the tail. The anterior region is composed of five bristled segments and apparently the same number of uncinigerous rows. Posteriorly it tapers to a somewhat pointed tail. The branchiæ seem to be comparatively short, like those of *Potamilla reniformis*, and the pinnæ of moderate length or rather short, whilst the terminal filament is long, large, and is often in screw-coils, thus differing essentially from those of *P. reniformis*, *P. Torelli* and *P. neglecta*, and resembling

[1] 'Archiv f. Naturges,' p. 62, pl. vi, fig. 3.
[2] 'Ann. Sc. Nat.,' 6$^{e}$ sér., t. ii, p. 92, pl. xi, fig. 23.
[3] 'Ann. Sc. nat.,' 9$^{e}$ sér., t. iii, p. 241.

apparently those of *Spirobranchus*. Moreover, there are no ocelli on the filaments, and none on the first segment or on the tail.

The first region of the body has only five pairs of setigerous processes. Each bears a tuft of comparatively short bristles, the tips of which, unfortunately, had for the most part disappeared, probably from their brittle nature as well as from rough usage. Those which are perfect have shafts which slightly dilate from the base to rather beyond the middle, then diminish at the neck and swell out at the origin of the wings, tapering thereafter to a somewhat long attenuate extremity. At the upper edge of the fascicle are the longer and more slender forms, the shafts of the others being thicker. Spatulate forms also occur as in the type. The anterior hooks (Plate CXXVIII, fig. 1 *b*) form a single row, and present a sharp main fang, the rest of the anterior face of the crown above it (about half the extent) being finely serrated in lateral view, as usual in such hooks. When the crown is examined from the front this region is densely spinous. The posterior outline is more or less straight below the forward bend at the crown, whilst the anterior is also straight immediately below the main fang, curved forward over the rounded prow. The projection of the base posteriorly is narrow, but somewhat shorter than in *Potamilla reniformis*. Each is accompanied by a short, broad, cuspidate or penniform bristle. The hooks behind the anterior region in the fragmentary example do not materially differ, though the neck is longer, the base somewhat shorter and their size less (Plate CXXVIII, fig. 1 *c*).

The small number of the anterior segments, so unusual in the group, though this number has been found in *P. Torelli*, raises the question as to its relationship to the latter, from which it differs in the terminal processes of the branchiæ and in the narrower web in the anterior bristles, but further investigations may clear up the divergences. Like many Sabellids it is acid to litmus paper. In the example from St. Peter Port, Guernsey, the tube is composed of a translucent, horny secretion somewhat like that of *Potamilla reniformis*. Some examples have nearly ripe ova (July and August).

Amongst the forms which show similar hooks anteriorly are the various species of *Eudistylia*, Bush, *Schizobranchia*, Bush, *Parasabella*, Bush, *Pseudopotamilla*, Leidy, and it is possible that further examination may lead to the diminution both of genera and species.

Potamilla Torelli, *Malmgren*, 1865. Plate CXIV, fig. 3—body; Plate CXX, figs. 7 and 7 *a*—branchiæ; Plate CXXVIII, figs. 3—3 *d*—bristles and hooks.

*Specific Characters.*—Cephalic plate and collar as in *P. reniformis*, the collar having a narrow slit dorsally, then extends to the ventral lamellæ, which are usually reflected in protrusion and separated from each other by a deep V-shaped notch. Branchial filaments of moderate length and pale, eight to sixteen in number, and each ends in a short, thick, distal process. Pinnæ of average length, the distal ten or twelve gradually diminishing, to end in a papilla-like rudiment at the base of the terminal process. Oral fold passes from each side of the ventral lamella upward, and its end fuses with the middle of each branchial fan. A considerable portion of the dorsal edge of the base of the branchiæ bordered by a mobile flap, the ventral edge adjoining the mouth. The branchiæ are

tinted with brownish and grey pigment. Body small, about 1 inch in length (Plymouth), grooved anteriorly on the dorsum, flattened ventrally, and with the median groove behind the five to eight anterior segments. The posterior region has from thirty to fifty or more segments, and ends in an anus often with a lateral projection on each side. Colour brownish with large spots of white.

The anterior bristles are in two groups, viz. an upper series with longer shafts and tapered winged tips, and an inferior group of spatulate forms with a filiform process at the tip. The bristles of the posterior region have comparatively broad wings and finely tapered tips, those near the tail being extremely attenuated. Anterior hooks with a moderately long base, a sharp main fang with a series of minute teeth above it. They are accompanied by the short (pennon-like) bristles with the spatulate tips (hook-like). The posterior hooks are smaller and have a shorter base. Scissiparous (Caullery and Mesnil).

Synonyms.

1851. *Sabella neglecta*, Sars. Nyt Mag., vi, p. 132.
1863. „ *fragilis*, Grube. Archiv f. Naturges., Bd. xxix, p. 61, Taf. vi, fig. 6.
1865. *Potamilla Torelli*, Malmgren. Nord. Hafs.-Annul., p. 402.
1867. „ „ idem. Annul. Polych., p. 222, Tab. xiv, fig. 76.
1880. *Sabella (Potamilla) Torelli*, Langerhans. Zeitschr. f. wiss. Zool., xxxiv, p. 112, pl. v, fig. 26.
1881. „ „ *breviberbis*, idem. Nova Acta Leop. Carol. Akad. Naturf., xlii, p. 118, fig. 27.
1883. „ *fragilis*, Levinsen. Vidensk. Meddel., p. 187.
1884. *Potamilla incerta*, Langerhans. Zeitschr. f. wiss. Zool., xl, p. 267, pl. xvi, fig. 29.
1885. „ *Torelli*, McIntosh. Annel. "Challenger," p. 484, pl. liii, fig. 2, and pl. xxix, figs. 16—19.
„ „ „ Marenzeller. Denks. k. Akad. wiss. Wien, xlix, p. 210, Taf. iii, fig. 1.
„ „ „ Carus. Fauna Medit., i, p. 272.
1892. *Sabella neglecta*, Marenzeller. Zool. Jahrb., Bd. vi, p. 429.
1893. *Potamilla Torelli*, Lo Bianco. Atti R. Accad. Sc. Nap., 2nd ser., vol. v, No. 11, p. 71.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 296, pl. xi, figs. 299—302.
1901. „ „ Whiteaves. Mar. Invert. E. Canada, p. 72.
1904. „ „ Journ. M. B. A., vol. vii, p. 231.
1906. „ „ Treadwell. U.S. Comm. F. & F., p. 1178.
1908. „ „ Ehlers. Deutsch. Tiefsee Exped., p. 156.
1909. „ „ Fauvel. Bull. Inst. Oceanogr., cxlii, p. 42.
1910. „ „ Elwes. Journ. M. B. A., vol. ix, p. 65.
1911. „ „ Mesnil and Caullery. Bull. Sc. Fr. et Belg., 7e sér., t. xlv, p. 89, pls. v and vi.
1913. „ „ Ehlers. Deut. Südpol. Exped., p. 575.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 139.
„ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 314.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 642.
„ „ „ Southern. Irish Sc. Invest., No. 3, p. 49.
1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 11.
„ „ „ (young of *P. torelli*), idem. Ibid., ser. 8, vol. xvi, p. 15.
1917. „ „ Rioja. Annél. Poliq. Cantáb., p. 65.

*Habitat.*—Plymouth and as *P. incerta* (Allen); Torquay, in limestone rocks (Elwes); West Coast of Ireland (Southern).

The distribution is wide:—Cape Agulhas and Antarctic Seas (Ehlers); Iceland (Malmgren); Canary and Madeira, young as *P. incerta* (Langerhans); Southern Japan (Marenzeller); amidst *Cynthia glomerata* and the tubes of *Pomatoceros triqueter;* and smaller forms also dredged on oyster shells at Dinard (De St. Joseph); Canada (dredged by Whiteaves); shores of France and Monaco (Fauvel); Hawaiian Islands (Treadwell).

The general aspect of the *cephalic plate* when the branchiæ are removed agrees with that of its allies, and in the preserved examples some have a prominent T-shaped projection formed by the developing bases of the branchiæ—a condition not observed in other forms. The collar has a narrow slit dorsally, then it extends on each side laterally and ventrally with an even edge to the ventral somewhat triangular lamellæ, which are reflected in protrusion, and which are separated from each other by a deep V-shaped notch. No eyes are visible in the spirit-preparations from Britain or from Canada. In the young forms the pinnæ develop as papillæ and the terminal filament appears to be slightly webbed—that is, has a thin border at each side. Moreover in some young examples the terminal process is moniliform—it may be from diminished vitality.

The branchial filaments are of moderate length and are opaque white in life, pale in the preparations. The structure of each filament is typical, and it ends in a short, thick process distally. The pinnæ are of average length, and it is only at the tip of the organ that shorter forms occur, the last ten or twelve gradually diminishing to end in a short papilla-like rudiment at the base of the distal process. The number of the filaments appears to be from twelve to fourteen in each fan.[1]

When the oral region is in a state of expansion a fold passes on each side from the ventral lamellæ upward and its end fuses with the middle of each branchial fan, and indeed appears to be the only representative of the tentacle of other forms. Malmgren states that it is very short, broad and sub-circular. This fold is quite separate from the ventral edge of the basal tissue of the branchiæ. On the other hand, a considerable portion of each dorsal edge of the base of the branchiæ is bordered by a free and mobile flap—the ventral edge adjoining the mouth.

The *body* (Plate CXIV, fig. 3) is of small size in the examples from Plymouth, viz. about an inch in length and of the thickness of stout thread, whereas in the Canadian forms it is between 2 and 3 inches long and as thick as a crow-quill. De St. Joseph also found large examples at Rocher-Vidé. It is grooved dorsally in the anterior region, rounded posteriorly, whereas the ventral surface is more or less flattened and marked by the median groove from the anterior region backward. The first region has a variable number of segments, viz. from five to eight (Langerhans—seven to nine). The posterior region has from thirty to fifty. Toward the tail it is flattened and tapered to end in the anus, which often presents a lateral projection. De St. Joseph describes the body as brownish with large spots of white. The first segment has two oval eye-spots (Langerhans). Fauvel[2] describes anal eyes, which are absent in the preserved examples from Plymouth.[3] The first bristle-bundle consists of simple bristles with moderately tapered tips and distinct

[1] Langerhans (1884) notes that the branchiæ (as in other Sabellids) are regenerated.

[2] 'Campag Sc.,' p. 315.

[3] Both are seen in small specimens kindly sent by Major Elwes from Babbacombe.

wings. The others in this region have two groups—an upper with longer shafts, more tapered and slightly curved tips with narrow wings (Plate CXXVIII, fig. 3), and a dense lower group of spatulate forms (Plate CXXVIII, fig. 3 *a*) with a process at the tip. The bristles of the middle region form the usual bristle-pillar of rather short bristles with striated shafts, comparatively broad striated wings and very finely tapered tips, two series, a longer and a shorter, being conspicuous. The shaft has a distinct curvature at the junction with the tip. The posterior bristles are fewer in number, and have wings distinctly striated and very attenuate tips (Plate CXXVIII, fig. 3 *b*). In glancing at small preserved specimens, it is found that most have the posterior bristles directed forward, and in several the anterior have the same direction. In the larger forms the anterior bristles are often directed upward, outward and slightly backward. The anterior hooks, which occur on all the anterior segments except the first, are avicular (Plate CXXVIII, fig. 3 *c*), with a sharp main fang and above it a series of minute teeth on the crown (Langerhans shows about twenty-four) and a moderately long base. Striæ pass from the neck to the base, after curving round the prow. These hooks are accompanied by the short bristles with the spatulate tips. The posterior hooks differ only in their smaller size and the brevity of the base. In comparing the larger with the smaller forms from Plymouth, the essential characters of the bristles and hooks are as well shown by the smaller as the larger. The tube is composed of a tough internal lining coated with fine sand-grains, the whole being firm and resistant—especially in the Canadian examples. In the spirit-preparations it often happens that the annelid can only be removed from its tube by the rupture of the tissues. Lo Bianco mentions the occurrence of a colony of *Balani* and of *Cellepora* on the tube, and that occasionally the annelid lives in a sponge (*Hircinia*) at considerable depth off Naples.

*Reproduction.*—Specimens from Port Erin in the second week of September had large and apparently nearly ripe ova. The great numbers of this species and of all sizes on certain sites is noteworthy.

The *Sabella neglecta* of Sars[1] appears to be a closely allied if not identical form. It is devoid of tentacles and the tips of the branchial filaments are short.

Arnold Watson[2] (1906) gives an account of a rock-boring *Potamilla*, probably *P. Torelli*, at Tenby, which reproduced both anterior and posterior ends, and which, he states, formed the anterior region by the addition of one segment only, the adjoining "abdominal" region having its bristles and hooks reversed to suit the normal condition of the parts.

Treadwell[3] mentions the occurrence of paired eyes just behind the tip of the branchiæ in an example from Honolulu. Such has not been observed in British waters.

Mesnil and Caullery (1911) give an interesting account of remarkable Protozoan parasites (*Haplosporidium potamilla* and *levine*) which they found in the tissues of this species, and which they could not readily compare with anything known. The parasites displaced the alimentary canal in the infected segments. The memoir is illustrated by excellent text-figures and plates. The same authors[4] have recently (1920) recorded the

[1] 'Reise Lofot. og Finm.,' p. 83, and 'Christ. Selsk. Forhandl.,' p. 31 (sep. copy).

[2] 'Proceed. Roy. Soc.,' vol. lxxvii, p. 332, 4 text-figs.

[3] 'U.S. Comm. F. & F.,' 1906, p. 1178.

[4] 'Comp. Rend. Paris,' October, 1920, p. 683.

occurrence of scissiparity in this species in so far as they found in the tubes adults with regenerating posterior extremities, whilst beside them were smaller forms of twenty-eight to thirty-five segments, corresponding to the original tails, and with developing branchiæ. They concluded, therefore, that the species was scissiparous.

*Potamilla incerta*, Langerhans, which Dr. Allen procured by the dredge on Yealm ground, Plymouth, seems to be the young of *Potamilla Torelli*, and in this Prof. Fauvel agrees. Indeed, it is difficult to find satisfactory distinctions between *Potamilla reniformis* and *P. Torelli*, for the absence of ocular points on the branchial filaments may not be of capital importance. *P. incerta* has five thoracic segments.

3. Sabella B.C. Plate CXX, fig. 6—ventral view of anterior region; Plate CXXVIII, figs. 1—1 *c*—bristles and hooks.

*Specific Characters.*—After removal of the branchiæ the cephalic region presents no deep dorsal fissure. Collar commences as a narrow process on each side of the dorsal furrow, slopes obliquely forward and outward and incurves laterally and ventrally into a deep though thin lamella, which attains its maximum in the mid-ventral line, where it is separated from its fellow by a fissure. Branchiæ reddish brown in spirit, about eleven filaments on each side, connected only at the base; pinnæ short; a terminal strap-shaped process. Body distinctly segmented; segments fifty-six or more. Ventral surface with scutes throughout. Five or six bristled segments anteriorly, the hook-rows being one less in each case. Bristles with straight shafts, finely tapered tips and narrow wings, dorsally and ventrally with spatulate tips, the outline of the wings being more or less elliptical. Posteriorly the bristles form a tulip-like fascicle. Anterior hooks with a main fang and a series of serrations above it, a boldly convex prow, and an oblique, tapered base. A series of modified (beak-like) bristles accompany them. Posteriorly the hooks are smaller, their necks longer and the bases more oblique.

Tubes of secretion with a few grains of sand attached.

It appears to be a variety of *Potamilla Torelli*, though presenting certain features of its own.

Synonym.

1916. *Sabella B.C.*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 13.

*Habitat.*—Procured at Berehaven in numbers by the Royal Irish Academy's Expedition, 1886. When the branchiæ are absent the cephalic region presents no deep fissure as in ordinary Sabellids, but the slight dorsal furrow ends in a solid mass, which, with an incurvation in the middle, passes from side to side, and then bounds the region laterally to the ventral surface. This rim forms a projecting base to the branchiæ. The collar commences as a narrow process on each side of the dorsal furrow, slopes obliquely forward and outward, and inclines laterally and ventrally into a deep though thin lamella, which attains its maximum in the mid-ventral line, where it is separated from its fellow by a fissure. The branchiæ preserve much of their reddish-brown coloration in spirit, and they are of considerable length. The pigment is arranged on the pinnæ so as to

make a series of circular bands, as in *S. penicillus* and other forms, thus conferring great beauty on the expanded organs. In some cases when mounted the reddish-brown pigment is in isolated masses at intervals along the filament and patches occur on the terminal process. There are about 11 filaments on each side springing from the central region of the cephalic plate, a basal fissure, most distinct ventrally, occurring dorsally and ventrally. They are connected only at the base and free throughout the rest of their extent, and are long tapering organs with proportionally short pinnæ, which as they reach the tip gradually diminish in length, and end in a series of short papillæ at the base of the terminal strap-shaped tapering process. The chordoid skeleton is continued along the centre of the flattened tip, and into each pinna. In young forms the pinnæ are short, but the flattened terminal strap is well developed.

The *body* is comparatively small, elongated, and distinctly segmented throughout—a feature characteristic of the species. Segments fifty-six, but the tail in the majority of the examples was in process of reproduction, so that the actual number of segments must exceed the figure mentioned. The body is widest in front and gradually tapers behind the middle to the posterior end, where the rounded anus is terminal. The dorsal surface is more or less rounded, the ventral flattened and marked by the scutes from end to end. A slight depression occurs in the mid-dorsal line anteriorly, and continuing to the right behind the sixth bristle tuft it crosses the seventh segment obliquely to the middle line at its posterior border, whence it passes to the tip of the tail, cutting the ventral scutes into two in each segment. Six bristled segments are present in the anterior region and five uncinigerous rows, but occasionally only five and four occur respectively. Other variations, apparently arising from lost parts in process of reproduction, show the ventral furrow running to the front, or a diminished number of anterior ventral scutes. Moreover, the two anterior scutes may be split by a furrow quite independently of the main ventral furrow. The first setigerous process is situated behind the collar, and is inconspicuous. It has a small tuft of simple bristles with acutely tapered tips and narrow wings as in the dorsal group of the anterior region. The bristles of the succeeding segments of the anterior region (five in number) have dorsally translucent bristles with straight shafts and finely tapered tips and narrow wings, the upper having longer and more delicate tips, and ventrally narrow, spatulate forms (Plate CXXVIII, fig. 1 *a*), the outline of the wings being more or less a long ellipse, the tapering shaft being continued as a fine process distally. Moreover, those with broader tips form a shorter row than those with more elongated tips. The outline of the tip of the latter bristles thus essentially differs from that in *Potamilla reniformis* and also from those of *P. Torelli*. In the posterior region the bristles form a tulip-like fascicle with a knee or curvature on each bristle toward the end of the shaft, the convexity with the wings being external. Those with the longest and most delicate tips (Plate CXXVIII, fig. 1) are dorsal, those with slightly broader wings (fig. 1′) are ventral, and the former are most conspicuous near the tip of the tail. In the anterior region five uncinigerous rows lie to the ventral edge of the setigerous processes, their inner ends impinging on the scutes opposite them. The first commences opposite the second bristle-tuft, and all are longer than those of the posterior region. The hooks (Plate CXXVIII, fig. 1 *b*) are in a single row with a main fang and a series of serrations above it, a neck of moderate length, with striæ where it enlarges into the boldly

convex prow, and an oblique, tapered base (corresponding to the shaft). Moreover, a series of short, modified bristles occur with them, the tips being short, bent at an angle and with broad wings, the whole resembling a beak. The curved shafts dilate from the base to the neck, where a slight constriction occurs; then it bends forward and tapers to the short tip. In some views slight grooves appear on the enlarged basal part of the tip, so that they at first sight resemble the long hooks of *Terebellides* and other forms. The posterior hooks (Plate CXXVIII, fig. 1 *c*) are smaller, their necks longer, and the bases more oblique.

*Tube.*—Some are in tubes of tough secretion with a few fine sand-grains attached, after the manner of the Canadian examples of *P. Torelli*.

Amongst the masses of the foregoing *Sabella B.C.* from Berehaven are a few characterised by the striking madder-brown pigment-spots on the branchiæ, and without the general arrangement of the pigment characteristic of the former Sabellid B.C. Yet in the disposition of the cephalic collar the two forms appear to be identical. It is true some of them show seven anterior segments with bristles, but others have the normal number, and some which apparently have lost the cephalic plate and other parts have fewer. Injury or abnormality also would explain the occurrence of the median ventral furrow from the first scute backward. The anterior hooks and their accompanying bristles and the posterior hooks are identical.

*Genus* CLXIII.—LAONOME, *Malmgren*, 1865.

Cephalic region with the collar slightly developed, and a wide dorsal fissure which increases from behind forward, the margins being slightly reflexed, whilst the edges of the ventral fissure are carried a little further forward and the one overlapping the other. Branchiæ forming a semicircle on each side, not elongated; filaments with slender tapering free extremities, and bearing ocular spots. Tentacles comparatively short, broad at the base, tapered to a blunt point. Body elongated, little tapered anteriorly, more so posteriorly, rounded, with the anus terminal. Ventral scutes broad in front, forming a narrow belt posteriorly divided by a median groove. Dorsal groove turns to the left and joins it. Setigerous lobes from the second segment, bearing long, tapering winged bristles and paddle-shaped forms, posteriorly bristles with broad wings and finely tapered tips. Hooks commence at the second segment, are avicular throughout, but the basal region posteriorly shows only a rudiment in the anterior bristles, and is absent in the posterior. Tube of secretion and mud. This genus extends to the Antarctic Seas.

1. LAONOME KRÖYERI, *Malmgren*, 1865. Plate CXXIX, figs. 3—3 *e*—branchia, bristles and hooks.

*Specific Characters.*—Cephalic region with a short collar widely split dorsally, the sides of the ventral hiatus overlapping in spirit. Branchiæ (fourteen to sixteen) of moderate length, the chordoid axis with narrow segments toward the base; pinnæ of moderate length, the tips delicately filiform. Tentacles short, bluntly tapered. Body narrow and long, somewhat rounded; ventral scutes broad in front, continued posteriorly

as a narrow belt split by the ventral furrow. Bristles of two kinds anteriorly, with long slender shafts and tapering winged tips, and others with broad wings and short tapering ends. Posteriorly only bristles with broad wings and tapering tips. Anterior hooks with a high crown, a moderate main fang and six or seven distinct teeth above it, the prow very large and prominent, the posterior outline straight and a short rudiment of a posterior basal process. The posterior hooks have the same high crowns and general shape, but are devoid of the basal process posteriorly. Tube of secretion and mud.

Synonyms.

1865. *Laonome Kröyeri*, Malmgren. Nordiska Hafs.-Annul., p. 400, Tab. xxvii, fig. 85.
1867. „ „ idem. Annul. Polych., p. 113.
1887. „ „ Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 669.
1889. „ „ Marenzeller. Arch. f. Naturges., lv, p. 132.
1913. „ „ Hofsommer. Wiss. Meeres. Komm. deutsch., Bd. xv, p. 324, Taf. iv, figs. 3—5.
1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 139.
1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 15.

*Habitat.*—Inishlyre Harbour, Clew Bay, single example (Southern); Firth of Forth (Cunningham and Ramage).

Abroad it extends to Spitzbergen and the northern seas.

The *cephalic collar* [1] is somewhat low, being deepest ventrally where the edges overlap at the fissure. In the median line dorsally the gap is both wide and depressed in front, and the edges of the collar there are slightly reflected. The branchiæ are short in proportion to the length of the body and from fourteen to sixteen in number. The filaments have a chordoid axis with narrow transverse septa, and terminate in a slender tapering process. The pinnæ are short at the base, increase in length till near the tip, where they again diminish before reaching the base of the terminal filament. No pigment-specks were visible in the spirit-preparation. Tentacles comparatively short, bluntly tapered distally. The *body* is comparatively long and slender, and the example showed little diminution throughout its length, having apparently been preserved in its tube and then cut out. The segments are fairly distinct, those of the anterior region ranging from eight to twelve (Malmgren). The ventral scutes of the region are distinct and undivided, and there is a dorsal groove, behind which a line marks the mid-dorsal region for some distance. The scutes are continued backward on the ventral surface as a somewhat narrow pale band, the central groove cutting the portion in each segment into two. In the preparation the bristles are inconspicuous. The anterior are of two kinds—a series with slender elongate shafts and short tapering tips with narrow wings (Plate CXXIX, fig. 3 *a*), and a larger number with stouter shafts and paddle-like tips with broad wings (Plate CXXIX, fig. 3 *c*) and a tapering process of the axis. The posterior bristles are of one kind only, viz. those with narrow but distinct wings and long tapering tips (Plate CXXIX, fig. 3 *b*). The anterior hooks (Plate CXXIX, fig. 3 *d*) are avicular with a characteristic short and stout outline and a high crown, a main fang of moderate size and six or seven distinct spikes in lateral view above it. The anterior prow is large and

[1] I have to thank Mr. Southern for sending the single example for examination.

bulging; the gulf between it and the great fang is small. The posterior outline is straight, and a small remnant of the base posteriorly is present. The posterior hooks (Plate CXXIX, fig. 3 *e*) agree in the general outline, but the process of the base is absent posteriorly. It is this hook which Malmgren shows in his figure, unless the Arctic species differs. In shape the hooks generally approach those of *Euchone*. The tube is composed of secretion and mud, very little of the latter constituent occurring on a third of the length at one end.

Cunningham and Ramage (1888) state that they dredged an example on the Middle Bank, Firth of Forth. Nothing more is mentioned.

*Genus* CLXIV.—Branchiomma, *Kölliker* (Clap. revis.), 1858.

Cephalic plate with a deep dorsal fissure; collar has a distinct dorsal lamella separated from the main part by a V-shaped notch; edges overlap at the fissure in the mid-ventral line. Branchiæ have a subulate terminal filament with a compound eye (minute in some) on the inner edge. Tentacles (or palps) a pair. Mouth with lateral labial processes. Body slightly flattened, tapering a little posteriorly, and ending in an anus. Segments 100—120. Anterior region of eight to nine segments. Anterior bristles in two groups, upper with narrow wings, lower with broader wings. Posteriorly tips are much elongated. Anterior hooks avicular with minute serrations on the main fang: accompanied by small penniform bristles. Posterior hooks similar but with shorter bases. Tubes colonial, coriaceous internally; externally with a coating of mud or fragments of shells, gravel, zoophytes, algæ and other growths.

1. Branchiomma vesiculosum, *Montagu*, 1815. Plate CXV, figs. 2 and 2 *a*—body and tube; Plate CXXVIII, figs. 4—4 *f*—bristles and hooks; Plate CXX, figs. 9 and 9*a*—anterior end and tip of branchia; Plate CXXXVIII, fig. 4—tip of branchial filament of var. *B. Kollikeri*.

*Specific Characters*.—Cephalic plate with a deep fissure dorsally, on each side of which the somewhat deep white collar has a separate dorsal lamella, a V-shaped notch separating it from the main part, which slopes downward and forward with an unbroken edge to the mid-ventral line where the full and rounded edges overlap. Two eyes over the brain. Branchiæ of moderate length; filaments white externally, from eighteen to twenty (thirty-two, Claparède), each ending in a subulate terminal process into which the chordoid axis does not go, and often with an eye on the inner edge. Pinnæ numerous, very fine, of average length, and brownish-violet in colour, or with white bands. Some are pale olive green with a band of white along the exterior of the filament. Others are rose-pink with white specks; a few milk-white with a faint roseate hue (Brunotte).

Body reaches 110 mm. or more; segments 100—120; slightly flattened, especially posteriorly, where it is tapered and ends in an anus. Anterior region of nine segments, eight of which are bristled; dorsal groove passes between setigerous processes 8 and 9, and reaches the mid-ventral line behind scute 9, from which it is continued to the tail. Nine scutes in the anterior region, the first with a median dimple. Colour brown with

white touches; anterior dorsal region violet brown, or dull orange, the anterior region being somewhat paler, branchiæ violet, banded with white. Anterior bristles in two groups: upper with long shafts and tapering tips with narrow wings; lower with shorter and thicker shafts, and tips with broader wings; bristles of the second region with intermediate tips, but which greatly lengthen posteriorly. Anterior hooks avicular with minute serrations above the main fang; neck rather long, and base long and tapered; accompanying bristles with pointed spatulate tip.

Synonyms.

1808 ?. *Amphitrite vesiculosa*, Montagu. MS. vol. Linn. Soc., pl. xxi.
1815. „ „ idem. Linn. Trans., xi, p. 19, Tab. v, fig. 1.
1828 ?. *Sabella* „ Stark. Elements, ii, p. 133.
1843. „ „ Milne Edwards. Règne Anim. illust., pl. v, fig. 3.
1845. „ „ Johnston. Ann. Nat. Hist., xvi, p. 449.
„ „ *penicillus*, Chenu. Bibl. Conch., t. 1er, p. 247, pl. xx, fig. 4.
1846. „ *lanigera*, Grube. Arch. f. Naturges., p. 51, pl. i, fig. 1.
1851. „ *vesiculosa*, Williams. Rep. Brit. Assoc., 1851, p. 205.
„ „ „ Grube. Fam. Annel., pp. 88 and 140.
1853. „ „ Williams. Ann. Nat. Hist., 2nd ser., vol. xii, p. 395.
1865. „ „ Johnston. Cat. Worms Brit. Mus., pp. 295 and 346.
„ „ „ (*partim*), De Quatrefages. Annel., t. ii, p. 450.
„ „ *terebelloides*, idem. Ibid., t. ii, p. 438.
„ ? „ *Kroyeri*, idem. Ibid., p. 438.
„ „ *arenilega*, idem. Ibid., p. 439.
1867. „ *vesiculosa*, Parfitt. Cat. Annel. Devon, p. 34.
1868. *Branchiomma vesiculosum* var. *Neapolitana*, Claparède. Annél Nap., p. 424, pl. xxii, fig. 5.
1869. *Sabella vesiculosa*, Grube. Mitt. St. Vaast, etc., Abhandl. Schles. Gesell., 1868—9, p. 105.
1870. „ „ idem. Arch. f. Naturges., p. 345.
„ „ *lanigera*, idem. Ibid., p. 345.
1873. *Branchiomma vesiculosum*, Claparède. Annél. sédent., pp. 34, 48, 99, 117, pl. xiv, figs. 9—11.
1874. *Sabella* (*Branchiomma*) *vesiculosa*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 205.
„ *Branchiomma vesiculosa*, Encycl. Brit., Helminthology, p. 68, fig. 16.
1875. „ *vesiculosum*, Panceri. Atti Soc. Ital. Sci. Nat., vol. xviii, p. 532.
„ *Sabella* (*Branchiomma*) *vesiculosa*, McIntosh. Invert. and Fishes St. Andrews, p. 130.
„ „ *vesiculosa*, idem. Encycl. Brit., Helminthology, p. 294, fig. 3, pl. cclxxv, fig. 5.
1884. *Branchiomma vesiculosum*, Langerhans. Zeit. w. Zool., Bd. xl, p. 268, pl. xvi, fig. 31.
1885. „ „ McIntosh. "Challenger" Annel., p. 493, and pl. xxxA, figs. 10—12.
„ „ „ Carus. Fauna Medit., i, p. 271.
1888. „ „ Brunotte. Recher. Anat. Branch., Nancy, pp. 5—75, pls. i and ii.
1891. „ „ Soulier. Anat. Annél. tubic., pp. 30, 38, 53, 98, 129, 235.
1893. „ „ Lo Bianco. Annel. tubic. Nap. Atti d. Scienze di Nap., 2 esér., t. v, No. 11, p. 69, pl. iii, fig. 4.
1894. „ „ De St. Joseph. Ann. Sc. nat., 7e sér., t. xvii, p. 300, pl. xi, figs. 303—314.
1904. „ „ Journ. M. B. A., vol. vii, p. 231.
1906. „ „ Bohn. Ann. Sc. nat., 9e sér., t. iii, p. 130 (movements).

1909. *Branchiomma vesiculosum*, Fauvel. Bull. Inst. Oceanogr., cxlii, p. 43.
" " " Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 578.
" " " Fauvel. Ann. Sc. nat. 9e sér., t. x, p. 210.
1913. " " Ehlers. Südpol. Exped., p. 574.
1914. " " Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 139.
" " " Fauvel. Campag. Scient. Monaco, xlvi, p. 317.
1915. " " Allen. Journ. M. B. A., vol. x, p. 641.
" " " Southern. Irish Sc. Invest., No. 3, p. 49.
1916. " " McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 16.
1917. " " Rioja. Anél. Poliq. Cantáb., p. 65.

*Habitat.*—South coast of Devon (Montagu), Yealm sand-bank, Rum Bay, etc., Plymouth (Allen). Generally procured by dredging, but also is found between tide-marks. West coast of Ireland (Southern). Elsewhere it occurs in the Channel, Atlantic, Mediterranean (Claparède), Madeira (Langerhans), Dinard (De St. Joseph), Naples (Lo Bianco); Azores, Bay of Fayal (Fauvel), shores of Cantabria (Rioja), Simonstown (Ehlers), St. Vaast-la-Hougue (Fauvel).

Kölliker,[1] in 1858, constituted the genus *Branchiomma* for those *Sabellids* possessing eyes on their branchiæ, and he gave us a type, *Amphitrite bombyx*, Dalyell. Sars a little later (1861)[2] made the genus *Dasychone*, characterised by the dorsal pinnules on the branchiæ. Claparède rightly restricts the term *Branchiomma* to those having sub-terminal eyes, such as *B. Köllikeri*—the form which Kölliker probably studied. Dorsally the *cephalic plate* presents a deep fissure between the firm basal pillars of the branchiæ. The somewhat deep collar arises from the outer edge of each pillar and slopes with an unbroken edge downward and forward to the mid-ventral line, where a fissure separates the two sides, each of which is produced into a prominent rounded edge which slightly overlaps its neighbour. The adjoining first scute is indented in the middle line, thus giving a character to the region. Whilst, therefore, the collar is largely developed ventrally, a considerable part of the dorsum is devoid of it. De St. Joseph found two pigment-spots (eyes) over the cephalic ganglia. An otocyst occurs on each side at the base of the branchiæ. The branchiæ are of moderate length (one-sixth length of body, Montagu), and their filaments are from eighteen to twenty-four in number. Each filament has the usual structure and tapers distally, ending in a subulate whitish terminal process into which the chordoid axis, which is remarkably attenuate toward the tip, does not go. The subulate terminal filament when no eye is present has a translucent thin margin, especially at the commencement of its inner edge. It is at this region, viz. the inner base, that the eye develops as a conspicuous dark brownish-violet organ, a stripe of the flattened translucent margin connecting its inner base with the line of the pinnæ, whereas the distal part of the process is slender. The pinnæ are very fine, of average length, and provided with a chordoid unjointed axis. When injured these organs are readily reproduced from the filament, to which they give a feathery appearance. When the animal projects itself from its tube, the branchiæ are gracefully spread like the flower

[1] 'Zeitschr. f. wiss. Zool.,' Bd. ix, p. 536.
[2] 'Vidensk. Selsk. Forhandl.,' 1861, pp. 28 and 33.

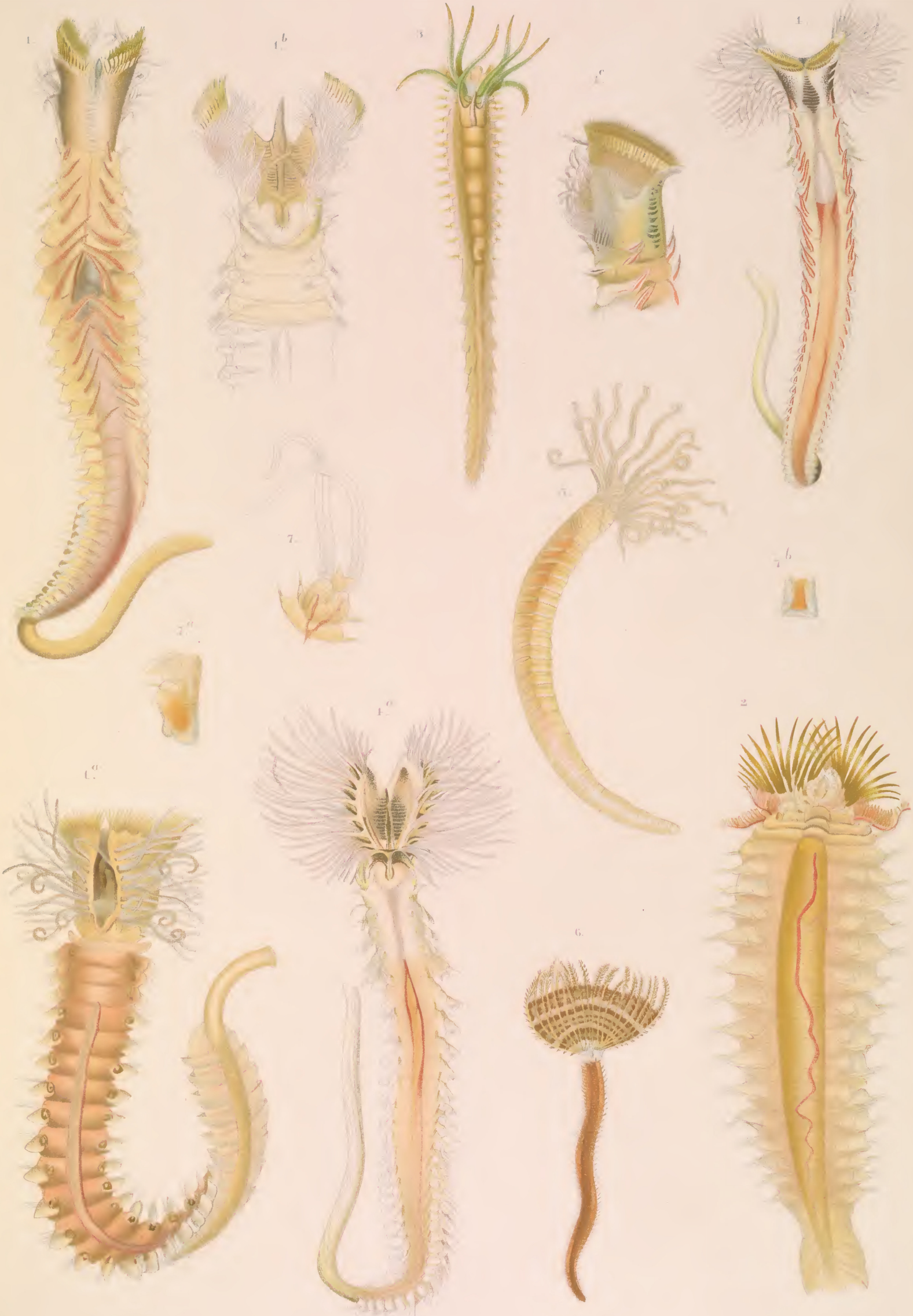
of a *Convolvulus* (Claparède). De St. Joseph describes the exterior of the branchiæ as white, or as brownish violet, or alternately of these colours. Sometimes they are entirely "colœur de rouille ou gris de souris." In the examples from Plymouth the colour was pale olive throughout, only the exterior of the filament being marked by an interrupted band of white, which broke up distally into isolated touches. The remarkable delicacy of the pinnæ is characteristic, each branchial process thus resembling a feather with its delicate barbs. When viewed from without the branchial fan has a slightly barred aspect from the arrangement of the white touches. The pinnæ are pale olive throughout. The eyes vary much in size on the same specimen, and in one case only a single large one was present, the rest being small—in varying degrees. All are double, with the terminal process passing off between them. Such therefore differs from the single eye of the *Branchiomma* described by Brunotte[1] and others, in which the crystalline bodies are arranged in a radiate manner round the central axis. The minute structure of each, however, would appear to be similar to that first described by Kölliker[2] and afterwards by De Quatrefages[3] and Chatin,[4] a figure from the var. *Kollikeri* being given in Plate CXXXVIII, fig. 4.

[1] 'Recherches Anat. Branchiomma,' pp. 37—45.
[2] 'Zeitschr. f. wiss. Zool.,' Bd. ix.
[3] 'Ann. Sc. nat.,' 3e ser., t. xiii, 1859.
[4] Ibid., 6e sér., t. viii, 1878.

## PLATE CXII.

Fig.

1. *Sabellaria spinulosa*, Leuckart, from the dorsal surface. Enlarged.
1 *a*. Ventral surface of a more brightly coloured example. Enlarged.
1 *b*. Ventral view showing the mouth and building organ. Enlarged.
1 *c*. Lateral view of the same. Enlarged.
2. *Lagis Koreni*, Malmgren, from life. Enlarged.
3. *Ampharete acutifrons*, Grube (after Fauvel). Enlarged.
4. *Sabellaria alveolata*, L., from the dorsum. Enlarged.
4 *a*. The same from the ventral surface. Enlarged.
5. *Nicolea venustula*, Montagu, male, no branchiæ. Enlarged.
6. *Dasychone argus*, Sars, from life, only to indicate the coloration. Enlarged.
7. Anterior end of *Polydora flava*, Claparède. Enlarged. See vol. iii, pt. i, p. 205.
7 *a* and 7 *b*. Tail of the foregoing. Enlarged.




R.M.Fig.G. V.H.W.sc.nat.del.

P.W.Tr.imp.

## PLATE CXIII.

Fig.

1. Lateral view of *Melinna palmata*, Grube. Enlarged.
2. *Amphitrite scylla*, Savigny, from Plymouth. Enlarged.
3. *Leprea lapidaria*, L., from the ventral surface. Enlarged.

3 *a*. The same viewed laterally. Enlarged.

4. Pelagic young of *Terebella*. First stage. × 50.

4 *a*. Pelagic young of *Terebella*. Second stage. × 50.

4 *b*. Pelagic young of *Terebella*. Third stage. × 50.

5. Ventral aspect of the collar-region of *Bispira volutacornis*, Montagu. Enlarged.
6. Portion of sand-tube of young *Lagis Koreni*, Malmgren, continuous with the larval transparent sheath. Observed and photographed by Mr. Arnold Watson. Magnified. (*Vide* p. 55.)



1.



2.







5.



6.





4.



3.

A.M.W. Cardinal del.

f.a P.W.M. Trap sculp. et pr.

## PLATE CXIII A.

FIG.

1. *Amphitrite figulus*, Dalyell. Slightly enlarged.
2. Dorsal view of *Lanice conchilega*, Pallas, from St. Andrews. Enlarged under a lens.

2 *a*. Ventral view of the anterior region. Enlarged under a lens.

2 *b*. Lateral view of the anterior region. Enlarged under a lens.

3. *Polycirrus medusa*, Grube. Enlarged under a lens.
4. *Amphiglena mediterranea*, Leydig, from the ventral surface. Enlarged.
5. Lateral view of a pale variety of *Dasychone argus*, Sars. Enlarged.

1.

3.

2.a

2.b

1

2.

W.M.Hay imp.

## PLATE CXIV.

Fig.

1. *Sabella penicillus*, L., pale variety, from Plymouth.
2. *Potamilla reniformis*, Leuckart, with 15 anterior (thoracic) segments, from the dorsal surface. Enlarged.

2 *a*. Another example devoid of eyes on the branchial filaments. Enlarged.

3. *Potamilla Torelli*, Malmgren, from the dorsum. Enlarged.
4. *Myxicola infundibulum*, Montagu, in its gelatinous sheath, from St. Andrews Bay. Drawn by Mr. J. Pentland Smith, M.A. Slightly enlarged.
5. *Amphicora Fabricii*, O. F. Müller, from the dorsum. Enlarged under a lens.
6. *Polymnia nebulosa*, Montagu, seen laterally and ventrally. Enlarged.

[*N.B.*—Coloured plates CXV, CXVI and CXVII are in the next or final Part.]


2.


1.


3.


2.*


6.


5.


4.

## PLATE CXVIII.

Fig.

1. Dorsal view of *Tetreres murata*, Allen, from Plymouth. Slightly enlarged.
1 *a*. The same from the ventral surface. Slightly enlarged.
1 *b*. Anterior end of the foregoing from the dorsum. More highly magnified.
1 *c*. Ventral view of the foregoing.
1 *d*. Portion of the tube. × a little more than twice.
2. Mass of tubes of *Sabellaria alveolata*, L., from the Humber. Nat. size.
3. Mass of tubes of *Sabellaria spinulosa*, Leuckart, from St. Andrews. Nat. size.
3 *a*. Opercular crown of the foregoing. Enlarged.
4. Lateral view of *Pectinaria belgica*, Pallas. Enlarged.
4 *a*. Tube of the foregoing.
5. Ordinary tube of *Amphictene auricoma*, O. F. Müller. Rev. J. M. Anderson. Enlarged.
5 *a* and 5 *b*. Tube composed of transversely arranged siliceous spicules of sponges, from deep water. J. M. A. Enlarged.
6. Anterior end of *Lagis Koreni*, Malmgren, projecting from its tube. Enlarged.
7. Lateral view of *Amphicteis Gunneri*, Sars. Enlarged.
8. Lateral view of *Samytha sexcirrata*, Sars, St. Magnus Bay, Shetland. Enlarged.
9. Lateral view of *Melinna cristata*, Sars. Enlarged.
10. Lateral view of *Amage auricula*, Malmgren. Enlarged.
11. Tentacle of *Sabellides octocirrata*, Sars, var. *britannica*, McI. × oc. 4, obj. A.
12. Dorsal view of the anterior end of *Ampharete acutifrons*, Grube. Enlarged. (After Fauvel.) (*Vide* p. 66.)
13. Lateral view of *Sabellaria alveolata*, L. Enlarged.

1.b

1.

1.a

6.

13.

1.c

11.

10.

9.

8.

7.

3.

3.a

5.a

5.

4.a

2.

1.d

4.

12.

Figs. 3.a W.C.M. Figs 5+5.a J.M.A. Caetera A.H.W. del.

Ft. P.W.M. lith. imp.

## PLATE CXIX.

Fig.

1. Edge of the dorsal collar of *Melinna elisabethæ*, McIntosh. × 40.
2. Edge of dorsal collar of *Melinna palmata*, Grube. × 40.
3. Ventro-lateral view of *Amphitrite grœnlandica*, Malmgren (?). "Porcupine," 1869. Enlarged.
4. Lateral view of *Amphitrite figulus*, Dalyell. St. Andrews. Enlarged. (*Vide* p. 117.)
5. Lateral aspect of *Loimia montagui*, from Plymouth. Enlarged.
6. *Nicolea venustula*, Montagu; deep-water variety, with long branchial pedicles, and finely branched tips. "Porcupine," 1869. Enlarged.
7. Tube of *Terebella B*, with long hair-like processes. "Porcupine," 1870, 690 fathoms.
8. Lateral view of the anterior region of *Lanice conchilega*, Pallas, Lochmaddy. Enlarged.

8*a*. Dissection of a spirit-preparation from the dorsum to show the ventral glandular layer. *a*, bifid tip of œsophageal pouch; *b*, glandular ventral wall; *c*, nephridia; *e*, branchial vessels; *f*, œsophageal pouch or cæcum; *g*, stomach; *h*, glandular wall of canal; *i* and *in*, intestine; *k*, vessels on intestine; *o*, blood-vessel; *p*, septum.

8 *b*. Tube with fan-like anterior end. Drawn by the Rev. J. M. Anderson. Enlarged.

8 *c* and 8 *c'*. Two fans pertaining to other tubes of the same species from St. Andrews. Natural size.

8 *d*. Isolated grains on a transparent tube of the same form.

9. Lateral view of anterior end of *Pista cristata*, O. F. Müller. Enlarged.

9 *a*. Valvular end of tube. Enlarged.

10. Tail of fragmentary form from Guernsey, with hooks resembling *Artacama*.

11 and 11 *a*. Tips of tubes of *Potamilla reniformis*, O. F. Müller and Leuckart, showing elastic coil at ends. Drawn by Mr. Arnold T. Watson.

4.

9.ª

3.

8.ᵇ

8.ª

8.ᵈ

e
a
b
c
f
g
h
p
i
m
k
o

9.

5.

8.ᶜ'

7.

10.

6.

8.

11.

11.ª

8.ᶜ

a

1.

2.

Figs. 8.ᵇ, 8.ᵈ T.A. Figs. 8.ª, 8.ᶜ, 8.ᶜ', 8.ᵈ W.C.M. 10, 11, 11.ª A.T.W. Cactera A.H.W. del.

Fᵈ P.W.M Trap imprᵗ

## PLATE CXX.

FIG.

1. Reproduced caudal region of *Thelepus cincinnatus*, var. *andreanæ*, McIntosh. St. Andrews. Enlarged.
2. Anterior end from S.W. Ireland. Enlarged.
3. Lateral view of *Terebellides strœmi*, Sars. Slightly enlarged.
4. Ventral aspect of a portion of *Polycirrus aurantiacus*, Grube. Enlarged.
5. Reproduced tail of *Sabella penicillus*, L., from St. Andrews. Enlarged.
6. Ventral view of the anterior end of *Sabella*, BC., from Berehaven, Ireland. Enlarged.
7. Branchia of *Potamilla Torelli*, Malmgren. Enlarged.

7 *a*. Extremity of a branchial filament. Still more enlarged.

8. Lateral view of *Bispira volutacornis*, Montagu, between tide-marks, Herm. Enlarged.

8 *a*. Cephalic plate seen from the front. Enlarged.

8 *b*. Ventral aspect of the anterior region. Enlarged.

9. Ventral view of the anterior end of *Branchiomma vesiculosum*, Montagu. Enlarged.

9 *a*. Distal region of branchia of *Branchiomma vesiculosum*, Montagu. × 60 diam.

10. Branchia of *Amphitrite affinis*, Malmgren. Enlarged.
11. Branchia of *Amphitrite gigantea*, Montagu. Enlarged.
12. Branchia of *Nicolea venustula*, Montagu, from Plymouth. Enlarged.

12 *a*. Branchia of *Nicolea venustula*, var. *zostericola*, Montagu, from Plymouth. Enlarged.

12 *b*. Branchia of *Nicolea venustula* (1863). × 40.

13. Lateral view of *Lysilla Loveni*, Malmgren, St. Magnus Bay, Shetland. Enlarged under a lens.

13 *a*. Ventral aspect of the foregoing. Anterior region with the tongue-shaped process in the median line. Enlarged under a lens.

14. Ventral aspect of the anterior region of *Dasychone argus*, Sars. *a*, fold of collar; *b* and *c*, folds at the mouth; *d*, foot with bristle-tuft and pigment-spot; *e*, copragogue (groove). Enlarged under a lens.
15. Scapha and posterior region of *Euchone Normani*, McI. St. Magnus Bay, Shetland. Enlarged.
16. Branchial filament of *Amphiglena mediterranea*, Leydig. Torquay. × 60.
17. Branchia of *Loimia Montagui*. Enlarged. (*Vide* p. 147.)

3.

16.

8.

9.

13.

11.

1.

6.

14.

12.

4.

8.

11.

5.

13.

7.

12.

15.

2.

17.

10.

12.

7.

W.C.M. Figs. 5, 12, 14 Caetera A.H.W. del.

Ed. P.W.M. Trap. impr.

## PLATE CXXI.

FIG.

1. Dorsal surface of the anterior region of *Dasychone argus*, Sars, with the branchiæ of one side. *a*, tentacles; *b*, pigment-speck at first bristle-tuft.

1 *a*. Lateral view of a somewhat short Zetlandic example from Burra Voe. Enlarged.

1 *b*. Ova of the foregoing. × 350.

1 *c*. Cephalic plate. *a*, oral region; *b*, chordoid supporting tissue; *c*, central mass; *d*, dorsal furrow; *e*, dorsal incurvation. Slightly enlarged.

2. Cephalic plate of *Chone Fauveli*, McIntosh. Slightly enlarged.

2 *b*. Ovum. × 200.

2 *c*. Membranous portion of tube. × 200.

3. Lateral view of *Chone Reayi*, McIntosh, with portion of tube. Between tide-marks, St. Peter Port, Guernsey. Enlarged.

3 *a*. Ventral view. Enlarged.

4. Body of *Myxicola viridis*, Milne-Edwards, as a transparent object, from St. Andrews Bay. × 60.

5. Extremity of a branchia of *Protula tubularia*, Montagu. Enlarged.

6. Spiked opercular disc of *Hydroides norvegica*, Gunner. Enlarged.

6 *a*. Lateral view of the anterior region of the same species. Enlarged.

6 *b*. Oblique view of the opercular region. Enlarged.

6 *c*. Free edge of the grooved region of the operculum. × 200.

6 *d*. Tubes of the same on *Cyprina islandica*, St. Andrews Bay. Natural size.

7. Lateral view of the operculum of *Serpula vermicularis*, L. Enlarged.

7 *a*. Tip of branchia. × 60.

8. Dried tubes of *Filograna implexa*, Berkeley, St. Andrews. About natural size.

9. Ventral view of *Chone infundibuliformis*, Kröyer, from the "Valorous" Expedition to the Arctic Sea, 1875. Enlarged.

1.a

2.

9.

3

7.a

4.

3.a

6.b

2.b

1

a

b

e

d

1.c

1.b

5.

6.c

c

d

6.a

a

2.

6.

7.

1.c

8

6.d

a

R.N. fig. 6.b; W.C.M. fig. 1–1.c, 6, 6.a, 6.c, 7. C. ... A.H.W. del.

Fd. P.W.M. Trap, impr.

## PLATE CXXII.

Fig.

1. Glandular organs of *Filograna implexa*, Berkeley, from St. Andrews (1863). Unfortunately the explanation has been lost. × 180.
2. Tip of branchia of *Pomatocerus triqueter*, L. (spirit-preparation). × 40.
2 *a*. Operculum of the foregoing, from Lochmaddy, North Uist. Enlarged.
3. Operculum of *Placostegus tridentatus*, J. C. Fabricius. × 40.
3 *a*. Tip of a branchia (in spirit). × 60.
4. Operculum of *Placostegus*, AB., from Shetland. × 40.
4 *a*. Outline of tip of branchia in spirit. × 60.
5. Lateral view of *Ditrypa arietina*, O. F. Müller, dredged off North Unst, Shetland. Enlarged.
6. Tip of a branchia (spirit). Enlarged.
6 *a*. Tube. Enlarged.
6 *b*. Tube with *Caryophyllia* attached, from St. Magnus Bay, Shetland.
7. Operculum and branchiæ of a very young example of *Spirorbis granulatus*, L., from St. Andrews. *a*, non-ciliated terminal process; *b*, pinnæ; *c*, opercular disc; *e*, central calcareous process (talon). × 200.
7 *a*. Tube and annelid in life, 1863, St. Andrews. Enlarged.
7 *b*. Branchial pinna and peritoneal contents of body of an adult in life. × 280.
7 *c*. Anterior region of an adult showing the anterior granular glands, *a*. × 40.
7 *d*. Ovum. × 280.
7 *e*. Group of ova from calcareous tube. Enlarged.
7 *f*. Embryo in capsule. × 80.
7 *g*. Free embryos. × 80.
7 *h*. Eye-specks. × 280.
7 *i*. Operculum. × 40.
8. Operculum of *Spirorbis*, CD., Cliff, Scalloway. × 40.
9. Operculum of *Spirorbis spirillum*, L., from Guernsey. × 40.
9 *a*. Operculum of the same from Aberdeen. × 40.
9 *b*. Tip of branchia (spirit). × 60.
10. Operculum of *Spirorbis borealis*, Daudin. × 40.
10 *a*. Tip of branchia. × 60.
11, 11 *a*, 11 *b*. Portions of three massive tubes composed of firm mud and with varying admixture of stones—resembling those of *Pista cristata*—from the "Porcupine" Expedition of 1869, the first, No. 25, at 164 fathoms, the second off the Hebrides, and the third off Valentia.
12. Operculum of *Spirorbis militaris*, Claparède. Enlarged.

12.

6.b

6.a

5.

b

b

c

e

a

7.

7.a

6.

7.c

7.e

7.b

2.a

7.f

8.

7.i

10.a

2.

9.

9.a

7.g

9.b

10.

7.h

11.

3.a

7.d

4.

4.a

3.

11.b

11.a

W.C.M. fig. 4.a 7-7.g Caetera. A.H.W. del.

Fe. P.W.M. Trap. impr.

## PLATE CXXIII.

Fig.

1 and 1′. Paleæ of outer row of the "crown" of *Tetreres murata*, Allen, the second figure more highly magnified.

1 *a*. Exterior palea of the same row. × Zeiss oc. 2, obj. A.

1 *b* and 1 *b*′. Paleæ of the inner row, the first figure more highly magnified. × oc. 2, obj. A.

1 *c*. Capillary bristle of first set. × oc. 2, obj. A.

1 *d*. Anterior dorsal bristle. × 1 in. Beck.

1 *d*′. Tip of anterior oar-shaped bristle. × oc. 4, obj. A. Enlarged.

1 *d*″. Paddle-shaped bristle. × oc. 4, obj. A, with draw-tube.

1 *e*. Whorled anterior ventral bristle. × oc. 4, obj. A.

1 *e*′ Portion of foregoing more highly magnified.

1 *f*. Anterior hook. × oc. 4, obj. F.

1 *g*. Posterior hook. × oc. 4, obj. F.

1 *h*. Great anterior dorsal hook. × Beck 2 in.

2. Spiked paleæ of crown of *Sabellaria spinulosa*, R. Leuckart. × oc. 4, obj. A.

2 *a*. Bill-hook palea. × oc. 2, obj. D, with draw-tube.

2 *b*. Shorter palea of same type. × oc. 2, obj. A, with draw-tube.

2 *c*. Three spine-like simple bristles of the first series. × oc. 4, obj. D.

2 *d*. Oar-shaped anterior bristle. × oc. 2, obj. D, with 1-in. draw-tube.

2 *e*. Tapering serrated bristle with whorls of spikes from the dorsal series of the second foot. × oc. 2, obj. D, with 1-in. draw-tube.

2 *f*. Whorled bristle of the ventral series. × oc. 4, obj. D, with draw-tube.

2 *g*. Portion of the foregoing. × oc. 4, obj. F.

2 *h*. Hook. × oc. 4, obj. F.

2 *i*. Tip of ventral curved, brush-like bristle. × oc. 2, obj. D, with 1-in. draw-tube.

3. Palea of *Sabellaria alveolata*, L., from the outer row. × oc. 4, obj. A.

3 *a*. Geniculate palea from the second row, from Naples.

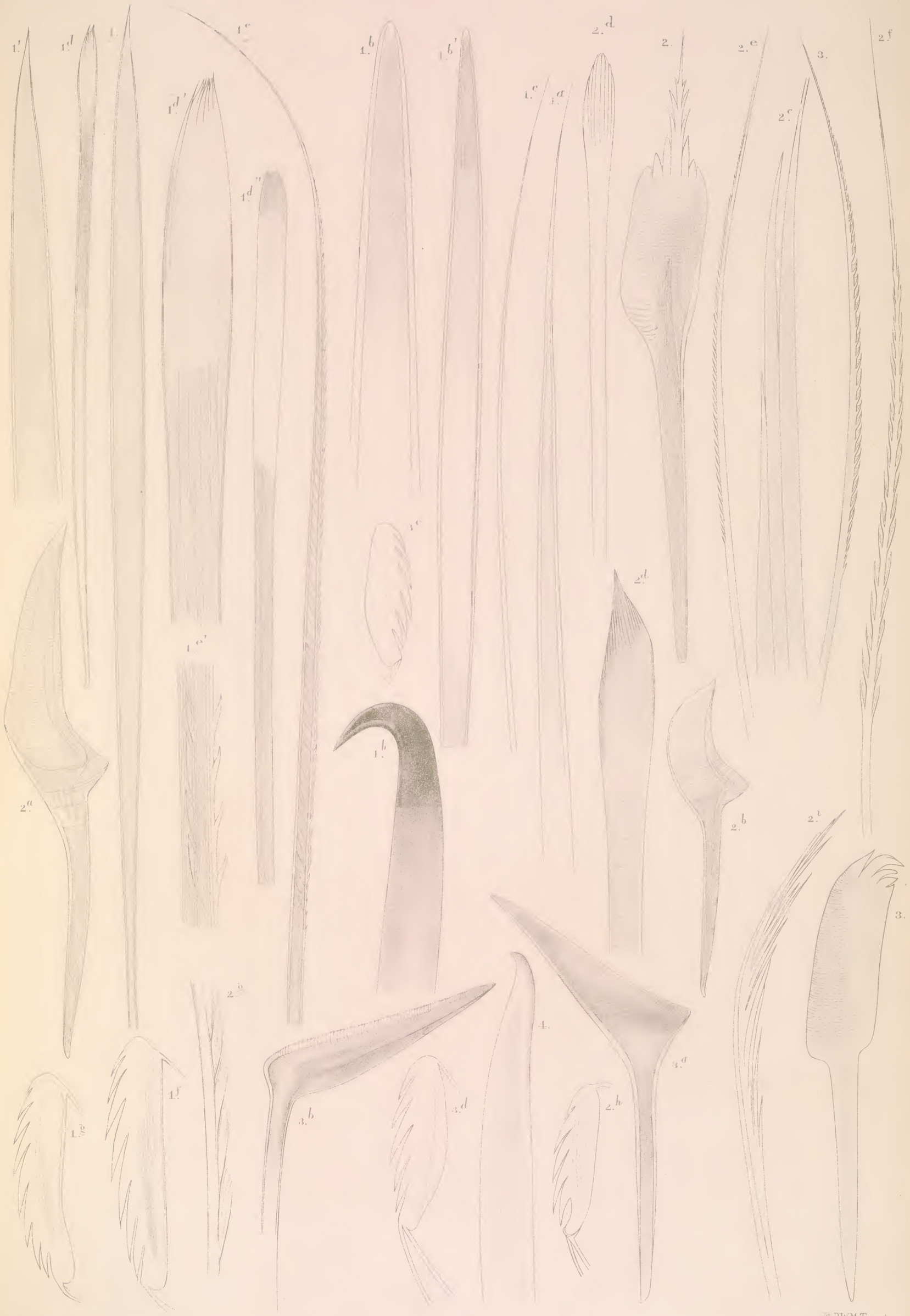
3 *b*. Palea from the third row (hatchet-like). × oc. 2, obj. D.

3 *d*. Anterior hook. × oc. 4, obj. F.

3 *e*. Posterior hook. × oc. 4, obj. F.

3 *x*. Tip of spiked bristle. × oc. 2, obj. D, with $\frac{1}{2}$-in. draw-tube.

4. Tip of caudal hook of *Pectinaria belgica*, Pallas. × oc. 4, obj. A. (*Vide* p. 38.)




A.H.W. del.

P.W.M. Trap. impr.

## PLATE CXXIV.

Fig.

1. Slightly winged bristle of *Pectinaria belgica*, Pallas, from the "Porcupine," 1870. × oc. 2, obj. A. Enlarged.

1 *a*. Hook. × oc. 4, obj. F.

1 *b*. Tip of anterior bristle with spear-like end. × oc. 2, obj. D.

1 *c*. Tip of palea. × oc. 2, obj. A.

2 and 2′. Paleæ of example from the Hebrides. × oc. 2, obj. A.

2 *a*. Bristle of the third region of *Amphictene auricoma*, O. F. Müller. × oc. 4, obj. D.

2 *b*. Caudal hook. × oc. 2, obj. D.

2 *c*. Hook. × oc. 4, obj. F.

3. Tip of palea of *Lagis Koreni*, Malmgren. × oc. 4, obj. A, with draw-tube.

3 *a*. Hook. × oc. 4, obj. F, with full draw-tube.

3 *b*. Modified anterior bristle. × oc. 4, obj. A, with 2-in. draw-tube.

3 *c*. Winged bristle. × oc. 4, obj. A, with draw-tube.

4. Palea of *Ampharete acutifrons*, Grube. × oc. 4, obj. A, with draw-tube.

4 *a* and 4 *a*′. Winged bristles. × oc. 2, obj. A.

4 *b*. Slightly winged anterior bristle. × oc. 2, obj. D.

4 *c*. Hook from example procured in St. Andrews Bay (probably different species). × oc. 2, obj. D.

4 *c*′. Hook of specimen from Guernsey. × oc. 2, obj. D.

4 *c*″. Hook from Canada (probably different). × oc. 4, obj. D.

5. Palea of *Amphicteis Gunneri*, Sars, from Tangiers Bay. × oc. 2, obj. A.

5 *a*. Winged bristle. × oc. 2, obj. D.

5 *b* and 5 *b*′. Hooks. × oc. 2, obj. D.

6. Slightly winged bristle of *Samytha sexcirrata*, Sars. × oc. 2, obj. D.

6 *a*. Hook. × oc. 4, obj. F.

7. Slightly winged bristle of *Sabellides octocirrata* var. *britannica*, McI., from Loch Portan, Lochmaddy. × oc. 4, obj. A.

7 *a* and 7 *a*′. Anterior hooks. × oc. 4, obj. D.

7 *b*. Posterior hook. × oc. 4, obj. D.

8 and 8 *a*. Hooks of *Amage auricula*, Malmgren. × oc. 4, obj. F.

8 *b*. Anterior bristle. × oc. 4, obj. A.

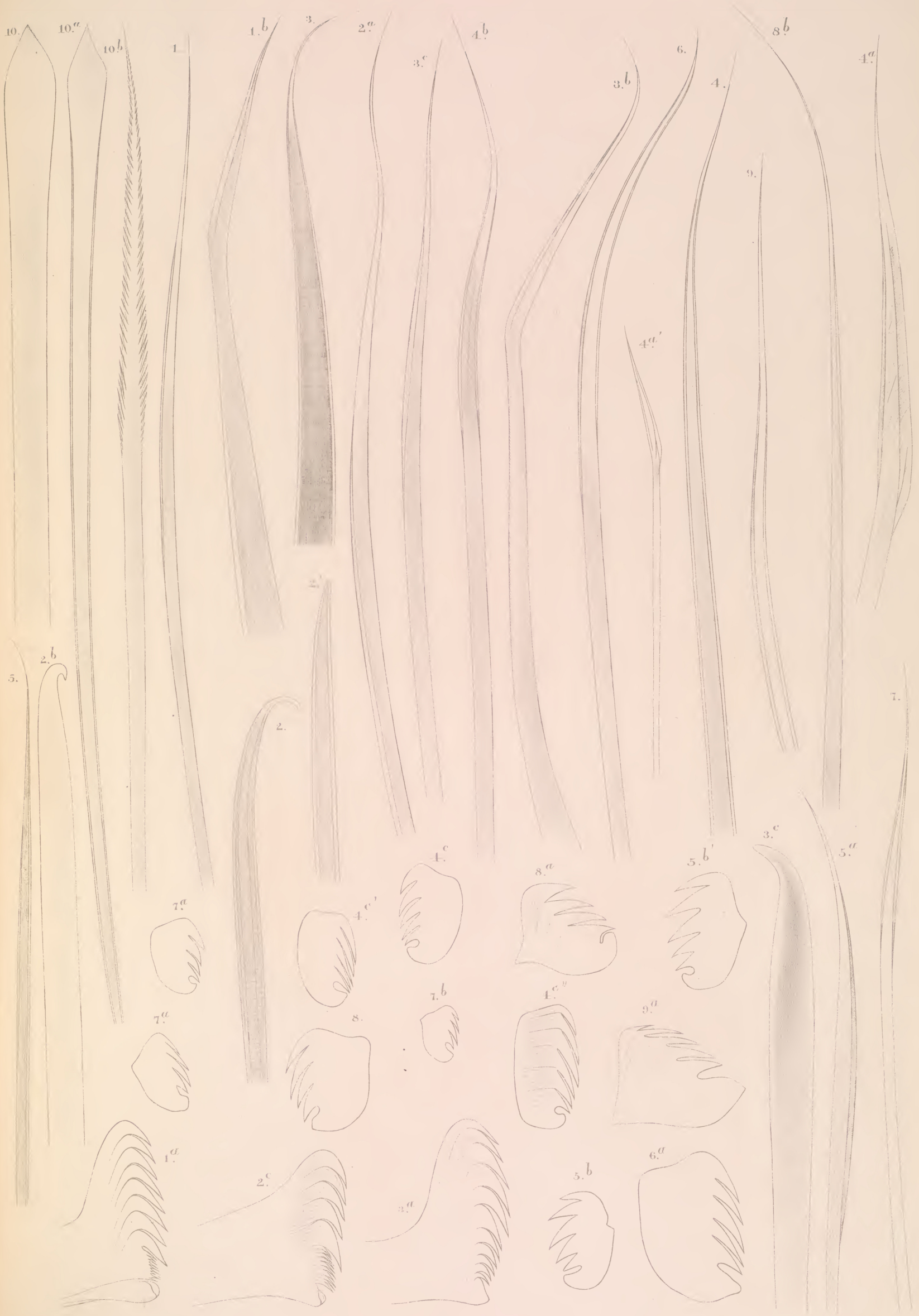
9. Slightly winged bristle of *Samytha equitis* (near *Amage*). × oc. 4, obj. D, with 1-in. draw-tube.

9 *a*. Hook. × oc. 4, obj. F, full draw-tube. (*Vide* p. 82.)

10. Tip of oar-shaped bristle of *Sabellaria spinulosa*, Leuckart. × oc. 4, obj. A, with 2-in. draw-tube.

10 *a*. Oar-shaped bristle of *Sabellaria spinulosa*, Leuckart. × oc. 2, obj. A.

10 *b*. Spiked bristle. × oc. 4, obj. D.



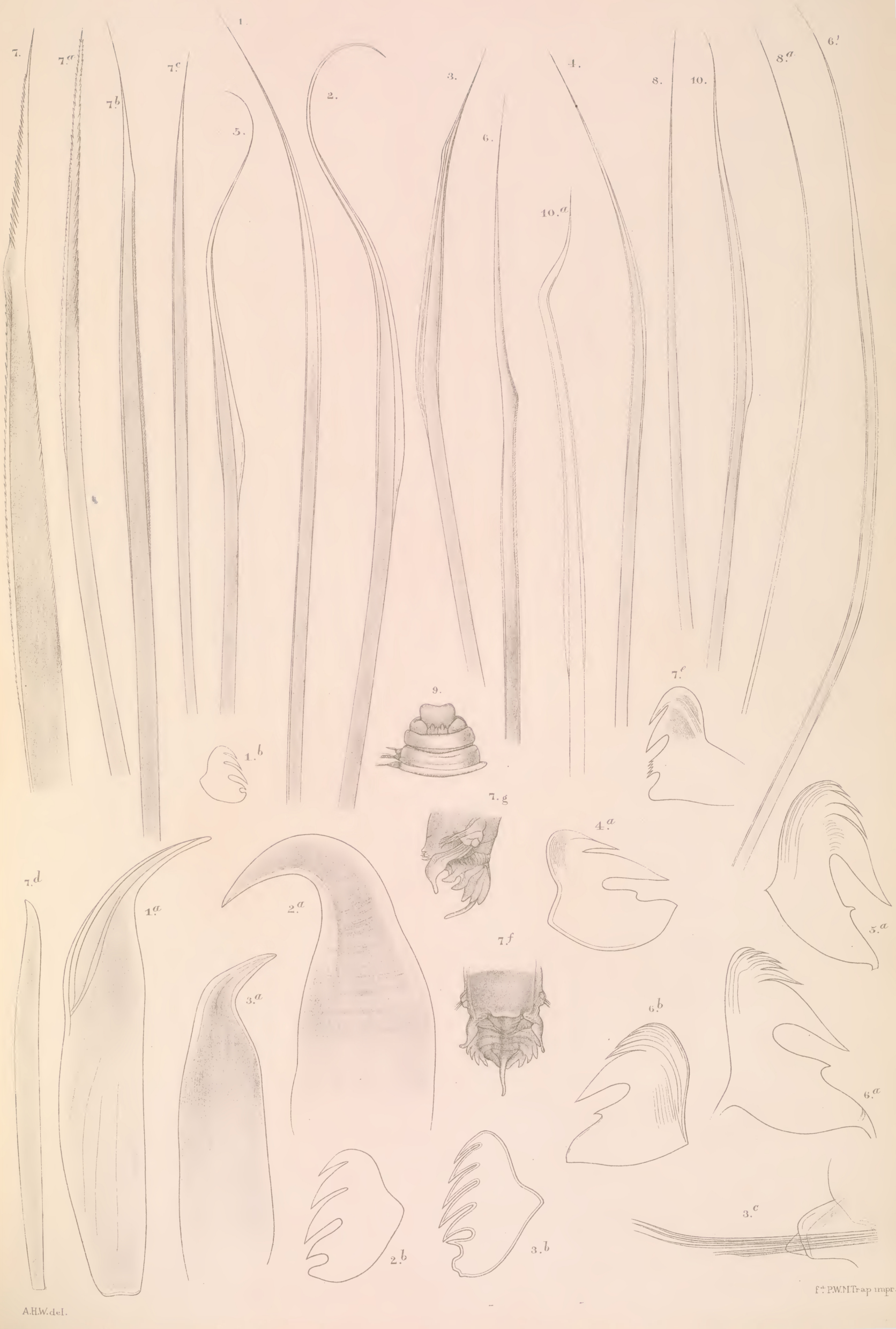

Arl.W. del. W.C.M. lug. 8.a

Fa P.W. Tap impr.

## PLATE CXXV.

Fig.

1. Slightly winged bristle of *Melinna cristata*, Sars. × oc. 4, obj. D.
1 *a*. Dorsal (post-branchial) hook. × oc. 2, obj. D.
1 *b*. Hook. × oc. 2, obj. D.
2. Winged bristle of *Melinna elisabethæ*, McI. × oc. 4, obj. D.
2 *a*. Dorsal hook. × oc. 2, obj. D.
2 *b*. Hook. × oc. 4, obj. F, with draw-tube.
3. Winged bristle of *Melinna palmata*, Grube (= *adriatica*, Marenzeller). × oc. 4, obj. D.
3 *a*. Dorsal hook. × oc. 2, obj. D.
3 *b*. Hook. × oc. 4, obj. F, with draw-tube.
3 *c*. Anterior setigerous process. × oc. 2, obj. A.
4. Slightly winged bristle of variety of *Nicolea venustula*, Montagu, from 640 fathoms. (*Vide* p. 150.) × oc. 2, obj. F.
4 *a*. Hook. × oc. 4, obj. F, with draw-tube.
5. Anterior bristle of *Amphitrite cirrata*, O. F. Müller. × oc. 4, obj. D.
5 *a*. Hook. × oc. 4, obj. D, with draw-tube.
6 and 6′. Winged bristles of *Amphitrite affinis*, Malmgren. × oc. 4, obj. D.
6 *a*. Anterior hook. × oc. 4, obj. D.
6 *b*. Posterior hook. × oc. 4, obj. D, with draw-tube.
7. Tip of an anterior serrated bristle of *Petta pusilla*, Malmgren. × oc. 4, obj. D.
7 *a*. Winged and serrated bristle. × oc. 4, obj. D.
7 *b*. Similar form with a slight spear-tip. × oc. 2, obj. D.
7 *c*. Capillary serrated bristle. × oc. 2, obj. D, with 1-in. draw-tube.
7 *d*. Caudal hook. × oc. 4, obj. D.
7 *e*. Hook. × oc. 4, obj. D, full draw-tube.
7 *f*. Posterior end with scapha. Enlarged.
7 *g*. The same in lateral view. Enlarged.
8. Simple capillary bristle of *Tetreres murata*, Allen. × oc. 2, obj. D.
8 *a*. More slender capillary form. × oc. 4, obj. A, with full draw-tube.
9. Anterior end of *Amage auricula*, Malmgren, from Norway. Enlarged under a lens. (*Vide* p. 80.)
10. Winged bristle of *Amphitrite figulus*, Dalyell. × oc. 4, obj. A, with 2-in. draw-tube.
10 *a*. Geniculate bristle showing striæ on curve. × oc. 4, obj. A, with 2-in. draw-tube.




A.H.W. del.

f.t P.W.N.Trap impr.

## PLATE CXXV A.

Fig.

1. Anterior bristle of *Amphitrite figulus*, Dalyell, with a double expansion. × oc. 4, obj. A, full draw-tube.

1 *a*. Hook. × 700 diam.

2. Winged bristle, with terminal expansion, of *Amphitrite scylla*, Savigny (= *gracilis*, Grube). × oc. 4, obj. D.

2 *a*. Bristle with more slender serrated tip. × oc. 4, obj. D.

2 *b*. Anterior hook. × oc. 4, obj. D.

2 *c*. Average hook. × oc. 4, obj. D.

3. Bristle of *Polymnia nebulosa*, Montagu. × oc. 2, obj. D.

3 *a*. Hook. × 700 diam.

4. Antero-posterior view of winged bristle of *Lanice conchilega*, Pallas. × oc. 2, obj. D.

4 *a*. Lateral view showing serrated edge of wing. × oc. 4, obj. D.

4 *b*. Shorter winged bristle with curved tip. × oc. 4, obj. D, full draw-tube.

4 *c*. Hook.

5. Anterior bristle of *Polymnia nesidensis*, D. Chiaje. × oc. 2, obj. F, with draw-tube.

5 *a*. Middle bristle. × oc. 2, obj. D.

5 *b*. Anterior hook. × oc. 2, obj. F, with draw-tube.

6. Slightly winged bristle of *Parathelepus collaris*, Southern. × oc. 4, obj. D, with 1-in. draw-tube.

6 *a*. Anterior hook. × oc. 4, obj. F, with 1-in. draw-tube.

6 *b*. Posterior hook. × oc. 4, obj. F, with 1-in. draw-tube.

7. Winged bristle of *Thelepus triserialis*, Grube. × oc. 2, obj. D.

7 *a*. Anterior bristle with very narrow wings without enlargement of the region. × oc. 2, obj. D.

7 *b*. Hook from the middle region. × oc. 4, obj. D, with 1-in. draw-tube.

8. Anterior slightly winged bristle of *Pista cristata*, O. F. Müller. × oc. 4, obj. D.

8 *a*. Bristle with broader wings from S.W. Ireland. × oc. 4, obj. D.

8 *b*. Sparsely pinnate or whorled bristle. × oc. 2, obj. D.

8 *c*. Hook of specimen from Lochmaddy, North Uist. × 700 diam.

8 *c'*. Anterior hook from St. Magnus Bay.

8 *c''*. Posterior hook.

9. Hook of *Artacama proboscidia*, Malmgren, from Canada. × oc. 4, obj. A, with 2-in. draw-tube.

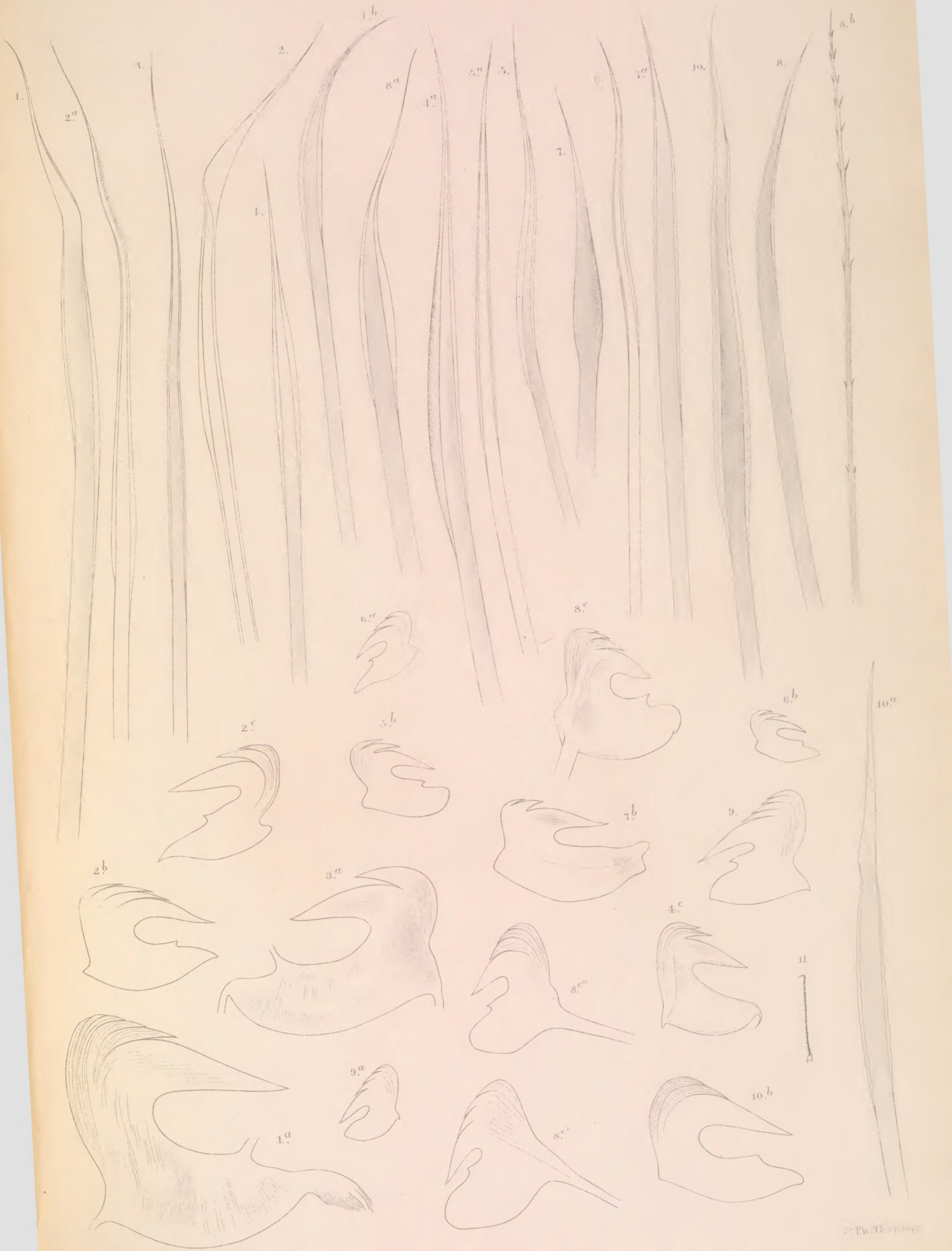
9 *a*. Hook approaching the foregoing, off St. Peter Port, Guernsey, 1868. × oc. 4, obj. A.

10. Anterior bristle of *Amphitrite gigantea*, Montagu, with terminal enlargement, and serrated tip seen more or less antero-posteriorly. × oc. 2, obj. D.

10 *a*. Another with narrower wings and the distal region seen laterally. × oc. 2, obj. D.

10 *b*. Hook of specimen sent by Prof. Fauvel. × oc. 4, obj. D, with 2-in. draw-tube.

11. Anterior edge of hook of *Spirorbis granulatus*, L., showing bifid terminal process.

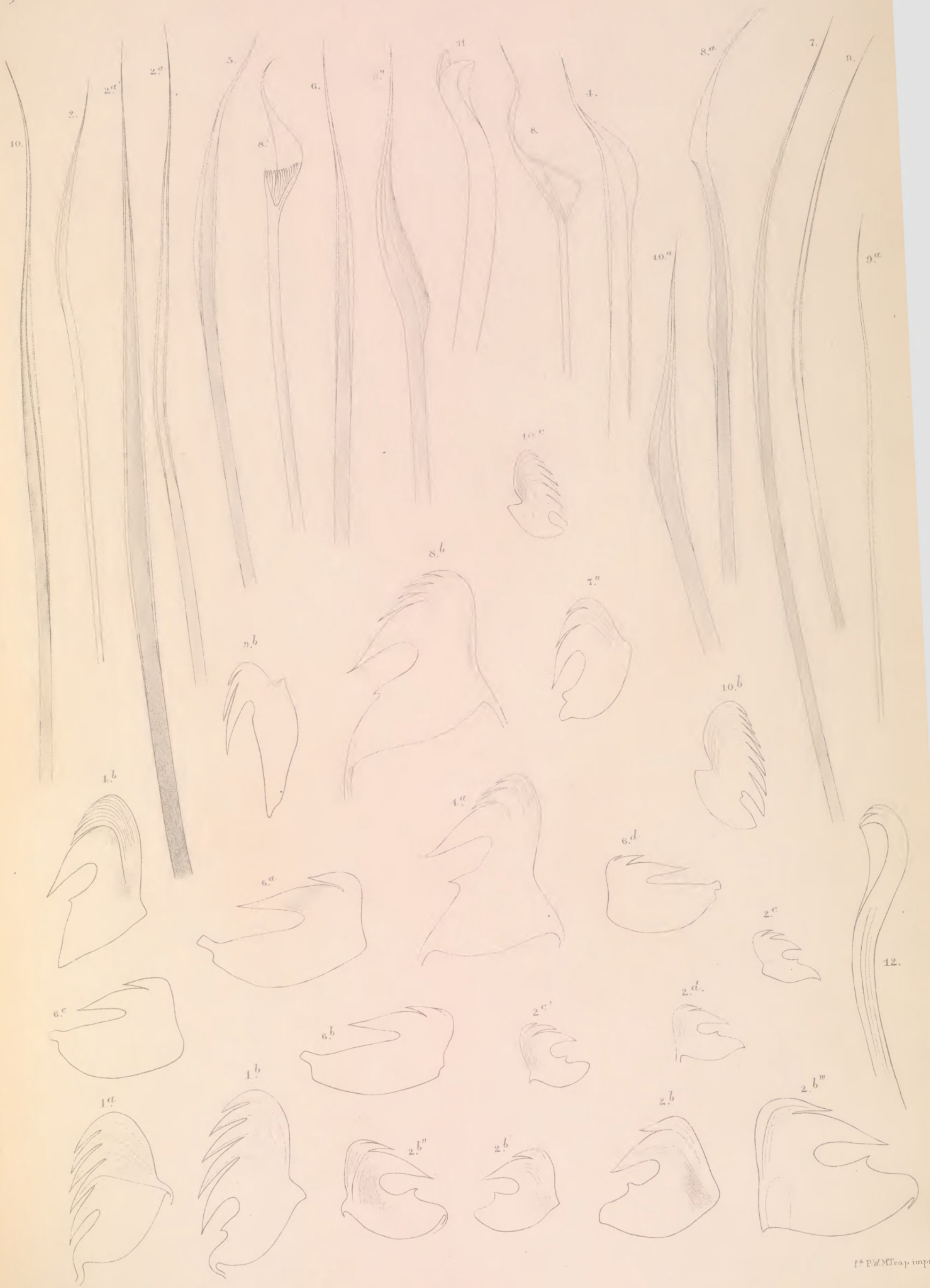



Figs. 1.a 3.d 8.c W.C.M. Caetera A.H.W. del.

## PLATE CXXVI.

Fig.

1. Winged bristle of *Loimia Montagui*, McI. × oc. 4, obj. A, with draw-tube.
1 *a*. Hook. × oc. 4, obj. D.
1 *b*. Hook of *Loimia medusa*, Sav., from the Mediterranean. × oc. 4, obj. D.
2. Middle hook of *Thelepus setosus*, De Quatrefages. × oc. 4, obj. D, with draw-tube.
2, 2 *a* and 2 *a'*. Bristles of *Nicolea venustula*, Montagu. × oc. 2, obj. D.
2 *b* and 2 *b'*. Hooks. × 700.
2 *b* . Hook (female—*arctica*). × oc. 4, obj. D, with draw-tube.
2 *b'''*. Hook of a larger type. × oc. 4, obj. D.
2 *c*. Anterior hook from "Porcupine." × oc. 4, obj. D.
2 *c'*. Posterior hook from same example. × oc. 4, obj. D.
2 *d*. Anterior hook from another small example. × oc. 4, obj. D, with 2-in. draw-tube.
4. Broadly winged bristle of *Laphania Boecki*, Malmgren. × oc. 4, obj. F.
4 *a*. Anterior hook. × oc. 4, obj. F, with draw-tube.
4 *b*. Posterior hook. × oc. 4, obj. F, with draw-tube.
5. Winged bristle of *Laphania*, variety A. × oc. 4, obj. D.
6. Winged bristle of *Thelepus cincinnatus* var. *Andreanæ*, McI.
6 *a*. Hook from Berwick Bay. × oc. 2, obj. D.
6 *b*. Hook from Canada. × oc. 2, obj. D, with 2-in. draw-tube.
6 *c*. Anterior hook of *Thelepus*, from Greenland. × oc. 2, obj. D, with 2-in. draw-tube.
6 *d*. Posterior hook of *Thelepus* from Greenland. × oc. 2, obj. D, with 2-in. draw-tube.
7. Winged bristle of *Streblosoma Bairdi*, Malmgren. × oc. 2, obj. D.
7 *a*. Hook. × oc. 4, obj. F.
8, 8' and 8''. Broadly winged almost flag-like posterior bristles of *Lepræa lapidaria*, L. × oc. 4, obj. D.
8 *a*. Anterior winged bristle with double enlargement. × oc. 4, obj. D.
8 *b*. Hook. × oc. 4, obj. D, with draw-tube.
9. Bristle, with very narrow wings, of *Polycirrus medusa*, Grube. × oc. 2, obj. D.
9 *a*. Simple bristle, Bressay Sound. × oc. 4, obj. F, with draw-tube.
9 *b*. Hook. × oc. 4, obj. F.
10. Winged bristle of *Proclea* (*Leæna*) *Graffi*, Langerhans. × oc. 4, obj. D, with 2-in. draw-tube.
10 *a*. Winged serrated bristle. × oc. 4, obj. D, with 2-in. draw-tube.
10 *b*. Anterior hook. × oc. 4, obj. D, with 2-in. draw-tube.
10 *c*. Posterior hook. × oc. 4, obj. F.
11. Hook of *Polydora cæca*, Œrsted. × oc. 4, obj. F.
12. Hook of *Pygospio seticornis*, Œrsted. × 350.




W.C.M. 2.$^{b}$ – 2.$^{m}$; Cartera A.H.W. del.

Ft.ª P.W.M.Trap impr.

## PLATE CXXVII.

Fig.

1. Slightly winged bristle of *Polycirrus aurantiacus*, Grube. × oc. 4, obj. D, with full draw-tube.

1 *a*. Simple bristle with faintly serrated edge. × oc. 4, obj. D, with full draw-tube.

1 *b*. Anterior hook. × oc. 4, obj. F, with 2-in. draw-tube.

1 *c*. Posterior hook. × oc. 4, obj. F, with 2-in. draw-tube.

2. Slightly winged and curved bristle of *Polycirrus hæmatodes*, Claparède. × oc. 4, obj. D, with draw-tube.

2 *a*. Another with slight serrations on the edge. × oc. 4, obj. D, with draw-tube.

2 *b*. Brush-shaped form, apparently from friction. × oc. 4, obj. F.

2 *c*. Anterior hook. × oc. 4, obj. F, full draw-tube.

2 *d* and 2 *d'*. Posterior hooks near the tail. × oc. 4, obj. F, with 1-in. draw-tube.

3. Simple bristle of *Lysilla Loveni*, Malmgren. × oc. 2, obj. D.

4. Simple winged bristle of *Trichobranchus glacialis*, Malmgren. × oc. 4, obj. D.

4 *a*. Long curved and slightly winged bristle. × oc. 4, obj. D.

4 *b*. Long anterior hook. × oc. 4, obj. D, with full draw-tube.

4 *c*. Posterior hooks in various positions. × 900 diam.

4 *d*. Dorsal view of the anterior end. Enlarged.

4 *e*. Lateral view. Enlarged.

5, 5′ and 5″. Antero-posterior and lateral views of the bristles of *Terebellides stræmi*, Sars. × oc. 2, obj. D.

5 *a*. Long anterior hook. × oc. 2, obj. D.

5 *a'*. Head of another example. × oc. 4, obj. D.

5 *b*. Posterior hook. × oc. 2, obj. D.

6. Bristle of the first series of *Sabella penicillus*, L. × oc. 2, obj. D.

6 *a*. Another with broader tip. × oc. 2, obj. D.

6 *b*. Tapering bristle (with bellied tip) of posterior region. × oc. 2, obj. D.

6 *c*. Bristle with wing and long tapering point from the same region. × oc. 2, obj. D.

6 *d*. Group of bristles from the second region. × 280.

6 *e*. Minute (flag) bristle with broad tip accompanying the hooks. × 280.

6 *f*. Anterior hook. × oc. 4, obj. D, with draw-tube.

6 *g*. Posterior hook. × oc. 4, obj. D, with draw-tube.

6 *h*. Capillary bristle from the posterior region. × oc. 4, obj. D.

6 *i*. Winged bristle with slender tapering tip from the same region. × oc. 4, obj. D.

7. Simple bristle of *Polycirrus denticulatus*, De St. Joseph. × oc. 4, obj. D, full draw-tube.

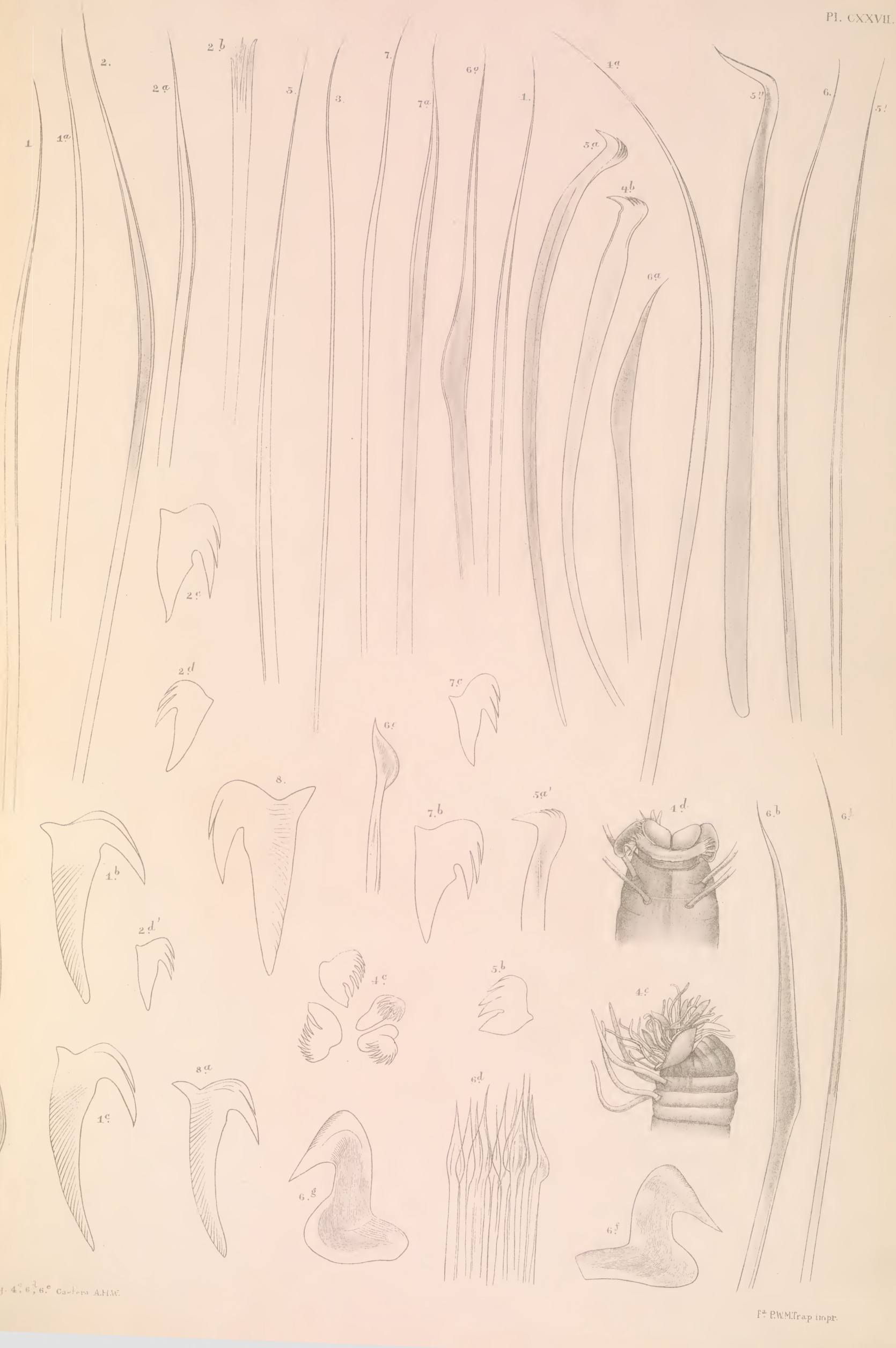
7 *a*. Anterior bristle slightly winged. × oc. 4, obj. F.

7 *b*. Anterior hook. × oc. 4, obj. F.

7 *c*. Hook from the tail. × oc. 4, obj. F.

8. Anterior hook of *Polycirrus caliendrum*. × oc. 4, obj. F.

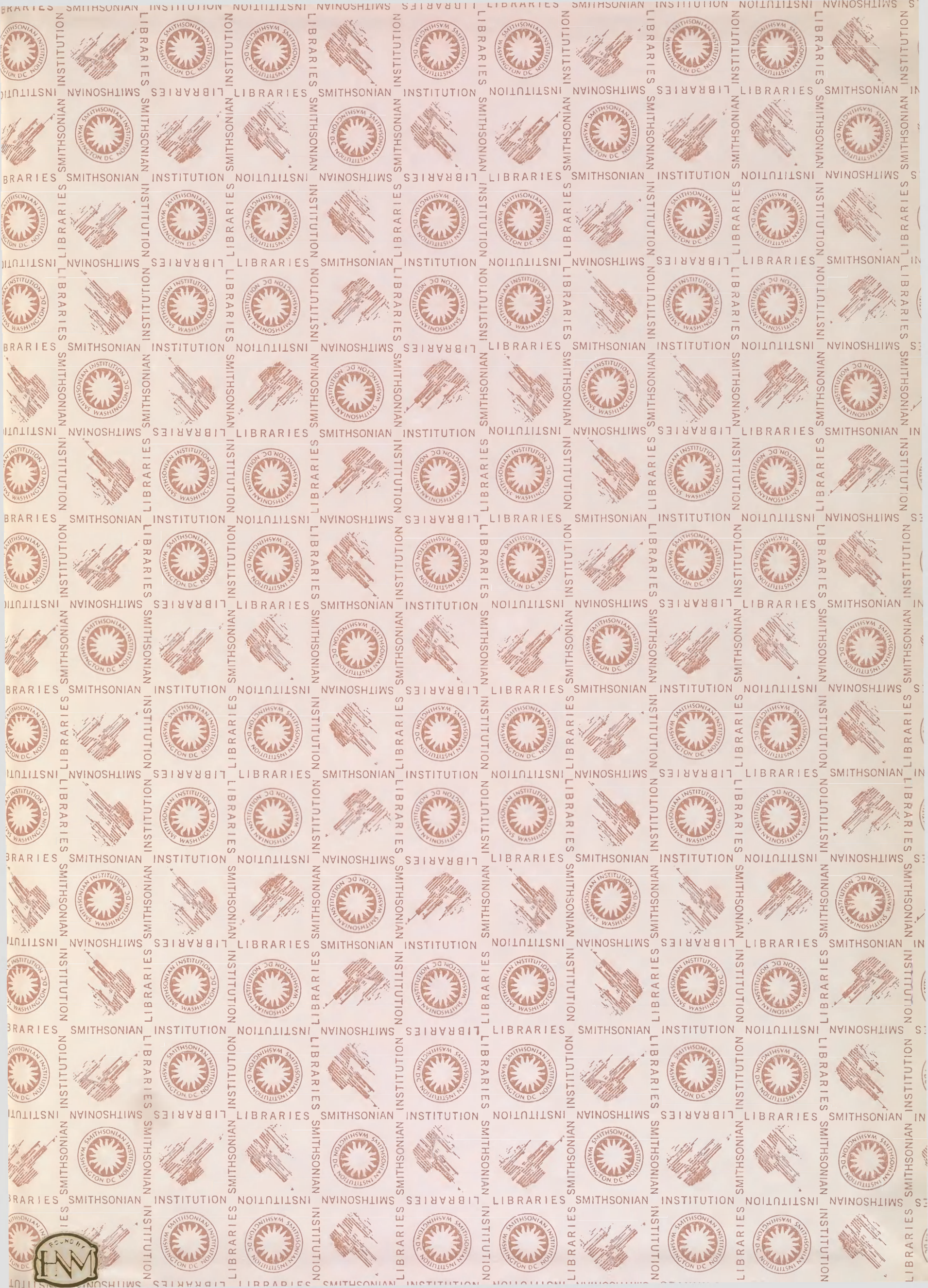
8 *a*. Posterior hook. × oc. 4, obj. F, with 1-in. draw-tube.




W.C.M. lig. 4c, 6, 6b, 6c Cattlers A.H.W.

Fa P.W.M. Trap impr.

SMITHSONIAN INSTITUTION LIBRARIES


SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 00438516 7
nhinvz fQL388.4.M15X
v. 4 A monograph of the British marine