MONOGRAPH

BRITISH MARINE ANNELIDS.

WILLIAM CARMICHAEL McINTOSH, M.D. Edin.

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CONTENTS OF VOL. I.

NEMERTINEA.*

POLYCHÆTA.

* Not including the Introduction, for which see pp. ix–xii of Part I.

THE

RAY SOCIETY.

INSTITUTED MDCCCXLIV.

This Volume is issued to the Subscribers to the RAY SOCIETY *for the Year* 1872.

LONDON:

MDCCCLXXIII.

A

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OF THE

BRITISH ANNELIDS.

PART I.

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BY

W. C. McINTOSH,

M.D., F.R.S.E., F.L.S., ETC.

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PAGES 97—213*d*; PLATES XI.—XXIII.

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Dedicated

TO

THE MEMORY OF

R.,

THE AUTHOR'S ARTIST, FELLOW-OBSERVER,

AND

SISTER.

PREFACE.

The following fasciculus may be described as the First Part of a Monograph of the British Annelida, a department of native Zoology which more than any other required investigation, and whose neglected condition formed the author's chief inducement to attempt something for its improvement.

So little was known in this country with respect to the Nemerteans, while their structure and zoological affinities opened up so many interesting questions, that they could scarcely be passed over in such a treatise. Accordingly they have been examined—both in the living and preserved conditions—with as much care as the circumstances of the author admitted. He hopes, moreover, that the publication of the skilful and laborious coloured drawings of the external configuration of these worms (which were so kindly executed by her to whom the work is dedicated) will assist in rescuing them from the comparative obscurity in which they have hitherto been involved in this respect, both in Britain and on the Continent. He has endeavoured to render the other parts of the treatise worthy of the delicacy and beauty of these figures.

The species of the group are, on the whole, distinctly marked, so that comparatively little difficulty has been experienced in discriminating them; indeed, the chief variation in the majority is in colour, which, of course, obscures none of the essential characteristics.

Considerable additions may be expected to the list of species subsequently described (though the dredge has been used and the coast-line minutely examined at many points from the Shetland to the Channel Islands), and not a little new matter in regard to anatomy and development; but, with such a field as the whole Annelida before him, the author could not devote more time to the group. As no freshwater species has yet been found in this country, such a habitat especially should be diligently explored. The author, however, will be satisfied if he has paved the way for a more extensive and accurate study of these beautiful and interesting forms, whose life-histories and structure so amply reward investigation.

The Nemerteans have received so little attention from British zoologists that the author's list of contributions in this respect cannot but be small, and it is solely to the ceaseless care of a friend that he has been enabled to pursue the investigation with that completeness necessary for the elucidation of their anatomy and zoology, an investigation demanding an abundant and ever-ready supply of healthy living animals. Mr. Parfitt forwarded a few living specimens from the Devonshire coast, and Dr. Howden of Montrose, Prof. E. P Wright of Dublin, Dr. Gray, Dr. Albert Günther, and the late Dr. Baird of the British Museum, Mr. G. S. Brady of Sunderland, Dr. Carrington of Eccles, Mr. J. F. Whiteaves of the Natural History Society, Montreal, and Prof. Dickie, Aberdeen, have also aided him by the communication of preserved examples or otherwise. Mr. Gwyn Jeffreys included some in his rich collections of Zetlandic Annelids, and, in conjunction with Dr. Carpenter and Prof. Wyville Thomson in the celebrated "Porcupine" Expeditions of 1869 and 1870, he secured a most valuable collection of Annelids and Nemerteans, which was most courteously placed at the author's disposal by these gentlemen. To all these he begs to return his sincere thanks for their valued assistance, and specially to Dr. A. Gunther, for his exertions in 1869. He has also to remember the many valuable hints in the microscopic department of this work received from the experienced hands of the late Dr. Fraser Thomson of Perth. Nor must he omit to acknowledge the steady encouragement given throughout these researches by Prof. G. Busk, whose cordial support at an early period was a source of the greatest satisfaction.

He has further to thank Professors De Quatrefages of Paris, E. Grube of Breslau, Kölliker of Wurzburg, and Van Beneden of Louvain, Mr. Alex. Agassiz of America, and Dr. Malmgren of Helsingfors, for their esteemed aid, by the communication of papers and otherwise. Two others, unfortunately, have since been early lost to science, viz. Professors W. Keferstein of Göttingen and E. Claparède of Geneva. The former did much to place Nemertean anatomy on a proper basis, and his conscientious original investigations gave promise of great advances in this as well as in other departments. M. Claparède, again, was, perhaps, the most distinguished investigator of the Invertebrates, especially the Annelida, of his time, and his splendid work both with pen and pencil will make his name enduring.

To the list of these losses he has now to add the lamented Dr. Baird, whose excellent labours amongst the collection of Annelida in the British Museum will long be remembered, no less than his genial and kindly aid to all interested in zoology.

For the delay in the issue of this portion of the work—a delay originating in the printing of the Plates—the author is not responsible, since it was ready at the end of 1869. He has to thank the Council of the Ray Society for their liberality in regard to the Plates, and Mr. Ford for his masterly touch in their execution.

MURTHLY; *September*, 1873.

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THE NEMERTEANS.

GENERAL REMARKS.

The NEMERTEANS are elongated non-bristled worms very plentifully distributed on all our coasts; yet, if not entirely overlooked, they have been generally regarded with a suspicion or aversion even more profound than that bestowed on the true Annelids; apparently, on the one hand, from their supposed resemblance to the forms that live parasitically in the bodies of the higher animals; and, on the other, from the intricacy of their structure, and the obscurity which shrouded their relations with surrounding groups. The appearance of the large species, indeed, has frequently given rise to feelings of superstitious wonder not unmixed with dread in the minds of the public; and some authors even have been more careful to indulge in the same vein in their narratives, than to increase our knowledge of the structure and economy of these interesting animals. They have especially received slight notice from British zoologists.

Cuvier first applied the name Nemertes[1] to designate the *Lineus marinus* of Montagu, and several subsequent writers have with propriety given the title NEMERTEANS to the Order, in which the name has been so long familiar. It is synonymous with the *Teretularia* of De Blainville, the *Annelosi Polici* of Delle Chiaje, the *Cestoidina* of Œrsted, the *Miocœla* of De Quatrefages, the *Aplocœla* of Blanchard, and the *Turbellaria Rhynchocœla* of others.

They have a soft, more or less elongated body, richly ciliated throughout, and the head is usually distinguished from the rest of the animal. The eye-specks and lateral slits (when present) are situated in the flattened snout.

The Nemerteans for the most part frequent the sea, though a few aberrant forms occur in fresh water. The British species, so far as yet observed, are all marine; one of them, moreover, having the semi-parasitic habit of a dweller in tubes attached to the hairs of the abdominal feet of female *Carcini*. This peculiarity amongst the Nemerteans was first noticed by Delle Chiaje.

[1] *Nemertes*, one of the sea-nymphs (Mediterranean as distinguished from the Oceanides)—daughters of Nereus and Doris.

who found his *Polia tetrophthalma* (a *Tetrastemma* with large eyes) in great abundance in the respiratory cavity of "*Ascidia mammellata*." Leuckart and Pagenstecher also state that the former got at Nice a pale *Tetrastemma* in all the stages of egg, young and perfect animal—living parasitically in the body-cavity of *Phallusia mamillaris*; such, however, in all probability, being only a confirmation of the foregoing. A. Agassiz, again, found a species of *Planaria*, which he thinks identical with the *Planaria angulata* of Müller, on the under surface of the base of the tail in *Limulus*. This habit had also been observed in another *Planaria*, that frequents *Velella* in the Atlantic, by Lesson in his zoology of the 'Voyage autour du Monde sur la corvette La Coquille;' and by Schneider in the case of *Anoplodium parasita* (one of the Rhabdocœlæ), which inhabits *Holothuria tubulosa*. Further observations will in all likelihood lead to the discovery of parasitic species in the Medusæ. Such do not seem to be true parasites like the Entozoa, but may appropriately be grouped under the comprehensive title "Commensalisme," recently constituted by Prof. van Beneden—in an interesting lecture delivered before the Royal Belgian Academy. The animals included under this head do not prey upon the juices of their hosts; but, like the *Adamsia* attached to the shell containing the *Pagurus*, or the accompanying *Nereilepas*, they simply live together for their mutual comfort and convenience.

Comparatively few specimens, and these generally the largest forms, are to be found in our museums; and even such examples, if named at all, are often specifically confounded, the same animal, *e.g.*, *Lineus marinus*, being characterised by many names. In looking over such collections, indeed, one meets with a curious nomenclature; thus I have found a large *Sipunculus* labelled '*Serpentaria*,' a *Bipalium* '*Meckelia*,' an elongated *Synapta* and a *Tænia* respectively termed '*Lineus*,' and not a few distinguished by the ambiguous title of 'leech.' This confusion is partly due to the great changes that ensue on placing the animals in spirit. Specimens measuring feet or even yards in length shrink to short processes a few inches long, and the contour of the head is often indistinguishable on account of its retraction within the anterior portion of the body. Moreover, although the worm is in a manner preserved, it is generally unfit for dissection, and the colours frequently fade. While difficulties thus beset the investigator of specimens in museums, the obstacles to the satisfactory examination of the living forms are scarcely less perplexing; and though I would not fully endorse the description of Sir J. Dalyell, yet there is much truth in his observations:—"That many worms have no external prominences rising above the smoothness of their skin, or depressions sinking into it. That neither specks nor eyes, nor the position of the mouth can be discovered in the living specimens; that the student of animated nature cannot destroy his subject, and if perishing in his possession, it often goes so speedily to decay, that it is impossible, were he even a skilful anatomist, to avail himself of dissection."

The colours of many species of the group are of such beauty as to attract even the casual observer, while in this respect also they widely deviate from their supposed allies the parasitic worms. The richest purples appear on velvety skins of deep brown or black, each of the soft and mobile folds giving shades that vary in intensity and lustre. Bright yellow contrasts with dark brown; white with vermilion, brown and dull pink; while individual uniformity is characterised by such hues as rose-pink, white, green, yellow and olive, the gradations of colour in the various parts of a single specimen being so subtle that enthusiasm as well as skill is necessary in the artist who sets himself to the task of faithful delineation. Our indigenous species as a whole do not seem to be less brilliantly coloured than those of warmer climates, if we may judge from

Schmarda's plates, and the descriptions of other authors. Thus as regards beauty and variety of colouring the Nemerteans vie with any other group in the invertebrate series; while in the silky sheen and ever-changing iridescence of the active cilia, with which their whole bodies are covered, they surpass in some respects their gaily tinted superiors—the true Annelids.

The sexes of the Nermeteans do not appear to be distinguished by any peculiarity of shading, except where the ova or spermatozoa are observed through the translucent tissues of the adults. The reflections in regard to the bright colouring of these forms are somewhat cursorily treated by Mr. Darwin in his recent work.[1] These animals, he says, like many other invertebrates, "apparently stand too low in the scale for the individuals of either sex to exert any choice in selecting a partner, or for the individuals of the same sex to struggle in rivalry." The Nemerteans, however, are not devoid of sexual instincts, and the deposition of ova by a female. even at some distance from the male, gives rise to the immediate discharge of his special secretion. Thus Mr. Darwin would be furnished with the facts for stating that the best developed and most forward individuals would have most chance of securing numerous and healthy progeny. Their colours are not due to blood or bile, but are strictly skin-products, yet it would be as easy (or as difficult) to prove them advantageous to the creature as to demonstrate that the pale blood of some animals, the green or red of others, has been formed (as to colour) by natural or sexual selection. Indeed, there is scarcely a limit to the range of theory on such subjects, and it is hard to decide the one way or the other. The argument that the bright colours may be of use in leading their enemies to recognise them as unpalatable will scarcely suit, since fishes feed readily on some of the brightest. Neither can the proposition, available in the case of the soberly clad blind beetles, be of service, since some of the most gorgeously tinted (*e.g.*, *Carinella annulata* and *Lineus bilineatus*) are devoid of eyes; nor are the animals coloured in any special manner so as always to resemble their surroundings, as may be noticed in the olive-green and reddish varieties of *Lineus gesserensis*. *Tetrastemma candida*, on the other hand, assumes a greenish hue in certain instances amongst the littoral algæ, and the food of the translucent *Cephalothrix* has a wonderful effect in colouring the cells of its alimentary region. Some of the most vividly tinted species live in obscure crevices and creeks, where light can rarely enter. The bright reddish ova, again, of *Amphiporus pulcher*, which shine through the pellucid integuments, must render the female for a period a more conspicuous object than the male or undeveloped animal.

Though Prof. Grube's boatman saw the head of *Lineus marinus* 'shine,' and Viviani states that *Planaria retusa* is uniformly luminous, none of the British Nemerteans show this property.

There are, so far as at present known, thirty-one species of Nemerteans inhabiting the British Islands, and described in the following pages. The majority have been previously found; a few are new to Britain or to science.

[1] 'The Descent of Man,' &c.

HABITS.

In their native haunts these animals exhibit considerable diversity of habit. The majority, however, live under stones that lie on a muddy or sandy bottom, between tide-marks, either in pools or moist places, and, as scarcely a vestige of them is at any time seen unless a stone is upturned, their period of activity is probably during full tide. As their haunts indicate, they are fond of the shade, but I do not know that for this reason they are to be called, after De Quatrefages and others, nocturnal animals. Thus *Lineus marinus* is observed occasionally gliding amongst the seaweeds of a warm and sunny tide-pool.

Hundreds of some of the common forms, such as *Lineus gesserensis* and *Cephalothrix linearis*, may be found under a single stone, sometimes in tangled masses, amidst the muddy sand so common in such places. *Tetrastemma dorsalis* is gregarious, in vast flocks, on *Ceramium* and other algæ dredged in the Laminarian region; and *Prosorhochmus Claparèdii* is frequently found in groups in fissures of the rocks near low-water mark in the Channel Islands. Leidy, in his 'Marine Invertebrata of Rhode Island and New Jersey,' also describes his *Nemertes socialis* as very abundant, often in masses, about the roots of corallines, between tides, at Point Judith. The larger and rarer forms occur either singly or in pairs, such as *Nemertes Neesii* and *Micrura*, which haunt the fissures of rocks near low-water mark. The great *Lineus marinus*, again, is often solitary, and the largest specimens almost always so, as well as limited in numbers—size, as in some of the higher forms of marine life, being thus inimical to profusion; and it may be noticed that a diligent search for a lengthened period in one locality diminishes very sensibly the number of large examples. Other Nemerteans frequent the coralline ground or its neighbourhood, such as *Micrura purpurea*, *Cerebratulus angulatus*, *Amphiporus pulcher*, and *A. spectabilis*, and they are partial to empty bivalve shells. Stones placed near the verge of low water, and covered with a profusion of algous and zoophytic life, furnish numerous specimens of the small *Tetrastemmæ*, which apparently delight to crawl amidst the roots and branches, no doubt attracted by the abundance of the other animal organisms that like themselves seek shelter and safety in these miniature forests. One of the best modes of collecting such small forms is to chip off at the proper season—for their abundance is probably periodic—shelving fragments of rock, and carry them home for immersion in shallow vessels of sea-water, when the worms leave their retreats and crawl to the water-line of the basin, after the manner of *Rissoæ*, *Skeneæ*, and other small Mollusca. The same may be said of the roots of the tangles dragged from the rocks near or beneath low-water mark, such treatment being often the only safe mode of procuring perfect specimens of *Carinella annulata*, *Nemertes Neesii*, and *N. gracilis*, which generally interlace their lengthened bodies with the radicles. No richer ground for Nemerteans of rare size and beauty probably exists than the intricate roots of the vast tangles that envelop the muddy masses of horse-mussels in Bressay Sound, where Forbes and Jeffreys have each done such good work by aid of the old drag of the Zetlandic fishermen. Colonies composed of examples of different species, such as *Lineus marinus*, *L. gesserensis*, *Micrura fasciolata*, *M. purpurea*, *Nemertes Neesii*, and *Amphiporus pulcher*, are occasionally met with in the same root; while the hollows of the rough roots of *Laminaria bulbosa* give shelter to select pairs or solitary individuals.

Empty limpet-shells that adhere to the under surface of stones in tidal pools are also favourite lurking places for these animals. Although many of the smaller forms fashion gelatinous or membranous tubes with facility on sea-weeds and stones, one British species alone may be said to inhabit a tube or burrow not secreted by itself, viz. *Borlasia Elisabethæ*, which was found at Herm in a pit or burrow of clay; and in this, as in other respects, the species is peculiar. A foreign example, the *Stimpsonia aurantiaca* of Girard, is also stated to dwell in vertical tubes in sand, near Fort Johnston, Carolina.

The group, as a whole, is composed of animals by no means inactive, for they glide swiftly about in their native sites, only their length sometimes proves a barrier to their rapid disappearance from a particular spot. Crustaceans, starfishes, and mollusks, indeed, are but clumsy athletes when compared with the Nemerteans, whose bodies, deprived of all external protection, covered with cilia and endowed with exquisite sensibility, seem the very essence of mobility. On a solid surface, the chief mode of progression is by crawling, the body being thrown into a number of minute undulations, or else rendered more boldly moniliform by evident waves, which pass from the snout backwards. Some of the more active small species, again, such as *Tetrastemma candida*, frequently glide over the surface of glass so smoothly that scarce a wrinkle is noticed in the soft outline of their bodies, which, for the time, seem to be propelled by an invisible agency. In progression, the body is extended in a rectilinear manner, or else thrown into one or more graceful curves; while the snout is closely applied to the surface, or occasionally rolled from side to side. If a Nemertean, for example, *Amphiporus lactifloreus* or *Lineus gesserensis*, is raised from the surface on which it crawls, it will generally be observed that it clings most pertinaciously by the anterior end; indeed, it would appear that the lips exercise a kind of sucker-action, or, at least, that the under surface of the flattened snout does so. The bodies of several of the elongated forms resemble a semifluid yet coherent substance that can be drawn through any aperture, bent round any angle, and looped, coiled, or twisted in the most elaborate manner. In the more slender species, such as *Cephalothrix linearis*, the mobility greatly resembles that of the tentacular processes of the *Terebellæ*, and I have been puzzled at least once, on lifting stones and sea-weeds from the dredge and placing them in water, by the independent and Nemertean motions of the spotted tentacles of *T. nebulosa*, the owner of which was for the time invisible. In the same species the living animals in confinement often group themselves into rounded masses, which become veritable Gorgon's heads when the constituent members push forth their struggling snouts. The larger kinds also, such as *Nemertes Neesii* and *N. gracilis*, follow a similar habit; and, when the water is changed, it is an interesting sight to watch the heads of the individuals slowly emerging, softly and with ease, from the apparently inextricable coils. In few other groups of animals can such extreme conditions ensue between contraction and extension, and this not by the agency of sea-water, but by the extraordinary shrinking of the muscular substance, and the mobility of the other tissues of the animal. Specimens, measuring only a few inches in contraction, stretch with ease to the length of several feet; and irritants cause a large *Lineus marinus*, several yards in length, to shrink without injury into as many inches, while shorter forms become quite baccate. If a large example of the last-named Nemertean be held over spirit, the body seems to disappear swiftly on touching the liquid, and the hand with the shrunken mass rapidly approaches the surface. On viewing the motions of these animals, the observer will often be forcibly reminded of the graphic descriptions of the arms of *Pleur[illegible]*, given by the elder Agassiz.

Like many of the true Annelids they also progress by floating on the surface of the water, either crawling up the side of the vessel, and thereafter pushing their snouts outwards from the water-line; or, if the water is shallow, raising their heads upwards from the bottom and gradually extending their snake-like bodies along the surface. As in the case of the Nudibranchiate Mollusca, a track of mucus is constantly left behind them in this position, and in the same manner they can be suspended by it. So abundant, indeed, is this mucus, that in jars containing numerous vigorous specimens of *Lineus gesserensis* a perfect gelatinous mesh-work is formed near the surface of the water, and even throughout the entire vessel. I had carefully tested by personal observation the correctness of the explanation given by Messrs. Alder and Hancock of the *modus operandi* by which the Nudibranchs crawl on the surface of the water, and the same explanation is very evidently applicable to this class. The adhesion of the body to the mucus gives the animal sufficient purchase for the use of its facile muscles, for it need scarcely be mentioned that the water has no influence in lessening the attachment. Hence the remark of M. de Quatrefages, that *Nemertes* glides through the water by means of excessively fine vibratile cilia, which are protruded from every part of the surface of the body, cannot meet with our support. When anxious to view the ventral aspect to advantage, no difficulty has been experienced in making many thus float on the surface of the water in the shallow trough of a large dissecting microscope, for by constantly irritating the animals in their endeavours to crawl along the bottom of the vessel, and arresting their progress, they at last pushed their snouts upwards, and sought refuge by this mode of progression.

While possessing the power of crawling and floating just mentioned, some species also swim freely through the water, and this habit in Britain is especially characteristic of the forms which inhabit deep water: indeed, I am not at present aware that littoral species exhibit it in any degree, though there is nothing inimical in their conformation. This habit has been noticed in the *Cerebratulus marginatus* of Nardo, the *Meckelia aurantiaca* of Grube, and by M. de Quatrefages, in his *Polia bembix*, dredged off the coast of Sicily. Four British species, as far as at present known, show this mode of progression, viz. *Amphiporus spectabilis*, *A. pulcher*, *Micrura fusca*, and *Cerebratulus angulatus*. When irritated, each throws itself on its edge, and by alternate lateral strokes of the tail propels itself rapidly through the water with a serpentiform wriggle. Thus, their mode of swimming closely resembles that of the freshwater *Nephelis*, and differs from the horizontal flapping of their allies, the Planariae, which M. Dugès compares to the motion of the Rays. The British species above noted are characterised by their somewhat short and broad form, and especially by the production of the lateral margins into a thin edge throughout the greater part of the body.

Many of the Nemerteans, as M. de Quatrefages mentions, are very hardy in confinement, if the observer is at all experienced in the management of such animals. It is not by the well-calculated adaptation of plant to animal life, of nicely balanced conditions supposed to be favourable to the healthy continuance of marine existence in these artificial states, that the experiment is always successful. Pure sea-water in clean glass vessels, and, in some instances, a clean shell or empty *Balanus*, with a little sand or gravel on the bottom, constitute the most suitable aquaria. Unless the vessel is large, only one or two examples should be placed in each, and this is a point of great importance; indeed, in the case of rare or valuable specimens, solitary confinement has generally been resorted to as most advantageous. I have thus been enabled to keep alive at a great distance from the sea-coast numerous individuals of *Lineus marinus*, *L.*

gesserensis, *L. sanguineus*, *Amphiporus lactifloreus*, *Micrura purpurea*, *M. fasciolata*, and others, as well as to observe various interesting phases in their development. The vessels were always placed in a cool, and, if possible, in a darkened position, in accordance with the habits of the animals in their native sites; but the sea-water was not changed more frequently than four or five times a year, and in some cases not at all. Such confinement generally blanched the snout of *Lineus marinus*, so as to render the groups of eyes visible. The pallor of the upper and under surfaces of the snout in this species is peculiar, for the other parts of the animal are not affected. It occurs chiefly in the region of the cephalic sacs, across the entire breadth of the snout, and extends forward at the margins to the tip; the pigment of the centre of the snout anteriorly, both dorsally and ventrally, and the reddish hue in the region of the cephalic pits remain. I have kept this species, indeed, so long that the snout has become completely etiolated, with the exception of the eye-specks and the reddish coloration of the cephalic fissures. Moreover, throughout an inch of the anterior part of the body, the ventral surface had assumed a pale pink colour, and the six dark stripes on the dorsum were separated by a ground-colour of the same pale hue, which, besides, here and there interrupted the longitudinal dark bands. In the instances, again, of *Amphiporus lactifloreus* and the pale *Tetrastemmæ*, the opacity of the cutaneous textures is considerably increased; and as the two latter are generally best adapted for the investigation of certain minute details, it always became necessary to send to the rocks for a fresh supply. This opacity in the pale species is due to an increase of yellowish colouring matter in the cutaneous cells, and the deposition of brownish-red pigment, a change probably arising from a more frequent exposure to the sun's rays. In some specimens of *A. lactifloreus* under these circumstances, a general augmentation also occurs in the reddish pigment of the ganglia and anterior portions of the lateral nerves. A similar alteration ensues in other species, such as *Carinella annulata* and *Lineus bilineatus*, the former changing from pale brick-red to deep brownish red, and the latter from pale-pinkish buff to brown, thus intensifying the contrast with the pure white lines present in each case. This variety of tint, from exposure or seclusion, likewise occurs in their native haunts. Thus, for example, specimens of *Nemertes Neesii*, from a chink in the Gouliot Caves of Sark, have a much paler aspect than those from an ordinary tidal pool. The rule, however, has many exceptions, for in the same caves very dark olive specimens of *Lineus gesserensis* are found, while a variety of a pale reddish hue lives under stones beneath the open sky at the mouth of one of them. After protracted confinement without food, the longer forms generally lie coiled in an intricate mass on the bottom of the vessel, or, if only moderately elongated like *Micrura*, rest as a double band, and their bodies diminish in bulk to a very great degree. Under the same conditions the smaller species, such as *Tetrastemma* and *Prosorhochmus*, are often found at the margin of the water, and some having receded too far from their element become dried on the side of the jar. The latter accident especially occurs amongst groups of recently captured specimens, which have not yet attained the experience necessary for their preservation in this artificial habitat. Some sustain life under almost complete abstinence for very long periods, such as a year or eighteen months, their bodies being apparently supported by the slow absorption of their own tissues, so that, as before mentioned, their size is greatly reduced. There is, indeed, no structure in the bodies of the majority that is not capable of such change, and thus decrease, in every respect, is easily attained. I have not sufficient facts to enable me to make generalisations on the subject of their longevity; but the larger Nemerteans, *e. g.* *Lineus marinus*, *L. gesserensis*, and *L. sanguineus* live for several years, even under very unfavourable circumstances, in confinement. With ordinary care, also, they can be carried alive from remote parts of the country, as from the Channel Islands to Scotland, and from Shetland, without the loss of a single example of any of the species.

If, therefore, animals so large live for a protracted period in very limited supplies of salt water without a trace of food, our wonder is diminished at the apparent paucity of nourishment in the abysses of the Atlantic for the sustenance of the Foraminifera and other minute organisms mentioned by Dr. Carpenter, since, putting aside for the moment the dissolving jellies and ciliated young of certain of their neighbours, they have free access to the trackless ocean and all its contained organisms.

Under certain irritants, as, for instance, great impurity of the water in the case of recently captured animals, the common *Lineus gesserensis* turns itself inside out, so that the inner surface of the digestive chamber can be viewed without dissection. This also occasionally occurs on placing it in alcohol. The extreme shrinking of *Lineus marinus* on immersion in spirit is also sometimes due to a literal doubling of its body, one fold of which is thrust within the other, the outer being in its normal position, but the inner having its alimentary surface external. *Cephalothrix linearis* is killed by fresh water in a few minutes, the body being swollen by contraction and contorted. *Amphiporus lactifloreus* lives a little longer, though it never moves from the spot, and only thrusts its snout hither and thither for a short time, and dilates its mouth. *Lineus gesserensis* does not crawl after immersion, but lies helplessly on the bottom of the vessel, a swollen body-wave passing rapidly from before backwards for some seconds, as if sickly, then all is still. In most cases, as noticed by M. de Quatrefages, a copious exudation of mucus takes place, and disintegration speedily ensues, the specimens becoming pulpy in a few hours. They are not less hardy, however, than the higher Annelids under the same circumstances.

FOOD.

The Nemerteans throughout are a carnivorous and predaceous race, either capturing living prey or devouring suitable portions of dead animals. Sir J. Dalyell observed *Lineus marinus* and his *Gordius minor viridis* feeding on fragments of mussel, the former also entering the tube of *Amphitrite* (*Sabella*) to devour the tenant, and M. de Quatrefages (after Cuvier and others), in his "Rambles,"[1] narrates that the former species is nourished by sucking the *Anomia*, a feat, however, that seems to me to be involved in obscurity. The erroneous interpretation of the proboscis of the Enopla (which he took for an alimentary organ) of course exonerates M. de Quatrefages in a manner from criticism in regard to the feeding of the animals. It may be observed, however, that the thrusting out of the proboscis noticed by him in *Polia mandilla* (*Amphiporus lactifloreus*) may have been due to other causes than hunger, and that the adherence of the same organ to a Cyclops for a quarter of an hour may be otherwise explained than on the supposition of suction. Mr. Kingsley gives a very graphic but not very accurate (since he says the proboscis assists in prehension) description of a specimen of the same species in the act of devouring a fish. *Lineus marinus*, indeed, would appear to have a very indiscriminate appetite, for not only does it devour its vertebrate and bristled superiors, but a specimen in the island of Herm swallowed an example of *Ascidia intestinalis* about an inch long and half an inch broad, which had been put into the same vessel. Mr. William Thompson, who did so much for the fauna of Ireland,

[1] Excellently translated by the accomplished Miss E. C. Otté. London, 1857.

mentions that Captain Fayrer, R.N., got an individual of the same species holding on to a bait of *Buccinum undatum* on his long line, while fishing for cod off Portpatrick. In confinement the *Lineidæ* readily feed on fragments of mussel. As soon as a specimen has come in contact with a suitable portion, the mouth is enormously dilated, the inner surface of the first part of the œsophageal region thrust outwards, and the bolus, although of considerable size, rapidly swallowed. The snout of the animal during this process is curved backwards, doubtless to afford assistance by its tactile properties, but there is no extrusion of the proboscis. They also feed on dead specimens of *Nereis pelagica*, *Harmothoë imbricata*, and other annelids, ejecting the bristles and indigestible portions *per anum*, and the only inconvenience which they suffer from the spines and bristles is an occasional perforation of the digestive tract and body-wall, and the formation of a vesicle in the cutaneous textures, through which the offending structures are by-and-by extruded. One specimen of *L. gesserensis* under examination boldly seized the head of a large *Nephthys*, upwards of an inch longer than itself, and partially engulphed its prey. Many, moreover, greedily swallow their fellows, and hence it is dangerous to leave examples of rare specimens together in a vessel, as the larger generally make a meal of the smaller. While thus predatory and voracious, they are in turn tolerant of much injury; for instance, a specimen of *L. gesserensis* had its head and anterior portion seized and confined in the stomach of a *Sagartia troglodytes* for about ten minutes, yet the worm afterwards got free, and crawled about as if nothing had happened. In *Cephalothrix* the contents of the digestive tract are easily observed, and in confinement often consist of fragments of each other. I have not been so successful in seeing the Enopla feed, but they probably take similar nourishment. Several of the large forms, such as *Lineus bilineatus*, have been found in the stomachs of haddocks and flounders caught off St. Andrew's Bay.

Their hardihood when confined in vessels without food has already been described.

HISTORY OF THE LITERATURE ON THE SUBJECT.

The early authors on Zoology, while conversant enough as a rule with a few of the conspicuous Annelids, altogether omitted to notice the Nemerteans. Thus no mention is made of them by Linnæus, Seba, Blumenbach, Swammerdam, and others.

In 1758 the Rev. William Borlase, F.R.S.,[1] introduced the Nemerteans to our Fauna by the following description of *Lineus marinus*:—"Fig. xiii, Plate xxvi, is the long worm found upon Careg-Killas, in Mount's Bay" (Cornwall), "which, though it might properly enough come in among the anguilli-form fishes, which are to succeed in their order, yet I chuse to place here among the less perfect kind of sea animals; it is brown, and slender as a wheaten reed; it measured five feet in length (and perhaps not at its full stretch), but so tender, slimy, and soluble, that out of the water it will not bear to be moved without breaking; it had the contractile power to such a degree that it would shrink itself to half its length, and then extend itself as before." A rough engraving of *L. marinus* accompanies this account.

Certain "marine insects" from amidst Sertularians and other Corallines are represented in Tab. iv of Baster's "Opuscula,"[2] vol. i, 1762, one of which, fig. 9, is a Nemertean, probably *Tetrastemma candida*. No further mention is made of the animal.

[1] 'The Natural History of Cornwall,' p. 255, tab. 26, f. 13. Oxford, 1758.

[2] BASTER, 'Opuscula Subseciva.' Haarlem, 1762.

P. S. Pallas,[1] in the year 1766, described a Nemertean of a bluish-white colour under the name of *Lumbricus oxyurus*, which I am inclined to identify with *Amphiporus lactifloreus*, from a careful examination both of the figures and text. He mistook the proboscis for an intestine, as many subsequent authors have done, but he observed that the organ was bathed in fluid, thus recognising a very important element in the anatomy of these animals. He interpreted the stylet-region as the stomach, and detected three muscular bundles proceeding from the posterior end of the latter, so as to fix the organ to the integuments. The intestine, again, terminated in an anus at the anterior pore. The medulla or nervous trunk formed a simple white cord, he said, without ganglia. While there is much that is erroneous in the foregoing description, there is also a considerable amount of penetration and judgment evinced by the learned author, for he appears to have made out the proboscidian fluid, the dilated region of the stylets, and the muscular ribands; and it is clear that this observer would not have omitted to notice the mouth and lateral fissures if his specimen had been a typical form of the Anopla. In the same work[2] he also figures a Nemertean resembling *Lineus gesserensis*, but the only reference thereto occurs in the explanation of the Plate, viz., "Alia Lumbrici *marini* species, tota atra."

The next important contribution was from the pen of the distinguished naturalist, O. F. Müller,[3] who in the first part of his "Vermium," published in 1773, grouped the Nemerteans under the Second Division of his worms destitute of tentacles (Serpentes), and in the third head (Mutica). In his second part, published in 1774, they were included, along with *Gordius*, *Ascaris*, *Hirudo* and others, in the first subdivision (Mutica) of his Gens Helminthica. Three or four of the common species were for the first time described (some of them more than once) as *Fasciolæ*.

In the new edition of his "Natural History of Fresh and Salt Water Worms,"[4] published in 1800, the same author describes a single example of the *Lineidæ* under the name of 'Der Stromische Röd-Aat,' a species no doubt identical with *Lineus gesserensis*. He did not discriminate structure further than by supposing the lateral slits at the anterior end to be connected with the anus, and the ventral papilla (mouth) the male organ of generation. His figures are quite recognisable.

This naturalist[5] in a subsequent publication (1776) enumerates the Nemerteans under his sixth Class (Vermes), and third Order—Mollusca. It is difficult to determine with precision the species referred to in this work, unless in those cases in which further mention in the "Zoologica Danica" confirms the diagnosis. He arranged them with the Planariæ according to the number of eyes, but erroneously placed *Lineus gesserensis*, *Amphiporus pulcher*, and others, under the group of eyeless forms.

The acute and painstaking Dutch naturalist, Martin Slabber,[6] noticed a Nemertean, under the name of *Gordius marinus*, which is evidently one of the Anopla, having in his figure (where

[1] P. S. Pallas, 'Miscellanea Zoologica,' pp. 146—147, pl. 11, figs. 7 and 8.

[2] Op. cit., p. 216, pl. 11, fig. 9.

[3] O. F. Müller, 'Vermium Terrestrium et Fluviatilium.' Havniæ et Lipsiæ, 1773-4.

[4] 'Naturgeschichte einiger Wurm-Arten des süssen u. salzigen Wassers.' Neue Ausgabe. Kopenhagen, 1800.

[5] O. F. Müller, 'Zoologiæ Danicæ Prodromus.' Havniæ, 1776.

[6] 'Natuurkundige verlustigingen behelzende microscopise waarneemingen,' &c., Blad. 61, Pl. 8, f. 1. Haarlem, 1778.

the animal is seen on its edge) a conspicuous lateral fissure. It appears to be related to *Micrura fusca*.

In 1780, Otho Fabricius,[1] following O. F. Müller, placed the Nemerteans in the genus *Planaria*, under his sixth Class "Vermes." He mentions *Planaria angulata*, *P. rubra*, *P. viridis*, *P. fusca*, *P. caudata*, and *P. candida*, most of which had been previously described in the 'Zool. Danic. Prodr.' of O. F. Müller. Under the head of *Planaria fusca* (*Lineus gesserensis*) he corrects certain statements of the latter author, who had only seen spirit-preparations. He considered the aperture of the proboscis to be the mouth, and the tube itself the intestine. He also noticed that it lived in numbers under stones.

Linnæus seems to have had little or no acquaintance with Nemerteans, which were either unknown or confounded with other animals, and it was only after the labours of O. F. Müller and others had brought them into view that they were noticed in Gmelin's edition of the 'Systema Naturæ,'[2] published in 1788. They were grouped by Gmelin along with the Planarians under the Genus *Planaria*, one of the divisions of his Class Intestina. They thus became associated with intestinal worms, Lumbrici, Sipunculi, and leeches. They were classified as follows:—(1) Those without eyes; (2) those with one eye; (3) those with two eyes; (4) those with three eyes; (5) those with four eyes; (6) those with many eyes. The animals, however, were so little understood that this arrangement is not to be depended on. Nothing new was introduced in Dr. Turton's translation of this edition of the 'Systema.'[3]

Otho Fabricius, returning to the subject in 1798 described[4] three Nemerteans under the names of *Planaria angulata*, *P. fuscescens*, and *P. candida*, from Greenland. Like Pallas he considered the proboscis to be the alimentary organ, though he correctly interpreted the mouth in the *Lineidæ*, and the anus in both.

In the following year, 1799, Jens Rathke[5] alludes to six species of the group, viz., *Planaria badia*, *P. lateritia*, *P. sanguinea*. *P. carnea*, *P. atropurpurea*, and *P. linearis*. The first two I have not satisfactorily made out, the third probably refers to *Lineus sanguineus*, the fourth to a variety of *L. gesserensis*, the fifth may be *L. marinus*, while the sixth is *Cephalothrix linearis*. Three of the species are figured.

Lamarck, in his 'Système des Animaux sans Vertèbres'[6] mentions only one Nemertean, viz., the *Planaria rosea* of O. F. Müller.

L. A. G. Bosc[7] classified the Nemerteans with the Planarians under the true worms with elongated articulated bodies, but without external organs, placing them with the Gordii and leeches. In regard to species he follows O. F. Müller.

Montagu was the next British naturalist after Borlase who paid attention to the Nemerteans.[8] In 1804 he gave a good superficial description of the worm mentioned by the former, under the name of *Gordius marinus*, with remarks on its habits. He was, moreover, the

[1] OTHO FABRICIUS, 'Fauna Grœnlandica.' Hafniæ et Lipsiæ, 1780.

[2] GMELIN'S, 'Linnæus Syst. Nat.,' tom. i, pars. vi, p. 3087. Leipsiæ, 1788. Editio decime tertia, aucta, reformata.

[3] London, 1802.

[4] 'Skrivter af Naturhistoire Selskabet,' 4de bind, 2det hefte, p. 52 et seq. Kiobenhavn, 1798.

[5] "Jattagelser henhorende til Jndvoldeormenes og Blddyrenes Naturhistoire." 'Skrivt. af Naturhist.,' Selsk. v, 1 heft., pp. 83, 84. Kiobenhavn, 1799.

[6] Paris, 1801.

[7] 'Hist. nat. des Vers.' Paris, 1802.

[8] 'Description of several Marine Animals found on the South Coast of Devonshire.' Trans. Linn. Soc., vol. vii, pp. 72 and 73.

first to describe *Carinella annulata*. He followed previous authors in classing these and allied forms under the 'Intestina.' The same species, termed respectively the Line-worm and the Hair-worm, appeared, from Montagu's descriptions, in Dr. Turton's 'British Fauna.' They were arranged in a similar manner under Class V, *Vermes*, and Order I, *Intestina*, but were placed under different genera, the former being alone, and the latter associated with *Gordius aquaticus* and *G. argillaceus*.

It is from the interesting manuscript, however, which the relatives of Col. Montagu have placed in the Library of the Linnean Society, that we gather how much and how closely the esteemed observer examined the Nemerteans. In this work he describes more than a dozen species, not a few of them for the first time, and the majority so truly, that it is with a sense of relief and satisfaction that one rises from its perusal. Little can be added to his account of the external appearance and habits of the animals; and, though he did not enter into their anatomy, he correctly interpreted the mouth and anus in the *Anopla*, and was too cautious an observer to locate the former organ in the same position in the *Enopla*. He explains that, though he termed the species above mentioned *Gordii*, this was only a provisional name until further discoveries of species should put him in a position to frame correct generic characters. To the description of the genus *Lineus* he appends the following remarks on the Nemerteans:—"Their use and general economy are little known, but we may conclude they contribute partly to the food of some fishes, and in their turn keep within bounds some smaller beings, and thus serve to support an equilibrium in the great scale of nature." A volume of carefully coloured figures, by the skilful hand of Miss E. Dorville, accompanies the manuscript.

O. F. Müller in his great work[2] described several new species, and gave figures of others mentioned in his previous works, grouping them still under the genus *Planaria*. Two of his forms, viz., *Planaria viridis* and *P. rubra* were communicated by the author of the 'Fauna Grœnlandica;' the others were *P. filaris*, *P. rosea*, *P. flaccida*, *P. gesserensis*, and in the fourth volume P. C. Abildgaard contributed another—*Planaria dorsalis*. The author observed the proboscis, the cephalic fissures, and the ventral slit in the *Anopla*, and likewise gave the correct position of the anus. This work then noticed seven species, most of them in a recognisable condition as regards description and figures, the latter especially deserving praise for their faithful delineation.

In 1806 J. Sowerby[3] gave the title *Lineus longissimus* to the Black Line-worm, which now bears the name of *Lineus marinus*. He first heard of it from Col. Montagu, and afterwards from Mr. Simmons, who sent specimens from Edinburgh. In his description he correctly located the mouth, and observed the longitudinal streaks on the body, as well as the tendency of the broken posterior end to decay, while the anterior remained alive. He mentions that the fishermen pull them in as they would a rope, but never find the posterior extremity, and that they estimate their length at twelve fathoms. A coloured engraving of the animal accompanies the description.

In 1811 Professor Jameson[4] included *Lineus longissimus* in his 'Fauna of the Frith of Forth,' mentioning that the worm was not uncommon on oyster-beds.

[1] 'British Fauna, containing a Compendium of the Zoology of the British Islands, arranged according to the Linnean System.' Vol. i. Swansea, 1807.

[2] O. F. Müller, 'Zoologica Danica.' Havniæ, 1788—1806.

[3] 'The British Miscellany.' London, 1806, p. 15, plate 8.

[4] 'Wernerian Memoirs.' Vol. i, p. 557. Edinburgh, 1811.

A very slight notice of the Nemerteans occurs in Pennant's 'British Zoology' (edit. 1812), two only being mentioned, and those previously described by Montagu.

Some remarks on the habits of *Lineus marinus* were made by the Rev. Hugh Davies in 1815. He observed that the animal was sensitive to light, though he could not discover eyes. He also considered that the spiral form was purposely assumed by the worm during progression, for he could not perceive how its amazing length could otherwise be transported. He thought it by no means improbable that it reached the length of twelve or even fifteen fathoms.[1] An almost verbatim report of this paper appeared next year (1816) in the 'London Medical and Physical Journal,' p. 207.

In the same year Oken,[2] in his "Lehrbuch," brings in this well-known species (*Lineus marinus*) after Nais and Lumbricus, under the name of *Borlasia angliæ*. He correctly describes the mouth, and gives a short *résumé* of what was known with regard to the Devonshire specimens, and a small outline of the species.

Lamarck, in his 'Histoire Naturelle des Animaux sans Vertèbres,' 1816, like other writers about this time, copies the arrangement of O. F. Müller. He did not think that the Planariæ were annelids, but that they approached the leeches.[3]

Cuvier, unaware of the names previously given to these animals by Sowerby and Oken, for the first time applied the term *Nemertes*[4] in 1817 to designate the species described by Borlase. He groups the animal in the second class (of his Zoophytes) "*Les Intestinaux*" (*Entozoa*, Rudolphi), and in the first order of this class, "*Les intestinaux cavitaires*," along with very heterogeneous companions, such as Lernæa and others. He thus separated them from the Planarians, which he placed under the head of the "*Intestinaux parenchymateux*." The sole species known to him was the *Nemertes Borlasii*, Cuvier, which, he says, insinuates its anterior extremity (by which he in the first instance means the tail, since he mistook the anterior for the posterior end) into Anomiæ, for the purpose of sucking the contents, a feat, it appears to me, of somewhat dubious veracity. In his second edition he left the Prostomæ amongst the Planarians, following, according to M. de Quatrefages, Dugès in this respect. In Griffith's edition[5] of the 'Règne Animal' of this author little further information is given. Of *Nemertes* it is said by way of description, "It is a worm extremely soft and elongated, smooth, slender, flattened, and terminated at one extremity by a large blunt point, pierced by a hole; widened, and broadly opened at the opposite extremity, by which it fixes itself. Its intestine traverses the whole length of the body. Another canal, probably connected with generation, winds along its parietes, and finishes at a tubercle on the margin of the wide aperture. MM. Dorbigny and de Blainville, who have seen this animal living, assure us that the wide aperture is the mouth." Besides repeating the remark about the sucking of the Anomia by *Nemertes Borlasii*, it is further explained that the animal remains sunk in the sand, and is "more than four feet long," neither of which observations adds in any way to our knowledge. The only point of interest in this description is the cautious correction of the mistake which Cuvier made in holding the anterior as the posterior end of the worm. In the illus-

[1] 'Some Observations on the Sea Long-Worm of Borlase, *Gordius marinus* of Monta.' Trans. Linn. Soc., vol. xi, p. 292.

[2] 'Lehrbuch der Naturgeschichte, Dritter Theil, Zoologie.' Erster Abtheil. &c. Jena, 1815, p. 365, tab. xi, fig. 1.

[3] 'Hist. nat. des anim. sans vert.' Paris, 1816, &c.

[4] CUVIER, 'Règne Animal.' Tome iv. Paris, 1817.

[5] Vol. xii, p. 468. London, 1834.

trated edition of the 'Règne Animal,'[1] by the disciples of the great master, M. de Quatrefages gives exactly the same description, and repeats certain of the figures—to be alluded to hereafter.

Schweigger, in his 'Handbuch der Naturgeschichte,' follows Cuvier too closely, for he now describes *Borlasia angliæ* as having a membranous disc posteriorly, and either occurring in a free state, or by aid of this disc adhering to Anomiæ.[2]

Dr. Fleming,[3] in 1822, represents the Nemerteans by *Lineus*, one of the genera of his family Gordiusidæ, the other genus being *Gordius*. He correctly observes that in *Lineus* the mouth is a longitudinal slit placed under the snout, but makes no further remark than that several species inhabit this country.

A very considerable increase to the knowledge of these animals was made by the investigations of the celebrated Italian naturalist Stefano Delle Chiaje, who, in the second volume of his 'Memorie,'[4] published in 1825, gave somewhat detailed descriptions of two Nemerteans, for which he constituted the genus *Polia*, named after the comparative anatomist Giuseppe S. Poli. In his sketch of the anatomy of *Polia siphunculus*, he mentions two muscular coats under the skin, an inner of longitudinal fibres, and an outer of transverse (circular). From the mouth springs a muscular rugose gullet (speiseröhre of the Germans), having an inner mucous coat and a fibrous layer. The alimentary canal has the same diameter, and extends throughout the entire length of the animal. In each articulation we have a right and a left sac or pouch in connection with the alimentary tube, into which the food may enter. Above the digestive tract is found a canal containing a long proboscis, which has four fibrous coats, and an internal mucous one covered with papillæ. The proboscis, moreover, is fixed to the wall of its sac by a muscular band. He imagines this to be an organ of touch, and states that when free its motions are so vermiform that one might easily mistake it for a *Lumbricus* or *Echinorhynchus*. In regard to the circulation, he observes that two arteries arise from the triangular lobe of the head, and proceed along the sides of the body, while two sacs, which have the function of hearts, occur at their commencement. In the angle of the basis are three slight whitish elevations, in connection with a whitish thread, which runs down to the middle of each artery. From the end of the mouth springs a very small vein, which gives branches to the lateral sacs (of the digestive cavity). In his other species (*Polia lineata*) he describes a prehensile disc around the anus, and the occurrence of pores on the ventral surface, analogous to the respiratory sacs of *Sipunculus*, but the position of the form is doubtful. This author therefore has the merit of being the first to anatomise these animals in a scientific manner, and to interpret fairly the physiology of the parts. He recognised the true mouth of his examples (which belonged to the Anopla), the general arrangement of the digestive tract, and the presence of distinct muscular layers in the body-wall. The errors he fell into with regard to the circulatory system may be easily explained, since he worked only with dead animals, or, at least, not with those capable of being employed as transparent living objects. The anal "sucker" in *P. lineata* may have been due to some eversion of the digestive canal, if the species pertained to this order.

[1] 'Règne Animal Illust.' Zoophytes, texte et atlas, p. 65, plates 33 and 34. Paris.

[2] 'Handbuch der Naturgeschichte der skelettlosen umgegliederten Thiere.' Von Dr. August Friedrich Schweigger. Leipzig, 1820, p. 591.

[3] 'Philosophy of Zoology,' vol. ii, p. 605.

[4] S. Delle Chiaje, 'Memorie sulla storia e notomia degli animali senza vertebre del Regno di Napoli.' Napoli, 1823—1829. 4 vols. (Vol. ii, p. 406.)

In his third volume, published in 1828, he describes several other Nemerteans. Amongst these in all probability falls also his *Planaria siphunculus*. I have not been able to identify his *Polia punctata*; the size and colour of the proboscis, and the thin edges of the body in his figure,[1] would lead me to place it near *Micrura fusca*. His *Polia oculata* is allied to *Lineus sanguineus*, but the occurrence of eight large eyes on each side, and the somewhat wide and flattened nature of the snout in his enlarged figure,[2] make it doubtful. The identification of *Polia cœrulescens* is also difficult; but his *Polia geniculata* is the *Cerebratulus geniculatus* of M. de Quatrefages.

In 1829 the same author figures three species in his fourth volume, viz., *Ophyocephalus murenoides*,[3] *Tubulanus polymorphus*,[4] and *Cerebratulus bilineatus*,[5] but I cannot find reference thereto in his text farther than the simple explanation of the plate. *O. murenoides* may be a variety of *Lineus marinus*, or else a species with which I am unacquainted. *Tubulanus polymorphus* has a broad hastate head with lateral fissures. There are no stripes on the brownish ground-colour. In his description of the figure (9) of *C. bilineatus* he terms the everted proboscis "sifone genitale." In a section of the proboscis of this species, he shows at least external circular and median longitudinal fibres, although in some other respects he is obscure, since he speaks of an accessory cavity—probably from the invagination of the proboscis. A representation[6] and accompanying explanation are also given of the ovaries of *Polia siphunculus*, in which the author shows a general acquaintance with their position.

An abstract of Delle Chiaje's observations was given in 1832 in Oken's 'Isis.'[7]

F. S. Leuckart[8] in 1828 established the genus Meckelia for the reception of a species (*Meckelia somatotomus*) which he found in a runlet connected with the Mediterranean. This species was evidently a true example of the Anopla, from the description given of its cephalic fissures and mouth, and therefore it is wrong to apply the generic title to a family so diverse as that containing the *Gordius annulatus* of Montagu.

In the same year Dr. George Johnston commenced a series of papers[9] on this department of British Zoology, and he proved a most able and persevering expounder of the habits and general structure of the group, rescuing them from the almost total obscurity in which they were shrouded in this country, and giving a fresh impetus to their investigation. Errors, doubtless, he made, but they were not more striking than those of many of his contemporaries, and not a few of his successors. He described on this occasion three species, viz. *Planaria flaccida*, *P. unicolor*, and *P. lactiflorea*. The first refers to *Nemertes Neesii*. The second may be *Lineus sanguineus*, though he himself does not seem to have been quite sure as to what it was, since no notice is taken of it in his subsequent writings. The last is *Amphiporus lactifloreus*. The first came from deep water, the last from the littoral region.

M. Ant. Dugès established the genus *Prostoma*, also in 1828, to designate what appears to

[1] Op. cit., vol. iii, p. 172, tav. 13, f. 11.
[2] Op. cit., tav. 11, fig. 1.
[3] Op. cit., vol. iv, tav. 62, figs. 6, 7, and 13—15.
[4] Op. cit., tav. 62, figs. 8 and 12.
[5] Op. cit., tav. 62, figs. 9 and 16.
[6] Op. cit., vol. iv, p. 37, and tav. 53, fig. 7.
[7] Isis, 1832, heft. 6, p. 647, taf. 10, figs. 3—5, and 11[1]—11.
[8] 'Breves animalium quorundam maxima ex parte marinorum descriptiones, F. S. Leuckart.' Heidelbergæ, 1828.
[9] 'Zoological Journal,' vol. iii, pp. 128 and 129.

be a freshwater Nemertean (*Prostoma clepsinoïdes*), which he discovered in French streams.[1] He found that it differed entirely in type from the Planarians which he had been describing, since it did not possess their gastric ramifications, but had a simple alimentary tube (proboscis), forming several convolutions. The latter organ commenced in front by a probably exsertile mouth, and terminated posteriorly in a rounded anus.

In the same year (1828) M. de Blainville[2] placed the Nemerteans along with the Planarians under the Class *Entomozoaires apodes* ou *Vers*, in the Sub-class *Parentomozoaires* ou *Sub-Annelidaires*, and in his first Order *Aporocephala*. He established his first Family, *Teretularia*, for their classification, but associated with them *Bonellia*, a Gephyrean. His genera of true Nemerteans were *Tubulanus* (Renier), *Ophiocephalus* (Quoy and Gaimard), *Cerebratulus* (Renier), *Borlasia* (Oken), *Lobilabrum* (De Blainville), and *Prostoma* (Dugès). He correctly described the mouth in the Anopla (to which group almost all his species, with the exception of *Prostoma*, belonged), and the general characters of the animals. His figures of *Borlasia angliæ* in the Atlas are fair.

Dr. G. Johnston[3] continued his observations on Planaria in 1829, describing *Planaria octoculata*, *P. quadrioculata*, *P. bioculata*, and *P. filiformis*. The first mentioned refers to *Lineus sanguineus*, the second to *Tetrastemma candida*, the third to *L. gesserensis*, and the fourth to *Cephalothrix linearis*. His accounts are short, but easily recognised.

In 1830 M. Dugès published descriptions[4] of four species of *Prostoma*, and gave certain anatomical details. One of these, however (now called *P. clepsinoideum*), was mentioned in the previous paper; the second, *P. lumbricoideum*, is probably *Tetrastemma candida*; the third, *P. candidum*, Müller, appears to be the same species; and the fourth, *P. armatum*, has so many eye-specks that, if the description is correct, it is a species with which I am unacquainted. His anatomical investigations were made on the latter. He confounded the proboscis with the digestive system, and the nervous with the circulatory system.

Professor Huschke[5] in a notice of the anatomy of *Notospermus drepanensis* (*Cerebratulus geniculatus*, De Quatref.), from tufts of *Corallina officinalis* on the shores of Sicily, published at this time, mentions that there are two muscular coats under the skin, an external longitudinal and an inner circular; the inner longitudinal muscular coat having escaped observation. He truly interpreted the alimentary canal, with its post-ganglionic mouth and terminal anus, but mistook the proboscis for a male organ, which, however, he correctly located in a sheath between the muscles of the body-wall and the digestive tract. The lateral fissures of the head he likewise connected with the generative organs, and described and figured the nerves as semen-canals. This appears to be an example of the Anopla, and hence we are enabled to predicate as to its probable structure.

In the same year (1830) Professor Leuckart,[6] in a further note on his *Meckelia somatotomus*, calls the aperture of the proboscis the genital organ, but he correctly names the mouth. He states that the genus *Meckelia* closely resembles *Borlasia*.

In the following year (1831) our knowledge of the group received a considerable accession

[1] 'Ann. des sc. nat.,' 1re Sér., vol. 15, p. 140, pl. 5, figs. 25 and 26.

[2] 'Dict. des Sc. nat.,' vol. 57, pp. 573—577. 1828.

[3] 'Zoological Journal,' vol. iv, 1829, pp. 56 and 57.

[4] 'Ann. des sc. nat.,' 1re Sér., vol. 21, p. 73, pl. 2, fig. 1—6.

[5] 'Beschreibung und Anatomie eines neuen an Sicilien gefundenen Meerwurms.' Isis, 1830, heft. 6, pp. 681—3, taf. 7, figs. 1—6.

[6] Isis, 1830, heft. 6, p. 575.

from the labours of the illustrious Ehrenberg,[1] who formed them with others into a distinct class, which he termed PHYTOZOA TURBELLARIA. It is true he included under this head animals, such as the Gordii and Naidina, which are widely dissociated from the typical group, and, in his arrangement, placed apart genera allied in the closest manner, yet his contribution forms an epoch in the literature of the Nemerteans. He characterised the Turbellaria briefly as "Evertebrate apodous animals, creeping; often with retractile vibratile hairs; with a distinct intestinal tube; separate vessels without hearts, rarely with a mobile dorsal and abdominal vessel; hermaphrodite or with distinct sexes, oviparous and spontaneously fissile; excreting a copious mucus." The Nemerteans were placed entirely under his second order, Rhabdocœla, that is, Turbellaria with a simple cylindrical or conical intestine, having the mouth at one end and the anus at the other. The family *Micrurea* he grouped under the second section (*Monosterea*) along with the Gordii, but he more consistently classed all the other Nemerteans described by him under the third section, *Amphiporina*. His arrangement is thus, as follows:—

Section II.—MONOSTEREA.

Fam. Micrurea.
Gen. Disorus, Micrura, and Polystemma.

Section III.—GYRATRICINA.

Gen. Orthostoma, Gyratrix, Tetrastemma, Prostoma, Hemicyclia, Ommatoplea, Amphiporus.
Fam. Nemertina.
Gen. Nemertes, Notogymnus.

The want of an anatomical basis for his classification rendered errors unavoidable, but his descriptions of the species are characterised by care and lucidity, and his figures are good. He erroneously considered the proboscis to be the intestinal canal, and its aperture the mouth, while the actual mouth in the Anopla he termed the genital opening. In the Enopla he could not of course find the latter. He correctly noticed the presence of an anus. Since he states that he saw a reddish viscus in *Tetrastemma flavidum* on each side in front of the proboscis (which reddish mass he took for an ovarium), it is probable he alludes to the ganglia. The stylet-region of the proboscis entirely eluded his notice.

The arrangement of this author is implicitly followed in the twelfth edition of Lamarck's 'Histoire Naturelle des Animaux sans Vertèbres.'[2]

Dr. George Johnston described and figured[3] in 1833 *Carinella annulata* under the name of *Carinella trilineata*. He was unacquainted with the previous description by Montagu in the 'Linnean Transactions.' Like many others he also called the proboscidian aperture the mouth, while the true mouth escaped his notice. He rightly stated that the anus was terminal.

Quoy and Gaimard in the same year give an account, with figures, of several Nemerteans in their zoology of the 'Voyage de la Corvette l'Astrolabe.' None of their species, however, seem to be

[1] 'Symbolæ Physicæ. Anim. evertcb. exclus. insectis.' Ser. prima. Berolini, 1831.

[2] 'Hist. Nat. des Animaux sans Vert.' 12th edit., par Deshayes et H. M. Edwards, vol. iii, pp. 610—613. Paris, 1840.

[3] Loudon's 'Mag. Nat. Hist.,' vol. vi, p. 232.

identical with the British forms. They correctly interpreted the mouth in the Anopla, but erroneously considered the aperture of the proboscis a genital pore, representing, moreover, as a parasite (Plate M, fig. 11) the proboscis escaping from the mouth of a specimen of *Borlasia tricuspidata*. A *Tetrastemma*, with a deeply notched snout and four large eyes ("Borlasie à quatre points"), which they took in the sea near Amboyna, was found inhabiting an *Anatifa*, but whether it occurred there accidentally or otherwise we are not informed. The worms are placed under the Zoophytes in the group "Vers Apodes."[1]

In 1838 Dr. George Johnston published further interesting observations on the genus *Nemertes*,[2] mentioning nine species as occurring on British shores. His general anatomy remains as before, the proboscis being described as the alimentary organ; but he rightly observed that one section of the worms had and another had not stylets in the proboscis; and accordingly this formed the basis of his classification. He termed the true alimentary chamber the general cavity of the body, though he qualified this description by saying that the lateral cæca were parts of the digestive system. He also observed that the ova were independent of these cæca, and were developed between them and the skin. He, however, thought the mouth in *Lineus sanguineus* a nerve-ganglion, and in the entire group called the ganglia "hearts." He discovered the gregariniform parasites infesting *Lineus*, though he could not make out their nature. Two plates of very fair figures accompany this paper, from the pencil of his accomplished lady. If M. de Quatrefages found that his species—*Polia purpurea*, 'Voy. en Sicilie,' ii, p. 122—approached very closely the *Nemertes* or *Borlasia purpurea* of this author, it must have belonged to the Anopla, and have had lateral fissures.

W. S. Macleay, in his remarks on the Annelida in Sir R. Murchison's 'Silurian System' (1839), considered the Nemerteans as aberrant annelids, classifying them along with the Lumbrici and leeches, under the group *Apoda*, in which the body was without a distinct head or feet. The "Nemertina" were further characterised as aquatic, without eyes or antennæ, and with indistinct articulations, which, indeed, were only visible in contraction. Special reference is made to the long vermiform impression in the Cambrian Rocks of Llampeter, which is termed *Nemertites Ollivantii*, Murchison: but, so far as I can judge from the description and plate, this is a very doubtful Nemertean.[3]

In 1840 Professor E. Grube[4] made some observations on the Nemerteans of the Adriatic, describing several species, two of which are figured, viz. *Polia delineata*, Delle Chiaje, and *Meckelia annulata*, Grube. The latter, however, is the *Notospermus drepanensis* of Huschke; and, while I am not acquainted with the *Borlasia annulata* of Ehrenberg, another which he mentions, his *Borlasia viridis* appears to be allied to *Lineus gesserensis*. Under Ehrenberg's name *Amphiporus*, he also refers to what, in all probability, is an example of the Enopla; but the identity of this form, or the succeeding new eyeless type *Akrostomum Stannii*, Grube, cannot be determined. This veteran investigator of the annelids and their allies recognised the correct situation of the apertures of the proboscis, mouth, and anus. He observed that the

[1] 'Voyage de découverts de L'Astrolabe—sous le commandement de M. J. Dumont D'Urville.' Zoologie, par MM. Quoy et Gaimard, tome quatrième. Paris, 1833.

[2] "Miscellanea Zoologica," 'Mag. Zool. and Bot.,' vol. i, pp. 529—538, pls. xvii and xviii.

[3] Murchison's 'Silurian System,' vol. ii, p. 699, pl. xxvii, f. 4.

[4] 'Actinien, Echinodermen und Würmer des Adriatischen und Mittelmeers,' pp. 57—60, figs. 7, 7*a*, 8, and 8*a*. Königsberg, 1840.

former had a special sheath, and that it was not connected with the alimentary system, which lay beneath it.

During the same year (1841) the valuable 'Descrizione e Notomia Animali Invertebrati,' of Delle Chiaje, was published at Naples, containing further and important observations on the Nemerteans. It has, indeed, been aptly said by the lamented Professor Claparède, that the productions of this author form zoological mines, from which succeeding investigators may quarry out much that is new and rare. In this fine work the author describes the Nemerteans as *Annelosi Polici*, and considers they offer certain analogies with the leeches, on account of the structure of the alimentary canal, while in the form of their bodies they approach the Planariæ. A good description is given of the digestive tract and its "hepatic sacs," with their varying arrangement, *e.g.* "pinnatifid-bifurcate" in *Polia delineata*, and bifid in *Polia rosina;* but he falls into the error of regarding the stylet-region of the proboscis in the Enopla as the stomach, and exhibits an imperfect and inverted figure of the region (Tab. 104, fig. 22; vol. v, p. 42) in the *Prostoma candidum* of Dugès. He, however, correctly interpreted the relations of the proboscis to its sheath, the anatomy of the generative organs, and showed an elaborate series of branching transverse arteries between the dorsal and lateral vessels in *Polia sifoncello*. Many species are described and figured, and for the first time he notices the semi-parasitic habits of *Polia tetrophthalmata*, which he found in the respiratory cavity of "*Ascidia mammellata*." Besides the new species, the descriptions and remarks concerning the old enable us to determine more clearly their nature and relationships.[1]

Mr. W. Thompson[2] contributed at this time, under the head of "Additions to the Fauna of Ireland," an account of some species of Nemerteans, viz. *Nemertes gracilis*, *N. lactiflorea*, *Carinella trilineata*, and *Gordius annulatus*. The two latter refer to the same species, viz. *Carinella annulata*, the one being Dr. Johnston's name, the other Montagu's prior title.

In P. Gaimard's 'Voyages en Scandinavie, en Laponie,'[3] &c., considerable attention is devoted to the Nemerteans; but, as only the plates of this work could be procured in the British Museum, its examination is incomplete. However, as none but he who is conversant with the anatomy of the parts can correctly represent in a drawing so minute and complex structure as is found in the proboscis of the Enopla, we may with propriety make a few remarks on these plates. In Plate C, most of the figures, from 1 to 20, seem to pertain to *Amphiporus pulcher*, and therefore the slit which is shown behind the ganglia in fig. 9 is erroneous. The entire animal is well represented in fig. 20. Figs. 23, 24, and 28 belong to a species resembling *Nemertes gracilis*. Fig. 1 of Plate D would do for *Amphiporus lactifloreus*. The whole of Plate E is devoted to the Nemerteans, and in this the structure of the proboscis of the Enopla is detailed. In Plate F a curious form is delineated (figs. 1 and 3), with a spear-shaped snout, a flattened body and widened tail. It appears to be an intermediate type between the Nemerteans and Planarians, and probably is a swimmer. The drawings were made by G. Boeck.

Œrsted,[4] in the fourth volume of 'Kroyer's Naturhistorisk Tidsskrift' for 1842-43, wrote

[1] 'Descrizione e notomia animali invertebrali della Sicilia citeriore osservati vivi negli anni 1822—1830,' da S. Delle Chiaje. Napoli. 1841.

[2] 'Ann. Nat. Hist.,' vol. vii, 1841, p. 482.

[3] 'Voyages de la Commission Scientifique du Nord en Scandinavie, en Laponie, au Spitzberg et aux Feröe, sur la corvette La Recherche.' Paris, 1842, &c.

[4] Kroyer's 'Naturhistorisk Tidsskrift.' Fierde Bind. Kiobenhavn, 1842—1843.

a paper on Planaria and Nemertes, promulgating those views, which afterwards were given at length in his 'Entwurf,' and which therefore need not be further alluded to here. The Nemerteans especially are curtly dealt with.

H. Rathke, in a very excellent structural chapter in 1843,[1] amended the errors of Dr. Johnston in regard to the mouth in *Lineus*, and described correctly the digestive system, the position and relations of the proboscis and other points. He was inclined to think the proboscis an organ of touch.

In the same year (1843) we have the forerunner of a series of elaborate investigations by M. de Quatrefages,[2] who notified to the Academy that he had found separate sexes in the Nemerteans, with the development respectively of ova and spermatozoa, as in the Annelids. He promised to make known the complete results at a future period.

M. Milne Edwards,[3] in reporting on the papers of M. de Quatrefages, in 1844, states, with regard to the Nemerteans, that the latter found that they approached the Annelids in the general distribution of their vascular system, the leeches in the structure of their buccal apparatus, and other points in their organisation; yet their reproductive organs were analogous to those of many helminths. Their nervous system he compared to that of the "Lingules," and he likened their digestive system (with a cæcal termination) to that of the lower helminths and zoophytes. The majority of these homologies are placed on no reliable data.

In 1844 A. S. Œrsted contributed a valuable addition to our knowledge of the Nemerteans and allied genera.[4] He classed the Nemerteans as the fourth sub-order (*Cestoidina*) of his order Apoda, the others in their respective positions being (3) *Trematodina* (Hirudinea and Planarica), (2) *Acanthocephalina* (Siphunculacea), and (1) *Nematoidina* (Gordica). The sub-order *Cestoidina* was thus characterised:—"Body linear, rounded rather than flattened, much longer than broad, indistinctly marked by soft annulations, covered with vibratile cilia; distinct muscles, but no true nerves (?). Eyes 2, 4, 6, 8, 10, many or none. Respiratory organs absent or in the form of lateral fissures on the head, which conduct the water to the proximity of the hearts. Complete circulation with two hearts. Digestive tube simple, with the aperture of the mouth situated ventrally (rarely terminal), and a terminal anus. Sexes separate; in each a stimulating copulating organ. Testicles and ovaries similar in structure except as regards contents (ova or spermatozoa), numerous, and placed laterally in each segment." The author thus confounded the ganglia with hearts, and hence was led to believe that the cephalic fissures were connected with respiration, in so far as they permitted a closer relation between the sea-water and the contents of the supposed hearts. He had a fair notion of the digestive system, but he misinterpreted the physiology of the proboscis. He arranged the sub-order into two families and eight genera, thus:—

[1] 'Beiträge zur Fauna Norwegens,' &c., pp. 231—237.

[2] 'Comptes Rendus,' tom. xvii, Dec., 1843, p. 424.

[3] 'Ann. des sc. nat.,' 3ème sér., tom. i, pp. 20-21.

[4] 'Entwurf einer systematischen und speciellen Beschreibung der Plattwürmer,' &c. Copenhagen. 1844.

I. *Fam.* NEMERTINA.

Mouth inferior; anus terminal.

(1) Body filiform, equally attenuated at either extremity (head indistinct); no respiratory fissures.

a. Mouth and ovaria or testicles considerably removed from the snout. Genus 1. *Cephalothrix.*

b. Mouth and ovaria or testicles not much removed from the snout. Genus 2 *Astemma.*

(2) Body linear, rounded, more or less dilated anteriorly (head distinct), respiratory fissures distinct or none.

a. Head distinguished from the body, no respiratory fissures. Genus 3. *Borlasia.*

b. Head not distinguished by a constriction from the rest of the body, respiratory fissures more or less distinct.

α. Eyes in groups. Genus 4. *Polystemma.*

β. Eyes 8—16, biserial. Genus 5. *Nemertes.*

γ. Eyes 4. Genus 6. *Tetrastemma.*

(3) Body linear-oblong, flattened, equally obtuse at either extremity, respiratory fissures distinct. Genus 7. *Cerebratulus.*

II. *Fam.* AMPHIPORINA.

Aperture of the alimentary tube terminal. Genus 8. *Amphiporus.*

The foregoing classification, being founded on external appearances, could not be expected to stand, the more so as the writer's knowledge of the anatomy of the groups was imperfect.

In this author's 'Inaugural Dissertation'[1] (for M.A.), published about the same time, mention is made of the Nemerteans and other marine animals occurring in the Sound—in the various zones, viz. those of the Trochi, Gymnobranchs and Buccini (corresponding with the Littoral, Laminarian and Coralline of Forbes). Little or no additional information on the subject is obtained in this work, mainly on account of the difficulty in recognising his species. He does not note the presence of any in the Laminarian zone.

Mr. H. Goodsir, in 1845, made some remarks on certain of the Anopla, viz. *Serpentaria fragilis* and "*Nemertes gracilis*," but his observations are characterised by serious structural defects, apparently from too limited observations.[2] He termed the nerve-ganglia and cords the testicles, and this upon the faith of his microscopic researches. He considered the alimentary canal, again, a space common to the respiratory, digestive, and generative systems; his digestive tract being the proboscis. He thought that in *Serpentaria* each of the "annuli," or fragments, contained all the elements of the perfect or original animal, viz. a male and female generative apparatus, the

[1] 'De regionibus marinis.' Havniae, 1844.

[2] "Descriptions of some Gigantic Forms of Invertebrate Animals from the Coast of Scotland." 'Ann. Nat. Hist.,' vol. xv, p. 337, pl. 20, f. 1—3. 1845.

cavity common to the generative, digestive, and respiratory functions, and a small dorsal vessel analogous to the intestinal canal of Nemertes.

A very interesting brochure on the Nemerteans[1] was contributed by Prof. Kolliker in 1845, a paper, I may remark, which has received too little attention from some continental writers. After indicating the ordinary characters of the group, the author gives a general account of their anatomy, correctly describing the mouth, alimentary canal and anus, the situations of the ganglia and the branches of the lateral nerves. He also notes the occurrence of lenses in the eyes of certain species. He is in error, however, when he states that he found two hearts with coloured blood in the head of *Nemertes roseus*, and that the proboscis is attached to the wall of the body posteriorly. He observed the stylet-apparatus in several species. His classification of the Nemerteans was founded, somewhat curiously, upon the presence or absence of a sheath to the proboscis, thus:—(1) With the proboscis floating freely in the body-cavity; body ciliated, and smoothly rounded. (2) With a smooth body, and the proboscis confined in a sheath. The latter group he again subdivided into (*a*) those with a flattened head and lateral furrows, and (*b*) those having neither a flattened head nor lateral furrows. He describes ten species, most of which are stated to be new. One of these is the strange *Nemertes carcinophila*, which he found in an apparently parasitic condition amongst the ova of the common shore-crab.

Dr. Johnston, in his 'Index to the British Annelides'[2] (1846), described a few additional Nemerteans; but this paper does not require further mention at present, except to observe that he arranged his species under five genera, viz., *Borlasia*, *Lineus*, *Serpentaria*, *Meckelia*, and *Prostoma*, which were comprehended by the Sub-family *Linina* of the Family *Planariadæ*, Tribe *Nemertinea* and Order *Apoda*.

In the same year (1846) M. de Quatrefages published his observations on the Nemerteans,[3] but as a more complete edition of his acute and comprehensive labours (especially as regards figures) subsequently appeared, I shall in the meantime reserve further criticism. A notice of this paper, with an appendix of his classification, was given in Froriep's 'Neue Notizen.'[4] Before the appearance of the foregoing, he had also made some remarks on the proboscidian fluid and circulation of the Nemerteans in his "Note sur le sang des Annélides" in the previous volume V of the 'Annales.'

This author observes[5] that he had found in the rocks of Solenhofen certain imprints which he considered difficult to attribute to other than Nemerteans. The impressions indicate cylindrical coiled animals, resembling these worms after immersion in alcohol. In the chips of stone from Strasbourg he thought the forms referable to the Genus *Borlasia*, and especially resembling *Lineus marinus*.

In 1847 the celebrated J. Müller[6] described and figured *Pylidium gyrans*, as a larva from Heligoland; but he did not then find out its connection with the Nemerteans, and indeed was in doubt as to its actual relations.

1 'Verhandlungen der Schweizerischen Naturforschenden gesellschaft bei ihrer Versammlung zu Chur, 1844,' pp. 89—93. Chur, 1845.

2 'Ann. Nat. Hist.,' vol. xvi (Supplement), pp. 433—462, pl. xv.

3 "Études sur les types inférieurs de l'embranchement des annéles. Mémoire sur la Famille des Némertiens" (Nemertea). 'Ann. des sc. nat.,' 3ème sér., Zool., tom. vi, pp. 173—303, pls. viii—xiv.

4 Froriep's 'Neue Notizen,' bd. xxxix, 1846, p. 276. From the 'Institut,' No. 660, 26 Aug., 1846.

5 "Soc. Philom. Extr. Procès verb. 1846." 'L'Institut,' xiv, 1846, No. 664, p. 154.

6 'Archiv für Anat.,' 1847, p. 159, taf. vii, f. 1—4.

Dr. Joseph Leidy[1] in the same year (1847) published notes on what appears to be a small freshwater Nemertean (*Prostoma marginatum*), but his remarks are so indefinite that they are of comparatively little value.

Frey and Leuckart next made some excellent observations, in their 'Beiträge' (1847), on the structure of the Nemerteans.[2] They described the ciliated coating, and pointed out that in these animals the spike-cells (Nesselorgane) present in the Planariæ were wanting. They mentioned two muscular coats—an outer longitudinal and an inner circular coat, and that the nerve-trunks lay on the inner side of the latter. The differences in regard to the ganglia of Tetrastemma and Borlasia were shown, the authors demonstrating the shape of the organs in the former by a drawing from *Tetrastemma variabilis*, of which, however, no additional mention is made. The cephalic sacs in Borlasia (*Lineus*) were thought to be appendages of the ganglia. They did not enter into the structure of the proboscis further than to mention that it has longitudinal and circular muscular fibres; but they correctly observed that its muscular ribbons were attached to the wall of its sheath, within which sheath a fluid with corpuscles existed. They did not know whether the generative products escaped through the body-wall, or by rupture at the posterior end, as in *Arenicola*; and at any rate rupture of the body-wall might ensue for this purpose, for it was not very likely that these products escaped into the body-cavity. Lastly, they compared the Nemerteans with the Flukes and Trematoda. On the whole they correctly appreciated most of the structures detailed by them.

The only book of Renier's which I have been able to examine is the posthumous volume on the zoology of the Adriatic, edited by Professor G. Meneghini (1847).[3] In this work the mouth of the Anopla is thought to be the genital opening, and the aperture for the proboscis the mouth. Little attention is paid to the proboscis, and the anatomy of the group in general is much less precise than that of Delle Chiaje. The drawings, also, which accompany the text, are indifferent. Six species are described, only one of which, however, appears to be British, viz., *Siphonenteron elegans* (Renier), which Meneghini avers is identical with the *Valencinia ornata* of De Quatrefages, and therefore with the common *Carinella annulata* of Montagu.

E. Blanchard in 1847 gives a brief but important notice of the structural position of the *Nemertina*, Ehrenberg.[4] After having shown the principal differences between the Anévormes (*Bdellomorpha*, *Dendrocœla*, and *Trematoda*), the Cestoidea and the Helminths, he contrasts the whole with the Nemerteans. (1) In regard to the *Nervous system*. He considers the cephalic ganglia of the Nemerteans analogous to the sub-intestinal ganglia of the other annelids; and states that their disposition quite differs from that of the Anévormes in general, and the Planarians in particular. They have no closer analogy with the Nematoidea in this respect. (2) The *Circulatory system*, he observes, presents nothing in common. (3) *Digestive system*. He follows M. de Quatrefages in describing the digestive canal (proboscis) as simple in the Nemerteans, whereas in the Planarians it is branched. (4) *Generative system*. He agrees with the former author also in regard to his designating the Planariæ and Trematoda *Turbellaria monoïques*,

[1] 'Proceed. Acad. Nat. Sc. Philadelph.,' vol. iii, 1847, pp. 251-2.

[2] "Zur Kenntuiss vom Bau der Nemertinen," 'Beiträge zur Kenntuiss Wirb. Thiere,' &c., pp. 71—8 and 150, taf. i, f. 14—16. Braunschweig, 1847.

[3] 'Osservazione postume di Zoologica Adriatica del Professore Stefano Andrea Renier,' edited by Prof. G. Meneghini. Venezia, 1847.

[4] 'Ann. des sc. nat.,' 3ème sér., Zool., tom. viii, pp. 123—127, pl. ix, f. 5.

while the Nemerteans are *Turbellaria dioïques*. As regards the separation of the sexes, the Nemerteans approach the Nematoda, but the configuration of their organs is entirely dissimilar. He hints at other differences in connection with the teguments and form of the body, but adds that in a rigorous examination these are of secondary importance. He concludes with the following remarks:—"Thus having shown how the Nemerteans differ from the Planarians in their entire organization, having exhibited these differences to be profound and characteristic, having demonstrated how far they diverge from the Nematoda in essential structure, we arrive at the necessary conclusion that the Nemerteans constitute a group quite unlike those with which we have been contrasting them, and that their affinities do not link them more closely to the Nematoda and Annélides in general than to the Planarians in particular." The author thus rather exaggerated the gulf between the latter and the Nemerteans, being misled by the erroneous observations of M. de Quatrefages on the digestive system.

In the same paper M. Blanchard goes on to describe *Cerebratulus liguricus*, one of the Anopla, chiefly with respect to its circulation. He mentions that on account of the delicacy of Nemertean tissues he had to add a small proportion of a salt of mercury to the sea-water, so as to enable him to inject the vessels. He states that the dorsal vessel shows no ramifications, but passes forwards to the cephalic region to unite with the two lateral vessels by the communications around the proboscis and nerve-centres, the latter being bathed by the circulating fluid. He contrasts this arrangement with the observations of M. de Quatrefages, but he was not aware that essential differences exist in this respect between the Anopla and Enopla. He saw transverse ramifications between the lateral vessels, and appears to have noticed the network in the œsophageal region, though he speaks of an internal lateral vessel, of whose presence we are unacquainted. He thought that transverse ramifications of the longitudinal vessels existed in all the Nemerteans, for he also observed them in *Polia geniculata*, Delle Chiaje, and in a *Valenciuia* of undetermined species; and agreed with M. de Quatrefages as to the presence of proper walls to the vessels. The Nemerteans, therefore, have a vascular network comparable with that in the Annélides, presenting nevertheless differences in anatomical disposition. The circulatory apparatus in these worms is perhaps more complete than that of the Aporocéphales (Planarians) or the Trematoda; for the dorsal vessel seems to carry the blood forwards, and the lateral backwards, though the oscillations are irregular. He would place the Nemerteans, consequently, in a division adjoining the Annélides, both on this account and the higher development of their nervous system.

Von Siebold,[1] in 1848, took the bold step of severing the Nemerteans from the Planarians by the intervention of the Rotatoria; and though we would not approve of such disjunction, the soundness of his decision in separating them from the Helminths can scarcely be questioned. He arranged them as the first Order of the Ringed worms:—

Order I. *Apodes.*—Body without bristles. Sub-order I. *Nemertini.*—Body posteriorly without an anus (Ausangeorgane); head often with lateral respiratory fissures.

His information is derived from Rathke and other observers.

This author subsequently gave abstracts of various papers on the Nemerteans in the 'Archiv für Naturgeschichte.'[2]

[1] 'Lehrbuch der Vergleichenden Anatomie,' von V. Siebold u. Stannius. Berlin, 1848.

[2] 'Archiv für Naturgeschichte,' 1850, p. 382, &c.

In a subsequent paper in the 'Annales' for 1849,[1] M. Blanchard adopts the general anatomy of the Nemerteans given by M. de Quatrefages, and agrees with the latter in thinking that the affinities of the group lie rather with the Helminths than the Planarians, on account of the erroneous view with regard to the cæcal nature of the digestive tract. Moreover, in all the known Aporocéphales (Planarians) the sexes are united in one individual, whereas in the Nemerteans they are separate. The latter likewise have a veritable œsophageal collar, which is wanting in the former. He proposes the name *Aplocœla* as distinctive of the characters of the group (the simplicity of their intestine), and thinks that the title Nemerteans should be applied only to a tribe or family. No fresh observations are produced in this paper, and the errors in regard to the digestive system are rendered more conspicuous.

M. de Quatrefages at this time published his valuable and extensive observations, begun at the *Iles Chausey* in 1841, and carried on subsequently at St. Malo, St. Vaast-la-Hougue, Brehat, Sicily, &c., on the anatomy and zoology of the order, with additional coloured plates, in the second volume of the 'Voyage en Sicilie,' the joint work of Milne Edwards, Blanchard, and himself.[2] The author, after giving an account of the history of the group, proceeds to treat of their characteristics and classification thus:—

Nemertians.—Nervous system distinct, composed of two lateral lobes united above by a slender commissure, beneath by a broad sub-œsophageal commissure, and giving origin to two isolated longitudinal nervous trunks. Circulatory system shut; circulation complete. Alimentary tube simple; proboscis exsertile; intestine cæcal. Sexes separate; reproductive organs placed at the sides of the abdominal cavity, and occurring throughout the entire length of the body. Surface quite smooth, covered with vibratile cilia. He distinguishes his six genera as follows:

NEMERTIANS	Nerve-trunks entirely lateral in position	Mouth subterminal, inferior			*Valencinia.*
		Mouth terminal	Body very long	Very flat	*Borlasia.*
				More or less rounded	*Nemertes.*
			Body short	Very proteiform	*Polia.*
				Form less variable	*Cerebratulus.*
	Nerve-trunks sublateral				*Œrstedia.*

This arrangement, from the inaccuracy and limited extent of his observations in regard to the position of the nerve-trunks in the various groups, is useless; and the subordination into genera rests upon an equally unreliable basis. Not a few in his list of thirty-two species are forms previously known, though described as new worms—several more than once; and it is to be remarked that some of the very common specimens, *e.g. Lineus gesserensis* and *L. sanguineus*, are not mentioned, or else are so described as to be unrecognisable.

He characterises the animals as chiefly nocturnal in their habits, with the exception of *Polia*

[1] "Recherches sur l'organisation des Vers," 'Ann. des sc. nat.,' 3me sér., Zool., tom. xii, pp. 28—35.

[2] 'Recherches Anatomiques et Zoologiques faites pendant un Voyage sur les côtes de la Sicilie et sur les divers points du littoral de la France,' par MM. H. Milne Edwards, A. de Quatrefages, et Emile Blanchard; deuxième partie, pp. 85—220; pls. ix—xxiv, par A. de Quatrefages. Paris, 1849.

mandilla (*Amphiporus lactifloreus*), and notices the ease with which the latter species can be kept in confinement. He remarks that his captive specimens thrust out their proboscides and stylets, probably for the purpose of capturing the Infusoria that swarmed in his vessels. Moreover, he also saw a little *Polia* attack a Cyclops. I am, however, of opinion that all the interesting motions he witnessed in such cases were accidental, and not due to predaceous habits. There is no wonder he found no débris of food in the proboscis, since this is not at all an alimentary organ. He observed their tolerance of pressure between glasses under the microscope, and the fatal result of immersion in fresh water, but gave no remarks of importance in regard to the reproduction of lost parts.

In the second division of the memoir he discourses on the anatomy of the Nemerteans, and it may suffice at present only to allude to his results. He was certainly one of the first to anatomise the animals in a truly scientific manner, and his drawings of structure, though scarcely accurate, are very beautiful. He is wrong in averring that a fibrous layer exists in connection with the dermal tissues; his muscular coats of the body-wall (external longitudinal and internal circular) agree neither with the arrangement in the Enopla nor with that in the Anopla; the description of the general cavity of the body is obscure and misleading, and he located the corpuscular fluid there instead of in the proboscidian sheath; he altogether went astray in his interpretation of the proboscis, which he took for a digestive system (dividing it into proboscis, œsophagus, and intestine), and even his anatomy of the organ (proboscis), as it exists, is erroneous. He only examined the circulation in the Enopla. He confounded the generative with the true digestive system, and, indeed, fell behind the early observations of Dugès in this respect.

In the third part he treats of the analogies and zoological affinities of the Nemerteans, which he regarded as the degraded representatives of a more elevated type. While descanting on their general structure and relations, he observes that the organic apparatus presents the same complication in the large *Lineus* as in the minute *Tetrastemma*, but the elements (of such structure) undergo a degradation in the latter; a statement which is somewhat obscure, since the types of the forms differ entirely. For the same reason his comparison of the integuments of *Borlasia angliæ*, *Nemertes balmea*, and *Polia filum*, is fallacious. He points out that no part of the vascular system is in immediate contact with the respiratory surface, while the vessels are always plunged in the liquid of the abdominal cavity, which he therefore considers as the active agent in nutrition. He compares this corpuscular fluid to the *chyle*, for, he says, into it the products of digestion are transmitted directly from the alimentary tube (proboscis); further, it resembles the *lymph*, because it receives the internal products of the organism; finally, it is like the *blood*, because it is the direct agent in the nutrition of the eggs, and, since it bathes the muscular coats of the body, it is also charged with their nourishment. With so formidable an array of functions for this (proboscidian) fluid, it is no wonder he asks—whether the contents of the blood-vessels merit the name of blood? He was not aware, however, that this fluid is enclosed within a special muscular sheath, and nowhere comes in contact either with blood-vessel, body-wall, or ovaries.

With regard to systematic arrangement, M. de Quatrefages retains the class *Turbellaria* of Prof. Ehrenberg, exclusive of *Gordius* and *Nais*, and which he would apparently link on to the *Trematoda* of M. Milne Edwards. He does not altogether place the Planariæ and Distomæ together, but mentions that if further researches should reveal the same vascular apparatus in the former as M. Blanchard has found in the latter, then there is no obstacle to their sequence. He regarded the *Rhabdocœla* as intermediate between the Planarians and Nemerteans; resembling the former by the general disposition of their genital organs, the union of the sexes, and the organs of the senses; the latter by the simplicity of the digestive canal and the disposition of the vascular and nervous systems. He places the Nemerteans under the second sub-class of the Turbellaria, for which he advances the term *Miocœla*,[1] thus:

CLASS.	SUB-CLASSES.		ORDERS.
TURBELLARIA	TURBELLARIA "MONOÏQUES"	Intestine ramified . . .	*Dendrocœla.*
		Intestine simple . . .	*Rhabdocœla.*
	TURBELLARIA "DIOÏQUES"	. . . .	*Miocœla.*

Various authors have followed more or less closely the descriptions and classification of De Quatrefages. Milne Edwards, for instance, in 1859 gives a summary of the views then known with regard to the Nemerteans, but inclines to the side of his distinguished countryman. Hence he observed that he considered it premature to decide as to the presence or absence of an anus, and to declare the fundamental structure of the digestive apparatus. This publication of M. de Quatrefages constitutes an important era in Nemertean literature, and, notwithstanding its errors, shows that the talented author strove to extend our knowledge of the structure of obscure invertebrate animals, at a time when such work was less common, and the instruments for minute research less complete.

In 1849 R. Leuckart[2] describes a Nemertean under the name of *Amphiporus Neesii*, Œrst., which in all probability refers to the common British form. He correctly locates the position of the mouth in the Anopla, but he does not define its position in the former (one of the Enopla) further than by mentioning that it is on the ventral surface, and in the form of a small fissure without swollen lips. The other species, viz. *Nemertes fusca*, *N. annellata*, and *Polia canescens*, described in this paper, I have not been able to determine.

The publication of the 'Systema Helminthum' of C. M. Diesing in 1850 is chiefly interesting in regard to his classification of the group.[3] He arranged the Nemerteans as the third tribe of his second order (*Turbellaria*) of his first sub-class and section *Achaethelminthα*. He characterised them as worms having a very contractile body, for the most part flattened or rounded, much longer than broad. No anus. Sexes distinct. This tribe (Nemertinea) he divided into four sub-tribes, according to the presence or absence of lobes or fissures, viz., *Holocephala*, *Lobocephala*, *Ptichocephala*, and *Rhagadocephala*, distinguishing the genera according to the presence or absence of eyes, position of the mouth, so-called genital aperture, and other evident external characters. The complete confusion apparent in the incongruous grouping of the genera by the author makes it advisable to dwell no longer on this phase of Nemertean history. His classification is quite worthless, and could only have been constructed by one almost totally unacquainted with the animals otherwise than from descriptions, which, unfortunately, were too often misleading.

[1] From μειόω, to diminish, and κοιλία, intestine.

[2] "Zur Kenntniss der Fauna von Island," 'Archiv für Naturges.,' 1849, p. 149.

[3] 'Systema Helminthum,' vol. i, pp. 182 and 183, and pp. 238—277. Vindobonæ, 1850.

A valuable paper on the embryology of Nemertes was produced by E. Desor in 1850,[1] which for the first time disclosed the remarkable development in certain of the Anopla. His observations were made on a species, from the shores of New England, allied in the closest manner to the common British *Lineus gesserensis*. The ova are laid in the form of flask-shaped capsules, each of which contains from one to seven yolks. Desor discovered that after a time the yolk becomes ciliated, and that the young *Lineus* emerges from this ciliated investment, so that just before extrusion there are two spheres of ciliation, viz. the external coating, and the skin of the contained embryo.

Dr. Joseph Leidy[2] described in 1850-51 a species of Rhynchoscolex (*R. simplex*), which is probably a Nemertean, and a new genus, *Emea*, constructed for the reception of a freshwater species from the neighbourhood of Philadelphia. He calls the proboscis the alimentary tract, and the stylet-region a gizzard armed with a dental apparatus. In the former, he states, are numerous villose appendages (evidently referring to the glandular papillæ of the proboscis). He recognised the proboscidian fluid and its corpuscles, but he defined it only as occupying the interior of the body. His statement that the generative system consists of two tortuous and capacious tubes is also open to doubt.

In a second paper in the same volume[3] he mentions *Meckelia lactea*, n. s., a form which can swim like an eel. This is evidently one of the Anopla, yet he terms the mouth the generative aperture.

In a third communication[4] he makes some amendments in the description of his genus *Emea*, apparently after having seen the memoirs of De Quatrefages. He now observes that the *œsophagus* is styliferous, being "furnished at its bottom with a single spine or nail-like tooth, and four others on each side in a rudimentary condition, enclosed in a sac." He likewise says that the *intestine* becomes obliterated posteriorly, whereas he formerly stated that the mouth and anus were terminal.

In a paper remarkable only for the unsoundness of the views contained therein, Mr. Charles Girard, in 1851, proposed to class the Nemerteans and Planarians with the Mollusca, and not with the Annelids at all.[5] It is scarcely necessary to enter into his theories, but it may be interesting to note that this reformer rests his conclusions on so many grounds (with special reference to the Nemerteans) as the following:—Their soft, glutinous, ciliated body; their simple nervous system, consisting of a small number of cephalic ganglia; their eye-specks, development and habits.

Dr. Max S. Schultze published an important work during the same year on the *Turbellaria* of Ehrenberg, accompanied by exquisitely engraved copper plates.[6] The Nemerteans, however, were but briefly alluded to in the third part of the treatise, under the heads of *Prorhynchus stagnalis* and *Tetrastemma obscurum* respectively. The former is chiefly interesting on account of the atrophied condition of the proboscis and its stylet-apparatus, which the author considered to be an aggressive organ, poison being instilled into wounds by the contraction of the posterior chamber. It forms an advantageous comparison with the aberrant *Nemertes carcinophila*.

[1] 'Boston Journ. Nat. Hist.,' vol. vi, No. 1, pp. 1—12, pls. 1 and 2.
[2] 'Proceed. Acad. Nat. Sc. Philadelph.,' vol. v, p. 125.
[3] Ibid., pp. 223 and 224.
[4] Ibid., pp. 287 and 288.
[5] 'American Journ. Sc.,' 2nd ser., vol. xi, No. 31, pp. 41—53.
[6] 'Beiträge zur Naturgeschichte der Turbellarien.' Erste Abtheilung. 7 pls. Greifswald, 1851.

Many valuable remarks occur in the article on *Tetrastemma obscurum* concerning the proboscis, the development of the stylets, the position of the mouth, the digestive and circulatory systems. He over-estimated the relation of the marginal stylets to the central, for he thought that the former supplied new organs to the latter. He also confounded the circulatory with a water-vascular system. He, however, exhibits great care and accuracy in his observations, which put Nemertean anatomy on a sounder footing than it had hitherto held.

He divided the Turbellaria into two sub-classes, thus:

Classis Turbellaria.

I. Sub-classis *Aprocta*.

1. Ordo Dendrocœla.
2. ,, Rhabdocœla.

II. Sub-classis *Proctucha*.

1. Ordo Arhynchia.
2. ,, Rhynchocœla (Nemertina).

This classification has been adopted by Dr. Rud. Leuckart in the appendix to Van der Hoeven's 'Handbuch der Zoologie.'

Dr. Thomas Williams, in his 'Report on the British Annelida,' at this time[1] propounded several erroneous statements in relation to the anatomy of the Nemerteans. Thus, while correctly regarding the sacculated chamber as connected with the digestive system (though he denied the existence of an anus), he called the ganglia "hearts," and wrongly averred that the "œsophageal intestine" (proboscis) terminated in a distinct papillose outlet situated a short distance behind the cephalic extremity of the body, as in the Sipunculidæ. His attempt to prove the homology between his "closed alimentary chamber" and the spongy mass in *Tænia* rests upon no secure foundation, and does not stand the light of the correct investigations of that period or the present; and the same remark applies with respect to his grouping *Gordius* with the Nemerteans.

An interesting addition to our knowledge of the development of the group was made by Dr. W. Busch, who at this stage gave a drawing and description of a novel animal from the harbour of Trieste, on which he bestowed the name of *Alardus caudatus*.[2] This is evidently the young of a *Micrura*, and J. Müller afterwards connected its growth with that of his *Pylidium*. Dr. Busch termed the aperture of the proboscis the mouth, did not recognise the proboscis (though its position is indicated in his figure), and was puzzled by the cephalic sacs, which, as usual in the young of the Anopla, were very large.

Dr. Thos. Williams in 1852 again introduces the subject of the Nemertean "chylaqueous fluid," in his paper "On the Blood-proper and Chylaqeous Fluid of Invertebrate Animals."[3] Here he also confounds the corpuscles in the proboscidian sheath with the contents of his "alimentary cæca."

[1] 'Report of the Brit. Assoc.,' 1851, pp. 238, &c., pl. xi.

[2] 'Beobachtungen über Anat. u. Entwickelung einiger wirb. Seethiere.' Berlin, 1851, p. 111, taf. xi, f. 8.

[3] 'Philos. Transact.,' 1852, part ii, p. 627, pl. xxxii, f. 25.

During the same year (1852) Dr. Max Müller[1] gave an account of certain structures from the proboscides of an unknown *Meckelia* and *Alardus caudatus*, which he termed bacillary bodies, and some of those from the first-mentioned form contained long urticating threads. These bodies are the elements of the glandular papillæ, and I have not as yet seen such (urticating) organs in the British species, although fine processes and mucus-threads occasionally project from the summits of the papillæ under pressure.

In the zoological sketches of Dr. Max Schultze, published at this time, the researches of E. Desor on development are reviewed and corrected from observations on *Nemertes obscura*, a species which the author considers identical with Dr. Johnston's form (*Lineus gesserensis*). He also issues a very important scheme for the arrangement of the Nemerteans, which scheme is founded on the basis advanced by Dr. Johnston many years before, viz. the absence or presence of stylets in the proboscis. It is as follows:

Nemertinea.

Central nervous system consisting of two ganglia on each side, an anterior and posterior, which have two commissures, a superior and inferior, between which the proboscis passes.

Anopla.

Proboscis without stylets.

The ganglia united at their anterior border by a long and slender dorsal commissure. The lateral nerve-trunk springing from the anterior portion of the anterior ganglion, so that the posterior end is rounded. The ventral commissure common to both ganglia.

On each side of the head is a large and often very shallow furrow, having a small ciliated pit at the posterior end.

Enopla.

Proboscis with stylets.

Anterior border of the ganglia rounded. The dorsal commissure in the form of a small band between the dorsal surfaces of the ganglia. The lateral nerve-trunks forming a continuation of the posterior ganglia. The ventral commissure common to both ganglia.

The long cephalic furrow absent; but there are ciliated pits.

Though his classification is by no means complete, it certainly marks a decided advance on the schemes of his predecessors.

Few modern naturalists have done more to advance our knowledge of the habits of these unfamiliar forms than the late Sir John Graham Dalyell, whose patience and perseverance—not devoid of intuitive skill—are worthy of all praise. In the second volume of his 'Powers of the Creator' (1853),[3] he describes about twenty British species. Several of these, however, refer to different states of the same animal, but all can be readily identified with the exception of *Vermiculus crassus*. He grouped the Nemerteans under three genera, viz. fourteen under *Gordius*, five under *Vermiculus*, and one under *Planaria*. He thought they might be classified thus:—(1) Those wanting specks or eyes; (2) those where specks of an indefinite number were evidently present; (3) those with two eyes; and (4) those with four eyes. If this worthy naturalist had lived to superintend the publication of the volume, several inaccuracies which had been overlooked in his earlier notes would have been corrected, as, for instance, the remark under

[1] 'Observat. Anatom. de Vermibus quibusdam maritimis.' Berolini. 1852.

[2] 'Zeitsch. für wiss. Zool.,' Bd. iv, p. 179. 1852.

[3] 'The Powers of the Creator displayed in the Creation,' &c., vol. ii. London, 1853.

Lineus marinus, that he was not aware the animal had a proboscis, for he distinctly refers to this organ in other species. He also correctly observed the true mouth in the Anopla, since he saw the animals feeding, and recorded many interesting facts with regard to the deposition of ova. The great *Gordius fragilis* has not been procured since he found it, so far as can be ascertained. The figures in this work are executed with care, and most are coloured. R. Leuckart, in his abstract of the literature of the Turbellaria for 1858[1] furnishes the synonyms of the majority of the species described by this author.

In the same year (1853) Charles Girard gives descriptions of some new Nemerteans from the coasts of the Carolinas, for which he establishes several genera.[2] He interprets the true mouth in the Anopla as the aperture of the generative system, while he terms the proboscidian aperture the mouth. The description of his *Stimpsonia*, as it appears in this paper, differs from *Bipalium* in several important particulars.

Dr. Thomas Williams[3] likewise published, in 1853, an account of the method of aquatic respiration in invertebrate animals, and specially refers to the "Nemertidæ" as having the whole of the digestive chamber filled with a corpuscular fluid, which, he states, carries out this important function. He shows a drawing of the alimentary system of a species named *Nemertes camillæ*, which may be synonymous either with *N. gracilis* or *N. Neesii*, probably the former. He still erroneously places the anus towards the anterior end, and avers that the organization of the "Nemertine Annelida" conforms in every essential particular to that of the Cestoid Entozoa.

Next year C. Gegenbaur[4] mentions that he frequently found *Pylidium gyrans* at Messina, and gives remarks on its structure. From his description it would appear that he found the Nemertean *Pylidium*, but did not quite interpret its full relationship. He noticed that it differed from the Echinoderm-*Pylidium*, and at first thought that the whitish oval body in its interior had been swallowed, but the occurrence of others of the same species convinced him of the connection between the two.

In his 'Archiv' for 1854 J. Müller adds still further to our information on the development of the Nemertean *Pylidium*.[5] He recognises the identity of the contained body with the *Alardus caudatus* of Dr. Busch, and gives a somewhat better figure of the worm, with a normal arrangement of the caudal process; and his remarks on its structure are likewise more correct. He mentions the fact that *Micrura fasciolata*, Ehrenberg, has a terminal process, but does not state the identity of the two, since his young form possesses only two eyes, whereas the former has ten. In this paper he also notes certain experiments with hot water which he performed on *Meckelia somatotomus*, Leuckart.

Dr. E. Grube,[6] in his introductory remarks on the Nemerteans (in 1855), criticises the interpretations of the proboscis adopted by M. de Quatrefages, and points out that the true digestive apparatus lies below the former, each system opening by a definite aperture in the snout of the Anopla. He thought it probable that the Nemerteans used the proboscis after the manner of

[1] 'Archiv für Naturges.,' 1859, pp. 187 and 188.

[2] 'Proceed. Acad. Nat. Sc. Philadelphia,' vol. vi. 1853, pp. 365-367.

[3] 'Ann. Nat. Hist.,' 2nd ser., vol. xii, pp. 341, &c., plate xiii. figs. 1 and 2.

[4] 'Zeitsch. für wiss. Zool.,' Bd. v, 1854, p. 345.

[5] 'Archiv für Anat.,' 1854, pp. 75—81, taf. 4, f. 2—8.

[6] "Bemerkungen über einige Helminthen u. Meerwürmer," 'Archiv für Naturges.,' 1855, pp. 145—152, taf. 7, f. 1—4.

the elephant, viz. for squirting fluid containing prey into their mouths. In this paper several species are described, viz. (1) *Meckelia annulata*, the greenish form with white stripes previously mentioned, which, if it had a terminal process, would be closely allied to *Micrura fasciolata*. (2) *Meckelia aurantiaca*, a species (of Micrura) with a caudal process. (3) *Ophiocephalus auripunctatus*, one of the Anopla. (4) *Nemertes purpurea*, Johnst., probably a reddish variety of *Lineus gesserensis*. (5) *Nemertes lactea*, a species intimately connected with the *Lineus lacteus* of Montagu.

In the same year (1855) W. Stimpson[1] gave descriptions of some Nemerteans from the China, Japan, and other seas. He considered the mouth to be the genital fissure. Two of his species, viz. *Valencinia annulata* and *Meckelia olivacea*, seem to be identical with those found in Britain, at least so far as one can judge from descriptions. External characters are chiefly relied on, and the accounts of the species are comparatively meagre.

Dr. J. E. Gray,[2] in 1857, made a few remarks on a large *Lineus*, which he had received from Mr. Beattie, of Montrose. He correctly called the longitudinal slit the mouth, and provisionally termed the animal *L. Beattiei*. Four lithographic figures are given in the plate connected with this paper, the three upper from the ventral surface of the snout in various degrees of contraction, and the fourth a side view in semi-contraction. The preparation in the British Museum is labelled by Dr. Baird "*Serpentaria fragilis*," and in all probability he is correct. It is a very large specimen, although fragmentary.

In the 'Icones Zootomicae' of Carus, Dr. Max Schultze contributes a paper on the structure of the Nemerteans, chiefly of *Tetrastemma obscurum*.[3] He supplies no definite account of the floor of the anterior chamber of the proboscis, or of the stylet-region, and the structure of the latter is not advanced in detail beyond his previous description. The marginal stylets are still termed reserve-stylets. No œsophageal division of the digestive tract is shown. He has endeavoured to reconcile his older and incomplete representation of the circulatory system with modern views by carrying the lateral trunks (which, in his previous figure, resembled the pale border of the proboscidian sheath) into the snout, and introducing a central vessel from end to end. As might be expected under the circumstances, however, some confusion occurs; thus, the central vessel is carried forward in the snout in front of the ganglia to the middle of the arch, instead of sending off the anastomotic behind the ganglia to join the lateral vessels. The arrangement of his water-vascular system is something quite different from anything seen in our examples. In his former delineation I considered he had mistaken the ordinary blood-vessels for a water-vascular system, but now, since he has put in the three main trunks as an entirely distinct series, our decision is the more accurate. The author is somewhat confused in this matter. He gives two new figures, one of which (*Tetrastemma*) correctly indicates the proboscidian bodies in the interior of the proboscidian sheath, while the other is by no means a characteristic figure of *Lineus gesserensis*, inside a sheath of ova.

Mr. Beattie,[4] without reference to the Nemertean previously sent to Dr. Gray, goes on, in the 'Proceedings of the Zoological Society' for 1858, to relate that he had received a very long

[1] 'Proceed. Acad. Nat. Sc., Philadelphia,' vol. vii, pp. 381 and 389. 1855.
[2] 'Proceed. Zool. Soc.,' part xxv, 1857, p. 210, Annulosa, pl. 17.
[3] 'Icones Zootomicæ,' J. V. Carus, part i, tab. 8, f. 10—15. Leipzig, 1857.
[4] 'Proceed. Zool. Soc.,' part xxvi, 1858, p. 307.

example of *Lineus longissimus*, which after four days' captivity produced a cream-coloured young one 18 inches long, and about two thirds of a line or $\frac{1}{18}$th of an inch in diameter. This "young animal" lived about a week after its expulsion. Dr. Gray adds that Dr. Baird had examined the specimen produced, and thinks it very probably the true offspring of the Nemertes. An examination in the British Museum shows that the "young animal," or "tubus cibarius," as the latter lamented observer afterwards named it, is the proboscis, probably, of *Cerebratulus angulatus*.

In the 'Archiv für Anatomie' for the same year, Dr. A. Krohn[1] repeats and confirms Müller's observations on the Nemertean *Pylidium*, and it may be mentioned that this author independently discovered the connection of the structure with a Turbellarian in 1851. The editor (J. Müller) appends a note to this paper, stating that *Micrura* of Ehrenberg is identical with *Alardus*, Busch, and he gives a list with the synonyms of four species of *Micrura*.

An elaborate article on the Nemertean *Pylidium* subsequently appeared in the same volume of the 'Archiv' (1858) by Leuckart and Pagenstecher, who found two species at Heligoland, viz. *P. gyrans* of Müller, and another which they termed *P. auriculatum*.[2] They traced most minutely the development and relations of the various organs in the embryo of *P. gyrans* (one of the Anopla), but the origin of the *Pylidium* itself had hitherto escaped notice. Their species had no style or caudal process after extrusion. Two eyes are developed before the worm separates from the *Pylidium*. Their account was the best on the subject until the appearance of E. Metschnikoff's recent paper.

In the same year (1858) W. Stimpson gave in his 'Prodromus' a list, with brief descriptions, of the Nemerteans collected in the United States' expedition to the Northern Pacific, and grouped his species under old and new genera, which were arranged to suit the views of the author. His classification is as follows :—

A. A ventral aperture situated under the head or neck. No eyes.

a. Lateral fissures on the sides of the head.

1. Body of the ordinary form.

Under this group he places *Lineus*, Sowerby, *Cerebratulus*, Renier, *Meckelia*, Auct. limit., and *Serpentaria*. The statement concerning the absence of eyes is erroneous.

2. Body rolled at the edges.—*Diplopleura*.

b. No lateral fissures.

1. Proboscidian aperture terminal.—*Tæniosoma*, n. g.

2. Proboscidian aperture subterminal.—*Valencinia*.

B. No ventral aperture. Eyes two or many.

a. Fissures or furrows at the margins of the head.—*Dichilus*, n. g., *Tetrastemma*. Hemp. and Ehrenb., *Cephalonema*, n. g., *Emplectonema*.

b. Without pits or furrows.

1. Eyes two.—*Diplomma*, *Dicelis*, n. g., *Polystemma*, Hemp. and Ehrenb., *Polina*, n. g., *Tatsnoskia*, *Cosmocephala*.

[1] 'Archiv für Anat.,' 1858, pp. 289—293.
[2] 'Archiv fur Anat.,' 1858, pp. 569—587, taf. 19.

By his first great division, based on the presence or absence of the ventral aperture (by which he probably means the mouth), the Enopla are in a rough way separated from the Anopla, but the classification, being founded on external characters, fails just where it is most wanted. The author considerably extends the limits of the known species, and gives an interesting chronological list of the genera.[1]

Dr. E. Graeffe[2] next furnishes an account of a yellowish-green *Tetrastemma* from Nice, which is remarkable in having lenses to its eyes, and in possessing what he terms otolithes. The presence of the latter organs, if no misconception occurred, is something very different from anything seen by us in the British Nemerteans, but is analogous to the otolithes described by several authors in other invertebrates, such as the Mollusca.

Dr. Thomas Williams, in a morphological paper, published in 1858, committed some serious errors in his interpretation of the Nemertean generative organs, which, he said, coincided in shape, place, and structure, with the ovarian or female series of the Hirudinei.[3] Moreover, he asserted that they corresponded in number not with the cæca of the alimentary canal, but with the annuli of the body, a statement requiring some further proof, since it is very doubtful if the term annuli can be used in any sense with respect to the Nemertean body, which is not in truth segmented. His representation of the ovaria or female segmental organs in *Polia quadrioculata* is imaginary, for the organs are reversed, made bifid at one end, and filled with minute cells,—conditions at variance with nature. He thought that the Nemerteans should be separated from the Planarians by a very wide interval; indeed, he affirmed that they had only one character in common, viz. the ciliated integument. This cannot be supported in the sense he means, though the gap between the two is by no means narrow.

Gegenbaur[4] the following year arranged the Nemerteans under the sub-class *Platyelminthes*, order 3, *Turbellaria Rhynchocœla*. He followed De Quatrefages in regard to the general anatomy of the animals.

Schmarda at this time described many foreign Nemerteans, which he had collected during his voyages, in a finely illustrated work.[5] He divided the order *Nemertinea* into two sub-orders—based on the absence or presence of the "respiratory organs," and termed respectively *Abranchiata* and *Rhochmobranchiata*. The former he portions into families according to the shape of the head; the latter is similarly divided, in conformity with the number of the supposed branchial furrows or fissures. He gave the opinion, in his introduction, that the structure of the stylet-region of the proboscis might be of service in classifying the smaller species, but was utterly useless in the larger forms, and those preserved in museums, hence he was obliged to take the former mode of discrimination. But it is impossible to study such animals with any degree of accuracy as spirit-preparations, without first having investigated them as living subjects. It is unnecessary to give

[1] "Prodromus descriptionis Animalium Evertebratorum, quæ in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa," &c., part ii, *Turbellariorum Nemertineorum*; 'Proceed. Acad. Nat. Sc.,' Philadelphia, 1858, pp. 159—165.

[2] 'Beobachtungen über Radiaten u. Würmer in Nizza,' pp. 53 and 54. Zurich, 1858.

[3] "On the Structure and Homology of the Reproductive Organs of the Annelids," 'Philos. Trans.,' 1858, pp. 131—132, pl. 8, f. 24.

[4] 'Grundzüge der Vergleichenden Anatomie.' Leipzig, 1859.

[5] 'Neue Turbell., Rotat. u. Anneliden beobachtet u. gesammelt auf einer Reise um die Erde, 1853 bis 1857,' i, 1; Introd., pp. xiii and xiv, and pp. 10—16, taf. 9—11. Leipzig, 1859.

minute details of the classification, since it appears to be little else than a confused grouping. In the first place, it has not yet been proved that these furrows and fissures are branchial; secondly, the locating in the family *Holocephala* genera so widely divergent as *Valencinia*, De Quatrefages, and *Ommatoplea*, Ehrenberg, the arranging under two different sub-orders of the closely allied forms *Œrstedia* and *Tetrastemma*, and the statement that in *Micrura* the head is furnished with a single terminal transverse fissure, are certainly sufficient to shake our faith in the author's knowledge of the subject.

An interesting contribution to the anatomy and zoology of the Turbellaria was published by M. van Beneden in 1860,[1] the Nemerteans occupying the first part of the memoir. He correctly observed the apertures of the generative organs along the sides, but erroneously considered that the proboscis floated in the general cavity of the body. He had good reasons for supposing that the coat of the digestive tract combined the functions of the liver as well as an alimentary organ proper. His anatomy of the cephalic sacs in the Anopla was inaccurate. He discovered that some of the embryos in *Nemertes communis* were ciliated in the ova before laying; and his observations on the development of *Polia involuta* (*Nemertes carcinophila*, Kölliker), form the most valuable portion of the memoir, though he was wrong in supposing that one form was evolved out of the other, like a *scolex* engendering a *proglottis*. He also made the mistake of placing the mouth of the Enopla (ex. *Polia obscura*) behind the ganglia, instead of in front of them. His memoir is illustrated by four lithographic plates, some of the figures being coloured.

E. Claparède, in his remarks on *Tetrastemma varicolor*, Œrst., and another from Skye,[2] in 1861, clearly pointed out the duct to the marginal stylet-sacs. He considered the latter to be the receptacles for stylets rejected from the central apparatus, and he combated the contrary view held by Max Schultze. While he observed the cavity of the reservoir, he fell into the error of calling the posterior chamber the muscular retractor of the organ. He also notes the form of the papillæ in the proboscis of *Cephalothrix lineata*.

In 1862 Diesing produced a 'Revision' of the *Turbellaria*,[3] the Nemerteans being placed under the second Tribe *Rhynchocœla*, some of them occurring after the Families *Rhynchoscolecidea* and *Gyratricina* in his sub-tribe *Rhynchocœla Aporocephala*, and the rest under a second sub-tribe *R. Porocephala*. The former contains the families *Borlasiea*, *Ommatophora*, *Micrurea*, *Hypoloba*, and *Acroloba*; the latter *Prorhynchidæ*, *Emeidea*, *Typhlonemertinea*, *Loxorrhochmidea* and *Eunemertinea*. The confusion and errors in this *brochure* are not fewer than in the preceding, and render it almost beyond the pale of criticism.

The most important and at the same time the most recent publication of note on the Nemerteans is that of Professor Keferstein, from observations made at St. Vaast-la-Hougue.[4] It will be necessary to enter somewhat minutely into this contribution, which marks another era in Nemertean literature. He first treats of their classification as follows:—

[1] 'Recherches sur la Faune Littorale de Belgique,' extrait du tome xxxii des 'Mémoires de l'Academie Royale des Sciences de Belgique,' 1860.

[2] 'Recherches Anat. sur les Anélides, Turbellariés, &c., observés dans les Hébrides.' Genève, 1861.

[3] "Revision der Turbellarien, Abtheilung Rhabdocœlen." 'Sitzungsb. d. Kais. Akad. d. wissensch. Wien.,' 1862, pp. 199—204 and 247—306.

[4] 'Zeitsch. fur wiss. Zool.,' Bd. xii, pp. 51—90, taf. 5—7, 1862.

Order.—NEMERTINEA.

Sub-order I.—NEMERTINEA ENOPLA, *Max Schultze.*

Proboscis furnished with a stylet-apparatus.

Fam. 1.—TREMACEPHALIDÆ.

The fissures of the head short, of a transverse (linear) form, or funnel-shaped. Brain with the superior ganglion less elongated than the inferior, and separated by an almost free border from the latter; the lateral nerve springing from the posterior end of the inferior ganglion, or almost a continuation thereof.

(A) *Tremacephalidæ* without the lobe-shaped front of the head.

Gen. 1. *Polia,* Delle Chiaje, 1825. Head easily distinguished from the body, narrowed anteriorly, without eyes. Mouth near the anterior end. Body diminished posteriorly.

Gen. 2. *Borlasia,* Oken (char. reform.). Head not distinguished from the body, mostly with eyes. Mouth in some removed the breadth of the head from the anterior end. Body less diminished posteriorly, and generally somewhat short.

Gen. 3. *Œrstedia,* Quatref., 1846. Head not distinguished from the body; lateral nerves coursing near the median line, not, as generally, entirely confined to the sides.

(B) *Tremacephalidæ* with the lobe-shaped head anteriorly.

Gen. 4. *Micrura,* Ehrenberg, 1831. Head not distinguished from the body; anteriorly with a transverse fissure, so as to form an upper and under lip, between which the proboscis emerges. With eyes. Mouth situated about the breadth of the head from the anterior end.

Gen. 5. *Prosorhochmus,* gen. nov. Head not distinguished from the body, snout with three lobes, the anterior border being heart-shaped, with the third lobe placed dorsally (over the notch). The track of the proboscis separates the inferior lobes anteriorly. With eyes. Mouth placed a pair of head-breadths from the anterior end. Body moderately long and contractile.

Gen. 6. *Lobilabrum,* Blainville, 1828. Head not distinguished from the body, anterior end with four lobes; this anterior end is separated into an upper and a lower lip, between which the proboscis passes; and, again, the border is heart-shaped (emarginate), the upper more deeply than the under, so that it seems to be provided with two tentacula.

Sub-order II.—NEMERTINEA ANOPLA, *Max Schultze.*

Proboscis not supplied with a stylet-apparatus.

Fam. 2.—RHOCHMOCEPHALIDÆ.

The cephalic fissures are long, and occupy the entire side of the head. Brain with the upper ganglion covering the inferior completely; the lateral nerve springing from the side of the inferior ganglion in front of its posterior and pointed ending.

(A) *Rhochmocephalidæ* without the lobe-shaped snout.

Gen. 7. *Lineus*, Sowerby, 1804. Head easily distinguished from the body, somewhat broad. Mostly without eyes. Cephalic fissures extending to the mouth. Posterior part of body almost pointed, flat, very long and contractile, sometimes knotted.

Gen. 8.—*Cerebratulus*, Renier, 1807. Head not distinguished from the body, somewhat smaller, but ending bluntly. Cephalic fissures extending to the mouth. Body not smaller towards the posterior end, flat, moderately long and slightly contractile.

Gen. 9.—*Nemertes*, Cuv. (char. reform). Head not distinguished from the body. Cephalic fissures long, extending to the mouth. Mostly with eyes. Body flat, moderately long and contractile.

(B)—*Rhochmocephalidæ* with the lobe-shaped snout.

Gen. 10.—*Ophiocephalus*, Delle Chiaje, 1829. Head distinguished from the body, somewhat smaller, but ending bluntly, the snout having a deep median groove on the dorsal and ventral surfaces, so that it appears bilobed. Cephalic fissures long, extending to the mouth. No eyes. Body long.

Fam. 3.—GYMNOCEPHALIDÆ.

The cephalic fissures entirely lost. Brain like that in *Polia*, but the superior ganglion covers the inferior much less. The lateral nerve proceeds from the entire side of the inferior ganglion, or is almost a continuation thereof.

Gen. 11.—*Cephalothrix*, Œrsted, 1844. Head not distinguished from the body, very long and pointed. The mouth lies more than the breadth of a head from the anterior end. Body rounded, very long, filiform, and very contractile.

No fault can be found with the primary subdivisions or sub-orders (after Max Schultze), and the family-name *Tremacephalidæ*, as applied to the *Amphiporini*, is not seriously wrong, but the sub-families and genera of this portion require complete reformation. His criterion of the "absence of the lobe-shaped snout" does not stand the author in good stead if we may judge from the genera he has thrown together in the sub-family. The first of his genera (*Polia*) seems to me to be in a questionable position, since the Nemertean described by Delle Chiaje under the name of *Polia siphunculus* is, so far as I can make out, one of the Anopla. The second genus, *Borlasia*, has a very unfortunate name; for, while I agree with the author as to the propriety of preserving the title commemorative of the early English naturalist, it certainly ought not to be bestowed on a group of Nemerteans totally different in structure from that form (*Lineus marinus*) to which the name was originally given by Oken. The author has simply followed De Quatrefages in the formation of the third genus *Œrstedia*, the anatomy of which, especially the position of the nerve-trunks, differs in no respect from the type of the Enopla. A still more serious error has been committed with the fourth genus, *Micrura*, this being a true member of the Anopla, and having no connection with *Tetrastemma*, Ehrenberg, or other representative of the Enopla. The fifth genus, *Prosorhochmus*, may be allowed to stand, as descriptive of a curious example of the Enopla, closely allied to *Tetrastemma*, discovered by the author. The sixth genus, *Lobilabrum*, was constituted by De Blainville for a form pertaining to the Anopla, and, therefore, is quite out of place in its present position. There are, perhaps, fewer errors of commission in his second sub-order (*Nemertinea Anopla*), though his description of the family requires some additions, and the application of the test of the "lobe-shaped snout" is of no moment. The genus *Lineus* is good, but *Cerebratulus*, the next or eighth genus, requires further examination. The ninth genus, *Nemertes*, seems quite superfluous, for the *Notospermus drepanensis* of Huschke will fall under other genera. It appears to be an example of the Anopla. The tenth genus, *Ophiocephalus*, is also very much open to doubt, since the *Ophyocephalus murenoides* of Delle Chiaje may be a variety of *Lineus marinus*. His third family (*Gymnocephalidæ*) is certainly worthy of separation, and the sole genus, *Cephalothrix*, is satisfactory.

The second part of his memoir is occupied with a description of several species. Amongst these, his *Borlasia splendida*, n.s., is the *Cerebratulus spectabilis* of De Quatrefages; *Nemertes octoculata*, n.s., had often been described before; while *Cephalothrix ocellata*, n.s., and *C. longissima*, n.s., may conveniently, as well as correctly, be included under the well-known form *Cephalothrix linearis*.

The third division is devoted to the anatomy of the group. He did not recognise the differences existing in the muscular system of the body-wall of the various types; the position of the mouth in the Enopla was misunderstood; and he had no correct knowledge of the true relations of the muscular sheath of the proboscis, or of the minute anatomy of the wall of the latter. He did not discriminate with sufficient accuracy the cephalic sacs and the posterior ending of the ganglia in *Lineus*. While the author went astray in these and several other anatomical points, he made advances of considerable interest in others, so that his paper is a valuable and most praiseworthy contribution on the Nemerteans. Keferstein's classification, with all its imperfections (and a few superadded), has been adopted by J. V. Carus in his 'Handbuch der Zoologie.'

Diesing now issued a third *brochure* on the subject,[1] bringing the literature up to the time; but he did not alter his arrangement, except when introducing "new" genera, many of which, however, had previously appeared in his publications. On the whole, the labours of the writer have chiefly been of value in rendering us acquainted with the various papers relating to the Nemerteans; and it will be the safest course for the investigator simply to regard these works in this light, and to remember that the author had the disadvantage of being unacquainted with the living animals, and strove to be of use to science even when attacked by a great misfortune.

E. Claparède, in a memoir[2] published shortly after Keferstein's, makes some further remarks on *Prosorhochmus Claparedii*. He mentions that he had seen ova in the body of the adult worm, and doubts the correctness of Professor Keferstein's statement, that he had found three stylet-sacs in a young specimen, since there are only two in this and other Nemerteans. He also describes a new species of *Tetrastemma*, viz., *T. marmoratum*, which, however, is only the *T. dorsalis* of Abildgaard; and, lastly, he adds a note on *Œrstedia pallida*. His observations were made on the coast of Normandy.

In the following year, Dr. Cobbold[3] did not hesitate to place the *Turbellaria* amongst the Sterelmintha; yet I am unable to find out any sound reasons in his description for this grouping, to which I am inclined to object. He arranges them as the first order, *Turbellaria*, under the

[1] 'Nachträge zur Revision der Turbellarien.' Sitzungsb. d. Kais. Akad. d. wissensch. Wien, 1863 (46 Bd.), p. 5.

[2] 'Beobachtungen über Anat. u. Entwicklung. wirb. Thiere,' &c., pp. 23 and 24, taf. v. f. 10—14. Leipzig, 1863.

[3] 'Entozoa: An Introduction to the Study of Helminthology,' &c., chap. i. London, 1864.

first sub-class of his Helminths (Sterelmintha), the second order being the *Trematoda*. He states that "the *Turbellaria* come nearer to the Trematoda than they do to the Suctorial Annelids, which latter, be it remembered, are furnished with a complete intestinal tube and anus; and, moreover, their characters, by the intervention of the Planarians, are too closely linked on to the Trematoda to permit their being elevated by themselves into a separate class." He divides the *Turbellaria* into two families, *Planariadæ* and *Nemertidæ*. Further, "in common with the *Trematoda*, the Turbellarians have their bodies composed of soft parenchymatous tissue, and in this loose substance the various specialized organs are lodged, without the intervention of any perivisceral cavity. Some of the animals have a flattened form, others are cylindrical, while a third kind are remarkably attenuated, and more or less barred by transverse rugæ, which form, as it were, a series of spurious joints or articulations. The mouth and digestive apparatus are well developed, but there is no certain evidence as to the existence of an anus in any of the species." It is not the case that the Turbellarians (any more than the Flukes) have their bodies composed of "soft parenchymatous tissue," for their cutaneous and muscular systems are highly developed and differentiated; and, while the Planarians are no doubt allied in external form, and in the branched condition of their digestive system, to the Trematoda, yet they are still more closely connected with the Nemerteans, which diverge so much from any parasitic worm recorded by this or any other author. With as much reason, I fear, we might place *Sagitta* amongst fishes, and *Amphioxus* amongst worms, as assert that "the Nemertidæ very closely resemble the common tapeworms, or Cestodes, properly so-called—not only by their band-like forms, but more particularly by their tendency to display transverse rugæ, which, as before remarked, acquire a certain degree of regularity." His observations on the anatomy of the Nemerteans are behind date; and in the recent 'Supplement'[1] he seems to have avoided the subject altogether. From what I have seen of the structure of the Flukes and Tapeworms, there would appear to be a considerable margin left for the minute anatomical investigators of the future.[2]

The Nemerteans are placed by Dr. Johnston, in the 'Catalogue of the British Museum,' under Ehrenbergs order *Turbellaria*, forming the second sub-order *Teretularia* of De Blainville.[3] Considerable errors still remain in the author's views as to the structure of the group; thus the mouth is stated to be terminal, and to give passage to the proboscis; while the anus is said to open well forward on the ventral surface in some, and in others at the posterior extremity. The mouth in the Anopla is called a genital orifice. Little is added to the information previously published by the author or others up to the time of his lamented death; and thus the work is thrown far behind date. His two genera, *Cephalothrix* and *Astemma*, are synonymous, while the others pertaining to the Enopla and Anopla are so mixed up that the value of the work is greatly impaired. Several species are described more than once under different names. Still further confusion is propagated in the Appendix by the observations, under the general characters of the *Teretularia*, that there is no anus; that there are two hearts; and that the female aperture (often mistaken for a mouth) is situated, "sometimes below the head, sometimes large and sucker-like, sometimes posterior and nearly terminal, when it has been mistaken for an

[1] London, 1869.

[2] The recent paper on the latter group by Professors Sommer and Landois bears out the above remark, which was penned more than three years ago. See 'Zeitsch. f. wiss. Zool.' for March, 1872.

[3] 'A Catalogue of the British Non-Parasitical Worms in the Collection of the British Museum.' London, 1865.

anns." The early structural observations of Dr. Johnston are also reprinted from 'London's Magazine,' the 'Magazine of Zoology and Botany,' &c., with the plates, and quotations made from the work of Sir J. Dalyell. It would not be just to state that this treatise advances British science; but much must be overlooked in the circumstances of its publication. Its value chiefly lies in being the only English work on the subject.

Dr. Baird, in the 'Proceedings of the Zoological Society for 1866,'[1] gives an account of a new species of Monœcious worm, which is evidently one of the Anopla allied to the *Gordius fragilis* of Sir J. Dalyell (*Cerebratulus angulatus*), with the margins of the body produced as in the swimming forms. The author stated that the ventral slit led into the "visceral cavity," and agreed with many others in regarding the proboscis as the alimentary canal, and its aperture in front, the mouth.

The observations of Mr. Alex. Agassiz[2] carry those of the experienced Prof. Lovén[3] a stage further with respect to the development of a curious larva, which the former regards as Nemertean. The most remarkable feature is the discovery of a kind of retrograde metamorphosis which the young animal undergoes, whereby it loses its segmented form and its tentacles, and assumes the simple outline (but not the structure) of a Nemertean. Further remarks on this interesting communication will be found elsewhere.

In 1867 the author published a short paper on the Gregariniform Parasite of Borlasia.[4] The occurrence of this parasite was observed in several species, together with certain other parasitic ova in gelatinous mucus, which occupied the alimentary tract of the worms. Pseudonavicellæ were also mentioned. Various notes were further communicated in the author's Reports to the British Association.[5]

Professor Keferstein in 1868 made known the singular fact that, in one of the Enopla from St. Malo, he had found the anterior generative sacs filled with spermatozoa, and the posterior with ova; thus establishing the occurrence of hermaphroditism in this formerly diœcious group.[6] A. F. Marion, the following year, observed the same fact, also in one of the Enopla—from deep water off Marseilles.[7] This species had four eyes, each furnished with lenses; and it differed from that described by Keferstein further in not having the male and female organs arranged in separate parts of the body.

In the same year, a paper on the reproduction of lost parts in the Nemerteans was communicated by the author to the Linnean Society.[8] In this it was shown that each of the fragments into which *Lineus sanguineus* breaks becomes a perfect animal. Allusion was also made to the curious manifestation of acidity presented by the majority of the Nemerteans, and a few exceptions noted in a paper on the boring of the Annelids.[9]

[1] 'Proceed. Zool. Soc.,' Feb. 13, 1866.

[2] "On the Young Stages of a few Annelids," 'Ann. Lyce. Nat. Hist. N. York,' vol. viii, June, 1866; and 'Ann. Nat. Hist.,' 3rd ser., vol. xix, p. 208.

[3] 'Ann des sc. nat.,' sér. 2, xviii, p. 288. 1848.

[4] 'Journ. Micros. Sc.,' vol. xv, n. s., Trans., p. 38, pl. ii. April, 1867.

[5] 'Rept. Brit. Assoc.,' 1867, p. 92; and 'Rept. Brit. Assoc.,' 1868, p. 340.

[6] 'Archiv für Naturges.,' 1868, p. 102, taf. 3, f. 1 and 2; and 'Ann. Nat. Hist.,' ser. 4, vol. i, p. 229.

[7] 'Ann. Nat. Hist.,' ser. 4, vol. iv, p. 136.

[8] 'Proceed. Linn. Soc.,' Zool., vol. x, pp. 251—253, tab. 7.

[9] 'Ann. Nat. Hist.,' ser. 4, vol. ii, p. 293.

In 1869 a memoir was published by the author on the anatomy of the British Nemerteans (communicated to the Royal Society, Edinburgh, in April, 1868), in which many facts were recorded, it is believed, for the first time.[1] Their minute structure, from the skin to the proboscis, was described, the chief varieties indicated, and observations on the development of a few species appended. In this year also the outlines of a classification, founded on anatomical data, were brought under the notice of the same society.[2]

Excellent researches, by Dr. Elias Metschnikoff, on the development of the Nemertean *Pylidium*, from the deposition of the ovum from which the latter is evolved onwards, have recently appeared.[3] His observations were made on the ova of an elongated, whitish example of the Anopla at Messina, and on a species of *Pylidium* from Odessa; and his paper is illustrated by finely executed steel engravings. The chief details will be found under the head of the development of the Anopla, and therefore need not be further alluded to at present. In his summary many suggestive comparisons are drawn between the development of the Nemertean *Pylidium* and the well-known phases in the growth of the Tapeworms.

The veteran naturalist, Professor E. Grube, in his most interesting *brochure*,[4] recently published, on the marine fauna of St. Vaast-la-Hougue, refers to certain common Nemerteans found there. He observes that his boatman stated that the head of *Lineus marinus* was luminous, but this he did not personally witness. He also notices a blood-red flat worm, *Proceros sanguinolentus*, Qfg., with cephalic furrows.

A few notes on the Nemerteans are appended to a paper by Professor Ehlers "On the Vermes collected in the Sea of Spitzbergen."[5] Three new species are described from spirit-preparations, but this is a somewhat unsatisfactory mode of examination, unless careful accounts are kept of the animals in life.

[1] 'Trans. Roy. Soc. Edinb.,' vol. xxv, ii, pp. 305—406, pls. iv—xiv.

[2] 'Proceed. Roy. Soc. Edinb.,' vol. vi, pp. 545—548.

[3] 'Mém. de l'Acad. Imp. des Sc. de St. Pétersbourg,' viie sér., tom. xiv, no. 8, 1869.

[4] 'Mittheilungen über St. Vaast-la-Hougue u. s. Meeres-, besonders s. Annelidenfauna.'

[5] 'Ann. Nat. Hist.,' 4th ser., vol. viii, p. 60. Transl. from the 'Sitzungsb. der phys.-medic. Soc. zu Erlangen.,' June 7, 1871.

ANATOMY AND PHYSIOLOGY.[1]

General Conception, or Archetype of a Nemertean.

Fig. 1.

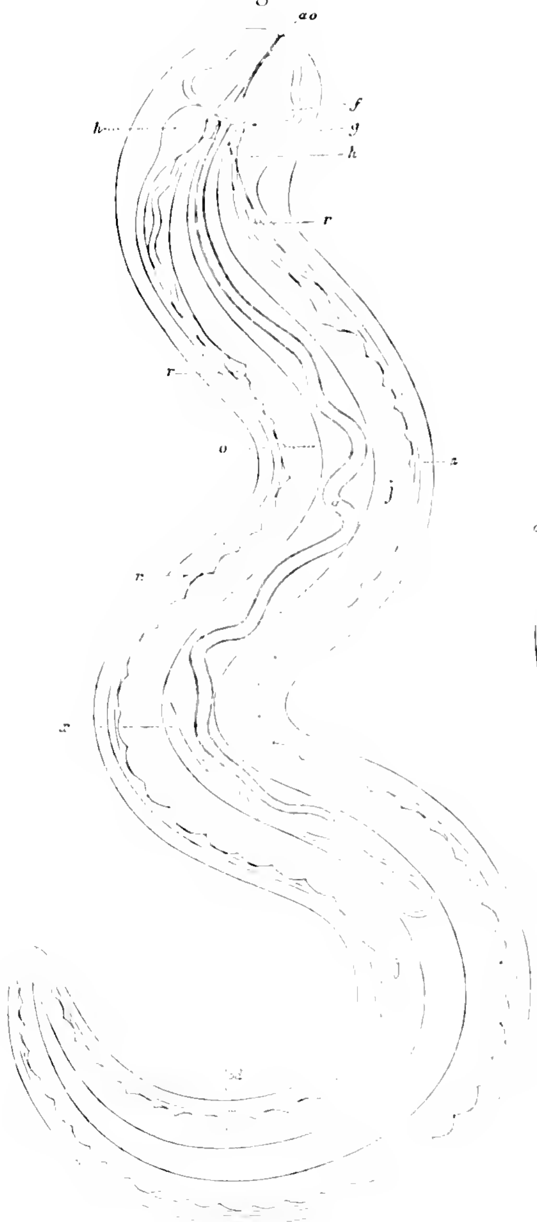
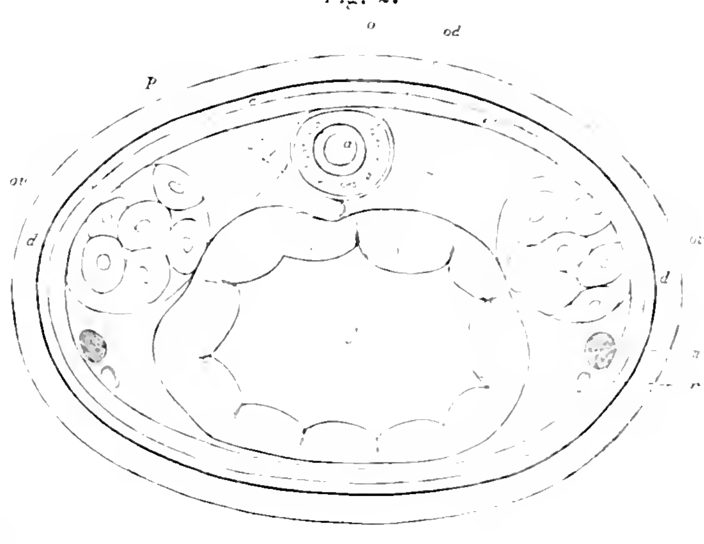


Fig. 2.



ARCHETYPE OF A NEMERTEAN.

FIG. 1. In its ordinary condition. FIG. 2. In transverse section.

a. Proboscis. *ao*. Aperture in snout for proboscis. *b*. Cutis or [illegible] and *c*. Muscular [illegible] of the [illegible]-wall. *f*. Superior commissure. *g*. Inferior commissure. *h*. Ganglia. *j*. Digestive chamber. [illegible] Lateral nerves. *o*. Muscular sheath for proboscis. *od*. Proboscidian chamber containing [illegible]rpuscles. [illegible] Dorsal [illegible]-vessel. *r*. Lateral blood-vessels. *ov*. Ovaries. *z*. Muscular ribbons.

[1] A description of the anatomy of the group was published by the author in the 'Transactions of the Royal Society of Edinburgh' (vol. xxv); but so many additions, both in text and drawings, were necessary, that this could not be allowed to stand. Accordingly the whole has been rearranged.

The essential character or archetype of a Nemertean may be thus described:—A soft vermiform body, covered with cilia, and furnished with a thick glandular cutis, beneath which the body-wall is composed of several strong, specially disposed muscular layers. Through the centre of the body-cavity (and entirely beneath the nerve-commissures in front) passes the digestive canal, which has two well marked divisions, an oral aperture anteriorly, and an anal posteriorly, and is richly ciliated throughout. The nervous system consists of two conspicuous cephalic ganglia, united by a double commissure, and giving off posteriorly a large lateral nerve-trunk, which passes backwards on each side to the tail. The circulatory system is composed of a series of closed contractile vessels. Along the median line of the dorsum lies a special muscular sheath, containing a complicated proboscis, and a highly organized corpuscular fluid, both the sheath and the proboscis passing between the commissures of the ganglia in front. The sexual organs are in the form of sacs, placed between the muscular wall of the body and the digestive canal.

I.—Anatomy of the Enopla.

1. *Cutaneous System.*

The body of every example of the order is universally covered with cilia, the motion of which may be very well observed in some of the larger forms by placing them in good light under a lens. The proboscidian aperture, the mouth, and the tip of the tail, are generally furnished with longer cilia. The ciliary motion is most active in the cephalic furrows of this group.

In *Amphiporus lactifloreus* the skin is somewhat opaque, and presents a cellular, or cellulo-granular appearance (Plate X, fig. 6), the entire field being definitely covered with glandular cells, and the reddish pigment, when present, grouped in irregular granular masses. I have not been able to demonstrate the cuticle as a separate structure, on account of the softness and delicacy of the tissues. On removing a portion of skin from a living specimen, and placing it under moderate pressure, it presents the aspect of a series of ovate or spathulate cells (Plate X, fig. 5), which contain soft and minutely granular contents, interspersed with large, clear masses of mucous or gelatinous matter, having a similar figure, the latter becoming more abundant as the pressure increases. There are also numerous pigment- and other granules scattered over the field. Changes, however, rapidly ensue under pressure, and the contents of the cuticular spaces or areolæ pass rapidly to the nearest free border, and there accumulate as mucous and granular circular masses (Plate X, fig. 7 *a*, *b*). A transparent gelatinous basis-substance, having a reticulated aspect, remains after the extrusion of the foregoing elements from the skin.

When a transverse section is made of the integument, after hardening in spirit and mounting in chloride of calcium, the appearance (Plate X, fig. 4) is as follows:—In rapidly prepared and newly fitted specimens, a structureless mucous film is sometimes observed to separate from the exterior of the skin, as indicated by the double outline at the edge of the figure. Chloride of calcium dissolves this; and it has not been seen in those hardened in chromic acid. This is not an epiderm, but only an exudation of transparent mucus, and it is also observed in the living animal under pressure. The areolar cutis (*a*) is now much altered, and streaked perpendicularly, an appearance due to the collapsed condition of the spaces, the contents of which to a greater or less degree have escaped, and thus greater prominence is given to the hyaline and cellular substance. It is granular throughout, especially towards the outer and inner edges. In many transverse sections, pressure of the thin glass cover causes a change in each of the preparations, so that the more cellular appearance of the outer edge is partly due to the fact that the texture is seen from without, and not laterally. Towards the inner edge, the skin in this state sometimes assumes a crenate aspect, and adjoins a pale and structureless basis-layer (*b*), which separates it from the subjacent muscular walls of the body. In longitudinal sections of the textures, particularly in those much hardened, or slightly exposed to air, spurious annulations are caused by the folding inwards or wrinkling of the skin (Plate XVI, fig. 2), but such crenations do not affect the muscular layers, and have no connection with the diverticula of the digestive chamber, or, as supposed by some of the older authors, with true annuli. A thin longitudinal section from the surface of the integument shows a series of meshes with crenated edges, the size of the spaces being variable. In *Nemertes Neesii* and *N. gracilis*, the cells or areolæ of the skin are smaller than in *A. lactifloreus*, the former having much dark pigment in its cutaneous textures dorsally; and the surface in *N. gracilis* sometimes presenting the appearance of microscopic mosaic work, from the beauty and fineness of its areolæ. In a young specimen, apparently of *A. [illegible]* (?)[1], transverse section demonstrates that while most of the longitudinal pigment-belts on the dorsum are in the cutaneous tissues outside the circular (external) muscular layer, two very well-marked stripes lie quite within both the latter and the longitudinal muscular coat. They are placed on each side of the arch of the proboscidian sheath, and doubtless are the cause of the darker appearance which characterizes the median bands when viewed from the dorsum. Similarly, in *Tetrastemma Robertianæ* the rows of pigment, constituting the two brown stripes on the dorsum, are at the inner border of the cutis—touching the circular muscular coat; while the median white stripe is placed within the longitudinal layer, exactly over the proboscidian canal. The reddish-brown pigment in the Zetlandic variety of *Tetrastemma candida* is also chiefly developed towards the inner margin of the cutis. Much brownish colouring matter is produced in the skin of the pale Amphiporidæ after prolonged confinement, and thus fresh examples from the rocks are always necessary for the more minute investigations. This is well marked in *Prosorhochmus*, where the pigment-cells and granules form a kind of meshwork by the looping of the rows.

The chief function of this elaborate glandular arrangement is, no doubt, the secretion of the abundant mucus, so characteristic of these animals, and which is often of a most tenacious description. I have seen a specimen of *A. lactifloreus* rapidly form an investment by this means, when placed in a vessel containing a little sand; and whether the sand-particles simply adhered to the gelatinous mucus by accident or otherwise, the animal took full advantage of the protection. The silky sheaths of *Tetrastemma dorsalis* are also examples of this cutaneous secretion. The same habit of tube-forming is extensively followed by the Amphiporidæ of our southern shores, apparently to protect themselves from the increased danger of desiccation. On placing a living specimen on a glass slip, and causing it to emit some mucus, the secretion proves to be a minutely granular fluid, intermingled with a few larger corpuscles; and it is produced by the entire surface of the skin, both in this group and in the Planariæ, not by any special portion thereof, as supposed by Mr. Darwin in the latter animals. One of the densest tubes is formed by *Nemertes carcinophila*, Kölliker, (Plate VI, fig. 5, and more highly magnified in fig. 6), and this has an

[1] This specimen was kindly sent, with other forms, by Mrs. Collings, of Sark.

areolar aspect, from the distribution of the granules or globules at intervals on the surface. Moreover, when viewed in profile, these globules are found to be elevated above the general surface, like a series of low pale warts. The tubes are attached to the hairs of the abdominal feet of female crabs (*Carcinus mænas*) bearing ova, and are evidently of intrinsic importance to the species, both as a protection against injury and desiccation. The very great change which ensues in the appearance of preparations deprived of the cuticular layer shows how important this is in giving character to the group. An interesting feature in regard to the skin of the Enopla (in common with the Anopla), is the reaction which ensues on testing with litmus-paper. An acid indication occurs in *Amphiporus lactifloreus*, *Tetrastemma melanocephala*, and *Nemertes gracilis*, amongst others, while a reaction not less distinctly alkaline is found in *Amphiporus pulcher* and *Nemertes Neesii*.

In regard to the chemical composition of the tubes secreted by these animals it may be remarked that Professor E. Grube submitted those of *Cerebratulus crassus* from Cherso to Dr. Lothar Meyer, who pronounced them to be formed of a substance closely allied to chitine. Tubes made by various British species are not much affected by strong acetic acid, and become pulpy only by prolonged action of *Liquor potassæ*.

The description of the tegumentary structures given by M. de Quatrefages differs materially from that just noted, a discrepancy arising partly from his confounding the structure of the Enopla with the Anopla, and partly from incorrect observations. His separation of the skin into two layers, the exterior composed of smaller, the interior of larger cells, is not evident in *Amphiporus*. Smaller cells sometimes do occur towards the ciliated surface, but the entire integument proper is continuous as a single layer. The only representative of his "fibrous" coat, which is described as lying within the former, is the structureless basement-layer. Max Schultze figures a small portion of the skin of his *Tetrastemma obscurum*, showing a series of large cells under the epidermis, with a few granular bodies interspersed, but the view is diagrammatic.

2. *Muscular Structure of the Body-wall.*

A very distinct belt of circular muscular fibres (Plate X, fig. 4, *c*), as in the Oligochaeta, occurs under the basement-layer of the cutis. The fibres are compact throughout, and less bulky than the next coat, with which their filaments do not mix. The succeeding layer (*d*) forms a powerful investment of longitudinal muscular fibres, and, in transverse section, is generally somewhat crenated on the inner border, and fasciculated throughout. The inter-fascicular substance is transparent and structureless, and evidently as mobile and contractile as the fibres themselves. Numerous fibrous bands stretch from the inner surface in connection with the various contents of the body. In common with the Anopla, the muscular tissue is furnished with a delicate yet complete sarcolemma. Thus there are only two distinct muscular coats of non-striated fibres around the body of the Enopla, making an essential difference in this respect between them and the Anopla, to which (latter) previous observers have for the most part confined their investigations. It will be observed, moreover, that in the general order of their muscular layers the Enopla agree with the Oligochæta.

Anteriorly the body-wall terminates in a rounded snout of the usual cutaneous textures, presenting in transverse section (Plate X, fig. 1) an areolar and granular appearance, the soft contents of the areolæ having for the most part escaped. The aperture for the proboscis perforates the tissues just at the ventral border of the tip. A remarkable interlacement of fibres, occupying almost the entire cephalic region, occurs in front of the ganglia (Plate X, fig. 3). Powerful bands (1) pass below both the buccal cavity and the tube for the proboscis, meet, and cross each other in an oblique manner, making afterwards, by their divergence, extensive lateral connections; indeed, it will be observed that towards the inner muscular layer the fibres just mentioned form a broad fan-shaped arrangement. Some (2) pass upwards by the side of the central canal, and mingle with those descending from this region, while others (3) curve downwards to the ventral wall. Those (4) meeting above the central canal intersect each other obliquely in the middle line, so as to constitute a firm arch; and, besides, there are some transverse fibres (5) which cross over the canal and spread out laterally. Another series (6) slants downwards and inwards on each side of the cavity, and forms a firm junction inferiorly. The arrangement of these bands and fibres is so intricate, that each seems to blend with the other, and make a continuous anastomosis of contractile meshes. In addition to these oblique and radiating fibres, a powerful longitudinal series is interwoven with them in a complex manner, besides the denser grouping (*e*) at the margin (which indicates the inner muscular coat of the body), and the glandular masses in the centre. It will be observed that the bands which pass beneath the central canal are the most powerful, and offer a much greater resistance to the bulging of the proboscis and its sheath than the superior fibres, so that in extrusion the organ is mainly directed upwards (Plate X, fig. 8). The inferior commissure of the ganglia is thus somewhat protected by the arrangement of the fibres in front of it. The blood-vessel (Plate X, figs. 3 and 9, *l*) lies on each side in a sheltered angle between two series of fibres; and its calibre would not seem to be much interfered with except in extreme protrusion of the proboscis, though this is not of much consequence in the economy of these worms. All the oblique or transverse fibres are connected with the body-wall and the inner muscular layer, as are also the longitudinal at the tip of the snout. This elaborate interlacement provides in the best possible manner for the varied changes which the region undergoes during protrusion and retraction of the proboscis, and the ordinary motions of a tactile and mobile, yet not too yielding snout. The arrangement of the oblique and circular fibres around the longitudinal layer of the central canal must also act the part of a constrictor, and adapt the cavity to its ever-varying calibre. On the whole, the stroma in this group, from the greater predominance of cellular and granular elements, is less dense than in *Lineus*, and the interlacement of the fibres, though not more complex, is more beautiful, because possessing greater distinctness and regularity.

The posterior end of the body does not present this intricate arrangement, but the muscular fibres blend together and close in the cavity, with the exception of the small and sometimes indistinct opening of the great digestive chamber. The modes of fracture of these muscular coats in certain of the *Amphiporidæ* in a sick and perishing condition are interesting, the animal being separated into a number of beads, from the constriction and rupture of the body-wall at somewhat regular intervals.

In specimens of *Amphiporus pulcher* from which the cutaneous textures have been removed by improper preservation, the muscular coating has a glistening aspect, and is marked by a conspicuous double row of genital pores along each side. This glistening appearance of the muscular layer on removal of the cutaneous tissues is also seen in certain Planariæ.

M. de Quatrefages described the muscular coats both in Borlasia and Nemertes (especially instancing *Nemertes balmea*, our *N. gracilis*), as consisting of "external longitudinal and internal transverse" fibres. In the Enopla, as just mentioned, it is exactly the reverse, the circular fibres being external, and the longitudinal internal. He also represented another layer, within the internal, as forming an aponeurosis, apparently referring to the fibrous prolongations from the internal or longitudinal coat. Physiologically, it is certainly a better arrangement for an animal possessing only two muscular coats, to have the longitudinal fibres internal, for, on the occurrence of rupture, they, as well as the other tissues, are clasped by the circular; whereas, in the supposed arrangement of M. de Quatrefages, the longitudinal are beyond the reach of the constricting belt. Other organs also in the same animal, such as the proboscidian sheath and long posterior gland, have their circular fibres exterior to the longitudinal.

The actions of this muscular system are very varied, and include swimming or floating on the surface of the water, an action performed, as in the Nudibranchiate mollusks, by aid of the mucous exudation, and not, as stated by M. de Quatrefages, chiefly by the cilia.

3. *Proboscidian Sheath or Chamber.*

In the Enopla this chamber originates just in front of the ganglionic commissures, and continues without interruption nearly to the posterior end of the worm. It is recognised in the living animal under the lens, or even with the naked eye, as that forming a pale dorsal streak, and containing a transparent fluid. The commencement of the chamber is constituted by a fold (Plate XV, fig. 4, *a*) from the tube of the proboscis becoming attached to the parenchyma of the head, or, in other words, instead of a canal (*ab*) simply hollowed out in the cephalic tissues, free and distinct walls to the proboscis become apparent at this point. The reflection is the anterior boundary of the proboscidian chamber under ordinary circumstances, and it is against the obstruction so formed that the wave of proboscidian fluid first impinges in the evolution of the proboscis. The cavity gradually increases in diameter, and again diminishes towards the posterior end, where it terminates in a distinct *cul-de-sac*, a short distance in front of the tail. Its general appearance varies much (Plate XV, fig. 3, and Plate X, fig. 10), according to the position, degree of extension or contraction of the animal, sometimes almost clasping the elongated proboscis, at others having its attenuated walls stretched over the doubled organ.

The various transverse sections of the worms also render the relations of the cavity more apparent. Like the proboscis, its anterior end passes through the ring formed by the arch of the superior commissure, the inferior commissure and the sides of the ganglia. The nervous matter must thus occasionally be very much stretched, or else the proboscis is rarely launched out. This will be more particularly noticed in the description of the ganglia, and a reference to Plate X, fig. 8, will suffice for the present. The inferior commissure separates it entirely from the ciliated œsophagus (Plate XI, fig. 1). In structure the wall of the chamber is distinctly muscular, as evinced by its ever-varying condition. The fibres, however, are much less powerful at its commencement (Plate XI, fig. 1, *o*) than they afterwards become (Plate XI, fig. 2, *o*). Externally it is furnished with a layer of circular, and internally with a series of longitudinal muscular fibres, both again becoming thinner posteriorly. The comparatively large size of the chamber during life has probably caused several observers to err, by confounding it with the supposed general cavity of the body. This may readily be understood by examining a transverse section (*e.g.*, Plate X, fig. 10) of an animal which has been preserved with a distended chamber; then, indeed, it seems to be the chief cavity of the body. The presence of the reproductive elements also has a considerable influence in modifying the size of the space, which in the ripe animal is pressed upwards and towards the median line, while in the spawned worm it expands freely in all directions. It is a mistake, however, to suppose, with M. de Quatrefages, that no chamber exists posteriorly in the ripe animal, for it holds the same anatomical relations from the ganglia to the tail as at other seasons, only its calibre is encroached on posteriorly, and the consequent distention by the proboscis and fluid makes it more conspicuous in front. The chamber is not continued throughout the body in long species, such as *Nemertes Neesii* and *N. gracilis*, and is absent in the aberrant *N. carcinophila*.

In the foregoing cavity the proboscis floats in a clear fluid, apparently first noticed by Pallas, rich in large flattened corpuscles, which possess a minutely granular appearance. In the living animal these generally have a fusiform outline, from a slight enlargement in the middle (Plate X, fig. 15, *b*). They are also accompanied by certain globules and granules. The corpuscles vary in size, and frequently adhere together in a dying animal, from the very coagulable nature of the transparent fluid in which they float; and occasionally fibrinous shreds may be observed attached to them under the same circumstances. The fluid, indeed, is highly organized, and very different from sea-water, to which Dr. T. Williams compares it. When the proboscis has been gently protruded under chloroform, the corpuscles in the interspace may by-and-by be seen grouping together, so as to form stellate bodies resembling miniature Solasters, spiked bodies like thornapples, flattened structures with pectinate ends, and various other forms. In *Tetrastemma melanocephala* the corpuscles are comparatively small, some being clear, spindle-shaped bodies, others granular and rounded. The enormous increase of cells and granular masses in the proboscidian fluid, after the rejection of a proboscis, is well seen in this species. In other *Tetrastemmæ* the corpuscles (Plate X, fig. 11), though similar in shape to those of *A. lactifloreus*, are comparatively large; and in a variety of *T. flavida*, which I am inclined to regard as the *Polia sanguirubra* of M. de Quatrefages, they are tinged pinkish or reddish by transmitted light (Plate X, fig. 11). All are not similarly tinted, some being pale, others yellowish, while many are bright red, the colour in each case being in the nucleus. Globular bodies and granules are present, as in *Amphiporus*. The skin of this specimen contained many minute reddish pigment-specks, so that to the naked eye it had a delicate salmon-pink appearance. Reddish granular masses occasionally occur in the proboscidian chamber of *A. lactifloreus*, and in various species of *Tetrastemma*, generally associated with reddish specks in the skin,[1] and it is curious that a rejected proboscis assumes the same hue by transmitted light. After extrusion into the water, the shape of the corpuscles soon alters, and they adhere together and become translucent.

Amongst the authors who have alluded to the proboscidian chamber, Delle Chiaje and Grube seem to have possessed a fair knowledge of its arrangement and structure. Œrsted, again, gives a small figure of a transverse section of his *Notospermus flaccidus*, and characterizes the cavity as "canalis in quo penis est," indicating by a blank beneath what is evidently the digestive tract. He thus did not advance the physiology of the parts further than Huschke, who called the proboscis a male organ, and the nerves semen-canals. His interpretation of structures, however, is more distinct in his section explanatory of the Family Amphiporina, in which the digestive cavity

[1] In the reddish-brown Zetlandic variety of *T. candida* the proboscidian chamber contains many brownish-red pigment-masses.

is correctly alluded to. The reflection of the wall of the proboscis before-mentioned, in front of the ganglionic commissures, is the only barrier (and a very effectual one) that separates the proboscidian chamber from the tissues of the head. In no species has such a cephalic diaphragm as represented by M. de Quatrefages been found; but the ciliated œsophagus, to be described hereafter, takes its place, and leads one to infer that the distinguished naturalist has misinterpreted the structure. Besides, the head is not a hollow organ, requiring such definition from the other parts of the body. The same author, while explaining a transverse section of *Nemertes Borlasii*, shows a canal surrounding the proboscis; but in his description he confounds it with the general cavity of the body, and figures the proboscis occupying the centre of the latter posteriorly. This account, no doubt, refers to one of the Anopla, but he states that the same arrangement occurs in the Amphiporidæ, and represents in a *Polia* a series of transverse fibres as forming a platform (*plancher*) at the anterior and upper portion of the general cavity of the body, indicating its presence in his figures by a dark shading. No such arrangement of transverse fibres has been seen by me, but the characteristic ciliated œsophageal chamber occupies this situation. The somewhat erroneous views he entertained with respect to the relations of the corpuscular fluid of the proboscidian chamber may be understood by a glance at one of his figures, which depicts in *Polia sanguirubra* the proboscidian bodies floating in what he terms the genital cavity, and in which the genital cæca are supposed to lie. I cannot corroborate his statement that these corpuscles become much more numerous at the epoch of reproductive activity. The diminished size of the chamber may cause them to crowd anteriorly, but this is not an increase. Dr. Johnston likewise confounded the proper sheath for the proboscis with the general cavity of the body; and Dr. Williams, who styled the canal the œsophageal intestine, stated that it opened externally on the side of the body not far from the head, after the manner of the Sipunculidæ. M. van Beneden alludes to the sheath in *Polia obscura*, and compares the fluid and corpuscles to pale blood. Prof. Keferstein does not describe the chamber with sufficient clearness, and mentions that the proboscidian corpuscles are placed in the general cavity of the body.

The structure of the special corpuscles, and the highly organized condition of the transparent liquid in which they float, point them out as being, in all probability, concerned in nutrition, as first mentioned by M. de Quatrefages, though he likewise associated generation therewith. Some very interesting questions, however, are raised by their entire absence in *Nemertes carcinophila*, especially to those who, like the late Dr. Williams, think the fluid analogous to the peritoneal or perivisceral fluid in the true Annelids, a fluid, we may remark, which Professor Huxley considers the true blood, while he imagines the red fluid in the branching vessels analogous to the water-vascular system in the Annuloida. If in *Nemertes carcinophila* the proboscidian fluid had been more important in nutrition than that in the vessels, it certainly would not have given way to the latter. It is to be remembered, too, that this absence coincides with the atrophied condition of the proboscis itself and all its apparatus. It cannot be affirmed, also, of the Nemerteans, that the fluid in the so-called blood-vessels is devoid of corpuscles, for they occur in several species. Again, I think there can be no doubt the fluid and corpuscles exercise a very important influence on the reproduction of the proboscis, a process hereafter to be described, as well as promote the absorption of the débris of the discarded organ when it happens to be included in the chamber. But, while thus affirming that the fluid has a certain influence on, and bears a certain relation to, the development of the proboscis, it cannot be said to be indispensable to the presence of the latter, since there is a small proboscis in *Nemertes* *carcinophila*, where the fluid is altogether absent. In *Nemertes gracilis* and *N. Neesii* the proboscidian chamber gives way to the blood-vessels posteriorly, the latter, therefore, being the more important structures. The views of Dr. Thomas Williams in regard to the corpuscular liquid, which he termed the "chylaqueous fluid," are so much at variance with accuracy, that I cannot pass them over in silence. He remarks that "in the case of the Borlasiadæ, Planariadæ, and Liniadæ, the chylaqueous fluid is contained in the digestive cæca and diverticula. In some of the Planariadæ, however, I have proved that a space does actually exist between the digestive diverticula and the solid structure of the body, *which is lined by a vibratile epithelium*, and into which probably the external water is in some way admitted. By this water, thus situated, the contents of the digestive cæca are aërated. The fluid oscillating in these cæcal appendages of the stomach is thickly charged with corpuscles, which, from their regular character, prove this fluid to have already reached a high standard of organization. They occur as elliptical cells in the *Borlasia* from which the illustration (fig. 25) was taken; the fluid abounded also in small orbicular points, constituting the 'molecular basis' of the digestive product. In this worm it is this fluid, and not the true blood, that is aërated; the latter system is too little developed."[1] This quotation clearly shows that he was quite unaware the so-called "elliptical cells" are always confined within the proboscidian sheath; as well as points out the erroneous notion he entertained of the true digestive tract, which in all cases can readily admit salt water (by mouth or anus), if such be required, but certainly not for the purpose of converting it into "a *vital* organized fluid." The proboscidian liquid and corpuscles, as I have previously shown, are very far removed from sea-water, and hence have little analogy with the "chylaqueous fluid" so frequently mentioned by investigators of the Invertebrates.

4. *The Aperture for the Extrusion of the Proboscis.*

This orifice is situated towards the ventral edge of the tip of the snout, and under favourable circumstances in the living animal, may be seen as a terminal pore, surrounded by a closely set series of radiating lines; as, for instance, when the snout is bent upwards towards the tube of the microscope (Plate X, fig. 16). The aperture has been called a genital pore by not a few authors, *e. g.* Œrsted, Leuckart, and Quoy and Gaimard; while others, such as Johnston, De Quatrefages, Busch, Williams, and Girard, have interpreted it to be the mouth; indeed, since the proboscis was by many considered the alimentary organ, it could not be otherwise. It is furnished with longer cilia from an early period; and in the adult these (cilia) form, when the lips are slightly pouting, a very pretty arrangement (Plate XV, fig. 4, *a c*), similar to the analogous opening in *Lineus* (Plate XIX, fig. 1). The striated ring surrounding this passage in transverse sections of the tip of the snout (Plate X, fig. 1) indicates the special muscular coat pertaining thereto. The canal (Plate XV, fig. 4, *a b*) proceeds straight backwards from the aperture to a point in front of the commissures of the ganglia, where it meets the differentiated walls of the proboscis (at *a*); and the cilia can be traced to this region, but no further. The tube is simply hollowed out in the tissues of the head, and is quite independent of the motions of the proboscis. It has a series of longitudinal muscular

[1] 'Philos. Trans.,' part ii, 1852, p. 627, pl. xxxii, f. 25.

fibres beneath the ciliated mucous surface, and the strong oblique and circular bands (Plate X, fig. 1) form a very efficient investment. When the proboscis is about to be ejected, it commences to fold over, like the turning of a finger of a glove inside out, at the point (Plate XV, fig. 1, *a*) in front of the ganglionic commissures, a fact which has escaped most observers. In withdrawal also, it may be noticed that, towards the conclusion of the process, the last wrinkle of the proboscis glides within the terminal aperture, and slowly passes backwards till this point is reached, when it ceases, and the organ is once more in its ordinary condition, any change that afterwards ensues being due to the stretching of the shortened tube—a process of simple elongation. Thus the anterior portion structurally and functionally differs from the succeeding, the wall of the proboscis always intervening between it and the proboscidian fluid.

The attenuated coats of the proboscis curve outwards all round, and become fixed to the wall of the foregoing canal and other cephalic tissues just in front of the ganglia; the reflection constituting the *point d'appui* against which the wave of proboscidian fluid impinges, when the organ is about to be extruded. The thin anterior wall of the proboscis unrolls, the terminal pouch is distended by fluid, and then the organ is rapidly launched forth. To judge from the descriptions and drawings of M. de Quatrefages, the entire force of this liquid would be thrown against the posterior part of the nerve-ganglia, and the straitened border of his hypothetical "diaphragm" would not pass further forward. In my specimens, the waves of the proboscidian fluid debouch readily into the yielding anterior canal in front of the commissures, and then externally into the loop of the extruded proboscis. I have never seen the very pretty lozenge-shaped arrangement of muscular bands in the snout, as figured by M. de Quatrefages, and whose function, he states, is to dilate the "oral" orifice, and carry the "gullet" forward; but the elaborate stroma, shown in Plate X, fig. 3, would amply suffice for this. During the motions of the proboscis, the reflection in front of the ganglia assumes various postures, and it frequently does stretch obliquely forward and outward from the tube, especially when that is drawn backwards. On the other hand, when the tube is thrust forward, the fibres slope forward and inward.

5. PROBOSCIS.

I shall divide, for convenience in description, the proboscis of the Enopla into three regions, viz., the anterior, middle, and posterior. The first (Plate XV, fig. 3, A) comprehends the somewhat cylindrical portion between the reflection in front of the ganglionic commissures and the commencement of the stylet-region; the second (B) includes the stylet-region and the well-marked swelling of the great muscular reservoir; and the third (C) is represented by the long posterior chamber.

A. *Anterior Region of the Proboscis.*

From the point of reflection backwards, the proboscis gradually increases in diameter until its full size is attained (Plate XIV, fig. 1, and Plate XV, fig. 3), and then it remains nearly cylindrical as far as the stylet-region. The entire organ is proportionally larger than in *Lineus*, and its anatomy more apparent; though I very much doubt, even in this group, if we can assign it the ideal office of a vertebral column. At the point of reflection there is sometimes a kind of *os* (Plate XV, fig. 4, *a*), from the slight folding of the lips of the organ in the early stage of ejection. The muscular fibres are chiefly longitudinal at the commencement, and if in a partially protruded proboscis a section be made in front of the ganglia (Plate X, fig. 9), the difference between this and the succeeding reticulated portion is very conspicuous. Occasionally the organ assumes a twisted position under examination, so as to give the fibres a spiral appearance (Plate XVI, fig. 1, *a*), and in such a state the structure might fancifully be likened to the spiral arrangement of the muscular fibres in the œsophagus of certain of the higher animals; but this condition of the proboscis is purely accidental. I fear, however, it has led M. de Quatrefages into an erroneous interpretation of the anatomy of the organ in *Polia glauca*, the proboscis of which is described and figured as having regular spiral belts at its commencement. The same author again avers that in *Polia mutabilis* the latter portion consists of two longitudinal muscular coats separated from each other by a cellular layer, a provision, he explains, for enabling each to act independently. He also adds that no circular fibres were seen in this species, in *P. filum* and some others. Dr. Johnston, on the other hand, considered the organ to be homogeneous.

In very small specimens of the British examples the transparency of the tissues of the proboscis renders definition of the coats somewhat obscure, especially after mounting in chloride of calcium; but, so far as I have observed, the structure is as follows:—Externally is a layer of elastic tissue (Plate XI, figs. 4, and 9, *g*), which is more distinctly striated in transverse than in longitudinal sections. Towards its free border, also, certain obscure granular markings observed in the latter sections (Plate XI, figs. 7 and 8, *g*) show that the course of the external fibres is different from the others; indeed, in some views, the appearance is such as to raise the suspicion of the presence of the ends of a few fine muscular fibres, the rest being nearly homogeneous. The next layer is a somewhat narrow belt of longitudinal muscular fibres (*f*), which may be termed the *external longitudinal muscular coat*. It consists of pale, unstriped, muscular fibres. Between this and the other longitudinal layer is a remarkable stratum, the *reticulated coat* (*e*), which in transverse sections (Plate XI, fig. 4) assumes a regularly moniliform appearance, from an increase of its constituent substance at certain points. In many longitudinal sections (*e.g.* Plate XI, fig. 8) the ends of numerous fibres are found in this layer, as if it was composed of circular fibres; but the appearance is due to intermediate bands which pass between the thicker longitudinal columns. If a thin longitudinal slice from the organ in *Amphiporus pulcher* is hardened and mounted in chloride of calcium, numerous well-marked homogeneous longitudinal belts are seen at regular intervals, and between them are many connecting transverse fibres. The ends of the fibres in these sections have therefore been caused by the knife severing the latter series. Thus the tube is surrounded by a complete investment of this elastic meshwork, which, doubtless, has an important physiological bearing on the varied movements of the organ. In the *Amphiporus grœnlandicus* of Œrsted, the longitudinal belts of this layer are somewhat rounded in transverse section. The succeeding stratum (*d*) consists of a powerful series of longitudinal fibres, fully twice as thick as the external longitudinal layer, and which may be termed the *inner longitudinal muscular coat*. In essential structure it resembles the exterior, differing only in bulk. In sections prepared by hardening in alcohol.

these fibres, in common with others in the organ, present a coarser appearance in transverse section than after hardening in chromic acid. The fifth layer from without inwards is a strong band of circular fibres (*e*), the *circular muscular coat*, which forms a counterpoise to the preceding. Within is a *basement-layer* (*b*) of pale translucent texture, best seen in longitudinal sections (Plate XI, fig. 8), for in transverse cuts the coat is apt to be confounded with the inner layer of circular fibres. It has, on the whole, a homogeneous appearance. Upon this layer rest the peculiar glandular papillæ, which arise from a distinct margin on its inner edge (Plate XI, figs. 8 and 9, *b*). In the ordinary transverse sections of the proboscis these organs form *en masse* a somewhat foliated or frilled arrangement, often of a very symmetrical appearance. In contracted specimens the entire cavity is filled up by them and their translucent gelatinous mucus. The largest villi or glandular processes (Plate XI, fig. 10) are situated some distance in front of the stylets, for towards this region they become smaller, and finally the fundus is clothed only by minute papillæ. Sometimes they present a coarsely fringed appearance, with large granules in their interior; and when the tube has been turned inside out they have a villose aspect, the tough mucus adverted to above projecting in filaments from their surface under the slightest pressure. I have generally observed, also, towards the first portion of the protruded organ, fine motionless processes like cilia jutting from the apices of the glands, and they are probably homologous with the minute spikes which occur on those of the posterior region after rupture from pressure. I do not think, at all events, that they can be called urticating organs. In *Tetrastemma* the glandular papillæ are leaf-shaped, and somewhat crenated at the border, where there is a regular moniliform appearance from the arrangement of the globules (Plate X, figs. 19 and 20). Under pressure, they are granular internally, and furnished with numerous globular or wedge-shaped mucous masses that refract the light like oil. The same type of structure is found in the proboscides of Amphiporidæ from New Zealand, only the longitudinal bands of the reticulated layer are more numerous than in *A. lactifloreus*.

The description just given of the structure of this region differs much from that of M. de Quatrefages, almost the only author who has entered into the minute anatomy of the proboscis in the Enopla. He states, like Mr. H. Goodsir, that externally the tube is supplied with a series of transverse muscular bridles, which maintain it in position within the body of the worm, and he shows a section of the parts in *Nemertes balmea*, which bears out his description very well; but he did not observe that, if such bridles existed, they would have to pass through the muscular sheath in which the organ glides, before reaching the body-wall of the animal. His minute anatomy of the proboscis is chiefly taken from the examination of *Borlasia angliæ*, and hence cannot apply in any degree to the Enopla, though he considered it the type of both. He makes only two muscular layers in the wall of this organ, and though in his section from *B. angliæ* he indicates "traces de fibres transversales," by a few lines crossing these longitudinal coats, he distinctly observes that they are not apparent in the smaller species. The longitudinal fibres are separated, he states, by a transparent homogeneous tissue, which forms a great number of bridles of very elastic fleshy columns, making, in other words, an elastic cellular layer; and he figures this in the before-mentioned section, adding that this lax cellular arrangement will give the two longitudinal muscular coats that independence of action necessary for the proper performance of their functions. It can only be supposed that he refers to the *reticulated layer* by this description. He mentions a transparent homogeneous coat within his longitudinal muscular layer, corresponding to the mucous coat of the higher animals, and adds that the papillæ of the latter are all covered with vibratile cilia. M. de Quatrefages thus describes only four coats, viz., mucous, internal longitudinal, elastic cellular, and external longitudinal; and if the stays or bridles which he notes as connecting the tube to the body-wall be taken into account, it may be surmised that the muscular sheath for the proboscis is included in his reckoning. No cilia occur in this organ.

B. *Middle Region of Proboscis.*

The elongated chamber just described terminates posteriorly in a sort of *cul-de-sac*, into which three small apertures converge; one at each side from the marginal stylet-sac, and a central (at *a*, Plate XII, fig. 1), in the pit of the cavity, connected with the reservoir. The walls of the proboscis undergo a considerable change in this division, especially with regard to the deeper layers. Externally the investing coat from the anterior region is continued on the commencement of the reservoir (Plate XIII, fig. 10), and has a crenated border in the contracted state of the parts, with transverse markings or rugae; but this appearance does not of necessity indicate the presence of circular fibres, for the contraction of the longitudinal layer underneath would cause even a very feebly elastic coat to assume similar markings. The thin subjacent layer of longitudinal fibres is likewise continued to a similar extent on the reservoir, and assists in connecting the divisions. These two layers lie exterior to the stylet-sacs.

The structure of the pit or termination of the anterior chamber (*a*, Plate XII, fig. 2) requires special notice. The large glandular papillae of the inner wall gradually diminish in size, as before-mentioned, until the floor is covered only by small, densely arranged and minutely granular processes, giving the surface, which in the ordinary state of the parts bends backwards all round the stylet in the manner shown in the figure, a smoother appearance. The fibres also become firmly bound together, so as to constitute a sphincter for the aperture, and gently curving outwards and backwards, are lost in the obscurity of the parts caused by the external circlet of glands, somewhat behind the anterior termination of the wedge-shaped investment of the apparatus at the base of the stylet. This floor of the chamber is composed of a series of muscular fibres, whose direction, in the ordinary state of the parts as a transparent living object, is outwards and backwards, but which assume various aspects during the motions of the organ. Thus the floor passes from the conical form with the apex directed backwards to that of a transverse platform; and in the everted condition has the shape of a cone the apex of which is directed forward (Plate XIII, fig. 14). In the latter position the secure binding of the fibres which surround the central aperture just permits the stylet to project, and no more. The whole arrangement constitutes a large muscular pit with very powerful and mobile walls, capable of many and varied alterations of form. In firm contraction of the region the floor of the chamber is pouted forward (Plate XIII, fig. 7), causing a radiated appearance of the fibres, which thus slant outwards and backwards from the central point. A firm constriction of the tube often takes place at the anterior border of the stylet-region, separating the pit of the organ from the more villose or glandular portion in front, and making a double swelling of the parts. Immediately before the marginal stylet-sacs lie some coarsely granular glands, which, however, are less conspicuous than in *N. gracilis* and others. Prof. Keferstein speaks of this region as having only a longitudinal muscular coat (though the crenated border of the anterior chamber is continued thereon in his figure), and as possessing much pigmentary and granular matter. The latter is not well-marked in *A. lactifloreus* or *Tetrastemma*, since the entire apparatus is either translucent or white; but in certain species, as will hereafter be shown, an increase in the granular substance occurs. The longitudinal fibres of the last-mentioned author end at the posterior border of the stylet-region.

This division is of the same glassy translucency as the reservoir, while both the anterior region and the long posterior are of an opaque-white in the fresh specimen. Externally it has the investing layer (Plate XII, figs. 1 and 2, *g*) carried from the anterior chamber, and which passes back to the next region. Beneath is a series of very powerful and conspicuous longitudinal muscular fibres (*f*), apparently to some extent continuous with the most developed longitudinal layer of the preceding region, but few of which pass on to the next. Internally the oblique fibres stretching backwards from the floor of the anterior chamber form the band *η* (Plate XII, figs. 1 and 2). The rest mingle with the radiating fibres from the central investment. In transverse sections of the anterior part of the region, in the line of the marginal stylet-sacs (Plate XVI, fig. 4), the centre is occupied by the basal granular apparatus, which is generally thrust forward in spirit-preparations, surrounded by its special investments and a belt of circular fibres. The greater part of the region without is occupied by a dense series of radiating fibres, which form the spokes of the wheel, while the ends of numerous longitudinal fibres fill up the spaces between them. If the section is close behind the floor of the anterior chamber, some of the circular fibres which close in the cavity, and other parts of the proper wall of that division are included, while if the cut is a little further back, the granular glands come in the plane of section. The exterior of the region in all cases is occupied by the elastic and longitudinal layers. The alternation of radiating or oblique with longitudinal or nearly longitudinal fibres continues to the posterior end of the investments of the basal apparatus, the only change towards the posterior part being the introduction of the ejaculatory duct, and a few circular fibres to its exterior. The pale region behind the basal apparatus has a very complex structure, consisting of densely interwoven fibres that surround the wall of the ejaculatory duct, those towards the circumference showing an arrangement similar to the anterior portion of the region, viz., having the (cut) ends of fibres in the axils of the radiating series. In longitudinal sections of the organ these interlaced fibres are chiefly transverse in direction; and in some preparations there are numerous granules at the sides, within the somewhat well-defined border formed by the fibres curving backwards (at *η*, Plate XII, fig. 2), and which corresponds to the lateral arches of the cavity in *A. pulcher*. The stylet-region proper is distinctly separated at its posterior border from the reservoir by a pale boundary-line under pressure, so that the parts have a somewhat jointed appearance.

a. The Marginal Stylet-Sacs.

These organs (*v*, Plate XII, fig. 2) occupy the exterior (covered only by the elastic coat and the external longitudinal fibres) of the somewhat solid wall of the section immediately succeeding the anterior region, and often cause a distinct swelling under examination. They are conspicuous by their aqueous translucency, as well as by the nail-shaped stylets in their interior, though the exact position of their long axes is rather difficult to determine. In ordinary views, when the animal is examined as a transparent object under pressure, their long diameter is antero-posterior, or slightly oblique; but in the prepared specimen this is often transverse (Plate XI, fig. 5). Each sac is ovoid in outline, has a thin, transparent, contractile investment (sufficiently tough to prevent the points of the stylets piercing it during the motions of the worm), which lies directly under the superficial layers of the division, and a duct passing from its central region to communicate with the pit of the anterior chamber of the proboscis. The direction of the duct in the position above mentioned (*i. e.*, viewed as a transparent object) is forward and inward, but, like other structures pertaining to this variable organ, it is liable to many alterations, and is occasionally much stretched and attenuated. It is also slightly narrowed on approaching the sac (Plate XIII, fig. 11, *a*), and has at its junction therewith a series of protecting fibres. De Quatrefages and Max Schultze do not notice the duct at all, and Claparède's figure shows it distorted from pressure in *Tetrastemma*, but Keferstein's representation is more accurate. Each sac contains a variable number of the characteristic nail-shaped stylets (*β*), from three to five—more or less—in different stages of development, as well as certain clear fluid vesicles (*ε*), globules and granules, and is quite filled by a transparent liquid. The stylets very much resemble a lath-nail of cast-iron, and are formed of a translucent calcareous secretion; indeed they appear like spikes of the purest crystal. The head is bulged, rounded at the edges, and somewhat flattened at the top, an elongated conical spike with a sharp point proceeding therefrom. The perfect spike or spikes in these sacs are usually about the size of the central stylet, and there are often three or four that can scarcely be distinguished from each other. Besides the perfect organs, there are some with heads not fully developed, but complete in other respects; the remainder again present the form of simple spikes of various lengths devoid of any head. In a few instances the centre or axis both of the head and point of the stylet is granular, while the superficial portion is of the usual homogeneous aspect. They seem to be formed by gradual increase of layer upon layer of the calcareous glassy secretion, as is well shown in some specimens mounted in chloride of calcium, which have assumed a stratified, or laminated appearance. Sometimes a process (Plate X, fig. 18), probably the remains of a globule, passes from the head a short distance over the base of the spike, as indicated by Max Schultze in *Tetrastemma*, though seldom to such an extent in the complete stylet. The knob on the head of the stylet figured by this author must be rare, and probably represents a casual globule. The stylets are dissolved in weak acetic acid, as first noted by M. de Quatrefages, and are roughened or corroded by a strong solution of caustic potash.

In a large animal (*A. lactifloreus*) an interesting arrangement of the stylet-sacs occurred on one side, for there were two of nearly equal size (Plate XII, fig. 1), connected with each other at one end, so that an interchange of fluid and granular contents took place. Only one had a duct of communication with the anterior chamber of the proboscis. The opposite side was furnished with a single sac of the usual formation, containing two large and perfect stylets, and a shorter without a head. On the abnormal side the outer sac (in this view) had two well-formed stylets, a larger and a smaller clear globule, besides some other minute globules and granules; the inner, which possessed the duct of communication, had one stylet as large as the preceding, and fully formed; another somewhat less, but also having a head; a third slender spike of greater length than the latter, but headless; and a fourth, rather more than half the length of the last-mentioned. No globule existed in the inner sac. It is interesting to notice the different degrees of perfection of these spikes in relation to what Dr. Max Schultze avers as to their development, viz., that they are the products of the smaller contained vesicles. In the one there were two large globules, and two perfect stylets, yet no trace of a developing spike; in the other there were three completely formed stylets, yet each varied in length; while the long spike without a head was fully as long as the largest in that sac—head included. Those in the outer cavity were quite as large as the central stylet. In *Tetrastemma candida* I have observed, besides the ordinary stylets, a group of minute crystalline spines, which had no connection with the clear vesicle of the sac. Thus, at present, though I have very often seen these organs inside, and connected with the fluid vesicles, I cannot altogether support Max Schultze's notion that they must be developed therein; and this would not signify much, since the entire cavity must act as a secreting chamber, else the large ones could receive no increase after they had outgrown the capacities of the globules. M. Claparède stated, in his 'Recherches,' that he had never seen spikes inside those vesicles, but in his subsequent 'Beobachtungen' he figured a developing stylet in a globule in *Prosorhochmus Claparedii*.

In a specimen that had often been under the microscope, I found on one occasion a pair of stylets, apparently from the marginal sac of one side (though this is by no means certain), advanced nearly to the ganglionic portion of the proboscis. One marginal pouch was at any rate empty, while the other retained its three stylets. The free stylets moved very slowly forward, scarcely any progress being made during an hour's observation. At this time the empty sac contained numerous granules, but no circular or ovoid vesicle. Twenty-four hours after the stylets had disappeared. The sac is now observed to be much less than its fellow of the opposite side, and somewhat shrivelled and undefined; but it contains a small ovoid vesicle, which is traversed by a minute slender spike, whose long diameter exceeds that of the globule, and therefore it cannot be supposed to be within it. In addition there is a free spike, about a third the length of the former. The larger has assumed the shape of a stylet without a head; the latter is as yet nearly cylindrical (Plate XII, fig. 3). Whatever the function of these organs in the marginal sacs may be, there can be no doubt they have nothing to do with the supply of the central apparatus, for that furnishes its own stylet.

b. Ejaculatory Duct.

Through the same region the ejaculatory duct (μ) passes to the point where it opens into the muscular space behind the constrictor of the central aperture in the floor of the anterior chamber. The opening (μ') of the duct is generally obscured by the apparatus of the central stylet, unless the observer sees it at the moment of contraction of the powerful muscular walls of the reservoir, when the mucous or villous lining is driven forward so as to render the channel more apparent, and a vigorous jet of the minutely granular fluid is propelled into the muscular sac, and then through the stylet-aperture into the floor of the anterior chamber. Closer observation, even when such convulsive contractions are absent, occasionally shows the molecular fluid passing onwards to the anterior chamber; and if the ejaculatory duct is not obscured by the glands, the moving granules of this peculiar fluid are seen therein. Moreover, when the large compound cells (Plate X, fig. 17) have been detached under pressure, and squeezed forward into the reservoir and along the duct, the calibre of the opening into the muscular sac may be ascertained with tolerable accuracy, and is so small that only a single cell at a time can be transmitted. The duct has a bent-conical form, a shape that avoids interference with the basal apparatus of the stylet, which occupies the centre of the region; and its posterior end (that opening into the reservoir) is capable of a certain amount of constriction, as indicated in one of M. Claparède's figures. In the latter state the inner or convex side of the duct is glandular, while the outer or concave is not. A layer of longitudinal fibres, continued forward from the reservoir, constitutes the proper wall of the tube, and it is this coat which causes the distinct ring round the duct in transverse section. Internally it has a mucous lining, which generally possesses a few small glandular papillæ towards its posterior end. The duct is not very dilatable, the cavity becoming elongated, but not much increased in diameter, even under violent expansive force. It can be firmly closed by the contraction of the region surrounding it (Plate XII, fig. 9, and Plate XIII, fig. 7 μ) so as to be indicated by a mere central streak. The whole structure of the channel, and its relations to surrounding parts, show that it is formed, not for transmitting fluids from before backwards, but entirely in the opposite direction. The mobile muscular space (ε), into which this duct opens, forms a kind of sac that is occasionally distended with the cells and granules, before they reach, through the central pore, the pit of the anterior chamber.

c. The Central Stylet and its Apparatus.

The central stylet projects straight forward into the floor of the anterior chamber in the usual state of the parts, and is generally about the same size as the largest stylet in the marginal pouches, with which (stylet) it likewise agrees in structure and composition (Plate XII, figs. 1 and 2). Its base is fixed to the granular apparatus (λ); the arrangement being not inaptly likened by Dr. Johnston to an awl, the anterior or smaller end of the structure sending its investing substance over the head of the organ, and grasping part of the spike. The basal apparatus (or awl-handle) is narrowed anteriorly, gradually widens backwards, is then marked by a constriction, and again terminated by a dilated portion, which may represent the butt of the awl. This structure is shorter in proportion to the stylet, and has its constriction placed further backwards than in *Tetrastemma candida*. It is opaque-white, and coarsely granular from an early age, the granules disappearing with effervescence under the action of weak acetic acid, and rendered pale, in some cases dissolved by caustic potash. These granules would not seem to be simply enclosed in the structure, as if in an ordinary sac, but they adhere together and form a consistent whole, as proved, amongst other things, by their not falling out of the fragment in transverse section, or when the anterior part is cast off with the stylet, as will hereafter be described. I have also seen the stylet and its granular apparatus thrown off together in a discarded organ in the proboscidian chamber of *T. melanocephala* and other species. This peculiar granular structure or sac (θ) is set in a firm wedge of translucent, and, under ordinary or external appearances, structureless substance; but the addition of caustic potash or acetic acid shows distinct striæ, chiefly of a transverse character when viewed under pressure, and therefore of a radiating nature in relation to the apparatus, as clearly proved by a transverse section. An interesting condition was found in two specimens of *Tetrastemma flavida*, which directly bears on the physiology of this part. In each a fragment of the granular apparatus, with the central stylet attached, lay towards the anterior end of the first region of the proboscis; and since injury would scarcely have caused a result so systematic, it is evident the stylet had been thrown off by the animal. In both cases the apparatus of the central stylet was complete, only in one its anterior part appeared pale, and there was a slight irregularity in its outline, similar to that in Plate XI, fig. 13. In each, the marginal sacs had the full complement of stylets, one or two of which equalled the central in size. There appears to be only one explanation of this condition, viz., that the central stylet can be thrown off, and somewhat rapidly regenerated; for it is unlikely that in each case it found its way there from without. Former experience in regard to the stylets shows that such bodies take some time to gain the exterior of the worm, and hence our surprise is lessened at the perfection of the new structures while the old have not yet escaped from the proboscis. Besides, the anatomy of the parts in *A. pulcher* will by-and-by throw still further light on the subject.

In front of the wedge-shaped translucent mass surrounding the basal apparatus of the central stylet is the muscular space (ϵ, Plate XII, fig. 1) previously mentioned, into which the ejaculatory duct opens (at μ'). This cavity is formed by the folding outwards of the floor of the anterior chamber all round, and it is furnished with a special inner muscular coat. The walls are thus very mobile, and occasionally form an hour-glass contraction in the middle, quite distinct from the narrowing between the sac (whose greatest diameter is in front) and the firm wedge behind. Its anterior border can be carried to the tip of the central stylet; while in the extruded state of the parts (Plate XIII, fig. 14, ϵ) it forms, when seen from above, a compressed process at each side of the basal apparatus of the central stylet; more correctly, however, and if viewed from the front, it has the shape of a muscular umbrella, which slopes all round the anterior portion of the latter. M. Claparède does not mention this arrangement at all, and M. de Quatrefages seems to have mistaken it for a pair of glands, which, he explains, probably secrete poison for cankering the wounds inflicted by the stylet, a supposition unsupported by any anatomical basis as regards this spot. Professor Keferstein's structure of the region also requires amendment, since he does not distinguish the separation between the cavity and the floor of the anterior chamber; thus, in his drawing of the extruded proboscis, the central stylet projects smoothly into the water, and the ejaculatory duct opens directly into the latter a short distance from the stylet.

d. Granular Glands of the Stylet-Region.

The glands (π) have the form of lobules, with the long axis of each parallel to that of the proboscis, and are situated beneath the two external layers of the part. The position of the stylet-sacs is always external to these organs. The constituent granules are proportionally large in *Tetrastemma*, and especially so in *Prosorhochmus*. I have not found any structural guide to their function, though they are invariably present in the Enopla.

e. The Reservoir.

The cavity or reservoir (ρ, Plate XII, fig. 1) from which the ejaculatory duct proceeds is a somewhat globular or ovoid chamber, with its long diameter for the most part directed transversely; or it may be compared to the bowl of a short and wide wine-glass, the stem being formed by the peculiar channel of communication with the long posterior region. It is liable to much variation in shape, from the contractility of its inner wall, independently of the action of the massive exterior muscular investment. Extreme contraction of the region transforms the globular cavity into a mere transverse slit. Its inner surface is provided with a series of glands, the larger and more distinct (σ) having minutely granular contents, and easily distinguished from those of the anterior chamber or long posterior region. Towards the opening of the ejaculatory duct the glands are smaller than in the dilated part of the reservoir, and they again decrease in size before the organ narrows to form its posterior channel of communication. In this comparatively large chamber the granules, hereafter to be described, have free scope for the display of their movements, and not only do they move themselves, but they cause bodies so large as the compound gland-cells from the posterior chamber, when they happen to be present, to revolve and jerk also, a state of matters that has probably helped to mislead M. de Quatrefages as to the ciliation of the organ. Such, however, is very distinct from ciliary motion. The reservoir diminishes posteriorly, so as to form in the contracted state of the parts a very narrow duct (ϕ), which by-and-by expands, and becomes continuous with the posterior chamber, the whole forming an hour-glass arrangement, as represented in the various figures.

The minute structure of the reservoir possesses considerable interest, both as regards beauty and complexity. On reaching the point *a* (Plate XIII, fig. 10), the elastic and the external longitudinal muscular coats of the proboscis for the most part cease. Before this occurs, however, the muscular fibres (τ, Plate XII, fig. 2) peculiar to the region arise, sweep backwards in a beautiful fan-like manner over the reservoir, curve round and meet those from the opposite side, and leave only a small space in the centre posteriorly, through which the channel of communication with the third region passes. When viewed as a transparent object under pressure, or in longitudinal section, the direction of these fibres is backwards and inwards. This great muscular mass does not receive accessions from the outer wall, but the whole of the loops come from the front. By the varied crossings of these fibres a felt-like aspect is produced (Plate XIII, fig. 01). In addition, there are circular and longitudinal fibres within the latter, to the presence of which the independent wrinkles of the cavity are due. The longitudinal layer ($\tau\omega$) is innermost, and forms a kind of spindle-shaped arrangement; the anterior fibres—commencing with the ejaculatory duct (of which they form the special wall)—soon expand to cover the dilated cavity of the reservoir, then are narrowed as they surround the channel of communication, and proceeding backwards, merge into the longitudinal coat of the posterior chamber. In some positions these fibres assume an obliquely crossed or spiral aspect in the channel; but, as in the case of the ganglionic region of the proboscis, this is purely accidental. The margins of the reservoir and the channel of communication are marked under pressure by the ends of muscular fasciculi, especially posteriorly; an appearance due to the doubling of the looped fibres, but also partly to the presence of the thin circular coat which lies without the longitudinal. The peculiar curvature of the fibres of the reservoir causes a transverse section of its posterior part (Plate XIII, fig. 15) to assume a radiated spiral appearance, the whole reminding one forcibly of Dr. Pettigrew's beautiful diagrams of the arrangement of the muscular fibres of the heart; and in this case no better structure could have been devised for the complete and forcible evacuation of the chamber. By the contraction of the various fibres, the cavity is squeezed with great force in every direction, like a thick caoutchouc ball or globular syringe in the hand. Its transverse diameter is lessened, and, still more, its antero-posterior, while a jet of the minutely granular fluid is squirted into the anterior chamber; and, in spasmodic efforts, even a prolapsus of its glandular lining occurs. In contraction (Plate XII, fig. 9) the entire region is much shortened, and the mass of the looped muscle increased posteriorly. Not only does the peculiar spiral curvature of the fibres cause the most powerful compression of the cavity, but the posterior aperture has a tendency to be closed and slightly carried forward, the anterior being less subject to interference. The closing of the posterior aperture (channel of communication) is also greatly assisted by the circular fibres lying outside the longitudinal.

In extrusion of the proboscis (Plate XIII, fig. 14), the entire spike of the central stylet projects, the floor of the anterior chamber forms all round a thick and powerful umbrella-shaped cushion (whose independent structure escaped Professor Keferstein), the marginal stylet-sacs are under cover, and the region of the reservoir is shortened and widened. The position of the muscular chamber (ε), which forms a second small umbrella round the apex of the basal apparatus of the central stylet, is characteristic.[1] The separation between the longitudinal fibres of the stylet-region proper and the looped fibres (τ) of the reservoir is distinctly indicated. It will also be observed that the whole stylet-region is dilated by the forcible wedging forward of the reservoir.

c. *Posterior Region of the Proboscis.*

Behind the translucent region just described, the opaque-white long posterior chamber (c, Plate XV, fig. 3) occurs. It communicates with the reservoir in front, but its posterior end is cæcal. The contractile nature of the parts renders comparison uncertain, but it is generally not much shorter than the anterior chamber in the perfect animal; sometimes, indeed, it exceeds the latter part in length, the simple structure of its wall giving it greater extensibility. In young specimens and in regenerating organs, again, it assumes a nearly globular form in contraction. Externally it is covered by a very delicate investing layer. Within is a series of circular muscular fibres, which towards the tapering posterior end become indistinct, and finally disappear altogether after the cæcal tip is reached (Plate XI, fig. 16). The next coat is formed of an equally strong series of longitudinal fibres, the anterior or primary bundles being continuous with the longitudinal layer of the reservoir, as previously mentioned. These run throughout the entire length of the chamber, becoming proportionally more developed as the central cavity diminishes posteriorly, and finally merging into the terminal muscular ribands. The mucous layer with its glands lies within the latter coat (Plate XIII, fig. 16), though in several views, both in the living animal and in transverse sections, I fancied some sub-mucous circular fibres were present; they are at any rate insignificant, and the two chief layers explain all the motions which ensue in this division. The mucous coat in contraction of the organ forms many rounded folds. The glandular papillæ which clothe the surface of the latter—from the commencement of the region behind the translucent reservoir—almost, but not quite, to its cæcal tip, differ materially in structure from those of the previous parts. Viewed as a transparent object under moderate pressure (Plate X, fig. 12) the field is covered with globular glands containing clear rounded vesicles in their interior. In contraction, and when the wall is less compressed, the glands have a larger and coarser appearance, the external wall only of each being visible. When the pressure has been increased, these bodies, especially towards the posterior end (where, from their diminished numbers, a clearer view can be

[1] The appearances shown by this chamber (ε) in the extruded organ must not be mistaken for "poison-glands," since they are caused by the pressure of the glass cover rendering the central portion of the continuous umbrella for the moment indistinct.

obtained), alter their shape apparently by bursting (Plate X, fig. 13), and seem like minutely hirsute double rings, while the contained globules are scattered over the membrane. If the organ has been ruptured and partly inverted, the free edge of the laceration and the shrivelled glands are more easily observed (Plate X, fig. 21). The globules from the glandular papillæ (Plate X fig. 17) and glands whose contents have been evacuated (rendering them minutely hirsute) readily pass forward to the reservoir, and roll through the ejaculatory duct—under pressure. The function of the vast array of glands in this chamber would seem to be the formation and elaboration of the peculiar fluid with the moving granules previously alluded to. This secretion is produced in considerable quantities, and towards the posterior portion frequently distends the cavity as a translucent pouch (Plate XI, fig. 16, *a*), wherein the granules are in full action, and even the experienced are apt to err in regard to the nature of the movements, so like are they to those caused by ciliary currents. Under a high power (700–1000 diam.), the molecules appear as mere specks or points; and they retain their curious motion for upwards of twenty-four hours after extrusion from the cavity. There is thus a special fluid rich in these granules secreted by the posterior chamber; and continued observation, and the whole anatomy of the parts, show that this fluid passes forward into the reservoir, where it is probably mixed with a small quantity of another secretion from the glandular walls of the latter, and then propelled with force through the ejaculatory duct into the anterior chamber. What its peculiar function in the anterior region, or when discharged into the surrounding medium in the extruded state of the parts, may be, can only be conjectured; but, from the elaborate structure of the tissues concerned in its economy, its action would seem to be important. I have no observations in support of the view that this granular fluid is poisonous. It cannot pass into a wound at any rate until the stylet is withdrawn; and if it really acts as a poison to animals when introduced into their tissues, it may reasonably be supposed to affect them injuriously when discharged into the water around them. Whether the liquid has any influence on the secretion of the stylets in the marginal sacs, or on the central apparatus, I am unable to say; but, as already stated, a minutely granular fluid has been seen in the former, and stylets are not unfrequent in the posterior chamber of *A. pulcher*. MM. de Quatrefages, van Beneden, and others, state that the foregoing apparatus is used in attacking prey. I have never observed the Enopla so engaged, and it may be asked,—Do the Anopla use their feeble and unarmed structures for the same purpose? The proboscis in the Enopla, indeed, is a somewhat precarious aggressive weapon, for when extruded it frequently adheres to the irritating body, and is thrown off. It is true a predatory function may be assigned with an air of probability to the central stylet, but this cannot be done with those in the marginal sacs, for, being developed in a free condition within almost closed cavities, they are quite useless as offensive organs.

The walls of the posterior chamber, after forming the *cul-de-sac*, are continued backwards in the form of one or two long translucent muscular ribands of extreme flexibility and contractility (ꝑ, Plate XII, fig. 4), which are attached to the proboscidian sheath, rather behind the middle of the animal; the fibres spreading out in a fan-shaped manner, and mingling with those of the tube. The motions of these muscular bands is most interesting, now jerking into numerous graceful folds or coils by a sudden contraction, like the stalk of a Vorticella, and again shortening more gradually—the curves being here and there thickened by the swelling of the fibrillæ. They are simply muscular fasciculi, which seem to restrain the irregular protrusion of the proboscis, and assist in its retraction. This muscular arrangement is also the *ultimum moriens*, showing contractions when all other signs of life have fled. In young animals the mobility of the fibrillæ is so great that they become broadly clavate when ruptured from their attachments (Plate XII, fig. 10, ψ).

f. Varieties in the structure of the Proboscis.

Before reviewing the statements of previous observers with regard to the structure of the foregoing parts, a description of the peculiarities of the regions in other examples of the Enopla may be given.

In *Amphiporus pulcher* the anterior region of the proboscis has a pinkish hue, and numerous small clear globules at its commencement. The glandular papillæ in the anterior chamber are finer than in *A. lactifloreus* (which may be taken as the type), and their marginal globules less distinctly marked. In transverse section (Plate XI, fig. 4) the large and somewhat lozenge-shaped columns of the reticulated coat are connected with the outer layer (*g*), while a process from the opposite angle passes inwards towards the circular fibres (*c*), so as to cut the great longitudinal layer (*d*) into a number of separate fascicles, which, in the fine specimen figured, amount to fourteen. When the organ is turned inside out the usually thin external longitudinal coat is thrown into dilated segments separated by the processes from the outer angle of each lozenge-shaped column of the reticulated layer. The marginal stylet-sacs are very large (Plate XII, fig. 6, *r*), and each contains, in well-developed specimens, from five to nine stylets, a large circular globule, and a granular orange pigment-mass, besides a fluid rich in moving granules, similar to the secretion of the long posterior chamber. It is, however, in the apparatus of the central stylet that the greatest deviation from the typical structure occurs. This (A, Plate XII, fig. 7) is small, elliptical rather than ovoid, and its granules are very minute. In addition to the ordinary stylet (*a*) fixed to the anterior end, another (*b*) projects into its substance, enclosed in a kind of sheath, the point thereof extending forward almost to the butt of the anterior stylet. This reserve-stylet is not in all cases fully formed, but apparently awaits the rejection of its precursor for complete development. Its head lies in a large cavity constituted by a peculiar disposition of the fibres composing the investment of the basal apparatus and the region behind. Instead of the usual wedge-shaped structure, fibres radiate outwards from the sides of the organ, curve backwards, and arch over a large cavity (Plate XII, fig. 6, *ov*) filled with a clear fluid, part of the floor being formed by the anterior fibres of the reservoir. In certain states of contraction the reserve-stylet is thrust backwards, so that its butt rests on the latter chamber, a position quite easily attained, on account of the yielding nature of the cavity and tissues placed immediately behind and around it. Streaks, due to the granular glands, are also observed passing from the central apparatus along the arch of the fibres. The glands themselves are distinct enough if the specimen is not too much pressed. The great development of the cavity behind the central apparatus might be supposed to assist in the rapid formation of the reserve-stylet, yet it cannot be absolutely necessary for its development, since the stylet is as readily replaced in front of the granular structure in other species. The ejaculatory duct is large, and being surrounded by a very yielding region, is more mobile than in the typical form. The clear globules interspersed amongst the looped fibres of the reservoir are numerous, so that under examination the cavity seems covered with them; continued pressure causing them to escape into the reservoir, and pass forward into the ejaculatory duct. The curved fibres have a laminated appearance posteriorly. Circular fibres are clearly indicated in this species by the peculiar contractions of the inner wall of the reservoir (Plate XII, fig. 6). The latter has more translucent walls and greater mobility than in *A. lactifloreus*, and the coats are diminished in total bulk posteriorly, so that the channel of communication is short. The glands of the reservoir are large transparent structures, with clear globules in their interior, and differ in general aspect from any hitherto observed. Those of the posterior chamber of the organ are larger than in *A. lactifloreus* or *Tetrastemma*. Occasionally several stylets lay in the *cul-de-sac* of the latter division, showing that they had passed along the ejaculatory duct, or that the reserve-stylets had fallen into the cavity behind, and thence made way through the reservoir into the posterior chamber; unless we are to suppose they had been formed in the latter. When the proboscis of this species is everted (Plate XIII, fig. 19), the central stylet projects much less than in *A. lactifloreus*. The cavity behind the central apparatus becomes elongated, apparently by the encroachment of the marginal stylet-sacs. There is no appreciable space at the base of the central stylet, which (space) in *A. lactifloreus* forms the small umbrella (*c*) in this position. The floor of the anterior chamber is less differentiated, and the spiral muscles of the reservoir less bulky.

Dr. Johnston observes of this species, "that the structure of the stomach" (proboscis) "is like that of its congeners, excepting in there being five or six spines on each side of it, instead of three, which is the usual number." He does not refer to the peculiar arrangement of the central stylets, though an incomplete woodcut in one of his early papers shows that it had not entirely escaped the notice of his accomplished artist. In fig. 19, Plate C, of the 'Voyages de la Commission Scientifique du Nord, en Scandinavie,' the structure of the central apparatus of this species is also fairly shown.

The proboscis in *Amphiporus spectabilis* has a faint pinkish hue. My sole specimen was partially decayed before examination, but it was at once apparent that no extraordinary curved horny comb as described by M. de Quatrefages existed in the place of the central stylet. The author, however, does not speak with certainty on the subject, since he states that he regrets he had mislaid his drawing of the actual relations of this organ to the other parts. The whole structure is essentially that characteristic of the *Amphiporinæ*, as represented indeed by Professor Keferstein.

The organ is comparatively large in *Amphiporus hastatus*, and the glands of the anterior region coloured of a pale brownish or dull yellowish hue. The central portion of the stylet-region (Plate XXIII, fig. 18), has its basal granular apparatus very slightly constricted towards the posterior third. The muscular investment of this structure presents a pale brownish appearance by transmitted light, whereas it is usually colourless. Behind is a cavity homologous with that found in *A. pulcher*, but much less capacious. The region is peculiar in having four marginal stylet-sacs, which occupy nearly the same level in the organ at different points of the circumference, and thus the pairs are not separated from each other, as represented by M. de Quatrefages in his *Polia armata* (a *Tetrastemma*), by a considerable antero-posterior interval. Each sac has the usual appearance and size, contains two or three perfect stylets, some free granules, and is connected with the floor of the anterior chamber by a duct. The external granular glands are well developed, and there are many larger globules amongst the others, sometimes resembling a nucleus in the midst of surrounding granules. The peculiar elasticity of the fibres composing the longitudinal layer of the proboscis is conspicuous in specimens which have been kept some hours in water, and then placed under pressure. The ruptured fibres keep jerking and twisting in a very characteristic manner, the free margin of the organ being fringed with coils.

The anterior region of the proboscis in *Amphiporus bioculatus* is faintly pinkish, and the glands rather numerous and small. The basal apparatus of the stylet-region (Plate XXIII, fig. 19, and woodcuts, figs. 3 and 4), is much elongated, rather wide anteriorly, so as to have a nearly uniform diameter throughout, and rounded posteriorly. The constituent opaque-white granules are minute, while the head of the stylet is large. The muscular cavity (ε) behind the floor of the anterior chamber is small, and obscured by the external granular glands, for the latter extend both before and behind the basal apparatus under pressure. The other parts of the organ

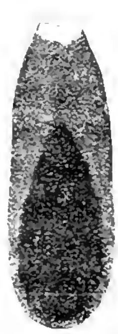
Fig. 3.

Central apparatus of the stylet-region of *A. bioculatus*. × 220 diam.

Fig. 4.

Isolated stylet. × 220 diam.

Fig. 5.



Central apparatus of the stylet-region of *Tetrastemma Robertianæ*. × 350 diam.

presented no noteworthy feature, except that no circular coat could be made out in the anterior region between the greater longitudinal and the mucous coats.

In *Tetrastemma melanocephala* the proboscis is somewhat larger than in *A. lactifloreus*; and exhibits certain important differences. The stylet-region (Plate XII, fig. 8) has the marginal sacs carried considerably forward, so that they lie quite in front of the central apparatus, and the floor of the anterior chamber has consequently to form a deep pit to reach the spike of the central stylet. The basal apparatus of the latter is proportionally large, while its wedge-shaped investment is comparatively meagre. The radiating or oblique fibres (near θ) which pass outward and forward from the latter, in the usual position of the organ under pressure, are very distinctly shown, and apparently sling the apparatus. The points of both central and marginal stylets (Plate XIV, figs. 8 and 9) are rather blunt, and their shape on the whole resembles that in *T. candida*. The circlet of granular glands is much developed, and often renders the subjacent parts obscure.

The remarks and figures of M. de Quatrefages relating to this species (his *Polia coronata*) require amendment. He mentions that it is the only exception he has met with to the uniform arrangement of the stylet-apparatus, as, in addition to the forward position of the marginal sacs, the central stylet and its surroundings are placed in his second œsophageal cavity, that is, in our reservoir; and his figure bears out his description, representing, moreover, the organ as placed at the commencement of the posterior channel. The species is easily identified by the position of the marginal stylet-sacs and other peculiarities, and there is certainly no such abnormality of the central apparatus or alteration of type as noted and figured by this naturalist.

In *Tetrastemma Robertianæ* the glands of the anterior division give the organ a faint pinkish colour. The middle region has two stylet-sacs of the usual structure, and a central apparatus (fig. 5) which differs from the ordinary form in *Tetrastemma* in being somewhat enlarged anteriorly. The stylets (Plate XIV, fig. 10, *a* and *b*) are short and stout, similar in shape to those of *T. melanocephala*, though decidedly smaller. Thus, while distinctions in the size and shape of these organs are valuable, they should not be too much relied on for specific separation. The external circlet of glands does not proceed further backwards than the posterior third of the basal apparatus of the central stylet.

The general arrangement of the proboscis in *Tetrastemma candida* agrees with that in *A. lactifloreus*. If under examination the ejaculatory duct is placed on the left of the central apparatus (Plate XIII, fig. 5), an explanation is obtained of the mistake into which M. Claparède had fallen in his description of the region in *Tetrastemma varicolor* Œrst. (the figure, however, appears to me to be very like that of *T. candida*). The central stylet and its apparatus have been slightly pressed backwards, so that the radiating fibres which sling them have been brought out distinctly, and sometimes a faint line of demarcation is seen on the right (in such a position)—simulating the presence of a separation; but numerous fibres are prolonged past this, and, moreover, a slight contraction or change of position obliterates the line, while the curved or radiating fibres are rendered more evident. On the left the only boundary to the supposed distinct coat around the wedge-shaped investment is the wall of the ejaculatory duct. The basal apparatus of the central stylet in this species (*T. candida*) has rather more shape than in *T. melanocephala*, and is proportionally more elongated (Plate XIII, fig. 6). I thought a slight difference could be detected between this species and *T. dorsalis* (Plate XIII, fig. 8, *c*), for the stylet in *T. candida* is generally shorter in proportion to the length of the basal structure. Considerable variations exist in the size of the several stylets in *T. candida*, independently of the magnitude of the animal, a fact perhaps the less surprising when the reproduction of the tube is remembered; but the greater size is generally diagnostic when compared with the three following species. The central and marginal stylets (Plate XIV, figs. 6 and 7) nearly agree in length. In a developing or recently repaired central apparatus (Plate XI, fig. 13) the basal portion is thinned off anteriorly from contraction of the parietes, and the difference in size between its stylet and one from the marginal sac of the same animal (Plate XI, fig. 14) is marked.

The stylet-region in *Tetrastemma dorsalis* is closely allied to that in the former species. The stylets, however, are on the whole more slender, and the central longer in proportion to its basal apparatus (Plate XIII, fig. 8). The same may be said of *T. vermicula* (Plate XIII, fig. 4).

The shape of the central apparatus in *Tetrastemma flavida* is characteristic (Plate XIII, fig. 9, *c*), the stylet being more slender than in the two former species, longer in proportion to the basal apparatus, and having the margins of the latter nearly straight. The comparatively large size of the glands of the reservoir in *Tetrastemma* is well illustrated in this species, where they form very prominent structures with granular contents, and more closely allied to those in the posterior chamber than in *A. lactifloreus.* The anatomy of the muscular and other tissues of the proboscis in *Tetrastemma* agrees with that in *Amphiporus.*

In *Prosorhochmus Claparedii* the stylet-region (Plate XIII, fig. 1) has the granules of the external circlet of glands unusually large and distinct. The basal apparatus of the central stylet has a straight border and sharp angles posteriorly, and obtuse angles at the sides. The pale investment of this structure is comparatively limited in bulk; and the curved fibres immediately behind sweep outward and forward very distinctly.

The size of the proboscis in *Nemertes gracilis* is greatly diminished in proportion to the bulk and elongation of the animal, the stylet-region, indeed, being found only a short distance behind the ganglia (Plate XII, fig. 11). The floor of the anterior chamber generally presents a bilobed aspect under examination, and has not the massive muscular structure usually found in front of the stylet-sacs; but it is furnished with a somewhat opaque mobile lobulated arrangement of glands, which, in extrusion of the organ (Plate I, fig. 6), appear as two semi-opaque whitish papillæ (one on each side), the stylet-sacs being prolapsed into their interior. The central stylet does not easily project in this condition. The stylet-region proper is somewhat opaque, on account of the glandular nature of the walls anteriorly, and the layer of granular glands posteriorly. The latter are placed far back, and in developing specimens form a granular mass on each side of the ejaculatory duct, sometimes entirely filling up the space (at *a*, Plate XII, fig. 11); and consist of a dense aggregation of minute clear granules, and coarsely lobulated glands, which are apparently homologous with the granular glands of other species. The marginal stylet-sacs have very long ducts, and each encloses from seven to ten stylets of a distinctive shape, besides other contents. The central stylet is appended to a basal apparatus of great length, its outline indeed resembling that of a long bone, such as the radius, the stylet being articulated to the head, while the distal extremity is represented by the dilated posterior end of the apparatus. The latter has the usual granular contents, but the exterior firm investment, so characteristically wedge-shaped in other species, does not proceed half-way forward, the slender anterior portion having only a thin covering for its support. While in ordinary views the stylet and apparatus seem straight, both have a decided curve in profile (Plate XIII, fig. 18). Just in front of the point where the clear investment of the apparatus becomes indistinct, the ejaculatory duct opens into the peculiarly elongated muscular cavity (ε), which extends forward to the circular opening in the floor of the anterior chamber. The channel shows a distinct inner layer of longitudinal fibres, which, however, seem to act only in company with the external oblique series surrounding them. The presence of this special coat demonstrates that it is not the mere doubling of the floor of the anterior chamber which forms the cavity, as indeed certain appearances, previously observed, had led me to suspect. The central and marginal stylets have the same shape, and the majority agree in size. In its usual position the stylet has the form of a spear-head (Plate XI, fig. 15), being sharp-pointed, then dilating gradually till near the posterior end, where a slight diminution occurs, and then a marked constriction—just in front of the somewhat small head. If minutely examined, both central and marginal stylets show a small secondary swelling or ring above the latter. The ejaculatory duct is comparatively large and distinct, comprising posteriorly almost the entire region of the reservoir, a slight demarcation, however, marking off the dilated extremity into a portion pertaining to the latter cavity, and another to the division in front. The widened posterior end is covered with small glands, which are continued along the tube to its opening in the muscular chamber behind the floor. One peculiarity in the elongated reservoir is the comparative thinness of the spiral fibres anteriorly, and the thickness of the longitudinal layer, which seems to afford compensation for the diminished strength of the exterior coat. This deviation from the usual structure is doubtless in connection with the enlarged posterior end of the ejaculatory duct, and the gradual blending of the cavity of the reservoir into it. The mass of the spiral fibres is grouped posteriorly, and in action would seem to compress the reservoir, so as to throw its contents forward to the gaping aperture of the duct. On this account also (*i. e.*, the grouping of the looped fibres posteriorly) the channel of communication is long. The external layers, continued from the preceding division, pass about half-way backwards over the reservoir. Another peculiarity is the presence of numerous clear cells and granules amongst the spiral fibres. Some of the cells contain nuclei; others do not. The glandular papillæ in the interior of the reservoir are large and prominent. The very great length of the posterior chamber, as compared with the short anterior, is noteworthy.

M. de Quatrefages seems to have devoted considerable attention to the anatomy of the foregoing species (his *Nemertes balmea*). He represents the stylet-region as having the marginal sacs rather behind the long central granular apparatus, each of the former possessing a carunculated gland attached to its posterior end, while the latter has two longer structures of the same description. None of these carunculated appendages have been seen by me, since it can scarcely be supposed he refers to the opaque granular condition of the space (at *a*, Plate XII, fig. 11)—previously described. His account of the contents of the marginal stylet-sacs is erroneous; for though the position of the stylets is of no moment, the assertion (and corresponding figure) that each has a developing basal apparatus attached to its extremity does not rest on facts. The outline of the stylets given by this author is inaccurate, since no constriction is represented in front of the head, and no mention made of their curvature. The other objections to his views are noticed elsewhere.

In *Nemertes Neesii* the proboscis, while approaching that of *N. gracilis* in general size, and the tenuity of the posterior region, is yet more closely allied to *A. lactifloreus* in the structure of its comparatively short stylet-region proper (Plate XII, fig. 12). The floor of the anterior chamber is furnished with very minute glands. The marginal stylet-sacs are small and somewhat rounded, their ducts being occasionally spindle-shaped, from evident constrictions situated respectively at the openings into the floor of the anterior chamber and the sac itself. The stylets are at once distinguished by their short, stout form, and peculiar markings resembling the longitudinal streaks in polished mahogany (Plate XI, fig. 12), which are due to irregularities or furrows on the surface. The granular basal apparatus of the central stylet (X, Plate XI, fig. 11) is short, and has only a slight constriction in the middle, so that the lateral line, from the apex of the spike to the base of the former, is nearly straight. The opening of the ejaculatory duct into the cavity (ε) behind the floor of the anterior chamber is wide. The reservoir is much elongated, and it may be observed that its soft fibres, as pressed between glasses, do not appear in a spiral series down the sides of the cavity, but in the form of a dense felt-like arrangement; yet, when freed from pressure, their elaborate crossings are better shown than in most species (Plate XIV, fig. 5). In the same region the longitudinal fibres are much developed anteriorly, though they are only well seen on stretching the parts, otherwise the felt-like arrangement of the spiral fibres obscures them. The glands of the reservoir are smaller and less distinct than in *N. gracilis*, especially anteriorly. The channel of communication with the posterior chamber is short and wide, and in marked contrast with the same part in the latter species. The long posterior chamber has its inner surface thrown into very prominent rugæ, which sometimes appear like large papillæ covered with the characteristic glands of the cavity. These plaits are not mere wrinkles and folds caused by the contraction of the organ, but are present under great pressure (Plate XII, fig. 13). The granules of the peculiar fluid therein are also conspicuous. It may here be mentioned that after prolonged confinement the integrity of the proboscis in this and other species is affected, the stylets degenerating, and even disappearing altogether, both from the central and marginal structures. Not only is this the case in the adults themselves, but under the same circumstances the more advanced young in the interior of *Prosorhochmus Claparedii* undergo a like degeneration. In a specimen of *N. Neesii* where this had occurred, the wave of the molecular fluid driven forward by the contraction of the reservoir distended the muscular cavity (ε) at the front of the granular basal apparatus (which in this instance was devoid of a stylet); and as the aperture into the anterior chamber permitted only a limited discharge at a time, the fluid rushed into the centre of the granular structure, and distended it and its wedge-shaped setting with every impulse. The absence of proper nutriment and free aëration, for the salt water was but rarely changed during the year, are sufficient causes for the above-mentioned degeneration.

In *Nemertes carcinophila* the proboscis and its apparatus are reduced to a minimum. The anterior region (Plate XII, fig. 14, A) is very short, and has an almost conical outline, the base of the cone being formed by the floor of the chamber. Its wall is proportionally thick and muscular, and the tube has a granular aspect internally, a condition probably due to indications of papillæ. Posteriorly it terminates in the usual floor, into which, however, only one aperture leads, viz., that of the central stylet. The stylet-region, while still retaining the type of the Enopla, differs much from that of any other British species. Instead of the ordinary well-defined arrangement of longitudinal and radiating fibres, the entire muscular structure is obscured by numerous granular or cellulo-granular bodies (γ). There is no trace of marginal stylet-sacs. The central stylet is minute, and furnished with an elongated and faintly granular basal apparatus, which is fixed in the usual transparent muscular investment. The mobile chamber (ε), into which the ejaculatory duct opens, is in the ordinary position. Though the whole apparatus is very minute, the stylet has been observed to be thrust forward by the contraction of the fibres of its basal investment, so that its point projected into the anterior chamber of the proboscis. The ejaculatory duct is large, and, from its central position in ordinary examinations, causes the stylet-region proper to appear bifid posteriorly; but this is due only to the greater translucency of the duct, which, for the time, makes a separation between the dense granular masses at the sides. The region of the reservoir is fairly developed, the wall being formed chiefly of muscular fibres having the usual spiral arrangement, and the inner surface covered with granular glands. Occasionally the reservoir contracts with force, and drives the contents forward into the ejaculatory duct and muscular space behind the floor of the first region. The channel of the reservoir leads into a posterior chamber of comparatively small dimensions, but having rather thick walls, and terminating in a *cul-de-sac* and bulbous end a short distance behind the œsophageal apparatus of the animal. The cavity has a cellulo-granular lining internally, and in some specimens the terminal portion is distended by a transparent fluid containing a few compound cells of similar aspect to those found in other species. It is kept in position by fibres from the strong bands at the posterior part of the œsophageal region of the digestive chamber. All M. van Beneden states with regard to the structure of this organ is that it is very short, and bears an "isolated" stylet. He also represents certain lines, which indicate a sheath (*cul-de-sac*) around the proboscis, a state that has not been seen in our examples.

g. Review of previous Interpretations of the Proboscis.

The proboscis was held to be a genital organ by some authors, as Huschke, Quoy and Gaimard, and Œrsted; others, *e. g.*, Ehrenberg, Johnston, De Quatrefages, Williams, Busch, Leidy, Girard, and Stimpson, maintained that it was the digestive canal; while H. Rathke called it an organ of touch. Some, again, have mistaken it for a parasitic worm, or a Nemertean embryo. Amongst those who have studied its anatomy in the Enopla, M. Ant. Dugès considered the organ to be part of the digestive system of his *Prostoma armatum*. He observed the stylet-sacs and their contents, which he described as six hard transparent points, disposed in two groups, while the central apparatus consisted of a horny oblong piece of a brownish colour. He thought the central organ would pierce the skin of the annelids on which the animal might prey, while the lateral points would retain them captive; and, moreover, that such an apparatus approached the hooks pertaining to parasitic worms, *e. g.*, *Polystomes* and *Echinostomes*.[1] He sketched rather rudely the structure of the organ in one of his plates,[2] and it is evident he was acquainted with the three regions; moreover, a sheath for the proboscis is indicated in his drawing.

In Gaimard's 'Voyages de la Commission Scientifique du Nord, en Scandinavie,' the anatomy of the proboscis in the Enopla is represented with considerable accuracy. The papillary lining of the organ is separated from the external layers. The central stylet, however, is placed far back, and no special floor of the anterior chamber is formed, the apparatus being enveloped in a broad mass of circular or transverse fibres, but the clear muscular investment is definitely figured, and there are longitudinal fibres posteriorly. Over the reservoir spiral fibres are clearly indicated, and the posterior region has at least two coats. Moreover, ducts to the marginal stylet-sacs are shown, and though they are two instead of one in each, yet their presence is thus early indicated. In Plate E, fig. 11 of this work, a single duct proceeds from each marginal stylet-sac, and, after a short course in a direction forward and inward, it divides into two branches, one of which communicates with the floor of the anterior chamber, and the other slants inwards and somewhat backwards to open into the ejaculatory duct. The proboscis is also figured in an extruded condition (Plate E, fig. 15), but the structure of the stylet-region in this position has been erroneously delineated. The artist represents the central granular apparatus and the stylets throughout very fairly.

The minute anatomy of the organ given by M. de Quatrefages is somewhat inaccurate. I have not observed that the dilatations and contractions of the channels of the reservoir (his œsophagus) vary in the manner he refers to in different species. He describes two swellings of this "œsophagus," a large lozenge-shaped one at its commencement, and another corresponding to our reservoir, these dilatations being connected by a straight channel. The former may have

[1] The stylets of the Nemerteans seem to me to have as little analogy or homology with such structures as with the "crystalline styles" in the stomachs of certain mollusca.

[2] 'Ann. des sc. nat.,' 1re sér. Zool., tom. 21, pl. ii, f. 5.

some connection with the mobile muscular chamber behind the stylet-aperture in the floor of the anterior region, but his descriptions and drawings are indistinct. He aptly likens the two central divisions (stylet-region) to crystal; but he says he required the action of hydrochloric and acetic acids to distinguish fibres, which, he observes, have a transverse direction, and he especially notes that he could not make out any longitudinal fibres. I have always been able to see these fibres in the fresh and living specimens, without any addition to the sea-water in which they happened to float; and, moreover, the presence of longitudinal, spiral, and other fibres, previously described, show how much more complex the structure is than the author imagined. He correctly reports the absence of vibratile cilia from this region; but he errs by affirming that they occur in the posterior chamber. His figures of the stylets differ from any seen by me, since they exhibit a swelling and then a contraction in front of the head. The basal apparatus is termed the "body" of the central stylet, and he narrates how in *Nemertes balmea* (*N. gracilis*, Johnst.) this body has an exterior coat composed of the same structure as the point. Nothing more than the usual firm muscular investment is really present (see p. 67). Again, the statement that the "body" acquires greater solidity is not borne out in fact, for the granular contents of the apparatus are homogeneous throughout. He speaks of a pouch containing a granular glandular substance in which the stylet and its "body" are placed in this species, and thinks it probably secretes the latter (body); and, though he has not seen it in *Polia*, he considers its existence likely. The author has evidently fallen into confusion here, for the granular structure (or so-called "body") is fixed in a clear investment of the firm muscular substance. He next describes and figures other two cavities, which are said to exist at the borders of the "stylet-pouch," semi-opaque and glandular in *N. balmea*, very transparent in *Polia*; and he considers that these two glandular organs secrete a poisonous fluid, for use in offence and defence, which (fluid) is poured into the pit in front of the stylet-region. Entomostraca, moreover, were killed instantaneously by wounds of the stylet, an effect which could not be due to mechanical injury only, but to the presence of an active poison. It is true he was not able to distinguish these glands or their cavities in many species, so that, if they existed, they must have been confounded with the neighbouring tissues by reason of their transparency. Such glands have never occurred in the British species, and the opaque granular substance really present in *N. gracilis* (*N. balmea*, Quatref.) totally differs in structure and function from his representations. The folding downwards of the floor of the anterior chamber, and the presence of the muscular space behind, have probably caused the mistake; and, indeed, it may be remarked, that the time and opportunities necessary for a correct appreciation of these complex structures make those best acquainted with them least surprised at such errors. The two muscular bands, also, which M. de Quatrefages figures and describes as for the probable purpose of carrying forward the stylet-apparatus, and compressing his hypothetical poison-glands, have not been seen, and the explanation of the parts already given renders such useless. With regard to the observations that the marginal stylet-sacs are free in *N. balmea*, but placed in the thick walls of the "œsophagus" in *Polia*, I can only state that the type of structure is the same in all, and that they occupy corresponding positions in the species referred to. It is probable also that the finding of only one marginal stylet-sac in *Polia quadrioculata* and *P. humilis* was accidental, and not by any means characteristic of such species (*Tetrastemmæ*). The remark, that in *Polia vermiculus* one sac is placed on the dorsal and the other on the ventral surface, is of no consequence when the ever-changing condition of this very mobile organ is remembered. The author further describes the "intestin" (our posterior chamber) as having the same coats entering into its composition as the anterior region, though, he adds, the muscular layers are proportionally thinner. As already stated, the structure of the walls of the two regions is essentially different, just as their functions disagree. He is correct in averring that the cavity ends in a *cul-de-sac*; but wrong in saying it is ciliated, and that the terminal ribands are attached "à la paroi abdominale." Lastly, he is only certain of the muscularity of these ribands in *Polia coronata* (*Tetrastemma melanocephala*), and he gives a curious figure (which cannot be verified in our specimens) of their termination as a series of arborescent fibres. This author also considered that the marginal sacs secreted stylets for the supply of the central apparatus.

Dr. Johnston's description of the stylet-region is as follows:—"First, we perceive on each side a small circular spot or cavity, in each of which are three spines with their sharp points directed outwards; beneath these there is a cup-shaped organ encircled above with a faintly plaited membrane, and armed in the centre with a strong spine, which can be compared to nothing more aptly than a cobbler's awl in miniature, the part representing the handle being very dark, and the point transparent and crystalline. This apparatus is placed within the intestine, is visible only when this is compressed, and is, as I believe, stomachial, having some distant analogy with the proper digestive organs of Laplysia and Bulla." His anatomy is thus imperfect; and he, moreover, held the opinion that the "intestine," as he termed the organ, proceeded to the tip of the body and terminated in a distinct anus.

Dr. Thomas Williams observes with regard to the proboscis (his digestive tract):—"The extremity of this organ is armed with several styleted jaws, which, from their construction, seem only designed to fix the suctorial end by perforating the alimentary object. When the proboscis is withdrawn into the interior of the body, fitting admirably into a short œsophagus, these sharp instruments are packed and folded upon themselves," the sides of the tubes closing round them. The correct examination of a single extruded organ would have at once dispelled such notions. His supposition, that the glands in the interior of this structure furnish an important secretion for the digestive process, which secretion is exuded into the "œsophagus" (apparently, judging from his figure, the proboscidian sheath), and thence into the great alimentary organ, rests upon no facts. He also errs in stating that the outlet of this organ is situated not far from the cephalic end of the body; but his remark, that there is no open communication between the œsophageal tube (proboscidian sheath) and the "alimentary cæcum," is correct.

Dr. Max S. Schultze, in his account of *Tetrastemma obscurum*, gives no definite description of the ending of the proboscis, and figures the central stylet as projecting freely into the cavity. He indicates the presence of the muscular space behind, but confounds its structure with the wedge-shaped investment of the basal apparatus, the whole forming, he remarks, a quadrangular mass. He erroneously describes the terminal ribands as attached to the wall of the body. In his figure he omits to notice the ducts of the marginal sacs, though he regards the latter as the producers of the stylets for the central organ. He first indicates, however, the connection between the developing spikes and the clear globules in the marginal sacs, showing that they are sometimes seen in their interior. Finally, he has not discriminated the structure of the reservoir and its relations to the neighbouring parts; and, indeed, his anatomy of the organ, from the limited nature of his observations, is somewhat imperfect. These remarks apply to his 'Beiträge,' as well as to his more recent representations in the 'Icones Zootomicæ.'

M. Claparède describes, in his 'Recherches Anatomiques,' the apparatus of the central stylet in *Tetrastemma varicolor* as set in a pale space of a triangular form, and he leaves the stylet-apparatus to hang therein, apparently by its anterior end. He has mistaken the translucent wedge-shaped investment of the organ for a cavity, and the triangular muscular structure to the exterior is imperfectly figured. He correctly observed the presence of a duct to each marginal sac; but supposed that these pouches were for the lodgement of stylets discarded from the central organ, and hence saw no connection between the clear globule and the developing spikes therein. His representation of the muscular fibres of the stylet-region is faulty. He discovered the presence of a liquid containing minute granules in the reservoir, and stated that the latter communicated with the "Trompe" by means of an efferent canal; but he fell into the error of regarding the posterior chamber of the proboscis as a "muscle retracteur." His delineation of the opening of the ejaculatory duct is inaccurate, from the absence of the muscular cavity behind the floor of the anterior chamber. The reservoir is regarded as a poison-gland, which squirts its contents along the ejaculatory duct into the wounds inflicted by the stylet. In his more recent 'Beobachtungen' he exhibits the structure of the region in *Prosorhochmus Claparedii*, but gives no details of the anatomy of the muscles. The central stylet and its apparatus are placed in the middle of a continuous and apparently homogeneous body, the wedge-shaped envelopment of the basal organ and the muscular cavity in front being confounded. The opening of the ejaculatory duct of the "poison-gland" (reservoir) has the same position as in his previous figure, viz., at some distance from the stylet, and passing directly into the floor of the anterior division. He now refers to the posterior chamber, which, he says, occupies the centre of *the muscle of the organ*, a modified but unsatisfactory description. The external granular glands are not characteristically figured.

In his anatomy of the region in *Polia obscura* (a *Tetrastemma*), M. van Beneden represents no ducts to the marginal stylet-sacs, and no ejaculatory duct. The reservoir has a cavity in the centre, but is likewise furnished with two hypothetical oval vesicles or spaces; while the muscular structure, the floor or ending of the anterior chamber, and other important points, are absent. The statement, that the marginal sacs contained stylets of a smaller size than the central, and of a different form at the base, is also ambiguous. He calls the former sacs pouches of replacement. While he asserts that the proboscis is enclosed in a separate sheath, he distinctly adds, that its muscular retractor is attached to the skin of the animal posteriorly; and that there may be no misunderstanding, he repeats the statement when drawing up his conclusions, by averring that the internal surface of the proboscis is ciliated, and that it is fixed to the bottom of the digestive tube by a retractor muscle, like the stomach of the Bryozoa.

So far as they go, Prof. Keferstein's remarks on this region in *Polia mandilla* (*A. lactifloreus*) are in advance of his predecessors. He does not mention, however, the minute glands on the floor of the anterior chamber, and represents the aperture for the central stylet much too large, so that in extrusion the muscular space (ε in our figures) becomes obliterated. The investment of the granular basal apparatus is continued too far forward in his drawing. He indicates no oblique fibres from the pit of the anterior division, is unaware of the complex anatomy of the proper stylet-region, and represents the coat of the reservoir as composed of longitudinal fibres. The external granular glands are not distinctly described; and the disproportion between the central and marginal stylets is so great, that probably some slip has occurred in their delineation. Lastly, his crenated border (external elastic coat) does not pass the constriction between the proper stylet-region and the reservoir, whereas both this and the longitudinal coat beneath are really continued some distance on the latter. His representation of the extruded organ is also much in need of amendment.

D. *Reproduction of the Proboscis.*

This has been observed in various species. In a specimen of *Tetrastemma melanocephala*, from which, three days before, the proboscis had been removed, there existed a pale conical papilla, which projected a short distance behind the ganglionic commissures. Two days after considerable progress has been made, and the organ proceeds backwards as a slender rod—tapered posteriorly (Plate XIII, fig. 2, *a*). There is a distinct exterior coat from one end to the other, and an inner—terminating at the commencement of the posterior narrow portion. The former has a crenated edge in contraction. The organ gradually increases in size and complexity, but continues quite free posteriorly for a considerable time, until, indeed, the stylets are well developed. At a further stage (Plate XIII, fig. 3), the walls are defined almost as in the complete structure, but of course are much more delicate and plastic; and the extreme contractility and elasticity of the entire organ are most interesting, and raise a doubt as to the identity of the muscular fibres with those of the higher invertebrates, since they so much surpass them in mobility. The floor of the anterior chamber ends in the usual pit, which is dilated on account of the shortening of the organ. The walls of the muscular cavity behind the floor of the anterior region are not well defined, though the space itself is large, and contains a granular fluid. There is no central stylet, and the basal apparatus is represented by a somewhat triangular group of the usual granules, round which the radiating fibres are placed. The wedge-shaped investment within the latter (fibres) is mobile and translucent. A somewhat indistinct streak (*f*) in the median line indicates the canal for the central stylet, and now and then this is bulged by projected fluid. The marginal stylet-sacs, from the expansion of the chamber in this instance, seem to be carried backwards, but in reality they have their distinctive position. Each contains a stylet or two, a few granules, and a clear globule.

The reservoir at this stage has assumed its characteristic shape, though the glands are barely visible. The contraction of the anterior and posterior chambers has annihilated the usual prominent appearance of this part, and the last has encroached very much on the cavity posteriorly. The glands are formed in the posterior chamber, though their contents are not elaborated, and the cavity terminates in the usual *cul-de-sac*. A few rounded papillæ at the termination indicate the early condition of the muscular riband. It is clear that at some time or other the latter becomes attached to the wall of the proboscidian sheath, and that, too, in a definite manner, since no great deviation in a series of specimens is met with.

In the developing organ of *N. gracilis* (Plate XIII, fig. 17) a very good analysis of the somewhat complicated structure is obtained, so that doubtful anatomical points are cleared up satisfactorily. The apparatus at the base of the central stylet is sometimes composed of granules in rounded masses; and they are all grouped posteriorly at an early stage, thus presenting a similar form to that seen in other species which have short structures in the complete state. It is curious to witness the accuracy with which the stylets are reproduced in this and other species. There is never any confusion, but each invariably develops them of their respective sizes and curves as infallibly as if they had been struck out of the same mould. Yet these bodies are not in any way organically connected with the tissues of the proboscis, but only spring from a secretion poured into the marginal sacs, or from the central apparatus. In the concentric arrangement of their constituent substance, and some other particulars, these spicula are analogous to those of the sponges, whose microscopic anatomy has been so excellently investigated by Dr. Bowerbank. Indeed, the morphology of the stylets in the Enopla offers elements for deeper reflection than even the hooks and bristles of the higher annelids, which are often so diagnostic of genus and species.

Besides the developing organ the proboscidian chamber contains (unless in cases where it has been violently expelled) the rejected proboscis; and it is an interesting sight to observe a fully-developed structure floating freely in the chamber, and still endowed with contractile power, while the new proboscis has advanced to the stage of the advent of stylets. The discarded organ soon becomes opaque, appearing reddish by transmitted light, and the stylets leave their positions. As there is no mode of exit after the new proboscis has begun to develop, the aborted one can only (not to speak of rupture) be removed by disintegration and absorption; and hence in the proboscidian chambers of such animals there is a vast increase of cells, granules, and granular débris.

6. Digestive System.

a. The Mouth.

Dr. Max Schultze, almost alone amongst foreign authors, seems to have noticed the true position of the mouth in his *Tetrastemma obscurum*. It forms a slit on the ventral surface immediately behind the aperture for the proboscis (Plate III, fig. 8, *w*; and Plate XIV, fig. 11, *w*). The two openings are especially distinct in *Amphiporus hastatus* and *Prosorhochmus Claparedii*. In animals which have been subjected to chloroform, the œsophageal apparatus is occasionally prolapsed through the mouth under pressure. The observations on this point have been often repeated, out of deference to the distinguished continental authors who hold different views, but I have never seen any deviation, and it is hard for the oral aperture to exist in the free portion of the œsophageal apparatus behind the ganglia. There is thus a marked distinction between the Enopla and the Anopla, the mouth in the first group opening quite in front of the ganglia, while in the other it is situated considerably behind the ganglia.

b. Œsophagus.

Though no transverse muscular plate, as described by M. de Quatrefages, occurs at the anterior part of the body of the worm, yet there exists a very distinct and comparatively large ciliated œsophageal chamber. The figures of the supposed transverse plate, indeed, given by the French author, show a degree of doubt, since in one drawing both wavy and longitudinal fibres are represented, while in another there are only transverse fibres. The wavy and longitudinal lines no doubt owe their presence to those actually existing in the œsophagus. Dr. Johnston indicates this structure in a figure of *T. melanocephala*, and he refers to it under *A. pulcher* thus:—"Immediately under the hearts" (ganglia) "we observe a large, somewhat muscular viscus, apparently hollow, and lying in the course of the intestine, but seemingly unconnected with it. Of its office and nature I can form no opinion; but I may remark, that in all the species a greater duskiness in its site shows that a similar organ exists in all." Professor Keferstein's notice of the organ in *Œrstedia pallida* is very brief, and he has abstained from figuring its relations, though affirming that its opening (constituting the mouth) is on the ventral surface behind the ganglia, as in the Anopla. M. van Beneden, while indicating an outline of the structure in *Polia capitata*, makes no reference thereto in his descriptions. The same omission is made by M. Claparède in regard to his figure of *Prosorhochmus Claparedii*.

In all the Enopla the œsophageal organ is easily observed (Plate XIV, fig. 1, *j*) as an elongated structure, occasionally tinted of a pale reddish brown colour, slightly narrowed posteriorly, and usually thrown into various longitudinal wrinkles. It diminishes somewhat abruptly behind the ganglionic commissures, and passes forward beneath the inferior one to the oral aperture at the ventral border. The narrow anterior channel for the proboscis lies close above the œsophagus towards the anterior part of the snout (Plate X, fig. 3). The two tubes become more evidently separated in most sections just in front of the ganglia, and the interposition of the broad inferior commissure soon renders the distinction more apparent (Plate XV, fig. 1); thereafter they have the tunnel of the proboscis as a party-wall, together with that portion of the extra-proboscidian region in which the median blood-vessel is situated. The œsophagus, moreover, occupies a special chamber, bounded by a series of well-marked fibres (Plate XI, fig. 2, *k*), which pass downwards from the upper wall by the side of the proboscidian sheath, and unite in the median line below it. The anterior narrow portion is translucent, and close behind the commissure a wrinkled arrangement is often seen, which is followed by the more opaque portion with its deep longitudinal rugæ. The former appearance is very similar to that which is caused by tying the mouth of a leather bag, and is due to the glandular folds and constriction of the organ in front. The pale division behind the ganglia shows active ciliary motion, but there is no trace of an aperture; indeed, the great and peculiar stretching of this pale portion, as it is dragged backwards from the region in front of the ganglia, at once demonstrates the fallacy of supposing it connected with any post-ganglionic aperture. The wall of the organ evidently contains some contractile circular fibres, which cause it to dimple inwards here and there during its motions; and in anterior transverse sections the ends of longitudinal muscular fibres are distinctly shown, though they are finer than those of the proboscis. Posteriorly the œsophagus opens into the alimentary cavity; but the communication is not actually seen in ordinary views, and I have not been able to observe the animals feeding.

The wall increases in thickness after passing the narrow portion in front, and again slightly diminishes posteriorly. In transverse sections of specimens hardened in spirit and mounted in chloride of calcium the structure has a streaked and fibrillated aspect (Plate XIV, fig. 12), being marked by a series of vertical striæ, and minutely granular, an appearance due to the position of the glandular follicles with respect to the inner surface, and the change caused by the preparation. It will also be noticed that in these sections the structure is thrown into numerous characteristic longitudinal folds. In the living example the inner edge of the organ (Plate XIII, fig. 20, *a*) has a somewhat translucent and well-defined border, garnished with moderately long and most vigorous cilia; indeed, the latter and the wall retain their irritability a considerable time after the death and partial decay of the animal, just as Darwin and Dugès observed in the proboscis of Planaria. The inner surface in the fresh specimen is always thrown into numerous wrinkles, and crossed by pale streaks—the ciliated edges of the folds (*b*). The entire structure is studded internally with a series of granular glands or follicles, which taper towards the free ciliated edge of the rugæ, and numerous brownish pigment-granules.

In *A. pulcher* the granular glands of the œsophagus are distinct and large, and in *T. melanocephala* the organ is curiously narrowed posteriorly. In *Nemertes carcinophila* it is short nearly globular under moderate pressure, and presents a very distinct terminal aperture. It is also conspicuously tied in this species by strong transverse bands posteriorly.

This ciliated glandular œsophageal region is physiologically and homologically an organ of great interest. It is peculiar to the Enopla in the condition just described, since what is shown here in the complete form is only indicated in the Anopla by the turning inwards of the margins at the junction of the two regions of the alimentary canal. The granular glands and cells which coat the latter in *Amphiporus* arise on the sides considerably in front of the posterior end of the œsophageal division (Plate XIV, fig. 1), being collected in transverse section (Plate XI, fig. 3) chiefly on the ventral surface of the organ. The first (œsophageal) region, besides, occupies a special space in which it rolls. Its rich ciliation, and the somewhat indistinct ciliary movements seen in the posterior division of the alimentary system, are points of importance when contrasted with the arrangement in the Anopla, and show that from structure to structure essential differences between the groups meet the inquirer at every step.

c. *The Digestive Cavity Proper.*

After explaining the hypothetical transverse diaphragm, to which I have already alluded, M. de Quatrefages proceeds to observe—"Le reste de la cavité générale occupe tout le corps proprement dit; mais les cloisons verticales auxquelles sont suspendus les organes générateurs le partagent en trois chambres distinctes, l'une médiane, qui renferme le tube digestif dans une portion de son éntendue; les deux autres latérales, dans lequelles flottent les ovaires ou les testicles, et qui à l'époque de la reproduction se remplissent d'œufs ou de zoospermes." In his figures the scalloped shaded portion, which he terms "ovaires ou testicles," is, as Professor Keferstein pointed out, the glandular wall of the digestive cavity. Thus the very same organ is made in the one case ovary, and its gland-cells developing ova, and in the other respectively testicle and sperm-cells. Dr. Johnston recognized the structure as "a close series of vesicles or cells, formed in the true *Nemertes*, apparently by the folds of a membrane." The cæca, he adds, are always full of some opaque matter, which varies "in intensity at least according to the nature of the animal's food." He thought the structure was connected with the digestive system, though not in communication with the proboscis (his alimentary organ). Dr. T. Williams had also an inexact idea of this cavity, for he speaks of it as a great spongy mass, or "great alimentary cæcum," which commences anteriorly immediately behind the hearts (ganglia), under the character of a cæcal end, and as "a perfectly closed sac, containing a milky fluid." The walls of this cavity, he states, act upon the exuded food, after its passage through the coats of the "œsophagus." He is correct in denying the ovarian character of the organ, and in showing that the so-called ova consist only of oil-globules. Dr. Max Schultze described it as a straight canal in *Tetrastemma obscurum*, ciliated on its inner surface, and opening anteriorly and posteriorly; he also figures its cells—altered by extrusion into the water.

The digestive cavity in the Enopla is a somewhat moniliform or pinnate canal, in so far as its surface is increased by the numerous diverticula, which are best observed on the ventral surface. It appears under pressure in *Tetrastemma* (Plate XIV, fig. 1) as a lobulated glandular organ, usually of a pale flesh or slightly pinkish hue, extending almost from the ganglia to the tip of the tail, and forming (in the individuals in which the reproductive elements are not developed) a lining to the body-wall, except where interrupted by the proboscidian sheath. In the ripe animal, however, the gradual enlargement of the ovaries or sperm-sacs pushes in the yielding organ, so that it occupies a more median position, and has its ventral portion increased in bulk. It is also well to bear in mind that the body of the adult worm is only rounded in contraction, and partly so when the ova or spermatozoa are mature, but at other times it is flattened, and very mobile; thus, what is space in the transverse section is often obliterated in the living animal by the collapsing and contraction of the yielding tissues in the neighbourhood. Anteriorly the only opening leading into this chamber is that of the end of the rugose œsophagus; posteriorly it terminates in an anal pore, which is less easily seen than in *Lineus*, from the absence of the strongly ciliated internal streak. In intimate structure the walls of this cavity resemble the anterior or œsophageal portion, only the gland-cells are larger and more numerous, and the fatty elements in greater abundance, so that, although the type of structure remains, there are considerable differences in microscopic appearances. I was for some time in doubt about the ciliation of this chamber in *Amphiporus*, since I have seldom been able to see cilia satisfactorily in the uninjured *A. lactifloreus*, though in the latter, *N. Neesii*, *Tetrastemma*, and especially *Nemertes carcinophila*, peculiar motions of the cells were apparent. When a specimen is kept some time under pressure, moving granules are observed at particular points; these continue to increase in number, and sometimes a few cells accompany them, the groups gradually enlarging and revolving with great velocity. Such motions are doubtless due to the ciliation of the chamber. On making a transverse section of the living animal (*A. lactifloreus*), the inner margin of the digestive cavity causes motion in the surrounding particles, but the cilia are indistinct, and the appearances very different from the richly ciliated tube of *Lineus*, or its œsophageal portion anteriorly. It is thus much more feebly ciliated than the others.

In the walls of this complex cavity are a vast series of gland-cells, which, with M. van Beneden, I consider have some analogy with the liver of the higher forms, notwithstanding the adverse opinion of Prof. Keferstein, who, however, probably refers more particularly to the Anopla. The cells (Plate XX, figs. 7 and 8) have an average diameter of $\frac{1}{800}$ of an inch, and consist of a delicate membrane containing a number of granular fatty bodies. After extrusion from a living specimen into salt water, a remarkable movement, which the observer is apt to attribute to cilia, occasionally ensues in the contents before breaking up. The contained bodies jerk about within the cell, and soon a number of very minute granules appear, having burst from the former, in which their presence is indicated by obscure markings. The peculiar motions would seem to be due, as usual, to the action of the water, and ultimately the minute structures are all set free. The various appearances of the contents of the cells are shown in Plate XX, fig. 9, some being granular, others presenting faint concentric lines like starch-corpuscles (though probably fatty), while three oil-globules are indicated on the right. The deep port-wine oil-globule is somewhat sparingly scattered throughout the wall of the tract, the yellowish-red being abundant, and the pale globule still more plentiful. These cells have a similar structure in *Tetrastemma* (Plate XIV, fig. 13), and often escape under pressure posteriorly. The quantity of deep yellow oil in this organ in *T. candida* is unusually great. The glandular structure just mentioned undergoes partial absorption at the period of reproductive activity, so that after the deposition of the ova the animal is much flattened; but by-and-by it regains plumpness, and often assumes a greyish hue, apparently from the increased development of this tissue, which is exuded as a pale, salmon-coloured, semi-fluid substance on rupture of the body-wall. In *N. gracilis* (Plate XIV, fig. 3) the posterior division of the digestive system, viewed from the ventral surface, has a somewhat regularly ramified arrangement, and this is especially evident some time after spawning, when the animal has regained its condition. The colour of the region is deep green by transmitted light, whereas the œsophageal division is brownish. The pinnæ in *A. pulcher* form simple tapering papillæ under pressure. In *Nemertes carcinophila* the cavity is greatly developed, both as regards the rest of the body and its individual structures; and it also presents a firmer and more consistent aspect than usual on transverse section. The absence of the proboscidian sheath and its contents leaves the central space almost entirely at its disposal.

Microscopically, the alimentary cavity has, on the whole, less of the regular and firm glandular appearance of the same structure in the Anopla, but is more friable and cellular. Its analogy with that of the higher annelids is also borne out; for although the biliary matter is not arranged as a distinct organ exterior to the alimentary, it is incorporated therewith, and probably has a similar function. The fluid, however, which bathes the liver in the higher forms (if we suppose that inside the sheath for the proboscis to be the homologue of the former), is here separated by the muscular walls of its special tube; thus those who imagine, like Mr. Lankester, that the so-called biliary tissue in *Chætogaster* and others has some connection with the production of the corpuscles of the perivisceral fluid, find here a fact of interest. I, however, do not see the advantage or necessity of deviating from the very generally applied law, viz. that the fluid itself produces its corpuscles. The large size of the proboscis in the Enopla renders the digestive system very obscure from the dorsal aspect, and it is only when the ventral surface is upturned that a correct knowledge of its relations is obtained. No food has been found in the alimentary cavities of those examined.

7. Vascular System.

The circulatory system is composed of three great longitudinal trunks—one central and two lateral—besides the cephalic arch and anastomotic vessels. Commencing with the central trunk posteriorly (Plate XV, fig. 3, *p*) in *Amphiporus*, it is found that the vessel, which in this region is about twice the diameter of the lateral, arises from the point of junction of the last-mentioned, just within the posterior border of the worm. It travels forward beneath the proboscidian chamber in an undulated manner—as usually seen—to the region behind the ganglionic commissures, where it bifurcates (*q*), a branch passing to either side to join the lateral trunk (*r*), which bends inwards to meet it. From this point of junction also a single vascular arch (cephalic) proceeds forward into the tissues of the snout (*l*, same figure, and in Plate X, fig. 2, the latter showing the vessels in transverse section), the pillars of the arch thus meeting the lateral and anastomotic vessels of each side. From the same point of union each lateral trunk passes backwards under the nerve-cord to the tail, where it meets its fellow of the opposite side, and gives origin to the single central vessel with which the circuit commenced. The lateral trunks appear to diminish slightly posteriorly. The median vessel does not actually touch the wall of the proboscidian sheath, though transverse sections usually show a close apposition, but is situated in a layer of transparent elastic tissue intervening between this organ and the digestive tract. At the ganglionic region the vessels which go to form the cephalic arch pass below the commissures, and unite in front beneath the channel of the snout. In *N. Neesii* there are three main longitudinal trunks as in *A. lactifloreus*; but it can be observed that the lateral communicate with the central, as in *Lineus*, by transverse branches, which, however, are proportionally smaller. Whether such anastomoses occur in the pale *Amphiporinæ* is thus an open question; but they are distinct enough in this species. Two lateral trunks only could be discovered in *Nemertes carcinophila* (Plate XIV, fig. 1, *r*), which unite by a very short loop just in front of the commissures. This arch (*l*) is distinguished from the ordinary arrangement by its not extending forward into the tissues of the snout. The lateral vessels are not so clear or well defined as in *A. lactifloreus* and *Tetrastemma*, and possess internal transverse bands or partial septa in front; while the fluid circulating therein has a few clear granules, as in *N. Neesii* and others. The contractions in the lateral trunks are very vigorous, and even a minute central vessel could not have been passed over if a trace of such had existed.

The course of the circulation, so far as observed, is as follows:—Posteriorly a gentle contraction from behind forward drives the contained fluid along the great central vessel to the front, where it is forced through the anastomotic into the lateral vessels and the cephalic arch. Each lateral trunk swells with the wave, and the fluid then proceeds to the posterior end to enter the median, as before-mentioned. In addition to the stream poured into the lateral trunks, another passes into the cephalic arch by the vessel on each side, and the counter-currents must meet and commingle, returning again during the diastole of the central vessel. I have not made out any branches in the British species except in *N. Neesii*; but this is a somewhat difficult task, on account of the transparency of the vascular medium and channels.

In many species the fluid contained in these vessels is transparent and homogeneous. M. de Quatrefages, however, found corpuscles in his *Polia bembix*, Professor Keferstein small oval discs in the reddish blood of his *Borlasia splendida* (*Amphiporus spectabilis*, Quatref.), and I have seen in *N. Neesii* minute granular corpuscles, but both they and the fluid are colourless. Minute colourless globules also occur in the blood of *A. pulcher*.

The ideas of M. Dugès with regard to the circulation in these animals were rather indistinct, though he discovered certain vessels. In his figure he represents a median and no less than three lateral trunks on each side, and he further joined the ganglia to this system under the character of pellucid pouches communicating with the arcade (cephalic arch). The latter he transformed into a complex series of vessels, which need not be particularly described. He thus confounded the nervous and circulatory systems. The first point to be noticed in the descriptions of M. de Quatrefages is the statement, that the lateral trunks pass through the cephalic diaphragm—a structure which has not been seen. He is slightly in error also when he states that the median vessel lies immediately under the subcutaneous muscles. The arrangement shown in his two sections of *Borlasia angliæ* cannot apply to this group. I have not been able to verify the elaborate curves which this author gives each anastomotic division of the central vessel anteriorly, and which may be described as first forming a loop behind the ganglion, with its curve directed outwards, and a second inversely curved round the anterior border—in its passage to join the lateral, which is scarcely bent inwards at all, but occupies a space where no vessel occurs in the British forms. The mere shortening of the anastomotic will not retrieve this anatomical error. The cephalic arch is also placed otherwise than "immediatement audessous des couches sous-cutanées," as already described (Plate X, fig. 3). He mentions the presence of distinct walls to these vessels, which, however, he learned from *Borlasia angliæ*, and in this I concur (Plate X, figs. 2 and 3). The walls are highly contractile, and in the latter figure the vessels have been cut just before they complete the cephalic arch; they are observed to be surrounded by a ring of finely granular texture. M. de Quatrefages likewise states, that though fixed in front the vessels are elsewhere free, and only connected here and there to the body-wall by ligamentous bridles; and in one of his plates he figures the ova between the lateral vessels and the wall of the body. All our transverse sections show that such could hardly occur, for the vessels occupy a secure position beneath the nerve-trunks; and while the ovaries or sperm-sacs sometimes press the vessels downwards towards the ventral surface, and increase the distance between them and the nerve-trunks, they never actually intervene between the latter and the body-wall in the perfect worm. This author appears to hold similar opinions still, since he reproduces several of his former figures in his recent 'Annéles.'

Many of the older naturalists confounded the ganglia with hearts, such as Ehrenberg, Schultze, Huschke, Delle Chiaje, Dugès, Œrsted, and more recently our countrymen, Drs. Williams and Johnston. The latter mentions that the only blood-vessel he has seen is one "winding down the middle, along the surface of the alimentary canal," but he can neither trace its origin nor termination. Dr. Max Schultze, at first, seems to have mistaken the edge of the proboscidian sheath under pressure for the circulatory system, which he figures as two long straight trunks on each side of the digestive tract. The true blood-vessels he describes as pertaining to the water-vascular system, but shows neither beginning nor ending, though numerous large branches are represented as issuing from them throughout their course. In a subsequent publication he endeavoured to reconcile his early views with more modern, but fell into considerable confusion. Professor Keferstein does not distinguish with sufficient clearness the different blood-systems of the Enopla and the Anopla; and, indeed, applies the definition of the former to the latter; but so far as they go his descriptions and representations of the arrangement in this group are good. He, moreover, shows an elaborate series of minute transverse anastomosing vessels in his *Borlasia splendida*, the structure of which therefore differs from that usually exhibited by the British Enopla. M. Claparède, though his publication is more recent, is less correct than the latter author, for he figures the dorsal vessel coursing above the ganglionic commissures before giving off the anastomotic to join the lateral, and thus a somewhat stiff square is formed in the cephalic region, while the lateral vessels have to pass to the outside and front of the ganglia before meeting the anastomotic. The vessel appears also to be placed on the dorsum of the proboscis.

8. Nervous System.

a. Ganglia.

In the living animal two carmine, pinkish, or reddish colorations are observed on the snout, some distance behind the tip; these mark the position of the cephalic ganglia or nervous centres in most of the Enopla. As previously mentioned, not a few authors, misled by their colour, pronounced them to be hearts. Under a lens they are somewhat pyriform, and each consists of two divisions—a superior, shaped somewhat like an almond, and an inferior, continuous with the great nerve-trunks. The superior lobe is connected with its fellow of the opposite side by the *large* or *superior commissure* (Plate XI, fig. 1, *f*), which passes over the proboscis. In ordinary circumstances this commissure is less than half as broad as the inferior, but it is considerably longer. It forms a simple ribbon of transverse fibres, some of which, after diverging, turn slightly forward, but the majority pass obliquely backwards to the pale central part of the lobe. The only remark made by M. de Quatrefages with regard to its physiology is that it removes the somewhat surprising condition of having a brain composed of two lateral masses, and only one commissure. This band, however, seems of more interest, since during the enormous distension which takes place in the extrusion of the proboscis, it is the superior commissure which is stretched to an extreme degree of tenuity. The organ, passing through a complete ring of nervous texture, must force this outwards in every direction during extrusion, and especially superiorly, the inferior commissure, indeed, being only slightly affected. Nearly half the circumference of the proboscis projects above the level of the ganglion (Plate X, fig. 8), and the superior commissure must be correspondingly elongated; hence we have an interesting example of the elasticity of a nervous band. The inferior commissure consists of a thick mass of fibres, the majority of which sweep backwards to form the lateral nerve-trunks; thus it becomes a commissure between these cords. A few of the anterior fibres are connected with the central region of the former division of the ganglion.

Carefully made transverse sections show how incomplete is the impression conveyed by the examination of the parts in a compressed though living animal. Instead of forming a flattened organ, whose greatest diameter is across the plane of the body, each ganglion has its long diameter nearly perpendicular to the latter (Plate X, fig. 8, and Plate XI, fig. 1). The nerve-cells do not appear to be confined to the superior portion, but occur in the inferior also (Plate XV, fig. 4), on each side of the origin of the great nerve-trunks. In the fresh specimen the sheath of the ganglion is moderately resistant; for under pressure the cells from the interior do not pass readily through, but escape by travelling along a portion of the great lateral trunk, and out at its torn end, or by other branches, such as the superior and inferior commissures and the anterior nerves, or through accidental punctures. The nerve-cells have a yellowish tinge, are minutely granular (Plate XV, fig. 6), and rapidly alter their appearance after escape into the water. Many contain a large reddish granule or granules, to which the colour of the organ is partly due; but I cannot say all the numerous pigment-granules are so located, though they may have been. In the fresh, as well as in the prepared condition (Plate X, fig. 8), the entire ganglion is dotted with minute pigment-specks and granules, which are also continued along the great nerve-trunk for a considerable distance. The superior commissure is faintly tinged with colouring matter, the inferior more so; both are paler than the masses of the ganglia. The hue of the ganglia is not destroyed by sulphuric ether, but is rendered pale by acetic acid. The distinction between the superior and inferior lobes is sometimes clearly shown in oblique sections, which give, on the same side, a portion of the superior lobe, as well as the origin of the nerve-trunk (Plate XV, fig. 1).

In the elongated species, such as *N. gracilis* (Plate V, fig. 4) and *N. Neesii* (Plate XV, fig. 5), the ganglia are not correspondingly lengthened, but are somewhat rounded. They are also rounded in *A. pulcher* (Plate XV, fig. 2) and *A. spectabilis*. In *Tetrastemma melanocephala* (Plate XIV, fig. 2) the arrangement is very similar to that in *A. lactifloreus*. In *T. flavida*, however, the inferior commissure is rather shorter and broader (Plate XIV, fig. 14), and the lobes more elongated. This is also the case in *Prosorhochmus*.

The ganglia, according to M. de Quatrefages, are surrounded by a sheath forming a sort of dura mater, at least in a large *Borlasia* (*angliæ?*), for he could see none in the smaller species. In the Enopla the muscular and other structures of the head form a somewhat condensed capsule round the ganglia, independently of the delicate sheath proper of the nervous matter. The longitudinal fibres of the former, indeed, constitute powerful bands between the ganglia and the inner muscular layer of the body-wall. This author also mentions the occurrence of ventricles in the interior of the ganglia, and figures them in *Polia berea;* such have not appeared in any British form, though under pressure collections of fatty matter closely resemble his drawing. I have never been able to see so many branches proceeding from the anterior borders of the ganglia (as he shows) to the eyes, cephalic fossæ, "mouth," and other tissues, in addition to the great trunks and other branches posteriorly. The arrangement in the British Enopla (Plate XV, fig. 1) is as follows:—Three very distinct branches occur on each side of the superior lobe anteriorly (two about equal in size); a third, much smaller, to the outer side; and, lastly, traces of a fourth branch. The outline of the ganglion, throughout the rest of its extent, is quite smooth. Various branches from these trunks proceed in the direction of the eyes; but the nature of the cephalic tissues renders it very difficult to trace such an object as a pale nerve-twig with certainty. Dr. Max Schultze gives a tolerably correct view of the ganglia and nerves in *Tetrastemma obscurum;* no branches, however, occur on the trunks in his figure. This author, in a subsequent publication, founded one of the chief distinctions of his *Enopla* and *Anopla* on the structure of the ganglia. E. Graeffe, again, in his remarks on a *Tetrastemma* from Nice, states that he found a small cluster of otolite-capsules between the eyes, each capsule containing a crowd of minute otolites. Professor Keferstein figures only two branches proceeding from the anterior part of each superior lobe to the eyes in his *Borlasia splendida* (*A. spectabilis*, De Quatrefages); but he represents a kind of meshwork, formed by three or four trunks, between the side of the lobe and the cephalic sac, and a pair of nerves from the inferior commissure to the proboscis. I have not made out the latter in the British specimens. He also describes the occurrence of an otolite or two in the middle of the ganglion of a young *Œrstedia pallida*. The latter condition has been delineated by M. Claparède, the otolite-capsule in each case being situated in the centre of the organ, and consisting of a cell-wall containing three spherical granules. The same author figures the proboscis passing beneath the great or inferior nervous commissure, with the central blood-vessel above both.

b. Great Lateral Nerve-Trunks.

These (*n*) spring from the inferior lobes of the cephalic ganglia, pass backwards within the inner (longitudinal) muscular layer of the body-wall to the posterior end of the worm, where they terminate near the tip. They are surrounded by a coat of the usual delicate fibrous stroma of the parts, and are often tinted of a reddish hue at their commencement. The branches given off by these trunks are generally pale and indistinct, but by the use of dilute acetic acid in *A. lactifloreus*, and in others without such aid, they can be satisfactorily observed. They are easily seen, for instance, in *A. pulcher*, the reddish colour which tinges them at their commencement shining through the translucent integuments. An elaborate plexus of branches from the lateral trunks has also been noticed in this species (Plate XVI, fig. 3). In the same form, and in *N. Neesii*, there remains, even after continued pressure, a peculiar narrowing of the great trunks immediately behind the ganglia, which, if not an original condition, may be due either to comparative immunity from pressure, or a tougher investment. In transverse section the nerves present a delicately granular appearance, from the ends of the fibres. No one who has seized on such specimens as *N. gracilis* in semi-contraction (though unwrinkled), and drawn them out to treble the length and upwards, can doubt the peculiar elasticity pertaining to the lateral nerves in these animals. According to Dugès, indeed, Darwin thought nervous substance was contractile.

The nerve-trunks are placed by M. de Quatrefages "between the external longitudinal and internal transverse muscular fibres" of the body-wall; a position which may in some respects apply to the Anopla, but is inapplicable to the present group. Frey and Leuckart mention that the lateral nerves lie inside the muscular coats; but while indicating the different arrangements of the "brain" in *Tetrastemma* and *Borlasia*, they do not explain the distinction in regard to the position of the nerve-trunks in these genera.

9. *Eye-Specks.*

The eye-specks are situated beneath the superficial muscular coat; thus, in many spirit-preparations none are visible until the dermal layers are removed. In most examples they consist of simple masses of black pigment. So far as has been seen, only four British Enopla, viz., *A. pulcher*, *A. spectabilis*, the Zetlandic variety of *Tetrastemma candida*, and *Prosorhochmus Claparedii*, show a special arrangement in their eye-specks, and even in those it is of a very elementary character. In the former the pigment in each eye-speck is grouped into a globular mass with a smooth outline, and in the living animal under examination there is frequently a clear patch in the centre (Plate XIV, fig. 15); but, though the mass retains its well-defined outline after the removal of the pigment by caustic potash, no capsule could be made out as a separate structure. The brownish Zetlandic variety of *Tetrastemma candida*, again, has the anterior pair of eyes considerably larger than the posterior, the former, moreover, often presenting a crescentic margin in front. The pigment-grains are arranged in the same manner in both, but the outline of the posterior pair is more irregular and less finished than that of the anterior. Each of the latter has a somewhat pale space in front of the crescentic margin, so that the eye appears to be furnished with a capsule or lens, but I have not been able to demonstrate either, and conclude that it is a pallor due to the greater translucency of the tissues in front of or over the pigment. Such, doubtless, may indicate a step in the formation of a lens. A clear globule has been seen in connection with the anterior eyes of *Prosorhochmus Claparedii*, but it may have been a simple cutaneous structure.

In *N. gracilis* and others, a few of the eye-specks are frequently connected together by bridges of the pigmentary substance. Though a pale portion is sometimes seen in the specks of the former, there is no evident capsule or lens (Plate XIV, fig. 2). The large black pigment-patch on the snout of *Tetrastemma melanocephala* often includes the first pair of eyes; while in *T. vermicula* the eyes of each side are connected by a longitudinal band of dark pigment, which frequently becomes crescentic in contraction. Mediterranean *Tetrastemmæ* with "lenses" to the eye-specks have been noticed by Delle Chiaje, Kölliker, Graeffe, and A. F. Marion.[1] I have found the specks disappear from adult specimens of *Prosorhochmus Claparedii*, after a year's confinement.

[1] 'Ann. Nat. Hist.,' 4th ser., vol. iv, p. 136.

10. *Cephalic Furrows and Sacs.*

Midway between the tip of the snout and the anterior border of the ganglion in *A. lactifloreus*, a furrow runs inwards and slightly forward on the dorsum, ceasing, however, before the central line is reached; and on the ventral surface a similar though shorter furrow exists, the two meeting in a dimple, furnished with longer cilia, on the side (where the cilia are more active and powerful than usual), which depression leads into the cephalic sac. A short distance behind the ganglia two other superficial furrows occur, each slanting backwards and inwards to meet its fellow of the opposite side in the middle line. These furrows are also continued inferiorly, but with a slightly different direction, so that they meet under the ganglia. The two sets of furrows are very distinctly marked in a flattened head by lateral notches. From the dimple mentioned in connection with each anterior furrow, a thick-walled ciliated duct leads into a considerable ovoid, pyriform, or almond-shaped glandular mass, which lies in front of and rather exterior to the ganglion of the side (Plate XV, fig. 1, *m*), and from what is seen in translucent species, such as *Tetrastemma vermicula,* it would appear to end in a *cul-de-sac*; the walls, moreover, under pressure are marked by transverse rugæ. Towards its first part the duct is surrounded by a minutely granular glandular structure, which usually has a somewhat triangular figure. Several glandular masses lie behind, one to the outer, and another to the inner side in this position. The glandular substance around and behind the posterior part of the ciliated external duct contains numerous granules and finely granular cells. From the posterior end of the outer mass in such a view, a structure having the aspect of a pale duct passes obliquely towards the superior lobe of the ganglion, crossing this for some distance in a direction inwards and backwards. Traces of a cavity are apparent at its commencement, and, besides, it is distinguished from the adjoining nerve-trunks under pressure by not being continuous with the ganglion at its edge. In transverse sections of the snout, each sac occupies a position outside the cephalic blood-vessel, and somewhat above it (Plate X, fig. 3, *m*), and has a special space in the muscular stroma of the head. In large specimens the sacs contain many reddish pigment-grains, and occasionally a large cell filled with coarse granules. Behind the foregoing glandular apparatus lie the coiled ciliated ducts (*m'*), which are sometimes pale and irregularly bulged from included fluid, or else collapsed and minutely granular in aspect. In some specimens of *A. lactifloreus* the commencement of the duct is tinged of a faint reddish hue. There seems to be no ground for the supposition that the sacs are connected with other organs. In *T. melanocephala* (Plate XIV, fig. 2) they are less dilated than in *A. lactifloreus*. The coils of the ciliated duct in *N. gracilis* are most elaborate, and can be traced a long distance backwards by the side of the nerve-trunk. In *N. Neesii* the external apertures are not so evident as in *A. lactifloreus* and *Tetrastemma,* because the furrows are less distinct when viewed as transparent objects. They are best seen when the ventral surface is upturned, and occur in the angle of the furrow some distance from the margin of the head in this position (Plate XV, fig. 5). The ciliated pit leading inwards is short. Like other parts of *A. pulcher*, there is a considerable deviation from the typical form in the shape and position of these sacs, as well as in regard to the furrows. This species (Plate XIV, fig. 11) has also numerous short longitudinal or accessory furrows on the front of the ventral grooves, and thus is allied to *A. spectabilis*. Instead of lying in front of the ganglia (in the ordinary position under examination), the sacs are situated laterally and posteriorly, forming somewhat elongated pyriform organs, which adapt themselves to the curves of the ganglia (Plate XV, fig. 2). Each sac is filled with rounded granular cells, reddish pigment- and other granules, has a ciliated duct opening anteriorly at the constriction or lateral dimple of the head just in front of the ganglia, and posteriorly ends in a ciliated tube which by-and-by bifurcates, each of the trunks giving off various branches. The latter are furnished with numerous granular cells, apparently imbedded in the wall of the tubes, so that in contraction they have a cellulo-granular appearance, somewhat similar to the "segmental" tubes of the Oligochaeta. There are also in this species a number of branched vessels of small calibre behind the ganglia, apparently in connection with the circulatory system. In the snout of the same worm is a series of well-marked glandular organs in front of the nerve-centres, viz., a lobulated mass (g) in the middle line, connected with a lateral (g') on each side of the blood-vessel. These glands agree in structure, containing granular cells, pigment- and other granules. A process (duct?) passed from the posterior end of the external lobule towards the cephalic sac. Traces of similar glandular masses were seen in other species (*e.g. A. lactifloreus*) near the middle line of the snout, behind the cephalic sacs, and elsewhere. In *A. spectabilis* the cephalic sacs appear to be allied to those in the foregoing, and possess an ovoid outline with a process posteriorly. In my softened specimen they were found behind the ganglia, and were filled with granular cells and granules. The cephalic furrows in this species have a series of accessory grooves (Plate III, fig. 7) much more developed than those in *A. pulcher*. In *Tetrastemma* the sacs coincide in structure with those of *A. lactifloreus*, and in translucent specimens, such as *T. flavida*, the ciliated posterior ducts are easily traced. Those of *T. Robertianæ* resemble the same organs in *T. candida*.

The slight furrows just described on the head in this group have been noticed by few investigators, and only Professor Keferstein and M. Claparède mention the occurrence of the sacs; the former using the term *Seitenorgane* for their signification, but his notice is very brief. He figures and describes his *B. splendida* (*A. spectabilis*) as furnished with sacs at the side of the ganglia, but without the ciliated ducts posteriorly; while in *B. mandilla* the latter reach no further back than the ganglia. M. Claparède, again, shows on each side of the eyes in the young of *Prosorhochmus Claparedii* a blind sac, apparently unconnected with the ciliated pits above-mentioned; moreover, in the drawing of the adult animal (fig. 10) there is on each side a ciliated duct, but no sac. M. de Quatrefages only noticed traces of these structures in the Enopla; for he describes bridles or bands stretching outwards to the "fossettes céphaliques." In his *Polia bembix* he represents a large nerve passing from the anterior part of each lateral column, not far behind the ganglion, and which, after a course directed obliquely forward, ends in a dilated granular condition at the cephalic fossa. A similar arrangement occurred in *P. humilis*; but in this instance the nerve arose from the superior lobe of the ganglion, passed obliquely forward and outwards, and ended in several branches at the fossa. In *Cerebratulus crassus* and *Nemertes peronea*, again, he figures the nerve springing from the posterior part of the superior lobe. He does not seem surprised that the nerve-trunks to these fossæ should come from sites so diverse as the front of the superior lobe and the lateral trunk. The disposition of an important nerve in species of the same genus, or even in allied genera, is seldom so varied. The structure seems to have been misinterpreted in the Enopla, the sac overlooked, and the process or duct, which sometimes crosses to the origin of the great nerve-trunk and ganglion of its side, assumed to be a nerve-branch. M. van Beneden, though he noticed the sac in *Lineus*, does not mention more than "fossettes céphaliques" in this group.

11. Generative System.

In the majority of the Enopla the sexes are separate, the only known exceptions being the *Borlasia hermaphroditica* of Keferstein, and the *Borlasia Kefersteinii* of Marion. The generative products are developed between the inner muscular layer of each lateral region of the body and the glandular digestive cavity, and enclosed in special spaces (Plate XVI, fig. 13) formed by transparent membranous sacs (*e*), which are connected with the inner muscular layer of the body-wall (Plate XVI, fig. 2, *f*). The contents are evacuated by pores above the lateral nerve-trunks, which (pores) are very distinct immediately after the issue of the ova or spermatozoa.

a. Male Organs.

The sperm-sacs in the male (Plate XVI, fig. 5, *e*) generally present a pyriform or flask-shaped aspect, especially in the early stages, being attached to the body-wall by a narrow tubular neck, which at the proper period doubtless gives transit to the contents of the sac. In the early condition the latter is minutely granular, then cellulo-granular; and in the mature state it has a finely fibrous or streaked appearance from the spermatozoa.[1] Sometimes both granules (Plate XIV, fig. 17) and spermatozoa occur in the same sac, and then the former are often observed to be somewhat regularly arranged (Plate XIV, fig. 16). The spermatozoa in *A. lactifloreus* (Plate XIV, fig. 18) have a slight curve of the body, which gently widens from the tip and ends in a perceptibly larger rounded knob, to which the long tail is attached. The mature males are easily distinguished from the females by their whitish or pinkish aspect, and their bodies are less distended. The spermatozoa of *N. gracilis* (Plate XVII, fig. 8) are most active wriggling structures, of a more slender shape than those of *A. lactifloreus* or *Tetrastemma* (Plate XVI, fig. 7), appearing under a power of 1000 diameters as simple rods, slightly larger towards the end from which the elongated and very fine tail proceeds.[2] The sperm-sacs are very numerous in *N. carcinophila*; but the tenuity of the spermatozoa (Plate XVII, fig. 9) renders their exact structure somewhat obscure. The body of the spermatozoon is elongated, gently curved, and slightly thickened at the end to which the filament is fixed. It is very common, moreover, to observe one or more minute clear globules attached to the spermatozoon, so that the structure seems to have a tail at both ends, or a flattened head. These appearances have misled even so experienced an observer as M. van Beneden, who figures the organs as possessed of a somewhat globular body, with a filament at each pole. But, independently of the strange exception which such a condition would make in Nemertean physiology, the frequent occurrence of more

[1] This peculiar striation resulting from the arrangement of the spermatozoa has been seen in other groups of the animal kingdom, *vide* Allman, 'Gymnoblastic or Tubularian Hydroids,' p. 65, f. 31, C. and Bütschli, 'Zeitsch. w. Zool.,' Bd. xxi, 1.

[2] Prof. Huxley finds the filament also attached to the broader end in the Hydrozoa.

than one globule on these thread-like organisms, and the comparative steadiness of the body of the spermatozoon, contrasted with the lashing of the tail, might have raised a doubt in the mind of the distinguished author. The spermatozoa in *Tetrastemma vermicula* (Plate XVI, fig. 6), though minute, are amongst the most active of the group. They are slender at one end, and gently dilate towards the opposite, which is furnished with a very long tail. Just in front of the posterior extremity is in certain views a somewhat abrupt swelling of the body, as if from an adherent globule, but none were observed without the enlargement. The spermatozoa of *A. pulcher* (Plate XVII, fig. 10) have bodies more or less dilated at one end, and tapered towards the attachment of the tail, but in other views they are spindle-shaped. They are very minute, even more so in the specimens examined than in the smaller Enopla. In *Tetrastemma Robertianæ* these bodies present the form of slender rods, having a small globule attached near the end (Plate XVII, fig. 26) furnished with the tail. After remaining in the water a short time, the form of the spermatozoon completely changes, the rod or body becoming fused into the globule, which enlarges accordingly, and assumes the form of a granular cell with the filiform tail still adherent. A granular aspect was likewise observed in many of the newly voided spermatozoa of *Amphiporus bioculatus*, the bodies in this case being ovoid and somewhat pointed at the ends (Plate XVII, fig. 25).

b. Female Organs.

In the matured females of *Amphiporus lactifloreus* the ova extend from the œsophagus almost to the tip of the tail, each ovary containing from one to seven ova, which, when fully developed, are seen with the naked eye through the attenuated parietes of the body. They attain a comparatively large size before deposition, and are not much less in small specimens, though few in number. The female in the ripe state has a greyish-white appearance, with the dorsal tube for the proboscis extending nearly from end to end, though its diameter is diminished posteriorly from the encroachments of the ovaries. In the smaller species the arrangement of the system can readily be observed in the living animal as a transparent preparation (Plate XVI, fig. 13). The outer hyaline investment of the egg is generally corrugated before extrusion.

M. Dugès correctly located the generative products in pyriform pouches along the sides of the body, and thought they resembled the ovaries of *Tænia*, which open exteriorly in every segment. He observed three or four vesicles containing a pulpy substance in *Prostoma lumbricoides*, so that in all probability his specimen was a female. M. de Quatrefages, Frey and Leuckart, and Dr. Johnston, again, describe the ova as occurring in a free condition between the body-wall and the alimentary cavity. The former (M. de Quatrefages) confounds the digestive with the generative system, indeed, gives a tolerable figure of a cell from the wall of the alimentary cavity as one of the true stages in the growth of the spermatozoa; and again refers ('Voyage en Sicilie,' Plate XXII, fig. 2) to the glandular wall of the said cavity as representing generative cæca. The spermatozoa, therefore, which he shows, had either been discharged externally, or procured from a specimen in such a condition as to leave no room for doubt. His figure of the male elements from *N. balmea* is incorrect, for the body of each is too short and thick. He considers that it is only after the granular corpuscles fall out of the cæca into the lateral cavities that they assume their special characteristics as sperm-cells. He thus fails to make out the correct anatomy of the parts and the physiology of the process. Dr. Williams states that the "segmental organs" in Lineus, Borlasia, and Nemertes correspond in number with the transverse divisions of his great "alimentary cæcum" (digestive cavity), and that there is only one British species (*Polia quadrioculata*) in which it is possible to demonstrate the segmental organs *in situ* as transparent objects. It is almost unnecessary to contradict the last statement, since small specimens of most Nemerteans are more or less translucent. This author also maintains that the group agrees in the structure of its generative organs with the type of the lateral ovarian pouches of the Hirudinei, differing from the latter, however, in having the sexes separate. Van Beneden and Keferstein give a correct account of the position of the ovaries and sperm-sacs in the species examined by them; but the term "biliary cæca" used by the former is objectionable, as tending to confound the generative and digestive systems. M. de Quatrefages imagined that the ova were extruded by a temporary aperture in the Enopla, and pointed out that Œrsted and Dugès were wrong in averring that they escaped through the walls of the body. Œrsted's observation, however, is correct, as subsequently proved by Van Beneden and Keferstein. Frey and Leuckart erroneously conjectured that the ripe ova were shed from the posterior end of the body, "as in Arenicola."

12. *Phenomena of the Deposition of Ova and Spermatozoa.*

The ova and spermatozoa in *A. lactifloreus* would seem to attain full development in February, March, and April; but the breeding season of other examples of the Enopla ranges from the latter month to November. Specimens of *A. lactifloreus*, which had been in confinement seven months, deposited their ova about the middle of February, and wild examples a little later. The actual number of ova was not counted; but in one instance those from a single female covered a circular space more than half an inch in diameter. In several species, *e.g.* *N. gracilis*, *N. Neesii*, and *A. spectabilis*, the number of ova is immense. Occasionally, in a crowded vessel, the ova of *A. lactifloreus* are found above the water-line, adhering to the vessel in an irregular mass; but they are held together only by accidental mucus, and easily fall asunder. There is, therefore, a characteristic difference in regard to the deposition of the ova between this group and the Anopla; for in the latter they have a totally different shape, and a special investment of tough mucus. The only exception, so far as I have yet found, in regard to the deposition of the ova in a free condition, occurs in the aberrant *Nemertes carcinophila*. The body of the worm considerably diminishes after spawning, and assumes a flattened form, especially in large examples. That impregnation of the ova (in *A. lactifloreus*) takes place only after deposition is proved by segregating a female ready to spawn, for then it is found that no further change ensues in the egg. Hence the large size of the male organs, as in fishes and other animals that shed their secretion in the surrounding water.

When fully developed, the mode of depositing the ova and spermatozoa may be illustrated by the following account:—Two specimens, male and female, of *N. gracilis* were taken from a deep vessel, and subjected to examination in a large glass trough. A very few minutes after the male had been placed on the bottom of the cell tiny jets or jet-like wreaths of sperm-fluid issued from the sides of the body, rather past the middle, and gradually increased in number, both in front and behind. The animal was soon enveloped in a wavy cloud of the milky substance, whose borders were slowly commingling with the surrounding water, while the numerous coiling jets, like so many miniature wreaths of white smoke from the sides of the worm, were constantly adding to the central mass. This operation lasted only a few minutes, and thereafter the animal moved about the vessel. The female specimen now protruded her snout from the sand and mucus in which she was coiled, and, passing to the side of the cell, deposited in a few minutes a group of ova, about three inches distant from the white edges of the sperm-cloud, retiring again under the mass of sand and mucus. The change of water probably caused the male to eject the matured spermatozoa, and some sympathetic influence, it may be the diffusion of the latter, induced the female at once to evacuate her generative organs, so as to afford the ova the benefit of the male element. A very few ova were found on examination to remain in the body of the female, and they differed in no respect from those deposited in the vessel. The apertures by which the respective elements passed out in these specimens were readily observed as pale specks, each furnished with a central opening, round which for the moment the cilia were well seen. These openings, as in *Lineus*, occur a little above the lateral nerve-trunk on each side, and even in specimens of *A. lactifloreus* not fully ripened, pressure forces the contents of the generative sacs in the same direction, although no aperture is visible.

13. Development.

The unimpregnated ova in *A. lactifloreus* (Plate XVI, fig. 8) are pure white, and measure $\frac{1}{72}$nd of an inch in diameter, the pale spot just before deposition being about $\frac{1}{225}$th of an inch. The ovum has two coats—an external hyaline investment (*a*), which becomes considerably firmer after extrusion, and an inner membranous sheath (*b*), of greater delicacy, enveloping the vitellus (*c*). With the exception of the pale spot the ovum is uniformly granular, the granules on gaining freedom showing active molecular motion in the surrounding water. At a particular point is a very distinct process (micropyle?) (*d*), as if from the remains of a tube that led through the outer coat. A few hours after deposition and impregnation the pale spot disappears, the yolk divides into two masses (Plate XVI, fig. 9), and shortly afterwards into four (fig. 10). On the second day almost all the ova are in the mulberry-stage (fig. 11). In seven or eight days the embryo revolves within the capsule by aid of its cilia, and the majority are extruded from the twelfth to the fourteenth day. The young animal is furnished with two eyes before bursting the egg (Plate XVI, fig. 12), and the coarse granular matter and globules of the digestive tract are apparent. In this condition the wall of the ovum is readily ruptured, and no sooner do the young get over their labours of extrusion than they glide rapidly off, head first, in a manner that shows no training is necessary to enable them to progress. They somewhat resemble the ciliated planules of the Hydroid zoophytes and the young of many of the higher annelids. Probably the action of the cilia may have some influence in determining their course. In these young animals, which are just visible to the naked eye as minute specks, the proboscis is marked by a pale space (Plate XVII, fig. 1), that has on each side a dense mass of the granules of the digestive canal. Outside the latter are two pale stripes, broader in front, caused by the nervous ganglia and trunks. Two longer cilia mark the posterior end. A further stage of development (after an interval of about eight days) is shown in Plate XVII, fig. 2, under somewhat less pressure. There are now four eyes, the anterior pair being the larger. Occasionally a few have an additional pigment-speck or two near the posterior eyes. The latter are further apart than the anterior, differing in this respect from those of the young *Tetrastemma*, in which the eyes are equidistant in both pairs. The ganglia (*h*) are large, pale, distinctly outlined, connected by the two commissures, and give off the lateral nerves (*n*), which approach each other very closely at the posterior end. The œsophageal sac (*j*) behind the ganglia is well defined; and two pale streaks mark the cephalic sacs (*m*). The proboscis has its anterior opening, and the first region (*a*) its glands, the posterior border being marked by a transverse line (*b*), after which follows an indistinct stylet-region and reservoir. No stylets are visible until much crushed, and then in one specimen two slender spikes, probably from the marginal sacs, were seen. The posterior region of the proboscis bends forward, and becomes lost at *c*. Shortly after the marginal stylet-pouches in some become very evident, opening by a short and wide tube into the floor of the anterior chamber, and either containing granules or small stylets, while the central apparatus is unarmed (Plate XIII, fig. 12). The specimen had really only granules in its sacs; but to save multiplication of figures one was deleted, and filled in with a correct drawing of stylets from another example. There is no trace of a central stylet, but the basal apparatus has coarse granules, which move with the muscular investment around them, for at this time the latter exhibits distinct contractions. The muscular space (*e*) behind the floor of the anterior chamber shows indications of an inner and special lining, which forms a transverse boundary in front. The basal structure is less defined than in the adult, but, as development advances, the form of the "awl-handle" becomes more characteristic. The marginal stylet-sacs a few days afterwards are generally furnished with stylets, but these organs are not so sharp and smoothly finished as in older examples. When the central stylet appears, the granules of the basal apparatus have a more definite shape than represented in the figure. An outline of the two kinds of stylets is given in Plate XII, fig. 5, from the same specimen, and the disproportion between them is evident, thus confirming the previous statement, that each apparatus furnishes its own organs. The central stylet (*a*) is generally more slender and acute, as well as longer than the marginal (*b*), the head of the latter being more globular than in the adult. As the specimen increases in age, the disproportion between the stylets lessens—one or more of the marginal being equal to the central in size. The long posterior chamber of the proboscis now contains the peculiar fluid with moving granules, and the reservoir sometimes contracts with force, so as to propel the granules, and even the glandular lining of the cavity itself, forward to the front of the basal apparatus. The superficial granular glands of the stylet-region are also well developed.

Some weeks afterwards (and there is no difficulty in preserving them for this period, even without a change of water) four eyes are observed in the majority. The head of the worm is distinctly marked in progression, and the cuticle richly ciliated, a few longer cilia occurring at the snout and tail. The cilia are also very active in the cephalic pits, the openings in which are circular; and there is, moreover, a slight constriction at this point between the two pairs of eyes. The dermal tissues are well seen, and the ganglia still remain relatively large. Every structure pertaining to the proboscis now shows considerable advancement; and it may be noted that the posterior glandular organ is wider and shorter in proportion than in the adult. In each marginal stylet-sac (Plate XIII, fig. 13) there are at least three well-developed stylets—the heads of which still appear somewhat more globular than in the perfect animal, besides a headless fragment or two, and a few clear granules. The normal position of these organs in the marginal pouches seems to be transverse. The stylet on the central apparatus is completely formed, and likewise has a somewhat globular head. The muscular cavity (*i*) is kept in constant jerking contractions under pressure, while the posterior part (*θ*) is quite still. The other structures, such as the cells of the digestive cavity, have made corresponding advancement, but no blood-vessels are apparent. It may be mentioned, in passing, that the cuticular tissues of these domesticated examples become less transparent than in the wild forms brought from the rocks, and the examination of the internal organs is consequently interfered with. In these young animals also (under pressure) the proboscis generally escapes by rupture at the posterior end, as in *Tetrastemma dorsalis*, probably by passing through the anus. In the adult protrusion rarely occurs posteriorly, but almost invariably anteriorly.

The ova of *N. gracilis* (Plate XVI, fig. 15) are much smaller than those of *A. lactifloreus*, and when first deposited slightly adhere together, so that they may be pushed *en masse*, but they afterwards lie flatly on the bottom of the vessel. Each likewise possesses two coats. The vitellus is dull yellow. Though there is no doubt the spermatozoa in this, as in other species, rapidly diffuse themselves throughout a large quantity of water, yet they were applied directly to the ova by means of a pipette. In about four hours many were adhering to the exterior of the hyaline coat, others were within it, while a few seemed to have penetrated both capsules (Plate XVI, fig. 16). At the sixth hour cleavage has proceeded much further, so that many present the usual mulberry-aspect. In *A. pulcher* the ova *in situ* have a beautiful rose-red colour, with a clear spot in the centre. Each ovisac in the middle of the body contains from twelve to twenty ova, therefore it is unlikely that this is a viviparous species, unless a single ovum only happens to be detained in an ovisac here and there, impregnated and developed. Numerous specimens of this form have been perseveringly forwarded from the deep water of St. Andrews Bay for several seasons, since I was anxious to watch the development; but, unfortunately, the great delicacy of the females at the time of deposition has hitherto frustrated my efforts. Towards the end of June and beginning of July (at which period the ova are matured) the females frequently break themselves in pieces, or discharge their ova in a mass only to perish in their midst. The males, although their spermatozoa are fully developed, do not appear to fecundate the female products. After deposition the ova have a delicate yellowish-red hue, with a pale, translucent spot, and a somewhat bulky hyaline investment. Like the coloured ova of many animals, they are blanched by death. The ova (Plate XVI, fig. 17) are matured in *Nemertes Neesii* from the end of March till June, and some even are loaded with ova in November. On deposition they are simply spread out on the bottom of the vessel, and unconnected by mucus. The yellowish yolk is surrounded by a fine translucent coat more than twice its diameter. The same delicacy in the ripe females and the non-fecundation of the ova by the males have prevented the study of their development. In *Amphiporus spectabilis* the ova, which were deposited by a captive specimen in November, had a white yolk and a loose transparent investment, but as they had perished before they were noticed the colour is uncertain.

The young of *Tetrastemma dorsalis* are found in swarms beside the adults in the beginning of July and September. They are so mobile that the body scarce retains the same shape for two consecutive seconds, though approaching a cylindrical form in general, especially when swimming (Plate XVII, fig. 3). The surface is coated with long cilia, by aid of which they are piloted through the water like infusorial animalcules; while, in addition, they are furnished with a single long tuft anteriorly, as observed in *Nemertes carcinophila*. The cutaneous textures are not distinguishable in the slightly compressed animal (Plate XVII, fig. 4) as separate layers, and the entire body has a cellular appearance, probably from the individual elements of the digestive cavity and the cuticular cells and areolæ. No eyes are visible. About a week afterwards considerable progress has been made in size (Plate XVII, fig. 5), but the cilia have become shorter in proportion to the bulk of the animal; and though the anterior and posterior ends show a few conspicuous cilia, the long tuft is absent. The proboscis is situated far back and scarcely recognizable. There are now four eyes. In another week the stylet-region of the proboscis is nearly complete, the marginal often appearing before the central stylets (Plate XVII, fig. 6). The usual mode by which the proboscis escapes under pressure is by rupture per anum (Plate XI, fig. 17), an accident to which the structure is peculiarly liable, on account of its posterior position. Thus there is a slight divergence in the development of this species, the young of which move freely as eyeless organisms, provided with a long ciliary tuft; while in *A. lactifloreus* two well-marked eyes appear in the young *in ovo*. The ganglia and lateral nerves, the œsophagus and other tissues are now distinctly outlined. The large size of the proboscis, as compared with the digestive tract, is also conspicuous in this form. In *T. vermicula* the ova are well advanced in April, and are generally deposited in May. They are surrounded by a loose hyaline capsule (Plate XVI, fig. 14), and the yolk is white.

Numerous specimens of *Nemertes carcinophila* were sent from St. Andrews in April, full of ova, and their development could easily be followed out. The newly deposited eggs (Plate XVI, fig. 19) are somewhat ovoid, about $\frac{1}{250}$th of an inch in their long and $\frac{1}{320}$th to $\frac{1}{350}$th in their short diameter, and appear to possess only a single investment. They are not simply enclosed in a sheath, as M. van Beneden says, but the animal, during deposition, envelopes them and its body in a tough hyaline mucus, afterwards withdrawing itself therefrom, as in *Lineus*, so that the whole forms a tunnel, with the ova in its walls. The spiral appearance of some of the masses is due to the coiled condition of the animal during deposition. After extrusion the ova pass through the usual stages, and the embryo in each is sometimes ciliated on the tenth day (Plate XVI, fig. 20), although entire dependence cannot be placed on this date, since development occurs within as well as without the body of the parent. In a short time the young are extruded either with a pair of eye-specks, or without them, and furnished with a very long anterior, and a shorter posterior tuft or whip of cilia (Plate XVII, fig. 7). Moreover, numerous adult specimens are found towards the end of April to contain ova with ciliated young, showing that impregnation, as may easily be understood, can take place through the genital pores. In many ova the embryo has two reddish eyes, and some are extruded from the sacs of the parent in a free state, so that they sail about actively as ciliated pyriform bodies. The motion of the cilia in the œsophageal region in those with eyes is very distinct; indeed, after the other and apparently more delicate tissues of the animal have become disintegrated, this region is left in full action—dissected out, as it were, by rapid decay. The somewhat globular œsophageal region has probably been mistaken by M. van Beneden for a mouth. The same author fell into the error of supposing that a form having a smooth outline was developed within its progenitor with the long ciliary tuft, the former representing the *scolex*, and the latter the *proglottis*; in short, as he says, a case of digenesis, and not a metamorphosis. But his drawing represents the so-called *proglottis* furnished with two eyes exactly in the same manner as the *scolex*, yet he neither mentions having seen the one form inside the other nor figures this interesting condition. No such mode of development has ever been seen by me, either in the case of those ova deposited in the unimpregnated condition or in those developed within the body of the parent; but the same gradual changes ensue in the young of this animal as in *Tetrastemma*, and, as will afterwards be seen, also in *Cephalothrix*.

Many of the parents with developing young in their interior are feeble, and almost in a decaying condition inside the sheaths, so that the inert bodies seem but the nidi for the growth of their progeny, each of which, provided with two boldly marked eyes, and other differentiated tissues, revolves rapidly within its capsule. The evolution of the ova in these decaying adults is a feature analogous to the elaboration of the respective generative products in the headless fragments of male and female specimens of *Lineus marinus* and others,—the last efforts of the parental tissues being devoted to the reproduction of the species.

Dr. Max Schultze was the first to describe a viviparous species (his *Tetrastemma obscurum*). He states that in the development of the proboscis in the young animal the marginal stylets appear before the central, and as the worm grows older he figures it with two loose stylets in the pit of the proboscis, an arrangement, as he supposes, for the supply of the central organ. I have also seen a loose stylet or two lying in the anterior chamber of the proboscis, but this occurred both when there was and when there was not a stylet on the central apparatus. The physiology of that region, as previously explained, demonstrates that there is no connection between the marginal and central stylets, except, perhaps, in the composition of the fluid with which both are bathed. Professor Keferstein next detailed the development of *Prosorhochmus Claparedii*, a species in which the young attain considerable advancement before extrusion, for they are found with four eyes, a well-developed proboscis, and other organs in the body of the parent, and on being set free have the same general form as the latter (Plate II, fig. 1). M. Claparède subsequently made a few remarks on the same species, mentioning that he had seen specimens with ova in the sacs, but they were never numerous. By the examination of this species I have been enabled to confirm many of the excellent observations of the two foregoing authors, and to see that the development within the body is very similar to that of the free ova and their products. The larger young specimens are often doubled within the parent, and apparently invested by the stretched covering of the ovisac, or in large cavities produced by the coalescing of many ovisacs; at any rate, it is clear that to describe them, after the former authors, as simply within the body-cavity of the worm, is not strictly accurate. It is curious to see these large young animals moving within the body of the adult, apparently without causing the latter any inconvenience. Such, then, appears to be a further stage of the type of development seen in *Nemertes carcinophila*, in which, after the deposition of the majority, a few ova are left in the body of the parent for subsequent evolution. It remains, however, to be observed whether all the ova in *Prosorhochmus* are so developed (in which case they must be very few) or whether part are deposited at one or different periods, and the rest retained in the body of the parent. It is probable, at least, if the ova are numerous, that they are not developed simultaneously, as in other forms, else the adult would be inconveniently distended, and the young much compressed.

From the foregoing it will be seen that the viviparous species are connected by insensible gradations with the true oviparous forms. It may likewise be found that the former have a close connection (if they are not identical) with the hermaphrodite species described by Prof. Keferstein and A. F. Marion. In *Borlasia hermaphroditica*, Kef., the anterior genital sacs were full of spermatozoa, and the posterior of developing ova; while in *B. Kefersteinii*, Mar., the sexual elements appeared to be distributed throughout the whole length of the body, but whether alternately or otherwise the author does not state.

II.—Anatomy and Physiology of the Anopla.

1. *Cutaneous System.*

The skin in this group, of which *Lineus gesserensis* may be taken as the type of the majority, is closely allied to that of the Enopla, though its structure is frequently rendered obscure by the greater development of the pigment. The cilia are very active in the cephalic fissures, and it is sometimes noticed that their motion is suspended and again resumed without evident cause. In the living animal the cutis has a cellular aspect (Plate XVII, fig. 16), the cells or areolæ measuring about $\frac{1}{1000}$ of an inch, and most distinctly seen towards the tip of the tail in the adult. Sometimes a number of minute clear granules are placed over the larger cells, as shown at the lower third of the figure. The pigment-cells and granules reach their greatest development anteriorly, and some of the former contain very dark brownish-black pigment in circumscribed masses. The dorsal pigment has in general a longitudinally streaked appearance (Plate XVII, fig. 15), a state probably arising from the peculiar arrangement of the fibres of the external muscular layer hereafter to be described. In some pale red specimens the coloration is due to a uniform impregnation of the cutis, and the tint is much deeper than that of the ganglia, which are thus rendered conspicuous by their pallor. Occasionally one or two pigment-cells of exceptionally large size are present anteriorly (Plate XVII, fig. 18), each containing from one to three clear granules.

In transverse sections, underneath the ciliated epidermis (*c*, Plate XVIII, fig. 4), a somewhat thick layer (*d*), composed of granular cells and globules in areolæ, occurs. From the facility with which these contents escape, the drawings show the parts in a slightly altered condition. Beneath is a pale structureless basement-layer (*d'*), the presence of which in *Cerebratulus* had led Prof. Keferstein into the error of supposing it to be a layer of circular muscular fibres; but an attentive examination of that genus, as well as the present, demonstrates that, while one may be deceived if only transverse cuts are made, no doubt can exist in longitudinal sections. This point may readily be settled without reference to the more explicit, because larger, condition of the parts in *Lineus marinus*. A thick compound layer is next encountered in *L. gesserensis*, consisting externally of pigment-granules and cuticular globules (*d''*), and internally of a series of powerful longitudinal muscular fibres (*e*). Under a low power, indeed, this compound layer in transverse section appears as one, the pigment and other cells, and the ends of the muscular fibres, presenting a similar aspect. The amount of pigment varies, of course, in different specimens, and is always much more developed dorsally than ventrally. Towards the anterior end of the animal this coat (*d''*) becomes thicker, and its reticulations more distinctly marked. Fine longitudinal sections of the snout from above downwards show superficially a series of very beautiful reticulations of a somewhat regular aspect (Plate XVIII, fig. 10, *k*), the chief interstitial bands having a longitudinal direction. Towards the tip the texture becomes denser in transverse section (Plate XVIII, fig. 7), and the pigmentary matter increases, especially just within the pale external layer of the cutis. A section still further back (Plate XVIII, fig. 8) exhibits a less compact arrangement, and the pigment is now for the most part grouped into a dorsal and a ventral band. The general stroma consists of radiating and longitudinal fibres, the ends of the latter and the granular matter being often situated in the axils of the diverging series. The pigment anteriorly attains its greatest density immediately beneath the pale external layer of the cutis, diminishing in quantity from this point inwards (Plate XVIII, fig. 9). The snouts of these mobile animals resemble in structure the elaborate arrangements which are sometimes met with in certain organs (such as the tongue) in the higher animals, where extensive and delicate motions are combined with high tactile power.

To assist in the latter function, there are three papillæ on the snout, one of which, from its situation, falls to be described with the opening of the canal for the proboscis. The other two are placed on each side of the central (Plate XIX, fig. 1), but are not always so prominent. Each is furnished with a series of cilia of greater length than those on the general surface, and which extend from the papilla during erection in a radiating or fan-shaped manner. They are probably of great tactile service to the worm.

The cuticular cells are finer in *Lineus lacteus*, Mont., MS., and the dorsum is not clouded by the granular pigmentary matter. In *Lineus bilineatus* the arrangement of the two white dorsal stripes is characteristic, for the pigment is strictly confined to the region corresponding to *d''* and *e* in *L. gesserensis*; and in transverse section (Plate VI, fig. 7) they appear as two opaque patches with an intervening pale space, bounded externally by the basement-layer of the exterior coat, and internally by the circular muscular fibres. In *Borlasia Elizabethæ* the cutis in transverse section presents a dappled aspect (Plate XXI, fig. 4) from the intervention of pale patches between the dark-brownish masses. Certain peculiarities are observed in the dermal tissues of *Lineus marinus*, a species which has been taken as the type of the Nemerteans in this respect by M. de Quatrefages. The external cuticular layer (*d*, Plate XVIII, figs. 5 and 6) is proportionally thinner than in *L. gesserensis*. The pigmentary layer (*d'*, *d''*) is divided by a definite black band (2), and distinctly separated from the first or external longitudinal muscular coat by a curious translucent stratum (3, 3), presenting in cross section (fig. 5) a transversely barred arrangement with linear interruptions, which divide it into numerous and somewhat regular elongated spaces. In longitudinal section (fig. 7), again, this stratum has a wavy aspect, or, if much contracted, presents a series of moniliform streaks. That this layer, however elastic, is not muscular, a glance at the position of the parts in longitudinal section at once demonstrates. It belongs entirely to the dermal elements, and with the interior pigmentary layer corresponds to the region *d''* in *L. gesserensis*, which (region) in the larger species attains much greater development, and becomes distinctly separated from the longitudinal muscular fibres. A similar structure is found in the cutaneous tissues of a typical form of the Anopla brought by Mr. McAndrew from the Gulf of Suez, and also in the *Borlasia novæ-zealandiæ* of Dr. Baird.

The skin in many of the Anopla, *e.g. Lineus marinus*, *L. gesserensis*, *L. sanguineus*, *L. lacteus*, *Micrura fusca*, *M. purpurea*, and *M. fasciolata*, gives a marked acid reaction when tested with litmus-paper.

2. *Muscles of the Body-wall.*

The longitudinal muscular coat (*e*, Plate XVIII, fig. 4), which is incorporated with the cutaneous layer (*d''*) at its commencement, is thick and powerful, and has a well-marked fasciculated aspect in transverse section. At the sides of the mouth, where it attains great development, and forms a strong lateral support, there is a very pretty radiate or somewhat arborescent arrangement of the interfascicular substance in transverse section (Plate XX, fig. 1). This appearance is due to numerous radiating fibres, which pass from the inner longitudinal layer through the circular coat, and then diverge widely in the great muscular mass (Plate XX, fig. 13). It is best seen in the neighbourhood of the lateral nerve, where the muscle is most developed, and especially in partially decomposed specimens. So thickly are these fibres placed, that they pass through the slightly coloured stroma surrounding the nerve. Such a condition permits great stretching in all directions without actual separation of the muscular bundles, and is thus eminently adapted for the functions of the parts. The intimate connection of the outer fibres of this layer with the adjoining coat is well brought out in some longitudinal sections of the body, which show the outer bundles of fibres quite separated from each other by rows of pigment- and other cells and granules, the whole having a curiously streaked appearance. Anteriorly this longitudinal layer becomes lost in the tissues of the snout. The next coat (*e'*) consists of a series of circular muscular fibres of considerable thickness, between which and the former the nerve-trunks are situated. It extends forward by the ganglia, and appears to merge into the wall of the passage for the proboscis in front of these organs. Within the last-mentioned coat is a layer (*e''*) of longitudinal muscular fibres, similar in structure to the corresponding stratum in the Enopla. It also passes the ganglia to become connected with the muscular channel for the proboscis in the snout. The several muscular layers retain nearly the same relative proportions towards the posterior end of the worm (Plate XVIII, fig. 11).

The cutaneous and muscular coverings of *Lineus sanguineus* are thinner than in *L. gesserensis*, but conform exactly to the same type. The only peculiarities observed in the muscular coats of *Lineus marinus* are the very evident transverse streaks of the external longitudinal (Plate XVIII, fig. 6, *e*), and the presence of certain cellular masses in it and the next outer layer. These bodies (Plate XXII, fig. 5, *a*) lie in definite spaces (*b*), and consist of groups of rounded cells filled with granules. In the contracted state of the animal, as after preservation in spirit, the circular coat in longitudinal sections has a wavy aspect (*e'*, Plate XVIII, fig. 6), apparently from the extreme shortening of the parts. In *L. bilineatus* the circular muscular layer is thicker than in *L. gesserensis*, a condition probably connected with the somewhat rounded form of the worm. The enormous muscular layers in *Borlasia Elizabethæ* (Plate XXI, fig. 1 have a fine red hue, so that the resemblance in this respect to the muscles of the higher animals is striking. The reddish coloration is most intense on each side of the circular coat all round, especially at the region of the nerve-cords, which are paler than their investments. The circular muscular coat is less tinted than the others, and forms a distinct line of separation between them. In this species, also, the fixing of the longitudinal fibres by the interfascicular substance is very favourably seen. In certain *Lineidæ* from Shetland the inner longitudinal muscular layer surrounds the sheath for the proboscis (Plate XXI, fig. 3), a feature of considerable physiological importance.[1]

In spirit-preparations of *Micrura fusca* the anterior third, especially if distended by the proboscis, is rounded, but the rest of the body has on each side a prominent thin margin, which in transverse section presents a great contrast to the same parts in *L. gesserensis*. The muscles on the whole are thicker, and the body more depressed in contraction. The circular muscular coat forms a flattened ellipse. The inner longitudinal layer is much diminished opposite the nerves, increases in bulk near the central dorsal region, and again abruptly tapers on each side of the median line, so as to form a broad wedge for the arch of the proboscidian sheath. It also increases in thickness towards the centre of the ventral surface, only a slight concavity occurring at the median point. The external longitudinal coat, however, presents the most typical deviation, for at each side, opposite the nerve-trunks, it extends outwards in the form of a prominent triangular process (in transverse section), the layer being then gradually narrowed towards the dorsal and ventral surfaces. In *Micrura fasciolata* the brownish-red pigment on the dorsum penetrates even to the circular muscular coat, but at other parts it is confined to the region without the external longitudinal muscular layer.

The posterior end of the body in *Micrura* requires special mention, since there is superadded a peculiar attenuate and contractile style. This appendage (Plate XVII, fig. 21) seems to be formed by a prolongation of the cutaneous and part of the muscular (longitudinal and circular) textures of the body-wall of the animal. The entire organ in contraction has a granular appearance, the coarsest granules, and occasionally a few circular masses of brownish pigment, being at the tip. Within is a central chamber (*a*), which undergoes various alterations in size, and contains a transparent fluid. This cavity is not connected with the digestive tract, which opens by a terminal pore (*z*) at the base of the process, nor can proboscidian discs be seen therein. I have not as yet ascertained with what system it communicates, but its connection with the circulatory appears most probable. The style is richly ciliated externally, and undergoes many and varied motions, now forming a verrucose knob, now stretched to an extreme degree of tenuity, and apparently assisted in the latter action by the fixing of the tip, the warty formations of which seem to perform the functions of suckers; for the animal may be observed progressing with a loose style, then the tip of the latter suddenly becomes fixed upon the clean and smooth glass, and the whole organ is gradually elongated. The fixed portion at the tip is usually more dilated than the succeeding part of the style. Prof. Grube thought the caudal process of certain Nemerteans might be due to reproduction of the tail, but, of course, this view is inapplicable to the foregoing.

a. Body-wall in the Carinellidæ.—In *Carinella annulata* the cuticular cells or areolæ are smaller (Plate XVII, fig. 17), but they have the same arrangement, and retain much of their shape after mounting (Plate XXI, fig. 3). The characteristic opaque-white dorsal and lateral pigment-stripes pass throughout the entire dermal tissue, while the white specks on the sides (apparently corresponding with the openings of some of the genital sacs) do not traverse the whole thickness, but lie towards the inner border.

There are only two muscular layers, an external circular coat (*e'*, Plate XXI, fig. 3), and an

[1] The animal in the British Museum termed "*Gordiophis subterraneus*" is an ordinary example of the same family.

inner thicker longitudinal (*e''*). The circular muscular fibres surrounding the digestive chamber, however, are unusually powerful. In a curious specimen from Balta, with a bifid proboscis and other peculiarities, the arrangement, which shows, perhaps, only an abnormality of this type, is as follows:—Externally (Plate XXII, fig. 2, *d'*), beneath the basement-layer of the cutis (which in the fragmentary specimen was almost absent), is a coat of circular fibres (*e'*). Within the latter is a very powerful layer of longitudinal fibres (*e*), which (layer), however, is not continuous, as in the ordinary form, but has at least one very distinct point of separation. On approaching the middle line of the dorsum, this longitudinal coat becomes thinned, so as to end on each side of the centre in a blunt point. In addition, a somewhat triangular portion (*ea*) is cut off by interfascicular substance and fibres. The dorsal curve of the proboscidian sheath is closely applied to this central point of separation, apparently receiving therefrom a few fibres, which retain it in position, while other fibres pass downwards to join the circular layer (*ja*), which here encloses the space for the digestive tract. The separation of the great longitudinal layer of the body-wall is marked externally by a distinct median line, which is rendered more conspicuous by the occurrence of the transverse striæ of the dorsum on each side of it. There is also a slightly marked median fissure in this muscular coat inferiorly. A pale, eyeless species (*Carinella linearis*), from Lochmaddy, shows a similar arrangement, for the inner longitudinal layer in transverse section is narrowed towards the centre of the dorsum, with traces of a separation by interfascicular substance. The fasciculi of the longitudinal muscular coat in this species and *C. lineformis* are arranged in a linear manner, the rows passing from without inwards.

b. Body-wall in the Cephalothricidæ.—The dermal tissues of *Cephalothrix* are exceedingly transparent, the pigment, when present, being only developed in the snout in front of the ganglia as a rose-pink or reddish shading within the superficial portion of the cuticular layer. The action of the cilia is most vigorous in the cephalic region. The cutis (*d*, Plate XXI, fig. 2), composed of the usual granular cells and gelatinous matter in areolæ, has on its inner margin a trace of a translucent homogeneous basement-layer. A very thin band of circular fibres (*e'*) comes next, the exact structure of which is best demonstrated in fresh animals, after the addition of a little dilute acetic acid. The fibres are also evident in fine longitudinal sections, but are not satisfactorily seen in transverse cuts on account of their tenuity. Beneath is a very powerful longitudinal muscular coat (*e''*), the ends of the fibres having the usual fasciculated appearance,—the inner being somewhat coarser than the outer. At each side a distinct increase occurs at the region of the nerve, where the layer is separated into two portions by a septum of fibres from the circular coat, the nerve lying in the line of demarcation. This arrangement is quite characteristic, and the position of the nerve-trunk probably points to the compound nature of the great longitudinal layer, viz., as analogous to the two longitudinal layers in *Lineus*, the circular muscular fibres cutting off only the lateral portions (*e*), instead of dividing it completely. This genus shows the mobility of the race even in a greater degree than the others. In progression the long yielding snout is used as an exploratory or boring organ, which it stretches hither and thither with ceaseless energy, and by its aid pushes aside its own mobile body in any direction; while through a narrow loop of mucus the latter is drawn like a thread of semi-fluid, yet coherent substance. The animal also moves readily on the surface of the water. When tested with blue litmus-paper the skin gives a most vivid red stain.

Delle Chiaje mentions only two muscular coats in his *Polia sipunculus*, an outer of circular muscular fibres, and an inner of longitudinal. He does not notice the external longitudinal layer.

A similar omission is made by Huschke, in describing his *Notospermus drepanensis*, which he provided with an external longitudinal and an internal circular layer. H. Rathke gives *Borlasia striata* two coats—an epidermis and a corium—combining under the latter both the pale and the pigmentary portions of the skin. He has not noticed the external longitudinal muscular layer, and mentions only an outer circular and an inner longitudinal muscular coat. It is somewhat difficult to comprehend the views held by M. de Quatrefages with regard to the same structures, since his descriptions and figures do not seem to coincide with each other. He divides the skin into three coats, viz. the ciliated epidermis, cutis, and the fibrous coat. Moreover, the cutis has two layers—an outer, formed of a homogeneous transparent substance, presenting in its mass a number of cells or simple rounded vesicles, refracting the light, and an inner, of large elongated cells in a double row; but in his figure the muscular elements occupy a bulk so insignificant that some error appears to have been committed, especially as the third layer of the skin is stated to be a transverse fibrous one. It is at all events difficult to see how the enlarged transverse section in pl. 23, fig. i, agrees with his figures iv and v, pl. 18, of the 'Voyage en Sicilie.' Two muscular coats only are described by this author—an external longitudinal and an internal circular—the internal longitudinal being omitted, or rather considered an aponeurotic layer. He also commits a serious error in affirming that the structure of the dermal tissues in the Enopla corresponds with that in *Borlasia angliæ*. Frey and Leuckart likewise describe only two muscular coats—an outer longitudinal and an inner circular. Prof. Keferstein, while representing the cutaneous textures of *Cerebratulus* (one of the Anopla) with greater accuracy, also falls into the mistake of applying what he found in this animal to all the Nemerteans. He describes two coats in the skin — a cuticula covered with cilia, and an inner thick, finely granular layer which contains the pigment—a definition which is scarcely comprehensive enough for the nature of the parts in such as *Lineus marinus*. He mentions the occurrence of crystals of the form of arragonite in the pigmentary layer of *Cephalothrix ocellata*, but such have not been seen in the British forms, except under the action of chemicals, or after the evaporation of the salt water. He also refers to a "transverse" tactile papilla on the snout of his *Cephalothrix longissima*, which resembles a slight protrusion of the lining membrane of the canal for the proboscis. His statement, that in *Cerebratulus marginatus* there are four muscular coats—an external circular under the pigment-layer of the cutis, a longitudinal, a circular, and lastly an internal longitudinal —has already been noticed. No more than three muscular coats are present in the *Lineidæ*. Lastly, Dr. Anton Schneider,[1] in his remarks on the muscles of worms, and their importance in the system, states that in *Nemertes* the following layers occur:—Circular, longitudinal, and circular, besides radiating muscles—a description that is unsatisfactory as regards the British species.

The elaborate system of muscles in the body-wall of these worms enables them to perform the most varied and complex motions, so that they have not inaptly been compared to a piece of living caoutchouc. When irritated, the larger species, such as *Lineus lacteus*, Mont., and *L. sanguineus*, suddenly contract in a spiral manner like a cork-screw or the stalk of a Vorticella, or twist their bodies into a rope of various strands. The great *Lineus marinus* may now and then be observed in its native pools extended between the Fuci of opposite sides in numerous loops, each several yards in length, and so intricately arranged that they can scarcely be unravelled

[1] 'Archiv für Anat.,' 1861, p. 595.

by other than the animal itself. The extreme stretching which the body undergoes before it snaps—as in attempting to secure a specimen in an intricate and inaccessible pool—and the extraordinary shortening on immersion in spirit, are only well-marked conditions into which the animal throws its yielding textures at will. *Borlasia Elizabethæ* contracts itself so firmly during life as to form a hard flattened mass, which somewhat resembles the siphonal process of a Mya (Plate VII, fig. 2). *Micrura fusca*, again, swims freely on its edge like a freshwater Nephelis, or its own ally *M. pulcher*, lashing the water with alternate strokes of its muscular and flattened posterior extremity. Sir J. G. Dalyell likewise noticed this edge-motion in his great "*Gordius*" *fragilis* (*Cerebratulus angulatus*), but he was not sure whether it was a natural condition, or caused by the confined vessel. *Carinella annulata* secretes in captivity a beautiful silky sheath, within which it lies in comparative security, until, tempted perhaps by love of change, it searches for a fresh site, whereon to manufacture a new chamber for its protection. In unhealthy and slowly dying animals the skin becomes raised into pale bullæ, not only from corrugation, but from degeneration of the dermal textures.

3. *Proboscidian Aperture.*

A channel, ciliated for some distance, leads inwards from the terminal pore of the snout to the reflection of the proboscis just in front of the commissures. This channel, shortly after its commencement (Plate XVIII, fig. 7, *a*), is surrounded by an elaborate series of muscular loops (indicated at 2), which, while keeping it closed under ordinary circumstances, permit of rapid and easy dilatation. Immediately below is a series of longitudinal muscular fibres, which attain a more distinct development somewhat posterior to this point (*a*, Plate XVIII, fig. 8). A very beautiful group of circular and diverging fibres lies outside the first series (2, in the last-named figure), crossing each other in a striking manner superiorly and inferiorly, as well as less distinctly at intermediate points, and forming with the longitudinal and other fibres the intricate stroma of the snout. The terminal pore is furnished with a prominent papilla, covered with a fan-shaped brush of cilia, the whole being only occasionally extruded, and no doubt assisting the papillæ previously mentioned in the tactile functions of the snout. This central papilla is sometimes bilobed, each division being supplied with cilia. In spirit-preparations of large examples of *Lineus marinus* the proboscidian aperture is distinguished by a slight slit on the inferior surface immediately behind the tip of the snout, the minute anatomy and relations of which agree very closely with the same parts in *L. gesserensis*.

4. *Proboscidian Sheath and Chamber.*

The proboscidian sheath forms a shut sac, as in the Enopla, from the bridge of the ganglionic commissures to the posterior end of the worm. The long proboscis glides smoothly in this chamber, the walls being united with it and other tissues just in front of the commissures. The other contents are the clear proboscidian fluid and its discs. The latter are circular granular bodies, similar to, though smaller than, those of the Enopla, and when seen on edge present a fusiform outline, having a dilated middle and two tapering ends. There are also a few small granules and granular cells. The muscular wall and other parts of this chamber agree so closely, both structurally and functionally, with the same parts in the Enopla, that it is unnecessary to describe further than refer to the aspect of the parts in the living animal (Plate XIX, fig. 1, *o*); and to the various transverse sections, in which the wall of the chamber is lettered *o*, and the cavity *ao*. Sometimes near its diminished posterior end the latter shows a series of moniliform spaces, from internal bridles, and often does not quite reach the tip of the tail.

In *Carinella annulata* the proboscidian sheath is not continued to the posterior end of the worm, and it is an interesting fact that this absence coincides, as in the next group, with greatly enlarged lateral vessels.

The chamber is divided throughout its entire length in *Cephalothrix* by transverse bands of contractile tissue, so that during the motions of the worm the anterior region is occasionally thrown into many moniliform spaces. These contractile septa (though imperfect in the middle), doubtless prove of much service during rupture, an occurrence so liable in this slender animal. Moreover, the wall of the chamber is thin, and the circular muscular fibres of the body not much developed; hence the advantages afforded by these safeguards against the inconvenient distension of the chamber during the motions of the worm. The transparent liquid in the cavity contains flask-shaped bodies and minute clear corpuscles.

Professor Keferstein seems to have had no definite idea of this chamber as a cavity with special muscular walls, but speaks of the peculiar discs as floating in the body-cavity (Leibeshöhle) —an error of some importance. In his two transverse sections of *Cerebratulus marginatus* he appears to have confounded the wall of the tunnel with that of the proboscis. He is thus less correct than several of his predecessors, who noticed the sheath of the proboscis and its contents.

5. *The Proboscis.*

The proboscis in the *Lineidæ* (Plate XIX, fig. 1, *a*) commences in the form of a somewhat slender tube just in front of the commissures, gradually enlarges, continues for a considerable distance of nearly equal calibre, and then, diminishing, terminates posteriorly in a long muscular ribbon (*z*, sometimes bifid), which, curving forward in the ordinary state of the parts, becomes attached to the wall of the proboscidian tunnel. Its cavity passes in front into the canal of the snout, and posteriorly terminates in a *cul-de-sac* at the commencement of the muscular ribbon. It differs from the organ of the Enopla in certain respects, such as the absence of stylets, its more slender proportions, and the shape of the glandular papillæ on its internal surface. Experience, indeed, generally enables the observer to distinguish by external characters the proboscis of the Anopla from that of the Enopla in spirit-preparations—by the abrupt diminution of the calibre at the posterior portion in the latter, caused by the presence of the stylet-region and globular reservoir; but where the organ is incomplete, a transverse section at once puts the question beyond doubt. There are, also, in the proboscis of the *Lineidæ* three longitudinal lines, the first of which corresponds to the intersection of the fibres at one pole, and the other two occur at the ends of the separate segment, hereafter to be described. In the living animal the organ is proportionally longer than in the Enopla, and when rejected is thrown into numerous screw-like coils.

In transverse section there is externally an investment (*a*, Plate XX, fig. 4, and Plate XIX, fig. 8) similar to that in the Enopla, apparently composed of homogeneous elastic tissue, yet showing some granular markings towards its outer border. This coat is tougher than any of the others, and often retains its integrity after they have ruptured. A powerful longitudinal muscular layer (*b*) lies within the former, its fibres in transverse section having the same histological characters as in the Enopla. At opposite or nearly opposite poles of the circle, however, a remarkable interposition severs the continuity of the layer (as seen at *g*, *g′*). At one pole, two symmetrical bundles of fibres spring from the succeeding circular belt, and, slanting outwards, cross each other, so as to disconnect the longitudinal coat just mentioned, and for a portion of its circumference wedge it between two bands of circular fibres. The outer or oblique bands of circular fibres become lost in the external coat of the organ. The longitudinal layer (*b*) is thus diminished to a blunt point on each side of the intersection of these peculiar fibres, and a region is formed externally which is occupied by a special and somewhat lozenge-shaped group of longitudinal fibres, through which the dotted line *g* passes. The longitudinal layer, especially near the wedge-shaped ends (where the fibres are often arranged in a thicker mass in these preparations), is marked in the centre by a faint linear streak, as if composed of two layers, but this does not continue all round, and is not apparent in every specimen, nor in *L. gesserensis*. At the other pole there is a variation, for it is found that an elongated portion (*g′*) is cut off without apparent intersection, the ends of the great longitudinal coat (*b*) being widely separated. It generally happens that towards this side the bulging of the contracted organ occurs, and, it may be, such forces the edges of the longitudinal fibres apart, and aids in causing the above appearances; but it would not account for them all. In contraction this coat is sometimes thrown into a silky belt of regularly waved fibres. Within the longitudinal layer is an equally powerful one of circular fibres (*c*) which, at opposite poles in the transverse sections, gives off the peculiar oblique bands previously mentioned. A basement-layer (*d*), better marked in *Micrura fusca* than in *Lineus gesserensis*, is situated on the inner surface of the circular coat. There is also present in the former species an incomplete belt of longitudinal fibres (*e*) within the basement-layer, and which is not evident in the latter. Attached to the inner surface of the basement-layer, or in the latter instance partly to the incomplete longitudinal, is the glandular mucous coat (*f*), which, from lengthened preservation, has in this case become somewhat altered. The glandular bodies are scattered chiefly towards its inner or free surface. In fresh preparations, *i.e.* in those made from the organ immediately after extrusion from the living animal, a regularly radiate arrangement of this coat is constantly observed, as if a series of explosions had occurred in the mucous substance so as to scatter the globules and gelatinous bands in a fan-shaped manner. Indeed, the aspect resembles thick and graceful tufts of grass with large spikes, for the granular glands are mostly at the tips of the streaks of mucus, a state probably due to their passage outwards under compression. Professor Keferstein figures this in *Borlasia splendida*, but he does not refer thereto in his descriptions. In the fresh specimen the glandular papillæ are much smaller than in the Enopla, and widely different in shape (Plate XVII, fig. 20, and Plate XVIII, fig. 14), the former representing them in the extruded proboscis, the latter as viewed from without. Under ordinary circumstances they have an ovoid form, and vary from $\frac{1}{1500}$th to $\frac{1}{2000}$th of an inch in size. Under pressure they become either flattened circular bodies, or assume a cylindrical and slightly barred aspect; and, after escape into the surrounding water, the contents are club-shaped or rounded (Plate XVIII, fig. 12).

The usual cross of fibres occurs at one of the poles of the transverse section of the proboscis of *Lineus marinus* (Plate XXI, fig. 5), but the separate piece at the opposite pole is somewhat larger than in *L. gesserensis*. The proboscis of *Cerebratulus angulatus* (Plate XXIII, fig. 18) differs from the foregoing at one of the poles of the circle in transverse section. The layer of circular fibres is divided into two bands, one of which (the inner) passes continuously round, while the outer, after the usual intersection at one pole, diverges much more at the other, so as to make a triangular space between its fasciculi. In the space thus formed is situated a band of longitudinal fibres (*g a*). Further, in the outer angle of the cross, that is, in a position agreeing with the wedge of fibres at the opposite pole, a narrow belt of longitudinal fibres exists (*g b*). In the *Lineus acutifrons* of Dr. Baird, from St. Vincent's, West Indies (L. Guilding's collection, British Museum), the cross made by the fibres is entirely absent, and this coincides with a continuous and powerful longitudinal muscular layer within the circular coat. The latter (inner longitudinal coat) also occurs in an example of the *Lineidæ* collected by Dr. Cunningham in Elizabeth Island. The *Lineus novæ-zealandiæ* of Dr. Baird, again, agrees with the ordinary British forms in regard to layers, but there is no cross of fibres at one pole. A small form from Greenland also shows no intersection of the fibres, but the circular coat is divided by a median line into two layers, and there is a complete inner longitudinal coat. In *Borlasia Elizabethæ* the white proboscis is extremely slender in proportion to the bulk of the animal, and, moreover, the walls are comparatively thin. Instead of the shrinking and condensation which usually occur on immersion of the organ in spirit, a considerable central cavity remains in this case. Externally in transverse section (Plate XIX, fig. 7) is a thin investment, which generally shows a central line, as if divided into two layers. Beneath is a coat of longitudinal fibres, and then a thin belt of circular fibres with the ordinary glandular lining. The papillæ of the latter are small, rounded, and minutely granular. *Meckelia asulcata* is distinguished from other *Lineidæ* by the structure of its proboscis (Plate XX, fig. 5), which has externally no distinct superficial layer. Its outer coat consists of densely woven spiral fibres, which at opposite poles in the sections cross each other more distinctly than at other parts. The next (inner) coat consists of a considerable layer of longitudinal fibres, upon which the glandular papillæ rest.

In *Micrura* the organ is furnished with somewhat slender papillæ, which assume various shapes under pressure. When viewed laterally, the rounded or flattened papillæ, that formerly seemed only granular, appear to be composed of a series of minute rods set closely together (Plate XVIII, fig. 13). In some, however, the striæ are longitudinal. When extruded from the organ into the water, the cylindrical bodies in the papillæ cling together in some instances like fibrillæ; and the appearance in the prepared specimens is quite characteristic, the inner surface being covered with a vast number of these elongated structures. The latter are the bacillary bodies described by Dr. Max Müller, but I have never seen in the British species any of the urticating organs mentioned by this author. The anatomy of the organ in this section agrees with that in *Lineus*, and in spirit-preparations the shrinking causes a protrusion of tissue at the separate segment opposite the intersection of the fibres.

In *Carinella annulata* the proboscis has externally a thin investment composed of two layers (Plate XX, fig. 6), the outer consisting of elastic and the inner of circular muscular fibres; then a thick layer of longitudinal fibres is met with, and, lastly, a coat of circular fibres, to which the glandular lining is attached. Rod-like bodies occur in the papillæ of the latter coat, as in other forms, and seem to be analogous to the "stabförmigen Körperchen" of Professor Kolliker,[1] and other investigators of the structure of the Annelida. In the *Carinella* from Balta, the proboscis proceeds from the tip of the snout in the usual manner, but instead of the posterior end diminishing insensibly into the long muscular fasciculus, the organ divides into two nearly equal trunks (Plate XXI, fig. 9), each about as large as the entire portion, and terminating in a somewhat abrupt and dilated end, to which a long muscular ribbon is attached. The wall of this peculiar proboscis, so far as I could make out from the single and rather unfavourable example, had the following structure:—A circular layer showing a few granules on the outer margin in transverse section occurs externally; within is a powerful and apparently continuous longitudinal muscular coat, from the inner surface of which the granular papillary mucous lining projects. The inner or free margin of the latter is comparatively smooth, a result probably due to the minuteness of the papillæ. Each limb of the fork has the same structure as the anterior region, and the thick longitudinal coat, after bending inwards at the posterior end of the dilated termination, becomes continuous with the muscular ribbon. The proboscis thus differs from the ordinary form in the *Carinellidæ* in the bifurcation, and in having no distinct circular coat within the longitudinal. It has no closer analogy with any other type.

In *Cephalothrix* the papillæ of the proboscis are acicular, and longest anteriorly (Plate XVIII, fig. 15). In transverse section the walls present a simpler structure than in *Lineus;* but, though in the living animal an external circular and an internal longitudinal muscular coat are apparent, the tissues become so confused after mounting, that I have not satisfactorily unravelled them.

Under the action of powerful irritants, such as alcohol, the *Lineidæ* detach, in their spasms, both the anterior and posterior connections of the proboscis at once, so that the extruded organ remains in its ordinary condition when expelled, and is not everted. In *Cephalothrix*, again, it sometimes ruptures near the ganglia, and is drawn backwards by the ribbon of attachment and its own elasticity; the animal apparently being unaffected by the injury, which regeneration soon repairs. I have never seen the worm use the proboscis for any purpose; and though M. van Beneden has observed it extruded in *Cerebratulus Œrstedii* (*Lineus bilineatus*), and threatening its prey, I fear it could not do much harm. The lifelike vermicular motions of this muscular tube, both *in situ* and when cast off, have misled Mr. Beattie and others, so that they described the organ as a young animal, and the possessor as viviparous, or even considered the expelled portion a parasite. This is at once apparent on examining Mr. Beattie's specimen of the supposed young animal in the British Museum. The proboscis is reproduced in the same manner as in the Enopla; and the discarded organ, if not ejected, may be seen floating in the proboscidian cavity amidst much granular débris. Sir J. Dalyell states that the usual colour of the proboscis in *Lineus marinus* is vivid red; our specimens have generally had white or faintly pinkish organs.

M. van Beneden does not mention the tissues to which the muscular retractor of the proboscis is attached in his *Nemertes communis*, and speaks of it as suspended freely in the cavity of the body, like the digestive tube of the Bryozoa. A further remark with regard to the organ in

[1] *Vide* 'Kurzer Bericht uber einige im Herbst 1864 an der Westküste von Schottland,' &c., pp. 12, et seq.

Cerebratulus Œrstedii (*L. bilineatus*) makes his error still more apparent, for he says—"Toute la trompe se meut librement dans la cavité intestinale." Prof. Keferstein gives a small figure of a transverse section of the organ in *Cerebratulus marginatus* turned inside out; but, though he indicates the lozenge-shaped space formed by the intersection of the fibres, it is misplaced on one side, and the entire figure is too indistinct for reference.

6. The Digestive System.

a. Mouth.

The mouth in *Lineus gesserensis* is a longitudinal fissure on the ventral surface, situated a short distance behind the ganglia, and varying in size according to the motions of the animal, and the degree of contraction or relaxation. Its ordinary appearance under examination is represented in Plate XIX, fig. 1, *w*. Certain broad pale lines radiate from the lips of the fissure, an arrangement which led Dr. G. Johnston into the error of considering the mouth a nerve-ganglion and the furrows branches. These radiating lines or folds are due to the same structural cause as in the ciliated œsophageal region of the Enopla—viz., prominent longitudinal rugæ of the thick glandular texture of the organ, which, in this case, permit great dilatation of the parts during ingestion. The number of these rugæ varies, as may be observed by a comparison of the figures. When *L. gesserensis* is killed by immersion in fresh water the mouth frequently presents five or six somewhat triangular folds of the œsophageal structure, which fill up and distend the aperture. The mouth is very conspicuous in *Lineus marinus* (Plate XVIII, fig. 2). In *Lineus lacteus* it is situated very far back (Plate XIX, fig. 3), so that a long space intervenes between it and the ganglia; and there is a marked difference in this respect between the present species and *L. sanguineus* (Plate XIX, fig. 2).

In *Carinella* the oral aperture forms a longitudinal slit, somewhat less conspicuous than in *Lineus*. In *Valencinia lineformis* the mouth is quite as distinctly marked as in any example of the latter, and placed far backwards.

In *Cephalothrix* the lips of the aperture are frequently thrust outwards in the form of a short funnel, so that the animal resembles an elongated Distoma. Some circular fibres are present round the mouth in this group, and probably exist also in *Lineus*.

b. Œsophageal Division.

The mouth leads into a large ciliated œsophageal chamber (*j*), which commences anteriorly in the form of a *cul-de-sac* behind the ganglia and cephalic sacs, and nearly closes by its anterior wall the vascular lacunæ there, while it may be said to terminate posteriorly at a distinct incurvation of its wall, by becoming continuous with the digestive cavity proper. In transverse section (Plate XX, fig. 1), the anterior part of this chamber is seen under favourable circumstances as a thickly folded glandular mass (*j*), with the ventral slit (*w*) leading quite freely into it. The cavity has not yet attained its full size, and the mouth is severed at its anterior border. Superiorly, a large space is occupied by the proboscidian sheath (a), and the great lacunæ (s, s), and indications of some other vascular meshes are seen at the sides. The margins of the mouth (w) curve inwards, and gradually merge into the ciliated glandular texture of the cavity. A little further back the glandular substance is confined to the inner surface of the body-wall (though not closely applied thereto), leaving a large central space. In full perfection the chamber and glandular texture are seen in Plate XX, fig. 3. The minute structure of the wall of this portion of the digestive cavity is similar to that of the ciliated œsophageal region in the Enopla, being composed of a thick layer of granular gland-cells and basement-substance, raised here and there into prominent rugæ, and possessing a rich coating of cilia on the inner surface. The incurvation of the borders of the region is an interesting circumstance, and demonstrates the distinction between it and the succeeding division, even from the earliest condition of the worm, without for the moment regarding the other cardinal facts relating to the peculiar arrangement of the circulating channels on the walls, the thicker texture of the latter, and the total absence of the gregariniform parasites. Moreover, it is only in this region that the cilia of the digestive cavity are apparent, probably because the greater firmness of the walls keeps the chamber somewhat distended. In certain lateral views of the animal (Plate XXII, fig. 4), the distinction between the œsophageal and the succeeding region is very evident, the point of junction being inflected in a characteristic manner.

Though in the various drawings of transverse sections of *Lineus* this chamber (œsophageal) is seen in its normal condition, it is well to remember that it undergoes very marked alterations in size, according to the condition of the proboscidian cavity in its vicinity, for the proboscis most readily distends the latter in this region, and bulges it so much that the walls of the former are pressed flatly together at the ventral surface. In the contracted condition of the worm, as after immersion in spirit, the communication between the œsophageal and the succeeding portion of the digestive system is almost obliterated.

c. Alimentary Cavity Proper.

The second or great division of the alimentary tube extends from the point of inflection previously mentioned to the posterior end of the worm, in the form of a ciliated chamber with glandular and sacculated walls; but the cilia, with the exception of a streak near the tip of the tail, are only well seen on making a transverse section of the living animal, though they are actually longer and more active than those on the cuticular surface. In pale species, such as *Lineus lacteus*, Mont. MS., the digestive canal is very distinctly divided, for the posterior region is not only more opaque than the œsophageal, on account of the greater development of its glandular elements, but its borders are crenate from the sacculations. The posterior aperture or anus is situated slightly in front of the tip of the tail, and is well guarded by the muscular structures surrounding it, as may be observed before granular matter escapes, for it requires the impulse of numerous waves of fluid before yielding under pressure. In some favourable specimens (Plate XIX, fig. 6) masses of cells and débris may be seen revolving within the dilated anus before extrusion. In various examples a distinct anal papilla (Plate XVII, fig. 22), furnished with a tuft of longer cilia, projects posteriorly.

In transverse section (Plate XXI, fig. 1), the encroachment made on the cavity by the ovaries, during the period of their activity, is well shown, and also the gregariniform parasites, which often occur so abundantly in these worms. When the animal, after spawning, has regained condition in its native haunts, the granular cells of the digestive chamber become largely developed, so that in transverse section the body is rounded (Plate XX, fig. 3), and the entire middle region filled up by the mass, with the exception of an irregular fissure in the centre; whereas considerable atrophy of these elements occurs during long confinement or the exigencies of reproduction. Towards the posterior end of the worm the tract is much diminished, and, in the living animal, more evidently ciliated when viewed from above. The minute structure of the wall of the cavity (Plate XVIII, fig. 16) bears much resemblance under pressure to that of the ciliated œsophageal region in *Lophiporus*, having a basement-substance, in which are imbedded a vast array of granular glands, and with the inner surface richly ciliated. The contents of the glands (Plate XXI, fig. 7) consist of granular cells and globules, which readily escape from the free border of the organ, and are often ejected per anum.

In *Carinella* and *Valencinia* this and the previous region agree so closely with the arrangement in *Lineus* that no special description is necessary.

The ciliation of the entire digestive canal is more apparent in *Cephalothrix linearis* than in *Lineus*. It has a similar arrangement in transverse section (Plate XXI, fig. 2), and the same gregariniform parasites and an *Opalina* occur. In structure the first or œsophageal portion has a much more lax and cellular aspect than the succeeding densely granular region; and from the translucency of the animal the distinctions between the divisions are more exaggerated. In one specimen sent from St. Andrews in April, the digestive chamber was coloured of a fine pea-green (Plate IV, fig. 5), instead of the usual pale pinkish hue, a state due to the uniform tinting of the cellular elements, it may be from the nature of the food, such as the deep-green ova of *Phyllodoce*.

Ehrenberg, De Quatrefages, Girard, and Stimpson considered the mouth to be the genital orifice, the former observing that a large quantity of mucus was discharged therefrom. Mr. H. Goodsir thought the canal common to the respiratory, digestive, and generative systems. "In *Serpentaria*," he observes, "it acts almost as an organ of digestion, while in Nemertes there is a trumpet-shaped exsertile proboscis, which, contrary to the opinion of Rathke and other naturalists, and according to the opinion already expressed by Ehrenberg, is the intestinal canal." He agreed with Ehrenberg in supposing the ova escaped into this chamber. His views were rather erroneous, such as imagining the first region of these worms to be composed of a single annulus; but the succeeding or terminal of many, each about an ⅛th of an inch in length; moreover, that each of the separate annuli contained all the elements of the perfect or original animal, viz., a male and female generative apparatus, the cavity common to the generative, digestive, and respiratory functions, and a small dorsal vessel analogous to the intestinal canal of Nemertes. *Serpentaria*, therefore, he explains, "is a composite animal, each perfect individual consisting of numerous and apparently still unformed or imperfectly formed individuals." Modern researches do not support any of these suppositions. Amongst the British zoologists who have examined these animals, Dr. Williams, while admitting the digestive nature of this chamber, misinterprets its true relations. He considers the organ a closed sac filled with a milky fluid, and having many diverticula, into which the nutritive matter passes by exudation from the proboscis. He appears thus to have drawn up his description from one of the Enopla, which possessed no large slit leading into the chamber. He denies the existence of a proper anus. While thus deviating from the true structure of the parts, he is correct at least in viewing the chamber as digestive, and quite independent of the generative system placed to its exterior.

Sir J. G. Dalyell, whose untiring scrutiny of the habits of such animals is worthy of all praise, saw a *Lineus* (his *Gordius gesserensis*) feeding by the ventral slit, which he therefore correctly termed the mouth. Dr. Johnston in his 'Catalogue' observes:—"There is another and much larger aperture in front, behind and underneath the head. Long mistaken for the mouth, this has been usually described of late as genital, but the orifice is doubtful." He terms the alimentary canal the general cavity of the body. M. van Beneden does not demonstrate that the so-called biliary elements are simply constituents of the wall of the digestive cavity, and not special cæca attached to the sides of the canal. In *Lineus bilineatus* (his *Cerebratulus Œrstedii*) he states that the nutritive chamber is divided into three compartments—the first short, and corresponding to the œsophagus; the second twice or thrice the length of the former, and representing the stomach; the third extending to the posterior extremity of the worm and constricted at regular intervals, and equivalent to the intestine. I have not yet noticed this in the British examples, which agree with the typical *Lineidæ* in the structure of the organ, although the external aperture or mouth is somewhat smaller. Prof. Keferstein's description of the cavity as applied to *Lineus*, though brief, is good, and his criticism of Van Beneden's view, in regard to the "liver" in the same group, fair.

7. *Nervous System.*

The cephalic ganglia or central organs form two large and conspicuous pale red masses situated a short distance behind the snout of the worm (Plate XIX, fig. 1). They differ in shape, as seen under slight pressure, from the same organs in the Enopla, each half being narrower and more elongated, so as to cause the entire arrangement to have the appearance of a horseshoe-magnet. In some specimens, instead of being more deeply tinted than the rest of the cephalic tissues, they are paler, on account of the deep red coloration of the latter; while in others they can scarcely be distinguished under the dense blackish-green coating of cutaneous pigment. They are surrounded by the usual fibres of the region, besides the proper sheath of the ganglia. The inferior commissure, often of a deep red hue, is well marked, and placed quite at the front. The curves of the ganglia do not bulge so much forward on each side as in the Enopla, and thus the anterior margin of the system forms a nearly uniform transverse line. The superior commissure is smaller and less distinct; indeed, it is with difficulty seen in the living animal as a transparent preparation. Each ganglion is composed of a superior and an inferior lobe; and in minute structure the nervous matter agrees with that in the Enopla. The inferior lobes and commissure rest upon the solid tissues of the snout (Plate XVIII, fig. 9) instead of having the buccal cavity beneath them, as in the latter. On making a transverse section of the ganglionic mass just behind the commissures (Plate XXII, fig. 1), the superior lobe is found to be more rounded than the inferior, and to communicate with its fellow of the opposite side by the superior commissure. The inferior lobes are somewhat ovoid, connected by the great commissure, and give off the lateral nerve-trunks posteriorly. In front the two lobes are soldered together, but towards the posterior part a section is now and then found, which shows the posterior end of the upper lobe separated from the inferior. This severance of the end of the upper lobe is not to be confounded with the free rounded sac which lies close behind, as demonstrated by a section in which the knife has cut the left ganglion somewhat further back than the right, and so indicated this separation on that side. The presence of the trumpet-shaped mouths of the ducts of the cephalic sacs in such a preparation shows that these bodies are posterior and not yet reached by the instrument. Longitudinal sections of the head of the worm exhibit the positions of the ganglia and the cephalic sacs with great clearness, each of the former often presenting different appearances on the respective sides from obliquity of section, but the posterior borders are always distinctly separated from the sacs (Plate XVIII, fig. 10).

In all sections of the ganglia a peculiar change occurs after mounting in chloride of calcium, the oily matter of the tissue collecting in curious streaks and circles, and apparently at some parts resisting the penetration of the fluid.

Considerable difficulty is experienced in making out the anterior branches of the ganglia, from the opacity of the snout; but three or four trunks of note are occasionally apparent—two large branches superiorly, and one or two smaller beneath. Some twigs seemed to proceed in the direction of the eye-specks, but their ultimate distribution could not be traced.

Each great nerve-trunk (Plate XIX, fig. 1, *n*) leaves the posterior end of the inferior lobe as in the Enopla, proceeds along the side of the body, and terminates at the tip of the tail. The calibre of the cords slightly diminishes as they course backwards; and their position is nearer the ventral than the dorsal surface. Branches probably exist, but only faint traces of such are seen in the longitudinal sections, for the opacity of the textures in the living animal prevents their being satisfactorily made out. The trunks are imbedded in a fibro-granular matrix (Plate XXI, fig. 6, *n'*) of the same reddish hue, and have, in addition, the proper sheath (*neurilemma*) of the nerve. In some pale species they are marked externally as two pinkish dorsal streaks. These trunks, as already indicated, have a very different position from the nerves in the Enopla, being situated outside the circular muscular layer, and between it and the great longitudinal. Two muscular coats (circular and internal longitudinal) thus intervene between the nerves and the body-cavity and its contents, whereas in the Enopla the nerves are within all the muscular layers.

The general arrangement of the cephalic ganglia in *Carinella annulata* agrees with that in *Lineus*, so that a special description is unnecessary. The lateral nerve-trunks lie between the basement-layer and the external (circular) muscular coat of the body-wall (Plate XXII, fig. 2, *n*). In *Valencinia lineformis* a variation is observed, since the nerves do not quite reach the external border of the great longitudinal muscular layer.

The chief peculiarity of the ganglia in *Cephalothrix* (Plate XIX, fig. 9), as first pointed out by Prof. Keferstein, is the advance of the almond-shaped upper lobes, so that the superior commissure is quite in front of the inferior. The lateral nerves are placed between an isolated longitudinal fasciculus and the great longitudinal muscular coat of the worm (Plate XXI, fig. 2).

Mr. H. Goodsir criticises the description given by M. de Quatrefages of the nervous system in *Serpentaria* and *Nemertes*, and, like Œrsted, denies its existence altogether, averring that microscopically the so-called nerve-trunks show no nervous elements at all, but are the testicles of the worms. I fear, however, this worthy naturalist depended rather upon analogy than actual observation in this case. He accounts for the nervous fibres seen by Rathke (the first who correctly described the ganglia in *Lineus*) passing from the cephalic ganglia to the narrow slits on each side of the head, by supposing them to be seminal tubes on their way to the furrows (his seminal apertures). M. de Quatrefages confines his examinations chiefly to the ganglia of the Enopla. Frey and Leuckart, again, confound the cephalic sacs with the posterior part of the ganglia. M. van Beneden makes a curious remark in regard to his *Nemertes Quatrefagii*—viz., that the "collier œsophagien" is peculiar for its red colour, which hue, he says, is less marked in the other species of *Nemertes*. This colour, he explains, is not due, as believed for a long time, to the nerve-ganglia, but to the vessels which surround them, and it can easily be understood how the ganglia were confounded with the vascular trunks. Nothing akin to this has ever come under my observation, and the minute anatomy of the region is adverse to the view. Prof. Grube had previously made the same remark in describing *Nemertes purpurea*, Johnst, a species which (judging from the descriptions) seems to differ very materially from *Nemertes Neesii*, and is apparently one of the Anopla, but I have not yet seen any British representative. Prof. Keferstein is scarcely accurate in affirming that the ganglia in this group are larger than those of the Enopla. In his figure of the parts viewed from the dorsum (Taf. vii, fig. 1), the cephalic sacs are not discriminated

8. *Cephalic Fissures.*

On each side of the head in the majority of the Anopla is situated an extensive fissure (Plate XIX, fig. 1, and Plate XVIII, figs. 3, 8, 9, *b*), which commences as a shallow groove at the anterior border of the snout, and terminates, in the form of a reddish pit, somewhat abruptly, just beyond the entrance to the cephalic sac. A distinct constriction of the anterior region occurs behind the fissures in *Lineus gesserensis*, thus marking off the cephalic boundary. There is nothing special in the anatomy of these fissures, for they are formed by a simple extension of the cutaneous elements superiorly and inferiorly, as represented in the transverse section (Plate XVIII, fig. 9). Their entire surface is covered with very active cilia, which, as before mentioned, I have often seen cease abruptly, and again begin to play vigorously. The vapour of chloroform, if applied in sufficient quantity, causes them to stop entirely, but they again commence vibration on the partial recovery of the animal. Œrsted and others have considered that these fissures perform a respiratory function, but of this there is no sound evidence. Mr. H. Goodsir thought they were the apertures of the male generative system, a supposition, as mentioned, scarcely requiring refutation. Prof. Keferstein gives a very good summary of the views of previous observers, but, while agreeing with none, he advances no new interpretation of these structures. He concludes by criticising M. van Beneden's statements, to which he objects, but he has scarcely reviewed them at sufficient length. M. van Beneden observes that the cephalic fissures are furnished posteriorly with a pit leading into a ciliated funnel, and that the lateral vessels when they approach the ganglia swell out into vesicles ("ils se renflent là en vesicules"), which simulate the ganglia, and convey their contents to the exterior by the ciliated funnel just mentioned. He considers that the central point of this apparatus lies immediately beneath the ganglia on each side; and he has seen, under compression, the pit of the lateral slit adjoin a large canal, which terminates exteriorly by a sort of funnel, and this leads into a pouch behind the nerve-ganglia. He did not see any vibratile movement within the vesicle; and states his conviction that this apparatus is similar to that in the Trematoda and Cestoidea. Thus, as Prof. Keferstein says, he has nearly retrograded to the time of Huschke, who thought these fissures connected with the lateral nerves, which he took for canals. In his enlarged figure, however, he represents the position of the cephalic sacs fairly, but he has a large blood-vessel running exterior to the nerves, and extending to the tip of the snout; this, of course, is at variance with a true interpretation of the structures in the Anopla.

The cephalic fissures, as characteristic of the typical *Lineidæ*, are absent in *Carinella annulata*, their places being supplied by two pale curved grooves on the dorsal and two continuous transverse furrows on the ventral surface of the snout. The depressions are richly ciliated. In the remarkable form from Balta, the snout is surmounted by two curious frilled processes (Plate XXI, fig. 9, *b*), which terminate posteriorly in a long filament. Whether the latter, however, is a structure *sui generis*, or only some normal constituent of the body (such as a nerve) in a peculiar position, the state of the specimen forbids our determining.

The cephalic fissures and furrows are entirely absent in the family *Cephalothricidæ*.

9. *Cephalic Sacs.*

At the posterior end of each lateral fissure, a funnel-shaped tube (*m'*, Plate XIX, fig. 1) leads into a large globular structure (*m*), often of a pinkish or reddish hue, and the apparent homologue of the cephalic sac in the Enopla. The globular body lies over the origin of the great nerve-trunk on each side, and abuts so closely on the posterior prominence of the upper lobe of the ganglion, as to have led some observers into the error of supposing it only a continuation of the ganglionic texture. Very careful preparations and examinations of the adult animal, as well as observations on the young at various stages, remove all doubt on this subject, and show that these globular structures belong neither to the nervous nor the circulatory system. The funnel-shaped duct (*m'*) is richly ciliated, and the cilia may be traced to the sac, wherein they are continued as a linear streak along its outer border, but its general mass is not furnished with these organs. The ciliated curve along the external margin is well seen in young specimens, but its exact superficial extent is difficult to determine. In favourable examples the walls are observed to contain finely granular cells, which have a clear and distinct nucleus. These cells are most evident on the inner and posterior curves, the outer curve being pale. The sacs project posteriorly into two large cavities—continuations of those indicated in Plate XX, fig. 1, *s*, *s*, on each side of the proboscidian tunnel, and are thus laved by the circulating fluid, which rushes forward from the walls of the digestive cavity; but there is nothing to support M. van Beneden's views as to their continuity with the circulatory system. Their relations to the ganglia have been adverted to already, and are well shown in some horizontal sections, where one sac has been severed considerably lower than the other.

Just in front of the external border of the curved dorsal groove on the snout of *Carinella annulata* (Plate XVII, fig. 24) is an ovoid body apparently homologous with the foregoing, but I have not yet been able to trace its anatomy, on account of the opacity of the cutaneous tissues in this animal.

The sacs are absent in *Cephalothrix*.

The function of these bodies may be excretory. Their gradual advance in position, and proportional diminution in size in the developing animal, are interesting features in this respect. Prof. Keferstein does not enter into structural detail with regard to these organs in this group, but states that they lie at the posterior end of the lateral fissure. In *Lineus sanguineus* he mentions they are in connection with the under surface of the ganglia, whereas they are situated distinctly above the latter. In his figure no separation is made, and the dilated organ is confounded with the posterior part of the superior lobe of each ganglion, the duct or ciliated canal running beneath. The development of these sacs in the very young Nemertean inside the *Pylidium*, as recently narrated by E. Metschnikoff, confirms all our views of their relations.

10. *Eye-specks.*

These are simply masses of black pigment, arranged on the sides of the snout with greater or less regularity, and without any special optical structure. The textures of the head and nerve-fibres themselves are so unfavourable for observation that I have had difficulty in making out nerve-branches thereto. A more definite structure is observed in the Enopla, both as regards nervous elements and complexity of organization. Some of the Anopla have no eyes (a remark, however, which does not apply to *Lineus marinus*), or have them only temporarily in their young state, like the Tornaria-larva of *Balanoglossus* or developing oysters and *Terebratulæ*, while all the known Enopla possess them. It is a curious fact that in transverse sections of the snout (such as Plate XVIII, fig. 7) considerable pigment-specks are seen towards the ventral surface.

11. *Vascular System.*

The circulation in *Lineus* diverges considerably from that in the Enopla, the vessels differing in definition, size, coiling, and contents. The main trunks, indeed, somewhat resemble long cavities, with contractile walls, within which floats a transparent fluid with corpuscles. I have termed this system the circulatory, but the current is driven by the contraction of the vessels now backward, now forward, so that it is rather a kind of oscillation.

There are three great longitudinal trunks—confining the description at present to the region behind the œsophageal division of the digestive tract—a dorsal (*p*) and two lateral or ventral, *r, r*, in the various transverse sections, and in Plate XIX, figs. 4 and 5. These three vessels in *Lineus* were first mentioned by Rathke. The dorsal is a large trunk situated immediately outside and to the ventral surface of the proboscidian sheath; while the ventral, also considerable trunks, lie on a lower plane, and nearer the middle line than the nerves. Indeed, when the three vessels are distended in *L. gesserensis* and *L. sanguineus*, they occupy almost the entire breadth of the worm under gentle pressure. They are frequently dilated in various ways, sometimes irregularly moniliform, crenate, or simply distended as long pale spaces. The three trunks are intimately connected by an array of simple and rather large transverse anastomosing branches (*y*, Plate XIX, fig. 4), some of which are forked. The transverse branches have special contractile walls, and are not mere random channels, as may be seen in the longitudinal sections of the worms (Plate XVIII, figs. 6, 4). They are subject to the various changes of form noted in the larger trunks. The great longitudinal vessels are further connected at the tip of the tail (Plate XIX, fig. 5). The dorsal generally contracts from behind forward, and drives the corpuscular fluid, not only to the front, but also through the transverse branches into the lateral trunks. The latter propel their contents in both directions.

At the posterior end of the œsophageal division of the alimentary canal the three great vessels, for the most part, lose their individuality, and, so far as I have observed, form an elaborate vascular meshwork between the œsophagus and the inner muscular layer of the body-wall (*u*, *u*, Plate XIX, fig. 1, and more clearly in Plate XX, fig. 2), again meeting in the lacunæ (*s*, *s*) in front of the cavity, and bathing the bulbs of the cephalic sacs which lie therein. These lacunæ or channels pass forward to unite at the ganglionic commissures, and the granules of the contained fluid may be seen rushing forward in the one and backward in the other. In addition to the smaller meshes surrounding the œsophageal region, there are two larger spaces on each side of the proboscidian sheath in transverse section, which may be held as the continuations of the dorsal vessel. The reticulations formed by this system are noticed under favourable conditions in the living animal (*e. g.* as represented in Plate XIX, fig. 1), as well as in numerous transverse sections. I have not been able to see any blood-vessel in the tissues of the head in *Lineus*. A distended pale portion may often be observed in the central line between the snout and the ganglionic commissures, as if the animal had gulped water by the aperture for the proboscis, so as to distend the channel, but this has no connection with the circulatory system. Transverse section demonstrates that there is no other channel in the snout in front of the ganglia than that just referred to.

In *Borlasia Elizabethæ* a reddish coloration is frequently observed in the living animal on the ventral surface at the white belts, showing that some contained fluid tints the dermal tissues during its passage. On puncturing the dilated anterior end, for example in removing the proboscis, a copious exudation of a reddish-brown fluid occurs. This presents many fusiform or clavate corpuscles, probably from the proboscidian fluid; but there are also present a vast number of minute granules of a yellowish colour by transmitted light (reddish in mass), which probably belong to the blood proper (Plate XVII, fig. 23). Many of the latter bodies show a contraction in the middle, so as to resemble a figure of eight.

In attenuate pale species, such as *Lineus lacteus*, Mont., MS., the intervention of an elongated region between the posterior end of the ganglia and the anterior border of the œsophageal region renders a special modification of the circulatory channels necessary. Accordingly, it is found that after the fluid collects in the spaces in front of the alimentary organ, it is conveyed by two long vessels forward to the ganglia, where the same ending occurs as in the other species. These channels seem to be simple elongations of the ordinary lacunæ, and are represented in transverse section in Plate XXII, fig. 3; thus forming an intermediate link between *Lineus gesserensis* and the still more extended post-ganglionic region in *Cephalothrix*.

In *Carinella annulata* two great longitudinal vascular trunks (Plate XXI, fig. 3, *r*) lie within the inner or longitudinal muscular coat opposite the nerve-trunks, and they are peculiar on account of their large size and the granular nature of their contained fluid. They form a coarse network in the œsophageal region, as in *Lineus*, and are continued forward just within the border of the snout to meet in a vascular arch.

In the fragmentary specimen from Balta transverse section of the anterior region (Plate XXII, fig. 2) shows a large ovoid and probably vascular tube (*r*) placed at the inner border of the great longitudinal muscular coat on each side, while the nerve-trunk (*n*) lies outside the latter. The cavity is partly filled in the preparation with minute granular cells. This agrees with the arrangement in *Carinella*.

Cephalothrix has also two great longitudinal vessels (Plate XXI, fig. 2, *r*) situated nearly opposite the nerve-trunks (*n*), from which they are separated by the chief longitudinal muscular coat. There is thus in this system also a deviation from the type of the *Lineidæ*. The size of the vessels is proportionally larger than in the latter, and their transparent fluid contains a number of minute corpuscles. In the living animal each lateral vessel contracts regularly and swiftly from before backwards, sending a wave of fluid towards its posterior end, at which the contraction ceases. A reversed movement by-and-by takes place, the contents being propelled towards the snout. Anteriorly the two vessels course forward by the side of the œsophageal portion of the alimentary canal without subdivision, pass along the sides of the proboscidian sheath in special cavities (*v*), as in *Lineus lacteus*, in front of the former, and reach the ganglia, where they communicate. A junction has not actually been seen posteriorly, but analogy would lead us to suppose its existence. There appears to be little regularity or rhythm in the movement of the fluid in these vessels, both occasionally contracting from before backwards at the same time. Generally, however, the contractions are alternate.

Whatever special function the œsophageal region may perform in regard to digestion, it is clear the circulatory fluid bathing its outer wall is placed in a favourable condition for oxygenation, as the mouth now and then must give entrance and exit to sea-water, under the influence of the powerful ciliary currents caused by the entire surface of this division. Besides, it is evident that during the varied actions of the oral aperture (*e.g.* during feeding) the circulation would sometimes be much interfered with if such a *rete mirabile* did not exist. The special branchial apparatus in the homologous region of *Balanoglossus* (*vide postea*) also gives further weight to our interpretation of the structure of the parts in this group.

Dr. G. Johnston, Œrsted, and Dr. Williams mistook the ganglia for hearts, and the inferior commissure for a connecting vascular trunk. The blood, says the latter author, derived from the cutaneous system of capillaries, is poured by a dorsal vessel into one of the chambers of the heart (the dorsal). From the latter it is sent into the ventral cavity, and thence distributed over the integumentary and intestinal systems. He, moreover, says the blood is red, and always devoid of corpuscles. Such remarks are not based on correct observations. E. Blanchard in his examination of *Cerebratulus liguricus*, describes the nervous centres as lodged in a cavity into which the vascular trunks open, and this can only refer to the post-ganglionic lacunæ, though such do not by any means encircle the ganglia. I have not seen any vascular space surrounding the "trompe" in front of the commissures, as described and figured by this author; and the fluid of the proboscidian cavity could only have been noticed there during the ejection of the proboscis. He found numerous branches proceeding from the longitudinal trunks in his *Cerebratulus liguricus*. I cannot agree with M. van Beneden's views of the circulation in *Lineus*, for he describes the lateral vessels as swelling into vesicles when they approach the ganglia, their contents being conducted to the exterior by a ciliated funnel. The erroneous nature of this supposition has already been noticed under 'Cephalic sacs.' He also mentions that each lateral trunk communicates only with that of the opposite side posteriorly, and concludes doubtfully thus:—"Le long des parois du tube digestif, on voit en outre plusieurs vaisseaux, mais dont les aboutissants sont difficiles à découvrir." Another deviation from accuracy is apparent from his remark (under *Cerebratulus Œrstedii*) that "En arrière un gros vaisseau très-large, à parois très-contractiles, qui parait et disparait par intervalles, occupe la ligne médiane et semble s'ouvrir au bout de la queue." A reference to his figure and its explanation at once makes it apparent that he has mistaken the proboscidian sheath for a blood-vessel. Prof. Keferstein again does not enter into detail with regard to the circulation in *Lineus*, and his figures and descriptions apply to the Enopla, with two exceptions, which represent transverse sections of *Cerebratulus marginatus*. In that through the anterior part of the body five circular vessels at least are transversely cut in the meshes round the œsophageal region, and, moreover, they are joined by a pink band in the figure, apparently from a connecting trunk. I fear the author has been misled by the carmine used in the preparation, for in the British examples of "*Cerebratulus*" the arrangement characteristic of the *Lineidæ* is found.

12. Organs of Reproduction.

The sexes in the known *Lineidæ* are separate, and the ova and spermatozoa developed in their respective sacs between the inner muscular layer of the body and the digestive cavity. The glandular elements in the walls of the latter, indeed, undergo a certain amount of atrophy during the period of reproductive perfection (Plate XXI, fig. 1). Both ova and spermatozoa escape by pores a little above the lateral nerve-trunks, the apertures being frequently indicated by pale specks (Plate IV, fig. 2). In *Carinella annulata* they are often boldly marked by white spots (Plate VII, fig. 5). In this species also, as well as in *L. gesserensis* (Plate XVIII, fig. 11), the rudimentary condition of the generative organs may be seen in transverse section as a series of small globular or pyriform sacs, filled with granules and globules, and situated above the nerve-trunk on each side of the body.

a. Male Elements.

In *Lineus gesserensis* the spermatozoa (Plate XXI, fig. 10) have the aspect of slender rods, with a scarcely perceptible enlargement at the end from which the filiform tail proceeds. When a mass is taken from a living animal, groups often adhere to a point by one end, and, spreading in a radiating manner, lash the surrounding water with their tails. The spermatozoa of *L. sanguineus* (Plate XXI, fig. 11) are more minute than the former, and somewhat resemble an awl-handle in shape, with the filament projecting from the butt, which is thus frequently agitated, while the tapered end is comparatively still. In *Lineus marinus* the outline of the body of the spermatozoon (Plate XXI, fig. 12) is less regular than in the foregoing, and seems slightly crenate in some specimens. A very long filament is attached to the larger end. In *Micrura fasciolata* there is likewise a slight constriction in the middle of the spermatozoon, and the tail proceeds from the larger extremity. The reproductive elements were nearly perfected in the large Zetlandic variety of this form in August, the sperm-cells being filled with slightly curved rod-like bodies, having one end less tapered than the other.

b. Female Elements.

The ova occupy similar positions to those of the Enopla. They are few and large in *Lineus gesserensis*, smaller and more numerous in *L. sanguineus*.

13. *Mode of Deposition of the Ova.*

Instead of being deposited as free circular bodies, the ova in *Lineus gesserensis* are placed within a flask-shaped membrane, with one end narrowed to a fine point, and the whole enclosed in a tough covering of gelatinous mucus, which is fixed either to stone or glass, in the form of a bulky cord, as noticed by Œrsted. When a female specimen is about to spawn, she seeks the water-line, or a space above it, and quietly settles along the vessel. By-and-by a copious exudation of tough translucent mucus takes place, which envelopes the entire animal. In this mucus (Plate IV, fig. 3), which, when fresh, is crowded with small ovoid granular corpuscles from the cutis, the ova are deposited in flask-shaped capsules, each of the latter corresponding to an ovary, and containing all its ova, viz. from one to seven. Hence, by the nature of the parts, the ova are arranged in a somewhat irregular double row along each side, the extremities of the cord—corresponding on the one hand to the head and œsophageal portion of the digestive tract, and on the other to the extreme tip of the tail—being free from ova. In some instances the posterior end of the animal is curiously frilled and grooved on the ventral surface during deposition. When newly exuded the mucus is softer and less tenacious than it afterwards becomes, and the same may be said of the membranous flasks. The solidification of the mucus is analogous to what takes place, under similar circumstances, in the egg-capsules of certain mollusks, *e. g. Buccinum undatum.* If one end of the animal be disturbed from its original site on the glass before the ova are all deposited, four rows will be found instead of two, for sufficiently obvious reasons. The ova of *Lineus gesserensis* are of two shades, viz. white and pale brownish; and though the dark greenish examples often lay white eggs, they do not seem to do so always. Each ovum measures from $\frac{1}{70}$th to $\frac{1}{80}$th of an inch in diameter. The deposition takes place in January and February in those long confined; but some specimens sent from the rocks at St. Andrews towards the end of April likewise deposited ova, so that some latitude in regard to date is necessary. The American examples spawned in January, and those from Cuxhaven in March; but the *Nemertes communis* of M. van Beneden only did so in September. It is often observed that impure water causes recently captured animals to lay their ova rapidly, as if from a kind of abortion.

14. Development.

The development of the ova of *Borlasia obscura*—a species apparently identical with our *Lineus gesserensis*—has been described by E. Desor up to the period of the extrusion of the young from the capsules; and Max Schultze and Krohn have also investigated the subject, especially the former, so that I shall dwell only on such points as have not been elucidated. The British forms seem to offer great facilities for these investigations, and I have had no difficulty in rearing the *Lineidæ* a long distance from the sea.

The ova on deposition in the flask-shaped capsules (Plate XXIII, fig. 2) are uniformly granular and opaque; and when broken up, are found to be composed of a granular oily matter, which forms streaks and rounded masses, and is not cellular, as described by E. Desor. The clear, semi-transparent spot mentioned by the latter as occurring in the ova after deposition is seldom visible, though the germinal vesicle (*a*) and dot (*b*) are apparent enough in the centre of a pale oleaginous space, while yet in the body of the female (Plate XXIII, fig. 1). The flask enveloping them is composed of a fine hyaline membrane, that assumes many silky folds in the collapsed condition, and evidently contains a fluid which, with the semi-solid yolks, may be thrust out into the mucus. The cleavage of the vitellus generally commences on the second day, when in some it is found divided into two and in others into four parts (Plate XXIII, fig. 3). As first pointed out by Max Schultze, Desor was in error when he stated that the irregularity of the divisions of the vitellus distinguished this species from other animals. The divisions proceed regularly and somewhat rapidly; for ova which presented four lobes at 9 a.m. were found at 1 p.m. broken into a number of rounded masses, so that each had a nodular or mulberry-aspect (Plate XXIII, figs. 5 and 6). No clear spot is observed in the centre of the secondary masses (Plate XXIII, fig. 4). During the next four or five days the changes consist chiefly of subdivisions of the vitellus. There is now a pale spot in the ovum, and a few free granules and cells in the flask, as noticed by Desor. Each likewise assumes a smoother outline from subdivision of the vitellus, and only a few nodules appear here and there on the otherwise even circumference. E. Desor found the ova ciliated on the twelfth and fourteenth days, Max Schultze on the eleventh and twelfth, and I have struck the average amongst the British examples on the latter date. The ova, again, which had been left entirely above the water-line did not develop so quickly. At first the ciliation does not cause the mass to revolve, but subsequently this motion takes place with vigour (Plate XXIII, fig. 7). They continue in this condition about a month, and then a further change ensues in the contents of the flasks (Plate XXIII, fig. 8); and the latter drawing will explain E. Desor's discovery, as well as enable me to correct a slight inaccuracy into which he has fallen. The opaque ciliated mass previously noticed by-and-by shows a double outline under pressure, caused by the development of the young *Lineus* within the ciliated coating; indeed, at an advanced stage, as in the middle of the flask represented in Plate XXIII, fig. 8, the embryo seems to be shrouded in a layer of fatty cells and oil-globules (*b*), within which it distinctly moves. In such a condition the animal readily escapes from its investment, and at the upper part of the same flask a free example (*a*) is seen. E. Desor falls into a slight error in his excellent description, when he states that the cells in the interior of the embryo are the "residue of the vitellus destined for the support of the animal;" they are nothing else than the cells in the developing wall of the alimentary canal. The large dark ciliated mass (*c*) at the lower part of the flask, and the scattered cells and granules, are portions of the discarded external covering of the embryo; and it is to be observed that the cilia on this texture are somewhat longer than those on the free young animal, though their motion is less vigorous. The "cells" of which this rejected covering is made up are entirely of a fatty nature (Plate XXII, fig. 6)—in short, an aggregation of fatty granules, with an oil-globule or two, and capable of changing form accordingly. It is a fact that this débris after a time quite disappears from the flask, and therefore it probably acts as nourishment for the young (being swallowed by the mouth, as in the case of the embryo of *Purpura lapillus*) just as the yolk-sac, by a different mode, does in other animals. In escaping from the flask, the young animals, in many cases, seem to have thrust themselves along the narrow apex, dilating it and bursting through.[1] For a considerable time afterwards, both in captive and littoral cases, they crawl in swarms amongst the gelatinous mucus, so that the latter has a strange aspect,

[1] E. Desor makes the following remark about the young *Lineus*, when removed from the flask:—"It appears perfectly master of its movements, and on seeing it swimming about, and striking

being filled, in addition, with the transparent flasks from which they have escaped, and a few undeveloped ova. Moreover, it is a common practice for the adults to creep through these masses, and several are generally coiled in proximity. The number of undeveloped ova is extremely small, showing how easy it is to rear these animals, even with very limited supplies of sea-water.

The young *Linei*, at the stage previously mentioned, are visible to the naked eye as small elongated worms, somewhat tapered at the ends, pale, or rather translucent in front, and opaque-whitish posteriorly (Plate XXIII, fig. 9), while in structure they now closely approach the adult. The whole surface of the body is richly coated with cilia, which are especially active in the cephalic fissures, and still more so at the openings of the cephalic sacs. The ganglia are indicated by a pale space (*h*) on each side, but their actual outline is indistinct. There are in all cases at least two well-marked eyes. The cephalic sacs (*m*) are large and well defined, indeed very much larger proportionally than they are in the adult; and from their present position with respect to the ganglia, demonstrate the true form of the latter, as well as the error into which those authors have fallen who have confounded the sacs in the mature animals with posterior ganglionic enlargements. The sacs open by their ducts at the posterior part of the cephalic fissures (*b*), and the ciliary action can be traced inwards from these points. The œsophageal division (*j*) of the digestive canal is distinguished by its pallor, more evident ciliation, and the well-defined border of the succeeding opaque region (*j'*). The proboscis (*a*) is marked by a central streak of papillæ, and, after tapering posteriorly, curves forward, and disappears. The proboscidian sheath (*o*) is banded here and there anteriorly by transverse bridles; and a clear line is occasionally visible on each side of the opaque alimentary tube, as if from circulatory undulation. An anal papilla (Plate XVII, fig. 22), with a ciliated line connecting it with the digestive cavity, is also apparent.

Shortly after reaching the degree of advancement shown in Plate XXIII, fig. 9, the young *Linei* leave the gelatinous masses, and congregate at the water-line. Hundreds now perish from want of sufficient food, which in their native haunts is probably both abundant and suitable, while in the artificial circumstances and confined vessel it is denied them. Ten weeks afterwards the young animals are found still of the same whitish hue, and possess only two eyes, rarely an additional pigmentary fragment. The proboscis has much increased in size; indeed, at this time it has attained a comparatively larger development than the digestive cavity, which is in active use, since the young animal is entirely dependent on its own exertions for a supply of food. The œsophageal region is very distinctly marked, though its dimensions are proportionally small when contrasted with the length of the head; at present it is not a quarter the length of the latter, whereas in the adult it is several times longer. Its space is also considerably encroached on by the large cephalic sacs.

At a further stage of development the animal is much elongated (Plate XXIII, fig. 10), yet still possesses only two eyes. In this condition it has been mistaken for the representative of a different genus, and is probably that referred to by Dr. Johnston, under the name of *Cephalothrix* (*Vermiculus lineatus*, Dalyell).

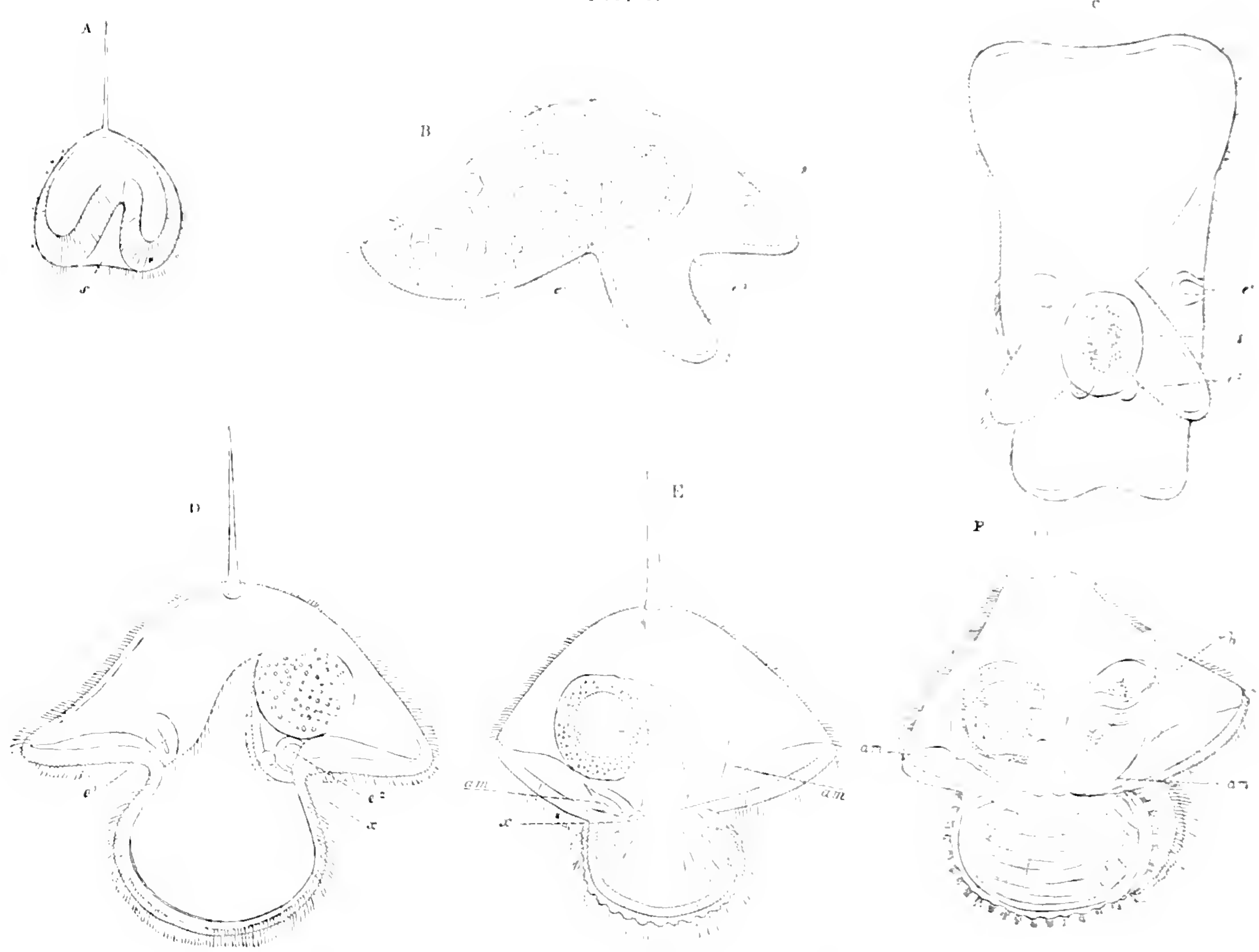
A vast cord of ova, about a foot long and half an inch in diameter, and which in all probability pertained to *Lineus marinus*, was brought from the deep-sea fishing off St. Andrews Bay about the end of June. The capsules are arranged in the gelatinous mucus in somewhat

against different objects, one might suppose it endowed with a certain amount of curiosity; sometimes, also, I saw them shake themselves convulsively, as if they had a chill."

indistinct transverse rows. Each ovoid flask (Plate XXIII, fig. 11) has a process as in *Lineus gesserensis*, but it is much smaller; and in the same manner contains several yolks. Unfortunately, from defective arrangements and the very hot weather, all the embryos were dead, only a little isolated ciliation being observed on certain cells. The embryos were furnished with black eye-specks.

In the remarkable development of the Nemertean from the *Pylidium*-form, as first described by Kröhn and the celebrated J. Müller, afterwards by Busch, Gegenbaur, Leuckart, and Pagenstecher, and recently by Metschnikoff, the phases mentioned in the foregoing pages are considerably increased in complexity. E. Metschnikoff finds that in the egg of a whitish *Lineus* from Messina the usual changes ensue after impregnation, resulting in the formation of a ciliated embryo, which by-and-by assumes the shape of a *Pylidium* (woodcut, fig 6, A), having a depression of the

Fig. 6.

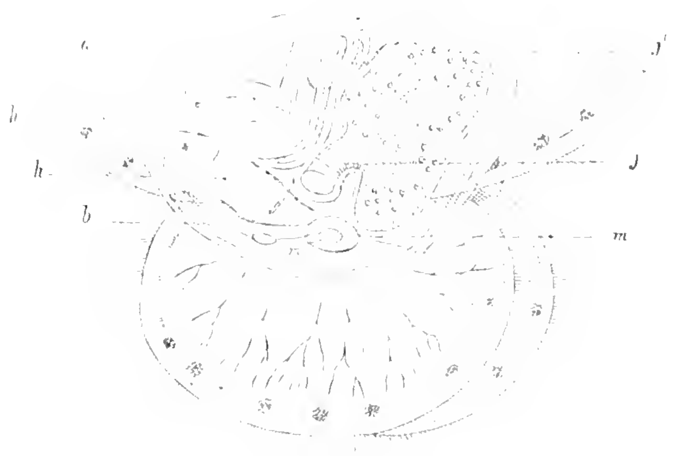


Pylidium-development. (After Dr. E. Metschnikoff.)

A.—Young *Pylidium* on its escape from the egg; *s*, the oral involution.
B.—Profile of a *Pylidium*, showing the early condition of the cæcal stomach (*s*), with its cellulo-granular coating; e^1 e^2, the anterior and posterior pair of processes from which the future Nemertean is developed.
C.—The same *Pylidium* viewed from the under surface.
D.—Profile of an older *Pylidium* with the processes developing, and after the appearance of the cephalic sacs (*x*).
E.—Another *Pylidium* showing the elongated leaves developed from the original processes, with the elementary amnion (*am*).
F.—A further stage in the process, the young Nemertean being now outlined; *rh*, the proboscis.

body corresponding to the mouth (*s*) and future digestive tract, and the usual long tuft of cilia. The involution is next differentiated into an œsophagus and cæcal stomach, the lining membrane being furnished with cilia and the wall with cellulo-granular elements (B). About this time the

FIG. 7.



Pylidium showing the young Nemertean and most of its internal organs.

Pylidium leaves the egg, and swims freely in the water. The second stage is the formation of the Nemertean in the interior of the *Pylidium*. The first step towards this end consists in the appearance of four round thickenings of the skin (B, C, e^1, e^2), two larger in front of the lobes of the helmet-like *Pylidium*, and two behind,—the four corresponding to the "suckers" of J. Müller. The anterior pair soon increase in size and become divided into a thicker and a thinner half, the former, moreover, making two folds. A "Seitenorgane" (*r*) (cephalic sac) appears in front of each of the posterior processes (e^2), which grow into two elongated vesicles, each with a thicker and a thinner portion. A commissure and the proboscis (*rh*) develop anteriorly, and other changes ensue both there and in the posterior processes; part of the latter investing the stomach, the thicker fold being directed towards the mouth of the *Pylidium*, while the thinner, coloured somewhat brownish, becomes converted into a very fine membrane, which forms a border to the thicker portion. These two processes (anterior and posterior), which are separated only by the utricle (Bläschen), become subsequently more closely arranged; so that the Nemertean embryo forms a semicircular mass. Further changes occur in the anterior and posterior processes, and the various parts of the Nemertean become differentiated. A membranous envelope, *am* (Amnion), is developed, in which currents are caused by the ciliated coating of the young worm. The ganglia, the ducts of the cephalic sacs, and a caudal style also appear, and the œsophagus and digestive sac assume a Nemertean type, the body of the young animal closing round the latter cavity. Finally, an almost complete young worm is found in the interior of its envelope (woodcut, fig. 7), and by-and-by it assumes a free existence. In the species described by Leuckart and Pagenstecher from Heligoland, no caudal styliform process was observed; but in J. Müller and Metschnikoff's forms this was present, and such may in all probability be the young of *Micrura fasciolata* (as mentioned by the former) or some other closely allied species.

E. Metschnikoff's summary of the development of the Nemertean in the *Pylidium* is as follows:—

1. The commencement of the Nemertean body is in the form of two pairs of cutaneous processes, which not only develop the body of the worm, but also the amnion.

2. Two median vesicles are produced, which at a later period become connected with lateral ducts.

3. The four structures developed from the cutaneous processes, which represent the future germ-fold, appear to be fashioned from two germ-leaves. From the outer leaf is formed the epidermis and central nervous system, from the inner the muscular coat (and perhaps also the circulatory system).

4. Through the coalescence of these four processes, primitive folds representing the future ventral surface, together with the head of the Nemertean, are developed; whilst the dorsal coverings are formed subsequently.

5. The proboscis is developed in the form of a simple process at the anterior part of the germ-streaks.

The reproductive organs of *Notospermus flaccidus* are correctly represented by Œrsted, but his drawing of the spermatozoa is inaccurate, since he shows a simple spindle-shaped body without a filament. M. de Quatrefages observes that the reproductive organs are digitate in *Borlasia angliæ*, and figures them after this manner; but such is scarcely a correct definition; neither have any cilia been detected in connection with these structures. Indeed, he has probably mistaken the digestive canal and its sacculations for the reproductive system, as he mentions that out of season the cæca are filled with a fluid more or less opaline. M. van Beneden found the ovisacs to contain from one to a hundred ova in his *Nemertes communis*; but though deposited in a membranous sheath in September, no change had ensued in November. His figure of the spermatozoa of this species is incomplete, as no tails are present, and he describes them as simple rods. He makes the interesting statement, that in the same animal he found the embryos in some ova covered with vibratile cilia even in the body of the parent, while others were only fecundated during or after deposition. The young Nemertean described by Dr. Busch, under the name *Alardus caudatus*, would seem to have some relation to *Micrura*, since it possesses a very distinct style at the posterior extremity.

Although I am not quite free from doubts concerning the exact position of the curious larval animal mentioned by Mr. Alex. Agassiz[1] as a further stage of the type first noted by the distinguished zoologist of Stockholm, Prof. Lovén, it may be well to conclude the present section by a few observations thereon. In the early stages it is a somewhat club-shaped animal, having a circlet of long cilia anteriorly, and another posteriorly in front of the anus. Behind the anterior ring of cilia, the mouth opens into an œsophagus, followed by a stomach and intestine. As the animal gets older two eyes and a pair of short cephalic tentacles appear, while the body becomes much elongated and distinctly segmented. At a further stage a remarkable retrograde metamorphosis ensues, whereby it loses the anterior and posterior ciliated rings, the tentacles, and

[1] 'Ann. Nat. Hist.,' 3rd ser., xix, p. 208.

the segmented condition of the body, and assumes the outline of a Nemertean, that is, has an elongated vermiform body without segments or appendages, a head furnished with two large eyes, and a mouth apparently opening behind the ganglia. The observations at present recorded, however, are not sufficiently decisive to satisfy us. Thus no mention is made of the important fact as to the presence of cilia on the general surface of the body, both before and after the shedding of the anterior and posterior circlets of long cilia. While it is true no bristles or other diagnostic structures connecting the form with the majority of the higher Annelids appear, it is equally evident that the essential Nemertean anatomy is wanting. Nothing is said of the characteristic cephalic ganglia and sacs, the lateral nerve-cords, the proboscis, or the structure of the cutis—points that are recognized in every known Nemertean long before it has reached the development and age of A. Agassiz's form. The latter thinks, also, that it approaches the *Nareda* of Stimpson, but this is doubtful, since the somewhat meagre description and the figure would indicate *Nareda superba* to belong to the division of the Enopla, whereas the young form has its mouth apparently opening behind the ganglia. Our judgment must therefore be reserved with regard to the particular type to which this interesting animal belongs.

The development of *Carinella* has not yet been observed.

In *Cephalothrix* the ova and spermatozoa are developed in a dense series of sacs (that give the animal a transversely barred aspect), which commence a short distance behind the mouth and continue nearly to the tip of the tail. The males are distinguished by their somewhat pale aspect when the reproductive organs are fully developed, viz. towards the end of January and during the subsequent months of spring. The spermatozoa (Plate XXI, fig. 13) consist of short flattened spindles with rounded instead of pointed ends, that to which the tail is attached being somewhat smaller than the other. In swimming the two ends appear as clear dots. Though the animal is extremely elongated, the bodies of the spermatozoa are comparatively short. The mature female presents a dusky or slightly fawn-coloured aspect, the ova, under gentle pressure in the living animal, being arranged in dense transverse rows in each ovary. The total number of ova produced by a single example must be very great. In transverse sections they occupy a large ovoid space on each side of the alimentary canal, upwards of twenty ova—very prettily arranged in a concentric manner—occurring in a single thin slice. The space of the digestive canal in these preparations had thus assumed the form of the letter *x*, the walls approaching each other in the middle, but diverging superiorly and inferiorly; while a wedge-shaped fold from the dorsum below the proboscis, and another from the ventral surface, completed the resemblance. This was the more marked if the proboscis had been ejected. The ova are deposited from the beginning of February till June; either adhering together in irregular masses by their edges or a little accidental mucus, or scattered about the vessel in detached groups. In several instances, however, they were enclosed in a translucent sheath of mucus. On deposition they have a granular structure throughout (Plate XXIII, fig. 12), with a clear spot and globule, and measure about $\frac{1}{180}$th of an inch in diameter. The ova pass rapidly through the usual stages, and on the 11th February the embryos revolve actively in the egg by aid of their cilia, and in some cases are hatched. The extruded animal (Plate XXIII, fig. 13), under moderate pressure, has a globular form, but assumes various shapes when free, the ordinary one being that of an apple—the long ciliary process representing the stalk, while the body slightly tapers towards the posterior end. It is opaque and granular, with the exception of the margin, which is somewhat translucent, from the slight differentiation of the cutaneous textures. Externally it is coated with long cilia, by aid of which it executes rapid motions, a tuft anteriorly having the form of a long whip-like process, and resembling a single mobile thread during the progress of the animal. The outline is sometimes pitted at the origin of the latter, while a slight papilla projects at the posterior end. When fixed between glasses the cilia are soon thrown off, and the body resolves itself into a number of cells and granules (Plate XXI, fig. 8). In two days the animal is somewhat elongated (Plate XXIII, fig. 14), and the mouth (*a*) is in the form of a strongly ciliated slit placed nearly in the centre of the body, which, with the above-mentioned exception, is still uniformly granular. A longer tuft of cilia at the anus is now more evident. Two days later considerable increase has occurred in the length of the body (Plate XXIII, fig. 15), and from the anterior position of the mouth, it is apparent the chief increment has taken place in the posterior region. The outline is now pear-shaped, the snout being much less tapered than the tail. The cutaneous textures are more distinctly marked, and the cells, with their refracting contents, very apparent; there is also a corresponding advance in the growth of the granules of the alimentary canal, its ciliation, and the posterior sacculations. The whip-like tuft on the snout is somewhat shorter, and there now exist a few longer cilia on the side of the head, the posterior group of which (*c*) are evidently the precursors of the long ciliary tuft, which by-and-by appears. There is yet no trace of eye-specks. A few cylindrical papillæ are observed on the snout and tail, and one or two along the sides, which processes do not seem to result from pressure. A day or two afterwards some are furnished with one and others with two eye-specks; moreover, the tuft of cilia on the snout is gradually diminishing, while the lateral cilia (*c*) before mentioned are becoming longer. During a period stretching from March to the beginning of June, the various vessels swarmed with successive broods of young (from different individuals), which in the form of minute white specks darted about most actively. They did not crawl along the bottom, but, like the young of *Phyllodoce* and other Annelids, swam freely throughout the water after the manner of *Infusoria*, or danced to and fro like *Ephemeræ* in the air. Externally at this further stage of advancement they still have a coating of very long cilia (Plate XXIII, fig. 16), which serve as natatory organs, the tuft (*c*) on each side being about thrice as long as the rest, while the anterior whip has disappeared. There are two large well-defined black eyes, no doubt provided by nature for the exigencies of the youthful state, just as the young of certain mollusks and cirripedes are similarly furnished. The mouth (*a*), the œsophagus, and succeeding region of the digestive cavity are all richly ciliated. The whole animal is soft and delicate, and few of my specimens survived this stage. Those which outlived the others became more elongated, and had a little reddish pigment developed in the snout. After the disappearance of the eyes (in October) they have the form of slender reddish bodies, with a conspicuous mouth a short distance behind the anterior margin. The cilia on the snout are very much longer than on the rest of the body, and project like a long brush or fan, so as to give the animal the aspect of an infusorial animalcule.

We have thus in *Cephalothrix* a certain resemblance to the development of M. van Beneden's *Nemertes carcinophila*, already described (see p. 93), and the phases of the growth of the present species likewise corroborate everything that has been advanced in contradistinction to the interpretations of the Belgian author. His views in regard to the *scolex* and *proglottis* receive no support from the foregoing observations, for all the changes that occur are only the gradual and very perceptible shedding of certain cilia, and the general advance in organization as shown by the differentiation of tissues and the appearance of pigment in the eye-specks. The moulting of the long anterior tuft of cilia by the young *Cephalothrix* has its analogue in the loss of the ciliated ring by the young *Phyllodoce* and others, in the shedding of the temporary bristles noticed by Busch and Leuckart in the young of a *Nerine*, and by M. de Quatrefages in the young stages of *Hermella*. I think there can be no doubt that the remarkable tuft of cilia occurring in the young *Cephalothrix* on each side of the snout, and which attains its full development after the long anterior whip has ceased to be conspicuous, is connected homologically with the entrance to the cephalic sacs in the Enopla, and the fissures of the *Lineidæ*, as well as with the ciliated ring of *Phyllodoce* above mentioned. It is an embryonic type of a structure which disappears entirely in the adult. The delicacy of the young at the period of the full development of the eye-specks is an interesting feature; but it prevented my observing their growth into perfect animals.

Thus, so far as development goes, *Cephalothrix* is nearly allied to the Enopla, especially to *Tetrastemma dorsalis*, *Nemertes carcinophila*, and probably to others of the group not yet investigated; while, in the structure of its digestive system, circulatory apparatus, and the unarmed proboscis with its bridled sheath, it leans rather towards the *Lineidæ*. Prof. Keferstein in his proposed classification of the Order rightly places the genus in a special Family, called *Gymnocephalidæ*, the chief characteristics described by him being:—Absence of cephalic fissures; brain like that of *Polia* (*Amphiporus*), but the superior ganglion covers the inferior much less, and is advanced in front of it. He bases his statement of the relationship to the Enopla, as it appears to me, on somewhat questionable grounds, for the ganglia are by no means closely allied in form and structure to those of that group.

III.—Reproduction of Lost Parts.

In the Nemerteans, as in the Annelida proper, the reproduction of rejected parts and the repair of wounds take place with accuracy and considerable rapidity. If but a fragment is left behind the head, a new body and tail are reproduced in the majority. The severed posterior half of the animal, or other headless fragment, seldom perfects a head in confinement, but remains alive for a year or more, slowly turning round when irritated, and, moreover, developing the generative products in its interior. Thus a specimen of *Lineus marinus*, sent from St. Andrews in September, broke into pieces on the journey; yet six months afterwards most of the fragments were alive, although the sea-water had not been changed more than once. The head and anterior portion of the worm, which at first scarcely measured two inches, had now grown a body and tail that when progressing extended at least seven inches, and of course was capable of much greater elongation, so that it looked like an independent animal; and this was accomplished without the aid of any food, except perhaps what it might have acquired from the fragments of its own body in the neighbourhood. Some of the latter measured about a foot in length, and all were coiled in various ways, with the ends puckered, and in most cases fixed by a whitish cicatrix, which was firmer at one end than the other, and occasionally tapered. One of the most interesting features was the gradual development and elaboration of the products of the generative organs (in this case the male elements) in the headless fragments, so that when in February they were placed in clean sea-water, some gave exit to milky clouds of perfect spermatozoa. This would seem in these animals to be the main aim of such a provision, since their very length and softness, if not fragility, apparently court dis-severance. They display greater vitality in this respect than the majority of the Annelida, and it is not necessary that the sea-water be changed for years, or that fragments of their own bodies or other débris be present. In one species, moreover, each of the numerous fragments into which its lengthened and fragile body breaks becomes a perfect animal.

In captivity, specimens of *Lineus sanguineus* (Plate V, fig. 2) have often a great tendency to rupture into many pieces. These fragments lie on the bottom of the vessel, and, in the majority, consist of the body-wall, its nerve-cords and vessels, the central alimentary chamber, and the dorsal sheath for the proboscis. Numerous parasitic gregariniform bodies, as well as the peculiar ova to be described subsequently,[1] may also be seen in them; and the new animals are thus supplied, *ab initio*, with such structures in their digestive tracts, without being subjected to the earlier stages in their development. For some time after separation the large aperture of the digestive chamber existing at each end remains closed by firm contraction of the circular muscular fibres of the body-wall; but by-and-by new cell-growth occurs at both extremities, especially the anterior. At the latter the parts firmly contracted by the primary muscular spasm gradually become more or less consolidated by a cicatrix. This new growth steadily increases in bulk, distinguishing the anterior end of the fragment, even in the early stages, by its conspicuous pallor. The appearance of this extremity in a specimen, probably about three weeks after rupture, is shown in Plate XXII, fig. 7. The head is represented by the pale, sprouting mass in front of the alimentary tract, and there is no further differentiation of organs than the separation of the exterior (cutaneous) elements from the inner mass, and the ciliated aperture (*a*) leading into the sheath for the proboscis. The three contractile circulatory channels of the body course forward to the pale developing region, and apparently communicate with each other without passing into it; they are connected by the usual transverse branches throughout their course. The posterior end of the fragment shoots into a conical tail (Plate XXII, fig. 8), with a well-formed anus (*z*) in its proper position, and through which, under pressure, a prolapsus of the wall of the digestive chamber occasionally occurs, or an escape of one or more gregariniform parasites.

In the next stage (Plate XXII, fig. 9) the anterior end has assumed a more conical form, and there is a greater differentiation of organs. The cutaneous elements are distinctly marked, and a miniature proboscis (*a'*) occupies its sheath, both springing from a point some distance behind the tip of the snout, and corresponding to the commissure of the developing ganglia (*h*), which latter, however, are scarcely apparent. The proboscidian sheath contains a clear fluid and granules, which now and then distend the front as in the figure. The proboscis (*a'*) is quite free posteriorly. The cephalic fissures are indicated on each side by slight superficial grooves, very strongly ciliated. Besides the faint contour of the ganglia, which spring from the anterior ends of the nerve-trunks, the cephalic pits and glands (*m*) are outlined. The circulation in the vessels extends only to the posterior border of the white snout. The digestive tract presents no subdivision into regions.

[1] See also 'Journ. of Micros. Science,' 1867, "Trans. Micros. Soc.," p. 40.

A more advanced condition of the head is found after two or three months (Plate XXII, fig. 10). The snout is very much elongated both before and behind the commissures. In some eye-specks now appear in their usual position, and there is a distinct channel leading inwards to the enlarged proboscis; the ganglia approach the normal shape, and the cephalic pits, with their ducts passing into the posterior end of the cephalic fissures, are well marked. The anterior part of the alimentary tract has assumed a rounded form behind the ganglia, with the mouth (*w*) in the usual position. In those best developed (*e.g.* Plate XXII, fig. 11), the first or œsophageal division of the canal is differentiated from the succeeding portion; and in the ordinary fragments it is apparent that the former consists, for the most part, of new texture. Such examples, however, do not always possess eye-specks. The circulation now scarcely differs from that in the adult.

The motions of those with reproduced heads (Plate XXII, fig. 11) are not so active as usual in young *Linei*, and the animals are at once distinguished by the pointed nature and pallor of their snouts.

The formation of a complete individual, and the prolonged retention of certain functions by the headless fragments, under circumstances so adverse as the above, may give some idea of the powers of regeneration and vitality possessed by these worms in their native haunts; for it is to be remembered that they were at a great distance from the sea-coast, had no food (except what they might obtain from microscopic animals or the fragments of their own bodies), and had a very limited supply of salt water.

Moreover, besides the application of the ordinary laws of natural and sexual selection (if such exist in these forms), we have thus the additional (fissiparous) operation by which mere fragments of the body of the animal are capable of reproducing the entire organism and all its complex parts.

In like manner very serious wounds made in removing the proboscis are easily repaired, without leaving a trace of the injury after the pigment is fully developed in the cicatrix. Portions may also be removed from the posterior end of long species for microscopic purposes, while the rest of the animal lives and thrives for further observations.

The reproduction of the proboscis is referred to under the anatomy of that organ in the Enopla.

Comparatively few abnormalities of external form are met with in the Nemerteans. An example of *Lineus sanguineus*, found at Lochmaddy, had a curious diverticulum about the posterior end of the œsophageal region. This process was covered by all the coats of the body, and, in the preparation, contained a knuckle of the proboscis. The accompanying woodcut (fig. 8) represents the anterior part of the specimen during life.

FIG. 8.

Lineus sanguineus, with a diverticulum of the body. Somewhat enlarged.

IV.—Parasites.

A very common parasite in the Nemerteans is a *Gregarina*, which frequents the alimentary chamber of *Amphiporus lactifloreus*, according to Mr. Lankester, and is found abundantly in the same region of *Lineus gesserensis* and its allies. The presence of such animals in the Nemerteans appears to have been first noticed by Dr. G. Johnston, who in 1837 described them in *L. gesserensis* (with an accompanying figure) in the first volume of the 'Magazine of Zoology and Botany,' thus:—"When pressing a portion of the body between the plates of glass, I have occasionally seen some bodies escape, of a curved fusiform shape, acute at both ends, and marked with a pale circular spot. They have shown no signs of life, nor can I say what they are, though it has occurred to me that they may be the embryo-young; and that the worms may in fact be ovo-viviparous." This excellent naturalist thus misinterpreted their true character. Prof. Kölliker[1] in his contribution to the genus *Gregarina*, in 1848, more clearly defines their nature, and describes them under the name *Gregarina Nemertis*, from the alimentary canal of *Nemertes delineatus* (*Polia delineata*, D. Ch.). Frey and Leuckart, Max Schultze, Van Beneden, and other authors have also noticed their presence.

The *Gregarinæ* occur in swarms in many examples, and consist of elongated comma-shaped bodies (Plate XIX, figs. 10 and 11), having a transparent investment filled with minutely granular contents, and each has a large pale nucleus, measuring from $\frac{1}{1500}$th of an inch upwards, according to the size of the specimen. The nucleus shows faint markings when the parasite is first extruded, but a distinct nucleolus is not very apparent, though from the recent excellent observations of Ed. van Beneden,[2] it is probably present. In perfect specimens the snout is pale, very faintly granular (and quite diaphanous), bluntly rounded, and marked by a slight swelling of the body at its base, from which prominence the snout gently tapers. There is no trace of rough points or other apparatus for attachment. Sometimes, as when the investment has received injury, the surrounding water seems to pass inwards and separate at certain parts the contained granules from the sheath, a fact which shows a certain degree of cohesion in the contents *in situ*, or the presence of another layer. A favourable opportunity of examining the parasites is occasionally afforded by the spontaneous rupture of some of the Nemerteans. The *Gregarinæ* then project from the granular parenchyma throughout their entire length, with the exception of the snout, by which they adhere. Indeed, this may often be seen in the perfect worm, for the waves of fluid bend hither and thither the free bodies of the parasites. After remaining for some time in the previously mentioned position (under pressure) a few separate themselves, and move through the salt water with a slow gliding motion like that of a diatome. On careful scrutiny the contour of the snout in a living specimen is observed now and then to vary. The motion of the body is not due to currents between the glasses, as it passes through mucus in the same manner. After remaining in salt water for eight or ten hours all movement ceases, and in some the body becomes club-shaped (Plate XIX, fig. 11); at the same time the clear portion at the snout is almost obliterated by encroachment of the granules. Occasionally one of the *Gregarinæ* is observed in a degenerating condition, forming an ovoid body in which the bent and atrophied parasite is scarcely distinguishable.

[1] 'Zeitsch. für wiss. Zool.,' Bd. I, pp. 1 and 2. Taf. I. fig. 4 *b*.

[2] 'Bullet. de l'Acad. Roy. de Belg.,' 2me sér., tome xxxi, No. 5, 1871. See also 'Quart. Jour. Micro. Sc.,' July, 1872, pp. 211 *et seq*.

The large number of the *Gregarinæ* in some examples of the Nemerteans must give them a position of importance in the economy of the worms. They likewise occur in the Planarians and in the true Annelids.

The small bodies shown in Plate XX, fig. 10, were extruded in multitudes with the *Gregarinæ* from *Lineus gesserensis* and *L. lacteus*. They were generally of an ovoid or pyriform shape—a few being circular, and contained many granules. Their diameter is about $\frac{1}{1000}$th of an inch, or rather more. They appear to be pseudo-navicellæ.

Accompanying the gregariniform parasites certain ova are sometimes ejected from the alimentary chamber, enveloped in mucus, and in the form of an elongated cordon (Plate XX, fig. 11), the latter being rather more than the breadth of two ova, which are loosely scattered in the slightly granular gelatinous matrix. These ova (Plate XX, fig. 12) measure about $\frac{1}{700}$th of an inch in diameter, and each contains an embryo that, for some time after the extrusion of the egg, makes very evident movements. They have two coats, and the embryo is finely granular, with a large pale nucleus. I have not seen the embryo hatched in a perfect state, but it is probable that these ova are connected either with the parasite of the muscles hereafter to be described, or with an unknown trematode-larva.

Another curious parasite is found burrowing in the body-wall of *Lineus gesserensis*, its presence being readily recognised by the perforated and honey-combed appearance of the dorsum of the affected animal, whose textures seem to be the seat of the workings of a microscopic *Tomicus typographus*. When highly magnified the affected region appears to be covered with a vast network of pale, minutely granular channels, which contain numerous opaque ovoid granular masses. On rupturing the body of the worm a large number of the peculiar structures (Plate XVIII, fig. 17) slide out of the channels, and swim through the surrounding water, generally, though not always, with the upper end (in the figure) first. Externally they are coated with long cilia, whose activity in the free state is of somewhat short duration, for after a time the animals remain quiet and they drop off. The body is distinctly segmented, and tapers slightly towards the posterior end; while the surface is marked by very fine longitudinal striæ, as in *Opalina*, though in a much more minute degree. Anteriorly is a conical portion (*a*), composed of three rather indistinctly marked segments. Two evident annuli (*b*) succeed, the posterior part of the last being narrowed, so as to cause a constriction of the body-wall. Behind are six nearly equal divisions (*c*), each often appearing double, that is, has a broad anterior and a narrow posterior annulus. The posterior region (*d*) consists of three indistinct segments. The body is minutely granular throughout, and an internal cavity is apparent from the fourth segment to the last, commencing in the former by a rounded end, and terminating just within the border of the latter. No aperture is observed at either end. The opaque ovoid granular bodies (Plate XVIII, fig. 18), scattered profusely throughout the infected portions of the *Lineus*, are evidently early stages in the development of this species, and they too are ciliated. On subjecting them to gentle pressure (fig. 19) transverse segmentation is apparent, the number of segments varying according to the degree of advancement. The parasites are very delicate structures, and in the free state soon break up into cells and granules, after discarding their cilia as above mentioned. Transverse section of the affected worms shows that they occur both in the skin and in the walls of the digestive tract, their ravages in the pigmentary layer of the former tissue causing the curious appearances which led to their detection. It is a somewhat difficult point to determine whether the skin, muscles of the body-wall, or digestive canal, constitute the common area of this creature's depredations; whether it is piercing the former on its way to the surface, or passing towards the alimentary cavity to be voided per anum. The characteristically segmented condition of the full-grown specimens, and their internal structure, exhibit a higher type of organization than the ordinary *Opalina*. Prof. Keferstein[1] found a very similar parasite in the stomach of *Leptoplana tremellaris*, but he did not describe it further than simply mention, under the explanation of the Plate, that it is an enigmatical structure. The centre of the body is occupied by a double row of large cells in his figure.

In the external longitudinal muscular layer and the region to the exterior in *Lineus marinus*, certain parasitic or adventitious cellular masses are found (*a*, Plate XXII, fig. 5). They lie in definite spaces (*b*), and consist of rounded cells filled with granules.

Another parasitic structure occurred in a large male specimen of *Amphiporus lactifloreus* in the shape of an oviform body enveloped in a granular lobulated mass, lying close behind the ganglion of one side (Plate XVII, fig. 11), to the exterior of the proboscidian sheath, and altogether unconnected with the œsophagus. Externally is a distinct hyaline capsule or cyst (γ), to which certain fragments of the fibro-granular lobulated covering adhere. The embryo (Plate XVII, fig. 12) is furnished with a very conspicuous opaque granular mass, and two discs; while the general stroma is cellulo-granular, here and there closely streaked by minute lines, apparently from its external investment. No motion of the included animal is observable, except an alteration in the size and aspect of the pores and discs after a period of eight or nine hours (Plate XVII, fig. 13). This is evidently a trematode-larva in its capsule, and by rupturing the latter a complete view of the embryo is obtained (Plate XVII, fig. 14). The oral sucker (*c*) is considerably smaller than the ventral (*b*). The œsophageal body (*d*) appears as a distinct swelling near the oral disc, and from the tube behind the former the alimentary cæca (*e, e*) branch off and become lost in the cellular tissues posteriorly. The opaque mass of cells and granules at *a* may be connected with the testicles, and the two circular granular bodies, *f* and *g*, are probably associated with the ovaries. A trace of the excretory tubes appears at the oral sucker.

In a specimen of *Cephalothrix filiformis* several examples of an *Opalina* occurred, but such on the whole seem rare in the Scottish Nemerteans.

V.—Classification.

As might have been expected in the case of animals whose anatomical structure was either unknown or much misunderstood, great diversity has prevailed in the classification of the Nemerteans. The early writers, such as O. F. Müller, O. Fabricius, and Gmelin generally placed them amongst the Helminths or intestinal worms (under the genus *Planaria*); and even Cuvier associated them with the same group. Others, such as Oken and Fleming, ranged them near *Gordius* and *Lumbricus*. De Blainville, again, established the family *Teretularia* for their reception, the title being founded on the external appearance of the animals. Ehrenberg next

[1] 'Der K. Gesellsch. der Wissensch. vorgelegt, am 4, Januar, 1868.'

constituted the class *Phytozoa Turbellaria* for them and the Planarians, as described in detail in the 'History.' Other authors, such as Quoy, Gaimard and Macleay, placed them under the group "Vers Apodes," without any definite basis of classification. Dr. G. Johnston first pointed out the important fact, that one group of the Nemerteans had and that the other had not stylets, and thus he has partly the credit of the classification promulgated by Max Schultze. They constituted, again, the *Annelosi Polici* of Delle Chiaje; and the fourth sub-order (Cestoidina) of the *Apoda* of Œrsted. Kölliker's division of the Nemerteans, according to the presence or absence of a sheath for the proboscis, rests upon a misunderstanding, as the sheath is present in all. De Quatrefages adopted Ehrenberg's classification with amendments, placing the Nemerteans under the third order *Miocœla*, and founding his subordinate groups on the position (lateral or sub-lateral) of the nerve-trunks, and the situation of the mouth. Von Siebold ranged them as the first order of his ringed worms (Apodes), and separated them from the Planarians by the intervention of the Rotatoria. Blanchard formed the term *Aplocœla* for the group, and thought the term Nemerteans should be restricted to a tribe or family, but the author was misled as regards the true alimentary organ. Diesing's arrangement is sufficiently alluded to in the Zoography, and rests on no secure basis. Girard wished to class them with the mollusks, an idea which found no other supporter. Max Schultze divided Ehrenberg's class Turbellaria into the sub-classes *Aprocta* and *Proctucha*, the Nemerteans being grouped under the latter. This author afterwards split the order Nemertinea into the *Enopla* and *Anopla*, according to the armed or unarmed condition of the proboscis. Stimpson's classification was based on the presence or absence of the ventral fissure, and other external characters, and therefore failed where it was most wanted. The same may be said of Schmarda's arrangement, where the characters of the sub-orders are founded on the "respiratory" fissures. Keferstein establishes the primary division of the order on the same basis as Max Schultze, but enters much more minutely into the subject. His families rest on characters derived from the fissures of the head and the arrangement of the ganglia. There is little new matter in the classification adopted in the Catalogue of the British Museum. In his 'Handbuch der Zoologie,' J. V. Carus arranges the Nemerteans as the first division (Turbellaria) of his fifth class (Platyelminthes) of the VERMES, the second division being formed by the Trematoda, to which he states the Planarians lead, and the third division by the Cestodes. Similar views prevail in several text-books of zoology.

The inquiry into the structure of the British Nemerteans rendered it apparent that considerable modifications of the existing schemes would be requisite, yet great care has been taken to interfere only where absolutely necessary.

With these brief remarks on the chief classifications already in existence, I may now proceed to explain the appended scheme.

CLASS TURBELLARIA.[1]

Order.	*Sub-Orders.*	*Families.*	*Sub-Families.*	*Genera.*
NEMERTINEA.	ENOPLA . .	AMPHIPORIDÆ . .	*Amphiporinæ*	I. Amphiporus.
				II. Tetrastemma.
				III. Prosorhochmus.
			Nemertinæ . .	IV. Nemertes.
	ANOPLA . .	LINEIDÆ		V. Lineus.
				VI. Borlasia.
				VII. Cerebratulus.
				VIII. Micrura.
				IX. Meckelia.
		CARINELLIDÆ		X. Carinella.
				XI. Valencinia.
		CEPHALOTHRICIDÆ		XII. Cephalothrix.

The characters of the order NEMERTINEA may be concisely described as follows:—Worms with more or less elongated, soft, ciliated bodies; nervous system composed of two conspicuous ganglia connected by a double commissure and two main lateral trunks; digestive system a ciliated canal with two apertures; circulatory system consisting of a series of closed contractile vessels. The proboscis forms the most typical organ in the group, is surrounded by a special muscular sheath, within which it glides in a corpuscular fluid, and passes in front between the commissures of the ganglia, while the digestive tract is placed inferiorly. Sexes separate in the majority, oviparous or ovo-viviparous.

The order may most naturally be divided into two great *sub-orders*, distinguished from each other by the presence or absence of stylets in the proboscis or typical organ of the group; the former being called after Max Schultze (but with amended characters) ENOPLA,[2] and the latter ANOPLA.[3]

The sub-order ENOPLA is characterised further by the globular and somewhat double nature of the nerve-ganglia, and by the fact that the lateral nerve-trunks are placed within the proper muscular walls of the body. The mouth, moreover, opens on the ventral surface of the snout in front of the commissures of the ganglia. The blood-vessels are more differentiated than in the ANOPLA. The young, so far as known, do not undergo any noteworthy metamorphosis in their growth.

In the ENOPLA there exist one great group and a subordinate one, which latter, however, retains so many of the characters of the former that it conveniently forms a sub-family. In the chief division (AMPHIPORINÆ) of the family AMPHIPORIDÆ the animals have two muscular layers in the body-wall, an external circular and an internal longitudinal: the proboscis is composed of three divisions, anterior, middle, and posterior, the former having in the typical species seven coats, viz. external elastic, external longitudinal, reticulated, inner longitudinal, circular, basement and

[1] *Turbella*, a little bustle or turmoil, referring to the ciliated integument of the animals.

[2] *η* and Ὅπλα, arms.

[3] *α* and Ὅπλα, without arms.

glandular layers. The middle region bears the stylets, and the posterior forms a long sac with two muscular coats, external circular and internal longitudinal. There are three great longitudinal vascular trunks, two lateral and one median, besides a cephalic arch. The cephalic sacs or glands are accompanied by long tubes or ducts. The animals as a whole have comparatively short and thick bodies, with proportionally large proboscides.

The sub-family NEMERTINÆ has the characters of the foregoing, with the exception of the last, since they possess more or less elongated bodies, and proportionally short proboscides.

It is right to mention that I have not been able to procure a specimen of *Prorhynchus*, but from the diminished size of the proboscis and other particulars, it would seem to follow closely on *Nemertes carcinophila*, Kölliker, one of the species in the previous sub-family.

The sub-order ANOPLA, again, is further distinguished by having the nerve-trunks generally placed between the muscular layers of the body-wall. The mouth opens on the ventral surface behind the commissures of the ganglia. The blood-vessels are somewhat less differentiated than in the ENOPLA. The young in the most conspicuous families undergo a remarkable metamorphosis.

This second sub-order has several families, the most typical of which is that of the LINEIDÆ, characterized by the more or less elongated shape of the ganglia (the arrangement with the commissures having the form of a horseshoe). The muscular covering of the body is composed of three layers, external longitudinal, circular, and internal longitudinal. The proboscis is furnished with five coats, viz. external elastic, external longitudinal and accessory band, circular, basement and glandular layers. The circulatory system consists of three great longitudinal trunks, two lateral and a dorsal, which frequently anastomose by transverse branches, form a *rete mirabile* in the œsophageal region, and unite in lacunæ behind the ganglia. The head has a deep lateral fissure on each side in connection with the cephalic sac, which is rounded, and devoid of long tubes or ducts posteriorly.

The curious specimen from Herm forms the type of a group that would perhaps require to be raised to the rank of a sub-family, but as no more than one specimen has yet been found, it is thought advisable to postpone this at present, and distinguish it only generically. In this animal the proboscis is extremely slender in proportion to the bulk of the body, and differs from the typical LINEIDÆ in having no accessory band cut from the longitudinal layer. Externally the organ has an elastic investment, then a longitudinal, a thin circular and a glandular coat. The reddish colour of the muscles of this species, and the tinted circulation, are likewise quite characteristic.

A more distinct sub-family of the *Lineidæ* than the foregoing, perhaps, might be formed by *Meckelia*, but for the present generic separation will suffice. The anatomy of the body-wall agrees with *Lineus*, but there are no cephalic fissures. The structure of the proboscis is also peculiar, for there is externally no distinct superficial layer, the outer coat consisting of spiral muscular fibres closely interwoven, within which lies a longitudinal layer, with the glandular coat on its inner surface.

The CARINELLIDÆ are a very characteristic family. The general structure of the nervous system agrees with *Lineus*, but the lateral nerve-trunks are placed between the basement-layer and the circular (external) muscular coat of the body-wall, that is, quite without the two muscular layers in the typical form, and just within the circumference of the outer muscular layer in the other. There are no cephalic fissures. The circulatory system consists of two great lateral trunks. The proboscis has externally a double elastic layer, a thick longitudinal coat, and lastly, a glandular layer.

The family of the *Cephalothricidæ* deviates still more from the typical group. The arrangement of the ganglia differs, and the commissures are separated by a considerable antero-posterior interval. The lateral nerve-trunks lie between the longitudinal muscular coat and an isolated inner band of fibres having the same direction. The proboscis is supplied with acicular papillæ, and seems to have an external circular and internal longitudinal layer. The snout is devoid of fissures. The circulatory system is composed of two great longitudinal trunks, whose contents communicate behind the ganglia and at the tail. Oviparous; the young undergoing no distinct metamorphosis, though they have eyes, whereas the complete animal is generally eyeless.

VI.—SYNOPSIS OF FAMILIES, GENERA, AND SPECIES.

Order.—NEMERTINEA.

Sub-Order.—ENOPLA.

Proboscis furnished with stylets.

Fam. I. AMPHIPORIDÆ.—Ganglia rather rounded. Lateral nerves within the muscular layers of the body-wall. Mouth opening in front of the ganglionic commissures.

Sub-Family, AMPHIPORINÆ.

Proboscis proportionally large.

Genus I. AMPHIPORUS, Ehrenberg.—Eyes more or less numerous, but never arranged in a square. Body rather short, sometimes flattened.

1. *A. lactifloreus*, Johnston.—Eyes grouped in two series on each side; body white, roseate, or greyish.

2. *A. pulcher*, Johnston.—Eyes well defined and numerous, irregularly grouped on each side. A central reserve-stylet in the proboscis. Cephalic furrows slightly branched.

3. *A. spectabilis*, De Quatrefages.—Head spathulate, peculiarly narrowed posteriorly. Eyes forming two long rows on each side. Cephalic furrows conspicuously branched. Longitudinally striped with brown on the dorsum.

4. *A. hastatus*, n. s.—Snout short and hastate, with a grooved dorsal ridge. Eyes indistinct. Brownish-yellow, with white grains on the snout.

5. *A. bioculatus*, n. s.—Snout acutely pointed, with a cephalic furrow—forming an angle directed forward on the dorsum—at its posterior boundary. Two eyes at the tip of the snout.

Genus II. TETRASTEMMA, Ehrenberg.—Eyes four; arranged so as to indicate a square or oblong.

1. *T. melanocephala*, Johnston.—A large black pigment-mass between the anterior and posterior pairs of eyes. Marginal stylet-sacs placed somewhat in advance of the central apparatus.

2. *T. Robertianæ*, n. s.—Head furnished with a brown collar, which sometimes hides the posterior (smaller) pair of eyes. Body longitudinally striped with two brown and a median white line.

3. *T. candida*, O. F. Müller.—Head flattened, wider than the rest of the body; eyes distinct. Stylets large. Pale yellow, greenish or reddish brown.

4. *T. vermicula*, De Quatrefages.—A longitudinal dark patch between (and connecting) the eyes of the respective sides.

5. *T. flavida*, Ehrenberg.—Head not wider than the rest of the body. Anterior and posterior pairs of eyes widely separated.

6. *T. dorsalis*, Abildgaard.—Body short, thick and rounded; speckled with yellow and brown; sometimes with a pale median stripe on the dorsum.

Genus III. PROSORHOCHMUS, Keferstein.—Eyes four; not forming a square. Snout dimpled and furnished with a transverse superior lobe. Ovo-viviparous.

1. *P. Claparedii*, Keferstein.—Snout blunt; eyes placed far back, the space between the anterior pair being widest. Yellowish.

Sub-Family, NEMERTINÆ.

Proboscis proportionally small.

Genus IV. NEMERTES, Cuvier.—Body more or less elongated, while the proboscis is very much diminished, the anterior region especially being shortened so as to cause the stylets to approach the ganglia.

1. *N. gracilis*, Johnston.—Eyes numerous. Snout broader than the rest of the body. Central stylet with a very long basal apparatus. Greenish or olive.

2. *N. Neesii*, Œrsted.—Eyes numerous. Stylets short and grooved. Streaked on the dorsum with purplish brown.

3. *N. carcinophila*, Kölliker.—Eyes two. No marginal stylet-sacs. Body pinkish.

Sub-Order.—ANOPLA.

Proboscis without stylets.

Family II. Lineidæ.—Ganglia elongated. Muscular layers of the body-wall three in number, viz. external longitudinal, circular, and internal longitudinal. Proboscis furnished with five coats, viz. external elastic, longitudinal and accessory bands, circular, basement and glandular layers. Snout with a deep lateral fissure on each side.

Genus V. *Lineus*, Sowerby.—Body more or less elongated, rounded or somewhat flattened, and tapered posteriorly. Head distinct, spathulate, and generally truncate in front. Eyes numerous, arranged along the sides of the snout anteriorly; rarely absent. Mouth in the form of a conspicuous longitudinal slit on the ventral surface. Other characters as in the Family.

1. *L. marinus*, Montagu.—Eyes numerous, deeply set in a marginal row on each side of the snout. Of a dull olive or blackish colour, more or less distinctly striped longitudinally.

2. *L. gesserensis*, O. F. Müller.—Eyes numerous, marginal. Snout distinctly wider than the rest of the body. Greenish-olive or reddish-brown.

3. *L. sanguineus*, Jens Rathke.—Eyes more regularly arranged than in the former; snout narrower. Body more elongated, and of a reddish or reddish-brown hue. Regenerates easily.

4. *L. lacteus*, Montagu, MS.—Snout similar to the foregoing, but the mouth is separated from the ganglia by a much longer interval. Body reddish anteriorly, pale posteriorly.

5. *L. bilineatus*, Delle Chiaje.—Snout rounded anteriorly; eyeless. Body of a pale brown or dull pinkish colour, with a white stripe on each side of a dorsal median line.

Genus VI. Borlasia, Oken.—Characters as in *Lineus*, but the proboscis is extremely slender, and has only four coats, viz. elastic, longitudinal, circular, and glandular.

1. *B. Elizabethæ*, n. s.—Snout pointed anteriorly; eyeless. Body generally contracted into a rugose mass posteriorly. Head pale, faintly streaked with greenish brown. Body marked with deep madder-brown.

Genus VII. Cerebratulus, Renier.—Body generally flattened, and thinned at the margins. Eyes in the usual position, but obscure. Proboscis with a cross of fibres at each pole in transverse section.

1. *C. angulatus*, O. F. Müller.—Snout somewhat pointed. Body much flattened; brownish.

Genus VIII. Micrura, Ehrenberg.—Characters as in *Lineus*, with the addition of a soft, filiform caudal process, capable of attachment.

1. *M. fusca*, n. s.—Eyes small, from four to eight on each side; body much flattened and thinned at the edges; caudal process often moniliform; colour pale brown or yellowish, speckled with brownish grains, especially in front.

2. *M. fasciolata*, Ehrenberg.—Eyes marginal, placed towards the anterior part of the snout; body various shades of brown, generally barred with white belts.

3. *M. purpurea*, Dalyell.—Eyeless. A bright yellow patch at the tip of the snout; body of a uniform rich dark brown colour.

4. *M. aurantiaca*, Grube.—Eyeless. A white patch at the tip of the snout; body rounded and of a fine brick-red hue.

Genus IX. Meckelia, Leuckart.—Structure of the rounded body-wall as in *Lineus*. Cephalic fissures absent. Proboscis furnished with only three coats, viz. external spiral, longitudinal, and glandular.

1. *M. asulcata*, n. s.—Eyeless. Body thick and round; of a uniform pinkish hue.

Family III. Carinellidæ.—Lateral nerves placed between the basement-layer of the cutis and the external (circular) muscular coat of the body-wall, or in the substance of the longitudinal layer close to the circular. There are only two muscular coats. The proboscis has four layers, viz. external elastic, circular, longitudinal and glandular.

Genus X. Carinella, Johnston.—Body elongated, tapering from the front backwards. Snout wider than the rest of the body, bluntly rounded in front; mouth sometimes small.

1. *C. annulata*, Montagu.—Eyeless, with a white patch on the snout; body round, of a rich red colour, striped longitudinally and banded across at somewhat regular intervals with white belts. Rarely pinkish throughout.

2. *C. linearis*, Montagu, MS.—Eyeless. Head spathulate, somewhat pointed in front; milk-white.

Genus XI. Valencinia, De Quatrefages.—Structure of the proboscis as in *Carinella*. The lateral nerves lie in the longitudinal muscular coat of the body-wall. The snout is shaped as in *Lineus lacteus*, and furnished with a row of eyes on each side. The mouth forms a distinct fissure a considerable distance behind the ganglia.

1. *Valencinia lineformis*, n. s.—Roseate in front, yellowish white posteriorly.

Family IV. Cephalothricidæ.—Commissures of the ganglia separated by a distinct antero-posterior interval. Lateral nerves placed between the longitudinal muscular coat and an isolated inner band of fibres. Proboscis has an external circular (or elastic), an internal longitudinal, and a glandular layer supplied with acicular papillæ.

Genus XII. CEPHALOTHRIX, Œrsted.—Head nearly cylindrical, slightly tapered in front; eyeless, or with a few obscure pigment-specks. Cephalic fissures and sacs absent.

1. *C. linearis*, Jens Rathke.—Body extremely attenuate. Of a pale yellowish or skin-colour, often with reddish grains towards the tip of the snout.

VII.—HOMOLOGIES.

The majority of the early investigators of the Nemerteans correctly associated them with the Planarians, and generally linked them to the Intestinal worms, *Lumbrici*, or *Gordii*, as a single genus—*Planaria*. Other animals, however, which had no affinity either in form or structure, were grouped with them, often in a perplexing manner. Lamarck thought the Nemerteans approached the leeches, while Cuvier amalgamated them with his Entozoa. Ehrenberg, again, while he took the wise step of forming a class (*Turbellaria*) for them and the Planarians, does not seem to have had a very definite idea of their relationship to other animals, and, more especially, to other *Vermes*. This author's class appears to me to be a very natural one, and though a considerable hiatus exists between the Planarians and Nemerteans, as will afterwards be pointed out, the gap is very much less than that which separates the Turbellaria from the other groups of animals, and especially from the Trematoda. Delle Chiaje considered they had certain homologies with the leeches, on account of the structure of the "alimentary canal," but that in regard to the form of their bodies they approached the Planarians. Dugès, De Quatrefages, and Frey and Leuckart, were inclined to link on the Turbellaria to the Trematoda, though the second author was of opinion that further researches as to the vascular system of the Planarians were needed to render the relationship distinct. In his report on the memoirs of De Quatrefages, M. Milne-Edwards observed that the Nemerteans approached the Annelids by the general disposition of their vascular system, the leeches by the structure of their buccal system and other parts of their organization, but that their reproductive and digestive organs were homologous with those of the helminths. He compared their nervous system to that of the "Lingules." The statement with regard to the digestive system, however, is founded on erroneous observations, since both reviewer and reviewed mistook the proboscis for the alimentary canal, and thus instead of the latter forming a blind tube, it is open at both ends, and very different from that of any helminth. Œrsted, again, placed them after the Leeches, while M. Blanchard, misled by the observations of M. de Quatrefages, exaggerated the gulf between the Nemerteans and the Planarians so much that he thought their affinities lay rather with the helminths than with the latter. Dr. Thomas Williams considered his closed alimentary chamber (digestive canal) the homologue of the spongy mass in Tænia, but this is open to doubt. He also drew a resemblance between the Nemertean reproductive organs and the "ovarian or female series" in the leeches. So struck was this author by the differences between the Nemerteans and the Planarians (which he affirmed were only allied by the ciliated integument), that he proposed to separate the former from the "true Turbellaria" under the name of the Cestoid Annelids. I think, however, that we are scarcely warranted on structural grounds in making so radical a change.

Amongst recent writers, Dr. Cobbold, it appears to me on somewhat insufficient data, has grouped the Turbellaria under the class *Helmintha*, which he conveniently widens to allow them, as he thinks, to be near their allies the Trematoda. But it is to be observed that, while the Planarians perhaps do approach the Trematoda, the Nemerteans diverge so much that the relationship is very difficult to discover. The outline of the ovate and flattened Planarian somewhat resembles that of the Distomes and their allies; but there is nearly as much similitude between the former and an *Elysia* or *Limapontia*, or again between a *Sagitta* and a Fish. The cutaneous texture of a Trematode (for instance, *Fasciola hepatica*), according to Dr. Cobbold, is covered with minute chitinous processes or spines, and is composed of an outer transparent epidermis, and an inner fibrous cutis. In the Planarian, on the other hand, we have the ciliated epidermis and the characteristic soft, cellular cutis, so conspicuous for its secretion and its tendency to diffluence under examination. "In the *Fasciola* the next layer is composed of numerous bands of muscular fibres, in which four separate groups may be recognized more or less distinctly. They have been described as so many layers, but they are not readily separated from one another." Such is the description this author gives of the muscular system. In the Planarian the muscular layers form distinct coats, which cannot be confounded, and moreover they seem to be formed after a different type. I would, however, remark that in a transverse section of *Campula oblonga*, Cobbold, a Distome from the bile-ducts of the Porpoise, there is below the chitinous cutis a delicate layer of circular fibres—slightly indented by the bulbs of the chitinous spines, and having a thin coat of longitudinal fibres underneath. Such therefore agrees with what Prof. Owen found in *Distoma clavatum*. Dr. Cobbold also speaks of soft parenchymatous tissue filling up the general cavity of the Fluke, and though not averse to such a disposition as a proof of further divergence of type, yet in the Distome just mentioned (*Campula oblonga*) transverse and longitudinal sections show a complex arrangement of fibres and cells—only inferior to the more differentiated muscular bands, fibrous tissue and cells, the presence of which in the Planarian is so intimately connected with the physiology of the parts. In the case of the digestive system there is apparently some analogy in form, since both Planarians and Flukes have branched, cæcal, alimentary organs, but then *Vortex*, and the whole of the Nemerteans to which the Planarian Dendrocœla are linked, deviate in a still greater degree from the parasites. The oral sucker of the fluke has little homology with the protrusible proboscis of the Planarian, and still less with the mouth of *Vortex* or the Nemertean. Moreover, the microscopic structure of the digestive ramifications of the Planarian agrees very closely with the same organ in the Nemertean, while it differs entirely from that of the fluke, with its "fibrous wall" and "columnar cellules," or, as I should call them, papillæ. Such differences probably depend much on the divergent character of the food. Dr. Ehlers, in his arrangement of Worms, separates the Nemertinea (Class V) from the Turbellaria, Ehrenberg, s. str. (Class IV), and interpolates the round worms and Gephyrea between them and the Annelida. It is doubtful if the Gephyrea are a higher type than the Nemertinea, and they certainly do not approach the true Annelida more closely. Prof. Huxley, again, groups the Nemerteans amongst the SCOLECIDA, characterising the "water-vascular system" of this heterogeneous class as having ciliated tubes throughout. This, of course, cannot apply to the Nemerteans, and not even to the Planarians.

The branched water-vascular system (which Prof. Owen regards as excretory) of the Fluke has no counterpart in the Planarian, and cannot be supposed to be closely allied to the vessels of the Nemerteans.

A decided difference is apparent in regard to the nervous system, which is much more conspicuous in the Planarian than the Fluke; indeed, observers who are familiar enough with other parts of the structure of some species of the latter have not seen such at all. It is described by Prof. Owen in *Distoma clavatum* as in the form of a pair of cephalic ganglia connected together by a thin commissural filament above the pharynx, and giving off two main lateral nerves. Two much larger ganglia occur in the Planarians, connected by a broad commissure, and the branches to the surrounding parts are more distinctly arranged. Prof. Owen states that pigment-specks, called "eye-specks," are present in the Polystoma of the urinary bladder of the toad and frog, as in the locomotive ciliated larvæ of most Trematoda; but as a whole the special organs of sense are much more highly developed in the Planarian.

In regard to reproduction there is some resemblance between the groups, both Flukes and Planarians having male and female organs developed in the same animal. Both are oviparous, and the ova produce ciliated embryos; but the young of the fluke soon lose the cilia, and represent only the first stage of a series of metamorphoses which occur before reaching maturity. The embryo of the Planarian, while, perhaps, undergoing metamorphoses in some cases, comes out of the egg in others nearly in the same form as the adult, and never loses its cilia at any period. Besides, too much reliance cannot be placed on this common metamorphosis, for we may as readily arrange the Echinoderms with the Nemerteans on account of the *Pilidium*-development, as class the Planarians with the Trematoda on this account.

The habits and motions of the two groups, it is well known, are widely different.

Having thus indicated some of the chief points of divergence and affinity between the Planarians and the *Trematoda*, we may now examine the relationship between the former and the animals with which we have more particularly to deal, viz. the Nemerteans.

In regard to the general structure of the cutaneous textures there is much resemblance. Both have a ciliated cuticle, a soft, easily disintegrated cutis, chiefly composed of cells and areolæ, and capable of secreting abundant mucus. In the skin of no Nemertean, however, have I seen any urticating or "stabförmigen" bodies.

The muscular coverings are similarly grouped into definite layers of longitudinal and circular fibres. On the ventral surface of the Planarian, however, we sometimes have an inner layer not represented on the dorsum, a fact that has been overlooked by Professor Keferstein in his recent valuable remarks on the Planarians.[1]

The digestive systems, though apparently divergent, are really allied in an intimate manner. The mouth in the Planarians follows the habit of the organ in the Anopla in opening behind the ganglia, but more posterior in position. The large proboscis in the Planarians is probably homologous with the œsophageal division of the digestive tract in the Nemerteans; and in the typical *Lineidæ* amongst the latter the œsophageal region is frequently everted during feeding in the form

[1] 'Beiträge zur Anat. u. Entwicklung. einiger Seeplanarien,' &c., 1868.

of a rugose prehensile organ. The ramose nature of the digestive cæca, which are all connected with a central cavity, is but a modification of the pinnate organ in the Nemerteans, the pinnæ in certain of the latter being even slightly branched. Moreover, the microscopic structure of the walls of this system (with perhaps the exception of the inner coating of cilia) is similar, and in both cases appears to combine the biliary with the intestinal system proper. In the Planarians, however, there is no anus, while such is present in all the Nemerteans. The system as a whole shows a higher degree of advancement in the latter, the connecting links apparently occurring in the Anopla, whose mouth opens behind the ganglia as in the Planarians.

The nervous systems of the groups are also related. The cephalic ganglia are two in each, but those of the Nemerteans are connected by two commissures, a dorsal and ventral, whereas in the Planarians there is only a single large commissural band, which is homologous with the ventral of the Nemerteans. The separation of the ganglia in the latter is more distinct than in the former, though this does not necessarily imply a higher type; indeed concentration of nervous matter is generally considered to be so. The senses in the groups are somewhat similar; over the entire surface touch is as exquisite in the one as in the other; the organs of vision consist of two well-marked series in each, viz. those with and those without apparent lenses or capsules, so that the pre-eminence in this respect is hard to adjudge, though I am inclined to give it to the Nemerteans. There is some doubt about auditory corpuscles or otolites in either group, though Gräfe and Keferstein mention their occurrence in certain Nemerteans. I have never seen such. The function of the special cephalic pits and neighbouring glands in the same animals is involved in obscurity. They may represent the segmental organs of the higher Annelids, or, perhaps, with greater probability, may be taken as the homologues of the water-vascular system.

In the circulatory system the Nemerteans much excel the Planarians. In none of the latter is there any circulation in distinct vessels, while in the former group all possess such, the vessels being filled with a more or less corpuscular fluid. It is true that a water-vascular system is described by O. Schmidt in certain freshwater Turbellaria, and that Max Schultze mentions a system of canals in *Thysanozoon* and *Polycelis*, but I agree with Professor Keferstein, after a careful examination of spirit-preparations, in considering further investigation necessary, and that in the present state of our knowledge we cannot admit this in the ordinary Planarians.

Considerable divergence occurs between them in regard to the organs of reproduction, the Planarians being hermaphrodite, while almost all the Nemerteans have the sexes separate. In regard to the complexity of the sexual system the former excel the latter, whose organs consist simply of a series of sacs placed along the sides of the body—for the development of ova or spermatozoa. Moreover, where hermaphroditism appears, as in *Borlasia hermaphroditica* and *B. Kefersteinii*, respectively described by Professor Keferstein and A. F. Marion, one part of the body has its sacs filled with spermatozoa and another with ova, or the male and female elements occur in the sacs without definite order as regards position, so that the type of structure remains unaltered, and essentially different from the arrangement in the Planarians.

The development of the young in the two groups has certain features in common, others at variance. Thus the ova of the Planarians in some instances produce ciliated embryos that have at birth more or less the form of the parent,—which form they retain throughout. The group Enopla of the Nemerteans agrees with the former; while in the division Anopla the young either emerge from a ciliated covering inside the egg-capsule, or they are produced from the *Pylidium*-form in the free state. Moreover, some of both great Nemertean groups are viviparous, the ova being long enough retained in the ovisacs to develop their contents, after impregnation through the lateral (sexual) pores.

In the homologies of no organ, however, does the separation between the Planarians and Nemerteans become more apparent than in those of the proboscis, which, with all its adjuncts, appears to be a structure purely Nemertean.[1] Its definite aperture in front, its relation to the ganglionic commissures (between which it passes), its remarkable microscopic structure, and distinct muscular sac or sheath containing the highly organized corpuscular fluid, all point it out as an organ *sui generis*, and apparently without prototype or homologue in the Planarians or their allies. As already mentioned, I am inclined to consider the proboscis of the Planarian as the analogue and homologue of the œsophageal division of the digestive tract in *Lineus* and *Amphiporus*, and the "Schlund" of *Vortex*. The diminished size and atrophied condition of the proboscis in *Prorhynchus* seem to lead on the Nemertean type to certain of the Rhabdocœla.

Both groups are characterized by great recuperative powers after injury, new parts and organs replacing those that have been cut off; while mere fragments not infrequently grow into perfect animals.

Both consist for the most part of predatory and carnivorous creatures that, notwithstanding their general deprivation of organs of offence and defence, manage to prey on animals much higher in the scale of organization than themselves, such as the Annelida. Their habits are also in many respects similar.

Bipalium.

I thought that considerable light might be thrown upon the affinities of the Planarians and Nemerteans by an examination of *Bipalium*, whose elongated body and central mouth indicated the probability of its intermediate position.

In *Bipalium*[2] there is externally (in the preserved condition) a rather dense cellular cutis, similar in structure to the same coat in the Planarians and Nemerteans, though less defined from the subjacent investment, which consists in this case of a thin belt of circular muscular fibres. There next occurs a longitudinal muscular layer, split into isolated fasciculi, between which certain pigmentary and cutaneous elements and connecting fibres lie. Thus the coat in transverse section presents a barred appearance, especially in the dorsal region, where the pigment is most marked, the dark band being interrupted by the pale longitudinal fasciculi. In superficial longitudinal sections, also, the same aspect is caused as in *Lineus* by the intrusion of the pigmentary and cutaneous elements amongst the muscular. The intermediate region below the coat just mentioned has numerous cells and granules amongst the fibres which connect it with the next layer and the general stroma of the body-cavity. There are also many cells, often of a flask-shape, with the narrow end external, filled with long and somewhat spindle-shaped

[1] It is probable some further light will be thrown on the homologies of this organ in the anatomy of the Annelida.

[2] I am indebted to Prof. E. P. Wright, of Dublin, for the opportunity of examining this form, which was kindly placed in my hands along with many foreign Annelida collected by himself. His genus *Dunlopea* is synonymous with *Bipalium*.

filamentous processes, which are termed by Schmarda "stäbchenförmigen Körpern." The most prominent features of the complex muscular arrangement filling up the body-cavity after the full bulk is attained are the following:—Within the intermediate layer all round the body are many longitudinal muscular bundles clasped in isolated fasciculi by divergent or curved fibres. Thus, with the exception of the central digestive cavity, the whole mass of the body is filled up by these interlacing, longitudinal, and other fibres.

For some distance at the tip of the snout the stroma quite fills the region, but shortly a differentiation ensues, caused by the prominence of three transverse bands of muscular fibres, which pass across the snout at a distance from each other, so as to leave spaces occupied by fibres which have more or less a vertical direction. At first the arrangement is merely indicated, but it steadily gains so distinct a character that at last a series of spaces is left in transverse section in the dorsal division. In their fully developed condition these spaces have a thick layer of cellulo-granular matter, forming an inner lining or investment, which is so consistent that, in some fine sections which have been torn, it remains as a ring, with a well-marked outer margin. There is much opaque granular matter, also, between the vertical fibres. The channels—now larger and better defined—become continuous with the anterior part of the digestive chamber. They are about twenty in number in the snout.

The long pale area (in transverse section), which forms with the preceding in the snout, though streaked by the vertical granular bands, presents a much more translucent appearance. Towards the tip it is a simple transverse pale belt, wider in the middle, tapering at the ends, and passing entirely across the snout, the usually opaque cutaneous margin being more translucent opposite the ends in such a view. At first it is more conspicuous than the dorsal belt, but after the three vertical bands previously described appear, the two areas are nearly equal in breadth. No aperture, however, occurs in that now under consideration. It becomes gradually more transparent and wider in the middle; and by-and-by there is a tendency to enlargement on each side of the median line, while the vertical fibres forming the latter increase in prominence. A pale ventral region also makes its appearance, at first faintly marked, then more distinctly; the cutaneous textures, moreover, being included in the pallor. This causes the translucent region on each side of the median line to assume a long club-shape, and then—as an increase of the opaque fibro-granular matter occurs in the centre—a wedge-shape. The central septum afterwards (proceeding backwards) gets wider, a ventral prominence becomes distinct, and the wedge of pale tissue shortens and assumes a somewhat ovoid form. Some pale fibres stretch across the septum between each ovoid space. With a few changes as to size and separation this arrangement continues to the posterior end of the worm, where it gradually ceases. So far as I can make out, the pale bands (just described in transverse section) are not composed of nervous tissue, for which they appear to have been mistaken by Schmarda.

The proboscis of the animal is Planarian in structure, having a glandular investment, with subjacent circular and longitudinal muscular fibres—the former being most conspicuous immediately below the mucous surface, and an intermediate and apparently erectile tissue. The digestive tract throughout is also Planarian. It is branched in front and laterally, and towards the posterior end becomes divided by a perpendicular septum into a right and a left division.

The structure of the generative system as described by M. Claparède[1] shows a wide divergence from the Nemerteans.

[1] 'Mém. de la Soc. de Phys. et d'Hist. Nat. de Genève,' tome xvi, 2eme partie, pp. 293—312, 1862.

This animal, therefore, leans to the Planarian rather than the Nemertean type, and on the whole it would appear that, while the affinities of these groups are sometimes in accordance, there can be little doubt as to the higher position of the latter in almost every respect.

Balanoglossus.

Two species of *Balanoglossus* dredged in the last cruise of the "Porcupine" (1870), in the one instance by Mr. Jeffreys outside the Strait of Gibraltar, to the south of Tangier, in 128 fathoms,[1] and in the other by Dr. Carpenter off the Algerine coast, at a point intermediate between Capes Falcon and Tenes, in 51 fathoms,[2] gave me an opportunity of investigating an apparently intermediate type of much interest. Unfortunately, none of the specimens were in good condition, either from rapid decay before being placed in spirit, or some other cause. None of the fragments exceeded $1\frac{3}{4}$ inch in length, and the diameter at the collar or widest portion was about $\frac{3}{8}$ths of an inch.

The general appearance of those dredged by Dr. Carpenter resembles the penis, the short conical anterior end or "proboscis," with the overlapping collar behind, closely imitating the *glans penis*, with its prepuce retracted. On the dorsum the "proboscis" is marked by a furrow at its base, and, continuous with this on the body, two well-marked ridges course along the median line. On the ventral aspect is a deep median furrow, a groove also being present on the head in the same line. The body is rounded anteriorly, flattened posteriorly.

The "proboscis" exhibits various appearances, from the bluntly conical form in contraction to a more elongated and pointed contour in partial extension; and it is evidently a very mobile muscular organ. On reaching the collar, its base becomes contracted all round, so as to be connected with the trunk only by a narrow pedicle, which is attached just over the anterior opening or mouth, the whole having the appearance of an operculum or plug. The anterior end or "proboscis" has lost its dermal layers in all the preparations, showing externally a tough, translucent and slightly granular membrane, probably the representative of the basement-membrane of the cuticular tissues. A considerable belt of circular muscular fibres forms the next investment. In transverse section a large number of vertical lamellæ are observed to be arranged within the latter coat, in a divergent manner with regard to the central space. These can readily be split from each other in a longitudinal direction, yet so intimately do the fibres mix that in longitudinal sections their main direction is longitudinal, while they follow a transverse direction in transverse section. From the shape of the region the lamellæ become narrowed in front and widened posteriorly. The nature of the specimens did not warrant a decision as to the presence or absence of a terminal pore, but, from an examination of specimens in the living condition, other authors, such as Delle Chiaje,[3] Keferstein,[4] Kowalewsky,[5] and Willemoes-Suhm,[6] have observed one. The posterior end of the "proboscis" in contraction fits into a kind of cup

[1] No. 36, surf. temp., 75°; bottom, 55° Fahr.
[2] No. 50, „ 75°; „ 54° 7'.
[3] 'Memorie sulla storia e not. degli,' &c., vol. iv, p. 117.
[4] 'Untersuchungen ueber nied. Seethiere,' p. 91.
[5] 'Mém. de l'Académie imp. des sc. de St. Pétersbourg,' vii^e sér., tom. x, No. 3, 1867.
[6] 'Zeitsch. f. w. Zool.,' Bd. xxi, 3, p. 383.

formed by the fleshy collar of the body, which projects after the manner of that in *Terebella*, but without the break or fissure.

In his excellent account of the anatomy of *Balanoglossus clavigerus* and *B. minutus*, Kowalewsky describes the chief muscular fibres of the "proboscis" as longitudinal, and the circular as insignificant. This does not quite agree with the state of the parts in the foregoing examples.

Structure of the Body-wall.

Few traces of the cutaneous elements remain in any of the specimens, but the structure of fragments in the furrows demonstrates that it is allied in the closest manner to that of the Nemerteans. The cutis consists of a multitude of cells and globules in a gelatinous inter-cellular substance, the skin on section being streaked and loaded with circular and elongated granular masses, as in the former group. Indeed, the ease with which almost the whole cutaneous elements had separated from the subjacent tissues corroborated the relationship. A tough and continuous basement-membrane, having a finely streaked appearance, intervenes between the former and the next coat, which is a thick layer of longitudinal fibres, most developed, perhaps, on the ventral surface. The interfascicular substance is slightly marked, but there are many intersecting fibres which radiate inwards from the outer margin of this investment, through the next layer, to the wall of the digestive chamber. In longitudinal sections the longitudinal coat has, therefore, a transversely streaked aspect. It also presents three well-marked dorsal gaps anteriorly, viz. a median and two lateral, while ventrally a single hiatus exists in the centre. The circular muscular coat, which comes next in order, is moderately developed. The space between the latter and the wall of the digestive canal is partly occupied by the divergent fibres previously mentioned, the glandular or "liver"-tissue, and a few cells and globules.

The examination of living specimens enabled Kowalewsky to see the cilia with which the whole integuments are covered, and he further describes a fine "cuticula;" but, so far as an examination of preserved specimens warrants me in affirming, this structure is not more differentiated than in the Nemerteans, and therefore not demonstrable histologically as a special layer. In his anatomy of the body-wall he places the circular muscular coat to the exterior of the longitudinal—beneath our basement-membrane, and thus his specimens deviate in type from the foregoing.[1]

Within the circle formed by the collar a conical process having a filiform terminal appendage projects from the truncated anterior extremity of the body, and fits into the hollow at the base of the "proboscis." This structure is supported upon a somewhat enlarged firm base, round which the tough basement-membrane of the "proboscis" is fixed. Below the line of attachment of the latter the process is again narrowed, and presents just over the opening of the

[1] There would seem to be considerable variety in the structure of the body-wall of these forms. Another species dredged in 125 fathoms off Cape Rosier, in the Gulf of St. Lawrence, by Mr. J. F. Whiteaves, shows (in the spirit-preparation) underneath the glandular lining of the digestive chamber all round a dense and almost cartilaginous layer marked on its inner surface by regular transverse striæ, but there is no specialization of chitinous tissue as in the Mediterranean examples.

mouth a smooth eminence of cartilaginous density, tinted of a reddish-brown hue. This terminates posteriorly in two brown chitinous rods, which diverge along the margin of a firm valvular process (forming on each side part of the lips of the oral aperture) and support the axis to which the "proboscis" is attached. A pointed and somewhat dense papilla lies at the fork of the chitinous processes. On the dorsal aspect of the valves and in the central line of the animal a series of transverse bars or ridges commences on each side. They are arranged in a double row, separated by a well-defined median furrow, which corresponds with the groove between the dorsal ridges externally. When first observed these firm bars had somewhat the appearance of a vertebral column—split as in a dried fish, and this special chitinous skeleton might therefore furnish the modern theorist with as good grounds as usual for the demonstration of the true stepping-stone to the vertebrate series. They are upwards of seventy in number, commencing by a well-marked chitinous bar just behind the fork of the axial processes, and, from the gradual diminution of the rows, terminating in a somewhat pointed extremity. Generally the whole structure may be separated into two divisions, viz. septal and branchial proper. Each septum is furnished with a brownish chitinous rod, which is conspicuous throughout its entire length in front, but is chiefly observed towards the median line posteriorly. These septa mark off the branchial spaces, since by splitting and uniting with others at the outer extremity, a branchial furrow is completed. From a point a little exterior to the median line each septal rod passes outwards to bifurcate as already mentioned, its course being easily seen anteriorly on account of the brownish hue of the process. This colour, however, is really confined to the central part of the flattened organ, which has throughout a thin translucent edge above and beneath, and is densest near the fork of the branchial lamella. From each side near its base is given off a translucent lamina, which, with another from the adjoining septum, forms the support of the branchial sabre. The junction of these laminæ with the septal process is interesting, for in transverse section the base presents the form of an anchor. The septal rod, elevated on a fold of the basement- and mucous membrane, constitutes the strong central support (shank) of the T-shaped structure, while the branchial laminæ, passing from the transverse bar as long recurved processes, correspond to the flukes. At the junction of the septal rod with the transverse portion is a slight swelling of the former, having the brown chitinous part in the centre, the rest of the process, as well as the branchial laminæ, being quite translucent. As the sections proceed outwards, however, a slightly brownish hue from the presence of dense chitinous matter is seen at the base of the branchial laminæ where they join the septal rod. The latter is marked almost from the commencement by a vertical median line, showing its double composition. The branchial laminæ at this part touch at the lower edges, but gape at the upper, so as to make a triangular channel, which is completed by the thick membrane of the region. Further outwards the branchial arches stand freely in their grooves, their supporting chitinous laminæ being enlarged at the upper end and bent inwards in transverse section, and the tunnel completed by the membrane formerly described. The supporting chitinous rods gradually taper from the median line to the outer edge, as also do those of the septal regions; thus the diminution in the former case has to be compensated by an increase of the soft parts of the tunnel. After the branchial lamella forms an independent sabre in the groove, the septal process is found (in transverse section) elevated on a still higher fold of the mucous membrane as a club-shaped structure, the central brown chitinous part—somewhat triangular in shape—appearing in the rounded summit. The next change is the increase of the brown hue in the chitinous supports of the branchial lamellæ. The double nature of the septal process also becomes more evident, even from the fold of membrane upwards. The summit, however, is still uniformly coated by the investing membrane of the branchial region; by-and-by the papilla on which it is placed shortens, and the pale chitinous tips of the rods split to form the arch at the boundary. The laminæ of the branchial processes diminish into slender pale chitinous rods, which lie towards the inner (lateral) margin of the canal, and each soon terminates in a closed extremity. Over the whole of the processes just described a thick mucous layer, probably ciliated during life, is spread. In ultimate structure it is glandular in appearance, being finely streaked in vertical section and minutely granular. A peculiar fibrillated condition is observed in that forming the wall of the branchial lamella, and also at the base of the chitinous supports of the septa. This mucous layer rests upon a basement-membrane, from which numerous divergent fibres pass to the exterior muscular coat of the body-wall, here and there enclosing spaces for the fatty "liver"-structure found in this region.

The foregoing account, of course, is only meant to convey a description of the framework of the branchial apparatus, which in other respects has received careful treatment from the excellent Russian naturalist Kowalewsky. The arrangement of the system in this form shows a close approach to that of *Balanoglossus clavigerus*.

Accessory Glands to the Digestive System.

Anteriorly a considerable space occurs between the dorsal surface of the branchial apparatus and the body-wall, which is occupied for the most part by transversely arranged sacs of the yellowish fatty "liver"-tissue. These bodies are surrounded by a distinct membrane, enclosing a vast number of compound fatty globules and granules, similar in minute structure to the same tissue in the Nemerteans. In transverse section the contents seem to fall out of the centre, but a thick layer of globules still adheres to the wall of the sac. These saccate glands occur under the branchial lamellæ, and generally in the space between the inner muscular layer and the wall of the digestive tract anteriorly. As soon as the branchiæ cease, however, they become much more prominent. The digestive and respiratory functions are thus performed in one chamber anteriorly, and the structure and arrangement throw considerable light on the condition of the same part in the Nemerteans, where a characteristic distinction exists between the two regions of the digestive system. Kowalewsky shows a folding of the branchial region in his species, so that a special chamber is separated from the general alimentary cavity. The digestive would therefore not intrude on the respiratory function.

Digestive Cavity Proper.

This chamber commences at the oral aperture, and continues in the form of a wide tube to the posterior end of the animal, which, however, is incomplete in all our examples. It is supported and held in position by the radiating fibres that pass inwards from the external muscular coat of the body-wall. Anteriorly the glandular mucous membrane, which forms its inner coat, presents a frilled appearance, from the rugæ, which, as in the Nemerteans, often assume an arborescent appearance, owing to the extrusion (under pressure and preparation) of their cellular and granular elements. The wall of the canal is somewhat thinner in front, while the glandular lining is largely developed. Behind the branchial region, however, the following structure is clearly seen:—Externally the radiating fibres from the outer coat of the body-wall pass into a well-marked layer of circular muscular fibres, upon which the continuous basement-membrane and its glandular lining rest. The latter is thinner than in front. The structure on the whole closely approaches the Nemertean digestive tract.

Kowalewsky mentions that the surface of the digestive chamber is richly ciliated. His specimens occurred on sandy ground, as might be expected from the nature of their food.

Circulatory system.

Two vessels only could be satisfactorily made out by an examination of the specimens. A large longitudinal dorsal vessel lies over the fibrous band connecting the branchial septal rods across the median furrow. At this point it has externally only the circular muscular coat, the basement-membrane and cutaneous tissues, since there is a hiatus in the longitudinal muscular layer. The vessel is continued to the posterior end of the specimen over the wall of the digestive tract. Exactly in the median line on the ventral surface a similar vessel occurs, with the same relations to the cutaneous and alimentary textures. Both trunks have distinct walls. Besides the elaborate arrangement of vessels in connection with the branchial lamellæ, Kowalewsky shows a lateral vessel on each side, and various minute twigs from the larger trunks.

A single imperfect example of the other form of *Balanoglossus* was dredged by Mr. Jeffreys as above mentioned. In general features and size it resembles the foregoing, but certain anatomical differences merit special notice.

The "Proboscis" consists of a bluntly conical mass, which has lost its cutaneous elements. Externally, instead of the basement-membrane and circular fibres of the former type, there is a coat of longitudinal fibres, or, rather, of fibres whose direction is chiefly longitudinal, for they are felted firmly together. Within is a belt of circular fibres, from which the vertical lamellæ of the central region spring. The lamellæ consist of fleshy columns, which are fixed to the outer wall all round, but have a free margin internally. In transverse section, thus, the region somewhat resembles the kind of fruit called *hesperidium*, such as that of the orange, only the carpels are enormously increased. The columns are composed of densely felted fibres—longitudinal, oblique, and radiating, besides circular fibres towards the inner free margin. The whole must therefore form a powerful squeezing or propelling organ, after the manner of the heart of the higher animals. This region is attached to the body by an elongated, chitinous, process which has a broad basis at the mouth, and sends four divergent chitinous spurs into the tissues for support, the posterior pair coursing along the borders of the dorsal valves or lips, as in the previous form. The broad, fleshy collar has two powerful conical bands of fibres (continuous with the dorsal belts) attached to the chitinous process on the dorsum, while ventrally a special bundle of fibres passes from the collar to the anterior margin of the trunk.

The dermal layers of the body agree in both species, as also does the external (longitudinal) muscular coat; but though certain circular muscular fibres lie under the latter, they are so indistinct as scarcely to merit the name of a special layer.

A considerable difference is apparent on opening the body-cavity, as at first sight the branchial arrangement characteristic of the former examples seems to be absent. On careful inspection, however, many minute, transparent, chitinous processes are found in the somewhat thickened membrane behind the dorsal valves. These processes have the form of a pointed molar tooth with very long fangs, and a fissure passing up the centre of the tooth to the crown. Some of the fangs or processes are bifid at the tip, each division diverging with a curve from the main stem. In all probability they form a short double row, after the type of the former species; but the specimen is not in a condition to bear searching investigation.

The digestive canal and accessory glands have a similar character to those in the foregoing species; the former being distended with muddy sand containing many Foraminifera and other microscopic organisms, the latter chiefly grouped along the dorsal area.

This species would not seem to approach any yet described.

In reviewing the several features presented by these curious forms, and contrasting them with what is known of Nemertean anatomy and physiology, the following reflections occur:—

In both the cutaneous tissues have the closest similitude as regards ciliation and minute structure. In *Balanoglossus*, however, the basement-membrane underneath the latter is more differentiated, and assumes a slightly fibrous appearance.

In the arrangement and histology of the muscles of the body-wall they much resemble each other.

The digestive system is similar. Both have a ciliated chamber divided into two great regions, represented by the first or branchial, and the succeeding division in *Balanoglossus*, and by the œsophageal and alimentary cavity proper in the Nemertean. The peculiar *rete mirabile* over the œsophageal region of the Nemertean, and the elaborate branchial circulation of *Balanoglossus* are apparently homologous. The minute structure of the proper wall of the chamber is closely allied. Moreover, while the "liver"-tissue is separated into elongated sacs in *Balanoglossus*, and simply diffused over the alimentary region in the Nemertean, its histological features are nearly identical. The mouth and anus are also similarly arranged.

With regard to the "proboscis" of *Balanoglossus* and that of the Nemertean I fear there is no homology; indeed, I would be inclined to regard the anterior region in *Balanoglossus* rather as the homologue of the Nemertean snout. The pore at the tip in the former would therefore correspond with the aperture for the proboscis in the latter, the mouth in both being placed a considerable distance backwards.

A great divergence happens in regard to the nervous system. It is not yet sufficiently understood to enable us to form a correct idea of its relations in *Balanoglossus*, while it is conspicuous in the Nemertean.

There is considerable similitude in the circulatory system. Both have a main dorsal and two lateral trunks, the blood in each group flowing from behind forward in the dorsal. The much greater differentiation of the branchial region in *Balanoglossus* necessitates a corresponding complexity of the vessels, yet there is a connecting link in the elaborate plexus in the œsophageal region of the Nemertean.

In regard to generation and development there is also a parallelism. The reproductive elements are developed in sacs in both, and the sexes are often distinct. Certain of the young in each case undergo a kind of metamorphosis, as shown on the one hand by the description already given, and on the other by the interesting observations recently made by E. Metschnikoff on *Tornaria*,[1] apparently the early condition of *Balanoglossus*. The occurrence of eye-specks in the anterior region ("proboscis") in the latter would seem to indicate that the above view of its homologies is correct.

Having thus examined the relations and homologies of the Nemerteans with their inferiors and apparent equals in the scale, we may next inquire into their affinities with the higher annelids. Here, however, there is room for very diverse opinions, since, so far as known, there are no intermediate forms through which they may be linked on to any higher group.

Their relationship would rather appear to be with the Leeches than with the *Gephyrea* or *Scoleidæ* of Prof. Allman's classification, although a considerable gulf intervenes. Thus, in regard to the cutaneous system the cilia are not present in the leeches, though the exudation of the cutis proper is abundant enough. The muscles of the body-wall are less definitely arranged in the latter (*e.g. Nephelis*), the internal longitudinal bundles for instance being placed in the body-cavity, and separated by regularly arranged vertical fasciculi at the lateral regions. The external coat is composed of circular fibres, within which lie a decussating series. The digestive system opens by a mouth in front of the ganglia, after passing through a nervous collar, and the muscular œsophageal region is distinguished from the more glandular stomachal portion, as in the Nemerteans. There are no cilia in the alimentary chamber, but it is occasionally furnished with cæcal processes. The alimentary canal adheres as much to the body-wall in the Leeches as in the Nemerteans, which in this respect differ from the higher Annelids. The dorsal and the two great lateral vessels of the leech are probably homologous with the three vessels of the Enopla, but the ventral is additional.

In regard to the nervous system, the superior lobes of the Nemertean brain seem to correspond with the supra-œsophageal ganglia of the leech, and the inferior (from which the great lateral trunks arise) with the sub-œsophageal. If in the Enopla the two ganglia were separated, and the lateral nerve-trunks thrown together in the median line of the body, the alimentary canal would become dorsal in position, and would perforce pass through the nervous system to open ventrally, while the lateral vessels would remain in their usual situation. Thus a partial resemblance to the state in the leech would ensue. A much greater amount of branching of course would occur after the concentration of the nervous system.

The two cephalic sacs and coiled ducts in the Enopla may be the homologues of the segmental organs in the leech.

[1] 'Zeitsch. f. w. Zool.,' Bd. xx, p. 131, taf. 13, 1870.

There is a considerable difference in regard to the reproductive organs, for the Leeches are hermaphrodite, whereas the Nemerteans are chiefly unisexual. The capsule of mucus for the ova in *Lineus* is homologous with the cocoon of the leech; the latter being apparently due to the same abundant secretion poured forth by the general cutaneous surface, and is not necessarily connected in any way with the numerous segmental organs. Some of the higher Annelids, again, agree with the Nemerteans in discharging the generative products through lateral pores, *e.g. Harmothoë* and *Phyllodoce*. As in the Enopla, no metamorphosis occurs in the embryo of the leech. All the latter are oviparous, whereas some of the former are ovo-viviparous.

There is no feature to connect them with the *Brachiopoda*, which Mr. Morse[1] thinks should be classed with the true Annelida; indeed, we are not prepared at present to admit the relationship until we are more acquainted with the grounds on which the American author bases his conclusions.

I would be inclined to place the Turbellaria next the true Annelida, without the usual interpolation of the Rotatoria.

General Distribution of the Nemerteans.

The Nemerteans have a very wide geographical range, extending from the arctic seas to those of the equator, and it is probable they occur on every suitable sea-beach, as well as in the surrounding depths. The forms adapted for swimming generally frequent the latter, and perhaps only approach the shallow water at the extreme limit of their range, and in a somewhat modified form, especially as regards size. Moreover, examples of the two great types (Enopla and Anopla) are common both to the arctic seas and the antipodes. The range of the freshwater species is involved in obscurity; they have been found in various parts of the world, but not yet in this country.

With regard to the distribution of the British species, some forms are cosmopolitan, such as *Amphiporus lactifloreus, Tetrastemma melanocephala, candida,* and *dorsalis, Nemertes Neesii, Lineus marinus, L. gesserensis, Cerebratulus angulatus,* and *Carinella annulata,* extending from the Zetlandic seas along both eastern and western shores to the Channel Islands, and, in addition, radiating widely all round. Thus I have received *A. lactifloreus* from Greenland, and apparently the same form is described by M. de Quatrefages from the Mediterranean. *Tetrastemma melanocephala, T. candida,* and *T. dorsalis* range from the latter to the extreme north of Europe. *Lineus gesserensis,* again, appears to be even more widely distributed, for besides being prevalent in the European seas, it (or a form almost identical in every respect) extends to the shores of the United States. *Cerebratulus angulatus* attains greater dimensions in the seas of Greenland and the Boreal province generally than it does in the Channel Islands. In other forms, however, *e.g. Lineus marinus,* I have observed no apparent difference in bulk between those from Shetland and those from Guernsey; though at the same time it must be stated that nowhere have the Nemerteans occurred of greater size and beauty than amongst the sheltered tangle-forests of the

[1] 'Ann. Nat. Hist.,' 4 ser., vol. vi, p. 267.

Zetlandic seas. *Carinella annulata* stretches from the north of Shetland to the Mediterranean, and a very similar species is found at the Cape of Good Hope.

Others, again, have a more southerly range, and have not yet been found in the northern portions of the British Islands; but on this point I would not speak dogmatically, for very much yet remains to be done in regard to the distribution of marine animals. *A. spectabilis*, *Borlasia Elizabethæ*, and *Micrura aurantiaca* may be instanced as specially southern forms.

Some of the Nemerteans live at a depth of many fathoms and at a considerable distance from land, as well as between tide-marks, for example, *Nemertes Neesii*, *Lineus marinus*, and *bilineatus*, *Micrura purpurea* and *Carinella annulata*. *Amphiporus pulcher* and *Cerebratulus angulatus* are rarely found elsewhere than in deep water, the limits being from 5 to 120 fathoms. Amongst the Nemerteans procured in the dredgings of the "Porcupine" in 1869 and 1870, no new form, so far as can be ascertained from the spirit-preparations, occurs. It is interesting, however, to notice that the Anopla much exceed the Enopla in number, the most abundant form being *Micrura fusca*, with its flattened and oar-like posterior extremity. *Tetrastemma candida*, again, was found at a depth of 420 fathoms, its usual site being the laminarian and litoral regions. Representatives of the Anopla come from the great depth of 795 fathoms off the coast of Portugal. The Planarians accompany them in these sites, and there is no reason why both should not be found at yet greater depths. *A. lactifloreus*, all the *Tetrastemmæ*, *Prosorhochmus*, *Nemertes carcinophila*, many of the *Linei* and *Micrura*, and *Cephalothrix*, have their habitat between tide-marks, though sometimes at the extreme border of the litoral zone; indeed, as a rule, *Tetrastemma dorsalis* is a laminarian form.

M. de Quatrefages states that he has seen imprints in the rocks of Solenhofen and Strasbourg, which he thinks belong to Nemerteans, in the latter case especially to the "genus *Borlasia*;" and palæontologists have expressed similar opinions. The fossils in the lithographic stone of Solenhofen recently noticed by Prof. Ehlers[1] under the name *Legnodesmus* bear a close resemblance to such as might be caused by the Nemerteans; but a perusal of his excellent descriptions and drawings leaves an impression so indefinite that further and more extensive investigations are evidently necessary before a safe decision can be arrived at. The most interesting part of this paper is the account of his finding stylets in the *Legnodesmus* figured in taf. xxxvii, figs. 1 and 2. My acquaintance with the living animals leads me to entertain doubts as to their connection with the so-called fossil Nemerteans (*Nemertites*) of the Cambrian rocks; at least, those coils I have seen suggest the following ideas:—Since they are simply casts without organic remains, the worms which made them could only have done so in shallow water, so as to have raised the snout to the surface, and crawled off in the usual manner (by floating). Any other mode of departure would have blurred the tracks in a deposit so soft as to receive such impressions. Moreover, I have often observed similar contorted tracks in the soft muddy sand in tidal pools—tracks made by litoral univalves in their daily wanderings.

[1] 'Ueber fossile Würmer aus dem lithographischen Schiefer in Bayern.' Cassel, 1869.

DESCRIPTION

OF THE

GENERA AND SPECIES

OF THE

BRITISH NEMERTEANS.

GENERA AND SPECIES OF THE NEMERTEANS.

Sub-Order.—ENOPLA.

Proboscis furnished with stylets.

Family I.—AMPHIPORIDÆ.[1]

Sub-Family.—AMPHIPORINÆ.

Proboscis proportionally large.

Genus I.—AMPHIPORUS. Ehrenberg, 1831.

BEFORE the time of Ehrenberg the species of this group had chiefly been included under the genera *Fasciola* and *Planaria*. In his 'Symbolæ Physicæ,' published in 1831, this author established three genera, viz., *Polystemma*, *Ommatoplea*, and *Amphiporus*, for the reception of animals probably belonging to the present type; and, while there is room for doubt with regard to the exact nature of the first two genera, as illustrated respectively by the examples *Polystemma adriaticum* and *Ommatoplea tæniata*, it is quite clear to every observer that his *Amphiporus albicans* from the Red Sea is a characteristic representative of the *Enopla*, closely allied to *A. lactifloreus*. I have therefore deemed it right to use for the typical forms that generic name about which there can be no misunderstanding, and which name, moreover, is contemporaneous with the others. Usage, perhaps, inclined me to favour the adoption of the generic title *Ommatoplea*, but in the present state of our knowledge this nomenclature would not have been strictly appropriate, and by the discovery of the typical form from which Ehrenberg drew up his description it might be our misfortune to find that it is one of the Anopla, since there is nothing decisive in his account or figure. The name here adopted is not free from faults, for the Anopla as well as the Enopla have a pore at either end; but the term *Ommatoplea* stands in the same position, numerous eyes occurring in the one group as often as in the other. In his description of the genus, Ehrenberg, although noting and figuring the glandular papillæ of the proboscis, omitted to observe the stylets, and did not truly comprehend the situation and relations of the mouth, as he mistook the proboscidian aperture for the latter. The name *Polia* instituted by Delle Chiaje, and

[1] Ἀμφὶ and πόρος, an aperture.

adopted for this genus by M. de Quatrefages, was applied by its founder to examples of the Anopla.

In distinguishing the species of *Amphiporus* the chief characters are drawn from the arrangement of the eyes, the nature of the cephalic furrows, and the structure of the stylet-region of the proboscis.

Generic character.—Eyes more or less numerous and large, but never arranged in a square. Body rather short, and often flattened.

1. Amphiporus lactifloreus, Johnston. Plate I, figs. 1 and 2.

Specific character.—Eyes grouped in two series on each side. Body whitish, roseate or grayish.

Synonyms.

1776. *Lumbricus oxyurus*, Pallas. Miscell. Zool., p. 146, tab. 11, f. 7 and 8.
1828. *Planaria lactiflorea*, Johnston. Zool. Journal, vol. iii, p. 489.
1837. *Nemertes lactiflorea*, Johnston. Mag. Zool. and Bot., vol. i, p. 535, pl. 17, f. 2 and 3.
1841. „ „ W. Thompson. Ann. Nat. Hist., vol. vii, p. 482.
1843. *Borlasia? alba*, W. Thompson. Rep. Brit. Assoc., 1843, p. 271.
1844. *Polystemma roseum* (partim), Œrsted. Entwurf Plattwür., p. 92.
„ „ „ „ Ibid. De Regionibus marin., p. 80.
1845. *Nemertes glaucus* (?), Kölliker. Verhandl. d. schweiz. nat. Gesellsch. zu Chur im Juli, 1844, p. 89.
„ *Borlasia alba*, W. Thompson. Ann. Nat. Hist., vol. xv, p. 320, with woodcut.
„ *Planaria rosea*, Ibid. Op. cit., p. 321.
1846. *Borlasia? alba*, Johnston. Ann. Nat. Hist., vol. xvi, p. 434 (Index).
„ *Prostoma lactiflorea*, Ibid. Op. cit. (Index), p. 435.
„ *Prostoma? rosea*, Ibid. Index, p. 436.
„ *Polia mandilla*, De Quatrefages. Ann. des sc. nat., 3me sér., Zool., tom. vi, p. 203, tab. 8, f. 1 and 1*a*, and tab. 9, f. 2.
„ „ *mutabilis*, Ibid. Op. cit., p. 205, tab. 10, f. 2.
„ „ *violacea*, Ibid. Op. cit., p. 210.
„ „ *berea*, Ibid. Op. cit., p. 211.
„ „ *glauca*, Ibid. Op. cit., p. 206, tab. 10, f. 3.
1849. „ *mandilla*, Ibid. Voyage en Sicilie, vol. ii, p. 115, pl. 15, f. 1, A B.
„ „ *mutabilis*, Ibid. Op. cit., p. 117, pl. 15, f. 4 and 5.
„ „ *violacea*, Ibid. Op. cit., p. 122, pl. 16, f. 16, and pl. 17, f. 1.
„ „ *berea*, Ibid. Op. cit., p. 123, pl. 15, f. 13.
„ „ *glauca*, Ibid. Op. cit., p. 118, pl. 15, f. 7—9, var.
1850. *Nemertes glaucus*, Von Siebold. Archiv für Naturges., ii, p. 382.
„ „ *mandilla*, Diesing. Syst. Helm., vol. i, p. 275.
„ *Omatoplea mutabilis*, Ibid. Op. cit., p. 252.
„ „ *violacea*, Ibid. Op. cit., p. 253.
„ „ *berea*, Ibid. Op. cit., p. 252.
„ „ *glauca*, Ibid. Op. cit., p. 253.
„ „ *alba*, Ibid. Op. cit., p. 252.
1853. *Gordius albicans*, Dalyell. Pow. Creat., vol. ii, p. 73, pl. 10, f. 5*a* and 6.

1862. *Ommatoplea mutabilis*, Diesing. Revision der Turbell., p. 257.
,, ,, *violacea*, Ibid. Op. cit., p. 257.
,, ,, *berea*, Ibid. Op. cit., p. 257.
,, ,, *glauca*, Ibid. Op. cit., p. 257, *bis*.
,, ,, *alba*, Ibid. Op. cit., p. 257.
,, *Nemertes mandilla*, Ibid. Op. cit., p. 303.
,, *Borlasia mandilla*, Keferstein. Zeitsch. für wiss. Zool., Bd. 12, p. 58, Taf. 5, f. 1—7.
1863. *Ditactorrhochma mandilla*, Diesing. Nachträge zur Revis. der Turb., p. 11.
1865. *Omatoplea rosea*, Johnston. Catalogue Brit. Mus., p. 23, pl. 11*a*, f. 2, 2*, 2**, 3, and 3*.
,, ,, *alba*, Ibid. Op. cit., p. 23.
1865-6. *Polia mandilla*, De Quatrefages. Hist. Nat. des Annelés, pl. 1, f. 3.
1866. *Ommatoplea rosea*, Lankester. Ann. Nat. Hist., 3d Ser., vol. xviii, p. 388.
,, ,, *alba*, Ibid. Op. cit., p. 388.
1867. ,, ,, McIntosh. Rept. Brit. Assoc., 1867; Trans. Sect., p. 92.
1868. ,, ,, Ibid. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
1869. ,, ,, and var. *rosea*, McIntosh. Trans. Roy. Soc. Edinb., vol. 25, pt. ii, p. 323 et seq.

Habitat.—Under stones between tide-marks and in the laminarian region; abundant. Generally distributed—from the Arctic Seas probably to the Mediterranean.

Body rounded on the dorsal surface, flattened on the ventral, not much tapered towards the tail, which is rather blunt. In newly spawned specimens the body is much flattened, but in those bearing ova it is rounded. Length one to three inches, and occasionally even reaching four inches; breadth three lines.

Colour.—Various shades of white or pinkish white, with a translucent streak along the centre of the dorsum—caused by the proboscidian chamber. Specimens with the generative organs well developed assume a grayish aspect. There are two conspicuous pink or reddish-pink spots indicating the ganglia in front. The under surface has the same colour as the dorsum, and during the quiescent state of the reproductive organs is distinctly marked by the pinnæ of the digestive chamber. A specimen found at St. Peter Port, Guernsey, had the body of a pale greenish hue, like that usually seen in *Tetrastemma melanocephala*; while in the Bight of Vatsland (to the north of Bressay Sound) in Shetland a variety with the pigment everywhere increased abounds on a sandy bottom.

Head spathulate, flattened, and slightly pointed; furnished with numerous eyes placed in two or three groups on each side, the anterior generally forming a marginal row; the posterior arranged in front of or sometimes over the ganglia, and three often forming a triangle. In the pale brownish variety from Shetland an eye-speck on each side in front of the ganglia is larger and more conspicuous than the others.

Cephalic furrows.—Midway between the tip of the snout and the anterior border of the ganglia a furrow runs inwards and slightly forward on the dorsum, ceasing before it reaches the middle line. On the ventral surface is a similar though shorter furrow, the two meeting on the side at a richly ciliated dimple, which leads into the cephalic pit. A short distance behind the ganglia two other superficial furrows exist, each slanting backwards and inwards to meet its fellow of the opposite side in the middle line. These furrows are also continued inferiorly, but with a slightly altered direction, so that they meet under the ganglia. The two sets of furrows are indicated in the flattened head by lateral notches.

This is a very common animal, generally lurking under stones between tide-marks, whether these rest on sand, gravel, or sandy mud, and sometimes the latter is odoriferous; thus at Herm it frequently lives amidst crushed and blackened fragments of *Zostera marina* and sea-weeds under stones. In such situations it generally resembles in contraction a cream-coloured larva, but when placed in sea-water it readily extends itself and crawls with a slow gliding motion, and likewise progresses on the surface of the water with the ventral region uppermost. It lives well in confinement, and numerous broods can be reared from captive specimens. The white ova are deposited in a free condition from January to April, and the young are from the first furnished with two eyes. I have not been able to see this species feed in confinement, but the rapid fattening in the free condition after spawning shows that it takes nourishment greedily.

The skin presents an acid reaction to test-paper, and the mucus secreted thereby is of a most tenacious description, the animal, indeed, rapidly forming an investment by this means when placed in a vessel containing a little sand.

Considerable confusion has prevailed with regard to this very abundant and widely distributed species. Johnston, Œrsted, and others have considered the *Planaria rosea* of O. F. Müller referable to this form, but, as will be noticed elsewhere, a careful consideration of all the facts has led me to a different conclusion. When descriptions and figures are so vague and uncharacteristic, it is impossible to clear away all doubts, but such uncertainty cannot be laid to our charge. The earliest reliable account of the species is, perhaps, that given by Pallas in his 'Miscellanea Zoologica,' but the specific name (*oxyurus*) there given is objectionable, and I have consequently adopted another. Dr. Johnston, amongst modern authors, first clearly described this common worm, and since his period less difficulty has been encountered in regard to its discrimination. This author changed the name originally applied by him to the species from various causes, none of which, however, interfere with our following the usual laws of zoological nomenclature. For some time I was inclined to include the *Amphiporus albicans* of Ehrenberg under the synonyms, as it has many characters in common, but it approaches *A. pulcher* in others, and the arrangement of the eye-specks in his figure is so different that I have struck it off. For the same reason the *Planaria elongata* of Montagu (MS. p. 231) was not included. The *Polia mandilla* of De Quatrefages, from St. Vaast, probably belongs to this form, and there is nothing in the slight differences noted in *Polia mutabilis*, *P. violacea* and *P. berea* to distinguish them from the same worm. The *P. glauca* of this author is also, in all likelihood, a dark variety of the species.

2. Amphiporus pulcher (O. F. Müller), Johnston. Plate I, fig. 3, and Pl. XIV, fig. 11.

Specific character.—Eyes well-defined and numerous, irregularly grouped on each side. A central reserve-stylet in the proboscis. Cephalic furrows slightly branched.

Synonyms.

1774. *Fasciola rosea*, O. F. Müller. Verm. terrest. et fluv. hist., i, 2, p. 58.
1776. *Planaria rosea*, Ibid. Zool. Danic. Prodr., p. 221, No. 2679.
1788. ,, ,, Ibid. Zool. Danic., ii, p. 31, tab. 64, f. 1 and 2.

1788. *Planaria rosea,* Linnæus. Syst. Nat. (Gmelin's), tom. i, pars vi, p. 3088.
1827. „ „ Bosc. Hist. Nat. des Vers., i, p. 256.
1837. *Nemertes pulchra,* Johnston. Mag. Zool. and Bot., vol. i., p. 536, pl. 17, f. 6.
„ *Polystemma roseum,* Œrsted. Kroyer's Nat. Tids., iv, p. 579.
„ „ *pulchrum,* Ibid. Ibid., p. 580.
1844. „ „ Œrsted. Entw. Plattw., p. 93.
1846. *Prostoma pulchra,* Johnston. Ann. Nat. Hist., vol. 16, p. 136.
1850. *Omatoplea rosea* (partim), Diesing. Syst. Helm., vol. i, p. 251 et postea.
„ „ *pulchra,* Ibid. Ibid., p. 252.
1853. *Vermiculus rubens,* Dalyell. Pow. Creat., vol. ii, p. 89, pl. 10, f. 13—18.
1862. *Ommatoplea pulchra,* Diesing. Revis. der Turbell., p. 257.
1865. „ „ Johnston. Catalogue Brit. Mus., p. 24, pl. ii *a*, f. 6 and 6*.
1866. „ „ Lankester. Ann. Nat. Hist., 3rd ser., vol. 17, p. 388.
1868. „ „ McIntosh. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
„ „ „ Ibid. Rept. Brit. Assoc., 1868, p. 340.
1869. „ „ Ibid. Trans. Roy. Soc. Edinb., vol. 25, pt. ii, p. 337 et seq.

Habitat.—Generally diffused round the British coasts in water eight to thirty fathoms deep, and specimens were dredged by Mr. Jeffreys off Unst, Shetland, even at a depth of 120 fathoms. It frequently occurs amongst shells and other débris brought from the coralline region by the fishermen.

Body one to three inches and a half long, and three to five lines broad; flattened, thinned at the edges, slightly narrowed behind the snout; of nearly equal diameter throughout the middle region when stretched, but the anterior part is often narrowed, while the posterior forms a broad flattened oar. In extreme contraction, the body resembles an *Elysia* or *Limapontia,* or even becomes baccate.

Colour.—During the period of reproductive quiescence the animal has a general dull pinkish hue, pale at the snout, along the margins, and at the tail. The pinkish tint proceeds forward in the centre of the snout in front of the ganglia. The under surface is pale pinkish. In the ripe females the lateral regions are enlivened by the rich reddish hue of the ova, which shine through the transparent integuments, so that, from their somewhat symmetrical disposition, the animal has a segmented appearance, from the termination of the œsophageal region nearly to the tip of the tail. In specimens which have lived a considerable time in captivity the dorsum becomes freckled with brownish-red grains, especially towards the snout.

Head broadly spathulate, pointed at the tip, flattened; the snout clearly defined from the rest of the body by a well-marked furrow, which notches each side, and passes inwards almost to the middle line. The tip is furnished with a distinct central papilla, from which an opaque line generally proceeds backwards to the central glandular mass. Some distance behind the transverse furrow another oblique groove coming from the ventral surface slants backwards and inwards—meeting its fellow of the opposite side in the middle line of the dorsum, so as to form an acute angle. There are numerous large, well-defined eyes, which form somewhat irregular groups on each side, to the number of about twenty-three in all, three or four lying behind the transverse furrow. These are much more distinct in some specimens than in others. On the under surface the furrows are continued straight inwards towards a dimple (Plate XIV, fig. 11), then curve forward and inwards to the middle line. Numerous longitudinal grooves slant from the front towards these furrows so as to produce a similar appearance to that in *Amphiporus spectabilis*, Quatref., but less marked in the lateral regions. The ganglia lie quite behind the transverse furrow, as indicated by the shading in the figure.

This species is often found in crevices of the coils of *Serpulæ* attached to shells and stones from deep water, and it is one of the most interesting of the group. It glides over the bottom of the vessel with considerable speed, almost without a wrinkle of its body; and when irritated a healthy example turns on its edge, and, by swift lateral strokes of the oar-like posterior extremity, swims rapidly through the water like a *Nephelis* or a horseleech, so that not infrequently the uninitiated mistake it for a species of the latter. In contraction the head is drawn within the anterior portion of the body, the neck forming a kind of collar through which the organ slips inwards.

It rapidly secretes a tough sheath of transparent and iridescent mucus, under which it remains for days. The skin presents an alkaline reaction to test-paper.

The ova are developed in the beginning of May and are nearly ripe towards the end of June, but though many ova have been discharged in the vessels, I have hitherto been unable to watch their development.

While, for a time, of opinion that the *Planaria rosea* of O. F. Müller ('Zool. Danica') might refer either to this or the previous form, I now think that in all probability this species has the preference in the description and figure. He says, "Body elongate, sub-equal, convex above, of a rosy colour, marked with black points and lines (not distinct in some); flat beneath, of a pale red interrupted with transverse striæ, posterior end blunt, anterior produced into an angular head; the latter is marked on each side by a semicircle of black points." The figure (which has its anterior end downwards) bears a considerable resemblance to this form, especially in the head and position of the eyes. His remark, however, that it is common everywhere leaves a certain degree of doubt, and I have therefore chosen Dr. Johnston's title. The latter author was the first to give a proper account of the species, from specimens procured amongst corallines and old shells in deep water off the coast of Berwickshire. He noted the appearance of the ova in the female, describing them as a series of bright scarlet spots along the sides. Sir J. Dalyell mentions a stripe, generally yellowish, which runs down the back, and a broader stripe along the ventral surface, but these probably refer to the colour of the digestive canal. Fair figures of the structure of the proboscis and the external appearance of this species are present in Gaimard's 'Voyages en Scandinavie, en Laponie,' as mentioned in the zoography.

I have not thought it necessary to include all the synonyms given by Œrsted and Diesing, since it is doubtful to what species they refer.

3. Amphiporus spectabilis, De Quatrefages. Plate III, figs. 2, 7, and 8.

Specific character.—Head spathulate, peculiarly narrowed posteriorly. Eyes in two long rows on each side. Cephalic furrows conspicuously branched. Longitudinally striped with brown on the dorsum.

SYNONYMS.

1846. *Cerebratulus spectabilis*, De Quatrefages. Ann. des sc. nat., 3me sér., Zool., p. 219, tab. 10, f. 7.
1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 131, pl. 17, f. 12 and 13.
1850. *Nemertes spectabilis*, Diesing. Syst. Helm., vol. i, p. 272.
1852. *Cerebratulus spectabilis*, Max Schultze. Zeitsch. f. wiss. Zool., Bd. iv, p. 183.
1861. ,, ,, Grube. Ein Ausflug nach Triest, &c., pp. 80 and 129.
1862. *Nemertes spectabilis*, Diesing. Revision der Turbell., p. 299.
,, *Borlasia splendida*, Keferstein. Zeitsch. f. wiss. Zool., Bd. xii, p. 59, taf. v, f. 10—18.
1863. *Ptychodes splendida*, Diesing. Nachträge zur Revis. der Turb., p. 12.
1864. *Cerebratulus spectabilis*, Grube. Die Insel Lussin u. ihre Meeresf., p. 91.
1869. *Cerebratulus* (*Ommatoplea*) *spectabilis*, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, pp. 342 and 355.

Habitat.—Dredged off St. Peter Port, Guernsey, at a depth of 18—20 fathoms, in a fissure of *Eschara foliacea*. Sicily, the Adriatic and St. Vaast-la-Hougue; generally in the crevices of shells.

Body rather more than three inches in length, and about a fifth of an inch in breadth, flattened; dilating rather abruptly behind the snout, and again diminishing towards the tail. The margins are thin.

Colour brownish, with six longitudinal brown stripes on the dorsum, and five pale intermediate lines. The two bands on each side of the central line are somewhat dark in colour, wide in front, narrow and somewhat closely applied posteriorly. The two adjoining brown belts become considerably wider towards the tail. Besides the foregoing there is also a marginal brown stripe, which is somewhat wider posteriorly. The tip and edges of the snout are pale, the four central brown bands of the dorsum being continued thereon, the two lateral becoming indistinct over the pigmentary region, the two central almost reaching the tip of the snout. All the four stripes are much narrowed and more closely approximated after passing the cephalic furrows, and the two lateral are in addition bent inwards towards the middle line at the latter. The under surface has a uniform pinkish colour, slightly marked within each border by a reddish coloration from the vessel.

Head narrower than the rest of the body, somewhat conical, defined posteriorly by a very distinct notch on each side. The region assumes various shapes according to the motions of the animal, sometimes presenting a blunt tip with a notch in the centre and almost cylindrical, at others a dilated tip and a constricted posterior portion. In the recently captured animal the eye-specks are not very evident on the dorsum, but after it has been blanched by captivity, they are observed to form two rows on each side, the central having about ten eye-specks, and the lateral a larger number. The former are best seen on the dorsal, the latter on the ventral surface, or from the side, and they proceed further forward than the central, indeed, almost to the tip of the snout. In the inner rows the eyes are nearly equal in size, while in the outer there are some larger ones towards the front.

Cephalic furrows.—From the notch, which on each side marks the posterior boundary of the snout, a well-marked furrow proceeds inwards and backwards, and is joined by eight or nine deep grooves which occupy the slightly dilated region immediately in front of the oblique furrow. These accessory grooves have in general a longitudinal direction, but they are curved in various ways, and are of different lengths. On the under surface of the snout the lateral furrow follows a different course, being directed forward and inward on each side.

This animal lives well in confinement; the sole specimen procured at Guernsey in the end of July survived till the middle of November. At this time it discharged a vast number of ova and perished in their midst, so that the effort of spawning had been too much for its health, or the water had become vitiated by the fluids exuded during the process. When irritated it swam rapidly through the water like *A. pulcher*, but generally lay quiescent on the bottom of the vessel surrounded by a delicate mucous investment, the body being shortened and thickened, but the head narrow and papilliform.

It has strictly the structure of the *Amphiporidæ*, the longitudinal bands of the reticulated layer of the pinkish proboscis being very apparent. The blood is reddish-pink.

The species was first described in a recognizable manner by M. de Quatrefages, and though his drawing of the complete animal and its head are not quite accurate, their identity is satisfactorily made out. He does not say anything about the blood of this form, but he mentions that in *Cerebratulus crassus* it is reddish, and this with other points at one time inclined me to unite the species. The arrangement of the eyes is, at any rate, very similar, and if more pigment is added to the dorsum of the present form, the distinction only rests on the author's account of the stylets, on which comparatively little reliance can be placed. It was erroneously described as a new species by the lamented Prof. Keferstein under the name *Borlasia splendida*, and as having the mouth behind the ganglia; but he correctly interpreted the structure of the stylet-region of the proboscis. Prof. Grube accepted the anatomy given by M. de Quatrefages, and did not dissect the animal himself.

The *Polia pusilla* of Delle Chiaje (Descrip. e Notom., &c., tom. iii, p. 126, tav. 103, figs. 13—15) is a closely allied species.

Amphiporus hastatus, n. s. Plate VIII, fig. 2.

Specific character.—Snout not wider than the succeeding portion of the body, with a grooved median ridge; ungulate when viewed laterally, hastate when seen from the dorsum. Eyes somewhat indistinct. Brownish yellow, with white grains on the snout.

Habitat.—In seven fathoms Bressay Sound, Shetland, amongst tangle-roots attached to horse-mussels.

Body about an inch and three fourths long, and a seventh of an inch broad, rather rounded, gently dilating from the snout backwards, a slight diminution only occurring at the tail, which is thick and broad. The edges of the body are not thinned off, as in *A. pulcher* and others.

Colour pinkish; very much resembling that variety of *A. lactifloreus*, the hue being deepest in front, behind the reddish spots caused by the ganglia. The snout is paler than the subsequent portion of the body, and shows a series of whitish grains on the upper surface. The proboscis and proboscidian fluid are visible in the median line of the body. The mouth (woodcut, fig. 9) has some grayish-brown pigment-grains along its margins, and there is a curved band of the same hue a little behind the tip of the snout on each side.

The under surface of the body is generally paler than the upper.

Head with a snout narrower than the succeeding portion; bluntly pointed, and similar in shape to the head of a short spear or harpoon. In the median line is a grooved ridge, which, although cut by the cephalic furrow, is continued some distance along the dorsum of the body. On each side of the ridge is a longitudinal hollow on the snout. The eye-specks are placed a little behind the tip of the latter, and from their deep situation are somewhat indistinct. When viewed laterally the peculiar tapering of the snout resembles the hoof of a horse. The mouth is marked on the under surface, either as a slit like a key-hole, or as a linear depression (fig. 9)—rendered conspicuous by its pigment, according to the degree of contraction: in few species, indeed, is it so well seen.

Fig. 9.

Under surface of the anterior region of *Amphiporus hastatus*. Somewhat enlarged.

Cephalic furrows.—At the posterior border of the snout a well-marked groove proceeds inwards and slightly forward on each side to the median ridge, where a Λ-shaped process is formed by a sudden turn of the furrow inward and forward. The groove is continued on the ventral surface in a similar manner, and also has a slightly developed median angle at the mouth.

This curious form combines the hardihood of *A. lactifloreus* with the irritability of *A. pulcher*. It is exceedingly contractile, becoming quite baccate when stimulated; the head being withdrawn through a collar of the body, as in the latter species. The grooves of the snout during the various movements become much exaggerated, and give the animal a very characteristic appearance. In minute anatomy it belongs strictly to the *Amphiporidæ*, the large proboscis, moreover, being furnished with four marginal stylet-sacs.

Amphiporus bioculatus, n. s. Plate VIII, fig. 3.

Specific character.—Dull orange; snout acutely pointed, with a distinct cephalic furrow forming an angle directed forward at its posterior boundary. Eyes two, placed at the extreme tip of the snout.

Habitat.—Amongst tangle-roots attached to horse-mussels, in eight fathoms, Bressay Sound, Shetland.

Body about an inch in length, and rather more than a line in breadth, rounded, increasing in diameter from the pointed snout almost to the posterior third. The tail is rather blunt.

Colour dull orange, or pale brownish, inclining to reddish in front, especially in the region of the snout. Under surface somewhat pale.

Head with a small, pointed snout, which is bounded posteriorly by an angular furrow (woodcut, fig. 10). The mouth is indicated on the ventral surface by a streak running forward from the arch of the latter (woodcut, fig. 11). Two eyes, consisting of simple masses of black pigment, are observed at the tip of the upturned snout (woodcut, fig. 10).

Cephalic furrows.—Viewed from the dorsum the furrow passes from each side of the snout inwards and forward, so as to form an angle. On the ventral surface, again, it makes an arch with the convexity directed forward, the slit for the mouth springing from the centre. The course of the dorsal and ventral furrows is such that when the snout is seen in profile, a somewhat acute angle is formed at their junction on the side.

This is another interesting species supplied by the rich tangle-roots on the mussel-ground of

Fig. 10.

Outline of the anterior dorsal region of *Amphiporus bioculatus*. Enlarged.

Fig. 11.

Ventral surface of the anterior region of *A. bioculatus*.

Bressay Sound. It lives well in confinement, and it can be observed that, instead of the usual gliding progression of its allies, this form moves its snout in a boring manner.

The specimens were loaded with fully-developed spermatozoa in the beginning of August

Genus II.—Tetrastemma,[1] *Ehrenberg*, 1831.

Like many others of the race, the species of this genus were included amongst the *Fasciolæ* by O. F. Müller, the first who, in the 'Zoologica Danica,' clearly described a species (*Fasciola candida*). Ehrenberg, in establishing his genus *Tetrastemma*, in 1831, seized upon a very constant character; but we must dissociate it from many of the genera which formed along with it the anomalous Family Gyratricina. Though he describes the proboscis as being exserted from a transverse fold of the snout in his typical species, and hence apparently connecting it with Keferstein's *Prosorhochmus*, an attentive examination of the other parts of his description and his figures has convinced me that he alludes to a form identical with one not uncommon in Britain, viz., *Tetrastemma flavida*.

Generic character.—Eyes four; arranged so as to indicate a square or oblong.

[1] Τετρὰς, four, στέμμα, a crown.

1. Tetrastemma melanocephala, *Johnston.* Plate II, fig. 1.

Specific character.—A large mass of black pigment between the eyes. Marginal stylet-sacs placed considerably in front of the central apparatus.

Synonyms.

1808. *Planaria unipunctata,* Montagu. MS., p. 236, tab. 55, f. 5.
1837. *Nemertes melanocephala,* Johnston. Mag. Zool. and Bot., vol. i, p. 535, pl. 17, f. 5.
1842-3. ,, ,, Œrsted. Kroyer's Naturhist. Tidskr., iv, p. 577.
1844. ,, ,, Ibid. Entwurf. Plattw., p. 88.
1846. *Prostoma melanocephala,* Johnston. Ann. Nat. Hist., vol. 16, p. 436.
,, *Nemertes melanocephala,* W. Thompson. Ann. Nat. Hist., vol. xviii, p. 387.
,, *Polia coronata,* De Quatrefages. Ann. des sc. nat., 3me sér., Zool., tom. vi, p. 213.
,, ,, *pulchella,* Ibid. Op. cit., p. 214.
1849. ,, *coronata,* De Quatrefages. Voyage en Sicilie, vol. ii, p. 125, pl. 13, f. 6—9.
,, ,, *pulchella,* Ibid. Op. cit., p. 126, pl. 16, f. 7 and 8.
1850. *Œrstedia pulchella,* Diesing. Syst. Helm., vol. i, p. 248.
,, *Nemertes melanocephala,* Ibid. Op. cit., p. 270.
,, ,, *coronata,* Ibid. Op. cit., p. 271.
1859. *Loxorrhochma coronatum,* Schmarda. Neue wirb. Thiere, I, i, p. 39.
1862. *Tetrastemma menalocephalum,* Diesing. Revis. der Turbell., p. 291.
,, *Loxorrhochma coronatum,* Ibid. Op. cit., p. 295.
1865. *Omatoplea melanocephala,* Johnston. Catalogue Brit. Mus., p. 23, pl. II*a*, f. 5 and 5*.
1866. ,, ,, Lankester. Ann. Nat. Hist., 3rd ser., vol. 17, p. 388.
1867. *Cephalotrix unipunctata,* Parfitt. Catal. Annel. Devonsh., p. 5.
,, *Omatoplea melanocephala,* Ibid. Ibid., p. 7.
1868. *Ommatoplea* ,, McIntosh. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
1869. ,, ,, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 333 et seq.

Habitat.—Under stones between tide-marks, in crevices of rocks near low-water mark, and ranging to twenty fathoms off Guernsey. Coast of France, and Sicily.

Body two to two and a half inches in length, somewhat flattened in progression, rounded in contraction, gently dilating behind the head, then continuing of almost equal calibre until near the tail.

Colour dull yellow, greenish yellow, or dull green; occasionally with minute brownish pigment-grains along the sides. A large and somewhat quadrate black patch on the snout, in some cases with one faintly marked band of white pigment in front, and another—more distinct—posteriorly. In a specimen from deep water off Guernsey the dark spot on the head was nearly invisible, and the whitish pigment indistinct. The fluid in the proboscidian sheath causes a pale streak along the centre of the dorsum.

Head flattened, much wider than the succeeding portion of the body, furnished with a notch in front. The first two eyes are placed some distance behind the tip of the snout, and incorporated with the anterior border of the black patch, so that they are not at first observed. The posterior eyes lie quite behind the pigment-patch, the white band, when present, intervening.

The pairs are equidistant. Rarely the single specks are represented by two or three smaller pigment-patches.

Cephalic furrows.—An oblique furrow runs from the margin on each side inwards and backwards towards the posterior eye, and behind the latter two other grooves meet at an angle, as in *A. lactifloreus*, in the middle line of the dorsum. On the under surface of the snout a furrow passes from the cephalic pit inwards on each side; and there is a continuation of the posterior furrows, as in the last-mentioned form.

It is less hardy than *A. lactifloreus* in confinement, but can readily be kept several months. It remains chiefly at the water-line in a silky sheath of the tough transparent mucus. Almost every specimen in the free state in the Channel Islands was furnished with the latter, though the case was less transparent on account of the adherent débris. The skin gives an acid reaction to test-paper.

I have not yet seen a specimen of this species with ova or spermatozoa, so that it must breed very late or very early. The young soon acquire the black patch on the snout, and other characteristics. It was absent from the rocks at St. Andrews in April and May.

This species was first discriminated by Col. Montagu under the name *Planaria unipunctata*, though Dr. Johnston's title has the priority by publication. The former described the species, which he procured on the south coast of Devonshire, as follows:—"Body filiform, with a black subquadrangular spot that nearly covers the head, behind which are two minute black eyes, distant from each other." The *Planaria ascaridea* of the same author had the "body long, linear, white, with a square black spot close to the anterior end," and in all probability is to be referred to the same species. Length one inch. Moreover, though he describes the square black spot of *Planaria filum* as situated between the pairs of eyes, this too can scarcely be any other animal than that now under discussion. Œrsted remarks that there is a transverse brown bar between the eyes of his *Tetrastemma rufescens*, but there is no other character to connect it with this form. It is probable Professor Kölliker refers to the same species under the name *Nemertes Knochii* (*Krohnii?*), as he describes a transverse brownish-red band of pigment on the head. There is no doubt of the identity of the present species with the *Polia coronata* of M. de Quatrefages, from Bréhat, though his figure of the head is faulty, and the colour peculiar, since he states that the spot between the eyes has a violet hue. The *Polia pulchella* of the same author, from Sicily, seems to be a greenish variety, in which the pigment-patch on the head is separated from the eyes in front and behind by a larger interval than usual.

2. Tetrastemma robertianæ, n. s. Plate III, fig. 1.

Specific character.—Anterior pair of eyes larger than the posterior, which are sometimes quite hidden in the pigment-belt; body longitudinally striped with two brown and a median white line.

Habitat.—Dredged in four fathoms in Lochmaddy amongst tangles, and from the roots of the same seaweeds in Bressay Sound at a depth of six to eight fathoms.

Body about $1\frac{1}{8}$th inch long, flattened, rather narrowed in front, then gently dilating towards the tail, which is slightly tapered, and furnished with a somewhat thin margin.

Colour a uniform dull pinkish or pinkish-brown, marked on the dorsum by three stripes a central white and two lateral brown belts. The latter commence at a ring of the same colour which surrounds the posterior boundary of the snout, and proceed backwards to the tail, where they join; and the central white line follows a similar course. They are not close to each other, but a stripe of the usual ground-colour of the dorsum intervenes. The abdominal surface has a pale pinkish-brown hue throughout, with the exception of the ventral portion of the brown ring in front.

Fig. 12.

Dorsal view of the anterior region of *Tetrastemma Robertiana*. Enlarged.

Head wider (in its greatest transverse diameter) than the succeeding portion of the body, spathulate, furnished with four black eyes, the anterior pair of which is the larger, while the posterior specks are closer and just in front of the transverse pigment-belt. The mouth is a well-marked longitudinal slit, in the usual position on the ventral surface.

Cephalic furrows.—These pass inwards and backwards from the prominent angles of the snout on the dorsum towards the posterior pair of eyes. The lateral notch is seen on the ventral surface, but the direction of the furrows thereafter (if such exist) is indistinct.

In a pale example from Shetland the brown ring anteriorly appears only on the dorsum, and the central white line is somewhat faint. In the coloured drawing (Plate III, fig. 1) only two eyes are visible, the posterior pair being covered by the great development of the pigment-belt. The ordinary condition is represented in the woodcut fig. 12.

Œrsted describes a *Tetrastemma bioculata*, but the snout in his species is peculiarly acuminate, and he indicates no stripes or other colouring of note.

3. Tetrastemma candida, *O. F. Müller*, 1774. Plate II, figs. 2 and 3.

Specific character.—Head flattened, wider than the rest of the body; eyes distinct. Stylets large. Colour pale yellow, greenish, or reddish.

Synonyms.

1774. *Fasciola candida*, O. F. Müller. Verm. terrest. et fluv. hist., I, ii, p. 71.
1776. *Planaria candida*, Ibid. Zool. Dan. Prodr., p. 223, No. 2701.
1780. „ „ O. Fabricius. Fauna Grœnlandica, p. 327.
1788. „ „ Linnæus (Gmelin). Syst. Nat., tom. i, pars vi, p. 3094.
1798. „ „ O. Fabricius. Skrivt. af Naturhist. Selskab., iv, p. 62, tab. 11, f. 11.
1828. „ „ Bosc. Hist. Nat. des Vers., i, p. 262.
1829. *Planaria quadrioculata*, Johnston. Zool. Jour., vol. iv, p. 56.
1837. *Nemertes quadrioculata*, Ibid. Mag. Zool. and Bot., vol. i, p. 535, pl. 17, f. 1
„ *Tetrastemma varicolor* (partim), Œrsted. Kroyer's Naturhist. Tids., iv, p. 575.
1844. „ *candidum*, Ibid. Entw. Plattw., p. 88.
„ „ *varicolor* (partim), Ibid. Op. cit., p. 85, f. 11 and 14.
„ „ „ Ibid. De Region. marin., p. 79.

1846. *Prostoma quadrioculata*, Johnston. Ann. Nat. Hist., vol. xvi, p. 136.
,, *Polia quadrioculata*, De Quatrefages. Ann. des sc. nat., 3me sér., Zool., tom. vi, p. 216, pl. 11, f. 1.
1847. ,, ,, Frey u. Leuckart. Beitrage z. Kennt. wirb. Thiere, p. 150.
1849. ,, ,, De Quatrefages. Voyage en Sicilie, vol. ii, p. 128, pl. 16, f. 10 and 11.
1850. *Tetrastemma varicolor*, Diesing. Syst. Helm., vol. i, p. 257.
,, ,, *grœnlandicum*, Ibid. Op. cit., p. 259.
,, ,, *Krohnii*, Siebold. Archiv für Naturges., ii, p. 382.
1851. ,, *varicolor*, Maitland. Descrip. syst. anim. Belg. septent., p. 190.
1853. *Vermiculus coluber?* var., Dalyell. Pow. Creat., vol. ii, p. 91, pl. 10, f. 24.
,, *Planaria algæ*, Ibid. Op. cit., p. 117, pl. 16, f. 24 and 25.
1858. *Polia quadrioculata*, Williams. Philos. Trans., 1858, p. 131.
1859. *Tetrastemma algæ*, Leuckart. Archiv für Naturges., ii, p. 188.
1860. *Polia obscura* (partim), Van Beneden. Mém. Acad. Belg., tom. xxxii, p. 23, pl. 4, f. 2, 4, &c.
,, ,, *capitata*, Ibid. Op. cit., p. 28, pl. 4, f. 12, &c.
,, ,, *farinosa*, Ibid. Op. cit., p. 29, pl. 4, f. 17.
1861. *Tetrastemma varicolor?* Claparède. Recher. Anat. sur les Annél. Turb., &c., p. 81, pl. 5, f. 6.
1862. ,, ,, (partim), Diesing. Revis. der Turbell., p. 289.
,, ,, *obscurum* (partim), Ibid. Op. cit., p. 291.
,, ,, *capitatum*, Ibid. Op. cit., p. 292.
,, ,, *grœnlandicum*, Ibid. Op. cit., p. 293.
,, ,, *farinosum*, Ibid. Op. cit., p. 293.
,, *Lororrhochma obscurum*, Ibid. Op. cit., p. 295.
1863. *Tetrastemma varicolor*, Diesing. Nachträge zur Revis. der Turbell., p. 10.
,, ,, *algæ*, Ibid. Op. cit., p. 11.
1864. *Polia quadrioculata*, Grube. Die Insel Lussin u. ihre Meeresf., p. 96.
1865. *Tetrastemma varicolor* (partim), Johnston. Catalogue Brit. Mus., pp. 20 and 289.
,, ,, *algæ*, Johnston. Op. cit., p. 20.
1865-6. *Polia quadriocellata*, De Quatrefages. Hist. Nat. des Annelés, pl. 4, f. 2.
1869. *Tetrastemma algæ*, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 339 et seq.

Habitat.—Not uncommon under stones near low-water mark, especially amongst the algæ and corallines which cover their surfaces, and, indeed, one of the best modes of procuring the species is to immerse portions of such stones in sea-water, when the animals seek the water-line and are easily observed. It extends from the Shetland to the Channel Islands.

Body one to one and a half inch long, and nearly a line in breadth; somewhat flattened, narrowed behind the head, and again tapered towards the tail.

Colour.—Various shades of grass- or siskin-green, but females bearing ova have a dull grayish aspect. Some varieties, also, are pale yellow. The head is usually paler than the rest of the animal. Two dull red spots indicate the ganglia. A Zetlandic variety occurs in Bressay Sound of a reddish-brown colour, and in some a few white grains are situated between the anterior pair of eyes.

Head much flattened, spathulate, wider than the succeeding portion of the body, with a pale streak in the median line anteriorly, where there is also a slight notch. Eyes four, forming a square; by the lengthening of the snout, however, they are placed at the corners of an oblong.

Cephalic furrows.—The two oblique anterior furrows course inwards near the posterior pair of eyes, and cause a notch at the margin of the snout in front of the latter. The posterior pair were only examined in small examples, and they were very indistinct, but they probably have the same direction as in other species.

A variety was dredged off St. Peter Port, Guernsey, in 10 fathoms, with the eyes of large size, very pale, and with whitish grains from the tip of the snout backwards between the pairs. The stylet-region had the posterior border of the muscular investment nearly transverse, but probably this was abnormal, as in all other respects it agreed with that of *T. candida.*

This is a very restless species, constantly gliding about with considerable speed; indeed, it is one of the most active of the group. It is tolerably hardy, and will survive more than twenty-four hours on a moist stone in a room. In Bressay Sound the variety above mentioned abounds amongst *Obelia geniculata* about half-tide mark, as well as amongst *Corallina* bored by *Leucodore* at the extreme verge of high-water.

Whether the variety shown in Plate III, fig. 5, and having a pale orange hue, will prove to be specifically different on further investigation, I am at present unable to say, as the drawing was the sole remembrance brought by my sister in one of her excursions. It was procured from the deep water off St. Andrews Bay.

The ova are developed in April and May, as well as in autumn.

I am inclined to refer the *Fasciola candida* of O. F. Müller to this common and variable form. It was discovered by O. Fabricius under stones on the shores of Greenland, and his specimens were unusually large, viz. from two to three inches, the only doubtful feature in the description. Œrsted's *Tetrastemma varicolor,* again, seems to include both this species and *T. dorsalis.* The occurrence of a single stylet-sac in the example of M. de Quatrefages is purely accidental. The *Vermiculus coluber* of Sir J. Dalyell is probably a pinkish variety of this form, and not *T. melanocephala.* M. van Beneden included this along with others under his *Polia obscura,* and the *Polia farinosa* of the same author presents no feature different from the young of this species. M. Claparède's *T. varicolor* comes under the same head, a view supported by his figure of the stylet-region. This is the only Nemertean mentioned in Maitland's 'Fauna Belgii septentrionalis.'

4. Tetrastemma vermicula, *De Quatrefages.* Plate III, fig. 3.

Specific character.—A longitudinal dark patch between the eyes of the respective sides.

Synonyms.

1846. *Polia vermiculus,* De Quatrefages. Ann. des sc. nat., 3me sér., Zool., tom. vi, p. 214.
1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 126, pl. 14, f. 12 and 13.
1850. *Nemertes vermiculus,* Diesing. Syst. Helm., vol. i, p. 270.
1862. *Tetrastemma vermiculus,* Ibid. Revis. der Turbell., p. 290.
1869. ,, ,, McIntosh, Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 339 et seq.

Habitat.—Not uncommon under stones between tide-marks, and occasionally dredged in the laminarian region, from the North of Scotland to the Channel Islands. Coast of France (Bréhat).

Body.—Three fourths to one inch in length, and about a line in breadth, moderately elongated, dilating very gradually behind the head, continuing for some distance of considerable diameter, and again diminishing towards the tail.

Colour.—Dull whitish, salmon, or pinkish, with two elongated dark spots on the head. In a specimen from St. Peter Port, Guernsey, the digestive tract was pale siskin-green. There was also a faint white streak on the middle of the dorsum, commencing between the posterior pair of eyes, and proceeding a short distance backwards.

Head wider than the succeeding portion of the body, flattened, having its greatest diameter in the middle, and marked by the cephalic furrows. Eyes four, the pairs separated by a considerable interval, which on each side is nearly filled up by a longitudinal patch of dark pigment. The latter is widest anteriorly, and often does not quite reach the posterior eye, which is thus prominent, while the anterior is indistinct. There is sometimes an opaque whitish patch between the anterior pair of eyes, and this is continued faintly along the central streak.

Cephalic furrows.—A little in front of the posterior pair of eyes is the groove connected with the cephalic pit, which (furrow) passes inwards and slightly backwards on each side and soon terminates. Somewhat behind the posterior pair of eyes another furrow slants inwards and backwards, and meets its fellow of the opposite side in the middle line.

T. vermicula in its lively and restless habits much resembles *T. candida*. Many perish by crawling out of the water and being dried on the side of the vessel.

The ova are deposited in a free condition about the beginning of May.

I have placed this pretty species under the name of M. de Quatrefages, but with amended characters. He erroneously states that the head is not distinguished from the rest of the body, and that the marginal stylet-sacs are situated on the "dorsal and ventral" aspects of the proboscis. His figure, also, of the entire animal is too elongated, and his remark that the pigment-patch between the eyes of each side is violet can only refer to the aspect under transmitted light. Stimpson has a *Tetrastemma* (?) *vermiculus* in his 'Prodromus' (ii, p. 19), but its identity with the present form is doubtful.

5. Tetrastemma flavida, *Ehrenberg*. Plate IV, fig. 1.

Specific character.—Head not wider than the rest of the body. Anterior and posterior pairs of eyes widely separated.

Synonyms.

1831. *Tetrastemma flavidum*, Ehrenberg. Symb. Phys., Phyt. Turb., No. 25, tab. 5, f. 3, *a*—*d*. and *a**—*c**.

1844-5. ,, *longecapitatum*. Œrsted. Kroyer's Naturhist. Tids., i, p. 418.

,, ,, *flavidum*, Ibid. Op. cit., iv, p. 576, in note.

,, ,, ,, Ibid. Entwurf Plattw., p. 87.

1846. *Polia sanguirubra*, De Quatrefages. Ann. des sc. nat., 3^{me} sér., Zool., tom. vi, p. 208, tab. 11, f. 3 and 7; tab. 12, f. 1.

1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 120, pl. 15, f. 11 and 12.

1850. *Tetrastemma flavidum*, Diesing. Syst. Helm., vol. i, p. 257.
,, *Nemertes hæmatodes*, Ibid. Op. cit., p. 270.
1860. *Polia obscura* (partim), Van Beneden. Mém. Acad. Belg., tom. xxxii, Recher. sur les Turb. (sep. copy), p. 23, pl. 4, f. 10.
1862. *Tetrastemma flavidum*, Diesing. Revis. der Turb., p. 289.
,, ,, *sanguirubrum*, Ibid. Op. cit., p. 290.
,, ,, *longecapitatum*, Ibid. Op. cit., p. 293.
1869. ,, *varicolor*, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 339 et seq.

Habitat.—Under stones between tide-marks and in fissures of rocks; less common than *T. candida*. From Scotland to the Red Sea.

Body one to one inch and a half in length, attenuated, flattened, nearly of equal diameter throughout, except where slightly tapered towards head and tail.

Colour pinkish or pale peach, from the hue of the digestive tract. The snout is translucent, with a slight opacity between and rather in front of the posterior pair of eyes, and a pale patch from the ganglia behind them. The lateral margins are pale.

Head rather indistinctly defined, bluntly rounded at the tip, from the centre of which the usual pale streak proceeds. The eyes are equidistant in each pair, and the latter are separated from each other by a much longer interval than exists in *T. candida* and the others. The anterior eyes have the larger masses of pigment.

Cephalic furrows.—The openings of the cephalic sacs are placed nearly opposite the first pair of eyes, so that the anterior furrows are carried far forward. They slant inwards and backwards just behind the eyes, while inferiorly they are nearly transverse. The posterior furrows lie a little behind the last pair of eyes, and, proceeding inwards and backwards, meet in the centre of the dorsum. They have a direction forward and inwards on the inferior surface, but less obliquely than on the dorsum; thus, while the dorsal meet towards the posterior part of the ganglia, the ventral coalesce near the anterior border of the latter. The two sets of furrows are indicated by lateral notches.

This species is more sluggish than *T. candida*, and much more delicate. It resembles *Nemertes carcinophila* in the slow, gliding manner in which it moves about the vessel, a very gentle undulatory motion of the head and body taking place.

The ova are developed in May.

Prof. Ehrenberg first gave a description and drawing of this species. The equidistant eyes, with the pairs widely separated, and the cephalic furrows passing inwards nearly opposite the first pair, are fairly represented. The *Tetrastemma assimile* of Œrsted, no doubt, has the anterior and posterior pairs of eyes widely removed, but this is the only character which can be identified with the present species. The *Polia sanguirubra* of De Quatrefages, again, appears to be a variety with tinted nuclei to the proboscidian discs (a phenomenon probably due to refraction of the rays of light), and the Sicilian *Polia baculus* of the same author differs only in the somewhat more attenuated condition of the snout. His *Polia armata* is also closely allied in external characters, but the presence of four stylet-sacs, if not accidental, is a distinguishing feature. Two of these marginal stylet-sacs, according to this author, occur a considerable way in front of the central stylet, or at the anterior part of the elongated stylet-region, and two behind, opposite the basal apparatus of the central organ. M. van Beneden seems to have included specimens of this species under his *Polia obscura*. In the absence of more definite characters I have not thought it proper to place the *Tetrastemma sanguirubra* of Stimpson amongst the synonyms.

6. TETRASTEMMA DORSALIS, *Abildgaard*. Plate I, fig. 4, and Plate III, fig. 4.

Specific character.—Body short, thick and round, little tapered towards either extremity. Speckled with yellow and brown, or with a single dorsal stripe.

SYNONYMS.

1806.	*Planaria dorsalis*, Abildgaard.			Zool. Danic., vol. iv, p. 25, tab. 142, f. 1—3.
1844.	*Tetrastemma fuscum*, Œrsted.			Kroyer's Naturhist. Tids., iv, p. 575.
,,	,,	,,	Ibid.	Entw. Plattw., p. 86, woodcut 14.
,,	,,	,,	Ibid.	De Region. Marin., p. 79.
1846.	*Œrstedia maculata*, De Quatrefages.			Ann. des sc. nat., 3^{me} sér., Zool., tom. vi, p. 222, tab. 8, f. 2.
,,	,,	*tubicola*, Ibid.		Op. cit., p. 223.
1849.	,,	*maculata*, Ibid.		Voyage en Sicilie, vol. ii, p. 134, pl. 17, f. 15—17.
,,	,,	*tubicola*, Ibid.		Op. cit., p. 135, pl. 17, f. 18 and 19.
1850.	,,	*maculata*, Diesing.		Syst. Helm., vol. i, p. 247.
,,	,,	*tubicola*, Ibid.		Op. cit., p. 247.
,,	*Tetrastemma fuscum* (partim), Ibid.			Op. cit., p. 257.
,,	,,	*varicolor* (partim), Ibid.		Op. cit., p. 257.
1853.	*Vermiculus variegatus*, Dalyell.			Pow. Creat., vol. ii, p. 91, pl. 10, f. 25 and 26.
1859.	*Tetrastemma variegatum*, Leuckart.			Archiv für Naturges., ii, p. 188.
1862.	*Œrstedia maculata*, Diesing.			Revis. der Turbell., p. 263.
,,	,,	*tubicola*, Ibid.		Op. cit., p. 263.
,,	*Tetrastemma fuscum*, Ibid.			Op. cit., p. 289.
1863.	,,	*variegatum*, Ibid.		Nachträge zur Revis. der Turbell., p. 10.
,,	,,	*marmoratum*, Claparède.		Beobach. über Anat. u. Entwicklung., &c., p. 24, taf. 5, f. 14.
1865.	,,	*variegatum*, Johnston.		Catalogue Brit. Mus., pp. 20 and 289.
1866.	,,	,,	Lankester.	Ann. Nat. Hist., 3rd Ser., vol. 17, p. 388.
1868.	,,	,,	McIntosh.	Rept. Brit. Assoc., 1868, p. 340.
1869.	,,	,,	Ibid.	Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 339 et seq.

Habitat.—Abundant in the laminarian region, in three to ten fathoms, where it haunts *Ceramium rubrum* and other algæ. It is also occasionally found under stones at extreme low water. Extends from Shetland to the Channel Islands.

Body half to three quarters of an inch in length, and rather more than half a line in breadth. It is so round as to be nearly circular in transverse section, with the exception of a little flattening on the ventral surface ; very slightly tapered at either extremity.

Colour.—On the coasts of Scotland two varieties are especially common. The most abundant form is of various shades of brown or reddish-brown, speckled with groups of yellowish-white granules, often of considerable size, which are placed along the centre of the dorsum from one end of the body to the other, but they do not form a continuous stripe. In some there is also a distinct brown lateral line. The other variety is reddish-brown, with a pale yellow dorsal stripe from snout to tail. The sepia-brown grains of the dorsum are placed on a reddish-brown ground. As soon as the pigment of the body becomes dark enough, a fine purplish lustre is produced by the play of light on the cilia, and the animal assumes a rich velvety aspect. In these dark examples, with a reddish-yellow central stripe, the under surface of the snout generally presents two pale symmetrical ovoid spaces a little behind the line indicating the mouth. In some cases the yellowish grains are scattered over both dorsal and ventral surfaces, and are quite characteristic of the species. In a large example dredged in Bressay Sound the dorsum was curiously variegated with patches of cinnamon-brown on a general ground-colour of pale brown speckled with yellowish grains, the pale brown of the ventral surface having a few specks of the same hue as the dorsum. The ventral surface is somewhat pale in all cases, and occasionally assumes a dull brownish-orange posteriorly. When floating with the ventral surface uppermost, a brownish margin is generally visible. Young examples are occasionally reddish-orange.

Head somewhat truncate and even notched in front, slightly narrowed posteriorly towards the cephalic furrows, and very little flattened. Eyes four, nearly in a square, the first pair being further from the tip of the snout than the last are from the cephalic furrows. They are deeply situated, and somewhat lateral in position—from the roundness of the snout when seen from above, and in profile appear considerably below the dorsal line. A variety from the harbour of Symbister, in Whalsay (Shetland), has the head somewhat pointed and better defined than usual, and the tail is also more tapered.

Cephalic furrows.—The anterior furrows are not visible on the dorsum. The posterior slant inwards and slightly backwards some distance behind the posterior eyes, meeting in the middle line. On the ventral surface they are directed slightly forward.

T. dorsalis is a marine rather than a littoral form, and sometimes occurs in vast numbers clinging to the débris of various seaweeds dredged in the laminarian region. It is hardy in confinement, either gliding with scarcely an undulation of its body, or rolling its snout from side to side in a peculiar manner as it progresses along the glass. It is also fond of enclosing itself in a tough transparent sheath, which is fixed to the wall of the vessel at the water-line. The sheath is highly elastic, and, while remaining perfectly transparent under a high power, is yet minutely streaked with translucent granules or specks, which are not due to fine creases or folds. The animal often reverses itself in the tube, and is sometimes doubled therein. It is curious to watch the pertinacity with which it progresses in a definite direction to stretch itself along the water-line.

The ova are deposited in the beginning of September, but some latitude is necessary in this respect, since specimens from deep water produced ova in June.

This species was brought into notice by P. C. Abildgaard in the fourth volume of O. F. Müller's celebrated 'Zoologica Danica;' and though he did not observe the eyes, his account is otherwise good. He terms it an eyeless brown 'Planaria,' with a pale ventral surface and a white dorsal line, and which constantly twists itself and loves to swim on its back. M. de Quatrefages, again, made a distinction between two varieties of this species, one of which (*Œrstedia tubicola*), he said, formed a tube, while the other (*O. maculata*) did not. Moreover, he elevated them into a new genus—characterized by the sublateral position of the nerve-trunks, and their cylindrical bodies. Their structure, however, is in all respects strictly conformable to the type of the Enopla. The large size of *O. maculata* (3 to $3\frac{1}{2}$ in.) from the shores of Sicily is peculiar. Sir J. Dalyell says it is rare, and that its colour is universally variegated red and white, with a white line down the back, but his drawing shows only interrupted specks along the dorsum. This excellent author held the opinion, which I cannot endorse, that the *Planaria dorsalis* of Abildgaard referred to a fragment of *Lineus bilineatus*. The *Tetrastemma marmoratum* of M. Claparède, from the coast of Normandy, is the present species. The cylindrical form of the body had previously been known.

Genus III.—Prosorhochmus,[1] *Keferstein*, 1863.

The typical species of this genus was first mentioned by Col. Montagu (MS., Library of the Linnean Society), who, however, was inclined to refer it to the *Planaria candida* of O. F. Müller. It is unlikely that so common a species escaped the notice of observers from the foregoing period up to 1863, the date at which Professor Keferstein published his descriptive characters of the genus in his 'Untersuchungen,' but it is probable that it was confounded with other forms. The four eyes which are characteristic of the previous genus are retained, only they do not form a rectangle. I would not place much weight (generically) on the ovo-viviparous character, as this is a condition which further investigation will probably extend to many genera.

Generic character.—Eyes four, not forming a rectangle; snout dimpled and furnished with a transverse superior lobe. Ovo-viviparous.

Prosorhochmus Claparedii, *Keferstein*. Plate II, fig. 4.

Specific character.—Snout blunt; eyes placed far back, the space between the anterior pair widest; yellowish. Other characters as in the genus.

Synonyms.

1808. *Planaria flava*, Montagu. MS., p. 237, tab. 35, f. 2.
1846. *Polia fumosa*, De Quatrefages. Annal. des sc. nat., 3me sér., Zool., vi, pp. 206-7.?
1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 118, pl. 14, f. 9—11.?
1862. *Prosorhochmus Claparedii*. Keferstein. Zeitsch. f. wiss. Zool., Bd. xii, p. 61, taf. 6, f. 1—5.
1863. ,, ,, Diesing. Nachträge zur Revis. der Turbell., p. 10.
,, ,, ,, Claparède, Beobach. über Anat. u. Entwick., p. 23, taf. 5, f. 10—12.
1869. ,, ,, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 344 et seq.

Habitat.—Under stones, and in fissures of rocks between tide-marks, on the southern shores of England, and in the Channel Islands.

Body an inch to an inch and a half in length, and three quarters of a line in breadth, flattened, somewhat narrowed behind the head, then gradually dilating, continuing for some distance of nearly equal diameter, and again diminishing towards the tail. In those examples in which the ovisacs are filled with developing young the body is round. The anus is very distinct.

[1] πρόσω, the front, and ῥωχμός, a fissure.

Colour pale yellow, or, in some, pale orange, with two translucent spots behind the eyes, marking the situation of the ganglia. Long confinement increases the number of the dull orange grains on the dorsum. The young have numerous orange pigment-specks in their skins at birth.

Head wider than the succeeding portion of the body, though not distinctly defined posteriorly, broadly spathulate as well as somewhat truncate in front, and with a well-marked central notch from which a pale streak proceeds some distance behind the ganglia. Just behind the notch is a transverse furrow, furnished with very long cilia, which have a radiate appearance under the microscope. Eyes situated considerably behind the tip of the snout, the anterior pair being the larger, and while those of opposite sides are widely apart, those on the same side are closely approximated. The anterior pair under pressure often present a crescentic margin in front, and I have seen a clear globule in connection with them, which may represent a lens. In profile the two halves of the snout in front form a pair of large and prominent lips, with the mouth underneath and behind—in the shape of a well-marked elliptical or ovoid slit, while a third lobe, less prominent, occurs on the dorsum. The trilobed condition of the snout is well seen in small specimens placed between glasses separated by a chip.

Cephalic furrows.—A very slight notch is observed opposite the first pair of eyes, which indicates the opening of the cephalic pit, and an indistinct furrow runs from this point inwards.

P. Claparedii is not so active and restless in its movements as some of its allies, but it is the most hardy four-eyed example of the Enopla I have yet seen, even more so than *T. dorsalis*. The specimens bore a journey from the Channel Islands to Scotland without the loss of one, or rather with a considerable increase, since the adults gave birth to numerous young individuals. It is interesting to see the comparatively large embryo moving in the interior of the adult, without interfering with its comfort in any way. They are observed in the bodies of their parents in July, and some remained there till October, having meantime considerably increased in size. Under pressure the embryos sometimes escape *per anum*. Both young and old are fond of leaving the water and remaining on the side of the vessel in the open air, and dozens of the former are frequently found floating on the thin whitish film which gathers on the surface of the sea-water after long keeping. They appear to be somewhat social animals in the free condition, as groups of adults (from ten to fifteen in number) are occasionally found in fissures of the rocks at St. Peter Port, Guernsey.

If the indefatigable Col. Montagu had published his notes and figure of this species it now would have borne his name. He describes it as "long, filiform, yellow, with the front rounded and slightly bifid. Four eyes placed quadrangular." Five were found entwined together on the coast of Devon. He thought it might be the *Planaria candida* of Müller, but the arrangement of the eyes and other points in his figure, together with the description, show its real nature. Œrsted remarks that the anterior pair of eyes in his *Tetrastemma subpellucidum* are widest apart, but we are otherwise left in doubt as to the actual species he describes. The *Polia fumosa* of M. de Quatrefages has certain close resemblances to this form, such as the arrangement of the eyes and the truncated snout, and it is difficult to see to what species the author refers if not to this. The colouring of the figure (op. cit., fig. ix, A, B) is much too dark, and the outline not at all characteristic. The enlarged anterior end, however, in fig. x, though not accurate, can scarcely apply to any other species. He found it in fissures of the rocks at St. Vaast and Bréhat. It was not till more than half a century after the English naturalist's observations that Prof. Keferstein published his account of the animal from specimens collected at St. Vaast-la-Hougue. His statement, however, that its mouth is behind the ganglia is erroneous, and it may be remarked that the position of the mouth is more easily seen in this species than usual. The occurrence of three marginal stylet-sacs in some examples is evidently accidental or abnormal.

The notched condition of the anterior border of the snout, so characteristic of this species, is very conspicuous in a large and flattened member of the Enopla, from New Zealand, in the British Museum. The specimens (in spirit) are about three inches long.

Sub-Family—NEMERTINÆ.

Proboscis proportionally small.

Genus IV.—NEMERTES, *Cuvier*, 1817 (Char. emend.

Cuvier founded this genus for the description of *Lineus marinus*, which previously had received other names, and therefore the new title ought to have lapsed. But being set abroad by a zoologist so distinguished, it naturally came to be much employed in describing numerous and often diverse genera, as well as used by subsequent authors as the title of the entire order. Though the genus was first established, therefore, for the reception of one of the Anopla, yet the name has very frequently been bestowed on forms belonging to the Enopla, and, besides, claims attention from its priority, both as a generic title and as applied to one of the typical forms (*Nemertes gracilis*) of this genus.

Generic character. — Body more or less elongated, while the proboscis is very much diminished, the anterior region of the organ especially being shortened, so as to cause the central stylet to approach the ganglia.

1. NEMERTES GRACILIS, *Johnston*. Plate II, fig. 5.

Specific character.—Eyes numerous; snout broader than the rest of the body; central stylet of proboscis with an extremely long basal apparatus. Greenish or olive.

SYNONYMS.

1837. *Nemertes gracilis*, Johnston. Mag. Zool. and Bot., vol. i, p. 534, pl. 17, f. 1.
1841. ,, ,, W. Thompson. Ann. Nat. Hist., vol. vii, p. 482.
1844. *Polystemma gracile*, Œrsted. Entw. Plattw., p. 93.
1846. *Prostoma gracilis*, Johnston. Ann. Nat. Hist., vol. xvi, p. 435.
,, *Nemertes balmea*, De Quatrefages. Ann. des sc. nat., 3me sér., Zool., tom. vi, p. 197; tab. 9, f. 3—6; tab. 11, f. 2, and 4; and tab. 12, f. 2.
1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 109, pl. 10, f. 6 and 7, and pl. 19, f. 3—6.

1850. *Omatoplea balmea*, Diesing. Syst. Helm., vol. i, p. 249.
,, ,, *gracilis*, Ibid. Op. cit., p. 250.
1862. ,, *balmea*, Ibid. Revision der Turbell., p. 255.
,, ,, *gracilis*, Ibid. Op. cit., p. 255.
1865. ,, ,, Johnston. Catalogue Brit. Mus., p. 22, pl. ii *a*, f. 1 and 1*.
1869. ,, ,, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 331 et seq.

Habitat.—Frequent under stones between tide-marks, and especially abounding under tangle-roots at low water. No example, however, was met with during an excursion to the Channel Islands.

Body.—Eight to twenty inches in length, and about a line in breadth, flattened in progression, and thrown into ever-varying wrinkles, dilatations and contractions. The diameter is nearly uniform for a considerable distance behind the head, and then the body gradually tapers towards the tail. It is occasionally attenuated to a mere thread.

Colour.—Dull greyish-green on the dorsum, deepest in front, and somewhat duskier in the centre from the hue of the alimentary tract. Some incline to bluish-green anteriorly, others are dull olive throughout. There are two reddish specks (due to the ganglia) behind the head. In some specimens the dorsum for a short distance posterior to the latter is marked with minute pale specks or with black pigment-grains, the latter occasionally continuing to the tip of the tail. The under surface is greyish-white, dappled in the ripe females with dull whitish spots from the ova. The reddish colorations from the ganglia are best observed on this surface, and there is also a pale streak in the œsophageal region.

Head.—Somewhat spathulate, flattened, rather blunt at the tip, and slightly dilated laterally, so as to be wider than the rest of the body. Eyes arranged in two or three groups on each side, the anterior cluster containing the larger number, and being situated just within the pale border of the snout. The number of eyes in this series ranges from five to nine, but, as usual, it is variable. The next group is placed distinctly posterior, nearer the middle line of the head, and consists of three, four, or five eyes, which in some are transversely arranged. The third cluster lies at the anterior border of the ganglion, or, occasionally, proceeds backwards along the outer border of the latter. The first-mentioned groups are visible from the ventral surface.

Cephalic furrows.—There are no evident furrows on the dorsum of the head, and inferiorly there is only the central slit of the mouth.

This species lives a considerable time in confinement. Sometimes, when it has stretched its snout beyond the water-line, while its tail reaches the bottom of the vessel, it assumes a very regular spiral arrangement. If the snout be loosened from its attachment, the body is at once gracefully shortened, like the stalk of a Vorticella or a coiled spring. It can also attenuate itself to an extreme degree. It secretes a very tenacious, transparent mucus, especially when irritated, and envelopes itself therewith, apparently for protection. The fine threads of this secretion are so tough that they support the animal when lifted above the surface of the water. The skin is acid to test-paper.

Nemertes gracilis spawns in May.

This animal was discovered by Dr. Johnston on the coast near Berwick, a region that became so rich in novelties under his patient and searching scrutiny. It was re-described many years later by M. de Quatrefages under the name *Nemertes balmea*, from Bréhat. The French author did not observe any cephalic furrows, or "genital aperture" (mouth), and therefore he concluded that the latter was a temporary orifice. Its mouth occupies the usual position.

2. Nemertes Neesii, *Œrsted.* Plate III, fig. 6; and var., Plate VII, fig. 6.

Specific character.—Eyes numerous. Stylets short and grooved. Streaked with purplish-brown on the dorsum.

Synonyms.

1828. *Planaria flaccida*, Johnston. Zool. Journ., vol. iii, p. 188.
1844. *Amphiporus Neesii*, Œrsted. Kroyer's Naturhist. Tids., iv, p. 581.
,, ,, ,, Ibid. Entw. Plattw., p. 95.
1846. *Borlasia? flaccida*, Johnston. Ann. Nat. Hist., vol. xvi, p. 135.
,, ,, *camillea*, De Quatrefages. Ann. des sc. nat., 3^e sér., Zool., tom. vi, p. 191, tab. 9, f. 1, and tab. 14, f. 3.
1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 106, pl. 10, f. 4 and 5.
,, *Amphiporus Neesii*, Leuckart. Archiv für Naturges., i, p. 149.
1850. ,, ,, Diesing. Syst. Helm., vol. i, p. 245.
,, *Nemertes camillea*, Ibid. Op. cit., p. 274.
1853. *Gordius fuscus*, Dalyell. Pow. Creat., vol. ii, p. 83, pl. 9, f. 15 to 17, and pl. 12.
1859. *Amphiporus Neesii*, Leuckart. Archiv fur Naturges., ii, p. 187.
1862. *Borlasia Neesii*, Diesing. Revis. der Turbell., p. 249.
,, *Emplectonema camillea*, Ibid. Op. cit., p. 306.
1865. *Serpentaria fusca*, Johnston. Catalogue Brit. Mus., pp. 28 and 298.
1865-6. *Borlasia camillæ*, De Quatrefages. Hist. Nat. des Annelés, pl. 4, f. 11.
1866. *Serpentaria fusca*, Lankester. Ann. Nat. Hist., 3rd ser., vol. xvii, p. 389.
1868. *Ommatoplea purpurea*, McIntosh. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
,, ,, ,, Ibid. Report Brit. Assoc., 1868, p. 340.
1869. ,, ,, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, p. 336 et seq.

Habitat.—Under stones between tide-marks, in crevices of rocks and tangle-roots near low water, and in fissures of the Gouliot caves, Sark. It also occurs on the tangle-ground in Shetland, and in deep water off the east coast of Scotland. Ranges from Iceland to the Channel Islands.

Body.—Four to eighteen inches in length, and, in large specimens, about a quarter of an inch in breadth, elongated, much flattened, appearing almost of equal diameter throughout, though in reality slightly tapering towards the posterior end. It is generally thrown into numerous equidistant transverse wrinkles, which are only obliterated in extreme extension.

Colour.—Variously speckled madder-brown, with a faint purplish iridescence from the play of light on the cilia. Towards the anterior part of the body the specks are more marked, and the general colour somewhat paler, especially on the head. Behind the latter the dorsum assumes a streaky appearance, brown being the predominant hue, with longitudinal flesh-coloured stripes, all of an interrupted character. The lateral regions abound with brown specks. Towards the tail the colour again becomes paler, and the dorsal specks more numerous. The entire under surface is pale pinkish-white, or skin-coloured. In the darker specimens the streaks are less numerous, though more boldly marked. Some examples are of a very pale brownish hue, the dorsum having only pale brown pigment-grains and no streaks. Other varieties, again, are very curiously mottled, like polished rosewood or walnut, or of a faint yellow, speckled with brown. Young specimens from deep water are occasionally almost white, or faint skin-colour, and some have a uniform dull orange hue, from the digestive chamber. The proboscis in the latter examples is pale pink. Young specimens, and those from dark recesses, are generally pale.

Head.—Spathulate, wider than the rest of the body, with a pale margin, and a central streak from the notch or dimple in front backwards. Eyes numerous, arranged in two dense clusters on each side—a little behind the tip of the snout. Unless in pale specimens, they are distinguished with difficulty on account of the dark coloration of the dorsum. They are larger than the eye-specks of *N. gracilis*.

Cephalic furrows.—The snout is bounded posteriorly by two dorsal transverse grooves, which also mark a slight constriction. On the under surface two furrows slant outwards and backwards from the mouth, a short distance behind the tip of the snout, and from these the openings of the cephalic pits proceed. They are visible as two curved lines, which do not reach the lateral margin of the body, and thus are wholly ventral.

N. Neesii is rather plentifully distributed on our coasts, four or five being occasionally procured under one stone, or in a fissure of the shelving rocks. The facility with which it coils and twists its body in all directions is most interesting. Sometimes the posterior part of the animal lies in a tangled knot, while the anterior extends outwards as a long screw, the alternate dark and light shades of the dorsal and ventral surfaces forming a very agreeable contrast; and from the frequency with which it assumes this attractive position one might be excused in attributing to the animal some sense of the splendour with which nature has endowed it. It floats with ease on the surface of the water, the body being thrown into various undulations, as when progressing on the surface of the ground, though, of course, more slowly and less distinctly. It is killed by immersion in fresh water, the body before death being surrounded by a tough coating of mucus, like many of its allies and the Dorides. The skin is alkaline to test-paper.

In one specimen of a pale brick-red hue, from Guernsey, the muscular investment of the basal apparatus of the central stylet was abnormal (a state that could scarcely have resulted from degeneration, for it was examined on the third day after capture), being elongated posteriorly and split into processes like rootlets, from the peculiarities of the fibres.

It spawns in March and April.

The *Lineus maculosus* of Montagu (MS., p. 274) can scarcely refer to any other British form than the above. It is described as "rufous-brown, mottled, beneath white, resembling *L. marinus*. Length more than a foot, and not larger than *Gordius aquaticus*." Dr. Johnston, however, first published an account of the species, from a specimen coiled in a valve of *Saxicava rugosa*, from deep water in Berwick Bay. The *Amphiporus Neesii* of Œrsted, as R. Leuckart mentions, is clearly synonymous with the *Gordius fuscus* of Dalyell (the present species), and as Œrsted's specific title is free from the objections connected with Johnston's, it has been chosen. Sir J. Dalyell noticed its tendency to coil in knots. His examples spawned in April, the ova merely lying in a "thin albuminous matter" (probably mucus), and covering the bottom of a vessel two inches in diameter. He hazarded the opinion that the mouth was apparently in the anterior part. There is nothing to indicate specific distinction from the present form in the description and figures of the *Borlasia camillea* of De Quatrefages. I cannot, however, make the same statement with regard to the *Emplectonema camillea* of Stimpson and the *Nemertes camillea* of Williams. Two specimens in the British Museum, from Greenland, have very short, thick bodies, and the proboscis in each is proportionally large; but these appearances may be due in some respects to the mode of preparation.

This species has sometimes been confounded with "Serpentaria fragilis" (*Cerebratulus angulatus*).

3. Nemertes carcinophila, *Kölliker*. Plate I, fig. 5.

Specific character.—Eyes two; proboscis furnished with a central stylet only. Body of a pale pink colour.

Synonyms.

1845. *Nemertes carcinophilos*, Kölliker. Verhandl. d. Schweiz. naturf. Gesellsch. in Chur., p. 89.
1850. ,, ,, Von Siebold. Archiv für Naturges., p. 382.
1860. *Polia involuta*, Van Beneden. Recher. sur les Turbell. (sep. copy, from Mém. Acad. Belg., tom. xxxii), p. 18, pl. 3.
1862. *Cephalothrix involuta*, Diesing. Revis. der Turbell., p. 251.
,, *Nemertes carcinophila*, Ibid. Op. cit., p. 298.
1869. *Polia involuta* (*Nemertes carcinophila*, Kölliker), McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 309 et seq.

Habitat.—Abounds in tubes attached to the abdominal hairs of female specimens of *Carcinus mænas* bearing ova. Messina and the Coast of Belgium.

Body.—One to two inches long, scarcely so thick as a thread during extension, flattened, nearly equal in diameter throughout, or very slightly tapered at head and tail.

Colour.—Pale skin or slightly pinkish; pale rose-pink in contraction or when coiled *en masse*. There is a pale patch behind the snout, indicating the region of the proboscis.

Head.—Slightly tapered towards the anterior end, not defined from the rest of the body, and ending in a blunt snout. Eyes two, situated considerably behind the tip of the latter.

It is a somewhat sluggish animal, lying doubled in its sheath, or when removed gliding about the vessel in a slow, feeble manner. It is also less hardy in confinement than the majority of the group.

N. carcinophila spawns in April, and it is easy to watch the development of the young.

Prof. Kölliker first found the worm in its usual position on a small crab at Messina, and his account of it is quite characteristic. This paper, however, escaped the notice of M. van Beneden, who re-described it as a new species from "*Cancer mænas*" many years subsequently. It is not strictly a parasite of the shore-crab, but, like diverse annelids in other sites, it seems to find the hairs of the abdominal feet of females bearing ova a convenient position for its sheaths, and probably for protection and a proper supply of food. In the same way the *Tetrastemma* before mentioned frequents the branchial chambers of the Ascidians, the *Planaria angulata* of Agassiz (not Müller) the under surface of *Limulus*, and the *Planariæ* the cavities of the Medusæ; or, as *Harmothoë imbricata*, *Polynoë areolata*, and others, live in harmony with *Chætopterus norvegicus* in its tube, and *Polynoe scolopendrina* with *Marphysa sanguinea* and *Terebella nebulosa* in their tunnels.

Prof. van Beneden, however, correctly indicates its affinity with the *Prorhynchus stagnalis* of Max Schultze, a freshwater species, and gives an interesting if not strictly accurate account of its development.

Sub-Order—ANOPLA.

Proboscis without stylets.

Family II.—Lineidæ.

Genus V.—Lineus,[1] *Sowerby*, 1806.

The typical species of this genus was one of the first Nemerteans known to science, viz. the *Gordius marinus* of Montagu. The generic name employed by the latter, however, as he himself was well aware, could not stand; and while he was waiting till the discovery of other species would enable him to give a more comprehensive description of the genus, Sowerby published 'The British Miscellany,' in which the generic name above mentioned was bestowed on the same characteristic species.

Generic character.—Body more or less elongated, rounded or somewhat flattened, and tapered posteriorly. Head distinct, spathulate, and generally truncate in front. Eyes numerous, arranged along the sides of the snout anteriorly; rarely absent. Mouth in the form of a conspicuous longitudinal slit on the ventral surface. Other characters as in the family.

1. Lineus marinus, *Montagu*. Plate IX; and Plate XVIII, figs. 1—3.

Specific character.—Eyes numerous, deeply set in a marginal row on each side of the snout. Of a blackish or very dark olive colour, more or less distinctly streaked longitudinally. Body rather rounded.

Synonyms.

1758. *Sea-Long Worm*, Borlase. Nat. Hist. Cornwall, p. 255, tab. 26, f. 13.
1804. *Gordius marinus*, Montagu. Linn. Trans., vol. vii, p. 72.
1806. *Lineus longissimus*, T. W. Simmons. Sowerby's Brit. Misc., p. 15, pl. 8.

[1] *Linea*, a line.

1807. *Lineus longissimus*, Turton's British Fauna, p. 130.

1808. ,, *marinus*, Montagu. MS., p. 271.

1811. ,, *longissimus*, Jameson. Wernerian Memoirs, vol. i, p. 557.

1812. *Gordius marinus*. Pennant's British Zoology, vol. iv, p. 71.

1815. *Borlasia angliæ*, Oken. Lehrbuch, &c., p. 365, tab. xi, f. 1.

,, *Gordius marinus*, Davies. Trans. Linn. Soc., vol. xi, p. 292.

1816. ,, ,, Ibid. Lond. Med. and Phys. Jour., xxxvi, pp. 207-9.

1817. ,, ,, Ibid. Extr. in Isis, 1817, pp. 1051-56.

,, *Nemertes Borlasii*, Cuvier. Règ. An., tome iv, p. 37.

1828. *Borlasia angliæ*, De Blainville. Dict. des sc. nat., 57, p. 575; ibid., Atlas, Parentome-zaires, f. 1 *a*—1 *d*.

1831. *Nemertes Borlasii*. Griffith's Cuv., vol. xii, p. 168.

1836. *Borlasia longissimus*, Templeton. Lond. Mag. Nat. Hist., vol. ix, p. 236.

1838. *Nemertes Borlasii*, W. Thompson. Charlesworth's Mag. Nat. Hist., vol. ii, p. 21.

1843. *Borlasia striata*, Rathke. Beitr. z. Fauna Norweg. Nov. Act. Nat. Curios., xx, p. 231

1842-3. ,, *angliæ*, Œrsted. Kroyer's Naturhist. Tids., iv, p. 572, in nota.

1844. *Nemertes Borlasii*, Ibid. Entw. Plattw., p. 92.

,, ,, *striata* (Rathke). Ibid. Op. cit., p. 92.

1845. ,, *gracilis*, H. Goodsir. Ann. Nat. Hist., vol. xv, p. 378, pl. 20, f. 3.

1845.? ,, *Borlasii*, De Quatref. Règne An. illust. Zoophytes, 12e livraison, pl. 83

1846. *Lineus longissimus*, Johnston. Ann. Nat. Hist., vol. xvi, p. 135.

,, ,, *gracilis*, Ibid. Op. cit., p. 135.

,, *Borlasia angliæ*, De Quatrefages. Ann. des sc. nat., 3me sér., Zool., tom. vi, p. 192, tab. 8, f. 4 and 5; tab. 10, f. 8; tab. 12, f. 3 and 4; and tab. 13, f. 1—3 and 5—9.

1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 104, pl. 9, f. 7; pl. 11; and pl. 12, f. 2, &c.

1850. *Meckelia Borlasii*, Diesing. System. Helm., vol. i, p. 265.

,, ,, *gracilis*, Ibid. Op. cit., p. 268.

,, *Nemertes striata*, Ibid. Op. cit., p. 271.

1851. *Lineus longissimus*, Williams. Rept. Brit. Assoc., 1851, p. 214, f. 61 (?)

1853. *Gordius maximus*, Dalyell. Pow. Creat., vol. ii, p. 63, pl. 8, and pl. 9, f. 1.

1855. "An ascaroid or planarian worm." North Brit. Review, No. 13, p. 38.

1856. *Borlasia nigra*, Byerley. Fauna of Liverpool, p. 98.

1857. *Nemertes Borlasii*, De Quatrefages. Ramb. of a Naturalist, Eng. edit., vol. i, p. 116.

1859. ,, ,, Kingsley. Glaucus, p. 124, pl. 3, f. 1.

,, *Borlasia angliæ*, Leuckart. Archiv für Naturges., ii, p. 187.

1860. *Nemertes Quatrefagii*, Van Beneden. Recher. sur les Turb., &c., p. 15, pl. 2, f. 5—9, var.

1862. *Meckelia Borlasii*, Diesing. Revis. der Turbell., p. 285.

,, ,, *gracilis*, Ibid. Op. cit., p. 303.

,, ,, *Quatrefagii*, Ibid. Op. cit., p. 304.

1863. ,, *Borlasii*, Diesing. Nachträge z. Revis. der Turbell., p. 8.

1865. *Borlasia striata*, Johnston. Catalogue Brit. Mus., pp. 22 and 291.

,, ,, *longissimus*, Ibid. Op. cit., pp. 25 and 293.

,, ,, *gracilis*, Ibid. Op. cit., pp. 26 and 295.

,, ,, *lineatus*, Ibid. Op. cit., pp. 26 and 295.

,, ,, *murenoides*, Ibid. Op. cit., p. 26.

,, ,, *fasciatus*, Ibid. Op. cit., pp. 26 and 295.

1866. ,, *longissimus*, Lankester. Ann. Nat. Hist., 3d ser., vol. xvii, p. 389.

1866. *Borlasia gracilis*, Ibid. Op. cit., p. 389.
,, ,, *lineatus*, Ibid. Op. cit., p. 389.
1867. ,, *longissimus*, Parfitt. Catal. Annel. Devon, p. 8.
,, ,, *lineatus*, Ibid. Op. cit., p. 8.
1868. ,, *longissimus*, McIntosh. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
,, ,, ,, Ibid. Proceed. Linn. Soc., vol. x, p. 251.
,, ,, ,, Ibid. Rept. Brit. Assoc., 1868, p. 340.
1869. ,, ,, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 374 et seq.

Habitat.—Not uncommon under stones between tide-marks, either in or out of tidal pools, in fissures of rocks, amidst tangle-roots in the laminarian zone, and occasionally in deep water.

Body.—Fifteen to thirty feet to as many yards in length, and from one to four lines in breadth, rather rounded, slightly narrowed behind the head, continuing of nearly equal calibre throughout the greater part, and then gradually narrowing towards the tail.

Colour.— Blackish-brown, relieved throughout by the fine purplish iridescence of the cilia. The tip of the snout is pale or whitish, and there are three pale bands from this region backwards. The central passes along the body a considerable distance, but gradually becomes indistinct, and the two lateral, which follow a similar course on the dorsum, vanish sooner. In addition to the foregoing, a very distinct pale stripe commences on each side at the posterior part of the cephalic fissure, and courses along the infero-lateral region of the body to the tip of the tail. Another well-marked stripe commences on the ventral surface at the centre of the snout, and continues along the middle nearly to the termination of the body. There is not much difference in colour between the dorsal and ventral surfaces. In young examples the brown is much paler, assuming an olive-brown or olive hue, and the stripes are more numerous and conspicuous; indeed, there is considerable variety in this respect. Generally, a reddish coloration is observed on both surfaces in the ganglionic region. The stripes exist on many good spirit-preparations, those on the head being especially distinct, and the slight eversion of the mouth causes a pale margin (or lip) all round. In dark specimens the lateral lines of the body are the most conspicuous. The rich dark colour of many shows that they are not unused to light in their native haunts.

Head.—Wider than the succeeding portion of the body, narrowed towards the anterior and posterior borders. The tip of the snout is generally bilobed, with a distinct papilla in the centre and two small ones on each lateral eminence. On each side is a deep lateral fissure with large lips, the superior being often rolled or curved inwards. The fissures have the usual reddish hue posteriorly. There is a dense group of eyes on each side of the anterior margin of the snout, arranged in a longitudinal manner, or rather their outline forms a long wedge—narrow anteriorly and wide posteriorly. In very dark examples these eyes are not easily seen, indeed they have escaped the notice of many observers; but if the animals are kept in confinement a long time, the bleaching of the snout renders them conspicuous, as may be noticed by contrasting the large coloured figure in Plate IX with Plate XVIII, fig. 1, which (latter) represents the head of the same specimen upwards of a year after its capture. In young animals the eyes are easily seen from the dorsum.

This is unquestionably the giant of the race, and even now I am not quite satisfied about the limit of its growth, for after a severe storm in the spring of 1864 a specimen was thrown on shore at St. Andrews which half filled a dissecting jar eight inches wide and five inches deep. Thirty yards were measured without rupture, and yet the mass was not half uncoiled. It chiefly delights to lurk under stones not far from low-water mark, or in tidal pools, and is occasionally found looped like a living string of caoutchouc amongst the seaweeds fringing the sides of the latter. It is useless in such a case to attempt to capture the worm by pulling at the free end, for, although it resists considerable tension, rupture is apt to follow: it should be allowed to contract itself, and then lifted or rolled in a mass into the vessel. At first sight it seems strange that nature should have fashioned an animal so soft and apparently so helpless as this, devoid of arms either of offence or defence throughout its extreme length, and which, moreover, can be so easily ruptured. Yet the facility with which reproduction can take place in wounded examples on the one hand, and the shelter afforded by its site on the other, give it sufficient protection in the struggle for existence as an adult form, while the enormous powers of increase in the ordinary way by ova render the continuance of the species doubly secure.

There is something remarkable in the movements of a large specimen of this huge worm, as its quivering body emerges from a dark creek in one of the little caverns that abound amongst the tidal rocks. No useless bustle warns its companions of its approach, but it glides silently forward with its exploratory snout, and scatters the smaller inhabitants by the very stealth and suddenness of its appearance. Some may even be excused in reckoning it the evil genius of the pool—dark, slimy and mysterious, moving hither and thither, as it were, by an invisible agency, and whose ways, like the inextricable knots and coils of its serpentiform body, are difficult to find out. It is not to be more harshly judged, however, than the young *Cotti*, Shannies, and *Cyclopteri*, that shelter themselves from its approach amidst the blades of the trailing tangles, the *Hippolytes* and *Mysidæ* that reconnoitre it from under the fringes of Corallina, Ulva and Cramium, the *Idoteidæ* and *Caprellidæ* that climb monkey-like on their branches, or than the sluggish *Doris* adherent to the variously tinted *Halichondria*. All are equally predatory, and subserve the special ends for which they live; and if the elongated worm preys by stealth and not by swift and open attack, this is due to its physical constitution, and not to any acquired vice or degradation. If it swallows its prey alive, it is, at any rate, devoid of instruments of laceration or torture, such as the jaws of its higher allies or the thread-cells of the Hydrozoa.

L. marinus lives well in confinement, and, without receiving any food, will survive for years, though the body greatly diminishes in size, both as regards length and thickness. Indeed, as in other examples, the insensible consumption of the formed tissues supports the animal under circumstances so abnormal, for we cannot place any weight upon food derived from microscopic organisms in so limited a supply of salt water, and one so rarely or never changed. Sickly specimens die from behind forward piece by piece, a fresh portion being thrown off at intervals until the head is reached. It is fond of taking refuge in tubes; thus a small one captured at Herm thrust out the rightful owner (a Protula), coiled itself therein, and is now preserved *in situ*. Several have also been found with the body looped through a broken *Trochus* or *Littorina*, which formed a kind of anchor in the runlets of sea-water in which their protecting stones lay. Not only do some fragmentary specimens, when put in spirit, turn themselves inside out, as Sir J. Dalyell saw in the living animal in salt water, but more than once I have been puzzled when making transverse sections by finding one part of the body doubled quite within the other, and this for a considerable distance. The entire skin gives a marked acid reaction to test-paper.

The breeding season would seem to be in June, but spermatozoa have been found fully developed in May and September. Sir J. Dalyell had a specimen which discharged innumerable white ova in May.

This Nemertean was first noticed by the Rev. W. Borlase, under the name of the Sea-Long Worm, but it received its scientific title from Col. Montagu. If subsequent writers on the Nemerteans had had the privilege of consulting the manuscript of this author, great confusion would have been avoided, and this not more conspicuously than in the present instance. He had observed the variable colours—from dusky to rufous-brown, and striped more or less plainly—of adults and young specimens. His description, on the whole, is excellent, though, in common with many other naturalists, he omitted to notice the eyes; and in his early account in the 'Linnean Transactions' it is probable he thought the proboscis the excreta. He makes the curious remark, that "It is not fragile unless contracted by spirits, for we have generally measured the length by winding upon a cylinder of wood of known circumference, suffering five or six feet of the animal to be pendent, in order to ascertain as nearly as possible the utmost length. In this state they have been suffered to die, and rarely break by contraction." Prof. Jameson observes that it was "noticed many years ago by my friend Mr. Neill, afterwards transmitted by the late Mr. Simonds to Mr. Sowerby, who has figured and described it . . . in his 'British Miscellany.'" He calls it the Black Worm of the Newhaven fishermen. The Rev. Hugh Davies did not see the eyes, and rather vaguely conjectured that it advanced by coiling its "amazing length into a compact spiral, each volution of which assisted in the act of progression," a supposition only less wide of the truth than that of M. de Quatrefages, who mentions that it glides through the water by means of excessively fine cilia. Sir J. Dalyell, again, considered that small examples floated less by their specific levity than by the repulsion of the lubricating matter investing the body, a method somewhat involved in obscurity. I am not satisfied that the *Ophiocephalus murenoides* of Delle Chiaje is this species; indeed, the flattened form and pointed snout shown in a figure in his 'Descrizione' point this out rather as allied to *Cerebratulus angulatus*, Müller, than to the present species. The so-called specimens of *Lineus murenoides*, also, of British naturalists, are all referable to *L. marinus*. I have included M. van Beneden's *Nemertes Quatrefagii* under the same head, for it seems to be only a pale and young variety, with the stripes distinctly marked. The arrangement of the eyes, as noted by this author in regard to his supposed new form, is equally characteristic of *L. marinus*.

2. Lineus gesserensis, *O. F. Müller.* Plate IV, fig. 2; and Plate V, fig. 1.

Specific character.—Eyes numerous, marginal. Snout distinctly wider than the rest of the body. Greenish, olive or reddish-brown.

Synonyms.

1766. *Alia* Lumbrici *marini* species, tota atra, Pallas. Miscell. Zool., p. 216, tab. 11, f. 9.

1771. Der Strömische Röd-Aat., O. F. Müller. Wurm-Arten des sussen u. salzigen W., p. 118, tab. iii, figs. 1—3.

1774. *Ascaris rubra,* O. F. Müller. Verm. terrest. et fluv. Hist., vol. i, ii, p. 36.

1776. ,, ,, Ibid. Zool. Danic. Prodr., p. 213, No. 2587.

1780. *Planaria fusca,* O. Fabricius. Fauna Grœnlandica, p. 324.

1788. *Planaria gesserensis*, O. F. Müller. Zool. Danic., ii, p. 32, tab. 64, f. 5—8.

„ „ „ Gmelin. Linn. Syst. Nat., tom. i, pars vi, p. 3093.

1798. „ *fuscescens*, O. Fabricius. Skriv. af Naturhist. Selsk., iv, ii, pp. 58—62, tab. 11, f. 8—10 (?)

1816. „ *gesserensis*, Lamarck. Hist. Nat. des an. sans vert., vol. iii, p. 179.

1827. „ „ Bosc. Hist. Nat. des vers, i, p. 262.

1829. „ *bioculata*, Johnston. Zool. Jour., vol. iv, p. 56.

1837. *Nemertes* (*Borlasia*) *olivacea*, Johnston. Mag. Zool. and Bot., vol. i, p. 536, pl. 18, f. 1.

„ „ *purpurea*, Ibid. Op. cit., p. 537, pl. 18, f. 3.

1843. *Borlasia rufa*, Rathke. Beiträge z. Fauna Norweg., p. 234 (?).

„ *Meckelia olivacea*, Ibid. Op. cit., p. 234.

1842-3. *Planaria gesserensis*, Œrsted. Kroyer's Naturhist. Tids., iv, p. 572, in nota.

„ *Nemertes olivacea*, Ibid. Op. cit., p. 578.

„ „ *purpurea*, Ibid. Op. cit., p. 579, in nota.

1844. *Tricelis gesserensis*, Œrsted. Entw. Plattw., p. 27.

„ *Nemertes olivacea*, Ibid. Op. cit., p. 89.

„ „ *fuscescens*, Ibid. Op. cit., p. 92.

„ „ *purpurea*, Ibid. Op. cit., p. 91.

1846. *Borlasia olivacea*, Johnston. Ann. Nat. Hist., vol. xvi, p. 434.

„ „ „ W. Thompson. Op. cit., vol. xviii, p. 388.

„ „ *purpurea*, Ibid. Op. cit., p. 388.

1847. „ *rufa*, Frey u. Leuckart. Beiträge z. Kennt. wirb. Thiere, p. 72, tab. 1, f. 15 and 16; var.

1849. *Nemertes fusca*, Leuckart. Archiv für Naturges., i, p. 152.

1850. *Notospermus gesserensis*, Diesing. Syst. Helm., vol. i, p. 260.

„ *Meckelia olivacea*, Ibid. Op. cit., p. 264.

„ „ *fusca*, Ibid. Op. cit., p. 266.

„ *Nemertes rufa*, Ibid. Op. cit., p. 271.

„ „ *olivacea*, Ibid. Op. cit., p. 273.

„ „ *purpurea*, Ibid. Op. cit., p. 275.

1852. „ *olivacea*, Max Schultze. Zeitsch. f. wiss. Zool., iv, p. 178.

1853. *Gordius minor viridis*, Dalyell. Pow. Creat., vol. ii, p. 72, pl. 9, f. 2—7.

„ „ *gesserensis*, Ibid. Op. cit., p. 73, pl. 10, f. 5.

„ *Vermiculus lineatus*, Ibid. Op. cit., p. 90, pl. 10, f. 19 and 20 (young with two eyes).

1857. *Cerebratulus oleaginus*, Stimpson. Proceed. Acad. Nat. Sc. Philad., p. 160.

„ *Nemertes olivacea*, Max Schultze. Icones Zootom. (V. Carus), tab. 8, f. 14.

1859. *Meckelia olivacea*, Leuckart. Archiv für Naturges., ii, p. 187.

„ *Gordius gesserensis*, Ibid. Op. cit., p. 187.

„ *Nemertes olivacea*, Ibid. Op. cit., p. 187.

1860. „ *flaccida*, Van Beneden. Recher. sur les Turb., &c., p. 14, pl. i, f. 14—17 (?)

1862. *Meckelia oleagina*, Diesing. Revis. der Turbell., p. 280.

„ „ *fusca*, Ibid. Op. cit., p. 285.

„ *Nemertes rufa*, Ibid. Op. cit., p. 298.

„ „ *gesserensis*, Ibid. Op. cit., p. 299.

„ „ *purpurea*, Ibid. Op. cit., p. 299.

„ „ *olivacea*, Ibid. Op. cit., p. 300.

„ „ „ Keferstein. Zeitsch. für wiss. Zool., Bd. xii, p. 66.

„ *Meckelia olivacea*, Diesing. Nachträge zur Revis. der Turbell., p. 8.

„ *Gordius gesserensis*, Ibid. Op. cit., p. 14.

„ *Nemertes olivacea*, Ibid. Op. cit., p. 14.

1865. *Borlasia olivacea*, Johnston. Catalogue Brit. Mus., pp. 21 and 289, pl. ii *b*, f. 1 and 1*.
,, ,, *gesserensis*, Ibid. Op. cit., pp. 21 and 290.
,, *Lineus viridis*, Ibid. Op. cit., pp. 27 and 296.
1866. *Borlasia olivacea*, Lankester. Ann. Nat. Hist., 3rd ser., vol. xviii, p. 388
1867. ,, ,, McIntosh. Jour. Micros. Sc.; Trans., p. 39.
1868. ,, ,, Ibid. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
1869. ,, ,, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 371 et seq.

Habitat.—Abundant on all our shores under stones between tide-marks, and in the laminarian region, from the Shetland to the Channel Islands.

Body.—Four to nine inches in length, breadth a line and a half or more, flattened, tapered towards the head, and more distinctly towards the tail; marked by numerous pale transverse wrinkles, somewhat regularly disposed, and most conspicuous in pale specimens.

Colour.—Two very distinct hues are characteristic of this species, viz. reddish-brown and dull olive, while pale reddish and green varieties are also occasionally met with. The pigment is generally darkest in front, before and behind the reddish mark in the ganglionic region, the rest of the body being uniformly tinted except towards the tail, which is paler. The snout is surrounded by a broad pale margin, as far back as the termination of the fissures. The ciliation gives the body under certain conditions either a purplish or an opalescent hue. The sides are often marked with numerous pale spots, from the generative apertures. The ventral surface is paler than the dorsal, especially towards the snout, which is also reddish posteriorly. The mouth is surrounded by a pale margin. Party-coloured varieties are sometimes found, the anterior region, for instance, being dark green mottled with white, while the posterior half is quite pale. Such bleaching is different from that caused by parasitic attacks.

Head.—Somewhat elongated, flattened, spathulate, rather truncate in front, with a small central and two lateral papillæ, and having on each side—from the tip of the snout backwards—a deep fissure with pale edges and a pinkish bottom, the latter hue being most distinct posteriorly. It tapers slightly anteriorly, and is decidedly wider than the succeeding portion of the body, on account of the lips of the lateral fissures. The eyes are situated at the anterior central pigmentary portion of the snout, and number from three to six or more on each side, the largest being generally in front. They are not always symmetrical; three, for example, occurring on one side, and occasionally eight on the other, besides some indistinct grains. The mouth opens as a longitudinal slit a short distance behind the ganglia.

L. gesserensis progresses in an easy, graceful manner, with slight undulatory motions of the head, its body being marked with successive contractile waves, which proceed from before backwards. The specimens frequently herd together in the water, which they are prone to leave, and remain attached to the side of the glass a considerable time. They are very easily kept in confinement for years; but, as with many of their allies, great diminution of bulk occurs, from deprivation of the natural supply of food. When recently captured specimens are placed in a jar containing injured Annelida, numerous fæcal masses, consisting of the bristles of *Nereis pelagica*, and other annelids and digested matter, are found lying on the bottom of the vessel, showing how greedily they have fed; a fact, indeed, very easily ascertained by actual observation. It is also frequently noticed that specimens confined in vessels along with the deep green *Eulalia viridis* assume a similar hue, probably from feeding on the rejected débris of those animals, if not upon the latter themselves. In their native haunts the stones under which they lie are often placed on dark, muddy and highly odoriferous sand or gravel, and the water cannot be otherwise than brackish at the estuary of a river.

The skin of this species gives an acid reaction.

The ova are deposited in gelatinous sheaths from January to May, and abound under stones in pools and moist places between tide-marks.

The want of precision in the descriptions of authors has burdened the literature of the present group of animals with diverse synonyms, especially as regards this widely distributed species. Though O. F. Müller's specific name *rubra* has the priority, and *fusca* comes next in order, yet, as each of these terms implies something at variance with the true description of the species, as contrasted with others, or retains some elements of doubt, I have chosen the succeeding title, viz. *gesserensis* (of the same author), as more appropriate. His description of the form under the latter name, and the accompanying figure, leave no room for uncertainty, even the pale specks for the exit of the reproductive elements being noticed on the sides. Muller's *Ascaris rubra* was probably a small specimen of the same worm. For some time I was inclined to include *Planaria viridis* under the present species, but the thick or almost baccate appearance of some of the figures in the 'Zoologica Danica' gives rise to so much doubt that I have not deemed it prudent to unite them. The *Planaria carnea* of Jens Rathke ('Skrivter af Naturhist. Selskabet,' &c., 5te Bd., p. 83, tab. iii, f. 10, *a*, *b*) appears to be referable to this common form. It is doubtful whether the *Lineus oculatus* of Montagu (MS) applies to *L. gesserensis* or to *L. sanguineus*. Dr. Johnston first described the species as having two eyes, but, as Œrsted states, the author had only seen a young specimen. He afterwards gave it four eyes, but the number of the latter is of little moment, since the animals are so liable to vary in this respect. Dr. Johnston also observed the presence of the gregariniform parasites for the first time, though he did not correctly interpret their nature. The *Nemertes obscura* of E. Desor, from the coast of the United States, is allied in the closest manner to this species, and the *Nemertes flaccida* of M. van Beneden is either a pale variety of the same or *L. sanguineus*.

3. Lineus sanguineus, *Jens Rathke*. Plate V, fig. 2.

Specific character.—Eyes more regularly arranged than in the foregoing; snout narrower. Body more elongated, and of a reddish or reddish-brown hue. Regenerates easily.

Synonyms.

1799. *Planaria sanguinea*, Jens Rathke. Skrivter af Naturhist. Selsk., vol. v, i. p. 83.
1828. ,, *unicolor*, Johnston. Zool. Jour., vol. iii, p. 188 (?)
1829. ,, *octoculata*, Ibid. Op. cit., vol. iv, p. 56.
1837. *Nemertes* (*Borlasia*) *octoculata*, Ibid. Mag. Zool. and Bot., vol. i, p. 537, pl. 18, f. 2.
,, ,, ,, Œrsted. Kroyer's Naturhist. Tids., iv, p. 579, in nota.
,, *Planaria sanguinea*, Ibid. Op. cit., pp. 572 and 579, in nota.
1844. *Nemertes octoculata*, Ibid. Entw. Plattw., p. 91.
,, ,, *sanguinea*, Ibid. Op. cit., p. 92.
1846. *Borlasia octoculata*, Johnston. Ann. Nat. Hist., vol. xvi, p. 434.

1846. *Borlasia octoculata*, W. Thompson. Ann. Nat. Hist., vol. xviii, p. 388 (?).
1850. *Nemertes octoculata*, Diesing. Syst. Helm., vol. i, p. 276.
,, ,, *sanguinea*, Ibid. Op. cit., p. 276.
1856. ,, *octoculata*, Byerley. Fauna of Liverpool, p. 98.
1860. ,, *communis*, Van Beneden. Recher. sur les Turb., p. 7, pl. i, f. 1—13.
1862. ,, *octoculata*, Keferstein. Zeitsch. f. wiss. Zool., Bd. xii, p. 63, taf. 7, f. 1 and 2.
,, ,, *communis*, Diesing. Revis. der Turbell., p. 302.
,, ,, *octoculata*, Ibid. Op. cit., p. 305.
,, ,, *sanguinea*, Diesing. Op. cit., p. 305.
,, ,, *octoculata*, Ibid. Nachträge z. Revis. der Turbell., p. 11.
1865. *Borlasia octoculata*, Johnston. Catalogue Brit. Mus., pp. 21, 287, and 290, pl. ii *b*, f. 2 and 2a.
1866. ,, ,, Lankester. Ann. Nat. Hist., 3rd ser., vol. xvii, p. 388.
1867. ,, ,, McIntosh. Jour. Micros. Sc.; Trans., p. 39.
1868. ,, ,, Ibid. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
,, ,, ,, Ibid. Proceed. Linn. Soc., Zool., vol. x, p. 251, tab. 7.
1869. ,, ,, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 374 et seq.

Habitat.—Under stones between tide-marks; less abundant than *Lineus gesserensis*, but having a similar range in the British Islands.

Body.—Four to eight inches long, and about a line and a half in breadth, flattened, of nearly equal diameter for some distance behind the head, and then gradually diminishing towards the tail. It is always proportionally much longer and more slender than *Lineus gesserensis*. The dorsum is crossed, sometimes at rather distant intervals, by transverse lines, which cause a dimple at each side, and it is probably at these furrows that rupture so frequently occurs.

Colour.—Various shades of red and brown. Some specimens anteriorly are of a very bright red, which becomes fainter posteriorly, the caudal region being pale brown. In the dark brown examples the ganglionic region (not the ganglia) is bright red, the succeeding portion of the dorsum dull brownish-red, and then dark brown, the latter gradually becoming paler towards the tip of the tail. The under surface is somewhat paler.

Head.—This differs from that of the former species by being scarcely wider than the succeeding portion of the body. Its posterior boundary can just be distinguished dorsally by the slight indentations at the termination of the cephalic fissures. The whole region is narrow, flattened, slightly tapered towards the tip, which is pale, and furnished with a central and two lateral papillæ, or, as the case may be, with a notch and two lateral papillæ. The eyes are placed further back than in *L. gesserensis*, are more distinctly defined, and form a regular row on each side, to the number of three or four. The lateral fissures have narrow lips, and extend from the tip of the snout backwards. The mouth opens in a pale space some distance behind the ganglia.

The worm is much longer and more slender than *L. gesserensis*, from which it is at first sight distinguished by the fine reddish coloration anteriorly. It is also a less active and restless species, and is prone to seek shelter under shells and stones, or in fissures and tubes, where it remains in a quiescent condition for weeks. It frequently lies coiled as a firm ball amongst the débris in the vessel, or loosely on the bottom, so that when the vessel is held obliquely the specimens roll from side to side. On account of these retiring habits it is somewhat difficult to get a good view of the animal. This may, however, be accomplished by transferring the hidden or coiled worm to another vessel of salt water, when the change of element generally causes it to move out of its shelter or unroll. It readily reproduces heads or other portions in fragments of its body, so that the irritation and discomfort of a long journey in a jar is found occasionally to increase rather than diminish the number of specimens. The skin is acid to litmus-paper.

L. sanguineus feeds on *Harmothoë imbricata* and other annelids in a decaying or at least dead condition.

The ova are developed in October.

After some hesitation I have referred the *Planaria sanguinea* of Jens Rathke to this species. The *Planaria unicolor* of Dr. Johnston may also be the same animal; indeed, so far as can be made out, it does not approach any other form. His preparation of *Borlasia purpurea* in the British Museum belongs to the same species. This author does not seem to have been aware that several varieties of *Lineus gesserensis* have a reddish-brown colour, when he described this hue as distinctive of the present species, yet he probably had the true *L. sanguineus* before him. M. van Beneden remarks that his *Nemertes communis* is distinguished from *L. gesserensis* by the length of the body and the double row of eyes. The latter character occurs in both species; and while his form, probably, differs from *L. gesserensis*, he does not satisfy us as to its separation from *L. sanguineus*. I have made Prof. Keferstein's *Nemertes octoculata* synonymous after some doubt, since there is little in his description to distinguish it from a pale variety of *L. gesserensis*.

4. Lineus lacteus, *Montagu*, MS. Plate V, fig. 3.

Specific character.—Snout similar to the foregoing, but the mouth is placed much further behind the ganglia. Body reddish anteriorly, pale posteriorly.

Synonyms.

1808. *Lineus lacteus*, Montagu. MS., p. 275.
1867. *Borlasia lactea*, McIntosh. Quart. Jour. Micros. Sc.: Trans., p. 39.
„ „ „ Parfitt. Catal. Annel. Devon. (Ext. Trans. Devonsh. Assoc. for the Advancement of Sc., &c.), p. 6.
1868. „ „ McIntosh. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
1869. „ „ Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 372 et seq.

Habitat.—South coast of England, under stones between tide-marks.

Body.—One to two feet in length, rather less than a line in breadth, flattened, almost insensibly tapered from head to tail, and marked by pale transverse lines. In contraction it is rounded, and very frequently the animal advances with its body thrown into various stiff wrinkles and dilated portions.

Colour.—Uniform dull whitish or cream-yellow, with the regions before and behind the ganglia (three quarters of an inch or more) of a fine rose-pink, which gradually fades posteriorly. The coloured region behind the ganglia corresponds to the long circulatory space in front of the mouth. Snout and tail translucent.

Head.—Elongated, very slightly broader than the succeeding portion of the body, and in many positions narrower, tapered anteriorly, with the tip rather rounded, and furnished with three papillæ. It is distinguished posteriorly by a slight incurvation at the termination of the cephalic fissures, which are rather shallow. Eyes forming a nearly parallel row on each side, distinctly separated, and to the number of six or eight in each row. They are not symmetrically arranged, and a considerable translucent space exists between their commencement and the tip of the snout. The mouth is situated much further back than in *Lineus sanguineus*, to which it is otherwise closely related.

Seven or eight specimens were sent me, in October, 1866, by Mr. Parfitt, of the Devon and Exeter Institution, in a tin box, and a few are still alive (Dec., 1871), so that they exhibit the usual hardihood in confinement. In progression the head is often ribbed in a longitudinal manner. When irritated, the extended worm contracts, generally in a spiral or closely coiled manner, and sometimes in a form so regularly twisted as to resemble a rope with its strands. It advances by gentle undulations of the body, and frequently the head is rolled from side to side. The worm also readily forms itself into a knotted mass, as well as stretches to an extreme degree of tenuity. The skin presents an acid reaction.

This is one of the many discoveries made by the acute and persevering Montagu on the southern coast. There are few external characters in the description of the animal that had escaped him. It is doubtful whether Prof. Grube's *Nemertes lactea* from Villafranca ('Archiv für Naturges.,' 1851, p. 151, taf. 7, f. 3 and 4) coincides with our species. His enlarged drawing of the head has certainly many more eyes, and the orange specks on the dorsum are quite different. Moreover, it is scarcely to be supposed that this author would not mention so important a point as the distance of the mouth behind the ganglia. He states that the "mouth is rounded," and about two millimètres from the snout. Dr. Johnston's preparation of *Lineus albus*, Dalyell, in the British Museum, resembles the present species very closely.

5. Lineus bilineatus, *Delle Chiaje*. Plate VI, fig. 1.

Specific character.—Head rather rounded anteriorly; eyeless. Body pale brown or dull pinkish, with a white stripe on each side of a dorsal median line.

Synonyms.

1841. *Polia bilineata*, Delle Chiaje. Descr. e Notom. degli anim. invert., tom. iii, p. 126, tab. 103, f. 11 and 12.
1844. *Nemertes bilineata*, Œrsted. Entw. Plattw., p. 91.
1850. *Meckelia bilineata*, Diesing. Syst. Helm., vol. i, p. 264.
,, ,, *cerebratulus*, Ibid. Op. cit., p. 269.
1853. *Gordius tænia*, Dalyell. Pow. Creat., vol. ii, p. 70, pl. 10, f. 1—4.
1860. *Cerebratula Œrstedii*, Van Beneden. Recher. sur les Turbell., p. 16, pl. 2, f. 1—4.
1862. *Cerebratulus bilineatus*, Ibid. Op. cit., p. 273.
,, *Meckelia Œrstedii*, Diesing. Revis. der Turb., p. 286.
,, ,, *cerebratulus*, Ibid. Op. cit., p. 286.
1865. ,, *tænia*, Johnston. Catalogue Brit. Mus., pp. 28 and 298.
1866. ,, ,, Lankester. Ann. Nat. Hist., 3rd ser., vol. xvii, p. 389.
1868. *Cerebratulus tænia*, McIntosh. Rept. Brit. Assoc., 1858, p. 340.
1869. ,, *bilineatus*, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 374 et seq.

Habitat.—Generally occurs in somewhat deep water on coralline ground, or oyster-beds, but also under stones and in cracks of oyster-shells between tide-marks. The largest specimen I have seen was procured from the stomach of a haddock caught off St. Andrews Bay.

Body.—A few inches to a foot and a half in length, and of variable breadth; not much flattened, except on the ventral surface, widest in front and gently tapering towards the posterior extremity.

Colour.—Various shades of pale madder-brown, chocolate or reddish-brown, darkest in front, and gradually fading posteriorly. From the centre of the snout, just within the pale border, a white or yellowish stripe commences by a wide origin, which occupies nearly the whole breadth of the region, and proceeds to the tip of the tail along the middle line of the dorsum. It is widest anteriorly, and is rendered double by a dark central streak. Sometimes a young specimen presents an opaque white pigment-patch on each side of the usual central bands of the snout, so that by transmitted light the organ seems furnished with two large eyes. In a variety the anterior third was very pale, the rest of the body being of a bright rose or carmine colour. The under surface of the body is paler than the upper, especially towards the middle line and the region of the mouth. Specimens found in exposed places between tide-marks are darker than those from more sequestered regions.

Head.—Flattened and somewhat spathulate, rather blunt anteriorly and somewhat narrowed posteriorly at the termination of the cephalic fissures, from which a slight depression slants inwards and backwards towards the central stripes. The lateral fissures are deep, and tinted of a vivid red colour towards the pit posteriorly. The narrowing of the snout anteriorly and posteriorly gives it a somewhat elliptical or ovoid appearance. There is no trace of eyes or eye-specks. The mouth opens a short distance behind the ganglia.

L. bilineatus is rather a sluggish species in confinement, but is easily preserved alive for years. It progresses with a rolling motion of the head, but will remain for weeks in a dormant condition under a shell or in a mass of hardened mucus. The skin is strongly acid to test-paper.

I have not found specimens containing developed generative organs, but Sir J. Dalyell relates of his captives that a vast quantity of white ova, amidst a thin glairy matter, appeared in the vessel in June.

I have little doubt the *Polia bilineata* of Delle Chiaje refers to this species; and since he describes the *Cerebratulus* (*Ophiocephalus*) *bilineatus* of Renier as quite a different form, probably the same as the *Nemertes peronea* of De Quatrefages, with two dorsal black lines, I have omitted Renier's name altogether from the synonyms, for I have not been successful in seeing a copy of his early work. It is unlikely that so acute an observer as Delle Chiaje would confound the two species, especially as the published description of the first form was in his own language. Sir J. Dalyell thought the *Planaria dorsalis* of Abildgaard (*Tetrastemma dorsalis*) was probably a mutilated fragment of this worm. M. van Beneden, again, not long ago described it as a new species from deep water off the Belgian coast. I have not been able to verify this author's remark, that there are three divisions in the alimentary canal, nor have I ever seen it or any other Nemertean "threatening its prey with its proboscis." In his 'Nachträge zur Revision der Turbellarien' Diesing erroneously places Dalyell's *Gordius tænia* (the present form) under *Ommatoplea peronea*.

Genus VII.—BORLASIA,[1] *Oken*, 1817.

The genus *Borlasia* was formed by Oken in his 'Lehrbuch der Naturgeschichte' for the previously named *Lineus marinus* of Montagu, and therefore very properly was disused in that instance. Instead of applying the title to represent forms belonging to the Enopla, as Prof. Keferstein and others have done, I have chosen rather to bestow it on the present new type of the Anopla, a type, indeed, not far removed from that to which the name was originally given.

Generic character.—Body round and massive, not tapered posteriorly. Snout acutely pointed. Proboscis extremely slender, furnished with elastic external, longitudinal, circular, and glandular coats. There are no accessory bands at the poles in transverse section. Circulatory fluid and muscles tinted reddish.

BORLASIA ELIZABETHÆ, n. s. Plate VII, figs. 1 and 2.

Specific character.—Eyeless; snout much tapered anteriorly. Posterior part generally contracted into a thick rugose mass. Head pale, faintly streaked with greenish brown; body mottled with deep madder-brown.

Habitat.—In a pool near low-water mark to the north of Rat Island, Herm.

Body.—About a foot in length and a fifth of an inch in breadth, rounded in extension, flattened in contraction, tapering towards the snout, and also slightly towards the tail, which ends bluntly; indeed, the posterior end generally forms a dilated mass with a dimple in the centre, and coarsely marked by transverse wrinkles. The body is seldom free from numerous longitudinal furrows, which are especially distinct anteriorly.

Colour.—The head throughout two thirds of its length anteriorly is pure white, with olive-green specks; for rather more than the posterior third, however, the deep purplish-brown and white touches of the dorsum occur. The speckled dorsum is marked at somewhat regular intervals by belts of pinkish white, which entirely surround the body. Some of the pale rings are broader than others, but there does not seem to be any regularity in this respect. They continue to the tip of the tail, but gradually grow faint posteriorly. The colours are brightest anteriorly, the greater part of the body being of a speckled olive-brown hue. A very slight reddening is noticed over the ganglionic region. The pale olive specks of the snout pass into the anterior part of the cephalic fissures, while the posterior end of each is deep red. The snout continues pale to a similar extent ventrally, while the olive-green specks are few and indistinct. The ventral surface of the body generally is somewhat paler. Captivity does not seem to affect these hues very soon.

Head.—Not distinguished posteriorly from the rest of the body, except in certain positions, when the slight elevation of the posterior fold of the cephalic fissure indicates a separation. It tapers rather abruptly to a somewhat narrow tip, furnished with a central papilla. From the angle of the tip on each side a deep lateral fissure runs to the posterior border of the snout, where

[1] In honour of the Rev. W. Borlase, the natural historian of Cornwall.

the dilated termination is conspicuous on account of its reddish coloration. A groove generally present on the side of the body is continuous with the end of the latter, but such a furrow, of course, is only one of the variable longitudinal rugæ of the body. The lips of the cephalic fissures are usually kept in apposition, except at the posterior dilated portion. The mouth commences just behind the ganglia, and forms a considerable longitudinal slit.

On turning over a large stone in the litoral pool above mentioned a piece of the tenacious grayish-white clayey mud so characteristic of the locality, and which was furnished with a smooth groove, adhered to a corner on the under surface; and on searching the now muddy pool from which the stone had been raised, the rest of the firm clayey groove and a purplish or dark madder-brown body about two inches long were found. The latter very much resembled the rough siphons of a bivalve mollusk, being flattened, transversely rugose, somewhat abruptly truncated at each extremity, hard and resilient under the touch. On placing this curious structure in pure sea-water, the head of the animal was by-and-by pushed out from the dilated mass, not by the gradual elongation of the whole, but as if an invisible power were drawing caouchouc through a fixed aperture. It was transported to Scotland without difficulty, and lived there until dissected, pushing its anterior end slowly about the bottom of the vessel, and seldom completely extending itself. Indeed, the remarkable dilatation of the posterior end, which was often enveloped in mucus, was characteristic. Sometimes, however, the stretched tail was attached to mucus at the bottom, while a dilated mass of the body remained about an inch in front of it, the rest of the animal being attenuated, and perhaps laid along the water-line. Its habits on the whole were sluggish, and corresponded with its native situation.

On taking the animal out of the water after several months' confinement it contracted itself firmly, an elliptical rent appeared on the ventral surface, and in a few seconds it ruptured into four pieces. The anterior fragment with the head lived several months longer, and during this time the posterior end had become considerably enlarged and paler, and there is no doubt the original size and shape would have been gradually attained under favourable circumstances, while its lost fragments were mounted as microscopic preparations.

The skin gives an acid reaction to test-paper.

An allied species was dredged by Mr. Jeffreys in the "Porcupine" Expedition, 1870, off Cape Finisterre, at a depth of 80 fathoms.

Genus VII.—CEREBRATULUS,[1] *Renier*, 1804.

The species upon which this genus in the present work rests was probably known to O. F. Müller as *Planaria angulata*. Renier in 1804, in his 'Prospetto della classe dei vermi,' established the genus *Cerebratulus* for a worm which appears to have been allied to the present form, and certainly one of the Anopla, if we may judge from Diesing's reprint of the characters given by this author. I have chosen rather to run some risk in using Renier's name than to aid in perpetuating the profuse nomenclature which arose chiefly from insufficient acquaintance with the literature and anatomy of the subject.

Generic character.—Body generally flattened, and thinned at the margins. Snout pointed

[1] *Cerebrum*, the brain; probably from the fancied resemblance of the respective tissues.

in front. Eyes obscure. Proboscis with a cross of fibres at each pole in transverse section.

CEREBRATULUS ANGULATUS, *O. F. Müller*, 1774.

Specific character.—Snout pointed. Body much flattened, brownish.

SYNONYMS.

1774. *Fasciola angulata*, O. F. Müller. Verm. Terrest. et Fluv., vol. i, part ii, p. 58.
1776. *Planaria angulata*, Ibid. Zool. Danic. Prodr., p. 221, No. 2680.
1780. „ „ O. Fabricius. Faun. Grœnland., p. 323, No. 303.
1788. „ „ Gmelin. Lin. Syst. Nat., p. 3088, No. 9.
1798. „ „ O. Fabricius. Skriv. af Naturhist. Selskabet, 4[te] Bind, 2[det] hefte, p. 52, &c., tab. ii, f. 1—7.
1844. *Cerebratulus? angulatus*, Œrsted. Entw. Plattw., p. 94.
1845. *Serpentaria fragilis*, H. Goodsir. Ann. Nat. Hist., vol. xv, p. 377, pl. 20, f. 1 and 2.
1850. *Meckelia serpentaria*, Diesing. Systema Helm., vol. i, p. 266.
1853. *Gordius fragilis*, Dalyell. Pow. Creat., vol. ii, p. 55, pls. 6, 7, and 7 (bis).
1857. *Lineus Beattiæi*, J. E. Gray. Proceed. Zool. Soc., pt. xxv, p. 210, pl. 48.
1858. „ *longissimus*, W. Beattie. Op. cit., pt. xxvi, p. 307.
1859. *Meckelia serpentaria*, Leuckart. Archiv für Naturges., ii, p. 187.
„ *Lineus longissimus*, Beattie. Ann. Nat. Hist., 3rd ser., iii, p. 160.
1862. *Meckelia serpentaria*, Diesing. Revis. der Turbell., p. 281.
„ „ *Beattiæi*, Ibid. Op. cit., p. 285.
1863. „ *olivacea* (*Rathke*), Diesing. Nachträge z. Revis. der Turbell., p. 8.
1865. *Serpentaria fragilis*, Johnston. Catalogue Brit. Mus., p. 28.

Habitat.—Generally in deep water throughout the British coasts. Greenland.

Body.—Fifteen inches to three feet long, and about an inch in breadth; flattened, bluntly and rather suddenly tapered in front, more gradually posteriorly, and thinned at the margins all round, so that a transverse section of the contracted body is elliptical.

Colour.—Universally gray, darker on the dorsal, paler on the ventral surface, and with a pale margin. Sir J. Dalyell's figure has a brown stripe commencing at the anterior third, and continuing to the tip of the tail, and the divisions of the alimentary organ are indicated inferiorly, but of course we must be cautious in making deductions therefrom. This author also observes that in one of his specimens a portion of the edge was reddish, a colour in all probability due to the nerve-trunk and its surroundings. Mr. Goodsir states that his example was of a slate-blue colour, with a yellowish edge.

Head.—Tapered to a blunt snout in front, with a cephalic fissure on each side, and apparently without eye-specks. Mouth forming a large slit on the ventral surface in the usual position.

I have referred this species to the *Planaria angulata* of O. F. Müller, from a careful consideration of all the circumstances connected with its history, including the examination of several examples from the north sea, and named by northern naturalists. Müller's account of its size, the pointed nature of its snout, its colour and other points, can scarcely apply to any other species; and in the preparations the flattened body, thinned edges, and the structure of the proboscis are quite characteristic. The late Mr. Harry Goodsir mentions that, "when swimming, the animal is very active, and advances with considerable rapidity by means of an undulatory serpentine motion. When handled it throws itself into various contortions, and instantly casts off numerous annuli from the posterior part of its body, each of which, immediately upon its separation from the original, begins to move in a similar manner." Sir J. Dalyell afterwards made like observations, and noted that the animal was full of a yellow substance, a remark which probably applied to the wall of the digestive cavity, the same colour being present in *Micrura fusca*. He also found numerous white ova discharged from a fragment in May. The *Lineus Beattiæi* of Dr. Gray, and the *L. longissimus* of Mr. Beattie, appear to belong to this species, if we may judge from the preparation of the former and the proboscis of the latter in the British Museum. Mr. Alex. Agassiz mentions that he found the *Planaria angulata* of O. F. Müller on the under surface of the tail of *Limulus*, but of course this refers to quite a different form, probably to a *Planaria*.

This species is very closely allied to *Micrura fusca*; and if the structure of the proboscis had not deviated so distinctly I should have been inclined to unite them.

Genus VIII.—Micrura,[1] *Ehrenberg*, 1831.

As has occurred in several instances, the typical form was known to the veteran naturalist O. F. Müller, as well as to Col. Montagu. Ehrenberg, however, separated the genus from others for the first time in his 'Symbolæ Physicæ,' and gave a good figure of *M. fasciolata*, though he was unaware that the same form had previously been observed by others.

Generic character.—Body not much elongated. Head distinctly marked, snout truncated. Other characters as in *Lineus*, with the addition of a caudal process or style capable of attachment.

1. Micrura fusca, n. s. Plate VI, fig. 3.

Specific character.—Eyes four to eight on each side, small. Body much flattened and thinned at the edges; speckled with brownish grains on the head and anterior region.

Synonym.

1869. *Micrura*, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii. p. 376, &c.

Habitat.—Not uncommon amongst the débris from the coralline ground in fishing boats, amidst oysters and tangles in the laminarian region in Shetland, under stones between tide-marks at Herm, and at a depth of 795 fathoms off the coast of Portugal.

Body.—Two to four inches in length, slightly tapered towards either extremity, flattened both

[1] Μικρὸς, small or slender, and οὐρὰ tail. Strickland applied the same title to a genus of Certhidæ in 1841 ('Ann. Nat. Hist.').

dorsally and ventrally, and furnished with a pale caudal filament. It is frequently marked by transverse lines or slight furrows.

Colour.—Pale skin, ash or brownish; dorsum speckled with pale brown touches, especially distinct over the head, which has also a well-marked reddish hue in the ganglionic region. A little within the pale margin of the body a pinkish streak occurs on each side from the coloration of the nerve-trunks. Posteriorly the lateral divisions of the dull yellowish digestive tract shine through the skin. Ventral surface of a pale skin-colour, also enlivened by the coloration of the nerves, and in some cases with a few pale brownish specks anteriorly. The caudal style occasionally shows a few white grains in the central line towards the base.

Head.—Spathulate, but much pointed towards the tip, dilating from the latter backwards to the termination of the cephalic fissures, the whole region being peculiarly hastate. Eyes small, black, grouped on each side of the pointed snout, and varying in number from four to eight on each side. The lateral fissures are deep, and have the reddish hue very brightly marked posteriorly.

This is one of the flattest among the shorter species of the group, both before and after preservation in spirit. During life it swims through the water on its edge, with an eel-like wriggle, similar to that of *A. pulcher*, but somewhat less vigorously. When progressing the margins of the body are often very prettily frilled, the reddish longitudinal lines just within the pale border increasing the effect. It is rather irritable, throwing out its yellowish proboscis when touched, or breaking into several fragments. The former clings closely to the finger by means of its tenacious secretion.

It fixes the tip of its caudal process as in *M. fasciolata*, and elongates it so as to resemble a very fine thread, which, however, is slightly moniliform. It agrees in minute structure with the foregoing, and, when detached from the worm, much resembles a long *Opalina*, or other ciliated organism, in facile and independent movements.

The skin presents an acid reaction to test-paper.

I at first thought that this form was only a small variety of the great *Gordius fragilis* of Dalyell (the previous species), and future investigators may establish a closer relation between them than I have been able to make out. I did not feel justified, however, in uniting them, on account of the remarkable difference in the structure of the proboscis, which in *M. fusca* has the anatomy characteristic of *Lineus*, while the double isolated longitudinal bands at one of the poles in transverse sections of the organ in *C. angulatus* exhibit quite a new feature.

No author, so far as I am aware, has mentioned the caudal process in the last species, but this is a point which may have been easily overlooked.

Whether the young animal shown in Plate VI, fig. 4, is an early condition of this or an allied species I am unable to decide. It was one of the novelties found by its artist during one of her trips to St. Andrews in the spring of 1866.

2. MICRURA FASCIOLATA, *Ehrenberg*. Plate VI, fig. 2.

Specific character.—Eyes marginal, placed towards the anterior part of the snout. Body various shades of brown, generally barred with white belts.

SYNONYMS.

1788. *Planaria filaris*, O. F. Müller. Zool. Danic., ii, p. 38, tab. 68, f. 18—20.
,, ,, ,, Gmelin. Linnæus Syst. Nat., tom. i, pars vi, p. 3093.
1808. ,, *lineata*, Montagu, MS. tab. 56, f. 5.
1831. *Micrura fasciolata*, Ehrenberg. Symb. Phys., Phyt. Turb., No. 15, tab. 4, f. 4, *a—i*.
1827. *Planaria filaria*, Bosc. Hist. Nat. des Vers., i, p. 261.
1844. *Nemertes pusilla*, Œrsted. Entw. Plattw., p. 90.
,, ,, *fasciolata*, Ibid. Op. cit., p. 91.
,, ,, *pusilla*, Ibid. Kroyer's Nat. Tids., iv, i, p. 578 (partim).
,, ,, ,, Ibid. De Region. Marin., p. 80.
1847. *Pylidium gyrans* (young form), Müller. Archiv für Anat., p, 159, taf. 7, f. 1—4.
1850. *Micrura fasciolata*, Diesing. Syst. Helm., vol. i, p. 261.
,, *Nemertes pusilla*, Ibid. Op. cit., p. 274 (partim).
1851. *Pylidium gyrans*, Busch. Beobachtungen über Anat., &c., p. 107, taf. 16, f. 1—8.
,, *Alardus caudatus*, Ibid. Op. cit., p. 111, taf. 11, f. 8.
1853. *Gordius fragilis spinifer*, Dalyell. Pow. Creat., vol. ii, p. 79, pl. 11, f. 5 (var.).
,, ,, *fasciatus spinifer*, Ibid. Op. cit., p. 80, pl. 11, f. 6—15.
,, *Alardus caudatus*, Müller. Abhandl. Berl. Akad. (1852), p. 59.
1854. *Pylidium gyrans*, Gegenbauer. Zeitsch. für wiss. Zool., v, p. 345.
,, ,, ,, Müller. Archiv, p. 75, taf. 4, f. 2—8.
,, *Alardus caudatus*, Ibid. Op. cit.
1858. *Pylidium gyrans*, Krohn. Müller's Archiv, p. 289.
,, *Alardus caudatus*, Ibid. Op. cit.
,, *Micrura filaris*, Müller. Archiv, p. 330 (note).
1861. *Pylidium gyrans*, Claparède. Recher. Anat. sur les Annel., Turb., &c., p. 54, pl. 5, f. 3 and 4 (?)
1862. *Micrura fasciolata*, Diesing. Revis. der Turbell., pp. 258—260.
,, ,, *filaris*, Ibid. Op. cit., p. 260.
,, *Meckelia cæca*, Ibid. Op. cit., p. 286.
,, *Nemertes pusilla*, Ibid. Op. cit., p. 298.
1863. *Micrura fasciolata*, Diesing. Nachträge z. Revis. der Turbell., p. 7.
1865. *Stylus fragilis*, Johnston. Catalogue Brit. Mus., pp. 24 and 293.
,, ,, *fasciatus*, Ibid. Op. cit., pp. 24 and 293.
1869. *Micrura fasciolata*, McIntosh. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 374.

Habitat.—In fissures of the rocks near low water, in the coralline region, and oyster-beds. Ranges from the Shetland Islands to the Adriatic.

Body.—Four to six inches in length, and about a line in breadth, flattened on the ventral surface, about as much tapered anteriorly as posteriorly, and with a slender styliform process attached to the tail.

Colour.—Fine reddish brown of various shades, banded across with white belts at somewhat regular intervals, and with the tip and sides of the snout pale. The styliform process is pale and translucent. Ventral surface paler than the dorsal, but also inclining to reddish brown, and marked by distinct lines or furrows, which are continuous with the white dorsal bands. The first white dorsal belt usually occurs a little behind the termination of the cephalic fissures, but occasionally the presence of some dark red pigment near the tip of the snout cuts a stripe off the pale portion. The white bars are sometimes lozenge-shaped, from a dilatation in the middle. Some specimens from the coralline ground off St. Andrews are of a very pale brown or fawn colour on the dorsum, darkest in front, without white stripes, the only markings being the transverse wrinkles of the body. The pale portion at the tip of the snout, and especially its margins, are increased in breadth; the latter, indeed, being continuous with a pale lateral border (not due to the cilia) throughout the entire length of the animal. The under surface in such examples is of a dull whitish hue, with the exception of the reddish ganglionic region. A dull olive variety of large size (six to ten inches) also occurs in the recesses of the tangle-roots in the Shetland Islands. Some of the examples with white bands have also a whitish ventral surface; and occasionally the bands, even when present, are very inconspicuous.

Head.—Somewhat spathulate, flattened, tapered towards the front, which is rounded and furnished with a central papilla, wider than the rest of the body. There is a deep lateral fissure on each side, with a reddish coloration posteriorly. Just within the pale margin of the snout are numerous eyes, those in front being best seen from the dorsum, especially in pale specimens, and also from the cephalic fissures. They form a single converging row on each side, to the number of eight or twelve. Young specimens are furnished with two conspicuous eyes only. The mouth occupies the usual position behind the ganglia.

This is one of the most beautiful Nemerteans, from the striking contrast in its colours and the soft and velvety aspect of its skin. It is evidently a dweller in crevices, and has a great tendency to hide under débris or other shelter in glass vessels; and if this protection be denied it, the animal frequently coils itself in a mass, either with or without enveloping mucus. Some are hardy in confinement and live for years, others are irritable and fragile, breaking themselves on the slightest interference into many fragments, the separation almost always occurring at the white belts. This rupture often takes place before they are removed from the collecting-bottle, especially if they do not have it all to themselves. Fragments of the posterior end of the body turn slowly in the vessel, and live a long time. Of the two well-marked varieties, viz., the banded and the uniformly tinted, the latter are the less fragile, and their bodies are more flattened. The styliform process at the tail can be elongated to an extreme degree. The skin presents an acid reaction.

The spermatozoa are fully developed in the beginning of November, causing pale transverse bars at the sides of the males. The same elements are fairly matured in Zetlandic examples in August.

It is doubtful whether the *Fasciola caudata* of O. F. Müller has any connection with this species, especially as it was found by O. Fabricius gregariously associated amongst litoral fuci on the shores of Greenland. The same author's *Fasciola flaccida* has closer resemblances both in description and figure; though, as regards the transverse white lines, it is to be remembered that he gives the same account of *F. viridis*. His figure and the remark concerning the fragility of the species show a close affinity. The *Planaria filaris* of this author, again, may be regarded as a young specimen, though he represents the tail too elongated. He found it on *Madrepora prolifera*. Montagu observes that the colour of his specimens (*Planaria lineata*, Mont. MS.) was "rufous brown, with about ten white lines across the back. Beneath pale, without the lines." The *Planaria rufa* of the same naturalist (MS., p. 232) is either a uniformly tinted example of this species, or a variety of *Lineus gesserensis*. It was found on a large oyster. Ehrenberg gave a good description and figure of the animal from specimens found in the Adriatic. He mentions the presence of five eyes on each side, and that the ovarian aperture (mouth) lies under the second dorsal white bar. He also alludes to the copious exudation of mucus with which it forms a sheath. I have followed J. Müller in including the young form, *Pylidium gyrans*, under this species. Dalyell observed that his specimens (*Gordius fasciatus spinifer*) had a tendency to rupture at the white belts. Moreover, his examples reproduced bodies to the anterior regions, but no heads on the posterior fragments, though he did not doubt that regeneration would ensue in every case under more favourable circumstances. His *G. fragilis spinifer* is probably a specimen of this species uniformly tinted, and its subsequent fracture into many pieces is corroborative of this view. I am in doubt, however, whether his *G. viridis spinifer* (op. cit., p. 78, Pl. XI, f. 1) is a distinct form or only a variety of this or the succeeding species.

The *Meckelia annulata* of Grube, and the *M. Knerii* of Diesing, are closely allied to the foregoing. The absence of the caudal process in the former may have been accidental, while, as regards the latter, Prof. Grube may be wrong in supposing such only a reproduced tail.

3. MICRURA PURPUREA, *Dalyell*. Plate VII, fig. 3.

Specific character.—Eyeless. A bright yellow patch at the tip of the snout. Body of a uniform rich dark brown colour.

SYNONYMS.

1853. *Gordius purpureus spinifer*, Dalyell. Pow. Creat., vol. ii, p. 78, pl. 11, f. 2—4.
1858. *Micrura purpurea*, J. Müller. Archiv, p. 300.
1862. ,, ,, Diesing. Revis. der Turbell., p. 260.
1865. *Stylus purpureus*, Johnston. Catalogue Brit. Mus., pp. 24 and 293.
1868. ,, ,, McIntosh. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
1869. *Micrura purpurea*, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 374, &c.

Habitat.—In fissures of rocks near low water, and between the valves of empty shells, or other crevices of the débris from the coralline ground on the east coast of Scotland. It seems to be generally diffused, and occurs of large size off the Shetland Islands.

Body.—Five to eight inches in length, flattened, slightly narrowed behind the head, and gradually tapered towards the rather blunt tail, from which the styliform process arises.

Colour.—Rich dark brown with a purplish lustre on the dorsum. The tip of the snout is pale, and immediately behind is a well-defined crescentic granular yellow patch. The convexity of the latter is directed forward. In some specimens the anterior margin of the patch only is yellow, while the rest is yellowish white or pure white. There is a slight reddish hue at the ganglionic region. The styliform process is pale brown. The ventral surface is very slightly paler than the dorsal, and from the translucency of the snout the yellow pigment-patch on the upper surface shines through.

Head.—With a truncate anterior margin which is also broad, so that it has a peculiar spade-shaped appearance, slightly wider than the succeeding portion of the body, and with three papillæ in front, a central and two lateral, the latter being small and inconspicuous. The lateral fissures are deep and well marked, the bottom tinted red posteriorly, and having anteriorly some yellowish grains continued from the pigment-patch of the snout. There is no trace of eye-specks.

Micrura purpurea appears for the most part to be a deep-water species. In regard to colouring it is one of the most striking of the group, the bright yellow patch in front and the ever-varying purplish lustre of the cilia on the deep brown body forming manifold contrasts, at once pleasing and novel. It is active and voracious, and it is dangerous to leave two in the same vessel, especially if there is disparity in size, as the stronger devours the weaker. Like many of its allies, grave injuries are borne with impunity; thus a specimen which had been so severely wounded in January that it divided itself behind the head, reproduced early in May a small but complete body, furnished with the usual caudal styliform process, and this without a single renewal of the sea-water in the vessel. The head had diminished much in bulk, but was still the widest part of the animal. The body measured an inch and a half after nine months' growth. The introduction of a fresh and hungry specimen from the coralline region proved fatal to this example. The posterior end of the ruptured worm also lived many months, turning slowly round on the bottom of the vessel, and showing a pointed process above the aperture of the digestive chamber in front, while the ova in its interior had arrived almost at complete development in April.

Sir J. Dalyell procured the first specimen of this species from Shetland, and so introduced it to science and our fauna. He also figures an example with reproduced (pale) anterior and posterior extremities. Few authors seem to have observed this form, the above, indeed, being the only published notice I have been able to identify. This is the more remarkable, as it has frequently been sent from St. Andrews in the débris of the fishing boats on their return from deep water.

4. Micrura aurantiaca, *Grube*. Plate VII, fig. 4.

Specific character.—Eyeless. A white patch at the tip of the snout. Body rounded, and of a fine brick-red hue.

Synonym.

1855. *Meckelia aurantiaca*, Grube. Archiv für Naturges., p. 148, pl. 7, f. 1.

Habitat.—Under stones in tide-pools to the north of Rat Island, Herm.

Body.—Three or four inches long, rather rounded on the dorsum and flattened inferiorly. A small caudal process or filament, as indicated in the figure, was noticed during delineation, but this was not present when I examined it subsequently.

Colour.—Dorsum fine brick-red, with a roseate lustre here and there from the cilia, and having a white patch a little behind the anterior border of the snout. The reddish pigment in front of the white spot is somewhat deeper in tint than the rest of the body. The under surface is pinkish-white.

Head.—Scarcely wider than the succeeding portion of the body, somewhat flattened, slightly narrowed towards the front, and with rather shallow lateral fissures, the upper lip of the latter projecting over the lower. No eye-specks are visible. The mouth forms an indistinct slit in the usual position.

In minute anatomy this species strictly agrees with the Lineidæ. The cells of the cutis are very distinctly marked, and the subjacent pigmentary region has a fine reddish hue on the dorsum.

The layer of longitudinal fibres underneath the latter is powerful. The proboscis is white, and furnished with small glands, somewhat like those in *L. gesserensis*.

Several specimens were brought alive to Scotland, but from their fragility they were in an imperfect state. After surviving a fortnight they deposited eggs, and died about the middle of September. It was interesting to observe the change of colour which ensued in certain fragments after rupture; inferiorly they were dull brownish-red, with the pinkish-brown ova projecting in masses, but by-and-by the latter were extruded, and the ruptured ends and the inferior surface resumed the usual whitish hue of the walls of the digestive chamber. On the whole they were inert animals, generally fashioning tubes on the side of the vessel and remaining therein.

I have incorporated the British form with Prof. Grube's species from Villafranca. His description is as follows:—"Body rounded, not changeable, 1—1·5 inch long, contracting into 7·5 lines long, and then ringed and wrinkled, 0·5 of a line broad. Orange-red, or sometimes brick-red, sides and under surface white; head white, only at the tip of the snout there is a violet spot, and then a broad white belt. The body tapers towards the posterior end, and terminates in a much thinner process, probably a short reproduced tail. The head is not pointed: lateral fissures and eyes not noticed." He had overlooked the lateral fissures, which are shallow. The description of the "growing tail" quite corroborates the correctness of my sister's drawing, for the styles had fallen off when I examined the specimens. Grube's figure shows a broader white belt anteriorly than I observed in the British forms, but such may have been due either to variation or want of scientific accuracy in his artist.

Genus IX.—MECKELIA,[1] *Leuckart*, 1827. (Char. emend.)

For the curious form described in the following paragraphs I have thought it better to appropriate the title of a genus established in 1827 by Leuckart in his 'Breves Animalium,' and set at liberty by the undisputed claim of priority. The name, it is true, was given to a form differing in some respects from the following; but the literature of the subject is already so burdened with generic names which have been fashioned on insufficient and unreliable data, that it is almost a duty to resent any addition thereto if it can be avoided. Priority, also, gives the present title a certain claim on our consideration.

Generic character.—Structure of the rounded body-wall as in *Lineus*. Cephalic fissures absent. Proboscis furnished with only three coats, external spiral, longitudinal, and glandular.

MECKELIA ASULCATA, n. s.

Specific character.—Eyeless. Body thick and round. Of a uniform pinkish hue.

Habitat.—St. Magnus Bay and adjoining seas, Shetland: and between tide-marks, Herm.

[1] Named in honour of Prof. Meckel. The same name was in 1830 given by Robineau-Desvoidy ('Essai sur les Myodaires') to a genus of Diptera.

This species can be only imperfectly described at present, as its distinction was not recognized on the sole occasion on which it was seen alive. The specimen found at Herm was of a rose-pink colour in front, pale posteriorly. There are no lateral fissures on the head. The mouth lies on the ventral surface some distance behind the tip of the snout, and in the preserved specimens forms a small puncture or dimple. The worm appears to attain the length of four or five inches.

Numerous specimens of an elongated example of the Anopla without lateral fissures occur in a collection brought by the Rev. L. Guilding from the West Indies, and now in the British Museum. All have a peculiarly corrugated and thickened anterior end, and a small round mouth like a puncture. Some measure about fifteen inches long.

Family III.—Carinellidæ.

Genus X.—Carinella, *Johnston*, 1833.

Before the time of Dr. Johnston the typical animal of this genus, the *Gordius annulatus* of Montagu, had not been sufficiently distinguished from its congeners; and though he named the species in ignorance of the prior observations of Montagu, yet his generic title is more appropriate than that of *Meckelia,* in favour of which the original name was suppressed. The latter term was given to one of the Lineidæ, while the type here is totally different. *Carinella,* as its originator says, labours under the disadvantage of being a name which the scholar may "in vain puzzle himself" to find out "from what, and whence, it is derived." At first sight it seems to be a diminutive of *carina,* a keel.

Generic character.—Body elongated, tapering from the front backwards. Snout wider than the rest of the body, bluntly rounded anteriorly. Mouth sometimes small.

1. Carinella annulata, *Montagu*, 1804. Plate VII, fig. 5; and Plate VIII.

Specific character.—Eyeless, with a white patch on the snout. Body rounded, of a rich red colour, striped longitudinally and banded across at somewhat regular intervals by white belts. Occasionally pinkish throughout.

Synonyms.

1804. *Gordius annulatus,* Montagu. Linn. Trans., vol. vii, p. 74.
1807. ,, ,, Turton. Brit. Fauna, p. 130.
1808. *Lineus annulatus,* Montagu. MS., p. 273, tab. 9, fig. A.
1812. *Gordius annulatus,* Pennant. Brit. Zool., vol. iv, p. 73.
1833. *Carinella trilineata,* Johnston. Loudon's Mag. Nat. Hist., vol. vi, p. 232, woodcut, f. 24, *a. b.*
1841. ,, ,, W. Thompson. Ann. Nat. Hist., vol. vii, p. 482.
,, *Gordius annulatus,* Ibid. Op. cit., p. 482.
,, *Polia crucigera,* Delle Chiaje. Descriz. e Notom. anim. invert., &c., tom. v, p. 10, tab. 174, f. 15—18, and tab. 176, f. 17.

1846. *Meckelia trilineata*, Johnston. Ann. Nat. Hist., vol. xvi, p. 135.
,, *Valencinia ornata*, De Quatrefages. Ann. des sc. nat., 3me sér., Zool., tom. vi, p. 187, tab. 10, f. 4 and 5.
1849. ,, ,, Ibid. Voyage en Sicilie, vol. ii, p. 99, pl. 10, f. 1—3.
1850. ,, *annulata*, Diesing. Systema Helm., vol. i, p. 244.
,, ,, *ornata*. Ibid. Op. cit., p. 244.
1853. *Gordius anguis*, Dalyell. Pow. Creat., vol. ii, p. 85, pl. 10, f. 7—10, and pl. 13.
1854. *Valencinia ornata*, Müller. Archiv, p. 83.
1859. ,, ,, Leuckart. Archiv für Naturges., ii, p. 187.
1861. ,, ,, Grube. Ausflug nach Triest u. dem Quarnero, pp. 35 and 129.
1862. ,, ,, Diesing. Revis. der Turbell., p. 252.
,, ,, *annulata*, Ibid. Op. cit., p. 253.
1863. *Valencinia ornata*, Diesing. Nachträge z. Revis. der Turbell., p. 6.
1864. ,, ,, Grube. Die Insel Lussin u. ihre Meeresfauna, p. 94.
1865. *Meckelia annulata*, Johnston. Catalogue Brit. Mus., pp. 27 and 296-8, with woodcut, as in 1833.
1866. ,, ,, Lankester. Ann. Nat Hist., 3rd ser., vol. xvii, p. 389.
1867. ,, ,, Parfitt. Catal. Annel. Devon, p. 8.
1868. ,, ,, McIntosh. Rept. Brit. Assoc., 1868, p. 340.
1869. ,, ,, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 372 et seq.

Habitat.—Under stones near low water, in obscure fissures of rocks, and also dredged in somewhat deep water. Often cast on shore amongst débris from the laminarian region. Generally diffused round the British coasts and the shores of France. In laminarian and coralline regions it prefers tangle-roots, the inner surface of bivalve shells, or the tubes of *Terebellæ*, *Serpulæ*, and other annelids.

Body.—Seven to thirty inches long, and about a line in breadth, somewhat narrowed behind the cephalic furrows, and gradually tapering to the tail. Dorsal surface rounded, ventral flattened.

Colour.—Various shades of brick-red, brownish-red or vandyke-brown (garnet-red, Montagu), and with a very regular arrangement of white stripes. The snout usually has a patch of white, with a crescentic margin anteriorly and posteriorly, so as to be narrowed in the middle, with a coloured portion in front. From the former a white central line proceeds backwards on the dorsum to the tip of the tail. A short distance behind the ciliated furrows of the head a circular white belt environs the body, and from each side of this ring a white stripe passes along the lateral aspect to the tip of the tail. At certain intervals, only two of which in front are distant, the body is encircled by white rings, which give a somewhat regularly segmented appearance to the elongated worm. Posteriorly, indeed, they are often equidistant, and in many there is a pale intermediate ring, sometimes faintly indicated by whitish pigment on the dorsum. Every alternate white ring in most of the specimens is double; that is, divided by a slight furrow. Col. Montagu mentions 220 as the number of white rings after the third, and Sir J. Dalyell counted 200 belts in a specimen eighteen inches long. There are likewise in many a series of white specks above the lateral white lines, generally commencing at the fourth or fifth space behind the cephalic furrows, though occasionally some occur on the third. These indicate for the most part the points at which the products of the generative organs escape. The under surface is paler than the upper. The ventral aspect of the snout has a white patch continuous with, but narrower than, that on the dorsum. The only other markings on this surface are caused by certain pale lines and the circular white belts; but in a characteristic variety a median white stripe passes along the entire belly from tip to tip. The space behind the first white circle is usually paler than the rest. In a very large dark specimen, sent from Montrose by Dr. Howden, the white stripes anteriorly had a beautiful rose-pink shade. Pale red examples from fissures of rocks, when placed in glass vessels, gradually become brownish-red or quite brown by exposure to light.

Head.—Horseshoe shaped, wider than the rest of the body, not much flattened, and without eye-specks. Posteriorly it is gradually narrowed to the cephalic furrows, where a slight shoulder occurs. There is a curved streak in the bend of each ciliated furrow on the dorsum, perhaps in connection with the cephalic sac. These furrows are continued straight inwards on the ventral surface, so as to meet just at the anterior part of the mouth. The latter forms a longitudinal slit somewhat less distinct than in *Lineus.*

A well-marked southern variety occurs in the island of Herm. The head is peculiarly flattened, larger in proportion than in the common form, and pale at the tip. At first sight the body appears to be dull orange throughout, but minute inspection shows a pale lateral line on each side, with a series of minute pale spots above it, and traces of faint transverse bars on the dorsum.

This species, one of the most handsome and graceful of the whole order, lives a long period in confinement, constructing on the bottom and sides of the vessel numerous hyaline transparent tubes, in which it lies either doubled or coiled in various ways. The tube or case has a fine silky lustre or iridescence, appearing under a high power as an almost structureless membrane with a few minute adherent granules, and irregularly streaked with fine lines, from microscopic folds of the very thin tissue. The animal progresses somewhat slowly; and though devoid of eyes, it needs but a touch to become aware of the proximity and apparently the nature of any object, so that, for instance, it at once enters head foremost or backs into a tube. Small fragments of the body survive a long time, and move slowly about. In these the anterior end is somewhat pointed. Probably they develop into perfect animals under favourable circumstances.

The skin gives a marked acid reaction.

This is another addition to our marine fauna for which we are indebted to the industry and enthusiasm of Col. Montagu. He distinguished the common form and that with the ventral median white line, as well as noticed the white specks at the sides and the broader nature of some of the circular white belts. In the variety with the ventral longitudinal line he states that "the first annulation of white is very close to the anterior end, the second is distant about an inch, and the rest (about 220) are nearly equidistant." The drawing accompanying the manuscript by some accident shows dark instead of white lines on the dorsum. Four succeeding authors of note, viz. Dr. Johnston, Sig. Delle Chiaje, M. de Quatrefages, and Sir J. Dalyell, each described the same animal as a new species. M. de Quatrefages based the distinction of his *Valencinia ornata* from Col. Montagu's form on the fact that the latter did not note the remarkable enlargement of the head, and because his specimens came from the laminarian region, Montagu's from the coralline. Such data, of course, are unsatisfactory. Moreover, since we observe that a species so prominently barred as *Micrura fasciolata* occasionally presents none of these characteristic markings, and that the variety of *Carinella annulata* from Herm showed few traces of stripes, we may be forgiven if we harbour some doubts as to the specific distinction of De Quatrefages' two species *ornata* and *splendida*. It is possible that *Tubulanus elegans* and *T. polymorphus* of Renier, Delle Chiaje, and others, may also have some connection with this species. Sir J. Dalyell compares *C. annulata* to a regular snake in miniature, of delicate form and proportions, and decked in lively colours. He observes that the mouth is at the very extremity, and opens by a wide horizontal gape, as if the creature had an upper and an under jaw, statements due to some erroneous recollections. He notices that a large number of reddish-brown ova were discharged from a specimen in June. M. de Quatrefages, again, mentions that specimens of his *Valencinia splendida* from Bréhat were loaded with ova in September and October.

2. Carinella linearis, *Montagu*, MS.

Specific character.—Eyeless. Head spathulate, somewhat pointed in front. Milk-white.

Synonym.

1808. *Lineus linearis.* Montagu, MS., pp. 274-5.

Habitat.—South coast of England, and Lochmaddy in the Hebrides, amongst sand at low water.

Body.—Five to six inches long, less than a line in breadth, flattened, slightly tapered towards the front, diminishing more decidedly posteriorly.

Colour.—Pure milk-white, with translucent margins towards the tail.

Fig. 13.

Anterior extremity of *Carinella linearis.*

Fig. 14.

Carinella linearis with the anterior end somewhat contracted.

Head.—Spathulate, assuming various aspects, sometimes pointed (woodcut, fig. 13), at others blunt and rounded (woodcut, fig. 11). The snout has an opaque-white central streak. No pigment-specks are present.

The species was procured whilst digging for *Priapulus caudatus* and Annelids at Lochmaddy. Its habits and motions are like those of other species. As usual with white forms, immersion in spirit gives a yellowish hue. On transverse section its anatomy is found to agree with the foregoing, and especially with the variety from Balta having the bifid proboscis, for the inner (longitudinal) muscular coat of the body-wall shows a marked tendency to separation in the middle line of the dorsum.

I was inclined to consider this species a doubtful variety of *Carinella annulata* until I saw the manuscript of the accomplished Montagu containing the description of "*Lineus linearis.*" He says—"*L. linearis,* with a cream-coloured body. Long, slender, considerably extensible and tenacious; the anterior end largest, sometimes elavated and flattened, at other times pointed; frequently that part is observed to be alternately inflated and contracted, while the rest of the body is quiescent. Length 5 or 6 inches when extended, but usually contracted to 3 or 4. This species inhabits the sandy shore at Dawlish, about five or six inches beneath the surface at low water. Like the *marinus,* its motion consists of contortion and variation in size of different parts of the body at the same time. A tenacious slime exudes from its body, which, collecting sand, readily forms a covering like a Sabella."

The *Valencinia longirostris* of M. de Quatrefages has certain affinities with this form, although the snout, as shown in his figures, is much more pointed. It is to be remembered also that he found his species in a similar region and medium (sand and mud) at the *îles Chausey.* The *Lineus albus* in the British Museum is one of the *Lineidæ* from Cornwall.

The shape of the head of this animal, the absence of eyes, its habit of residing amongst sand, and other points, make it clear that there are grounds for specific distinction.

Genus XI.—Valencinia, *De Quatrefages.* (Char. emend.)

This genus was instituted by M. de Quatrefages for the typical and other forms of the previous genus, but lapses in virtue of the priority of other names. Since the term was applied to an allied form, it may not inappropriately be used for the description of the present species. The genus *Polia,* perhaps, has prior claims, but it is already employed by the entomologists.

Generic character.—Structure of the proboscis as in *Carinella.* The nerves lie in the longitudinal muscular coat. The snout is shaped as in *Lineus lacteus,* and furnished with a row of eyes on each side. The mouth forms a distinct fissure a considerable distance behind the ganglia.

Valencinia lineformis, n. s.

Specific character.—Roseate in front, yellowish-white posteriorly.

Habitat.—Amongst shell-gravel and the fine purplish ramose form of *Corallina officinalis* in five fathoms, Bressay Sound, between the Point of Scotland and the Green Head.

Body.—Six to eight inches or more in length, and about a line in breadth, generally resembling that of *Lineus lacteus*, except in the greater tendency to encircling furrows.

Colour.—Richly roseate in front, the rest of the body being pale pinkish-yellow or yellowish-white.

Head.—Spathulate, as in the above-mentioned species, the lateral fissures, of course, being absent. The eyes are also fewer in number and smaller, but similarly arranged. The mouth is large and situated far backwards, the position and size being equally interesting in this group.

So like was this species to *Lineus lacteus* (Plate V, fig. 3), that most examples were consigned to spirit before a more critical examination discovered the essential differences. Those specimens, even, which were destined for transmission southward proved so delicate as to break into short fragments in a day or two. The structure of the body-wall and the proboscis at once distinguishes it from the *Lineidæ*, while the fact that the nerves in the longitudinal muscular coat do not quite reach its outer border separates it from its ally *Carinella linearis*.

Family IV.—Cephalothricidæ.

Genus XII.—Cephalothrix,[1] *Œrsted*, 1844.

This genus was established by A. S. Œrsted in his 'Entwurf Plattwürmer' for the reception of animals identical with the *Planaria linearis* of Jens Rathke. The typical form was distinguished by several names, and a variety included also under the genus *Astemma* of the same author, for I consider the distinctions as to the presence or absence of eye-specks and the vague remarks about respiratory fissures of little consequence.

Generic character.—Head cylindrical, slightly tapered in front; eyeless, or with a few obscure pigment-specks. Cephalic fissures and sacs absent. Mouth situated a considerable distance behind the snout.

Cephalothrix linearis, *Jens Rathke.* Plate IV, figs. 4 and 5.

Specific character.—Body extremely attenuated, pale yellowish or skin-colour; often with reddish grains towards the tip of the snout.

Synonyms.

1799. *Planaria linearis*, Jens Rathke. Skrivter af Naturhist. Selsk., v, p. 84, tab. 3, f. 11.
1829. „ *filiformis*, Johnston. Zool. Jour., vol. iv, p. 56.
1837. *Nemertes* (*Borlasia*) *rufifrons*, Johnston. Mag. Zool. and Bot., vol. i, p. 538, pl. 18, f. 4 and 5.
1844. *Cephalothrix bioculata*, Œrsted. Entw. Plattw., p. 81, woodcut 12.
„ „ *cæca*. Ibid. Op. cit., p. 81, tab. 3, f. 39.
„ „ *linearis*, Ibid. Op. cit., p. 82 (note under *C. cæca*).

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[1] Κεφαλή, the head, and θρίξ a hair. There is a genus of Lamellicorn beetles (established by Hope in 1837) called *Cephalotrichia*.

1841. *Astemma rufifrons*, Œrsted. Op. cit., p. 82, woodcut 13 (?)
,, *Cephalothrix bioculata*, Ibid. Kroyer's Nat. Tids., iv, p. 573.
,, ,, *cæca*, Ibid. Op. cit., p. 574.
,, *Planaria linearis*, Ibid. Op. cit., p. 573
,, *Astemma rufifrons*, Ibid Op. cit., p. 574.
,, ,, *longum*, Ibid. Op. cit., p. 574.
,, ,, *rufifrons*, Ibid. De Region. Marin , p. 79
,, *Cephalothrix bioculata*, Ibid. Op cit., p. 79.
1846. *Borlasia ? filiformis*, Johnston. Ann. Nat. Hist., vol xvi, p. 434, pl. 15, f. 1, *a*, *b*.
1850. ,, *rufifrons*, Diesing. Syst. Helm., vol. i, p. 244.
,, ,, *longa*, Ibid. Op. cit., p. 244.
,, ,, *cephalothrix*, Ibid Op. cit., p. 244
,, ,, *filiformis*, Ibid. Op. cit., p. 242.
,, ,, *linearis*, Diesing. Syst. Helm., vol. i, p. 242
,, *Cephalothrix Œrstedii*, Ibid. Op. cit., p. 246.
1853. *Gordius gracilis*, Dalyell. Pow. Creat., vol. ii, p. 74, pl. 9, f. 8—11
1859. ,, ,, Leuckart. Archiv f. Naturges., ii, p. 187.
1861. *Cephalothrix lineata*, Claparède. Recher. Anat. sur les Ann., Turb., &c., p. 82
1862. *Borlasia longa*, Diesing. Revis. der Turbell., p. 249.
,, ,, *rufifrons*, Ibid. Op. cit., p. 249.
,, ,, *cephalothrix*, Ibid. Op. cit., p. 250.
,, ,, *filiformis*, Ibid. Op. cit., p. 250.
,, ,, *linearis*, Ibid. Op. cit., p. 250.
,, *Cephalothrix Œrstedii*, Ibid. Op. cit., p. 254.
,, *Meckelia cæca*, Ibid. Op. cit., p. 286.
,, *Cephalothrix ocellata*, Keferstein. Zeitsch. f. wiss. Zool., Bd. xii, p. 63, taf. 6, f. 11—16.
,, ,, *longissima*, Ibid. Op. cit., p. 65, taf. 6, f. 6—10.
1863. *Borlasia linearis*, Diesing. Nachträge zur Revis. der Turbell., p. 5.
,, ,, *? longissima*, Ibid. Op. cit., p. 6.
,, *Ommatoplea ocellata*, Ibid. Op. cit., p. 7.
,, *Gordius gracilis*, Ibid. Op. cit., p. 15.
1865. *Astemma rufifrons*, Johnston. Catalogue Brit. Mus., pp. 19 and 288.
,, ,, *filiformis*, Ibid. Op. cit., p. 19.
1866. ,, *rufifrons*, Lankester. Ann. Nat. Hist., 3rd ser., vol. xvii, p. 388.
,, ,, *filiformis*, Ibid. Op. cit., p. 388.
,, *Cephalothrix lineatus*, Ibid. Op. cit., p. 388 (?)
1867. *Astemma rufifrons*, Parfitt. Catalogue Nat. Hist. Devon., Annelids, p. 5.
,, *Cephalothrix filiformis*, McIntosh. Rept. Brit. Assoc., 1867, Trans. Sect., p. 92.
1868. ,, ,, Ibid. Ann. Nat. Hist., 4th ser., vol. ii, p. 293.
1869. ,, ,, Ibid. Trans. Roy. Soc. Edinb., vol. xxv, pt. ii, p. 376 et seq.

Habitat.—Under muddy stones between tide-marks, often in great numbers, and on oysters and other shells and ascidians in the laminarian region. Ranges from Shetland to the Channel Islands.

Body.—About three or four inches long, flattened, tapering towards the snout, and much more towards the tail; most variable in appearance, now stretched to a mere thread, and again shortened to a worm of some volume, or thrown into alternate dilatations and contractions. It is marked along the centre by the pale streak of the proboscidian sheath.

Colour.—Variable. Sometimes the animal is of a pale cream-colour throughout, with no special pigmentary accumulation. A patch of yellowish pigment occurs in other cases on the snout, and the œsophageal region is yellowish; or the yellowish, orange or reddish pigment is increased towards the tip of the snout, and the œsophageal region is reddish-orange. The succeeding part is also faintly tinged in those most deeply coloured, the rest of the animal being of the usual dull whitish or skin colour, and more opaque than the former. In a female specimen laden with ova, sent from the St. Andrews rocks in April, the entire digestive cavity was of a fine dark green hue (Plate IV, fig. 5), a condition probably due to the absorption of colouring matter from the food, as specimens kept in vessels beside the ova of *Phyllodoce maculata*, Johnst. become similarly tinged towards the posterior part of the digestive tract.

Head.—Rounded, slightly tapered to a blunt point, not distinguished from the rest of the body; without eye-specks, and devoid of furrows or fissures. The mouth forms a conspicuous slit a little behind the commencement of the œsophagus, and the pouting lips would seem to be occasionally used as a kind of sucker, since a jerk occurs on raising the body from this point.

C. linearis is easily kept in confinement, moving about actively, or reclining at ease along the vessel as a slender thread. It is fond of associating with fellows of the same or a similar species, forming a tangled bunch or grouped as a radiating series of living filaments. In progression the mobile snout is used as an exploratory organ, being thrust hither and thither with ceaseless energy under a glass cover, and pushing aside its own yielding body in any direction. The latter is also frequently drawn through a loop of mucus like a thread of coherent yet fluid substance, which becomes thickened or attenuated by each successive contractile wave; and it is sometimes bent in a peculiar manner from twists round loops of mucus or the bodies of others. The skin is strongly acid to test-paper.

The ova and spermatozoa are ripe from January to June.

I have taken the *Planaria linearis* of Jens Rathke to be the present species. It was noticed by Col. Montagu and afterwards by Dr. Johnston in Britain. The *Lineus spiralis* of the former (MS.) is probably a variety to which the description exactly applies, with the exception of the "red spiral intestine." The proboscis may occasionally be tinted. The presence of pigment- or eye-specks does not seem to be of sufficient weight to separate Œrsted's *C. bioculata* and *C. cæca*, if, indeed, the former is to be included in this genus at all. The *Astemma rufifrons* of the same author is only a variety of the present species with a greater development of pigment in the snout. The woodcut (op. cit., fig. 13), however, very much resembles a compressed anterior region of *Lineus bilineatus* viewed as a transparent object. It is somewhat doubtful if his *Astemma longum* (Kroyer's Naturhist. Tidskrift), is a *Cephalothrix*, though he places it next *A. rufifrons*. Sir J. Dalyell was the first to notice the development of this species, which he saw producing a rope of spawn in June. He correctly describes the young as having two eyes. The *Polia filum* of De Quatrefages has much resemblance to *C. linearis*; indeed, his remarks can only apply to this form or to *Nemertes carcinophila*, and the probability is in favour of the former, though he had omitted to notice the mouth. The enlarged drawing of the ganglia given by this author still further indicates the connection. This arrangement is never seen in an example of the Enopla. The *C. lineata* (Œrst.) which M. Claparède found at Skye is evidently this common species. There is also nothing in the descriptions and figures of Prof. Keferstein's *C. ocellata* and *C. longissima* to distinguish them from each other or from this form. The presence of dark pigment-specks is of no greater value specifically than the anterior red pigment in the British examples. There is considerable variation, but no character of sufficient importance to merit specific distinction. The form of the papillæ of the proboscis (which are stated to be hook-shaped) and other minute points in the author's descriptions require confirmation.

EXPLANATION OF THE LETTERS USED IN THE PLATES.

The following letters have been employed both in the Enopla and Anopla to designate similar structures :—

a. Proboscis.
f. Superior ganglionic commissure.
g. Inferior do. do.
j. Œsophageal region.
j'. Digestive canal proper.
k. General stroma of the snout.
m. Cephalic sac.
m'. Duct of do.
n. Great lateral nerve.
o. Proboscidian sheath.
ov. Ovaries, ova, or their indications.
p. Dorsal blood-vessel.
r. Lateral do.
w. Mouth.
z. Anus.
Ł. Muscular ribbon of proboscis.

Letters confined to the Enopla.

ac. Reflection of the proboscis in front of the ganglia.
b. Epidermis.
ab. Channel in the snout for the proboscis.
c. Cutis.
d. Circular muscular coat.
e. Longitudinal do.
h. Superior lobe of the ganglion.
i. Inferior do. do.
l. Cephalic blood-vessel.
q. Anastomotic do.
A. First region of the proboscis.
B. Second do. do.
C. Third do. do.

α. Globule in marginal stylet-sac.
β. Stylets in do. do.
δ. Duct of do. do.
ι. Muscular chamber behind the floor of the anterior region of the proboscis.
η. Floor of the anterior chamber of the proboscis.
θ. Muscular investment of the granular basal apparatus.
λ. Granular basal apparatus.
μ. Ejaculatory duct.
μ'. Aperture of do. into chamber ι.
ν. Marginal stylet-sacs.
π. External granular glands.
ρ. Reservoir.
σ. Glands of do.
τ. Spiral muscular fibres of the walls of the reservoir.
$\tau\omega$. Longitudinal do. do.
ϕ. Duct of communication with the posterior chamber.
χ. Wall of the posterior chamber.

Letters used in describing the anatomy of the Anopla.

aa. Tube for the proboscis in the snout.
b. Cephalic fissures.
c. Ciliated epidermis.
d. External layer of cutis.
d'. Basement-layer.
d''. Pigment-layer in *Lineus gesserensis*.
e. External (longitudinal) muscular layer.
e'. Circular muscular layer.
e''. Inner (longitudinal) do. do.
h. Ganglia.
h'. Superior lobe of the ganglion.
h''. Inferior do. do.
s. Vascular lacunæ behind the ganglia.
u. Vascular meshes around the œsophageal region.
v. Larger vascular space at each side of the sheath for the proboscis in front.
y. Constriction between the œsophageal and succeeding alimentary regions.

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APPENDIX.

The delay which has taken place in the preparation of the coloured plates has enabled me to make a few remarks on certain recent papers bearing on the subject. Several of these are by A. F. Marion, who has already (p. 40) been alluded to as the discoverer of an hermaphrodite Nemertean, which he found, with developed generative organs, in the month of March in the Mediterranean.[1]

In a communication entitled 'Histologie du Système nerveux des Nemertes'[2] the author describes the lateral nerve-trunk as enveloped in a fine membrane, and gives an interesting account of the fibres after they have entered the ganglia. He mentions that the nerve-cells in the latter are chiefly elliptical and apolar, though multipolar are also present. He further notes that in certain forms a pulpy granular mass occurs between the external sheath and the internal fibres of the lateral nerve, probably referring to the fibro-granular matrix described on page 110, and shown in Plate XXI, fig. 6, *n'*, of the present work. In these forms, moreover, the cephalic ganglia are composed of the same pulpy mass, without a trace of cells.

Another French author, M. Léon Vaillant,[3] next advances certain remarkable opinions concerning contested points in the Nemerteans. He revives the idea, as he says, of Max Schultze and De Quatrefages, that the proboscis is the digestive organ. The works of the latter author have already been fully gone into, but I am unacquainted with the paper in which the former has propounded this erroneous idea; indeed, the contrary opinion has been taken in the review of his labours (see pp. 28, 29, &c.). His assertion that the marginal stylet-sacs furnish the stylet for the central apparatus through the ducts of the former organs has already been disposed of (pp. 57 and 67). His remarks that the posterior chamber of the proboscis has an aperture leading into "the general chamber of the body" (the proboscidian sheath being unknown), and that *Valencinia longirostris* (one of the Anopla) takes nourishment by the proboscidian aperture, scarcely require refutation.

A. F. Marion published an important article on the subject in his recent 'Recherches sur les Animaux inférieurs du golfe de Marseille,'[4] which, indeed, mainly consist of an account of an hermaphrodite Nemertean named *Borlasia Kefersteinii*, already alluded to in the "Zoography" (p. 40). The form was dredged by the author at the above-mentioned locality amongst the roots of sea-weeds, and, in conjunction with three other species of similar organization, its examina-

[1] 'Comptes Rendus,' tom. 69, 1869.

[2] Ibid., tom. 68, 1869, p. 1474.

[3] 'La Revue scientifique de la France et de l'Étranger,' &c., 2e série, 21st Sept., 1872. I am much obliged to Mr. Waterhouse, of the Zoological Department, British Museum, for a perusal of this note.

[4] 'Ann. des. sc. nat.,' v^{e} sér., tome xvii, Nos. 3 & 4, 1st March, 1873.

tion afforded, he says, an opportunity of giving a very complete description. He follows Prof. Keferstein in his classification, and therefore the observations on this head in the "Zoography" are equally applicable here. He is also rather behind date in his remarks on the value of the stylet-region in the discrimination of species.

In what he calls the granular coat of the skin he found small brilliant bodies, sometimes in the form of prisms, sometimes in the form of buckles. This peculiar condition has not been observed in the British Nemerteans. Only longitudinal muscular fibres were present in his species, but he does not say that he made any transverse sections. In consonance with the structure of the Enopla, to which the form belongs, there ought to be external circular as well as internal longitudinal fibres. I cannot agree with his proposition that naturalists generally consider the proboscis an organ of offence and defence, for observations on the living animal, and the anatomy and physiology of the organ in both Enopla and Anopla, render this view quite theoretical. He is safe, however, in objecting to the interpretation of his countryman, M Léon Vaillant, previously narrated.

A vital discrepancy is the affirmation that the mouth in his species (one of the Enopla) opens behind the ganglia, because in every example (British and foreign) of this group seen by me the position of the oral orifice is quite in front of the ganglia and ganglionic commissures, and thus, very properly, forms one of the most important distinctions between them and the Anopla, in which (latter) the mouth invariably opens behind the ganglia. As an accompaniment to this erroneous view the author has quite overlooked the characteristic œsophagus, which forms a longitudinally plaited ciliated sac (essentially differing in appearance from the rest of the digestive chamber) behind the ganglia. The oral slit shown in his figure might pass for one of the longitudinal rugæ of the organ. It is by no means easy to arrive at an accurate knowledge of the anatomy of these animals, and hence the greatest care and patience are necessary.

He further observes that the proboscis is fixed to the wall of the "general cavity of the body," a position it does not occupy, since it is enclosed in its special sheath of two coats, and to the inner surface of which the terminal ribands are duly fixed. M. Marion's interpretation implies a total want of this sheath, which, I am sure, a single transverse section would at once render apparent. He next narrates that the anterior region of the proboscis is covered with papillæ, but he would have been more exact if he had mentioned that these organs are internal, for on glancing at his figure (Pl. 17, fig. 3, op. cit.) it is difficult to say whether they are wholly internal or also common to the external surface. To have got the figure the organ must have been turned inside out at its anterior part. The basal apparatus of the central stylet is described as brownish. It is only so by transmitted light—from the dense mass of white granules. The terminations of the ducts of the marginal stylet-sacs have never, in any form observed by us, been close to the aperture for the central stylet in the floor of the anterior chamber, but at some distance therefrom. The statement, also, that below the stylet-sacs the fibrous tissue is furnished with fine pigment-granules is not sufficiently comprehensive, for no mention is made of the regularly arranged circlet of granular glands (π in our figures), neither is any help on this point obtainable from the plate.

Another discrepancy is the arrangement of the duct from the reservoir (his *poche de réserve du liquide venimeux*), which canal he describes and figures as extending forward to open into the floor of the anterior chamber near the point of the central stylet. If the author had watched an organ under careful pressure he would have seen the granular gland-cells from the posterior chamber (his *région glandulaire de la trompe*) roll forward into the reservoir, and find exit singly into the muscular cavity (ε in our figures) behind the floor of the anterior chamber, and which the author actually represents without comment. Moreover, that afterwards they passed into the cavity of the anterior chamber by the aperture for the central stylet. With regard to his discussion concerning the venomous nature of the fluid in the reservoir, I would not, for my part, say that it is poisonous. It is clear, from the minute anatomy of the organ, that the fluid cannot enter a wound inflicted by the stylet until the latter is withdrawn; and, as stated previously (p. 62), the proboscis is a somewhat precarious aggressive weapon. The jerking movements observed by the French author in the protruded proboscis are common enough in a structure so muscular and mobile, but they may be explained otherwise than on the supposition of attacking prey. My experience of the organs in the Anopla, also, does not coincide with his observation that they subserve the same function, viz. the secretion of poison. Neither has anything been observed to support the view that other marine animals, such as Crustacea, manifest great repugnance to the Nemerteans, nor is it probable that nature furnished the latter with cilia (in lieu of urticating organs) to warn their fellows of their deadly approach.

The author admits that he has only imperfectly examined the organs of circulation, a fact apparent from his remark (and figure) that a central dorsal vessel springs from the middle of the cephalic arch at the tip of the snout. As formerly shown (p. 79), the dorsal vessel arises from the two lateral—by the anastomotic—behind the ganglia.

He indicates the discovery of a curious species, having small clear processes like buckles in its cutis, and analogous to the bodies in the muscles of Echinoderms; hence he calls it *Borlasia echinoderma*. The basal apparatus of the central stylet in this species is truncate posteriorly, as in *Prosorhochmus Claparedii*. Some interesting details are given of its nervous system, amongst others the curious fact that the first eleven pairs of lateral nerves (from the great lateral trunks) go to a series of eyes furnished with refracting globules. The anterior eyes are supplied, as usual, by branches from the ganglia.

The paper concludes with an account of the reproductive organs of *Borlasia Kefersteinii*. The statement that on attaining full development the ova and spermatozoa burst their envelopes and escape into the "general cavity of the body" is not in accordance with our observations. The apertures along the sides, which the author failed to see in this small species, render such a supposition unnecessary, though, of course, not impossible. His asking if, like Keferstein, we are to consider the cephalic sacs and "fossettes céphaliques" the channels whereby the reproductive products are expelled, is not in keeping with a thorough knowledge of the subject. In the viviparous *Prosorhochmus Claparedii* even the largely developed young are confined to certain definite spaces in the body of the parent, but their actual mode of exit in this species is still involved in obscurity. It is to be remembered in connection with the subject that in *Nemertes carcinophila*, also occasionally a viviparous species, the sexes are separate.

The author's allusion to the literature of the subject is meagre, and though several of his views are nearly identical with, or modifications of, those promulgated long ago by his distinguished countryman, M. de Quatrefages, he does not even mention his name. The plate of figures accompanying the paper is considerably behind date in accuracy.

An important memoir (an abstract of which has only been published) in connection with the homologies of the subject is that 'On the Anatomy and Histology of the Land-Planarians of

Ceylon,'[1] by Mr. H. N. Moseley, now one of the naturalists in the "Challenger" expedition. The author specially examined the genera *Bipalium* and *Rhynchodemus*; and since my observations on the former had been made some years ago, and printed off several months before the above paper reached the Royal Society, a comparison of the results will be interesting. He agrees with me in affirming that the skin closely conforms to the Planarian type. The flask-shaped cells filled with "stäbchenformigen Korpern" below the cutis he thinks homologous with the "nail-like bodies of the Nemertines;" but if he means by the latter expression the proboscidian stylets, the homology is not very apparent, any more than the conjecture concerning their possible alliance with the bristles of the Annelida. He makes the curious statement that "it is commonly said that whilst in all other Vermes the external muscular layer is circular, and the longitudinal internal, in Turbellarians the reverse is the case;" but he might have observed, in a paper on the "Anatomy of the Nemerteans,"[2] that considerable differences exist in the arrangement of the muscular coats of the great groups—for example, between the Enopla and Anopla, the external muscular layer in the former being circular, while in the latter it is longitudinal. With regard to the nature of the pale areas described on p. 113, and which Mr. Moseley calls primitive vascular trunks, I was in doubt after the examination of my specimen, though I could not see anything nervous about them. If such be a water-vascular system it is totally different from the circulatory trunks in the Nemerteans, which I hold to be the blood-vessels of the animals. Some interesting theoretical remarks are appended to the communication.

The latest publication pertaining to the subject is by M. E. Zeller,[3] on the "Structure of the Proboscis of *Borlasia Kefersteinii*," Marion, the author having worked under the direction of the latter. He is of opinion that the species must be united with that parasitic on the branchial tissue of *Phallusia mamillata*. It is therefore probably a similar—if not the same—form as Delle Chiaje or Leuckart and Pagenstecher long ago described (see p. 2, &c.). Unfortunately the author is not more precise than M. Marion with regard to the anatomical position of the proboscis, which, he states, is attached to the "walls of the general cavity." The complex structure of the anterior region is not precisely detailed, and the same remark is applicable, as in the case of M. Marion, to his definition of the granular basal apparatus of the central stylet, which is held to be brownish. He, however, has evidently more acquaintance than his colleague with the muscular cavity (*ε* in our figures) behind the floor of the anterior chamber, though his description is somewhat obscure. Three marginal stylet-sacs are mentioned as characteristic of the species. The dark layer above the styliferous apparatus would have been whitish by reflected light. He agrees with M. Marion in calling the reservoir a poison-sac, but is not definite enough in his account of the termination of its duct (which opens into the chamber *ε*). The physiological observations on the ejection of the proboscis have been anticipated.

[1] 'Proceed. Roy. Soc.,' vol. xxi, No. 142, received January, 1873; also in 'Annals Nat. Hist.,' vol. xi, 4th ser., No. 64, April, 1873, &c.

[2] 'Trans. Roy. Soc. Edinb.,' vol. xxv, p. 305, 1869.

[3] 'Ann. Nat. Hist.,' vol. ii, 4th series, No. 65, p. 398, May, 1873 (from the 'Comptes Rendus,' April 14th, 1873).

ERRATUM.

Delete the first synonym (date 1770) on p. 156, and the allusions thereto on pp. 10 and 158.

PLATE I.[1]

FIG.

1. *Amphiporus lactifloreus*, Johnston, pinkish variety. Enlarged.

2. ,, ,, whitish variety. Slightly enlarged.

3. ,, *pulchra* (O. F. M.), Johnst. Enlarged. The specimen is a female, and the bright reddish ova shine through the translucent integuments.

4. *Tetrastemma dorsalis*, Abildgaard. Enlarged. This variety has a pale dorsal stripe.

5. *Nemertes carcinophila*, Kölliker. Enlarged.

6. Everted proboscis and anterior end of *Nemertes gracilis*, under pressure × 55 diam.

[1] The lines in the various plates indicate the natural length of the animals.

PLATE II.

Fig.

1. *Tetrastemma melanocephala*, Johnston.

2. ,, *candida*, O. F. Müller. Head elongated.

3. ,, ,, Siskin-green variety, with the head contracted.

4. *Prosorhochmus Claparedii*, Keferstein, and young.

5. *Nemertes gracilis*, Johnst. Enlarged.

PLATE III.

FIG.

1. *Tetrastemma Robertianæ*, n. s.

2. *Amphiporus spectabilis*, De Quatrefages.

3. *Tetrastemma vermicula*, De Quatref., with the body slightly turned over in the middle.

4. ,, *dorsalis*, Abild. A very large and fine specimen.

5. Head of *Tetrastemma candida*, var.? From deep water, St. Andrews.

6. *Nemertes Neesii*, Œrst., in one of its usual spiral conditions.

7. Dorsal aspect of the anterior region of *Amphiporus spectabilis*, De Quatref. Enlarged under a lens.

8. Ventral surface of the same region in *A. spectabilis*. Enlarged under a lens.

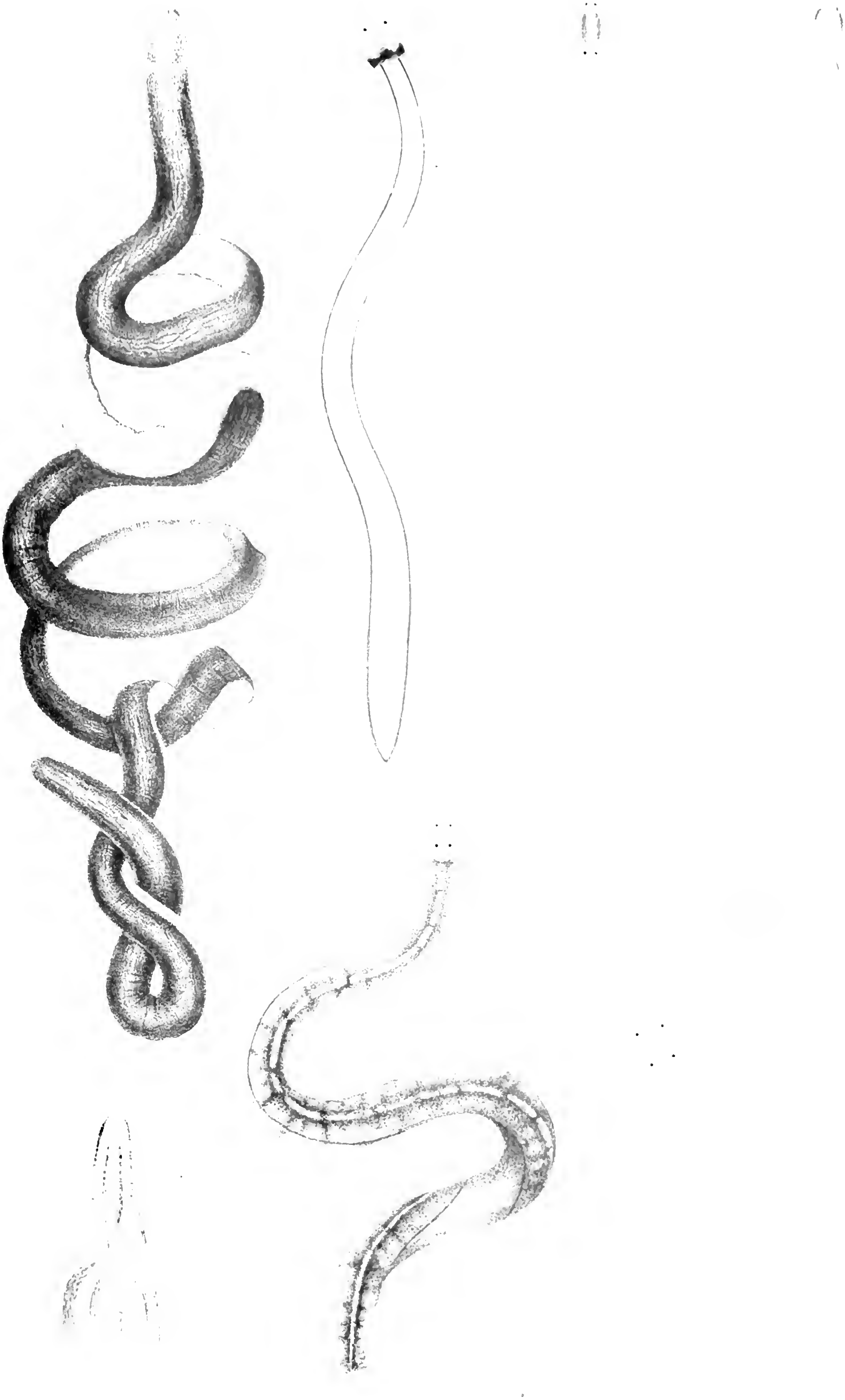

PLATE IV.

FIG.

1. *Tetrastemma flavida*, Ehrenberg.

2. *Lineus gesserensis*, O. F. Müller, green variety, showing the generative apertures as a series of pale specks along the sides.

3. Small mucus-cord of the same species, with dull yellowish ova. Enlarged under a lens.

4. Pale variety of *Cephalothrix linearis*, Jens Rathke.

5. Anterior fragment of the same species, with reddish pigment at tip of snout. The digestive cavity is tinted of a fine deep green behind the œsophageal region, and the entire surface speckled with minute white grains.

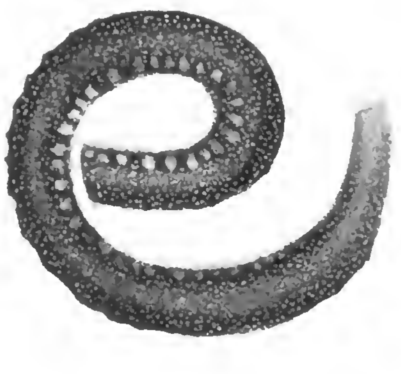

PLATE V.

Fig.

1. Reddish variety of *Lineus gesserensis*, O. F. Muller. Enlarged under a lens.

2. *Lineus sanguineus*, Jens Rathke. Enlarged.

3. *Lineus lacteus*, Montagu, MS. Enlarged.

4. Enlarged view of the head of *Nemertes gracilis*, seen as a transparent object.

PLATE VI

FIG.

1. *Lineus bilineatus*, Delle Chiaje. Enlarged.

2. *Micrura fasciolata*, Ehrenberg. Enlarged.

3. *Micrura fusca*, n. s. Enlarged. The reddish band on each side is caused by the nerve-cord.

4. Young specimen of *Micrura fusca*? showing the early condition of the eye-specks, and the proportionally larger size of the head.

5. Portion of the tube of *Nemertes carcinophila*. × 55 diam.

6. Fragment of the outer surface of the same. × 350 diam.

7. Transverse section of the cutaneous tissues of *Lineus bilineatus*, so as to show the arrangement of the two white dorsal bands. × 90 diam.

PLATE VII.

FIG.

1. *Borlasia Elizabethæ*, n. s. Enlarged

2. Body of the same species contracted into a firm mass. About the natural size.

3. *Micrura purpurea*, Dalyell. Enlarged

4. " *aurantiaca*, Grube Enlarged

5. Portion of the posterior end of *Carinella annulata*, showing the white specks which indicate the openings of the generative organs.

6. Head of a southern variety (reddish) of *Nemertes Neesii*.

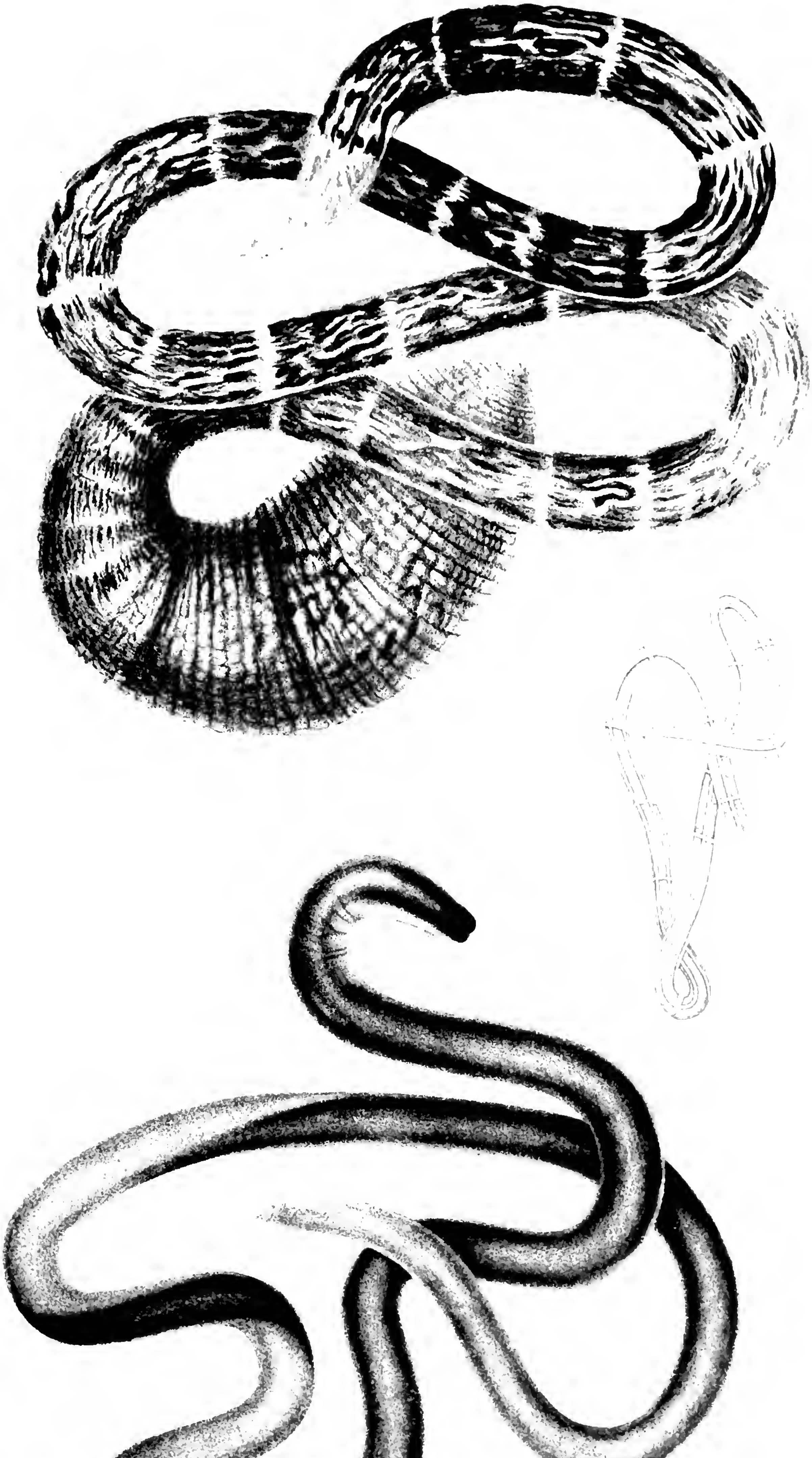

PLATE VIII

FIG.

1. *Carinella annulata.* The specimen from which the drawing was made was rather pale. Enlarged under a lens.

2. *Amphiporus hastatus*, n. s. Enlarged

3. ,, *bioculatus*, n. s. Similarly enlarged.

PLATE IX

Slightly enlarged drawing of *Lineus marinus*, Montagu. The specimen was even more elongated than the figure indicates.

PLATE X.

FIG.

1. First transverse section of the snout of *Amphiporus lactifloreus*. *a*, aperture for the proboscis; *b*, delicate superficial film seen in recently mounted preparations; *c*, dermal layer × 210 diam.
2. Section of the snout of the same species somewhat posterior to the former, showing the channel for the proboscis (*a*), and the cephalic blood-vessels (*l*), just before they complete the arch. × 210 diam.
3. Transverse section of the snout of *A. lactifloreus* in front of the ganglia, somewhat flattened from pressure. 1, 2, 3, 4, 5, 6, the various bands of fibres described in the text; *e*, longitudinal muscular fibres; *l*, section of cephalic blood-vessel; *m*, section of cephalic sac. × 210 diam.
4. Transverse section of the body-wall of *A. lactifloreus*. *a*, the cutis, with its cells and areolæ, somewhat compressed; *b*, structureless basement-layer; *c*, circular muscular coat; *d*, longitudinal muscular layer; *e*, delicate fibres proceeding from the latter to the viscera × 700 diam.
5. View of a portion of skin snipped from a living specimen, under moderate pressure. × 350 diam.
6. Skin from the caudal region of a small example, under slight compression. *a*, the ciliated free margin. × 350 diam.
7. Elements of the skin as they escape from the living animal. *a*, granular cells; *b*, mucous or gelatinous masses having the appearance of oil-globules. × 350 diam.
8. Transverse section of the anterior part of the cephalic ganglia, in a specimen which had been put under chloroform and then immersed in strong alcohol, so as to protrude a small portion of the proboscis. The inferior commissure (*g*) is not much stretched, but the superior (*f*) is almost imperceptible; *j*, œsophagus. × 55 diam.
9. Section of the region anterior to the former in the same specimen. The invagination of the proboscis and the changes in the region surrounding it are well shown. *a*, the anterior and hence outer fold; *l*, cephalic blood-vessel. × 90 diam.
10. Transverse section of the body of a specimen of *A. lactifloreus*, in which no reproductive elements are visible. The dilatation of the proboscidian chamber (*o*) is characteristic, and the walls of the digestive cavity are pressed downwards and outwards. × 55 diam.
11. Corpuscles of the proboscidian fluid from *Tetrastemma flavida*. × 350 diam.
12. Portion of the glandular surface of the posterior chamber of the proboscis of *A. lactifloreus* in its normal condition. × 350 diam.
13. Portion of the inner surface of the same chamber viewed *in sitú* under pressure. The papillæ are hirsute, and their contents scattered over the surface of the organ. × 350 diam.
14. Corpuscles of the proboscidian fluid from *Tetrastemma dorsalis*. × 350 diam.
15. Corpuscles of the proboscidian fluid from *A. lactifloreus*. *a*, minute nucleated cells and granules; *b*, spindle-shaped corpuscles. × 500 diam.
16. The proboscidian aperture in the snout of the same species. × 210 diam.
17. Isolated gland-cells from the posterior chamber of the proboscis. × 350 diam.
18. Stylet from a marginal sac of *A. lactifloreus*, having an abnormal point, and the remains of a globule at the base. × 210 diam.
19. Glandular papillæ from the anterior region of the proboscis of *Tetrastemma vermicula*, seen on the free edge of the everted organ. × 700 diam.
20. Lanceolate and pedicellate papillæ from the first part of the anterior region of the proboscis of the same species. × 210 diam.
21. Portion of the everted inner surface of the posterior chamber of the proboscis. The glandular papillæ have for the most part burst and become minutely hirsute. × 350 diam.

PLATE XI.

Fig.

1. Transverse section of the cephalic ganglia of *Amphiporus lactifloreus*, in the line of the commissures, the superior of which, from the flattening of the preparation, is shown very plainly. *a*, proboscis; *d*, circular muscular fibres of the body-wall; *k*, muscular and cellular stroma of the region. × 90 diam.
2. Section through the body of the same animal some distance behind the ganglia. The sheath for the proboscis now separates the latter from the œsophagus, which has attained considerable size. The lateral nerve-trunks have nearly reached their proper position, viz. to the inner side of the internal muscular layer of the body-wall; *s*, granular masses (from the digestive cavity proper) at the sides of the œsophagus. × 55 diam.
3. Section of the same specimen behind the foregoing and towards the posterior end of the œsophageal apparatus. *u*, ova pressed forward by the contraction of the textures.
4. Transverse section of the anterior region of the proboscis of *Amphiporus pulcher*. *a*, central cavity; *b*, the papillary glandular layer; *c*, internal circular muscular coat; *d*, inner longitudinal layer; *e*, reticulated or beaded layer; *f*, external longitudinal muscular layer, *g*, external (elastic) layer; *h*, basement-layer. × 55 diam.
5. Transverse section of the stylet-region of the proboscis of *A. lactifloreus*, in the line of the marginal sacs. The circumference of the preparation is somewhat distorted from pressure. × 350 diam.
6. Transverse section of the same region in another specimen, in which the knife has pressed aside the basal apparatus of the central stylet (λ), and in which the ejaculatory duct (*n*) has been cut obliquely. In this and the preceding preparations the peculiar arrangement of the muscular fibres of the region is represented. × 210 diam.
7. Longitudinal section of the anterior region of the proboscis of *Amphiporus lactifloreus*. × 90 diam.
8. Longitudinal section of the same region of the proboscis. × 350 diam.
9. Transverse section of the same part of the proboscis. *e'*, the ends of the longitudinal bands of the reticulated layer, which have assumed a finely granular aspect in the preparation. × 350 diam.
10. Glandular papillæ in the anterior region of the proboscis of *A. lactifloreus*, seen in the ordinary condition of the organ under pressure. × 210 diam.
11. Central stylet and basal apparatus of *Nemertes Neesii*. × 350 diam.
12. Central stylet of *N. Neesii*. × 700 diam.
13. Developing or recently repaired central stylet-apparatus of *Tetrastemma candida*. × 700 diam.
14. Stylet from a marginal sac of the same animal. × 700 diam.
15. Central stylet and a portion of the basal apparatus in a large *Nemertes gracilis*. × 350 diam.
16. Extremity of the posterior region (c) of the proboscis of *A. lactifloreus* distended with fluid. *a*, a group of the peculiar moving granules. × 90 diam.
17. Posterior end of a young example of *Tetrastemma dorsalis*, showing the usual hernia of the proboscis under pressure. × 350 diam.

PLATE XII.

FIG.

1. Structure of the stylet-region in a large *Amphiporus lactifloreus*. The specimen had two marginal sacs on one side. × 350 diam.

2. Structure of the stylet- and reservoir-regions in the same form. Considerably magnified.

3. Abnormal stylet-region in the same species. *a*, perfect stylet-sac of the left side; *b*, shriveled sac of the right side. × 210 diam.

4. Termination of the posterior chamber of the proboscis (*c*) of *A. lactifloreus*, with muscular ribands. × 210 diam.

5. The central (*a*) and marginal stylets (*b*) from a young *A. lactifloreus*, on the first appearance of the former. × 700 diam.

6. Structure of the stylet-region of the proboscis of *Amphiporus pulcher*. × 90 diam.

7. Central stylet-apparatus of the same species. *a*, central stylet; *b*, reserve-stylet *in situ*. × 210 diam.

8. Structure of the stylet-region in *Tetrastemma melanocephala*. × 90 diam.

9. Structure of the stylet-region in *Tetrastemma flavida*, with the reservoir somewhat contracted. × 210 diam.

10. Extremity of the posterior chamber of the proboscis of *Tetrastemma dorsalis*, apparently after rupture of the muscular ribands from the sheath of the organ. × 350 diam.

11. Structure of the stylet-region of the proboscis in *Nemertes gracilis*. × 210 diam.

12. Structure of the stylet-region of the proboscis of *Nemertes Neesii*. × 210 diam.

13. Portion of the posterior chamber of the proboscis of the same species, showing the characteristic plaits of the mucous surface. × 90 diam.

14. Structure of the stylet-region of the proboscis of *Nemertes carcinophila*. × 700 diam.

PLATE XIII.

FIG.

1. Structure of the stylet-region of the proboscis of *Prosorhochmus Claparedii*. Degeneration of the marginal sacs has ensued from long confinement. × 90 diam.
2. Aspect of the developing proboscis (*a*) of *Tetrastemma melanocephala*, about the fifth day after the removal of the original organ. × 55 diam.
3. Structure of the stylet-region of a developing proboscis of the same species. *f*, canal, which by-and-by is occupied by the central stylet. The organ is contracted. × 350 diam.
4. Central stylet and basal apparatus with radiating fibres in *Tetrastemma vermicula*. × 350 diam.
5. Stylet-region of the proboscis of *T. candida*, with the ejaculatory duct pressed to the left side. The marginal stylet-sacs are out of focus. × 210 diam.
6. Central stylet and basal apparatus of a small specimen of the same species. × 120 diam.
7. Structure of the stylet-region in *Tetrastemma dorsalis*, somewhat contracted, with the floor of the anterior chamber pouted forward, and the reservoir shortened in its antero-posterior diameter. × 210 diam.
8. Stylets of the same species. *a*, central stylet; *b*, stylet from a marginal sac. × 700 diam. *c*, central stylet and its basal granular apparatus. × 420 diam.
9. Stylets of *Tetrastemma flavida*. *a*, central stylet; *b*, stylet from a marginal sac. × 700 diam. *c*, central stylet and its basal apparatus. × 120 diam.
10. Superficial structure of the stylet- and reservoir-regions of *A. lactifloreus*. Considerably magnified.
11. Isolated marginal stylet-sac of the same species. *a*, fibres which probably act as constrictors of the aperture of the duct. The laminated arrangement of the calcareous layers of the stylets is indicated in this figure. × 350 diam.
12. Stylet-region of the proboscis of a young animal of the same species, illustrating the first appearance of the stylets and the development of the parts. The organ is drawn as it bulged from a wound in the body-wall of the specimen. × 700 diam.
13. Stylet-region of a young *A. lactifloreus*, some weeks older than that represented in the previous figure. × 350 diam.
14. Proboscis of an adult of the same species, gently but completely extruded under chloroform, so as to render the central stylet prominent. × 55 diam.
15. Transverse section of the contracted reservoir-region of the proboscis of the same species, showing the complex spiral arrangement of the fibres. The organ is cut towards its posterior end. × 55 diam.
16. Transverse section of the posterior chamber of the proboscis in a large example of the same species. × 90 diam.
17. Structure of the stylet-region in a developing proboscis of *Nemertes gracilis*. × 350 diam.
18. Central stylet and its basal apparatus in the same species, turned round so as to demonstrate the curve of both. × 100 diam.
19. Proboscis of *Amphiporus pulcher* treated as in fig. 14. × 55 diam.
20. Fragment of the œsophageal region of the digestive tract from a living *A. lactifloreus*. *a*, inner edge of ciliated fold; *b*, sulcus between two folds. × 350 diam.

PLATE XIV.

FIG.

1. The anatomy of *Tetrastemma candida*, chiefly with respect to the digestive and proboscidian systems. Considerably magnified. *h*°, abnormality of the right ganglion.
2. Structure of the head of a young *Tetrastemma melanocephala*, showing the ganglia and the relation of the pigment-patch to the eyes. Considerably magnified.
3. Digitate or lobate arrangement of the digestive canal of *Nemertes gracilis*. × 24 diam.
4. Head and anterior portion of *Nemertes carcinophila*. *f*, powerful transverse fibres which retain the posterior part of the œsophagus *in sitú*. × 180 diam.
5. Superficial structure of the reservoir in *Nemertes Neesii*, showing the elaborate interlacing of the fibres. × 210 diam.
6. Stylet from a marginal sac of *Tetrastemma candida* (same animal as in fig. 6, Plate XIII). × 700 diam.
7. Stylet from the central apparatus of the same specimen. × 700 diam.
8. Stylet from a marginal sac of *Tetrastemma melanocephala*. × 700 diam.
9. Stylet from the central apparatus of the same specimen. × 700 diam.
10. Marginal stylet of *Tetrastemma Robertianæ*. *a* × 350 diameters, *b* × 700 diam.
11. View of the under surface of the snout of *Amphiporus pulcher*. The mouth is indicated at *w*, the cephalic furrows and their branches at *m''*, and the situation of the ganglia at *i*. Enlarged under a lens.
12. Transverse section of the wall of the œsophagus of *A. lactifloreus*, after mounting in chloride of calcium. × 210 diam.
13. Compound cells from the wall of the digestive cavity of *Tetrastemma dorsalis*. × 350 diam.
14. Cephalic ganglia of *Tetrastemma flavida*. × 210 diam.
15. Eye of *Amphiporus pulcher* from a dead and slightly injured specimen. × 210 diam.
16. Portion of a sperm-sac from *Tetrastemma flavida*, exhibiting a streaky and granular aspect from the varying nature of the contents. × 350 diam.
17. Granules from a developing sperm-sac of *T. dorsalis*. × 400 diam.
18. Spermatozoa of *Amphiporus lactifloreus*. × 800 diam.

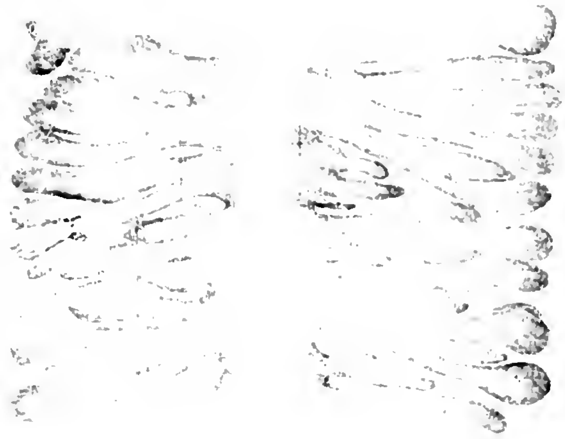


PLATE XV.

FIG.

1. Transverse section somewhat behind that shown in Plate XI, fig. 1. The instrument has passed obliquely across the body so as to cut the ganglia at different distances from the front. On the right only the tip of the superior lobe remains, while the commencement of the great nerve-trunk—in full bulk—is cut beneath. × 90 diam.

2. Snout and anterior region of *A. pulcher*. *g*, *g*. glandular masses. × 55 diam.

3. Arrangement of the circulatory and nervous systems in *A. lactifloreus*, a small specimen. × about 10 diam.

4. Portion of the head of the same species considerably flattened. × 210 diam.

5. Head of *Nemertes Neesii*. × about 60 diam.

6. Nerve-cells from a cephalic ganglion of *A. lactifloreus*. × 400 diam.

PLATE XVI.

FIG.

1. Anterior end of *Tetrastemma dorsalis*. *a*, proboscis, whose fibres have temporarily assumed a spiral aspect from twisting. *b*, tube connected with the cephalic sac of the right side. Considerably magnified.
2. Longitudinal section of the body-wall of *A lactifloreus*, in a somewhat shriveled condition. *f, f*, ovisacs from which the contents have fallen. Other letters as usual. × 90 diam.
3. Nervous plexus from the lateral trunk (*n*) in *A. pulcher*. × 210 diam.
4. Transverse section of the anterior part of the stylet-region proper, showing the divergent arrangement of the oblique fibres and the position of the longitudinal series. × 210 diam.
5. Three sperm-sacs (*ef*) with a portion of the body-wall of *A. lactifloreus*. × 90 diam.
6. Spermatozoa of *Tetrastemma vermicula*. × 1000 diam.
7. Spermatozoa of *Tetrastemma dorsalis*. × 400 diam. This drawing was made many years ago, and probably represents imperfectly developed bodies.
8. Unimpregnated ovum of *A. lactifloreus*. *a*, outer coat; *b*, inner coat; *c*, vitellus; *d*, "micropyle," or cicatrix-like arrangement. × 90 diam.
9. The same ovum some hours after impregnation. The vitellus (*c*) is now divided into two portions. × 90 diam.
10. The same ovum a few hours later. The vitellus is in four portions. × 90 diam.
11. Ovum of the same species in the mulberry-stage. × 90 diam.
12. Ovum just before the extrusion of the embryo. × 90 diam.
13. Arrangement of the ova in the ovisacs of *Tetrastemma vermicula*. *a*, proboscis; *o*, proboscidian sheath. × 24 diam.
14. Ovum of the same species. × 90 diam.
15. Ovum of *Nemertes gracilis* after impregnation. *a*, outer coat; *b*, inner coat; *c*, vitellus. × 90 diam.
16. The inner coat and vitellus of an ovum (of *N. gracilis*) at the same stage of development, with the relations of the spermatozoa. × 210 diam.
17. Ovum of *N. Neesii*. × 55 diam.
18. Portion of the mucous sheath with the ova of *Nemertes carcinophila*. × 24 diam.
19. Ovum of the same species immediately after deposition. × 350 diam.
20. Another ovum, about the tenth day, showing the ciliated embryo revolving therein. × 350 diam.

PLATE XVII.

Fig.

1. A young specimen of *A. lactifloreus* on extrusion from the egg. Somewhat compressed. × 55 diam.
2. Another specimen eight days older than the preceding. *b*, stylet-region; *c*, point where the posterior chamber of the proboscis becomes lost, after curving forward. × 90 diam.
3. Outline of a young specimen of *Tetrastemma dorsalis* shortly after extrusion from the egg × 350 diam.
4. The same compressed, so as to exhibit its cellulo-granular structure. × 350 diam.
5. Young specimen of *T. dorsalis*, about a week older than the preceding. *a*, cutaneous textures; *b*, cells and granules of the alimentary tract; *c*, stylet-region. × 210 diam.
6. A specimen eight days older than the foregoing, showing a considerable advancement in all the organs. × 210 diam.
7. A young example of *N. carcinophila* extruded from the body of the adult under pressure. It has the same appearance when originating in a free ovum. × 350 diam.
8. Spermatozoa of *Nemertes gracilis*. × 700 diam.
9. Spermatozoa of *N. carcinophila*. × 950 diam.
10. Spermatozoa of *Amphiporus pulcher*. × 700 diam.
11. Magnified view of the ganglionic region of a large *A. lactifloreus*, in which a parasitic ovum (*y*) lay imbedded in a granular lobulated mass (*y'*).
12. Parasitic ovum immediately after removal. *a*, opaque mass of cells and granules; *b*, ventral disc; *c*, oral disc; *d*, capsule, to which some shreds of the surrounding tissue are adhering. Considerably magnified.
13. The same ovum some hours afterwards, showing slight contraction of the discs.
14. Parasite extruded from the capsule. *a*, opaque cellular and granular mass; *b*, ventral disc; *c*, oral disc; *d*, œsophageal bulb; *e*, alimentary cæca; *f* and *g*, large circular granular bodies.
15. Streaked arrangement of the cutis from the dorsum of *Lineus gesserensis*. × 210 diam.
16. View of the cutis of the same species (at a pale portion) as a transparent object × 210 diam.
17. Portion of the skin of a living *Carinella annulata*. × 350 diam.
18. Pigment-cells from the anterior dorsal region of *Lineus gesserensis*. × 350 diam.
19. Papillæ on the snout of the same species. × 210 diam.
20. Tip of the snout in the same species, with the proboscis partly extruded. × 210 diam.
21. Posterior extremity and styliform process of *Micrura fasciolata*. *a*, central cavity, containing fluid; *z*, anus. × 210 diam.
22. Posterior extremity of a young example of *L. gesserensis*, showing the anal papilla. × 210 diam.
23. Corpuscles of the extruded fluid (page 114) from *Borlasia Elizabethæ*. Highly magnified.
24. Anterior extremity of *Carinella annulata*. *a*, aperture in snout for proboscis; *b*, cephalic furrows; *c*, cephalic blood-vessel; *m*, cephalic sac; *w*, mouth. Magnified.
25. Spermatozoa of *Amphiporus bioculatus*. × 700 diam.
26. Spermatozoa of *Tetrastemma Robertianæ*. × 700 diam.

PLATE XVIII.

Fig.

1. Dorsal view of the head of *Lineus marinus* after long confinement. The blanching of the cutaneous tissues renders the eyes conspicuous. Magnified under a lens.
2. Ventral view of the same specimen exhibiting the mouth (*m*). Similarly magnified.
3. Profile of the same head, showing a cephalic fissure with its reddish coloration posteriorly.
4. Transverse section of the body-wall of *Lineus gesserensis*. × 350 diam.
5. Transverse section of the body-wall of *Lineus marinus* at a somewhat narrow portion. *d*, external cuticular layer; *d″*, pigmentary layer divided into two strata by a definite black band (2); 3, curious translucent stratum cut into regular spaces. Other letters as usual. × 210 diam.
6. Longitudinal section of the same tissues. 4, 4, sections of the transverse connecting trunks between the lateral and dorsal vessels; 5, granular stroma within the inner longitudinal muscular coat, supporting the former and various other tissues. × 90 diam.
7. Transverse section just behind the tip of the snout of *L. gesserensis*. The grouping of the pigment (3) readily enables the observer to distinguish the dorsal from the ventral surface; 2, powerful series of fibres arching over the channel for the extrusion of the proboscis, and radiating into the surrounding stroma (*k*). × 55 diam.
8. Transverse section somewhat behind the preceding, and through the anterior part of the cephalic fissures. The channel for the proboscis has become more central in position. The superior pigmentary belt (3) is somewhat narrower, and an inferior (4) has now appeared. The central channel has a layer of longitudinal muscular fibres internally, and a powerful series of oblique and circular fibres (2, 2) form a very efficient exterior investment. × 55 diam.
9. Transverse section of the cephalic ganglia of a smaller specimen than the preceding. × 55 diam.
10. Horizontal section of the snout of the same species through the ganglia, exhibiting the relations of the latter and the reticulations of the cutaneous tissues in front of them. × 90 diam.
11. Transverse section of a specimen of *L. gesserensis* (after spawning) a little in front of the tip of the tail. × 90 diam.
12. Elements from the glandular papillæ of the proboscis of the same species, after their escape into the water. × 700 diam.
13. Elements from the proboscis of *Micrura fasciolata*. Similarly magnified.
14. Portion of the inner surface of the proboscis of *L. gesserensis*, showing the glandular papillæ. Slightly compressed. × 700 diam.
15. Snout of *Cephalothrix linearis* with the proboscis slightly everted, so as to exhibit the acicular papillæ. × 350 diam.
16. Fragment of the wall of the proper digestive chamber of *L. gesserensis*. The cilia mark the inner surface. × 350 diam.
17. Parasitic ciliated animal from the tissues of the same species. The letters *a*, *b*, *c*, and *d* correspond with the groups of segments described in the text. × 350 diam.
18. The foregoing parasite at an earlier stage of development. × 350 diam.
19. The last-mentioned specimen subjected to slight pressure, so as to exhibit the segments. × 350 diam.

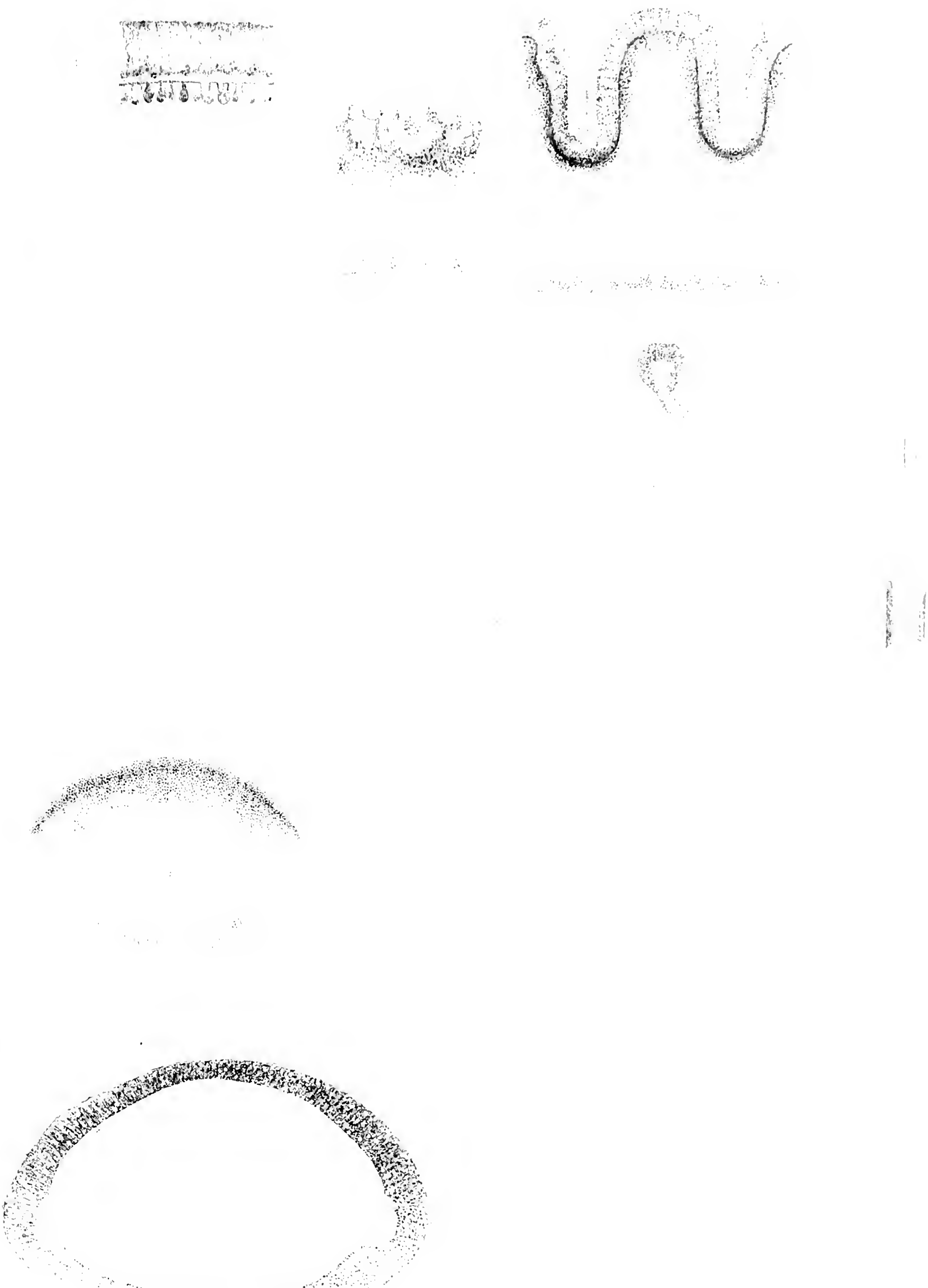

PLATE XIX.

FIG.

1. Enlarged view of the anterior region of *Lineus gesserensis*, as a transparent object.

2. Anterior portion of *Lineus sanguineus*. *y*, peculiar incurvation of the wall of the alimentary canal, marking the boundary between the œsophageal and the succeeding division of the digestive apparatus. × 90 diam.

3. Anterior portion of *Lineus lacteus*. × 90 diam.

4. Portion of the middle region of *L. gesserensis*, representing the arrangement of the vessels in the living animal. Considerably enlarged.

5. Arrangement of the vessels at the posterior extremity of the same species. Similarly magnified.

6. Posterior portion of a specimen of the same species having an unusually distinct anus (probably from partial repair after injury). *a*, mass of granular and cellular débris revolving in the direction of the arrow by aid of the cilia of the digestive cavity; *b*, anus. × 210 diam.

7. Transverse section of the proboscis of *Borlasia Elizabethæ*. × 210 diam.

8. Transverse section of the proboscis of *Micrura fusca*. × 350 diam.

9. Highly magnified view of the anterior end of *Cephalothrix linearis*. *b, b*, bridles of the sheath for the proboscis.

10. Gregariniform parasite from the digestive canal of *Lineus lacteus*. × 350 diam.

11. Outline of one of the same parasites after prolonged immersion in water.

PLATE XX.

FIG.

1. Transverse section of the œsophageal region of *Lineus gesserensis* after the channel has attained full development. × 55 diam.

2. Transverse section of the œsophageal region of a large specimen of the same species in which a favourable view of the vascular meshes *u* around the cavity is obtained. *v*, one of the larger spaces on each side of the sheath for the proboscis. × 55 diam.

3. Transverse section of a fine specimen of *L. gesserensis* some time after spawning, and when the animal has regained its plump condition. The shriveled traces of the reproductive organs are seen at *ov*. A doubling of the proboscis in its sheath has occurred × 10 diam.

4. Transverse section of the proboscis of *Micrura fusca*. *a*, external coat; *b*, great longitudinal muscular layer; *c*, belt of circular muscular fibres; *d*, basement-layer; *e*, incomplete series of longitudinal fibres which do not occur in the common species; *f*, glandular mucous coat; *g*, peculiar lozenge-shaped portion of longitudinal fibres, formed by the splitting and crossing of two bands from the circular muscular coat; *g'*, separate segment at the other pole of the circle. × 90 diam.

5. Transverse section of the proboscis of *Meckelia asulcata*. *a*, external spiral coat; *b*, longitudinal layer; *c*, central cavity surrounded by the glandular coat; *d*, cross of fibres at the poles. × 210 diam.

6. Transverse section of the proboscis of *Carinella annulata*. × 90 diam.

7. Gland-cells from the wall of the digestive cavity of *Amphiporus lactifloreus*. × 400 diam.

8. One of the same slightly compressed glands. × 700 diam.

9. Contents of the former, with oil-globules. × 700 diam.

10. Pseudo-navicellæ extruded with the former parasites from the digestive canal of *Lineus sanguineus*. × 350 diam.

11. Portion of a gelatinous cord containing ova from the digestive canal of *L. gesserensis*. × 180 diam.

12. Ovum from the same. × 350 diam.

13. Transverse section of the body-wall in the region of the lateral nerve of a *Lineus* from Fetlar, showing the intricate arrangement of radiating fibres which pass through the circular coat and divide the external longitudinal muscular layer into endless fasciculi. × 90 diam.

PLATE XXI.

Fig.

1. Transverse section of a specimen of *Lineus gesserensis* in which the ova are well developed. The shrunken condition of the walls of the digestive cavity (f), with the numerous gregariniform parasites, is in strong contrast with the state of the animal after spawning. The specimen had been in spirit a considerable time before dissection. × 55 diam.

2. Transverse section of *Cephalothrix linearis*. The proboscis is coiled in its sheath. × 90 diam.

3. Transverse section of one of the *Lineidæ* from St. Magnus Bay, Shetland, in which the sheath for the proboscis is surrounded by the internal longitudinal muscular coat. × 28 diam.

4. Transverse section of *Borlasia Elizabethæ* after contraction in spirit. The enormous muscular mass forming the body-wall is well shown in this preparation. × 24 diam.

5. Transverse section of the proboscis of *Lineus marinus*. × 55 diam.

6. Transverse section of a lateral nerve-trunk (a) in *Lineus gesserensis*. n, fibro-granular matrix, in which the nerve lies in its own proper sheath; c, external longitudinal muscular layer of the body-wall; c', circular muscular layer. × 700 diam.

7. Cellular elements of the wall of the digestive chamber of the same species. × 700 diam.

8. Cells from the digestive cavity of a young *Cephalothrix linearis*. × 700 diam.

9. Head and proboscis of a remarkable variety of *Carinella* brought from Shetland by Mr. Gwyn Jeffreys. b, frilled arrangement, apparently homologous with the superior lip of the cephalic fissure; w, prolapse of textures from mouth. Magnified under a lens.

10. Spermatozoa of *Lineus gesserensis*. × 700 diam.

11. Spermatozoa of *Lineus sanguineus*. × 800 diam.

12. Spermatozoa of *Lineus marinus*, from a fragmentary specimen. × 900 diam.

13. Spermatozoa of *Cephalothrix linearis*. × 900 diam.

PLATE XXII.

FIG.

1. Transverse section of the cephalic ganglia of *Lineus gesserensis*. The pale central portions are caused by the imperfect penetration of the fluid in mounting. × 210 diam.

2. Transverse section of the curious variety of *Carinella* from Balta. *d*, external layer of cutis; *d′*, basement-layer; *e*, longitudinal muscular layer; *e a*, dorsal subdivisions of the latter coat in the central line; *e′*, circular muscular coat; *j*, section of the œsophageal region of the digestive tract; *j a*, distinct band of muscular fibres enclosing the latter; *n*, lateral nerve; *o*, sheath for proboscis; *r*, vascular spaces. × 55 diam.

3. Transverse section of the post-ganglionic region of *Lineus lacteus*, showing the long vascular lacunæ (*s*, *s*) in front of the œsophageal region. The slice of the proboscis has fallen out of its sheath (*o*). × 90 diam.

4. Anterior end of a contracted specimen of *L. gesserensis*, turned round so as to exhibit the marked separation between the œsophageal region and the digestive cavity proper. × 90 diam.

5. Adventitious granular mass (*a*) in a longitudinal section of the dermal tissues of *Lineus marinus*. *b*, *b*, spaces from which similar structures have fallen. Other letters as in previous figures. × 210 diam.

6. Aggregations of fatty granules from the discarded coating of the embryo of *Lineus gesserensis*. × 210 diam.

7. Anterior end of a fragment of *Lineus sanguineus*, about three weeks after rupture. *a*, terminal aperture; *d*, cutaneous layers. × about 40 diam.

8. Posterior end of the same fragment, similarly magnified. *z*, anus.

9. Anterior portion of a fragment in a more advanced condition. *a′*, developing proboscis; *h*, indication of ganglia.

10. Anterior region of a complete, or nearly complete, animal developed from a fragment; *j*, œsophageal division of the alimentary canal; *m*, cephalic pit and sac; *w*, mouth.

11. View of a similar specimen; the regenerated anterior portion, consisting of the head and the œsophageal region of the digestive chamber, is recognized by its pallor; *b*, cephalic fissure. Magnified under a lens.

PLATE XXIII.

FIG.

1. Pale oily region with germinal vesicle (*a*) and germinal dot (*b*), in an ovum removed from the body of the female *Lineus gesserensis*. × 350 diam.
2. Flask containing two ova from the mucous cord of the same species after deposition. One is simply outlined, but the other is shaded—to indicate the natural opacity. × 55 diam.
3. Flask on the second day, showing the yolk divided into four portions. × 55 diam.
4. Ovum some hours older and somewhat compressed, exhibiting the further subdivision of the yolk. × 55 diam.
5. Flask having its single ovum in the mulberry-stage. × 55 diam.
6. Flask containing three ova in the same condition. × 55 diam.
7. Flask having a ciliated embryo (about the 12th or 13th day); it remains in this condition some weeks. × 55 diam.
8. Flask enclosing two young animals, somewhat compressed. *a*, embryo forced from its ciliated cellulo-granular fatty coating, the bulk of which lies at *c*; *b*, embryo still within the ciliated coating. × 55 diam.
9. A young specimen of *L. gesserensis* immediately after leaving the flask; *b*, opening of the right cephalic sac. × 90 diam.
10. Magnified view of a young example of the same species after it has attained a considerable degree of advancement. It still possesses only two eyes.
11. Flask from the mucous cord of *Lineus marinus*. The contained embryos are nearly disintegrated from decomposition. × 55 diam.
12. Ovum of *Cephalothrix linearis* immediately after deposition. × 350 diam.
13. Embryo of the same species shortly after extrusion from the egg. × 350 diam.
14. A young specimen two days older than the preceding. *a*, mouth; *b*, granules of digestive cavity. × 210 diam.
15. An example about three days older than the last (fig. 14). × 210 diam.
16. A young specimen of *Cephalothrix linearis* after shedding the long anterior whip of cilia, but having the lateral tufts (*c*) and eyes. *a*, mouth; *b*, granules of digestive cavity. × 210 diam.
17. Transverse section of the proboscis of *Cerebratulus angulatus*, O. F. Müller. *g a*, the inner wedge of longitudinal fibres described in the text; *g b*, the outer band of longitudinal fibres. The other letters as usual. × 40 diam.
18. Stylet-region of *Amphiporus hastatus*, somewhat contracted. It has the same letters as other figures of the ENOPLA. × 55 diam.
19. Stylet-region of *Amphiporus bioculatus*. × 55 diam.

Prof. [illegible]

[illegible]

23 March [illegible]

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A

MONOGRAPH

OF THE

BRITISH ANNELIDS.

PART II.

POLYCHÆTA.

AMPHINOMIDÆ TO SIGALIONIDÆ.

PAGES 215—442; PLATES XXIV—XXVI, XXVIA, XXVII—XLII.

BY

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DEDICATED

TO

CHARLES HENRY GATTY, Esq., M.A.,

LL.D., F.R.S.E., F.L.S., F.Z.S., F.G.S., ETC.,

OF FELBRIDGE PLACE, EAST GRINSTEAD,

THE MUNIFICENT FOUNDER OF THE GATTY MARINE LABORATORY,

ST. ANDREWS.

TEMPORARY PREFACE.

When the author, as already explained in the Introduction to Part I, undertook the task of placing the British Marine Annelids on a more satisfactory footing, he did not foresee either the difficulties of isolated work in the country—apart from libraries and the sea-shore—or the increasing strain of very responsible official duties. Again, when he had at length secured the advantages pertaining to the sea and a university library, the constant succession of fresh labours—connected respectively with the volume on the Annelida of the 'Challenger,' the engrossing work accompanying the comparatively recent development of the scientific aspects of the Fisheries, and the foundation and superintendence of the first Marine Laboratory in Britain—were inimical to rapid progress with the subject. But this was not all; the revival of zoological science and zoological teaching in a university so admirably situated for both, the reorganisation and development of the University Museum, and the numerous official duties, requiring a large amount of time, which devolved on him might have seemed to prove almost fatal to the undertaking. But during this period he had unique opportunities of extending the knowledge of the Annelids and their distribution, so that not even the absorption of time in upholding science and medicine in the oldest Scottish university—at, perhaps, the most critical period of its existence—for a moment caused doubt as to the ultimate progress of the work.

Such a brief explanation is necessary, for it is no less than a quarter of a century since the first part was published.

The great extent of the field necessitates but a brief reference to anatomy and embryology, were it only for the cost of plates and text. These and the historical parts can follow either in this or another channel. Publication has become the more clamant since in this country no book of reference on the subject is up to date, and hence the group has not received that care from zoologists which is desirable—for instance, in extending the species and accurately defining their distribution.

Amongst those who have largely aided the author by the collection of specimens the late Dr. Gwyn Jeffreys holds a foremost place, since he took with him for several years specially prepared bottles for the preservation of the Annelids, and thus forwarded them in excellent condition. I desire to record my grateful remembrance of his constant care in this respect. Exceeding even the foregoing in number and variety of specimens come the collections made by several relatives in St. Andrews, one of whom for more than twenty years enriched the museum of the author in a noteworthy manner. Few took deeper interest in the progress of the work than the late Prof. George Busk, whose unselfish devotion to zoology is another memorable example of the brotherhood of medicine and natural history. The late Mr. Spence Bate, of Plymouth, Dr. Baird, of the British Museum, Dr. W. B. Carpenter, Sir Wyville Thomson, Dr. Bowerbank, Dr. David Robertson, of Cumbrae, Prof. Grube, of Breslau, Edouard Claparède, of Geneva, Dr. Howden, of Montrose, Dr. Carrington, of Eccles, Mr. A. G. Moore, of Dublin, James Duncan Matthews, of Aberdeen, and Profs. Dickie, Ogilvie, and Dyce, of the same place, were of signal service in forwarding specimens. I have also to acknowledge similar and valued aid from the late Prof. Allman, Canon Norman, Prof. Ray Lankester, Mr. Whiteaves, of Canada, Ludwig von Graff, of Gratz, Mr. Brooking Rowe, Plymouth, Miss Florence Buchanan, Prof. G. S. Brady, Prof. Percival Wright, Prof. Howes, Sir John Murray, Prof. Haddon, Dr. Scharff, Dublin, Mrs. Collings, late of Sark, Dr. E. P. Ramsay and Prof. Haswell, of Sydney, Dr. John Anderson, late of Calcutta, Prof. Herdman, Mr. Beddard, Dr. Sydney Harmer, Prof. Jeffrey Bell, Mr. J. T. Cunningham, Prof. Ewart, Mr. Shipley, Mr. Parfitt, Exeter, Dr. Fulton and Mr. H. C. Williamson, of the staff of the Fishery Board, Mr. Arnold Watson, Sheffield, Mr. Shrubsole, Sheerness-on-Sea, Mr. Sibert Saunders, Whitstable, and Mr. Hornell, of Jersey.

For assistance in other respects I have gratefully to remember Prof. Giard, of Paris, Prof. Alex. Agassiz, A. E. Verrill, John Murdoch, J. Walter Fewkes, Prof. H. E. Webster, Dr. H. P. Johnson, Miss M. Lewis, J. E. Benedict, Dr. T. H. Montgomery, of the United States, Dr. J. P. Hill, of Sydney, Prof. A. G. Bourne, Madras, Prof. W. B. Benham, Otago, Prof. Harvey Gibson, Liverpool, J. Jennings Hind, Mr. Garstang, Plymouth, Prof. Gilson, of Louvain, the late Prof. Lovén, Stockholm, the late Dr. A. J. Malmgren, Helsingfors, Dr. Emil Marenzeller, Vienna, Prof. A. F. Marion, Marseilles, MM. Pruvot and Racovitza, Prof. G. O. Sars, Dr. Fridiof Nansen, Christiania, Prof. Hjalmar Théel, Stockholm, Dr. A. Wirén, Upsala, Prof. Hubrecht, Utrecht, Prof. Haeckel, Jena, Dr. W. Michaelsen, Hamburg, Prof. C. O. Minot, Boston, Prof. Playfair McMurrich, Michigan, Dr. Langerhans, Madeira, Louis Roule and Baron Jules de Guerne, Paris, Baron de St.-Joseph, Prof. Paul Hallez, Prof. Barrois and M. Malaquin, Lille, F. Mesnil, Paris, M. Caullery, Lyons, Pierre Fauvel, Caën, Julian Fraipont, Prof. Julin, Liège, Jules Bonnier, E. Brumpt, Dr. Kükenthal, Jena, Prof. Ehlers, Gottingen, Prof. B. Hatschek, Dr. R. Greef, Dr. F. Vejdovsky, Praag, Prof. Hensen, Kiel, Prof. K. Brandt, Dr. J. Reibisch, Th. Kuhlgatz, Dr. V. Hacker, Freiburg, P. Tauber and G. M. R. Levinsen, Copenhagen, Dr. R. Horst, Leiden, Dr. G. A. Hansen, Dr. C. Apstein, Kiel, Dr. Apellöt, Bergen, Ivar Ardwidsson, Dr. C. Aurivillius, Dr. D. Carazzi, Florence, Dr. S. Orlandi, Dr. C. J. Cori, A. Birula, St. Petersburg, Prof. Möbius, Berlin, Prof. Kishinouye, U. Takura, S. Goto, S. Hatai, and A. Iizuka, Tokyo, the late Prof. Moseley, Dr. Murie, Capt. Fielden, Dr. Marcus Gunn, the Duke of Argyll, and the late Sir Walter Elliot, of Wolflee. My colleague, Prof. Lawson, kindly looked over certain proof-sheets when they were delayed by an illness; Dr. A. T. Masterman also gave me his valued aid at this time. I am also indebted to Prof. Wiltshire for his careful revision and suggestions.

Various Fishery officers in Scotland, especially Mr. Bain of Peterhead, Mr. Duthie of Lerwick, Mr. Mair of Montrose, and Mr. Cooper, formerly of Aberdeen, have been of much service in forwarding specimens used as bait or otherwise interesting.

For the best of the coloured drawings from life I am indebted to my late sister, Mrs. Gunther, the loss of whose delicate touch and experience has been greatly felt in the completion of the work. I have also to thank Dr. A. T. Masterman, Rev. J. M. Anderson, my artist, Miss Ada Walker, and Mrs. Burnet of St. Andrews, for aid in this respect. The present part contains comparatively plain examples of the group, which is remarkable for beauty of coloration in such as the Phyllodocidae, Nereidae, and many others.

It has been found impossible to represent all the parts required for identification from the living form, because many have not been seen alive, or if so, under circumstances inimical to anything else than preservation. Yet this is not altogether a drawback, since many workers have only spirit-specimens to deal with, and the parts so preserved retain certain useful characteristics. On this head, indeed, diverse views are held, one of the most recent being that of Dr. H. P. Johnson, of California, who asserts that descriptions from life are only advantageous in respect to colour.

W. C. M.

Gatty Marine Laboratory,
St. Andrews;

DESCRIPTION

OF THE

GENERA AND SPECIES

OF THE

BRITISH MARINE ANNELIDS

(ANNELIDA POLYCHÆTA).

Order POLYCHÆTA.

Marine worms usually with a definite head (prostomium), which dorsally bears eyes and tentacles, and ventrally palps, besides possessing other sense-organs.

From the buccal region (peristomium), which frequently carries cirri or other organs, the fore-gut often sends out a protrusible proboscis—armed or unarmed. Œsophagus may have a pair of diverticula. Alimentary canal simple or branched, and a median dorsal and median ventral mesentery may be present.

Body of one or more regions, generally elongate and cylindrical, sometimes flattened and compressed, of numerous segments, which internally are marked rather by the oblique muscles than by diaphragms. The last segment in many has long ventral (anal) cirri. It is invested by a thin, tough cuticle covering a granular layer,[1] bounded internally by basement-lining, then a more or less complete layer of circular muscular fibres, while within are four longitudinal muscular bands,—as a rule, two dorsal and two ventral. The oblique muscles converge from the dorso-lateral region to the vicinity of the nerve-cords.

The segments in the free examples bear lateral processes of the body-wall (feet or parapodia), and each foot is frequently divided into a dorsal and a ventral lobe, with a spine (aciculum) to which motor muscles are attached, and a group of specially differentiated bristles, besides a dorsal and a ventral cirrus.

Respiratory organs either free branchiæ or the general surface.

Circulatory organs generally closed, contractile or non-contractile vessels. Blood red, pink, green, or pale, corpusculated or non-corpusculated (?); occasionally absent.

Perivisceral (cœlomic) fluid abundant, highly organised and corpusculated. In certain forms the perivisceral corpuscles are coloured, and the whole may act as a substitute for the circulatory fluid.

Nervous system consists of cephalic and subœsophageal ganglia with commissures, separate or closely applied longitudinal ganglionated trunks, with or without neural canals; placed in or internal to the granular layer under the cuticle. A stomato-gastric system of nerves also occurs.

Reproductive organs are developments of the perivisceral (cœlomic) epithelium in connection with the ventral blood-vessels. The products escape by the segmental organs (nephridia), or by rupture of the body-wall. Sexes, as a rule, are separate, but some are hermaphrodite. Polymorphism and asexual reproduction also occur.

The segmental organs may act as genital ducts, and are arranged in pairs in few or many segments.

Larva a trochophore. Metamorphosis during development.

Free or sedentary (errant or tubicolous).

[1] Formerly named hypoderm, a term, however, which has given rise to misapprehensions.

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

(ANNELIDA POLYCHÆTA.)

ORDER—POLYCHÆTA.

Family I.—AMPHINOMIDÆ.

Cephalic lobe rounded or compressed. A median and two lateral tentacles, though the latter may be absent, an elongated dorsal caruncle, and four eyes. Body elongate, oblong or ovate-oblong, feet with the dorsal and ventral divisions widely separated and furnished with cirri. Mouth removed from the tip of the snout ventrally, with modified segments laterally; protrusible proboscis devoid of jaws. Feet peculiarly modified, the dorsal lobe being extended and merged into the dorsum, but with bristles, branchiæ, and cirri. Bristles brittle, calcareous, and tubular, with gelatinous contents; rarely hook-like spines. Buccal apparatus and proboscis large and complex; alimentary canal often with a cæcum in front. Anus dorsal. Two posterior appendages. Nerve-cords either lie within the body-wall, the decussation of the oblique muscular bands being beneath them, or the latter are attached at the outer border of each trunk. Oviparous.

Sub-family—AMPHINOMINA.

Cephalic lobe rounded, furnished with a median and two lateral tentacles; body elongate; branchiæ on the dorsum of the feet, which have their dorsal and ventral divisions widely separated. Bristles brittle, calcareous, tubular, with gelatinous contents.

Nerve-cords somewhat small and flattened, occupying an area bounded internally by a transverse band of fibres, and externally by the circular muscular layer and the granular layer beneath the cuticle. The oblique muscles are attached at the outer border of each trunk. Intestine simple.

Savigny in his 'Système' (1820) made the Amphinomæ the fourth Family of his first Order Nereidæ, characterising them as follows:—Branchiæ large, complex, situated along the superior border of all the dorsal divisions of the feet, the first three or four excepted, or behind the border, and extending to the ventral branch, resembling a pinnatifid leaf (feuilles), with tufts or arbuscles, which generally divide at their origin into several trunks, now coalescing, and again separating more or less distantly the one from the other. Mouth with a short proboscis, opening longitudinally at the extremity, without prominent folds or tentacles, and devoid of jaws. Eyes two or four; antennae of moderate length and generally complete. Sometimes the middle and exterior are absent; the unpaired is always present and inserted at the front of the caruncle superiorly, the latter extending to the third or fourth segment. Feet with large separate divisions, each furnished with a single bundle of bristles and without a spine. Cirri well marked, subulate, enlarged at the base, or in the form of two articulations, of which the one, large and short, serves as a support for the other, which is completely retractile. They are inserted within the orifice of the sheath, behind the bundle of bristles. The anterior feet do not differ materially from the posterior. The feet of the first and second segments exist in all the genera.

Lamarck[1] (1818) followed Savigny in his classification of the group.

Œrsted[2] placed the family Amphinomaceae in his division Maricolae, characterised by having bristled pinnae, a depressed body, segments numerous and defined, and with the alimentary canal often branched. They were finally distinguished as Chaetopoda Trematodina, with branchiae completely ramose. He does not include any representative, however, in his list.

Kinberg[3] describes the Amphinomea as having the mouth inferior, formed by the anterior segments; pharynx protrusible, devoid of papillae and jaws; cephalic lobe with four eyes and a caruncle. The cirri and branchiae do not alternate. He divided the group into two families—the Amphinomacea and the Euphrosynea. His first family, the Amphinomacea, included *Chloeia*, Sars, *Notopygos*, Grube, *Lirione*, n., *Amphinome*, Bruguière, *Hermodice*, n., and *Eurythoe*, n. The characters were—cephalic lobe rounded; no tentacle; two antennae; two antenniform palpi; branchiae on few segments; dorsal and ventral divisions of the foot distinct. The representatives of these genera are more characteristic of the warmer seas, as shown by the earlier writers, as well as by Kinberg's paper and the voyage of the "Challenger." Even the expedition of the "Porcupine," in 1870, brought fine specimens of *Chloeia* from the Mediterranean. The labours of Prof. M. Sars, however, introduced in 1861 a northern example of the genus *Eurythoe*;[4] and his distinguished son, Prof. G. O. Sars, added another representative of the family in *Paramphinome*,[5] which he had found amongst the unpublished manuscripts of his father.

In the catalogue of the Royal College of Surgeons[6] an account of the circulation and the branchial plexuses of *Amphinome capillata* is given.

[1] 'An. sans Vert.,' vol. v, p. 327.
[2] 'Ann. Danic. Consp.,' p. 4, 1843.
[3] 'Öfversigt af Kongl. Vet. Akad. Förhandl.,' Aug. 14, No. 1, p. 11, 1857.
[4] 'Christ. Vidensk. Selsk. Forhandl.,' 1861.
[5] 'Some Remarkable Forms, &c., off the Norwegian Coast,' Christ., 1872, p. 45.
[6] Vol. vi, p. 14.

Ehlers (1864) placed the Amphinomea as the first family of his order Nereidea, characterising them as having the mouth on the under surface, surrounded by several segments. The head is not clearly defined, and bears a caruncle which extends over several segments. Under this family he includes *Chloeia*, *Notopygos*, *Lirione*, *Amphinome*, *Hermodice*, *Eurythoe*, *Euphrosyne*, *Spinther*, *Aristenia*, *Hipponoe*, *Lophonota*, *Zothea*, and *Didymobranchus*.

Grube, in his 'Annulata Semperiana' (1878), comprehended the Euphrosynidæ in his family Amphinomea. He describes them as having an oval or elongate body, more or less depressed, frequently tetragonal; and with one or two anal appendages. The cephalic lobe is united with the buccal segment beneath, generally with a caruncle and a bifid pre-buccal process. Tentacles one or three, sub-tentacles (palpi) two or none. Eyes two pairs. Mouth inferior. Buccal segments several, rarely one. Dorsal cirri single or double; ventral single, cirri rarely absent. Fascicles of bristles double on each side. Spines none. Bristles simple, now capillary, now unequally bifurcate; rarely compound, hooked. Branchiæ dorsal or marginal; pinnate, ramose or simple, rarely absent. Pharynx (proboscis) somewhat suboval, having neither jaws nor papillæ. This is a more detailed diagnosis than he gives in his 'Familien der Anneliden' (1851).

Claus, in his 'Grundzuge' (1880), made the Amphinominæ the first sub-family of the Amphinomidæ.

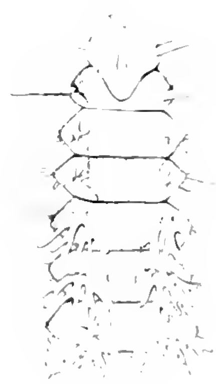
Carus describes the Amphinomea ('Prod. Faun. Medit.,' 1884) as having the mouth on the ventral surface, surrounded symmetrically by several segments; cephalic lobe little differentiated, or represented by a caruncle on the dorsal surface covering several segments. The genus *Amphinome* he characterises thus:—Head with three antennæ, four eyes, and a distinct caruncle; tentacular cirri two; caruncle covering two to three segments, more or less plicate; feet biramous, divisions distinct, a hiatus between the bristles; branchiæ arborescent, branches and ramuscles numerous.

Genus I.—PARAMPHINOME, *Sars*, 1867.

The genus Paramphinome was characterised by Sars as having a moderately elongate vermiform body, segments few. Cephalic lobe small, produced posteriorly; no caruncle; no eyes. Five short tentacles, cylindrical and subequal—a median in the posterior part of the head, two anterior, and two lateral. Dorsal and ventral cirri present in the first segment of the body, elongate, similar to the cephalic tentacles; rudimentary in the other segments. Mouth a longitudinal fissure surrounded by four fleshy lips. Anus terminal. Feet biramous, the dorsal and the ventral divisions, which are small, widely separated. The dorsal bristles are of two kinds—a shorter simple serrated series, and a longer and much more slender kind, with a spur at the base of the terminal region. Amongst these are also some long, slender, and tapering bristles—faintly and sparsely serrated towards the tip. The inferior bristles have in some the distal end of the shaft dilated and bifurcate, one of the divisions being short and simple, the other elongate and serrate; others are long and slender, with fine serrations towards the tip, while a few are shorter and more boldly serrate. Two strong and somewhat S-shaped hooks are in front of the insertion of the dorsal bristles of the first segment. Branchiæ occur only on the anterior segments, and are large and dichotomously divided, extending across the dorsum.

PARAMPHINOME PULCHELLA.

FIG. 15.



Anterior end of *Paramphinome pulchella*, Sars. (After G. O. Sars.) Enlarged.

Specific Characters.—Body nearly cylindrical, a little broader than high, slightly tapered anteriorly and posteriorly. Setigerous segments twenty-four to thirty-three. Cephalic lobe narrower than the first segment, produced into a conical process posteriorly. Branchiæ commencing on the fourth setigerous segment, and from four to six in number, dichotomously divided; terminal processes cylindrical. Colour pale. Length 9 mm.

SYNONYMS.

1868. *Hipponoe Jeffreysii*, McIntosh. Ann. Nat. Hist., 4 ser., vol. ii, p. 250.
1869. „ „ Idem. Trans. R. S. E., vol. xxv, p. 406, pl. xv, f. 1.
„ *Paramphinome pulchella*, M. Sars. Vidensk. Selsk. Christian. (Aar, 1868), 1869, p. 254.
1872. „ „ G. O. Sars. Remark. Forms An. Life, vol. i, p. 45, pl. iv, f. 19—35.
1873. „ „ Sars. Bid. Christ. Fauna, p. 15.
1875. „ „ Ehlers. Zeitsch. f. w. Zool., vol. xxv, pp. 17 and 31.
1876. „ „ Hansen. Annel. Norsk. Nordhavs-Exped., 1876, Nyt. Mag. f. Nat., vol. xxiv, pl. i, p. 4.
1879. „ „ Tauber. Ann. Danic., 78.

Habitat.—Dredged in St. Magnus Bay, Shetland, by Dr. Gwyn Jeffreys in 1867, at a depth of 100 fathoms. G. O. Sars found it occasionally at Lofoten in water ranging to 300 fathoms; in the Christiania Fjord in 100 to 230 fathoms; and also more frequently at Aalsund on a muddy bottom in 20 to 30 fathoms near the shore. It has even come from a depth of 600 fathoms. The species extends to Norway and the Arctic seas (Hansen).

In 1872 G. O. Sars gave an excellent description with figures of this form under the name of *Paramphinome pulchella*, M. Sars, mentioning that it is widely distributed round the Norwegian shores. As he had an opportunity of observing living specimens his description has been, as far as possible, added to the original account.

The head is rounded oval, convex dorsally, somewhat conical in front and even more so behind, since it projects over the first segment almost to its posterior border. It is furnished with five tentacles—two shorter in front and two longer on the projecting median region. The unpaired is behind the latter on the tongue-shaped posterior part of the head. No eyes are present.

The body is nearly cylindrical, a little wider than high, and tapering at both ends. The bristle-bearing segments range from twenty-three to thirty-three, are about twice as wide as long, and distinctly divided from each other. Each has a dorsal and a ventral division of the foot, and a dorsal and a ventral cirrus, the latter organs being short—except in the first and three last segments. The mouth has four fleshy lobes or lips, and the proboscis is often everted in spirit-preparations. The anus is terminal and crescentic.

The branchiæ are confined to the anterior part of the body, and appear to be normally five pairs, six pairs being less common, while four occur in younger specimens. They increase in size from before backwards, the first being on the fourth bristled segment. They are dichotomously divided, broad, fan-shaped organs, which even overlap on the dorsum. They have two primary divisions, each of which is more or less subdivided. Two lateral vessels are visible winding along the body and connected by branches with the gills, besides a median ventral vessel which anastomoses with the former.

The dorsal and ventral divisions of the foot are widely separated. The bristles of the superior lobe (Plate XXXV, figs. 19 *b*, *c*) are for the most part shorter and stouter than the inferior, the former (*b*) being one of the largest, viewed somewhat obliquely so as to show the faint serrations. When the bristle is turned round (as in *c*), the latter are scarcely observable. Besides, there are some long, slender, and tapering bristles faintly and sparsely serrated towards the tip. The inferior lobe of the foot has likewise two kinds of bristles, a few (Plate XXXV, fig. 19 *a*) with the tip of the shaft dilated and bifurcate, one of the distal portions being short and simple, the other elongated and serrate. The rest of bristles in this lobe are either long slender forms with fine serrations towards the tip, or short and more boldly serrate.

In the first body-segment, in front of the insertion of the dorsal bristles, are on each side two strong and somewhat S-shaped hooks.

The want of eyes, and of a distinctly marked caruncle, as Sars says, distinguishes it from other known representatives of the family. The form of the bristles resembles that of other members of the group, but the remarkable hooks on the dorsum of the first segment are unique.

Colour.—Pale and rather transparent, so that the dark intestine is readily visible.

The animal is somewhat sluggish, rolling itself up in a circle when irritated, so as to make the long bristles project outward like those of a *Nerine*-larva. When unmolested it uncoils and moves hither and thither with a sluggish snake-like motion.

Genus II.—EURYTHOE, *Kinberg*, 1857.

Body elongated, with flattened rectangular segments. Cephalic lobe large, rounded or pentagonal; eyes four, dorsal; a median, and two lateral tentacles; caruncle trilobed. Palpi forming two adnate lobes inferiorly in front of the mouth, each with a tentacular process or stylode (Racovitza).

Dorsal cirrus single; bristles of the dorsal lobe linear, subarticulate, others subbifid, with a serrate limb and a short process. Ventral bristles bifid. Branchiae from the third segment backward.

EURYTHOE BOREALIS, *Sars*, 1861. Plate XXVII, fig. 16.

Specific Characters.—Head somewhat horse-shoe shaped, with two short awl-shaped tentacles (lateral) in front, and two longer a little behind. A curved line separates the head into an anterior and a posterior region, the latter more elevated and furnished with four reddish eyes, the anterior being about twice the size of the posterior. A little behind the anterior pair is a filiform tentacle, while behind the eyes the caruncle extends to the anterior border of the third bristled segment. Body elongate, straw-yellow or pale vermilion, twenty-three to sixty-seven segments, and in transverse section nearly square, though the ventral surface is most flattened. Branchiae commence on the second bristled segment as a tuft of four papilliform processes, and generally arise behind and somewhat below the dorsal fascicle of bristles, and consist of a tuft of three or four pale finger-like processes. They are continued almost to the tip of the tail (antepenultimate segment), which terminates in a rounded papilla with a minutely crenate margin. The dorsal division of the foot has a jointed cirrus, and bristles of two kinds—bifid with a serrated limb of greater or less length, and somewhat stronger simple bristles with serrate tips. The ventral division has also a jointed cirrus, and many bifid bristles somewhat stouter and with shorter tips (about four serratures). Length one to one and a half inches.

SYNONYMS.

1861. *Eurythoe borealis*, Sars. Vid. Selsk. Forh., 1861, p. 56 (p. 9 sep. copy).
1869. *Amphinome vagans*? McIntosh. Trans. R. S. E., vol. xxv, p. 406, pl. xv, f. 1.
1876. *Eurythoe borealis*, McIntosh. Trans. Z. S., vol. ix, p. 373.
1896. ,, ,, Racovitza. Arch. Zool. Exp., 3e sér., iv, p. 179, pl. i, f. 1—6.

Habitat.—Under a stone in a tide-pool in Herm, August, 1868. Sars found a smaller example at Manger, in the neighbourhood of Bergen, in shell-sand.[1]

[1] It is doubtful if Dr. Benham's view that specimens six inches long occur all round the British area refers to this species, which appears to be rare in our seas.

The head is pale, somewhat horse-shoe shaped, with two short, conical, awl-shaped tentacles in front, and two longer ones—stylodes (Racovitza)—a little behind, opposite the wide part of the snout. A curved line separates the anterior from the posterior part of the head (Plate XXVII, fig. 16), the former being flattened, the latter more elevated, and furnished with four reddish eyes, the anterior being about twice the size of the posterior pair. A little behind the anterior pair a filiform tentacle projects upward in the middle line, and, immediately behind, the caruncle extends as a wrinkled ridge to the anterior border of the third bristled segment, and is of the yellowish colour of the rest of the dorsum.

The body is elongated, nearly cylindrical throughout the greater part of its length, only a little tapered at the extremities. The number of segments is sixty-seven in the larger, forty-one in the smaller specimens. In contraction the body is somewhat square in transverse section, the inferior surface especially being flattened. The great shortening which takes place causes the prominent rows of bristles to project very boldly. The sulci between the first three bristled segments are somewhat less marked, and the slope of the bristles more oblique, but the rest are very distinctly separated, indeed the body is occasionally more or less moniliform. The first bristled segment is small and has no branchiæ. The second has a tuft of about four papilliform branchial processes. Each segment is furnished with a dorsal and ventral division of the foot—bearing bristles, besides the branchial tuft which springs from a point behind and rather below the dorsal fascicle of bristles, and consists of about four finger-like processes arising from a common origin. They continue almost to the tip of the tail, being apparent on the third last segment. All are pale in colour.

The dorsal division of the foot (Plate XXXVI, fig. 16) has a jointed cirrus, and a group of bristles consisting—of bifid forms with elongate finely serrate tips (Plate XXXV, figs. 20 and 21), of those with shorter tips with four or five serratures, and of somewhat stronger tapering simple bristles with serrate tips (Plate XXXV, fig. 22).

The inferior division has also a jointed cirrus, and many bifid bristles somewhat stouter than in the superior division, and with shorter tips having about four serratures (Plate XXXV, fig. 23).

The tail terminates in a rounded papilla with a minutely crenate margin.

The proboscis commences at the posterior third of the fourth bristled segment (as indicated by two brownish specks), and occupies the fifth and sixth segments. It is somewhat fusiform, truncated anteriorly and posteriorly.

The specimens were of a general straw-yellow hue, somewhat paler anteriorly, and pinkish here and there from the dorsal blood-vessel.

The animal is sluggish, crawling slowly about, and contracting into a bristled mass when irritated. Occasionally the posterior extremity is twisted like a screw, and it also coils its body into one or two convolutions, the condition it assumes in spirit; hence the examination is rendered difficult, and most of the fragile bristles are broken during the efforts to decipher their structure.

This form seems to be the same as that found by Prof. M. Sars in 1861, though the brevity of his description leaves some doubt. His sole specimen was a small one of 10 mm. in length, and occurred at a depth of sixty to seventy fathoms. As in other types of Annelids, however, forms which in the north frequent the offshore are found between tide-marks in the south. The number of the branchiæ differs slightly in the two forms. Sars giving five as the usual number. Further inquiry is thus necessary before the absolute identity can be satisfactorily ascertained.

Sub-family—EUPHROSYNINA.

Cephalic lobe compressed, bending downwards anteriorly to the ventral surface. Dorsally a median tentacle, two eyes, and a trilobed caruncle, ventrally two eyes, two short lateral tentacles, and a pair of adnate palpi in front of the mouth.

Body oblong or ovate-oblong, segments few, feet crest-like, the dorsal and ventral divisions being indistinct. Bristles of the dorsal region brittle and hollow, with simple or bifid tips or hooks with jointed stems, accompanied by simple bristles. Branchiæ on almost all the segments. Buccal apparatus large and complex; alimentary canal simple, with only a trace of an anterior cæcum. Anus dorsal. Two posterior appendages. The nerve-cords are separate and comparatively large, and lie quite within the body-wall,—the oblique muscles, which generally bound the longitudinal ventral muscles, in this case decussating beneath them.

When Savigny established the genus *Euphrosyne* in 1820, he placed it, as his nineteenth genus, under his fourth family, the Amphinomæ of Bruguière; and several subsequent authors, such as Milne Edwards, Kinberg, Ehlers, and De Quatrefages, have adopted the same arrangement.

Kinberg (1857) made the Euphrosynea the second family of his second group, Amphinomea. A single genus and species only are mentioned. His description is—cephalic lobe compressed; neither antennæ nor palpi; branchiæ on many segments; feet crest-like and transverse. He subsequently (1867) made three groups of the Amphinomea, viz. the Chloeia group, the Notopygos group, and the Amphinome group, and gave a brief *résumé* of the literature of each. He does not, in this paper, mention *Euphrosyne* or *Spinther*.

Grube included the genus *Euphrosyne* under the family Amphinomidæ both in his earlier and later publications (1851—1878), having followed Savigny and the preceding authors in this respect. It is placed under his primary division (tribe) Rapacia.

Ehlers[1] likewise adopted Savigny's classification, placing all those with the dorsal caruncle under this group (Amphinomea). He[2] gives an account of a fossil form (*Meringosoma curtum*) from the lithographic slate of Solenhofen which approaches *Euphrosyne* in character. In his recent publication ('Florida Anneliden,' 1887) he adheres to this arrangement. Amongst other features he noticed the hollow nature of the bristles.

The Euphrosynidæ in the classification of De Quatrefages[3] were grouped under the

[1] 'Borstenwürmer,' 1864.
[2] 'Cassel,' 1869, p. 161, pl. xxxvi. f. 3.
[3] 'Annelés,' 1865.

Amphinomiens, and separated from the Aphroditidæ by the Palmyridæ, Eunicidæ and Lumbrinereidæ. The Amphinomidæ he characterised by the similar or sub-similar segments, by the absence of buccal armature or its simple nature, and by the presence of arborescent branchiæ on the segments. The separation of the Euphrosynidæ and their allies from the proximity of the Aphroditidæ does not seem to be warranted on anatomical grounds.

Claus in his 'Grundzuge' (1880) placed the Euphrosyninæ as a sub-family of the Amphinomidæ.

Carus[1] makes *Euphrosine* one of the genera of his Amphinomea, and describes it as having the head with one or several antennæ, two eyes, and a caruncle; body ovate; feet biramous, rami confluent; branchiæ springing from numerous trunks more or less branched.

In Benham's[2] (1896) classification they form part of his eighth family Amphinomidæ, placed between the Nephthydidæ and Eunicidæ, a position which, as already indicated, cannot be supported on anatomical or other grounds of value.

Genus—SPINTHER, *Johnston*, 1845.

ONISCOSOMA, *M. Sars*, 1850.
CRYPTONOTA, *Stimpson*, 1854.

Body ovoid; dorsum more or less convex; segments few. Cephalic region incised as in the other segments, and bearing dorsal bristles, lamellæ and uncinate setæ. Eyes four, at the base of the dorsal tentacle. Buccal aperture inferior—set in the midst of the neighbouring segments. Proboscis exsertile, short and semi-tubular. Intestine pinnate. Anus posterior. Nerve-cords widely separated. Segmental organs absent. Neither cirri nor branchiæ.

Since few opportunities have occurred in this country of seeing living examples of the genus, it will most conduce to brevity and clearness if the recent work of von Graff be summarised.

Polychæta with elliptical and dorsally convex bodies gently rounded anteriorly and posteriorly, and having distinctly marked segments. The flanks have a series of short parapodia with a dorsal lamella in each segment. In the centre anteriorly is a single tentacle, while posteriorly two wart-like anal cirri occur. At the base of the dorsal tentacle are four small eyes. On the ventral surface a little behind the snout is the mouth. Posteriorly is the anus, with the reproductive aperture in front. The free dorsal lamellæ have a double row of chitinous bristles with simple or bifid tips. The parapodia have a prominent hooked and jointed bristle, and from one to four of the same kind undergoing development, besides from eight to thirteen simple bristles. The brain lies under the dorsal tentacle. The sincipital region of Racovitza is the only part of the head remaining, and consequently the middle region of the brain is alone present—both the

[1] Op. cit., 'Prod. F. Medit.'
[2] 'Camb. Nat. Hist.,' p. 318.

anterior and the posterior being absent—the result, according to Racovitza, of parasitism. The two ventral nerve-cords are widely separated, with a ganglion in each segment, and a transverse commissure. The alimentary canal has a muscular pharynx without dental armature, with paired diverticula of the middle and hind gut, and a dorsal blind gut. A vascular system is present, but both branchiæ and nephridia are absent. The sexes are separate.

The genus *Spinther* was established by Dr. George Johnston in 1845 for an Annelid (*S. oniscoides*) half an inch in length, and fully a quarter of an inch in breadth, which he had received from W. Thompson of Belfast, who had dredged it in six to ten fathoms in the neighbouring bay. It is remarkable that no undoubted example of this species has been found in British waters since that date, though another species has once been procured in the Minch. Dr. Johnston mentions its cream-yellow colour, the absence of distinct "head, tentacula, and tentacular cirri," and gives the number of the dorsal lamellæ at thirty. He correctly noticed the general form of the "feet," the presence of the cirrus and other features. He also distinguished the hooks and the various kinds of bristles, though his figures were not drawn with that scientific accuracy—probably from deficient microscopic power—which modern requirements demand. He grouped the genus under the Amphinomidæ. Unfortunately the type-specimen[1] is not in the British Museum, where Dr Johnston's collection of Annelids is. The ciliated pits on the anterior portion of the cephalic region are probably sensory (Racovitza)

Michael Sars five years later (1850) described his *Oniscosoma arcticum*, n. g. et sp., which he had dredged in Komagfjord, in thirty to forty fathoms, on a sponge. This form had twenty segments, a tentacle and four eyes in the third segment. He gave an account of the dorsal lamellæ, the marginal expansions with the bifurcate bristles, and the ventral division with the hooks. He linked it with *Euphrosyne*.

Edouard Grube next year (1851), in his 'Familien der Anneliden,' considered that *Spinther* leaned to the Siphonostomæ or to the Amphinomea rather than to the Aphroditidæ.

A few years later (1854) Dr. Stimpson formed the genus *Cryptonota* for a similar Annelid, giving most of the characters already known, and stating further that the branchiæ resembled those of *Euphrosyne*, though he could not satisfactorily make them out.

Grube (1860), in describing *Spinther miniaceus*, a new species, placed it near *Amphinome*.

In A. de Quatrefages' 'Histoire des Annelés' Johnston's species is given at the end of the Chlorèmiens, under the genera and species of uncertain position, it being noted that while Johnston considered it near the Aphroditidæ, Grube thought it approached the Amphinomaceæ and Siphonostomæ, and that he (the author) was entirely of the latter opinion, which he based on the structure of the feet, the presence of "albuminous" matter in them, and the nature of the hooks.

Claparède in a note[2] states that the genera *Spinther* (*Oniscosoma*) and *Cryptonota* are identical.

[1] I am indebted to Prof. Jeffrey Bell for making a search.

[2] 'Arch. sc. Phys. et Nat.,' t. xxii; 'Bibl. Univ. et Rev. Scientif.,' Apr., 1865.

Malmgren in his 'Annulata Polychæta' (1867) included Sars's species under the genus Spinther—as *S. arcticus*, Sars.

In 1865 I found in the Minch, off North Uist, a form which was placed under *S. oniscoides*, Johnst., but which is clearly *S. miniaceus*, Grube, or more correctly *S. arcticus*, Sars (*non* Wirén).

Hansen next (1882) describes a form which he identified with *S. arcticus*, Sars, from the Norske Nordhavs-Expedition. The description and figures, however, as von Graff says, agree better with *S. oniscoides*, though the somewhat indifferent drawings of the bristles leave some doubt.

In the account of the Annelids of the Vega Expedition (1883) Wirén described a species which he calls *S. arcticus*, but which materially differed from Sars's form in size and in structure.

The same year Levinsen, in his systematic account of the geographical distribution of the northern Annelids, confused Sars's species with Wirén's, and made Hansen's (*S. oniscoides*) a new species.

Drasche[1] further in 1885 gave an excellent anatomical description of *S. miniaceus*, Grube. He found this species chiefly on the surface of the sponge *Tedania anhelans*, Lieberk., at Trieste. He pointed out the double nature of the dorsal membranes—of the structure of which he gives good figures. Underneath the cuticle is the hypoderm, which is thickened in certain regions. The muscular investment which occurs next is more or less continuous as an outer longitudinal and an inner circular layer, but in his figure (pl. ii, fig. 7) of the ventral region the reverse arrangement is shown. His description and figures of the cephalic ganglia (brain) are good, as are also his remarks on the eyes. He gives a clear account of the alimentary canal and of the dorsal blind gut, which joins the intestine in front of the rectum. His account of the circulatory system is brief, since he had only examined the system in section—a dorsal vessel, a ventral trunk, and transverse vessels in each segment being the chief features alluded to. He concludes his paper with remarks on the body-cavity and its septa. Between each pair of septa are the ganglia of the ventral cords and their commissure, the diverticula of the gut and the transverse blood-vessels. The rest of the cavity, in his specimens, was filled with the reproductive products. In the male the region of the dorsal blood-vessel is specially connected with the development of the sperms, as Haswell and Selenka showed in the Aphroditacea. He found no segmental organ (nephridium).

The most complete account of the genus, however, is that of L. von Graff (1887). This author had an extensive series of specimens, and brought to bear on their structure modern methods of investigation. After an historical introduction he gives the characters of the genus and the three species known, viz. *S. oniscoides*, Johnston, *S. miniaceus*, Grube, and *S. arcticus*, Wirén. The adoption of the specific term *arcticus* for the latter, however, seems to be open to some objections, since Sars's name *arcticus* has some claim to priority over Grube's term *miniaceus*, and confusion may result from the application of the same name to a different species, northern though it be. He shows that *S. miniaceus* is the smallest of the series, *S. oniscoides* considerably larger (26 mm.), while *S. arcticus*

[1] Drasche, R. von, 'Beiträge z. feineren Anat. der Polychæta,' Wien, 1885, 14 pp., 2 pls.

reaches the length of 50 mm. A general structural description follows, and he points out the essential differences of the dorsal lamellæ in the three species. Bifid dorsal bristles only are present in *S. miniaceus*, while in the other two simple bristles accompany the former. The mouth opens on the ventral surface anteriorly, and four small brown eyes lie at the base of the tentacle, each with a short thick nerve from the cephalic ganglion. The nerve-cords are separate except for the transverse commissures. The alimentary canal consists of fore, middle, and hind gut, besides cæcal appendages. The pharynx is muscular. The mid-gut possesses generally a pair of diverticula in each segment, and terminates in an anus which has a pair of short cirri. Excretory organs are absent, but a blood-system is present. There are no differentiated branchiæ. The reproductive elements are separated from the body-wall, and lie in the body-cavity. All are parasitic on sponges.

Recently Racovitza[1] (1896) has carefully investigated the structure and homologies of the cephalic region, and he is of opinion that only the sincipital region of the head remains with the tentacle and the four eyes, and the much reduced brain internally: the latter (brain) consisting of the middle region only, whereas in Eurythoe and Euphrosyne both the anterior and posterior regions of the brain are present. This reduction of the cephalic region he attributes to parasitism on *Esperella* and other sponges.

The species show a certain amount of variation, and von Graff thinks that the somewhat radiate arrangement of the parts anteriorly and posteriorly approaches the condition in *Myzostoma*, which occurs on starfishes, while *Spinther* frequents sponges.

In the pinnate arrangement of the alimentary cæca *Spinther* differs from the typical Euphrosynina, and approaches the Aphroditidæ.

1. Spinther oniscoides, *Johnston*, 1845.

Specific Characters.—A dorsal cirrus at the end of the parapodium. The dorsal lamellæ project at the free margins and have a series of strong, simple or bifid bristles. The hooks of the parapodia are powerful, pectinate at the projecting margin, and the tip is strongly curved. Ventral surface furnished with small papillæ (warts) on the ridges which flank a median furrow. Posterior end split to the anus.

Synonyms.

1845. *Spinther oniscoides*, Johnston. Ann. Nat. Hist., vol. xvi, p. 8, pl. ii, f. 7—14.
1854. *Cryptonota citrina*, Stimpson. Marine Invest. Grand Manan, p. 35, pl. ii, f. 27.
1865. *Spinther oniscoides*, Johnston. Cat. Brit. Mus., p. 127, pl. xiv, f. 7—14.
1882. " *arcticus*, Hansen. Annel. Norsk. Nordhavs-Exped., p. 44, pl. i, f. 1—5.
1883. " *major*, Levinsen. Syst. Oversigt. nordiske Annulata, &c., Vidensk. Meddelels. p. 125.
1887. " *oniscoides*, Graff. Zeitsch. f. w. Zool., vol. xlvi, p. 90, pl. vi—viii, and woodcuts.

Habitat.—Dredged off Castle Chichester, Belfast Bay, by Mr. Hyndman in 1844, and off Anglesey in seventeen fathoms (Hornell)? (*fide* Dr. A. Merle Norman). Abroad

[1] 'Arch. Zool. Expér.,' 3 sér., vol. iv, p. 197, &c., 1896.

it has been met with in the Bay of Fundy, New Brunswick, by Stimpson and Leidy, and at Station 275 (Ost Havet) den Norske Nordhavs-Expedition 1876-8 (Hansen). Verrill includes it in his list of marine forms from Cape Cod to the St. Lawrence.

Body.—Length 11 to 26 mm., the British forms seen by Johnston approaching the first-mentioned figure, ovate or somewhat oblong, convex dorsally, smoothly rounded at each extremity. The more convex dorsum has a series of symmetrical double lamellæ, strengthened by simple or bifid bristles, the tips of which slightly project beyond the skin, these lamellæ being continuous with the feet, which in Von Graff's example amounted to forty-eight, Johnston's specimens, apparently having fewer. The ventral surface has a series of low ridges studded with minute warts, the anterior sloping forward and the posterior backward, the middle line being marked by a furrow, likewise warty. In the largest example (26 mm.) the thickness in the centre of the body was 2·5 mm., thinning off at the sides, and the breadth about 11 mm.; the height of the dorsal lamellæ in the same being 1·5 mm. The anus terminates some distance within the posterior border, the adjoining pair of ventral ridges presenting no special differentiation.

Colour.—Johnston's examples were of a uniform cream-yellow colour, while Von Graff's had a yellowish-ochre hue. Stimpson observes that his specimen was of a beautiful lemon-yellow colour, resembling very much that of some sponges occurring with it on a gravelly and muddy bottom in thirty-five fathoms in Hake Bay, Grand Manan.

Head.—This region is merged into the general contour of the body, but bears superiorly over the brain the ridge-like dorsal tentacle with four eyes at the base. The mouth opens on the ventral surface some distance behind the anterior border, often as a radiate button—from the protrusion of the proboscis.

Feet (parapodia).—These are distinguished by the possession of a ringed base, and the presence of a short dorsal cirrus of about four or five segments, the lamellar ridge of the dorsum curving smoothly away from it on the one hand, while on the other the golden hooks emerge near its base ventrally. The hooks, which are excellently figured by Von Graff,[1] have strongly curved and sharp points, while the terminal process of the shaft is boldly serrated. One or two of these project freely, while internally one or two are in course of development, the point appearing first, according to Von Graff, in a cellular matrix.

It is remarkable that, notwithstanding the great increase of zoological explorations of the British seas, no example of this species has been procured since Dr. Johnston described it, with fair accuracy—both with regard to external form and the characters of the bristles and hooks—from two examples forwarded by Mr. Wm. Thompson of Belfast. Moreover, Prof. Jeffrey Bell informs me the type specimens cannot be found in the British Museum. Under these circumstances the only alternative was to utilise what had been so ably written by Von Graff and others, and place materials for ready identification in the hands of future observers.

The species follows the habit of certain marine forms, adhering to sponges and feeding on them, so that the alimentary canal, including the dorsal blind sac, is packed with sponge-débris and spicules.

[1] Op. cit., pl. viii, figs. 4 and 5.

2. SPINTHER MINIACEUS, *Grube*, 1860. Plate XXIV, figs. 1, 2.

Specific Characters.—Parapodia without cirri; the dorsal lamellæ are prominent processes with leaf-like external borders. The supporting bristles are bifid and more slender than in the previous species, and arranged in a radiate manner in the leaf-like lateral lobes. The distal end of the shaft of the hook is smooth. The ventral surface appears to be smooth, but it has rows of minute warts.

SYNONYMS.

1850. *Oniscosoma arcticum*, Sars. Nyt. Mag. f. Naturvid., vol. vi, p. 210 (Sars' paper).
1860. *Spinther miniaceus*, Grube. Archiv f. Naturges., Jahrg. 26, Bd. i, p. 74, Taf. 3, figs. 4—5 (?).
1861. ,, ,, Grube. Ein Ausflug nach Triest, pp. 51 and 140, Taf. 3, figs. 3—5.
,, ,, *arcticus*, Sars. Saersk. aft. Vidensk. Forthand., p. 3.
1862. ,, ,, Sars. Christiania Vidensk. Selsk. Forhandl., p. 52.
1867. ,, ,, Malmgren. Annul. Polychæt., p. 1.
1876. ,, *oniscoides*, McIntosh. Trans. Z. S., vol. ix, p. 373, pl. lxvii, figs. 1—3.
1879. ,, *arcticus*, Tauber. Annul. Danic., 77.
1883. ,, ,, Levinsen. Vidensk. Meddelelser; Kjøbenhavn, p. 125.
1884. ,, *miniaceus*, J. V. Carus. Prodr. Faunæ Medit., p. 208.
1885. ,, ,, Drasche. Beiträge zur Anat. Polychæt., Heft. 1, Taf. ii, Wien.
1887. ,, ,, Graff. Zeitsch. f. w. Zool., vol. xlvi, p. 93, Taf. i—v, and woodcuts.
1890. ,, ,, McIntosh. Ann. Nat. Hist., Aug., 1890, p. 152.
1891. ,, *oniscoides*, Hornell. Trans. Liverp. B. S., p. 239.
1896. ,, *miniaceus*, Racovitza. Arch. Zool. Exp., p. 197, pl. iii, figs. 22—26.

Habitat.—The Minch, near North Uist, on a yellowish sponge (McIntosh); on *Antennularia ramosa* and yellow *Halichondria* in seventeen fathoms off Holy Island, Anglesey (Hornell). Finmark and west coast of Norway; Bay of Muggia at Trieste on reddish sponges (*Tedania*); north coast of Denmark (Lütken). Stimpson (1853) found the American example of the genus also on a yellowish sponge.

Colour.—The Hebridean specimen was of a straw-yellow hue, the lamellar processes at the side being pale and marked with opaque-white spots. The Mediterranean examples are of a cinnabar tint, or dull reddish, brownish, or violet-brown, according to the colour of the sponges which they frequent.

Head.—The caruncle presents no feature of interest. The exserted pharynx is smooth and trumpet-like, thus diverging from the condition in *S. arcticus*.

Body.—Ranging from ·9 to 8·5 mm., the Hebridean example being about 5 mm., with a thickness in the centre of 1 mm. in the largest, ovate or somewhat oblong, with the sides flanked by the translucent lamellæ, which dorsally form a series of symmetrical processes provided only with bifid bristles, and in the largest examples 0·4 mm. in height. The lamellæ on the two sides of the body are separated by a median furrow. Ventrally the surface is more or less smooth, only minute warts being present, and there is no well-defined median furrow. This surface is covered with areolæ (polygonal spaces) in the Mediterranean examples. The segments range from twelve to twenty-four. The body terminates posteriorly in two somewhat globular anal cirri.

The bristles of the dorsal lamella are all bifid (Plate XXXV, figs. 5 *a* and 5 *b*), the somewhat delicate process resembling a web stiffened by the spiculæ. They are arranged with considerable regularity, and are all characteristically curved. A sensitive papilla also occurs at the tip of each lamella laterally.

Feet.—These are more or less cylindrical. One conspicuous hook (Plate XXXV, fig. 5 *c*) in the British example projected beyond each foot, generally another of similar form (but shorter) within the tip, and the developing extremities of two in the tissues. A group of simple bristles (eight to twelve) with tapering tips also accompany the central hook.

Von Graff found considerable variation in the condition of the alimentary canal, so that he made two series, viz. the Stenocœla and the Eurycœla. He mentions also, as Grube had previously done, that the ova wander into the bases of the feet, and probably are the "opaque white spots" seen in the Hebridean example. The ripe ova have short protoplasmic processes in the body, which elongate subsequently into structures like pseudopodia, somewhat symmetrically arranged as in a Radiolarian. The spermatozoa present a head with an acute tip, two granules at the base, and a long filament.

Grube's original description was carefully drawn up, and he gave the chief features in regard to form and coloration, though his examples were small, having only twenty-two parapodia. He, however, placed too much reliance on the reddish-orange colour as distinctive from Johnston's species. Von Graff was at first inclined to place the Hebridean example under *S. arcticus*, Wirén, but further investigation showed that it was *S. miniaceus*.[1]

It is probable that the *Spinther arcticus* of Sars (1861) is this species, and there is nothing in his description to invalidate this view. As already mentioned, the adoption of his name would lead to considerable confusion.

Genus IV.—EUPHROSYNE, *Savigny*, 1820.

Body generally short, oblong, equally narrowed at either end, segments not numerous; two thick styles posteriorly. Cephalic lobe narrow, frontal part narrowest, a band passing downward to the inferior ridge. Eyes both on the dorsal and ventral surfaces. One median tentacle situated in front of eyes. Lateral tentacles two, very short, springing in front of the inferior eyes. Fascicles of bristles arranged on each side of the segments. Superior bristles forming a transverse row, no barbs; inferior grouped in a broad pencil. Capillary bristles unequally bifurcate. Dorsal cirri two (or three—Ehlers) on each side, the one at the inner border of the fascicle, the other at the outer margin. Ventral cirri single. Branchiæ dorsal, in rows, and more or less ramose. Palpi forming fixed lobes on each side of the mouth. Mouth opening on the ventral surface and extending over several segments. Buccal apparatus complex, alimentary canal simple.

[1] *Vide* 'Ann. Nat. Hist.,' August, 1890, p. 182.

The genus Euphrosyne of the family Amphinomæ was established by Savigny in his 'Système des Annélides' (1820) for two species (*E. laureata* and *E. myrtosa*) from the Red Sea. Briefly his description is as follows:—Mouth with a simple unarmed proboscis. Eyes distinct, two in number, separated in front by the caruncle. Antennæ incomplete, the middle and exterior absent, the unpaired subulate. Feet slightly separated, but each division provided with bristles having a minute denticle near the tip. Cirri nearly equal; an additional one resembling the others inserted at the upper extremity of each dorsal division. The last pair of feet forming two small globular cirri. Branchiæ situated immediately behind the feet, extend from the dorsal to the ventral division, and consist of seven separate arborescent tufts arranged transversely. Head very narrow and much produced (très rejeté) posteriorly, split into two lobes in conformity with the feet ventrally, and provided dorsally with a depressed caruncle which is prolonged to the fourth or fifth segment. The body is oblong or ovate-oblong, with comparatively few segments.

Lamarck adopted the foregoing views in the classification of the group.

Audouin and Milne Edwards followed Savigny in regard to the systematic position and description of the genus, and gave an account of a new species (*E. foliosa*) from the shores of France.

Grube, Ehlers, and subsequent authors made little change in the characters attributed to the Euphrosynidæ.

The Euphrosynidæ frequent both the littoral region and comparatively deep water, a distribution that characterises both foreign and British species. Thus *Euphrosyne foliosa* is diagnostic of the tidal rocks of the Channel Islands, while the other species have been procured only by the dredge. They extend to the American shores.

1. Euphrosyne foliosa, *Audouin and Edwards*, 1834. Plate XXIV, fig. 3.

Specific Characters.—Caruncle extending to the anterior part of the fifth segment, with a filiform tentacle in front between the dorsal eyes. Branchiæ much branched, with ovate expansions at the tip. The middle cirrus between the fourth and fifth branchial stems. Bristles longer than the branchiæ, which are from eight to nine in number. The serrated bristles have the longer fork peculiarly curved towards the tip. Segments thirty-one to thirty-five.

Synonyms.

1833. *Euphrosina foliosa*, Audouin and M. Edwards. Ann. d. Sc. Nat., vol. xxviii, p. 201, pl. ix, figs. 1—15.
1834. ,, ,, Ibid. Litt. de la France, vol. ii, p. 126, pl. ii, B, figs. 1—4.
1836–7. ,, ,, Cuv. Reg. An., Crochard's Edit., tab. viii, fig. 2.
1840. *Euphrosyne foliosa*, Grube. Actin., Echinod., &c., p. 84.
1841. ,, ,, Delle Chiaje. Descrizione, Tav. 62, Tab. 139, figs. 6—8.
,, *Lophonota Audouinii*, Costa. Ann. d. Sc. Nat. (2), vol. xvi, p. 270, pl. xiii, fig. 1.
1849. *Euphrosyne foliosa*, W. Thompson. Ann. Nat. Hist., ser. 2, vol. iii, p. 355.

1851. *Euphrosyne foliosa*, Grube. Fam. der Annel., pp. 41 and 122.
1853. „ „ P. H. Gosse. Ann. Nat. Hist., 2 ser, vol. xii, p. 384.
1863. „ *mediterranea*, Grube. Archiv f. Naturges., 1863, i, p. 38, pl. iv, fig. 2
1864. „ *foliosa*, Ehlers. Die Borstenw., p. 65.
„ „ *racemosa*, Ehlers. Die Borstenw., p. 67, Taf. i, figs. 1—11.
1865. „ *foliosa*, Johnston. Cat., p. 126.
„ „ „ De Quatrefages. Hist. Nat. Annélés, p. 408.
1868. „ „ Baird. Proceed. Linn. Soc., vol. x, p. 237 (1870).
1870. „ „ Grube. Archiv f. Naturges., 1870, p. 301.
1875. „ *Audouini*, Marion and Bobretzky. Ann. Sc. Nat., 1875, p. 10.
1876. „ *foliosa*, McIntosh. Trans. Z. S., vol. ix, p. 273.
1881. „ *Audouinii* (Claparède), V. Carus. Faunæ Medit., p. 207.
1888. „ *foliosa*, St. Joseph. Ann. d. Sc. Nat. (7), vol. v, p. 190.
1896. „ *Audouini*, Racovitza. Arch. Zool. Exp., p. 186, pls. i et xi, figs. 7—13.

Habitat.—Belfast Bay, Hyndman; Weymouth, Gosse. Plentiful under stones near the border of low water mark at Herm, Lankester, McIntosh, Hornell. Off the Hebrides, Gwyn Jeffreys. Birterbury Bay, Connemara, fifteen fathoms, Gwyn Jeffreys, Haddon. Arran Isles and Bay of Galway, E. P. Wright. Off Marsden, co. Durham, twenty to thirty fathoms, A. M. Norman.

It was discovered in European waters by Audouin and Milne Edwards, viz., on a bank of oysters and Anomiæ between Granville and Chausey in fifteen fathoms, and on a small bank of the same kind at St. Malo. Ranges to the Mediterranean, where it occurs at considerable depths.

Colour.—Some of those from Herm are of a very fine deep reddish orange on the dorsum, the branchial processes being of this colour. Ehlers describes his *E. racemosa* as of an intense red ("zwischen orange und zinnoberfarben"). Others, again, were quite greyish, or of an earthy hue. The under surface is either pinkish or pale flesh-colour. They tinge spirit brick-red. Gosse's example from Weymouth was of a bright cinnamon-red, with the median ventral line purplish. Milne Edwards' example seems to have been vividly tinted of a fine cinnabar colour, very marked on the branchiæ, and mingled with yellow and green on the dorsum. The cirri were yellow, with a band of red in the middle; while the caruncle was of a vivid red. The pinkish ventral surface had a median band of vivid red.

The *head* is wedged between the anterior segments, and is distinguished mainly by the caruncle and eyes. It is more or less linear, with the elevated region somewhat ovoid. The two dorsal eyes, which are black and of considerable size, lie at the anterior border, and have the tentacle, which does not seem to taper much, rising between them. The fillet, which runs forward from the caruncle, carries a pair of short tentacles, with tactile hair-like processes, and bending over the tip of the snout, bears the two elongated ventral eyes, which are smaller than the dorsal.[1] The dorsal part of the fillet is stated by Ehlers in *E. racemosa* to be covered with cilia, and it is probable that they also occur on the ventral surface of the band.

The body of this species forms a somewhat elongate oval, the dorsal surface being elevated, the ventral flattened. Dorsally a broad groove, smooth but for the segment-

[1] J. V. Carus, in his 'Prod. Faun. Medit.' (1884), gives the genus only one pair of eyes.

lines and the characteristic furrows of the cuticle, occupies the centre, the sides being flanked by the cirri and the dense rows of bristles and branchiæ. Each row has a palisade of bristles towards the front of the segment, the cirrus (Plate XXXV, fig. 1) standing freely a little behind, while the branchiæ form a series of arbuscles—after an interval—extending outwards from the latter. The second cirrus occurs in the position formerly noted, and is generally longer than the other appendages. The anterior part of the median groove is occupied by the caruncle, which stretches from the front to the anterior part of the fifth segment, the tentacle springing between the dorsal pair of eyes in the second segment.[1] J. V. Carus says his *E. Sebastianii* (= *E. furcata*, D. Ch., and *E. racemosa*, Ehlers) has a pair of tubercle-like antennæ, seven branchial trunks, and both bifurcate and smooth dorsal bristles. The ventral surface is marked in the British examples by the presence of a slight median groove, and by the regularly arranged segments. The first bristle-bearing segment lies on each side of the median fillet, and ventrally forms a pad on each side of the middle line in front of the mouth; the second and third slope obliquely inwards towards the first, whilst the halves of the fourth are continuous behind the mouth, the outer ends being directed forward; and a similar inclination characterises the eight or nine which follow. The posterior segments, on the other hand, have the outer regions sloped backwards. Two globular cirri terminate the body posteriorly, the anus lying above them.

The *segments* are much more distinctly marked than in *Spinther*, being readily recognised dorsally by the palisades of bristles flanked by rows of branchiæ, and ventrally by the sulci between each.

The *feet* are also fairly defined for a group in which the dorsal division forms part of or becomes confluent with the dorsal arch of the body, and it is this structure which, amongst other features, gives grounds for the classification followed in the "Challenger" Annelida and in the present treatise. In each segment the innermost structure is the cirrus, which is attached rather behind the middle of the segment, and is a tapering organ of considerable length, with a filiform tip richly covered with cilia. About the middle of the segment the palisade of bristles runs from the inner to the outer border. The ordinary bristles have a well-marked spur with a slightly curved tip (Plate XXXV, figs. 15 and 16). The serrated forms have a deeply cleft tip, both limbs being curved, the longer doubly so when viewed laterally (Plate XXXV, fig. 17). Milne Edwards' figure of this bristle is quite diagnostic, though not absolutely correct. The figure of the same kind of bristle given by Ehlers for *E. myrtosa* differs only in its artistic treatment. Antero-posteriorly, again, this kind of bristle is straight (Plate XXXV, fig. 18). The palisade of bristles just mentioned terminates at the dense tuft of bifid bristles of the first-mentioned type (figs. 15 and 16) which projects from the foot on each side. This tuft includes stout forms with comparatively short bifid tips, as well as numerous slender forms with the tips almost in a line with the shaft and having serrations on the edge of the tip (Plate XXXV, fig. 17); the short spur, moreover, has a membranous guard from the tip to the side of the larger limb. The bristles in the Hebridean example were remarkably developed all over. Schmarda found a golden

[1] Ehlers describes the caruncle of his *E. racemosa* as having an ovoid basal and a compressed upper region.

fluid in the axis of the bristles of *E. polybranchia*, and more careful investigation of the British forms in life might lead to further information on this point.

In section about four rows of bristles are observed in the tufts, the more slender being guarded by outer (*i. e.* anterior and posterior) rows of large bristles. The median cirrus is situated opposite (in front of) the third branchia, and behind the palisade of bristles; De Saint-Joseph says between the second and third branchiæ.

The ventral cirrus lies between the parapodia, and is thus hidden in the ordinary position of the parts.

The branchiæ form a series of arbuscles with foliate tips ranged transversely behind the palisade of bristles. They vary in number from seven to eight. Each consists of a short main stem, which rapidly and somewhat dichotomously divides into branches terminating in the expanded ovate processes. The latter (Plate XXXV, fig. 3) have a well-marked cuticle with the subjacent granular layer (hypoderm) filling up the central region. The cells under the cuticular investment are larger and somewhat regularly arranged. So far as the preparations show, the long cilia occur on the sheltered parts of the larger branches.

De Saint-Joseph states that he has seen the red blood penetrating the branchiæ, contrary to the opinion of Claparède, but without reaching the terminal enlargement of the organ, which is shut off by a septum. This has not been observed in our examples.

Very considerable variation in the form of the branchiæ occurs during development, young examples having few branches, and the tips more or less cylindrical or only slightly tapered; then they become broadly lanceolate. What relation the condition of the terminal processes of the branchiæ have to injuries and regeneration is at present unknown, but small forms do not always show elongated tips, some measuring about a quarter of an inch presenting short branchial arbuscles with broadly ovate tips.

Reproduction.—Ripe ova occurred in the specimens from the Channel Islands in July. The axial blood-vessels of the ovaries in the species from the Cape were mentioned by Schmarda.

In describing this species for the first time Audouin and Milne Edwards observe that it differs little from *Euphrosyne myrtosa*, found by Savigny on the shores of the Red Sea. In the latter species, however, he finds but seven branchiæ, whereas in his species eight occur; and they are shorter than in *E. laureata*, and more densely tufted than in *E. myrtosa*, while the tips are large and ovoid. The caruncle, moreover, is narrow, almost linear, rather elevated, instead of being ovoid, very large, and depressed.

The same form was mentioned as British in 1844 by Mr. W. Thompson, who dredged it in Belfast Bay on shelly ground in six to ten fathoms, the discrimination of the species having been made by Prof. Allman. Mr. Gosse, again, procured it at Weymouth in 1853, and describes the minute tentacle at the tip of the caruncle as flattened and truncate instead of subulate, and the general colour bright cinnamon-red rather than cinnabar, while the median ventral line is purplish.

The *E. mediterranea* of Grube[1] appears to be closely allied if not identical with this species. It comes from Lussin Piccolo, Villa Franca, and other places on the southern shores, and the same remarks apply to Victor Carus's *E. Audouinii* (=*Lophonota Audouinii*,

[1] 'Arch. f. Naturges.,' 1863, p. 38.

Costa (?), *E. laureata*, D.Ch., *E. mediterranea*, Grube, and *E. racemosa*, Ehlers). So far as the description of *Euphrosyne racemosa* of Ehlers goes there is little to distinguish it from *E. foliosa*, for it has yet to be proved that the variation in the number of the branchiae (eight to nine in *E. foliosa* and five and six in *E. racemosa*) is not due to age, and that the position of the middle cirrus is not due to the same cause.

Grube, who examined the species in the Parisian Museum, found that the median dorsal cirrus did not extend between the fourth and fifth branchial process, as in the figure of Audouin and Edwards, but between the second and third, as is also the case in Ehlers' *E. racemosa*. Both from the structure of the branchiae and the structure of the bristles Grube concludes that the *E. racemosa* of Ehlers is synonymous. Grube was likewise of opinion that the *E. laureata* and *E. myrtosa* of Savigny agree with the *E. foliosa* of Audouin and Edwards. In all probability, therefore, the nomenclature might be considerably simplified. The *E. Audouinii*, Claparède, as given by Carus,[1] is probably referable to the common species (*E. foliosa*). This seems to be the dull reddish species figured by Delle Chiaje (1841). At Naples the common name is "Ti veggo rosso senza spine."

The *E. mediterranea* of Grube[2] is the same species, though Horst[3] thinks the tips of the branchiae clavate rather than foliate. Baron de Saint-Joseph, who agrees in regard to the association of *E. racemosa*, *E. Audouinii*, and *E. mediterranea* with the present species, found that at Dinard specimens of 12 to 15 mm., and having thirty segments, were distended with ova. The *Euphrosyne intermedia*, 1888, of this author, rests mainly on the presence of longer forms of bristles—amongst the dorsal and ventral series—having the axial oil-like contents. He thinks they are offensive and contain poison. In all probability this is only a variety of *E. foliosa* with longer bristles.

2. Euphrosyne armadillo, *Sars*, 1851.

Specific Characters.—Caruncle extending to the anterior border of the fifth segment, with a proportionally long biarticulate tentacle between the dorsal eyes. Branchiae divided dichotomously, and terminating in lanceolate processes. The bristles are of considerable length, the bifid forms having a short spur and quite smooth, the serrated kinds having the longer arm somewhat flattened, only slightly, though distinctly, curved, the serrations extending along opposite parts of the fork.

Synonyms.

1850. *Euphrosyne armadillo*, Sars. Reise i Lofoten og Finmark. Nyt. Mag. f. Naturv., B. vi, p. 211.
1861. ,, ,, Forhandl. Vidensk.-Selsk. (Aar, 1860), vol. viii, p. 55.
1876. ,, *lanceolata*, McIntosh. Trans. Z. S., vol. ix, p. 395, pl. lxxi, fig. 1.
1886. ,, *armadillo*, Langerhans. Zeit. f. w. Zool., vol. xl, p. 253.

[1] 'Fauna Medit.,' p. 207, 1884.
[2] 'Arch. f. Naturges.,' 1863, p. 38.
[3] 'Notes from the Leyden Museum,' vol. viii, 1886.

Habitat.—Dredged in the Porcupine Expedition of 1869 on sandy mud amidst corals off the west coast of Ireland, in 173 fathoms.

The *body* appears to be somewhat flattened, and in the injured preparation is about 3 mm. in length, and consists of only about nineteen segments. The dorsum agrees generally with the typical form, except that the branchiæ differ considerably in structure, and thus give a character to the region. Both dorsal and ventral eyes are very distinct, and the tentacle is comparatively long in the example. On the ventral surface the palpi form two rounded pads in front of the mouth, and abut on the eyes in front. Posteriorly the vent is indicated by two rounded or globular processes which project on the ventral surface. The segments in the latter region are much curved, and the tips of several project beyond the globular anal cirri, the lines of the segment-junctions being in one or two almost antero-posterior.

Colour is unknown.

The condition of the single specimen is unfortunately indifferent, and it is, moreover, small (possibly immature), but the following characters were ascertained. The palisade of bristles dorsally consists of a series of smooth bifid forms with a distinct curve at the tip, which is slightly hooked, and a short spur at the base (Plate XXXV, fig. 8). The serrate kind has a proportionally longer spur, the serrations on it corresponding in extent with those on the longer fork of the bristle, which tapers a little towards the tip (Plate XXXV, fig. 13). Some present more distinct flattening of the longer limb (Plate XXXV, fig. 14), and the serrations are less marked,—indeed, only a limited area of similar extent on each side of the fork shows them clearly, though very minute processes occur on the longer limb of the fork above the former. The tips of all these bristles are distinctly curved. On contrasting them with the bristles of *Euphrosyne armadillo*, Sars, from Norway (Plate XXXV, figs. 9—12), a certain resemblance is apparent in all, but the tips both of the smooth and serrate kinds are proportionally longer and narrower in the Norwegian form, and the curvatures differ; such, however, may be due to age or other conditions. The longest tips in the case of the smooth bristles occur in the foot.

The branchiæ (Plate XXXV, fig. 2) appear to be five or six in number, and when viewed under a lens have a different character from those of *Euphrosyne foliosa*, since the tapering tips are much more slender. They branch from near the base in a similar manner, the tips being truly lanceolate. The variations, however, seen in the branchiæ of *E. foliosa* show that no strict reliance on the external appearance of these organs can be maintained. The only feature of moment is the tufted condition of the tips in the larger Norwegian examples, which also have proportionally longer terminal processes.

Michael Sars describes this species as of a pale yellowish colour, and having nineteen segments. The narrow caruncle reaches the fifth segment. Cephalic lobe elongate, narrow; the posterior (dorsal) eyes situated in front of the caruncle, at the base of the biarticulate tentacle, which is conico-acuminate, shorter than the caruncle. Two short cirri on the dorsum between the pinnæ. Branchiæ five, rarely six (two or three of the anterior and posterior segments with fewer), four to five dichotomously divided, with conico-acuminate tips. Superior edge of pinna with two cirri, ventral with one. Setæ unequally bifid, with serrations in the fork of the dorsal form, while the inferior bristles are smooth, with the exception of a single small denticle near the apex. Length 8 mm., breadth $2\frac{1}{2}$ mm.

It was dredged at Manger, about three miles north of Bergen, on shell-sand.

There is still a degree of uncertainty in regard to the identity of the British and Norwegian forms, which can only be cleared up by the capture of fresh specimens in this country.

3. Euphrosyne Robertsoni, *n. s.*

Specific Characters.—The tips of the branchiæ are digitate, with only a trace of a swelling. Dorsal bristles smooth and bifid. The forked and serrate bristles somewhat resemble those of *E. foliosa*.

Habitat.—From the Firth of Clyde, whence an example was sent to the British Museum by the late Dr. David Robertson. It is labelled *Euphrosyne foliosa*, Aud. and Ed., No. 1049, 64, 6, 30, 6.

The specimen is upwards of half an inch in length, and shows a similar arrangement of the caruncle and eyes to *E. foliosa*, from which, indeed, there is little to distinguish it in external appearance with the naked eye. The branchiæ, however, differ, presenting stout stems, with dichotomously but sparsely divided tips, which have a nearly uniform diameter; for the slight enlargement in some does not alter their character as digitate processes, slightly lobate and then tapered at the tips (Plate XXXV, fig. 5). They somewhat resemble the figure of the branchiæ of *Euphrosyne myrtosa*, as given in Savigny's plate, but little reliance can be placed on it.

The dorsal palisade of bristles[1] consists of smooth bifid forms, some with longer (Plate XXXV, fig. 7) and some with shorter tips (Plate XXXV, fig. 6). The bifid serrate kind (Plate XXXVII, fig. 33) appear to approach those of *Euphrosyne foliosa*, though the curves and general character are different.

I have named this species after one of the most persevering and patient of Scotland's naturalists, who for many years devoted his energies and experience to the fauna of the Clyde, and to whose influence and example the marine laboratory at Cumbrae owes its existence.

Family II.—Aphroditidæ.

Annelids of an ovate or oblong form, convex dorsally, with a distinct head (prostomium), on which are a pair of eyes and a median tentacle, and under which is a papillose facial tubercle. No lateral tentacles; two palpi; tentacular cirri long; buccal cirri (ventral cirri of the second foot) moderately long. Proboscis large and powerful, with four thickened muscular ridges representing teeth, and tough internal

[1] I am indebted to Prof. Jeffrey Bell and Mr. Sumner for most courteously making preparations of the bristles and branchiæ and forwarding them for examination.

lining. Alimentary canal pinnately-branched, the glandular intestinal cæca being long and complex. Dorsal fimbriæ small, alternating with the scales, or absent. First foot bearing three dense tufts of bristles. Elytra fifteen pairs, occurring on the second, fourth, fifth, thereafter on all alternate segments to the twenty-fifth, and then on every third segment. Segmental organs (nephridia) opening by a well-marked papilla pointing upwards between the feet. Nerve-cords median, between the ventral attachments of the oblique muscles, or in a well-defined epidermal granular layer within the dense cuticle.

Genus V.—Aphrodita, *Linnæus*, 1735.

Eyes sessile; dorsum covered with a thick, close felt of matted simple hair; setæ of the ventral division of the foot very numerous, long, silky, and iridescent, and, like all the other bristles, simple, not barbed or toothed. Intestine with eighteen long and complex cæca (figs. 16 and 17, p. 250). Nerve-cords in a transversely elongated space between the ventral attachments of the oblique muscles, and bounded externally by the basement-tissue and the cuticle.

Swammerdam's account of *Physalus*, as this form was then called (1758), contains a notice of the three rows of bristles on the feet, which he considered only papillæ. He thought the scales the branchiæ, and was of opinion that the animal was able to "swell and bloat itself with air." He observed the ramifications of the alimentary canal and the presence of blood-vessels. He criticised Rondelet for placing it amongst sea-worms, and was inclined to relegate it to the proximity of the sea-urchins. His figures are recognisable, though the whole dorsum is rough with tufts of bristles.

Pallas, in his 'Miscellanea Zoologica' (1766), showed the propriety of removing the Aphroditæ from the Mollusca, with which Linnæus had grouped them. He indicated that a more natural classification would be to conjoin the three genera, Aphrodita, Nereis, and Serpula. He gave a general and fairly accurate description of the Aphroditidæ, the only feature requiring special notice being his observation that branchiæ are present on the dorsum, and that he included in the group *Chloeia* and Amphinome (*Pleione carunculata*).

O. F. Müller, in his 'Zoologia Danica Prodromus' (1776), included the Aphroditidæ and other Chætopods under his Helminthica Setosa, the other group being his Helminthica Mutica, in which were *Gordius*, *Ascaris*, and *Hirudo*.

In Gmelin's edition of Linnæus (1788)[1] the Aphroditaceans were placed in the Vermes Mollusca, after Doris, notwithstanding that there was little more than the general ovoid outline to suggest the relationship.

By Lamarck[2] the Aphroditidæ were grouped under his second order of Annélides, *i.e.* A. *Antennata*, along with Nereids, Eunicidæ, and Amphinomidæ. He simply followed Savigny.

[1] 'Syst. Nat.,' p. 3107.

[2] 'An. sans. Vert.,' 1818, tome v, p. 304.

Savigny in his 'Système'[1] made the Aphroditidæ the first family of his Néréidées, characterised by having the branchiæ in the form of a ridge or papilla situated superiorly at the base of the dorsal branch of the foot. They are absent from the second, fourth, fifth, seventh, ninth, and eleventh pairs of feet, and so on until the twenty-third or twenty-fifth. They determine by their absence that of the superior cirrus, and are replaced by scales. The scales, when present, number from twelve pairs or fewer to thirteen pairs or more, and extend to the twenty-third or twenty-fifth segments, and are followed or not by supernumerary pairs. They are formed of separate membranous lamellæ, the upper thickened, sometimes horny, the inferior delicate, and attached by a hollow pedicle to the base of the feet without branchiæ—in a position, however, corresponding to the attachment of the latter. The mouth has a proboscis and four jaws. The former is cylindrical, massive, striated transversely, and furnished with a fringe of small tentacles at the orifice. The jaws are horny or cartilaginous, flat, short, more or less free at the point, and have a vertical motion on each other. The eyes are four in number, two anterior and two posterior. The antennæ are retractile, elongated, generally complete; the median of two articulations, the first being short; the unpaired the same; the anterior always present and much larger than the others, finely ringed, conical, and with tapered tips. The feet have either two divisions or these are united—furnished with aciculi. Cirri prominent, generally composed of two chief divisions: the first, short and thick, lies at the base of the other, which is retractile. The superior cirri are large, extending beyond the bristles, while the latter pass beyond the inferior cirri. The first pair of feet have the divisions intimately united, without bristles or with numerous bristles, and the two cirri elongated like tentacles. The second pair of feet have also a long inferior cirrus, a little larger than the succeeding. The intestine is provided with numerous cæca, which are most distinct in Aphrodita proper. Savigny, from the foregoing, used the term (Aphroditidæ) in its widest sense.

In Cuvier's 'Règne Animal'[2] (Mem. Edit.) M. Audouin arranged the Aphroditidæ and Polynoidæ under the order Dorsibranchiata (corresponding to the Néréidées of Savigny).

Audouin and Milne Edwards (1834) classed the Aphrodisiens (which included *Aphrodita*, *Polynoe*, *Sigalion*, and *Palmyra*) as the first family of their Annélides Errantes, and they gave a description which defined the somewhat extensive group. One important feature is the presence of a double row of membranous scales, the elytra of Savigny, fixed on the dorsum by a pedicle to the superior division of the foot, and according to the authors filled with ova at certain periods. They occur in some on all the feet or on alternate feet, while in others they are absent. They refer to small processes attached to the under surface of the scales as branchiæ. Cirri occur on the segments devoid of elytra, with the exception of *Sigalion*, where they are present on all the segments. The feet are bilobed, each division being armed with a spine, bristles, and cirri, the last existing on every foot ventrally. In the first segment the dorsal cirri become tentacular cirri. The antennæ are attached to the head, and are three in number

[1] 'Système des Annélides,' tome i, 3e part., 1820.

[2] MM. Audouin, &c., 'Règne An.,' 1836–7.

—a median and two lateral. The eyes are usually four in number and placed in pairs—one in front of the other.

As the result of their own researches they restored the older name Aphrodisiens for Savigny's Halithées, and made three principal groups: (1) those in which the elytra alternate with dorsal cirri and branchiae, (2) those having these organs on the same foot, and (3) those devoid of elytra. In the first tribe the authors placed *Aphrodita*, *Polynoe*, and *Polyodonta*. In the second division, which from the elongated body they termed *Aphrodisiens vermiformes*, they ranged Acoëte and Sigalion; while in the third group is placed *Palmyre*. We shall deal at present only with the first mentioned, viz. *Aphrodita*, which was characterised by the authors as furnished with thirty elytra fixed to feet which bear neither branchiae nor superior cirri, and which alternate regularly (with the exception of the fourth and fifth segments) to the twenty-fifth segment, with other feet which have cirri and branchiae. The elytra fixed to the succeeding segments are differently arranged. Three antennae are present. The jaws are small and cartilaginous or absent.

A sea-mouse and parts of its digestive system are figured in Tav. iv, fig. 10, of Delle Chiaje's Memoire (1822), but no description is given.

The same author[1] (1841) speaks of a pair of oval ovaries in *Polyodontes maxillosa*, filled with a transparent liquid at the dissepiments and at the bases of the feet, and of an analogous group of rosy ovaries in *Hermione hystrix*, and yellowish ovaries in *A. aculeata*. These Meckel considered to be small branchiae. In April they had advanced considerably. He did not consider the scales respiratory, as Cuvier, Carus, and Duvernoy had done, and he supported his opinion by the presence of special branchiæ in *Sigalion squamosum*. He described the ventral ganglionic chain as a nerve-artery in *A. aculeata* and *H. hystrix*, but had seen vascular trunks in both on the intestine. The blood-vessel in his figure seems to ensheath the œsophageal trunks and ventral chain. Long before,[2] he had compared the alimentary system of the Aphroditaceans with that in such as Pleurophyllidia.

Oersted[3] (1843) signalised the Aphroditacea amongst the Nematode-like Chætopods as having imperfect branchiæ (simple). He considered the scales the branchial organs.

Grube's description of the Aphroditea in his 'Familien der Anneliden' (1851) is brief but characteristic. He included *Palmyra* under the same family.

Sir J. Dalyell[4] says that, "though seemingly timid, the Aphrodita is probably fierce and rapacious, overpowering creatures incapable of resistance; and there is even reason to believe that it occasionally devours its own kind." By Aphrodita he means the Aphroditacea.

Kinberg[5] (1857–8), following on the lines of Audouin and Milne Edwards, grouped the Aphroditea of Savigny into seven families, the first of which, Aphroditacea, corresponds with our Aphroditidæ. These have an oblong wide body, with a rounded head

[1] 'Memoire,' vol. i, p. 121.

[2] 1823.

[3] 'Ann. Danic. Consp.,' 1843, p. 4.

[4] 'Powers of the Creator,' vol. ii, p. 163, 1853.

[5] 'Eugenies Resa,' &c., p. 1, 1857–8.

and a facial tubercle between the palpi and the front of the mouth. Tentacle extending from the middle of the cephalic lobe. No antennæ. The sessile or subpedunculated eyes are situated in front of the middle of the cephalic lobe. The palpi are long, thick, tapering, and ciliated; and two tentacular cirri are on each side of the first pair of feet. The buccal cirri (ventral pair of the second feet) are longer than the succeeding. The exsertile pharynx has ridge-like transverse processes—*quasi*-cartilaginous, and resembling jaws. The branchiæ are in the form of low papillæ, situated above and internal to the bases of the dorsal cirri, and covered by the elytra. They are not always obvious. The elytra occur on segments 2, 4, 5, 7, 9, &c. The other families were Iphionea, Polynoina, Acoëtea, Sigalionina, Pholoidea, and Palmyracea.

The genus Aphrodita he distinguished as follows:—Eyes sessile (pigment-spots in pairs). First pair of feet furnished with numerous bristles, and with tentacular cirri. Dorsal division of the foot distinct from the ventral, low (small) and broad, with strong sharp spines and capillary bristles, forming a kind of felt on the dorsum; ventral division carried outwards, blunt, with numerous bristles, smooth, acute, but neither glochidiate nor bidentate.

Chenu[1] (1859) chiefly followed Milne Edwards in placing the Aphroditiens as the first family of his Annélides Errantes, the Amphinomiens and Eunicìens forming the second and third families.

In the posthumous 'British Annelids' of Dr. G. Johnston, published by the British Museum in 1865, the first family, Aphroditaceæ, included not only the genera pertaining to the Aphroditidæ, but the Polynoidæ and Sigalionidæ. The author followed in his description Audouin and Milne Edwards. He gives three species of Aphrodita, viz. the common form, *A. borealis* (which is the young of the former) and *A. hystrix* (*Hermione hystrix*). Like Grube, he classified the Annelids under the Rapacia and Limivora.

De Quatrefages[2] included the whole of the group forming the subject of this fasciculus—with the exception of the Amphinomidæ and Euphrosynidæ—under the family Aphroditidæ, in which the regions of the body are similar while the segments are dissimilar. They fall under his first order Errantes. The author criticised the classification of Kinberg, and held that only two families existed in the sub-order, viz. the Aphroditidæ and the Palmyridæ, the one characterised by the presence and the other by the absence of scales. The Aphroditidæ form a very natural family of the Errant Annelids. The head bears two to three antennæ and two to four eyes; while the buccal segment is often indistinct, and with or without tentacles. The body is more or less covered by the elytra, and the segments present differences which are repeated with regularity. The antennæ (tentacles) receive their nerves directly from the brain, and their number is at most three. The external antennæ (palpi) are really the tentacles of the buccal ring, and receive their nerves from a special ganglion. The nerves of the tentacular cirri, again, come from the first ganglion of the ventral chain, being modified processes of the first pair of feet. The head bears a kind of caruncle (facial tubercle?) in front. The eyes in general are small, resting on the brain, though in some they are pedunculated and susceptible of movement. The mouth has thick lips.

[1] 'Encyclop. d'Hist. Nat.,' 1859.
[2] 'Annélés Marins, &c.,' 1865.

The feet are biramous, bearing scales or tentacular cirri, in general only the one or the other. The ventral cirrus occurs on all the feet. Some have a resplendent covering of hairs, and a felt-like coating on the dorsum protecting the scales. Those without such sometimes show a radiate arrangement of the bristles. In the scales he describes a lacunar system in connection with the general cavity of the body, and therefore he thinks Savigny was right in associating them with respiration, though he was so far misled by a balloon-like condition in imperfectly preserved specimens. He does not regard the elevated and ciliated processes on the dorsum of the feet as branchiæ, for they have no central vessel and no lacunæ, and the cutaneous tissues present no special modification. On the other hand, De Quatrefages saw in the pretended branchial function of the branching digestive system an analogy with what he had formerly described in the Æolidæ as phlebenterism.

The circulatory apparatus he says agrees with the typical condition, but is difficult to follow, as the blood is pale. There are dorsal and ventral vessels as described by Treviranus, and a third considerable trunk accompanying inferiorly the abdominal nerve-chain.

The cephalic ganglia are comparatively large, and the exterior thereof brownish red. The ventral chain has the ganglia united, though in general the two halves are distinct. No commissure exists between the lateral ganglia of the first three pairs of feet—a condition absent in the Polynoidæ. The visceral system of nerves consists of a muscular trunk and a ganglion with a connective joining the brain. It supplies the muscles of the proboscis.

The only remarks the author makes in regard to the reproduction of the group is that in a large number of examples of *Aphrodita hystrix* he found irregular mounds consisting of eggs enveloped by delicate tissue along the digestive canal and touching the body-wall. These individuals consequently showed a large number of ova or of sperms in the perivisceral cavity. Further, in a male he observed sperms escape as a white thread at the base of the ventral division of the foot about the nineteenth segment.

The classification adopted by De Quatrefages was based for the most part on external characters, such as the arrangement of the scales, the absence, alternate or continuous condition of the dorsal cirri, the nature of the antennæ (tentacles), and the jaws.

In his general remarks on the Aphroditidæ, Claparède[1] corrects the error of Williams that vibratile cilia are absent from the peritoneal surface of *Aphrodita aculeata*. This author was, however, in doubt concerning the vascular system, for though he found a dorsal and a ventral vessel according to the old observations of Pallas and Treviranus, yet he could not satisfy himself that they pertained to the vascular system. He makes a few remarks also about the respiration in the group, stating that in *Hermione hystrix*, during the alternation of expansion and contraction, the last pair of scales in the latter function are raised, and a powerful stream of water sent out. The same is seen, though to a much less notable extent, in *A. aculeata*. In the latter species bubbles of air sometimes accompany the currents, so that Swammerdam had some foundation for the remark that the Aphroditæ swallow (*gorgeant*) air. He had, however, overlooked the observation of Sir J. G. Dallyel when he said former authors had not observed these respiratory movements.

[1] 'Ann. Chét. Napol.,' 1868.

In his summary of the Aphroditacea[1] (1868) Dr. Baird showed that while Audouin and Milne Edwards included six and Grube seven species, later authors had so increased the number that Kinberg found it convenient to form most of the older genera into distinct families. He gives a description of the family Aphroditidæ after Kinberg, with four genera, viz. *Aphrodita*, *Hermione*, *Aphrogenia*, and *Lætmonice*. A succinct account of the species follows under each genus, and he seems to have acquiesced in Dr. Johnston's view that *Aphrodita borealis* was a distinct species—a position he subsequently vacated, this being only the young of *A. aculeata*. He added one or two new species to the list. His *Lætmonice Kinbergi*, however, as he afterwards admitted, is identical with *L. filicornis*, Kinberg, a species widely distributed in Northern waters.

Ray Lankester[2] found hæmoglobin in the nerve-cords of *A. aculeata*.

Grube next gave a survey of the family Aphroditidæ (which included the whole series here considered). He divided the group into sub-sections thus:—A. The one segment with elytra, the other with cirri; no jointed bristles. These he subdivided as follows:—*a*. Between the elytra-bearing segments of the body one segment carrying a dorsal cirrus; in the posterior part of the body mostly two bearing cirri, or the elytra absent. 1. *Hermionea* (Aphroditacea, Kinberg). 2. *Polynoina*. The first group, the *Hermionea*, which alone concerns us at present, he classified according to the condition of the ventral bristles and the state of the eyes. (*a*) All the ventral bristles have simple tips. In *Aphrodita* he gives as characters the following:—The ventral bristles in three rows, short, thick; the dorsal bundle of all the segments bearing the elytra furnished with longer and stronger bristles and two bundles of fine hair-like bristles, the alternate segments also with another felted series, under which the elytra lie; two eyes.

Schmarda[3] included the Aphroditidæ and Amphinomidæ under his Notobranchiate Chætopods.

In his treatise on the Annelids collected by Semper in the Philippines (1878) Grube terms the family Aphroditea. Besides the characters previously stated, he mentions that all the segments bear ventral cirri and two fascicles of bristles, and that the fourth and fifth segments always carry elytra. The stomach is subcartilaginous, and the intestine has pinnate cæca.

Claus[5] (1880) grouped under the family Aphroditidæ the sub-families Herminioninæ, Polynoinæ, Acoëtinæ, Sigalioninæ, and Polylepinæ; while his second family was the Palmyridæ. Under the Sigalioninæ he embraced *Psammolyce* and *Pholoe*.

Levinsen[6] (1883) follows Malmgren's classification of the Aphroditidæ in his paper on the Northern Annelids.

Carus[7] (1884) describes the genus *Aphrodita* as having fifteen pairs of elytra on alternate feet, which are destitute of cirri; the intermediate bearing a cirrus and branchia:

[1] 'Journ. Linn. Soc.,' vol. viii, 1865.

[2] 'Ann. Nat. Hist.,' 4th series, vol. xi, p. 97, 1873.

[3] 'Sitzung. d. Schlesischen Gesell.,' 1874.

[4] 'Zoologie,' 2nd edit., 1877, Wien.

[5] 'Grundzuge d. Zoolog.,' 1880, pp. 490–98.

[6] Aftryk, af. 'Vidensk. Meddel. f. d. Nat. Foren. i. Kjobenhavn,' 1882–3.

[7] 'Fauna Mediterr.,' 1884.

tentacles three; long tentacular cirri; maxillæ small or none; dorsum covered with a close layer of felt; ventral spines simple at the apex.

In his 'Annelids of the 'Blake'' (1887) Ehlers keeps to the family Aphroditidæ, with sub-families Hermionea, Polynoina, Acoetea, and Sigalionina. The Hermionea he distinguishes by the facial tubercles and the arrangement of the scales; and he separates them from the Acoetea and Sigalionina by the condition of the branchiæ and the structure of the bristles.

APHRODITA ACULEATA, *Linnæus*, 1765. Plate XXIV, figs. 4 and 5.

Body broad, cephalic lobe inflated anteriorly, basal part of the tentacle only half the length; facial tubercle with sparsely distributed small globular papillæ; central region of the gut differentiated from the complexly lobed glandular cæca; spines of the dorsal division of the foot long, piercing the felt; capillary bristles greenish, iridescent (burnished). Ventral bristles in three rows.

SYNONYMS.

1554. *Physalus*, Rondelet. De Piscibus, p. 428.
1602. *Scolopendra marina*, Aldrovandus. Insect., p. 636, f. 1.
1634. *Physalus*, Moufet. Theatr. Insect., f. 8—15.
1677. *Vermis aureus*, Oligerus Jacobæus. Acta Hafniae, vol. iii, pp. 87, 88, and 89.
,, ,, ,, Bartholinus. Act. Haf., vol. iii, p. 88, tab. 88.
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Habitat.—*A. aculeata* is by no means uncommon in deep water off the eastern shores, indeed all round the British Islands. It generally frequents a somewhat soft bottom. A specimen comes from 580 fathoms, on oozy ground in the Faröe Channel, 'Knight Errant,' 1880 ('Challenger Report,' p. 34). After great storms the beach at St. Andrews is sometimes, *e. g.* in April, 1857, strewn with multitudes, so that the retiring tide leaves a line of them for more than a mile. As the species is seldom encountered within the bay proper, many were probably brought by the currents from the off-shore grounds, such as near the Bell Rock and south-east of the Island of May. Grube, who found it in the Adriatic (Lussin?), says that, according to Claparède and Malmgren, *A. aculeata* is distributed both in the Atlantic and the North Sea, while Von Martens found it at Madeira. It extends to the shores of America (Massachusetts, &c.), and a closely allied species to the north-west coast, though the minute characters of the form from the latter region have not yet received that attention necessary for certainty.

The head in *A. aculeata* (Plate XXIV, fig. 6) is smoothly rounded in front, with a median elevation posteriorly, and thus differs from that of *Lætmatonice filicornis*. The comparatively small, smooth tentacle proceeds from the centre of the anterior curvature, and has a short basal articulation; then it gently dilates to the somewhat clavate tip of the central piece, the terminal portion beyond having a dilated basal region, after which it narrows and ends in a slightly enlarged tip. The terminal articulation varies, being longer in some, shorter in others, and often presents a fusiform outline, with the tip slightly enlarged. A little behind the tentacle is, on each side of the median line, a blackish or brownish area (in the preparations)—the eye. The palpi are proportionally shorter than in *Lætmatonice filicornis*, and taper gently from their basal articulation to the tip. One is sometimes longer than the other—from reproduction of a lost organ. They are papillose, as in *L. filicornis*, only the papillæ are somewhat shorter. The facial tubercle has sparsely distributed small globular papillæ (Plate XXXVI, fig. 23), thus differing much from *L. filicornis*. O. G. Costa's fig. 2, Tav. i, therefore, is not an accurate representation of the part in this species.

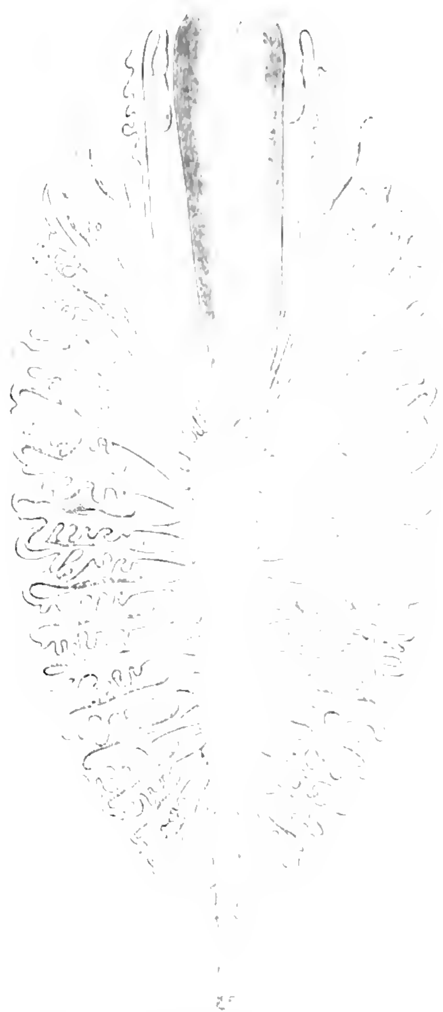
Body.—The body is somewhat ovoid or broadly spindle-shaped, with the broad end in front. The dorsum is convex, covered with the dense greyish felt in the middle, and flanked by the gorgeously iridescent green and golden hairs and lustrous brown spines. The scales are entirely concealed by the felt, while in it many foreign structures are often fixed. Segments (bristled) forty-three.

The ventral surface is flattened, and the skin is somewhat warty and rough, giving rise to the somewhat fanciful comparison by Pallas to that of the shark, and often tinged of a brownish hue. It is marked by the transverse ridges indicating the segments. The arrangement of the folds at the mouth is seen in Plate I, fig. 1.

The papillæ of the segmental organs commence at the ninth and continue to the twenty-third foot. There thus appear to be fifteen pairs. The removal of the apertures of these organs entirely from the ventral surface is a feature of the sub-family, and distinguishes them at once from the Polynoidæ.

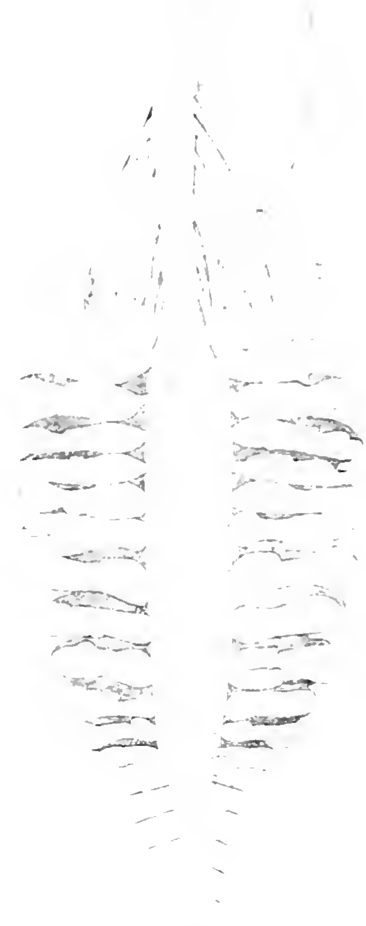
Digestive System.—The papillæ of the terminal region of the extruded proboscis

FIG. 16.



Digestive apparatus of *Aphrodita aculeata*. From a well-preserved spirit-preparation.—A. W.

FIG. 17.



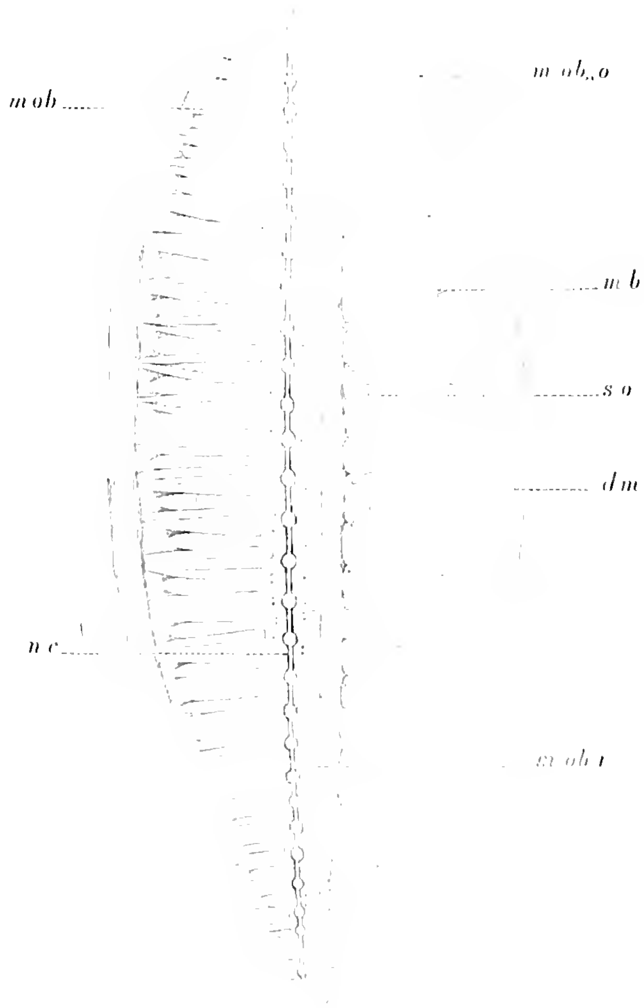
Digestive apparatus of *Aphrodita aculeata* in a fresh specimen. The stomach is drawn forward.—A. W.

are somewhat lobate, though usually termed fasciculate (Plate XXXVII, fig. 1). They differ from those of *L. filicornis*, yet they sometimes appear as if obscurely dichotomous.

The proboscis itself is a powerful muscular organ, formerly eaten by the natives of the Belgian shores, and even in our own country. Only shreds of a fibrillar gelatinous substance have been found in it. Grube[1] describes six layers in the organ.

About six of the anterior caeca may be considered pregastric (Fig. 16—in contraction). The lateral caeca of the gut are longer than in *Laetmatonice* or *Hermione*,

Fig. 18.



Dissection of *Aphrodita aculeata* to show the segmental organs (nephridia), *s.o.*; *d.m.*, dorsal longitudinal muscles; *m.ob.o.*, outer attachments of the oblique muscles; *m.ob.i.*, inner attachments of the oblique muscles; *m.b.*, oblique muscles; *n.c.*, nerve-cord.—A. T. M.

and form slender tubes connecting the remarkable cæca near the body-wall and the long moniliform glandular appendage inferiorly with the central system. These tubular portions of the cæca are less truly dorsal in their origin than those of the genera mentioned. The woodcut just referred to shows the canal and its appendages in a state of contraction. In the living and fresh condition the parts often present a different

[1] 1873.

aspect (Fig. 17), the caeca forming voluminous organs in the body of the Annelid. Pallas found nothing in the proboscis (his ventriculus), whereas in the gut he met with particles of fuci. In many at St. Andrews and elsewhere mud of various degrees of darkness occurs in the canal and its branches. Swammerdam thought the ramifications of the intestine anastomosed with each other.

Scales.—The overlapping, irregularly rounded scales[1] number fifteen pairs, and are of considerable size. The first two show a narrow external margin beyond the pedicle, but in the rest the latter occurs at the external border, and it is proportionally large throughout, the scale being thus firmly adherent over an extensive surface while readily moved by the muscles of the parts. The surface of the cuticle on the dorsum and the scale-pedicle is minutely papillose, but the scale proper is smooth, only a few minute papillae occurring along the edge. They are often coated with patches of a blackish-brown granular deposit. The size of the scales does not always seem to correspond proportionally with that of the specimen. Many of the older authors, like Swammerdam, considered these organs the gills.

Dorsal Fimbriated Papillae. On the dorsum of the sixth foot an elevated ridge at the posterior border, rather beyond the line of the scale-pedicles, gives origin to a short process with a thin, flat, fimbriated extremity, generally of three divisions. The terminal fimbriae of the papillae become more complex and the process longer as we proceed backwards, the organs appearing, after the sixth, on the eighth, tenth, and every alternate foot (devoid of scales) to the twenty-sixth, when they occur on the twenty-seventh and the last, a small one on the twenty-ninth, that is on the foot behind the last scale. These organs have been interpreted as branchiae by Pallas, Savigny, Kinberg, and others; while many, such as Cuvier, Carus, Duvernoy, and Oersted, held that the scales were respiratory organs. The great thickness of the cuticle of these processes, and the absence of large blood-vessels, as De Quatrefages showed, do not favour the view that they are special branchial structures, though the lobes of the alimentary caeca come close to them. The cuticle occasionally may be comparatively thick on the surface of branchiae, as in certain Euphrosynidae, but it does not attain the great density seen in these processes of the sea-mouse.

Feet.—The structure of the foot is shown in Plate XXXVI. fig. 10 (representing the tenth foot), and the organ in the various regions of the body conforms to the same pattern. The dorsal division bears the beautiful iridescent hairs, which gleam with all the beauty of a permanent rainbow. A dense and most gorgeous tuft of these, thicker than the dorsal series, occurs just above the ventral division of the foot, and extends more or less to the dorsal edge of the spines, where another dense tuft of hairs, less brilliant than the first series and much finer, occurs, and which form the felt on the dorsum. This property of felting does not appear to be due to any roughness of the exterior of these fine hairs, though fracture may render such rough, but to their flexible and attenuated condition. The tips of the hairs are often curved (see Plate XXXV. fig. 27). The first-mentioned series are brittle and gorgeously iridescent, the tips under a lens being wavy, a feature

[1] Darwin was of opinion that these were homologous with the wings and elytra of insects, "and it is not improbable that with our existing insects, organs which at an ancient period served for respiration have actually been converted into organs of flight." Unfortunately, proof is deficient.

due not to any change in outline, but to the play of light on the organs. The rainbow lustre is lost on drying these hairs in a spirit-preparation, but is again restored on immersion in water. De Saint-Joseph (1888) thinks Krukenberg[1] was wrong in considering the felt was like chitin; it is more like keratin.

The lustrous brown spines spring in a fan-shaped series from the middle of the foot, and form slightly curved sharp weapons of defence. They end in an acute two-edged tip, and readily pierce the skin. They have the same brittle chitinous structure as the other spines in this species.

In young specimens the dorsal spines are longer, more tapered and curved, and meet in the middle of the dorsum so as to guard the back, as in other Aphroditidæ. These and the rest of the spines are also often of a lighter golden hue. The thin and comparatively even coating of felt which covers the dorsum of some young specimens gives a character to such examples on clean ground, as off the west sands at St. Andrews. A great change ensues in these bristles during growth. Small specimens from a quarter of an inch upward to an inch appear to be common on muddy ground, and are densely coated with it,—as, for instance, in St. Magnus Bay, between the Skerries and Fetlar, and the Fjords of Norway (Canon Norman). On sandy ground, on the other hand, they are beautifully clean, and the long golden spines curve as guards over the dorsum.

The first foot bears a dense tuft of simple, slightly iridescent, slender, hair-like bristles, chiefly directed upwards and forwards. In the middle is another fan-shaped series directed forward and slightly curved (convexity outward). Below is a third group of similar structure, probably representing the ventral series, directed downwards and forwards, and with their convexity (for they are stiffish) downwards. On the outer side of the bases of the first two series are the tentacular cirri This foot shows no marked division into dorsal and ventral parts, but has a somewhat clavate outline.

The second foot has the ventral division separated. Dorsally the rounded boss has externally a dense series of stiff hairs, which stand out in a fan-shaped manner, while towards the dorsal median line (Plate XXXV, fig. 25) the second or adjoining series are modified to form the very slender hairs of which the felt is composed. The ventral division bears smooth spines (Plate XXXVI, fig. 18), and inferiorly the tuft of somewhat stiff, pinnate bristles (Plate XXVI, fig. 17).

The ventral division of each typical foot, as noticed by Baster and Swammerdam, bears three series of bristles arranged in transverse rows (Plate XXXVI, figs. 10 and 22). The strongest occur dorsally, and consist of about three powerful dark brown bristles (Plate XXXVI, fig. 2 *c*), flattened at the tip, which varies in condition, though fundamentally the type is somewhat hastate, as observed in the posterior region of the body (Plate XXXVI, fig. 20). In front view (*a*) the tip resembles a broad spear, sometimes asymmetrical; in lateral view, again, the tip (*b*) is more or less tapered, and posteriorly has a slight dilatation at the commencement of the shaft.

The middle series (Plate XXXV, fig. 25 *b*) has the same type, but the bristles are paler and more numerous, about eight occurring in the row. The curvature at the tip is more distinct. Posteriorly the hastate condition is evident (Plate XXXVI, fig. 19).

[1] 'Vergleichende physiol. Stud.,' 2e ser., part 1, p. 51, Heidelberg, 1882, 8vo.

The lowest bristles are still more slender (Plate XXXV, fig. 24 a), and many present a remnant of the pilose coat at the tip, as in the figure. Posteriorly the hastate condition is marked (Plate XXXVI, fig. 19).

The second and third feet thus differ from the succeeding in having, instead of the most ventral series just described, a tuft of somewhat slender pinnate bristles (Plate XXXVI, fig. 17), the pinnæ in the third foot being stronger. These probably represent the primitive bristles.

The slender feet at the posterior end of the body have ventrally a series of elongated bristles, with short spikes somewhat alternately arranged distally (Plate XXXVI, fig. 3). They end in a tapering tip. These bristles are further modifications of the pinnate forms.

The warts on the feet and near their bases are often coloured dark brown or blackish, and in many also the general surface of the feet.

A small specimen ($1\frac{1}{2}$ inches) procured in Cromarty Frith on August 31st had the bases of two anterior feet fixed together by an elongated, hard, brownish mass, which was sunk in the tissues, and another circular patch was near. Only an indefinite granular structure was visible with the microscope, and the structure was more or less calcareous, giving off gas on the addition of hydrochloric acid. Both were firmly fixed in the skin.

Reproductive Organs.—Pallas represented the ova of *Aphrodita* as originating in the perivisceral fluid itself, a supposition in the same category as the notion that the glandular wall of the alimentary canal in the Oligochætes gives rise to the perivisceral corpuscles. At Naples Lo Bianco found the males emitting sperm in March. At St. Andrews specimens have abundant ova in May. The larvæ have not been seen.

The direction of the papillæ of the segmental organ would apparently send the reproductive elements dorsally under the felt, and as streams of water are constantly pouring through this space, the ova would be duly impregnated and aërated. The sperm would likewise be rapidly distributed all around.

A specimen off Howth, Ireland, showed *Loxosoma*, and a delicate creeping Campanularian on the ventral surface and between the feet. In one from St. Andrews Foraminifera were thickly dotted over the ventral surface along with Balani (small), great numbers of stalked Infusorians, and an occasional very young mussel.

In the felt of the dorsum many small marine organisms are entangled, from algæ to mussels, Annelids, crustaceans, sponges, zoophytes, polyzoa, and spines of Echinoderms. Small preserved specimens are proportionally broader than the adult, and taper much more rapidly at either end. Such probably is partly due to rigid contraction. They occur from an inch downward in the stomach of the haddock, and occasionally in the stomach of the dab.

Delle Chiaje[1] records a nematode as a parasite in the dorsal felt, and as having a translucent body and a filiform tail. This is like *Phoronis* in the test of *Cerianthus* from Australia. The nematode, however, may only have lodged temporarily.

The species lives fairly in confinement, but as a rule not for a long time. The difficulty of supplying it with suitable nourishment—for mud in a confined tank soon

[1] 'Descrizione,' vol. iii, p. 138.

becomes odoriferous—is probably the cause of its mortality. In its native sites it seems to make its way in the mud and sandy mud by aid of its powerful ventral bristles, whilst its back is laved by currents of sea water under the felt which protects this somewhat delicate surface from direct contact with its surroundings. It appears to be a limivorous form, pursuing its work in the depths of the sea, where its beautifully iridescent hairs can be seen by few admirers. It does not always follow that the reasons for gorgeous apparel or brilliant phosphorescence lend themselves readily to the inquirer.

The smallest example in my collection was procured on the bottom by Dr. Alford Anderson on board the 'Garland,' on the 9th August, 1888, on the trawling grounds near the Bell Rock. It measures 3·5 mm. in spirit. The dorsum is covered with sandy mud in which are a few fine hairs. The ventral surface forms a proportionally broader area than in the adult. There are nineteen segments besides the pro- and peristomium, and there are no signs of the lustrous hairs, yet the larger bristles of the feet are prominent, though few in number. Each foot has superiorly in the ventral division a long hastate bristle slightly bent downwards at the extremity, the hastate region having a coating of fine agglutinated hairs which project beyond the tip. One or two shorter forms of the same type occur in the next row, the larger having a similar though less developed terminal coating. The third series of two smaller bristles has smooth hastate tips. The spine has a long free point. The dorsal felt is already formed as a dense interlacing series of fibres, which entangle minute particles of mud and sand. The dorsal spines are still comparatively short and pale, and do not project beyond the felt and mud of the sides.

The soberly tinted young form is thus a contrast to the adult in the colour of the bristles, spines, and hairs. Its hues coincide with the surrounding sandy mud.

Baster's account (1765) of this species is, on the whole, careful and characteristic, the arrangement of the ventral bristles and even their number having received attention. His structural remarks are also interesting, and he found the male and female elements in June. His figures are fairly accurate.

Rondelet and Swammerdam called the sea-mouse *Physalus*, while Bartholinus termed it the golden worm. Seba, Molyneux, and Barrelier, again, named it *Eruca sive Scolopendra marina*. Swammerdam was of opinion that it deserved a place near the sea-urchins, probably from the prominence of its spines.

Pallas's description of the external and internal structure is excellent. He had not, however, seen one seven inches long, as Baster reports. He describes the muscular bands, the perivisceral fluid, the digestive system, and the stomach (*ventriculus*), which the Belgian fishermen call *meatulum Aphroditæ*, and eat it boiled—a poor kind of nourishment Cuvier afterwards thought. It somewhat resembles the human uterus, he says, with its *os*. He is of opinion that the scales are not branchiæ, but that fourteen pairs of sacculate bilobate organs (the dorsal fimbriated papillae) are. He mentions the pinnate condition of the intestine, figuring the lateral cæca, and describing their attachment to the "integument." He thinks that Redi's view of the insertion of the cæca in dorsal sacs will not bear scrutiny. The cæca communicate with the median gut freely, and chyme enters and is absorbed,—indeed, he saw particles of algæ in them, but nothing in the ventriculus or œsophagus. He corrects Redi's notion that the nerve-cord and its ganglia formed a systemic trunk with hearts, the reddish colour being characteristic of the various parts of the nervous system in this species. The true sanguiferous system is best seen in moribund fresh examples. In the dorsal region is a membranous space (the great vein) filled with turbid lymph, and it gives off twigs between the intestinal pinnae, and long branches anteriorly. He alludes to the anterior extremity of the great vein over the *ventriculus*, and figures it. Under the intestine is a longitudinal vessel with lateral branches. He noticed the perivisceral fluid and its corpuscles, and found ova in June in masses therein, and also spermatozoa in males, but did not know how they gained exit. It is the Soe-Muus and Gold-Muus of O. F. Muller in his 'Zoologia Danica Prodromus' (1776).

In the first volume of his 'Memorie' (1823) Delle Chiaje refers to his figures on Tav. iv, in which the exterior, the structure of the proboscis, and alimentary canal are sketched. In his fourth volume (1829) he again recurs to the same form, giving a somewhat indifferent view of the body, several sketches indicating the arrangement of the nervous and digestive systems, and the three series of bristles on the ventral surface of the foot.

Treviranus[1] described the external apertures of the segmental organs in *Aphrodita*. Delle Chiaje and he regarded them as openings by which water got into the perivisceral cavity; that in reality the ciliary current moves the reverse way.

Audouin and M. Edwards considered this the most beautiful and brilliant of all the Annelids, stating that it is called the sea-mole and sea-mouse, and that it inhabits the depths off shore, and also the oyster-banks. Rarely is it tossed on shore. The *Aphrodita sericea* of Savigny they could not find in the museum, while his *A. aurata* is probably a young example of *A. aculeata*.

Carus and Jourdan[2] figure the body of *A. aculeata* in vertical section, and also the alimentary canal, but nothing is added to previous knowledge.

In the Memorial Edition of Cuvier it is said that the flexuous bristles of Aphrodita shine with all the brilliancy of gold, and change into all the tints of the rainbow. They do not yield in beauty to the plumage of the humming-bird, nor to the most lively lustre of precious stones. The gills are concealed by the scales, and are in the form of small fleshy crests.

Sir J. Dalyell[3] (1852) noticed the habit of elevating, or, as he calls it, recurving the posterior extremity of the body, and "discharging a stream of water from an orifice there." None of his specimens fed on any substance offered to them. The account of the segmental organs of this species by Dr. Thomas Williams[4] seems to rest on a misinterpretation of the parts. He also states that the blood-vascular system is absent.

De Quatrefages (1865) gives a somewhat detailed account of its external characters. He records thirty-nine rings and fifteen pairs of scales, and a length of 16—17 centimetres (6 or 7 inches). He mentions an elevated cutaneous fold (facial tubercle?) in the middle line running to the mouth. The median antenna is implanted on a caruncle. His

[1] Tied. and Trevir., 'Zeitsch. f. Physiol.,' Bd. iii, 2, p. 157, 1829.

[2] 'Traité élém. d'Anat. comp.,' Paris, 1835, pl. v, figs. 24, 25.

[3] 'Pow. Creator,' vol. ii, p. 171.

[4] 'Philos. Trans.,' 1858, p. 134, pl. viii, figs. 26, 28.

Milnesia borealis (Johnst.) is only the young of *A. aculeata* in a somewhat imperfect condition.

Grube was of opinion that the *A. sericea* of Savigny, and *A. borealis*, Johnst., refer to this species, and that Risso's form, *A. aurata*, is the young of the same.

Claparède[1] describes the peritoneal coat of this species as being the most distinct example in the group, and he figures the fine striæ which characterise it. At intervals on this surface he found groups (*mouchets*) of vibratile cilia as in *Hermione*, and as Sharpey had long previously observed. He alludes to the ovaries which he found on the ventral surface at the bases of the feet They were in bands (*boyaux*) in the median line attached to a cord. He could not satisfy himself as to the nature of this cord. He further points out the peculiar structure of the papillæ, the bases of which can be traced to the interior of the palpi. He differs from De Quatrefages, who states that the first two pairs of ganglia are completely separated from their homologues of the other side. He considers that these ganglia do not exist; they are simply the inferior part of the œsophageal connectives.

A good account of the distribution of the blood-vessels of this species is given by Prof. E. Selenka.[2] He describes in injected specimens a dorsal and a ventral vessel running above and below the gut, the former being connected with the trunks of communication—which course in a parallel manner round the gut—by an intermediate series of inosculating vessels. A fine network is found in the dissepiments and the membranes in connection with the intestinal cæca, as well as certain vessels which end blindly over the dorsal muscles, the nephridia, and other parts. He describes also the growth of the ova in dense masses on the vascular trunks at the bases of the feet. The larger eggs have a fine membranous capsule with nuclei; the smaller ova are brownish red.

Grube[3] (1874) says that in large examples of *Aphrodita aculeata* forty-three segments occur, and that Savigny observes that the two dorsal tufts of hairs (felt) come from the elytra-bearing segments, while Audouin and Milne Edwards held that they come from the cirrus-bearing segments. Grube's examples were in the former condition.

Carus[4] (1884) mentions that it is called Ti veggo (Claparède) at Naples, a name, however, given to other forms; and that an Annelid, *Branchiomma vigilans*, Claparède, is parasitic on it.

Dr. Hugo Eisig[5] (1887) makes an interesting comparison, with figures, of the bristles and hairs of this species with the golden yellow secretion of the spinning glands of *Polyodontes maxillosus*.

[1] 'Ann. Chæt.,' Nap., 1868.

[2] 'Niederlandisches Archiv für Zool.,' Bd. i, Heft 2, p. 33, Taf. iii and iv, 1872.

[3] Op. cit., 1874.

[4] 'Fauna Medit.,' vol. i, p. 199.

[5] 'Monogr. der Capitelliden,' Naples, 1887, p. 331, *et seq.*, Taf. xxxvi.

Genus VI.—Lætmatonice, *Kinberg*, 1854.

Eyes on short peduncles placed near the anterior border of the head, dorsum covered with felt. Spines of the elytra-bearing feet glochidiate, other segments with lateral bundles of stout bristles and a tuft of hair-like bristles. Bristles of the ventral branch semi-pinnate. Intestinal cæca strictly dorsal, arising on each side of the median dorsal vessel. Segmental organs (nephridia) opening externally by a papilla directed upwards between the feet. Nerve-cords flattened, less distinctly separated than in *Aphrodita*.

1. Lætmatonice filicornis, *Kinberg*, 1855. Plate XXIV, fig. 9.

Cephalic lobe rounded, two curved longitudinal lines making it tripartite; facial tubercle with long mammillate papillæ.

Elytra obliquely reniform, with minute cells.

Glochidiate spines with three or four teeth.

Synonyms.

1843. *Aphrodita hystrix*, Oersted. Ann. Danic. Consp., p. 11.
1850. ,, ,, Sars. Nyt. Mag. Naturv., 1850, vol. vi, p. 210, n. 57.
1855. *Lætmatonice filicornis*, Kinberg. Ofversigt Kongl. vet. Akad., 1855, p. 382.
1857–8. ,, ,, Kinberg. Freg. Eugen. Resa. Zool., vol. ii, p. 7, Tab. iii, t. 7.
1859. ,, ,, Danielssen. Norske vid. Selsk., 4de Bd., 2 Hft., Throndhjem, p. 114.
1861. *Aphrodita hystrix*, Danielssen. Nyt. Mag. Nat., vol. xi, p. 19.
1865. *Lætmatonice filicornis*, Malmgren. Nord. Hafs-Ann., p. 53.
,, ,, *Kinbergi*, Baird. Proc. Linn. Soc., vol. viii, p. 180, 1865.
,, ,, ,, De Quatrefages. Annelés, p. 199.
1869. ,, *filicornis*, McIntosh. Trans. Roy. Soc. Edin., vol. xxv, p. 407.
1873. ,, ,, Sars. Bid. Christ. Fauna, p. 1.
1875. ,, *Kinbergi*, Ehlers. Ann. 'Porcup.,' op. cit., p. 31, Taf. ii, f. 1, 2.
1879. ,, *filicornis*, Tauber. Ann. Danic., p. 79.
1885. ,, ,, McIntosh. 'Challenger' Rept., p. 39.
1887. ,, *Kinbergi*, Ehlers. Annel. U. S. S. 'Blake,' p. 45, pl. vii, f. 6; pl. viii, f. 1—5.
1894. ,, ,, Flor. Buchanan. Proc. Roy. Dubl. Soc., vol. viii (n. s.), ii, p. 170.
1896. ,, *filicornis*, Roule. Camp. d. 'Caudan' (Ann. Univ. d. Lyon), p. 442.

Habitat.—This species was first dredged in British seas by Dr. Gwyn Jeffreys off the Hebrides in 1866, and often subsequently in various grounds off Shetland in depths ranging from 75 to 100 fathoms, and chiefly on muddy sand. The same persevering explorer found it off the west coast of Ireland (Valencia Island). It extends into the

Atlantic on Holtenia-ground or stones and coral, and even to the depth of 1950 fathoms ('Knight Errant'), and is found on the shores of America (Verrill) and Canada (Whiteaves). Northward it is met with in the Faroe Channel, while Grube gives from Bohuslan along the Norwegian coast to Finmark. A few examples were dredged along with *Hermione* on the oyster-ground off St. Peter Port, Guernsey, but it is absent along the eastern shores from the Pentland Frith to the south coast.

Head.—The head (Plate XXVII, fig. 2) is somewhat rounded, the median separated from the lateral region by two curved longitudinal grooves. The tentacle arises between and rather behind the ocular peduncles above the conical basal segment, and is a long, slender process gently tapering towards the tip, then slightly enlarging, forming a constriction, and lastly a bulbous swelling as shown in the figures. In none of the examples, however, did the tentacle reach the length of the great palpi, as Kinberg says, nor could Baird's description as "short and conical" apply. Its length, probably from injury, varies, but the longest are far short of the palpi, so that Kinberg's were either recently reproduced or varied in this respect. It agrees in form with a dorsal cirrus. The somewhat globular ocular peduncles occur on each side of the former, and in the preparations are devoid of pigment. The long palpi spring from each side of the facial tubercle in front, and have a smooth basal articulation, from which they gently taper till near the extremity, when a somewhat elongated dilatation occurs, after which the tip tapers to a fine point. The whole organ beyond the basal articulation is setose with long, sharp papillæ, which are finer on the distal region (Plate XXXVII, fig. 2). The slight enlargement below the tip is not evident in every example, probably from injury, but it seems to be present in the most perfect.

The facial tubercle has numerous long, mammillate papillæ, thus differing much from *Aphrodita aculeata* (Plate XXXVI, fig. 24).

The body is somewhat flattened, elongate ovoid, about equally tapered at both ends, though from the contraction of the parts and the condition of the feet the posterior end often has a slightly broader aspect. The dorsum is covered with a greyish felt, and the sides are flanked by the proportionally large and iridescent brownish bristles. These do not overlap the dorsum as in other species, only a few of the shorter bristles spreading slightly over the outer edge of the felt,[1] which is usually coated with sand, and is so flexible as to take wrinkles from the edges of the scales. The dorsal felt is formed of a moderate number of very fine hairs tapering to an attenuate point, and connected together by a fibrillar gelatinous basis, which has sand-grains, diatoms, and other algæ, mud, and foreign particles of various kinds, *e.g.* sponge-spicules and anchors of Synaptæ, in it. So far as observed the fine hairs do not terminate in hooked points as in *A. aculeata;* they spring from the inner edge of the dorsal division of the foot. The felt is friable, thicker, however, in the larger and older specimens, and more easily torn and gelatinous in the smaller. The delicate dorsal cuticle under the felt is smooth, and the body-wall of this region is much thinner than in *Hermione.* The long bronzed spines extend posteriorly somewhat beyond the line of the feet, terminate nearly in a transverse line with the body, and give a truncated outline to the region in contrast

[1] Grube thought only mucus was present.

with the anterior end. Kinberg's figure differs, therefore, considerably from British and other examples—both small and large—that have come under observation; indeed, it is more or less diagrammatic.

The entire ventral surface, including the feet, is studded with closely set globular papillæ.

The papilla of the segmental organ begins on the seventh foot as a small process, becomes a free tubular structure on the ninth, and extends to the twenty-ninth foot. The papilla is comparatively large and long.

Digestive System.—The extruded proboscis has at its extremity a densely villous border, divided into two by a bare papilla at each side. The long processes (papillæ) are divided dichotomously (Plate XXXVII, fig. 2) in a very regular manner, about five times from the base. The great proportional size of this organ—for it is more than half the length of the preserved form—is a noteworthy feature, and indicates its importance in the economy of the animal.

The pre-gastric cæca have their terminal appendages even more conspicuous than in *A. aculeata*. The intestinal cæca arise from the dorsal aspect of the gut close to the median vessel. They thus slightly differ from those of *Aphrodita* and *Hermione*. In regard to the arrangement of the terminal cæca, they approach those of the former.

In the Zetlandic examples masses of mud and mucus in the stomach were very rich in Foraminifera, sponge-spicules, radiolarians, diatoms, bristles of Annelids (Spionidæ), and fragments of crustaceans.

Scales.—Fifteen pairs, smooth, somewhat pellucid, and slightly iridescent. They are more or less rounded or ovoid, and with the exception of the first two are attached by the centre of the outer border as in *Aphrodita* and *Hermione*. While the first pair are small, they rapidly increase in size, the middle third of the body having only three or four large scales. They occur on segments 2, 4, 5, 7, and so on to 23, 25, 28, and 31.

Feet.—The long, brownish, iridescent spines which flank the sides are flattened and flexible, with the tip somewhat abruptly tapered in lateral view (Plate XXXVI, fig. 8), whereas when seen on the flattened face the sides have four or five recurved teeth (Plate XXXVI, figs. 4 and 6). The majority have three teeth on each side (Plate XXXVI, fig. 12), but some have four. The barbed bristles have guards or sheaths, or traces of these in the preparations (as in the figure), but whether they are only perfect in the young condition of the bristle is unknown. They seem to be removed readily.[1] The main part of the shaft is flat, broad, longitudinally striated, and it somewhat diminishes inferiorly, and terminates in a flattened, blunt extremity, to which the muscles are attached. For some distance above the base the shaft is paler, and shows a central band as if from an axial cavity. The spines present a distinct curvature. About twelve well-marked groups of the long spines occur in a good example. These spines retain the same essential structure posteriorly.

The first pair of feet are directed forward, and bear the tentacular cirri (which are much longer than in *Aphrodita aculeata*). Each has two tufts of pale, simple bristles,

[1] Perfect examples occasionally adhere to the felt.

which taper to a fine hair-like point. Their outline seems to be smooth, though sandy débris lodges readily amongst them. The anterior tuft is directed forwards and inwards as an expanded fan, while the compact posterior one goes inwards and backwards. A strong spine supports the foot. The bristles are similar but somewhat stronger dorsally in the second foot. In the third foot a more slender series of bristles occurs to the exterior of the cirrus, while a stronger series is dorsal. This and the next have pinnate bristles in the ventral division.

The fourth foot, which is provided with a ventral cirrus, has in the inferior division a tuft of pale pinnate bristles, like those of *Aphrodita*. The same pinnate bristles occur in the fifth foot, adjoining the ventral cirrus, while above them are a few of the ordinary kind with feathered tip and hook. In the sixth only the latter are present. The typical forms are shown in Plate XXXVI, figs. 5 and 7.

In the same way the last foot or two have a modification of the ventral bristles, for the spikes above the hook are short and distinctly separate. Moreover the last foot has pinnate bristles as in front, along with an ordinary form or two.

The feet appear to be about thirty-four, the dorsal division alternately bearing cirri and long bristles.

The dorsal cirri spring from the centre of a fringe of the more slender bristles, their places being taken in the scale-bearing segments by the long hooked spines. In the case of the cirrigerous feet a group of stout, short, brownish bristles occurs in front of the cirrus, and a somewhat longer and stronger series springs in the scale-bearing feet on the dorsal side of the long spines. All are densely covered with a muddy and sandy investment, but their surface appears to be smooth.

A typical foot, *e. g.* one bearing the long dorsal spines, has dorsally (from within outward) the slender hairs which form the felt, then a group of short stiff bristles, followed by the papilla carrying the long brown spines, which have a distinct curve. A tuft of delicate bristles occurs beneath. The scale is fixed posteriorly. After an interval the ventral branch of the foot bears the semi-pinnate bristles and the ventral cirrus.

The last pair of feet are rudimentary, and lie in ordinary positions behind the anus, which is dorsal.

The segmental organs (nephridia) point upward between the feet, and are as well developed as in *Aphrodita aculeata*.

A Norwegian example, sent by Dr. Merle Norman,[1] shows guards to the front of the dorsal spines, and a slightly hastate tip beyond the barbs. The ventral bristles seem to have shorter tips.

A series of small specimens occur from North Unst—from 5·5 mm. upwards. These have pale spines and bristles, yet all the bristles and the dorsum are densely coated with sand-grains. They were captured in July, and probably represent the growth since the previous spawning season.

Loxosomæ are common in this species on the feet, ventral surface, and on the dorsum under the scales.

[1] Op. cit., p. 171.

Reproduction.—Ova of considerable size are present in examples dredged by Dr. Gwyn Jeffreys off North Unst in June, 1867.

Kinberg (1857) characterised this species as having a rounded cephalic lobe, tripartite from two curved sulci, filiform tentacle longer than the palpi, and the median elytra reniform. It was procured on the western and northern shores of Scandinavia.

Ehlers (1875) considered the *Lætmatonice Kinbergi* of Baird as different from Kinberg's *L. filiformis*, but, as previously stated, there is no reason to doubt their identity.

Ehlers (1887), in his 'Annelids of the United States Expeditions,' considers, as he did in the former publication ('Annel. of the 'Porcupine'') that he is still dealing with a new species *fide* Baird. Only a single form appears to occur in British seas, and it extends to Norway and the American coast. His figures are the work of an artist, and thus the scientific accuracy is not beyond doubt, as a glance at the dorsal spine of his pl. viii, fig. 3, demonstrates. The peculiar flattening of the main part of the shaft, and the characteristic narrowing of the tip, have been overlooked. This form, however, may be a variety of *L. producta*, allied to *L. prod.*, var. *benthaliana*. His description gives nothing diagnostic.

2. Lætmatonice producta, var. *Britannica*.

Specific Characters.—Body ovate-oblong, of a pale flesh-tint, and devoid of dorsal felt. Scales pale, their reticulate cordate structure being better marked than in any other form. Segments forty-five. Head triangular; ocular peduncles globular at the tip, narrowed inferiorly at the peduncle; no eyes. Lateral process at the posterior part of the head smaller than in the typical forms. Papillæ of the angular facial tubercle more lobate than in *L. producta*. Glochidiate bristles with four recurved fangs, besides the process at the base of the terminal spear-tip. Ventral bristles with stiffer basal and more slender distal pinnæ.

Synonym.

1894. *Lætmatonice producta*, Flor. Buchanan. Proc. Roy. Dubl. Soc., vol. viii (n. s.), ii, p. 169.

Body more or less oblong, of a pale flesh-tint, devoid of dorsal felt, scales pale; forty-four bristled segments, which increase to the middle or behind the middle of the body, and again diminish posteriorly, though the latter region is somewhat blunt. The centre of the head is more or less triangular, with a prominent swelling, and bearing in front the two ocular peduncles, which are globular at the tip, but have a distinct peduncular portion, thus differing from those of var. *Willemoesii*, which are more or less sessile, and without a trace of eyes. Those of *L. producta* are more elongated. The lateral process towards the posterior part of the head is much smaller than in *L. producta* from Kerguelen. It forms a lobate flattened process in the latter, and nearly reaches the base of the ocular peduncles. On the other hand, in the British specimens it is only a small papilla, touching the base of the lateral cephalic swelling. It appears to be the rudiment of a scale-bearing process. The ridge from which the tentacle arises extends backwards in the middle line, and at the posterior border of the head it bends outward on each side to bear the papilla, viz., the modified scale-bearing process. The papillæ of the facial tubercle are more lobate than in *L. producta* from Kerguelen, and proportionally less elongate. The palpi are, so far as the specimens go, less powerful than in *L. producta* from Kerguelen, but the difference in regard to the papillæ or spikes is small. Both have numerous papillæ as in *L. filicornis*. All that can be said is that perhaps they are a little more numerous towards the tip of the palpi of *L. producta* from Kerguelen. The tentacular cirri are somewhat longer than the tentacle, and their tips are rather more elongate than in *L. filicornis*, while they are shorter than in *L. producta* from Kerguelen.

The segmental papillæ begin on the posterior face of the fifth foot, and extend to the thirty-eighth. They form flattened processes somewhat more distinct than in *L. producta* from Kerguelen. Besides, in the latter form they begin on the tenth foot, and extend to the thirty-ninth.

The papillæ of the proboscis (Plate XXXVII, fig. 3) have broader tips than those of *L. filicornis*, and are less regularly dichotomous. The tips are sometimes divided into three, and occasionally are ovate, clavate, or irregularly lobate. There is not much ground for calling the thickened regions of this organ parts representing maxillæ, as Grube does.

No specimen is in a condition to give a reliable opinion of the arrangement of the dorsal spines. The papillæ bearing them are a little more prominent than in *L. producta* from Kerguelen, but this may be due to their condition, for they have evidently been subjected to considerable hardships. They probably spread, in the scale-bearing feet, over the dorsum as in the forms from Kerguelen, the feet carrying cirri having dense groups of more slender bristles.

The structure of the first two feet agrees with that in the form from Kerguelen. The other feet are also similar in structure. The tips of such of the long dorsal spines as were present agreed with the figure (Plate XXXVI, fig. 4), which shows a spine slightly turned to the left, four recurved fangs occurring on each side, besides the point at the base of the spear-like tip. The ventral bristles (Plate XXXVI, fig. 5) conform mostly to the type of *L. producta*, var. *Wyvillei*, having somewhat stiffer (stouter) basal bristles and numerous slender distal ones.

In describing this form in the Annelids of the 'Challenger,' I for some time had the varieties ranged under separate species, distinguished by certain evident characters.

The reticulate cordate structure of the scales is very well marked (apparently better than in any other species), forming a series of wavy lines like those on the sand of the sea-shore.

No parasitic Loxosomæ occur on this form, yet foreign varieties abound with them, such as *L. producta*, var. *benthaliana*, on which the remarkable new gymnoblastic hydroid, *Stylactis vermicola*, described by Prof. Allman, occurs on the under surface of the scales of this inhabitant of the depths (2900 fathoms) of the North Pacific.

The species was first procured by Prof. Haddon during the Royal Dublin Society's Survey, on a bottom of sand and gravel at a depth of 500 fathoms, fifty-four miles off

Achill Head, and recognised by Miss Florence Buchanan,[1] who thought it had hitherto been procured only at Kerguelen; but it and its varieties have a much more extensive range, even to the shores of Nova Scotia, near Halifax. The varieties described in the 'Challenger' were devoid of eyes in the preparations, as this also is.

Genus VII. HERMIONE, *Blainville*, 1828.

Cephalic lobe with a single tentacle and two palpi. Peristomium bears bristles and two long cirri. Pedunculated eyes fixed to the margin of the cephalic lobe; maxillæ absent or small (thickened processes). No dorsal felt. Elytra alternating with dorsal cirri. Dorsal and ventral divisions of the feet distinct. Elytra-bearing feet with glochidiate dorsal spines, and a tuft of strong bristles over the elytra. Ventral bristles bidentate.

The pregastric and intestinal cæca are shorter than in *Aphrodita*, and even than in *Lætmatonice*, but they have large terminal dilatations. The latter are shorter than in *A. aculeata*. The lateral cæca do not approach the median line as in *Lætmatonice*. Segmental papillæ from the eighth to the twenty-ninth foot. Nerve-cords closely applied and flattened.

HERMIONE HYSTRIX, *Savigny*, 1820. Plate XXIV, fig. 7.

Specific Characters.—Head broad; each ocular peduncle bearing two eyes; facial tubercle with globular or slightly ovate papillæ. Body elongate-ovoid. Segments thirty-two to thirty-three. Elytra somewhat reniform, furrowed by divergent and transverse lines, and having large rounded cells. Dorsal spines glochidiate, with three fangs on each side; ventral bristles with a spur, and, in the anterior part of the body, accessory spikes above it. The tip of the bristle is curved.

SYNONYMS.

1818. *Halithea hystrix*, Lamarck. Hist. des An., s. v, vol. v, p. 307.
1820. ,, ,, Savigny. Systèm. des Ann., Descr. de l'Égypte, t. xxi, p. 345.
1823. ,, Delle Chiaje. Memorie, vol. i, p. 181, tav. iv, f. 10, 11.
1826. ,, *hystrix*, Risso. L'Europ. Mérid., p. 413.
1828. *Hermione hystrix*, De Blainville. Dict. des Sc. Nat., 'vers,' p. 457, pl. ix, f. 2.
1834. *Aphrodita hystrix*, Aud. and Ed. Ann. des Sc. Nat., vol. xxvii, p. 406, tab. vii, f. 1—9; and Annélides, p. 70, pl. i, f. 1—9.
,, ,, ,, Cuvier. Règn. An., vol. iii, p. 207.

[1] 'Sc. Proceed. Roy. Dubl. Soc.,' vol. viii, pt. 2, No. 15, p. 169, 1893.

1836–7. *Hermione hystricella*, De Quatref. Reg. an. illust., pl. xix, f. 1
1840. " *hystrix*, Grube. Actin., Echin., u. Würmer, p. 88.
" *Aphrodita hystrix*, Johnston. Ann. Nat. Hist., iv, p. 370, v, f. *a—e*; and x, p. 305.
1842. *Halithea hystrix*, Delle Chiaje. Descrizione, pp. 57 et 105, tav. lviii, f. 10.
1843. *Aphrodita hystrix*, Oersted. Ann. Danic. Consp., p. 11.
1851. " " Grube. Fam. der Annel., p. 36.
1856. " " Thompson. Fauna of Ireland (partim ?), p. 273.
1857. " *mediterranea*, O. G. Costa. Fauna d. Reg. d. Napoli, Annel., p. 8, tav. ii, f. 1—1c.
" *Hermione hystrix*, O. G. Costa. Annel. di Napol., p. 5, Tav. i, f. 11—14, and Tav. ii, f. 1.
1858. " " Kinberg. Fregatt. Eugen. Resa, p. 4, tab. 2, f. 1.
" " *hystricella*, Kinberg. Ibid., p. 5, tab. 2, f. 1.
1861. *Aphrodita hystrix*, Danielssen. Nyt. Mag. f. Naturvid, Bd. xi, p. 19.
1864. " " Grube. Die Insel Lussin, &c., p. 77.
1865. *Hermione hystrix*, De Quatref. Hist. nat. d. Annel., vol. i, p. 206, pl. vi, f. 9—14.
" " *Kinbergi* (?). Ibid., p. 209, pl. vi, fig. 16.
" " *hystrix*, Baird. Proceed. Linn. Soc., vol. viii, p. 178.
" " " Johnst. Cat. Brit. Ann., p. 106, pl. ii, f. *a—e* (a repetition of former).
1868. " " Claparède. Annel. Chétop. d. Nap., p. 48, pl. i, f. 2.
1875. " " Marion and Bobretzky. Ann. Sc. Nat., 1875, p. 3.
1884. " " V. Carus. Faun. Med., p. 199.
1886. " " Harvey Gibson. Vermes Liverp., p. 147.
1888. " " De Saint-Joseph. Ann. d. Sc. nat. (7), vol. v, p. 146.
1890. " " Malaquin. Ann. Boulon., p. 11.

Habitat.—A southern form,[1] abundant at a depth of fifteen to twenty fathoms off St. Peter Port, Guernsey, amongst débris of shell-gravel, dead oyster- and mussel-shells, and occasionally at various parts of the southern coast of England and Ireland. It is common in the Mediterranean. The German exploring ship 'Gazelle' procured it at Soleton Bank. It ranges to eighty fathoms.

On the whole it is partial to shell-débris, gravel, and similar regions, and thus frequents rougher ground than *A. aculeata* (Hornell).

The smooth head (Plate XXIV, fig. 8) is rounded, and the posterior fillet which bounds it is considerably overlapped in the preparations by the peduncles of the first scales. This fillet appears to bear no papilla or homologue of the scale-peduncle externally. The median ridge which runs forward to and ends in the base of the tentacle is slightly marked. The ovoid lateral swellings are more prominent than in *Laetmatonice filicornis*. The ocular peduncles are somewhat clavate, with rounded tips, and each has dorsally a well-marked black eye, and just in front of it a larger one looking forward and downward. The facial tubercle has numerous globular or slightly ovate papillæ—a few being longer (elongate-ovate).

All except the basal region of the palpus is "ciliated" with spike-like papillæ as in the foregoing species, this being a character apparently subject to little variation. The tentacle, the base of which possesses scattered globular papillæ, has a peculiarly crenate outline, slightly enlarged at the tip, and with the clavate terminal process (Plate XXXVII,

[1] The notion that it occurs "all over the British area" (Dr. Benham) does not accord with our experience. It is a southern form.

fig. 5). The tentacular cirri are similar. The dorsal cirri increase in size, but have the same structure. In all these, minute rounded glands (like papillae) are dotted over the granular layer of the epiderm, and may be associated with sensation. They are quite beneath the cuticle, which is somewhat dense. At the tip or bulbous part of the appendix the cuticle is thin, so that the nervous expansion comes close to the surface.

Body.—About two inches long, large specimens being two and a quarter inches (De Quatrefages), and is covered dorsally by the fifteen pairs of scales, which largely overlap. They vary in tint from pale to dark brown, with a slightly iridescent purplish sheen, and are firmly fixed by their pedicles near the middle of the external border. Under a moderate power they present a fibrillar or cordate structure, and the exposed surface has a series of minute papillae, the anterior region alone being devoid of them. The edge is smooth. The first pair are small, and have the scar for the attachment of the pedicle near the centre. They again diminish posteriorly, but the structure remains the same. The Mediterranean forms are generally darker than those from the Channel Islands.

The ventral surface of the body is covered with a firm cuticle studded with minute papillae, which are slightly brownish, especially on the feet at the commencement of the posterior third. Anteriorly the buccal fold forms a broad, rounded, finely grooved flap, diminishing to a nearly cylindrical ridge posteriorly. The minute papillae are numerous on the edges of the buccal fold. A median and two lateral ridges flanked by the feet characterise this surface, as in allied members of the group.

The segmental papillae commence on the eighth foot, and continue to the twenty-ninth, that is, about the fourth foot from the tip.

The papillae of the proboscis are, like the others, somewhat dichotomous in their division (Plate XXXVII, fig. 4), the tips of many of the processes being broadly and more or less symmetrically lobate, or having a process at one side so as to be pedate. They seem to be flattened, and thus in the preparations do not readily separate from each other. They differ much in outline from the same processes in *Laetmatonice filicornis*.

The dorsum is flanked by the lustrous brown spines (Plate XXXVI, fig. 11), which are directed backwards and slightly outwards. In some views they are brownish, while in others they have a rich golden sheen. Anteriorly the granular spines stand upwards with the curve directed towards the middle line, the inner bristles spreading over the dorsum. The lateral brush, again, on the cirrus-bearing foot is directed outwards and with a backward curve. As soon as the long spines become prominent the pedicle for the scales causes a radiate arrangement of the stiff tapering bristles (Plate XXXVI, fig. 9), which spread over the dorsum and meet those of the opposite side in a symmetrical and graceful manner. The outer bristles of this series are more erect; the inner are adpressed, so as to guard the scales. These bristles are of a rich golden colour, with pale tips.

Three recurved fangs, as a rule, occur on each side of the tip of the spines (Plate XXXVI, figs. 12, 14, and 15), besides the smaller pair at the angle of the spear-tip. They are more nearly opposite (though the last two are not so) than in *Laetmatonice filicornis*.

Feet.—The first foot has pale, simple bristles, the tufts being directed forwards and inwards, and the basal portions of the tentacular cirri are warty like the tentacle.

The second foot has dorsally a tuft of pinnately spinous bristles as in the other members of the group, for instance, *A. aculeata*,—little variation occurring in the species. In the ventral branch are two bristles (Plate XXXVII, figs. 6 and 7), an upper with a strongly spinose edge above the powerful tooth, and a lower with indications of four spines, viz. the usual powerful inferior one, the somewhat less spine above it, and indications of two others beyond, the last being slightly developed. The foot has numerous globular papillæ on its surface.

The third foot, which carries a cirrus, has dorsally and internally a series of powerful bristles minutely nodular (Plate XXXVI, fig. 9), and with a well-marked curve, while externally a group of smaller forms of a similar kind occurs. This nodular development on the surface is peculiar, and forms a swelling below the tip as if it were a secondary development. The prominent granules or minute nodules are not affected by potash. The ventral division has often stout bristles with the spinose tips above the powerful fang, as shown in Plate XXXVII, figs. 6 and 7 before mentioned; but in some the spines above the fang are only four in number, while in others they are eleven. At the ventral edge of this division of the foot are numerous pinnately spinous bristles, as indicated in the dorsal division of the second foot.

In the fourth (a scale-bearing foot) the dorsal bristles are still curved, and occasionally minutely nodular, but much longer than in the third, and the tips of some are shaped as in the hooked forms. A few shorter and straighter spines occur externally. Ventrally the powerful bristles still show spinose tips, but the spines above the inferior fang are diminishing in number, one having only two.

The fifth (likewise a scale-bearing foot) has dorsally the somewhat broad, granular bristles, the tips of the amber-coloured ventral still having spines, the number of the latter above the great fang from above downwards in the three bristles present in the example being two, three, five.

The sixth foot (cirrus-bearing) has dorsally short, curved, and slightly granular flattened bristles dorsally and internally; externally a shorter and more slender form of similar character. Ventrally three bristles occur, with two, two, and three spines above the great fang.

The seventh foot has numerous curved, granular bristles dorsally, besides the spines, some with greatly elongated tips, which, moreover, are somewhat hastate. On the ventral bristles only two spines in all are present above the fang.

In the eighth foot (cirrus-bearing) the dorsal bristles are curved and granular, with a tuft of longer and more slender bristles to the exterior (below the cirrus). The three ventral bristles had each two spines above the fang. The segmental (nephridial) papilla begins on the posterior border of this foot, completely hidden in the fissure between it and the next foot.

Dorsally in the ninth foot were numerous curved granular bristles with somewhat blunt tips. Beyond these stretch the long characteristic brown spines with the glochidiate tips. Ventrally the three bristles have from above downwards one spine above the fang, two and one. Their shafts are strongly grooved.

The tenth (a cirrus-bearing foot) has dorsally the shorter curved granular spines, and the shorter and more slender bristles externally. Ventrally are three bristles having above the fang respectively two, one, two spines.

The thirteenth foot has dorsally scales and spines. Ventrally three bristles, the hooks above the fang being respectively one, two, one.

The fifteenth has scales and spines. Ventrally the two bristles have one spike each above fang.

The twentieth foot (cirrus-bearing) has longer and more tapered dorsal bristles, the granules on which are less distinct, especially in the tapered forms. The shorter, broader forms show the granules distinctly. Ventrally the three powerful bristles have only the great fang. A typical foot is shown in Plate XXXVI, fig. 13.

The terminal feet have dorsally the granular bristles more pointed and less curved than in front, moreover the tips are smooth; while ventrally the tips are more elongated, and have numerous spines above the great fang. One of the smaller forms is × 90 in Plate XXXVII, fig. 8. The ventral bristles of this form are much stouter than in *Lætmatonice filicornis*.

This species is specially subject to the attacks of *Loxosoma*, which occurs abundantly on the ventral surface and cirri, on the feet, mouth, and other parts. Parasitic algæ often grow on the bristles and spines, with mud, sponge-spicules, and other débris entangled. A remarkable hydroid creeping along the bristles is also present. Hydroids and Polyzoa, indeed, are not uncommon.

In habit this species appears to correspond with *Aphrodita* and *Lætmatonice*.

Reproduction.—The ova were well advanced in July in those from Herm and other parts of the Channel Islands. Lo Bianco found the Neapolitan examples with developing ova in October, and increasing in size in November.

An interesting account of the development is given by Dr. R. von Drasche,[1] of Vienna, from observations made at the rich Marine Station of Trieste. He found the ripe forms in October and November, the latter month being probably that in which deposition of the eggs generally takes place. The egg measures 0·2 mm., and he watched it through all the stages of segmentation till the embryo moved within the capsule by aid of cilia. It then issued as a pear-shaped trochosphere, with an equatorial circlet of cilia and a tuft in front; while a solid mass of deutoplasm occurred in the middle of the body. The violet-coloured larva soon acquires another ring of shorter cilia behind the first or pre-oral, an anal ring of cilia appears, and it swims about actively. Two red eyes are developed in front. The anterior end becomes triangular, and a characteristic broad cellular collar lies behind the eyes—the mouth, with a tuft of cilia, opening towards (in front of) its posterior border ventrally. On the fourth day the larva has increased in size, and the yolk-mass has concentrated into a covering for the alimentary canal. On the under surface of the snout are five small papillæ—organs, however, not homologous with the cephalic processes of the adult. There are now three segments with bristles. On the sixth day it is still larger. The alimentary canal is complete. The equatorial belt is smaller. There are five segments. The feet show a large yellow spine and bristles, the latter having a structure conformable to the adult type, though the glochidiate forms

[1] 'Beitr. z. Entwickelung d. Polychaeten,' pp. 7—11, Taf. ii, f. 8—20; and Taf. iii, f. 1—4, 1885.

are not yet present. Besides the structures mentioned, the young *Hermione* has now three pairs of eyes, and a process (first foot) behind the collar.

Savigny (1820) first distinguished the species, though his description is by no means diagnostic.

Delle Chiaje (1823) refers to the condition of the alimentary system in speaking of the anatomy of *Pleurophyllidia*, and gives a figure of a moribund example in his 'Memorie.' He thought the papillæ of the proboscis were taste-organs. He shows the globules of the blood. In his 'Descrizione' he mentions its common occurrence at Naples, and reproduces the plate from the 'Memorie.'

The *Aphrodita hystrix* mentioned by Oersted[1] probably refers to *Laetmatonice*.

Kinberg (1858) followed De Quatrefages in making two species, viz. *H. hystrix* and *H. hystricella*; but so far as can be ascertained this distinction rests upon variation, and Claparède was of the same opinion.

De Quatrefages (Annelés) saw in a male *Hermione hystrix* the spermatozoa issue in the form of a white thread at the base of the inferior branch of the foot of the nineteenth segment. They probably escaped from the segmental papilla between the feet. This author distinguishes between his *H. fallax* and this species by the fact that the median antenna in *H. hystrix* is least, and that the bristles of the scale-bearing feet have the points unarmed, while those of the inferior feet are tridentate (instead of the tips straight and the inferior bristles bidentate as in *H. fallax*). The bristles of the ventral division have curved apices, whereas in *H. hystricella* from the Mediterranean, &c., these are straight, and Kinberg says so also.

Claparède[2] has already pointed out that De Quatrefages was wrong in thinking that absolute reliance was to be placed on the number of the denticles at the tip of the spines or of the ventral bristles, and he also showed the condition generally of the anterior feet in contrast with the posterior. He enters into the uses of the guard for the tips of the long dorsal spines, and demonstrates that a process also appears in the developing ventral bristles before they pierce the surface. He alludes to the granular bristles, which had previously been described by Johnston and Kinberg, and points out the nature of their tips, with the swollen part beneath the point, as shown in one of the present figures. He mentions having found in a single example a long, simple bristle in the ventral division of the foot, probably a pathological phenomenon. He speaks of the warts on the surface, already mentioned by Pallas, Johnston, and Kölliker. He likewise alludes to the structure of the peritoneum, and that of the dorsal cirri.

Grube (1874) says De Quatrefages relegated *Hermione hystrix* to the Mediterranean and *H. fallax* to the Atlantic.

Prof. Jourdain,[3] in his account of the histology of the integument and sensitive appendages of this species, describes the irregular polygons formed by the cells of the epithelial coat, the nerves which ramify in it, and the thinly distributed nerve-cells. On the ventral surface, the warts, of which Claparède had formerly given a figure, have a central pore, through which communication with the granular layer of the epidermis

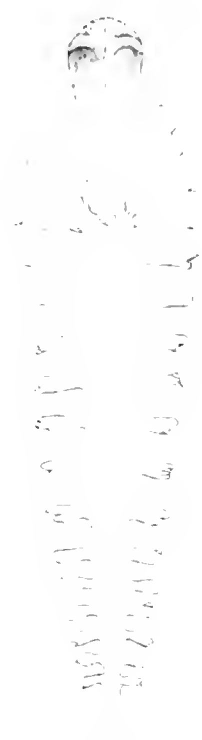
[1] 'Annulat. Danic. Consp.,' p. 11, 1843.
[2] 'Ann. d. Golfe d. Nap.,' p. 50, 1868.
[3] 'Archives Zool. Expériment.' 2e, vol. v, p. 91 (1887), pls. iii and iv.

occurs, and by which the nerve-supply to the cells and protoplasmic contents of the sensitive organs takes place. He also notes that the muscular fibres show no striæ, either transverse or longitudinal, and that the elytra, after Haswell's description, have a double cuticle superiorly and inferiorly, two layers of cells, and an intermediate fibrous layer. They contain no cavity, but have a nervous plexus. They are evidently organs of considerable sensibility. Amongst other interesting points he refers to the nerve-supply of the palpi and dorsal cirri with their ganglia near the base of the terminal division, the nerve-trunk in each breaking up into a tuft of cells in this region.

Family III.—Polynoidæ.

Body more or less elongate; no facial tubercle, convex cephalic lobe; the base of the tentacle arising from the middle anteriorly; two lateral tentacles; four eyes; palpi elongate. Peristomium, bearing the first foot, with long dorsal and ventral cirri, and the ventral cirrus of the next segment long. Pharynx exsertile, muscular,

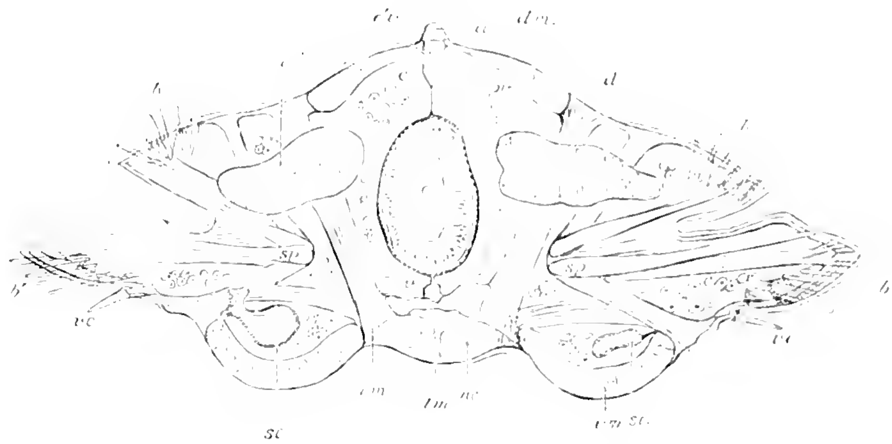
Fig. 19.



Alimentary apparatus of *Harmothoë imbricata*.—A. W.

cylindrical, with papillæ round the margin; horny jaws. Intestinal cæca shorter than in the *Aphroditidæ*, slightly branched; first foot bearing only a few minute bristles conforming to the dorsal type. Scales twelve to thirty-five pairs or more; segments carrying these devoid of cirri. Segmental organs (nephridia) opening ventrally on a papilla near the bases of the feet; nerve-cords within the granular layer of the epiderm and between the oblique muscles. Dorsal bristles with more or less tapered simple tips; ventral bristles with simple or bifid hooked tips. Development by trochophores. The general arrangement of the body-wall in this family may best be understood by consulting the accompanying figure.

FIG. 20.



Section of body-wall of *Polynoë scolopendrina*, Sav., in the line of a median dorsal papilla (*cr*), about the middle of the body. *b*, bases of dorsal bristles; *b'*, bases of ventral bristles; *c*, ova scattered in the various parts of the perivisceral (cœlomic) space (*pv*); *d*, intestine; *d'*, portions of intestinal cæca; *dm*, dorsal longitudinal muscles; *lm*, band of longitudinal muscular fibres above the nerve-area; *om*, oblique and nearly vertical muscles; *vm*, ventral longitudinal muscles; *nc*, nerve-cords; *dv*, dorsal vessel with mesenteries at side; *v*, ventral vessel with mesenteries; *vc*, ventral cirrus; *so*, segmental organs (nephridia). The dorsal cirrus is not shown, nor the perivisceral corpuscles. The drawing was made by Dr. Masterman from a somewhat contracted example.

Many authors, such as Audouin and Milne Edwards, Johnston, Œrsted, Grube, De Quatrefages, and Marenzeller, following Savigny, regarded the Polynoidæ as one or more genera of the family Aphroditidæ.

Kinberg, on the other hand, gave them the position of an independent family, or indeed two, if we include *Iphione*, with the characters indicated in the subsequent summary. In this he was followed by Malmgren and Théel. Claparède, again, varied the latter arrangement a little by making them his second Tribe, an equivalent position.

Savigny (1820) placed the Polynoidæ as a genus of his family Aphroditæ under the Nereids, the general characters being the oval or oblong body, with its elytra, which were typically a dozen pairs, branchiæ (which he says are easily recognised), head and its median unpaired, and external antennæ, four eyes, and armed papillose proboscis. With the exception of the remarks on the branchiæ his description is fairly good.

By Audouin and Milne Edwards (1834) the Polynoidæ were distinguished from the Aphroditidæ by the number of their antennæ, by the armature of the proboscis, and by the alternation of scales with cirri. Some have large scales completely covering the dorsum, others have them so minute as to leave the dorsum more or less bare, and in some cases they are vesiculate. The antennæ are five or rarely four; proboscis armed with large jaws. The simple branchiæ occur with the cirri. The first pair of feet terminate in long tentacular cirri; the appendages of the last segment form styles. They frequent banks of oysters, and some construct mucous tubes with fragments of shells. Some are phosphorescent. They described thirteen species of the genus.

The Polynoidæ were included by Kinberg (1857) under his third family, Polynoina. His diagnosis was:—Elongated body; no facial tubercle; convex cephalic lobe with the base of the tentacle from the middle anteriorly; two antennæ; four eyes; palpi thick. Pharynx exsertile, cylindrical, without long papillæ; horny jaws. Scales twelve to thirty-five pairs. Segments bearing elytra devoid of cirri. He gave six genera, viz. *Lepidonotus*, *Halosydna*, *Antinoë*, *Harmothoë*, *Hermadion*, and *Polynoë*, the second, third, fourth, and fifth being new.

Michael Sars (1860) reviewed the condition of the Polynoidæ, as shown by Œrsted and the subsequent writers up to date, and gave a list of the northern examples with new species, viz. *P. nodosa*, *P. asperrima*, *P. rarispina*, and *P. scabriuscula*.

De Quatrefages (1865) described the Polynoidæ as having a very distinct head, furnished with three antennæ and four eyes. The buccal segment is characterised by the presence of two pairs of tentacles, the superior being bifurcate, the much longer and larger inferior, simple. The feet are more or less biramous, but the setigerous processes are united to a common base. Elytra alternating with superior cirri, and covering the back throughout. Proboscis armed with two pairs of horny jaws.

In his remarks on the tribe of the Polynoidæ Claparède (1868)[1] criticises the great increase in the genera caused by Kinberg and Malmgren. Thus the former subdivided the genus Polynoë of Savigny into six, taking as his basis of classification the position of the lateral antennæ; the number of the scales; the fact of their covering more or less of the dorsum; and the length of the body. Malmgren again augmented the number of the genera by nearly as many more as Kinberg, so that the original genus of Savigny was multiplied nearly twenty-fold. Claparède points out that the objections of Sars to the methods of Kinberg apply equally to those of Malmgren, because he not only employs the same elements in classification, but adds others of less value, such as the structure of the terminal parts of the ventral bristles. He shows that, for instance, the same species of *Syllis* presents features which would appear to subvert the reliance to be placed on this method, since the compound bristles are often replaced by simple bristles. There is, however, more in the systematic study of the bristles than Claparède imagined. Claparède grouped the Polynoidæ as one of the Tribes of his family Aphroditiens, Sav. (*sens str.*).

In his supplemental volume he correctly indicated, under *Hermadion fragile*, the position of the nephridia and their function as channels for the extrusion of the reproductive elements.

Grube, in his 'Annulata Semperiana,' gave the following description of the genus *Polynoë*. Body oblong or elongated, flattened and vermiform; segments more or less numerous, second, fourth, fifth, and every alternate segment to the twenty-third bearing elytra, the intermediate ones having cirri. The segments after the twenty-third have scales on every third foot or they are absent, rest bear cirri. Cephalic lobe rounded, more or less bipartite; two pairs of sessile eyes, three tentacles, two subtentacles (palpi). Buccal segment with two tentacular cirri, no setæ; two bundles of bristles and two cirri.

[1] Ann. Nap.

Ventral cirrus twice as long as pinna, setæ simple, two anal cirri. Elytra covering dorsum or leaving it bare. Pharynx with a crown of simple papillæ. Jaws horny, not denticulated. He grouped the species chiefly according to the arrangement of the tentacles, the number of the elytra and their structure, with a few additional particulars. The account is thus more detailed than that of 1871.

G. Darboux[1] fils distinguishes in the dorsal cirrus the cirrophore and the cirrostyle. The former is an evagination of the entire musculo-cutaneous envelope. The cirrostyle is inserted on the cirrophore by a delicate epidermic membrane. A secretion, he says, fills a glandular pocket at the insertion and causes a strain so that rupture ensues.

Whether as a family or a sub-family the Polynoidæ are sufficiently distinguished from the Aproditidæ by the shape of the body, the absence of a facial tubercle, the diminished size and the chitinous armature of the proboscis, the reduction in size of the alimentary cæca, and the position of the segmental (nephridial) papillæ.

They are cosmopolitan forms, yet each area has its characteristic species. Thus in Britain such as *Eupolynoe anticostiensis*, McI., *Melænis Loveni*, Mgrn., and *Eucranta villosa*, Mgrn., are absent, while they are found in more northern latitudes.

Commensalism is not uncommon in the group; thus Dr. Baird found *Harmothoe cirrata* (?) in the tubes of *Chætopterus*, *Gattyana cirrosa* is common in the tubes of *Amphitrite*, *Polynoë scolopendrina* in tubes of *Terebella nebulosa*. *Malmgrenia* and *Acholoe* occur on *Echini* and starfishes (*Astropecten*), and *Harmothoe* in *Euplectellæ*. Dr. Baird notes that Mr. Lord found at Vancouver's Island a *Lepidonotus* coiled under the foot of a *Fisurella*, and another on a starfish. Verrill,[2] again, mentions an orange-red *Polynoe* which occurs amongst the tentacles of the anemone, *Bolocera Tuediæ*, and another species with a dark purple proboscis and finely spinulose scales is very abundant among the branches of *Acanella Normani*. Dr. H. J. Johnson adds two species to the forms living as commensals, viz. *Polynoë reticulata*, in tubes of *Amphitrite* and *Thelepus*, and *P. gigas* in an *Amphitrite*, both from the Pacific coast of California.[3]

Genus VIII.—LEPIDONOTUS[4] (*Leach*, 1816), char. emend.

Body short, more or less linear. Anterior part of the cephalic lobe produced into the bases of the median and lateral tentacles. Palpi smooth or with papillæ in five longitudinal rows. Three comparatively short alimentary cæca directed forwards into the peri-pharyngeal space. Elytra, twelve pairs, covering the dorsum entirely, and occurring in segments bearing feet thus: 1, 3, 4, 6, 8, and so on to 20, 22. Bristles of the superior lobe slender, serrate, shorter than the inferior, which have a smooth portion below the slightly hooked tip, and then a spinulose region beneath. Nerve-trunks in the granular layer of the epiderm, between the powerful oblique muscles.

[1] C. R., 126 (1878), pp. 257–8.

[2] 'Albatross' Explorations, 'U.S. Fisheries Report,' 1885, p. 525.

[3] 'Proceed. Calif. Acad. Sc.,' 1896, 3rd ser., vol. i, No. 5, p. 170, &c.

[4] Kinberg (op. cit., 1857) gives as a diagnosis of the genus:—"Anterior part of the cephalic lobe produced into the bases of the tentacle and antennæ; pharynx with papillæ; jaws; elytra covering the dorsum entirely; body short." Nothing special can be made out of his remarks on the jaws and tentacular cirri.

1. Lepidonotus squamatus, *Linnæus*, 1788. Plate XXV, fig. 1.

Specific Characters.—Lateral tentacles longer than the cephalic lobe, median tentacle, tentacular cirri, buccal and dorsal cirri inflated below the apex, smooth. Palpi elongated and tapering, but in spirit scarcely longer than the median tentacle, the basal part of which equals the length of the cephalic lobe. Scales ovate and reniform, studded with chitinous bosses and ciliated on the outer margin. Bristled segments twenty-six. Dorsal bristles long, tapering, and finely serrated, longer than those of *L. clava*. Ventral bristles stout, with a short series of spikes on the distal and slightly thickened portion of the shaft below the falcate apex. The distal row has two longer spines. Ventral nerve-cords comparatively small, lying within the dense cuticle and thin granular layer of the epiderm, and in the area between the attachments of the oblique muscles; only connective tissue internally.

Synonyms.

1766. *Aphrodita squamata*, Linn. Syst. Nat., 12th edit., p. 1084.
1788. „ „ „ „ Gmelin p. 3107.
1765. „ „ Baster. Opusc., subsec. ii, 2, p. 66, tab. vi, f. 5, A, B, C, D.
1766. „ „ Pallas. Misc. Zool., p. 91, tab. vii, f. 14 *a*—*l*.
1768. „ „ Pennant. Brit. Zool., iv, tab. xxiii, f. 26.
1776. „ *punctata*, O. F. Muller. Prod. Zool. Dan., p. 218, n. 2642.
1789. „ „ Abildgaard. Zool. Dan., iii, p. 25, tab. xcvi, f. 1—4.
1800. *Die getüpfelte Aphrodite*, O. F. Muller. Naturges einiger Wurm-Arten, p. 170, tab. xii.
1816—1830. *Aphrodita squamata*, Cuvier. Dict. des Sc. Nat., ii, p. 283.
1820. *Polynoe squamata*, Savigny. Syst., 22.
1828. *Eumolpe squamata*, Blainville. Dict. des Sc. Nat., lviii, p. 458, pl. ix, f. 2.
1834. *Polynoe squamata*, Aud. & Ed. Annél., p. 80, tab. i, f. 10—16.
1839. „ „ Johnston. Ann. Nat. Hist., ii, p. 432, tab. xxii, fig. 1.
1840. „ „ Grube. Actin. Echinod. u. Wür., p. 87.
1843. *Lepidonote punctata*, Œrsted. Annul. Danic. Conspect., p. 12, f. 2, 5, 39, 41, 47, 48.
„ *Lepidonotus squamatus*, H. Rathke. Beiträge z. Faun. Norweg., 149.
1851. *Polynoë squamata*, Maitland. Fauna Belg., p. 213.
1855. ? *Lepidonote armadillo*, Leidy. Mar. Invert. Rh. Is. & N. J., p. 16, pl. ii, f. 54.
1858. *Lepidonotus squamatus*, Kinberg. Freg. Eugen. Resa, p. 13, tab. iv, f. 15.
1860. *Polynoe squamata*, Sars. Vid.-Selsk., Forhandl. for 1860, p. 4 (sep. copy), 57 (original copy).
1865. *Lepidonotus squamatus*, Johnston. Cat. B. M., p. 109, pl. viii, f. 1.
„ „ Malmgren. Nord. Hafs. Ann., p. 56.
„ *Polynoë dasypus*, De Quatrefages. Hist. Ann., i, p. 266.
1873. *Lepidonotus squamatus*, Willemoes-Suhm. Zeitsch. f. w. Zool., xxiii, p. 347.
„ „ „ Verrill. Invert. An. Vin. S., Rept. U. S. Fish., i, p. 581, pl. x, f. 40, 41.
1874. „ „ Möbius. Untersuchung. d. Ostsee, p. 112.
„ „ „ McIntosh. Ann. Nat. Hist., April, 1874, p. 261.
1875. „ „ McIntosh. Invert. and Fishes St. And., p. 115.
1877. „ „ Huxley. Man. Invert., p. 227, &c.
1879. „ *squamata*, Webster. Annel. Chaet. Virgin., p. 4.
„ „ *squamatus*, Tauber. Ann. Danic., p. 79.

1883. *Lepidonotus squamatus*, Levinsen. Nord. Annulat., p. 194.
1884. „ „ Webster & Benedict. Ann. Mass., p. 699.
„ *Polynoe squamata*, A. G. Bourne. Trans. Linn. Soc., Zool., ii, p. 349, &c.
1886. *Lepidonotus squamatus*, Harvey-Gibson. Verm. Liverp., p. 150.
1888. *Polynoe squamata*, De Saint-Joseph. Ann. d. Sc. Nat. 7, v, p. 151.
1890. *Lepidonotus squamatus*, Malaquin. Ann. Boulon., p. 15.
1896. *Polynoe squamata*, H. P. Johnson. Pacific Annel., p. 166.

Habitat.—Everywhere round British shores, from Shetland to the Channel Islands, under stones between tide-marks, and stretching to the laminarian and coralline regions beyond, as well as to comparatively deep water (fifty fathoms), where it is partial to crevices in old shells, especially univalves covered with coils of Sepulæ, and the bottoms of stones. It is common in the stomachs of the cod and other fishes, and is frequently tossed on shore after storms along the east coast, as at St. Andrews. It extends across the Atlantic to the Canadian and American waters—from the St. Lawrence to Cape Cod, and passes as far south as the Azores, off which (Fayal) it was dredged at a depth of 450 fathoms in the 'Challenger.' In the north it ranges from Greenland to the Norwegian and Western European coasts, and Gould includes it in his list from the shores of Massachusetts.

Length about 25 mm.; more rarely 50 mm.

Head (Plate XXV, fig. 2) broadly ovate or rounded, bounded posteriorly by the fold of the nuchal plate, and anteriorly running into the bases of the median and lateral tentacles. It is smooth, iridescent, purplish pink, has a longitudinal median furrow, and bears on its dorso-lateral margins the four black eyes, the first and slightly larger pair of which are rather in front of the middle line, and the second towards the posterior border. Anteriorly the base of the median tentacle occupies the centre, and is distinguished from the smaller bases of the lateral tentacles, conjoined with it, by the arrangement of the dark pigment which forms a **V** with the point posteriorly. The median tentacle is considerably longer than the lateral, all having the bulbous and more deeply pigmented region below the pale filiform tip. Beyond the ceratophore the column is opaque, whitish, toned off gradually to the dark ring at the enlargement. The tentacular cirri are similar in structure but more slender. All these organs and the palpi are smooth. In life the latter (palpi) are longer than the median tentacle. Moreover, the first foot (basal process of the tentacular cirri) bears on its inner edge towards the front a tuft of six or seven slightly curved and tapered spinous bristles. These are shorter and thicker than the ordinary dorsal bristles. They are thus apparently more numerous than in *L. clava*. The small size of all the appendages of the head is a distinctive character when contrasted with the latter species.

Body of about twenty-six bristled segments. Dorsum smoothly rounded, with three or four bars in each segment, at the sides of which are soft elevations upon which the scales are placed, or which bear cirri at their external borders, the former being more prominent than the latter. The dorsum is pale, but between the elevations for the last pair of scales posteriorly a brown central patch occurs, while the segment behind presents a median, blunt, spear-head of brown, and a lateral ocellate arrangement, the whole being symmetrical. In the preparations the rigid contraction of the longitudinal ventral muscles divides the surface into a median and two lateral regions, the former having the furrows of the segments from side to side, the latter only at the edges, as the muscular region is smooth. In some the dorsum is rendered dull ochreous by a deposit of this colour in the grooves, the ridges being pale, and the same ochreous coating is found on the under surface and inner edge of the scales. A solution of potash makes no change, but dilute hydrochloric acid slowly removes the deep orange colour and renders the granules invisible.

Posteriorly the body terminates in two symmetrical basal processes which bear cirri longer than on other parts of the body, but having the same structure and coloration. The anus is a small aperture (especially when contrasted with that of *L. clava*) opposite the posterior border of the penultimate pair of feet.

Proboscis.—The exserted proboscis shows a series of eighteen[1] papillæ around the margin. These vary somewhat in shape, being conical or hatchet-like in outline, with a terminal process and a beak, or in shape somewhat like a dactylozoid of Millepora. All have a trace of dark pigment in the centre. The horny teeth alternate, so that the upper go slightly to the right of the under pair. The horny ridge on each side of these organs will also subserve the functions of division of food.

Three cæca from the gut pass obliquely outward to the dorsal wall, the fourth being nearly transverse. They are larger and less alternate than those of *Harmothoë*, and of a darker yellow hue. They are richly glandular, with deep yellow granular cells or masses here and there, giving a minutely dotted aspect to the surface. Their tips present only a short lobe in addition to the terminal one. Their arrangement and aspect thus differ from those of *Harmothoë*.

The food in the intestine consists of sand-grains, fragments of crustaceans, and other débris.

Colour.—The dorsum is of an uniform brownish-grey hue in some, or with a lighter area on each scale, the inner edge of which has, moreover, a dark brownish spot. In others the central pale area has a nearly complete brownish ring encircling it. In those from the stomach of the cod the papillæ, especially on the anterior scales, retain their colour, so that they are conspicuous. Again, in examples from Guernsey and Shetland the larger bosses on the anterior scales were of a reddish amber hue, while some young specimens were mottled with reddish brown or madder brown. Those from the Gulf of St. Lawrence had bristles of a dusky golden hue, and the papillæ of the scales were also darker. Under surface iridescent, bluish pink anteriorly, and pinkish posteriorly. In some from Shetland (Bressay Sound) the bases of the posterior feet ventrally had a well-marked touch of blackish pigment situated between the nephridial processes and extending from the tail fully a dozen feet forward, and a series of dark touches in the median line in each segment, a pale longitudinal streak, however, cutting each into two.

Scales.—The first pair of scales are rounded, and, like the two or three following, have large horny tubercles, the darker colour in some specimens making them very prominent, and each is ciliated for more than half its circumference. The next pair are reniform, and the succeeding are more or less ovoid. The brownish horny tubercles or

[1] De Saint-Joseph says sixteen.

bosses project as blunt points from the surface in profile. The scales (Plate XXXII, fig. 1) increase in size posteriorly, the general shape being ovoid, though they are wider at the ciliated posterior border. The under surface is smooth and iridescent, and shows the pear-shaped scar for the attachment of the pedicle. In some, however, the surface presents the ends of fibres torn from the pedicle, and this sufficiently explains why some are readily removed, and others require separation with a knife. All the scales considerably overlap each other, and cover the dorsum entirely. The simple filiform cilia which occur on the edge appear to preserve the same relative length from the first to the last, and they are often coated with a muddy deposit, and have various microscopic growths. So far as can be observed, these cilia are simple and nearly cylindrical processes with a smoothly-rounded tip, and a median streak, as if from an axis of differentiated tissue. Under the action of potash the scale becomes coarsely granular or areolar, the areas of the bosses or blunt spines being characterised by a more regular arrangement of granular cells.

In young examples, barely 3 mm. in length, the scales have a few large tubercles, and the cilia are hirsute, with grains of various kinds, besides being proportionally larger than in the adult. De Saint-Joseph found that in a small example, 5 mm. long, the scales were covered with *Grammatophora marina*.

In general structure the scales have externally a more or less chitinised cuticular layer, with a cellular (columnar) coat beneath, a fibrous stroma passing between the dorsal and ventral layers, and finely-branched nerves, from the ganglionic mass at the scale tubercle, terminating in end-organs. The external surface has various chitinous tubercles or processes, and the edge has cilia.

The chitinous tubercles and spines are placed in the thick cuticular layer, and the larger are hollow in the centre, and the surface is roughened with small processes so that they look honeycombed. This is due to the minutely nodular condition on the surface, and not to scales, as Baron de Saint-Joseph[1] states. When the dark brownish (Algoid ?) coating begins to cover their surface, the "bosses" present a reticulated appearance, since the parasitic growth first invades the hollows between the minute tubercles. Pigment occurs in the cellular layer beneath. The scar has a complex series of muscles, some of which pass into the hollow of the organ. The majority of the muscular fibres are fixed to the scale-tubercle. As Prof. Haswell[2] says, they serve in the Polynoidæ for protection, for the production of phosphorescence, for sensation, and in certain forms for incubation.

The scales readily separate in ripe examples, and the under surface is as finely iridescent as in *Haliotis*. Captured specimens reproduce their scales. Thus in a month they reach about a third the size of the original organs, but are pale, and their translucent condition shows that the tips of the papillæ are minutely nodular.

Many parasitic structures occur on the scales, but none more beautiful than *Carchesium*, the long tufts of which resemble, under the lens, miniature zoophytes.

Occasionally examples occur with a deep orange coating on the under surface of the scales and the dorsum of the body. In structure it is minutely granular, as in the darker (blackish) coating on the bristles and other organs.

[1] 'Ann. des Sc. Nat.,' 8th sér., v, p. 231. [2] 'Ann. Nat. Hist.,' 5th sér., x, p. 241, 1882.

Feet.—The second foot has a small dorsal division, which projects anteriorly, and no dorsal cirrus. The dorsal bristles are tapering and spinous from the skin outwards, as in other parts of the body. On the other hand, the ventral division has more slender bristles, with longer and more tapered spinous tips than elsewhere. When seen antero-posteriorly they somewhat approach the pinnately spiked forms of the Aphroditidæ, though, of course, differing in character. The long tentacle-like ventral cirrus comes from the anterior and inner base of the foot, and is directed forwards, thus diverging both in size and relation to the parts of the foot from the subsequent organs.

The third has become more or less normal in structure, except that the ventral division has not attained the size of that in the fully-developed foot. The serrated dorsal bristles spring from an elevation on the upper and anterior border, the only representative of the dorsal division, if we except the elevated crest bearing the dorsal cirrus. The ventral bristles are stronger, the serrated tips somewhat shorter, and the points slightly hooked. The slender inferior series alone still resemble those in the second foot. The ventral cirrus has now the normal position and form.

The fourth foot, though smaller, is nearly typical, and the short curved dorsal bristles are also present. The ventral bristles have tips only a little longer than those of the central feet. The ventral cirrus is in the normal position, but the long papilla of the segmental organ does not appear till the eighth foot, and it continues to the penultimate one.

The typical foot (Plate XLII, fig. 25) is massive, and presents little differentiation of dorsal and ventral divisions other than the bristles and spines, for the main mass of the foot is formed by the ventral division. The dorsal bristles rise from a papilla placed far back on the dorsal edge and in the front of the cirrus, where that is present, and their tips, as a rule, extend little beyond the bases of the ventral bristles. In structure they consist of long, tapering, spinous bristles (Plate XXXVII, fig. 13), the spines being arranged in close rows from base to apex, a few on the dorsal edge being shorter and stouter, with coarser spikes (Plate XXXVII, fig. 12). The ventral bristles (Plate XXXVII, figs. 9 and 10) have slightly longer tips than in *L. clava*, and the two spines at the tip of the rows are characteristic.

The shape of the foot does not essentially alter posteriorly, and the ventral bristles of the last foot have tips only a little longer than in the centre of the body, a feature which almost disappears in that next in front.

The dorsal cirri spring from a dilated base (ceratophore) which has anteriorly and posteriorly an area in which a whitish granular amorphous substance is deposited. The deposit, indeed, marks the bulbous region on each side. The column is pale, but at the dilatation is a blackish band, while the filiform tip is pale.

The dorsal bristles are generally covered with fine mud and parasitic growths. The general hue of the ventral is golden, but it varies in intensity, some of the northern forms, *e.g.* from Norway and the Gulf of St. Lawrence, having darker bristles. In one large example from St. Abb's Head one side had golden bristles, while in the other all were of a pale colour. The same form had an enigmatical, hyaline, stalked structure, with numerous rootlets on a posterior scale. An occasional foraminifer and a small patch of *Lepralia* also are met with in large examples.

The large deep-water forms (forty fathoms off St. Abb's Head) seem to be softer than those between tide-marks, and have the scales more or less abraded.

Reproduction.—Large examples from the neighbourhood of St. Abb's Head were loaded with ova and ripe sperms on August 1st, 1884, and the Irish examples were so in July. At St. Andrews nearly ripe as well as ripe males and nearly ripe females occur from the beginning of May to the end of June, and it is probable that the spawning period is in June and July. The males are distinguished by their pale hue, whereas the ripe females are of a slate-grey. The spermatozoa have a globular or slightly ovoid head and a long tail, as in *Nereis*. No ova could be pressed out of the long segmental (nephridial) processes with their dilated and truncated ends, but they readily issued from ruptures of the parietes of the body. The segmental papillæ are alike in both sexes, of moderate length, and with a little dark pigment at the trumpet-like ends.

Young examples of about 3 mm. in length occur in July ('Irish Exped.,' 1886, to Gweedore). These show proportionally larger cilia, larger and fewer bosses on the scales, and the cirri have more elongate tips, with scarcely a trace of the enlargement below. The ventral bristles have proportionally longer tips.

When disturbed in their native haunts, their motions are comparatively slow and cautious, so different from the restless activity of *Harmothoë imbricata* or *Evarne*. They cling tenaciously, partly by aid of their bristles, to rough surfaces, so that, for instance, the tubes of *Filigrana* give way in extracting them, and it is difficult to pull them from grooves in shells and similar hollows. Fine examples are procured in rock-pools under large stones that have been little disturbed for many years, where, for instance, *Ægirus punctilucens* and patches of *Alcyonium* occur. They are partial to hollows and crevices; thus one thrust itself into the tube of *Protula*, and being preserved therein has retained the cylindrical shape. Hitherto, however, they have not been found commensalistic in the tubes of other annelids, but occupy their sites independently under stones in rivulets and rock-pools near low-water mark, and for some distance landwards. In confinement, specimens of *Evarne* and *Harmothoë* will occasionally cling to the dorsum, and small examples may even insinuate themselves along the dorsum under the scales.

The crustacean parasite, *Sellius bilobus*, Kroyer,[1] is found on this species in northern waters, while *Perigonymus repens*[2] occurred in great beauty on the anterior scales of fine specimens trawled in thirty-five to forty fathoms off St. Abb's Head.

While they are not infrequently found in the stomach of the cod and other fishes, it is curious that young green cod in the tanks refused them and other Polynoidæ, such as *Harmothoë* and *Lagisca*, while they readily devoured *Nereis*, *Trophonia*, and *Cirratulus*; the mode in which the Polynoidæ curved themselves and kept the bristles prominent, showed that they were aware of the value of such protective organs. Taken into the mouth of the green cod they were at once rejected, and fell to the bottom of the tank, where they were engulfed by *Cottus*, but with a similar result, viz. immediate rejection.

O. F. Müller, in his 'Wurm-Arten,' calls this species "die gedüpfelte Aphrodite mit rauhen einfärbigen Schuppen."

[1] 'Naturhist. Tidskrift.,' 1ste R., i, 1837.

[2] This zoophyte recalls the loss lately sustained by science in the death of the Rev. Dr. T. Hincks, whose patient and accurate work amongst the Hydroids and Polyzoa will long be remembered.

Pallas ('Miscellanea Zoologica') mentions that Linnaeus found it in deep water. It occurs also with pelagic Fuci, and amongst the latter and Sertularians at the bottom of the sea. He gives an account of the external appearance and arrangement of the scales, and a brief outline of its anatomy.

It is doubtful if O. F. Müller's *Aphrodita punctata* refers entirely to this form, since he speaks of sub-crescentic bluish spots.

Audouin and Milne Edwards (1834) describe it as having twenty-seven segments, and reaching eighteen lines in length. They think that the *Polynoë punctata* of O. F. Müller comes near *P. squamata*, and so with the *Aphrodita clavigera* of M. Fréminville;[1] but this cannot be, as M. Fréminville found it phosphorescent.

It is difficult to say what H. Rathke's (1837)[2] *Polynoë granulosa* is. It may be this species in which a pair of scales has been lost.

Leidy's[3] *L. armadillo* appears to be allied to this species or to *L. clava*. His observation in regard to the unusual number of the tentacles is erroneous.

Kinberg[4] rested his specific characters on the comparative length of the tentacles, and the fact that the inferior bristles were serrated below the apex. He gave a correct account of the scales. De Quatrefages[5] adds nothing new to the foregoing, and he includes *Lepidonotus clava*, Mont., as a synonym, though with doubt. Subsequent French authors have corrected this error.

2. Lepidonotus clava, *Montagu*. Plate XXVI, fig. 1.

Specific Characters.—Head similar to that of *L. squamatus*. The large anterior eyes are in front of the middle line, and the respective pairs on each side are wider apart. Anteriorly the broad basal region of the median tentacle is more distinctly separated from the bases of the lateral tentacles than in *L. squamatus*, and the transverse diameter of the three processes is greater. Median and lateral tentacles thicker, and the bulbous region below the tip marked by a more distinct band of blackish pigment. Palpi with five rows of minute papillae. Segments twenty-seven, characteristically marked with pigment on the dorsum; segmental (nephridial) papillæ large and thick. Scales more or less circular throughout, and do not quite cover the dorsum, more flexible than in *L. squamatus*, and, with the exception of the first four pairs, smooth. The first three have numerous small tubercles generally distributed, while the fourth pair have a smaller number. Papilla for the dorsal bristles more prominent than in *L. squamatus*. The dorsal bristles are shorter, thicker, less tapered and more curved than in *L. squamatus*, but have similar structure. The ventral bristles have shorter curved or falcate tips, with fewer rows of spikes, and the bare portion is shorter than in *L. squamatus*.

[1] 'Nouveau Bulletin de Sc. par la Soc. Philomat.,' iii, p. 253.
[2] 'Beitr. z. Fauna der Krym,' p. 408.
[3] 'Americ. Journ. Nat. Sc.,' p. 148, pl. xi, f. 54.
[4] Op. cit., 1857.
[5] Op. cit., 1865.

SYNONYMS.

1808. *Aphrodita clava*, Montagu. Trans. Linn. Soc., ix, p. 108, pl. vii, f. 3.
1821. *Lepidonotus clavatus*, Leach. Supp. Ency. Brit., i, p. 452.
1826. *Polinoe scutellata*, Risso. Hist. nat. Europ. mérid., iv, p. 414.
1828. *Eumolpe squamata*, Blainville. Dict. Sc. Nat., lvii, p. 458, Atlas, f. 2.
1829. *Eumolpe squamata*, D. Chiaje. Mem. sulla Storia, iv, p. 155, tab. lvii, f. 8 and 17.
1836. *Halithæa clava*, Templeton. Lond. Mag. N. Hist., ix, p. 234.
1838. ? *Polynoe squamata*, Grube. Anat. u. Physiol. Kiemenw., p. 60, tab. ii, f. 13.
1840. ? „ „ (Sav.), Grube. Act. Echin. u. Würmer, p. 87.
1860. „ *clypeata*, Grube. Arch. f. Naturges., Bd. xxvi, p. 71, taf. iii, f. 1.
1861. „ „ Grube. Ausflug n. Trieste, p. 138, taf. iii, f. 1.
1864. „ „ Grube. Insel Lussin, p. 77.
1865. *Lepidonotus clava*, Johnston. Cat. Brit. Mus., 111, pl. iv, f. 5 and 6.
„ *Polynoe modesta*, De Quatrefages. Hist. nat. Annel., i, p. 243.
1867. *Lepidonotus clava*, Malmgren. Ann. Polych., p. 130.
1870. *Polynoe grubiana*, Claparède. Suppl. Annel. Chétop., 9 (373), pl. i, f. 2.
1875. *Lepidonotus clava*, Marenzeller. Sitzb. der k. Akad., I Abth., Juli-Heft (sep. Abd.), p. 1.
1876. „ „ McIntosh. Trans. Z. S., ix, p. 374.
1880. „ „ Langerhans. Zeit. f. w. Zool., xxxiii, p. 273, taf. xiv, f. 2 ?
1881. *Polynoë clava*, Langerhans. Canar. Annel., Nova Acta, 42, iii, p. 108.
1884. „ „ A. G. Bourne. Trans. Linn. Soc. Zool., ii, pp. 347—356, pls. xxiv—xxvi.
„ *Lepidonatus clava*, Carus. Faun. Medit., p. 202.
1885. *Polynoë grubiana*, Jourdan. Zool. Anz., viii, p. 128, f. 1, 2.
1887. „ „ Jourdan. Arch. Zool. Expér., v, pp. 115—120, pl. iv, f. 11, 12, 16, 17.
1898. *Lepidonotus clava*, De Saint-Joseph. Ann. d. Sc. nat., 8 sér., v, p. 225.

Habitat.—This species is a southern and western form—ranging from Falmouth and the Devonshire coast to Gairloch, Ross-shire, and extending to Valencia Harbour in Ireland. None appear on the eastern shores. It is chiefly littoral, occurring under stones in tide-pools even near high-water mark, as in McNiel's Bay, Lochmaddy, as well as on oyster-beds under water. It is distributed along the shores of France to the Mediterranean, Adriatic, and perhaps to the Canaries (Langerhans).

Length about 30 mm.; breadth 8 mm.

Head (Plate XXXVII, fig. 4) similar in outline to that of *L. squamatus*, bounded posteriorly by the nuchal collar, which has the dark pigment of the dorsum on its edge. The surface is smooth and iridescent, as in the former species. The eyes are visible from the dorsum, the larger anterior pair in front of the middle line and wider apart, and two posteriorly. Anteriorly the broad basal region of the median tentacle is more distinctly separated from the bases of the lateral tentacles than in *L. squamatus*, and the transverse diameter of the three processes is greater than in the latter species, as might be expected from the larger size of all the appendages. The median and lateral tentacles are proportionally thicker, and the bulbous region below the tip better marked, especially as a band of blackish pigment occurs below the enlargement. A little brownish-black pigment also exists on the columns of these processes and of the tentacular cirri, all these organs being somewhat stouter and more boldly pigmented than in *L. squamatus*. The palpi are somewhat filiform at the tip, and, as shown by Grube, are marked by five rows of elongated papillæ, which are conical and taper to a point. They are best developed towards the tip of the organ. Prof. Bourne describes each as furnished with a sensory hair.

Body.—The dorsum is marked in the median line by broad interrupted patches of blackish-brown pigment, three or four of the most prominent anterior touches having a pale area in the centre. These touches extend outward to the feet posteriorly; moreover, dorsally the bases of the feet have black pigment, which becomes strongly pronounced after the anterior third, the effect of the mottling of the feet and body posteriorly being somewhat like that on tortoise-shell.

The ventral surface has a similar arrangement of areas to that in *L. squamatus*, only the lateral are marked off from the bases of the feet posteriorly by a slightly elevated and pigmented border, which terminates at the bases of the caudal styles, and is connected with touches which extend a short way forward in the median line.

Posteriorly the body terminates in a grooved pedicle for the large symmetrical caudal styles, all these parts being better marked than in *L. squamatus*. The anus is situated dorsally at the base of the pedicle, to which it sends a ridge-like process.

The bristled segments are twenty-six.

Proboscis and Digestive System.—De Saint-Joseph found sixteen papillæ along the margin of the proboscis, but there are eighteen, as in *L. squamatus*, in all the examples examined. They are speckled with black pigment. In transverse section the organ is typical.

Only two cylindrical and rather massive cæca pass forwards into the peripharyngeal space, and their extremities appear to be devoid of any distinct differentiation. The stomachal region of the gut anteriorly is remarkably muscular, the fibres at the front end forming a row of separate dull orange lobes which clasp the proboscis, and which resemble a series of glands. Their tissue, however, is wholly muscular, the powerful fibres forming loops in the rounded lobes, which are sometimes made by rupture of the fibres from the proboscis.

Colour.—The dorsum is of a dull brownish hue speckled with white, and with dark touches on the scales. The under surface is pale, with some dark touches at the mouth and the sides of the tail. The segmental papilla has a dark column and a whitish tip in the posterior half of the body. At the reproductive season the males are pale under the scales, the females dark grey.

Scales.—The scales (Plate XXXII, fig. 2) of this species are more or less circular throughout, and do not quite cover the dorsum, or, as Marenzeller says, leave bare rhomboidal spaces. Some are firmly fixed, others easily separate from the pedicle as in *L. squamatus*. They are more flexible than in that species, and, with the exception of the first four pairs, show only minute tubercles. The first, second, and third have numerous small tubercles or blunt dumb-bell shaped papillæ, distributed generally over the surface, while the fourth has a smaller number, less distinctly raised above the surface. The edge of the scale throughout is smooth. They are fixed by the umbilicus, which is nearer the outer than the inner margin, this area being generally marked dorsally by a white patch bordered with black pigment. The scales give the dorsum generally a leaden hue, or in some a dusky brown, speckled with white. Besides the white patch, which posteriorly is sometimes reniform, at the umbilicus the scales are mottled with a blackish or slightly glistening dull leaden hue, or with more numerous black specks, which posteriorly do not seem to be connected with papillae. The under surface is smooth and iridescent, and has the opaque whitish patch of the umbilicus. In spirit the anterior scales generally show a fold from the umbilicus to the external margin.

The minute structure of the processes of the scales has been specially described and figured by De Saint-Joseph,[1] who states that the tip is "scaled" and spinous. His figure, indeed, is regularly and closely diced. So far as can be observed in the British specimens, it is the tip and neighbouring part of the capstan-like column of the process of the scale which is thus covered, as recently described and figured.[2]

Feet.—On the dorsum of the first foot is a minute tuft of tapered serrate bristles (Plate XXXVII, fig. 14), and a single large spine which penetrates the skin beneath the former. Prof. Bourne speaks of four bristles being borne by each division. This is probably a misprint, as his figure differs.

The second foot diverges from that of *L. squamatus* in having its comparatively large ventral cirrus directed more distinctly inwards and forwards, in the smoother foot and the more translucent bristles. Moreover, while the dorsal series more or less correspond at first sight, yet the character of the serrations slightly differs from those of *L. squamatus*, being somewhat shorter and finer, and the tips of the bristles are more tapered. The ventral bristles of *L. clava* again differ in having their long tips spinous to the apex, whereas in *L. squamatus* the spinous tips are shorter, the tip is bare, and in some slightly hooked.

In the third bristled foot (the second of some authors) the dorsal bristles are less gradually tapered than in *L. squamatus*, while the ventral series have longer spinous regions bare in the upper at the tip—which is more slender than in *L. squamatus;* indeed, the whole bristle is more slender than in the latter species, and the rows of spines longer. Both dorsal and ventral cirri, moreover, are different, being proportionally larger and more bulbous below the filiform extremity.

In the fully-formed foot (*e. g.* the tenth, Plate XLII, fig. 26) the papilla for the dorsal bristles is more prominent than in *L. squamatus*, and has a distinct black bar in front, and the bristles are somewhat shorter and more curved (Plate XXXVII, fig. 15). The tips of the ventral bristles are shorter, the curve more pronounced (Plate XXXVII, fig. 11), and the bare portion shorter. The stronger and larger hooked tip in *L. squamatus* is a characteristic feature. The segmental papilla is visible on the eighth bristled foot as in *L. squamatus*, and is continued to the last foot.

In the terminal foot the dorsal bristles are shorter and more curved than in *L. squamatus*, a feature present throughout the body. The ventral bristles have the curvature of the shorter tip more pronounced than in *L. squamatus*. In both species these bristles preserve great strength.

A marked difference between the species is the diminished size of the body and last feet in *L. squamatus*, contrasted with the comparatively large size of all the parts in this region in *L. clava*.

[1] Op. cit., Aug., 1898, p. 229, t. 1, &c.

[2] 'Ann. Nat. Hist.,' 1898, p. 108, pl. ii.

Reproduction.—Fine specimens from Gairloch, Ross-shire, were laden with ripe ova in February, and had a dull greyish hue from the tint of the eggs.

Habits.—It is a sluggish form.

This is one of the discoveries of the acute and sagacious Col. Montagu on the southern coast.

Like other Polynoidæ it is predaceous, masses of the bristles of *Harmothoe imbricata* being found in the intestine, with shreds of skin and other débris.

It is probable that Risso's *Polinoe scutellata*[1] is either this or *L. squamatus*.

Delle Chiaje's figures in the 'Memorie'[2] would appear to belong to this species; the first represents the entire animal, and the second the posterior end enlarged, though in the text it is termed the anterior end.

The statement by Audouin and Milne Edwards in their 'Annéles' that perhaps Montagu's *Aphrodita clava* approached their *Polynoe laevis*, is due to a misapprehension. The species much diverge.

Marenzeller,[3] in 1875, reviewed the literature of this species, and showed the identity of Risso's *P. scutellata*, Delle Chiaje's and Grube's *Polynoe squamata*, and the *P. modesta* of De Quatrefages; he also linked on the *P.* [illegible] of Claparède[4] with Montagu's form; but the palpi (Unterfühler) of this species present a different appearance from those examined, since they are studded all over with papillæ, whereas those of *L. clava* have only rows of pointed papillæ, as indicated by Grube, in 1860, in the Mediterranean examples. Marenzeller procured British specimens from Cumbrae in the Clyde.

It is doubtful whether the form considered by Langerhans to be a young variety is this species, since the palpi are smooth and the bristles diverge.

Baron de Saint-Joseph includes the *Polynoe dorsalis* of De Quatrefages under this species, but this is doubtful, since *P. dorsalis* has cilia on the external margin of the scales. An examination of the specimen, however, may have shown that this is an error in description. He likewise places *Lepidonotus wahlbergi*, Kinberg, under the same head, but the foreign species differs, even under a lens, by the fact that the scales throughout, that is to the last, have numerous tubercles, those in front forming prominent spines; and, besides, the scales of *L. clava*, Montagu, are proportionally larger and, with the exception of first four pairs, are nearly smooth. Only in the old scales is there a belt of minute tubercles within the edge, and similar minute processes over the surface. These are, however, very different from those of *L. wahlbergi*. This distinction is clearly shown in the figure[5] in the 'Challenger' volume. Moreover, the dorsal bristles are much less tapered and acute than in *L. clava*, the reverse being the case with the ventral, which are proportionally more slender and elongate, and with a longer row of spines than in *L. clava*.[6]

[1] 'L'Europ. mérid.,' p. 414.

[2] Op. cit.

[3] "Zur Kenntniss der adriatischen Annel.," 'Wiener Akad. Ber.,' 1 Abth., Juli-Heft, 1875, p. 1, sep. Abd.

[4] A view still held by Dr. Benham, 'Camb. Nat. Hist.,' "Polychaet., &c.," p. 310, 1896.

[5] Pl. xi, f. 1.

[6] *Vide* McIntosh, 'Ann. Nat. Hist.,' ser. 7, vol. ii, p. 108, pl. ii, f. 12, 1898.

Genus IX.—GATTYANA (NYCHIA,[1] *Malmgren*), McI.

Lateral tentacles arising below the base of the median, they and the cirri densely covered with long cilia. Palpi with numerous short clavate papillæ truncate at the tip. Scales fifteen pairs, minutely spinous, covering all the dorsum, and attached to segments 1, 3, 4, 6, 8, ... 22, 25, 28, 31. Bristles of the dorsal lobe ranging from stout, curved, and spinose inner forms to elongated ones with tapering, hair-like tips, finely spinous. Bristles of the inferior division stouter, with spinous distal regions and simple hooked tips.

GATTYANA CIRROSA, *Pallas*, 1766. Plate XXV, fig. 3.

Specific Characters.—Body of thirty-five to thirty-six bristled segments with a transverse impression in most. Head produced anteriorly into two pointed lobes. Tentacles and cirri densely covered with cilia. Scales, with the exception of the first pair, somewhat reniform, with long cilia on the posterior and external margins, smooth to the naked eye, but with many minute spines on the surface, the larger being external and posterior, with the tips often bifid, generally pale olive or buff, and frequently with a dark spot at the point of attachment. Dorsal bristles somewhat slender, with long tapering hair-like tips and rows of spines. Ventral bristles with simple hooked tips, beneath which is a spinous region which diminishes in length in the bristles from above downwards. Ventral cirrus short, with a few short clavate papillæ. Segmental process slightly tapered towards the tip, and of moderate length.

SYNONYMS.

1766. *Aphrodita cirrhosa*, Pallas. Miscell. Zool., p. 95, Tab. 8, figs. 3—6.
1780. ,, *scabra*, Fabricius. Fauna Grœnl., p. 311, n. 292.
,, ,, *punctata*, Fabricius. Ibid., p. 311.
1792. ,, *scabra*, Bruguiere, Encyc. Méthod., vers. i, p. 88.
1815. ,, *viridis*, Montagu. Trans. Linn. Soc., vol. xi, p. 18, Tab. 4, fig. 1.
1820. ,, *scabra*, Savigny. Syst. des An., 26.
,, ,, *punctata*, Savigny. Ibid.
1828. *Eumolpe scabra*, De Blainville. Dict. d. Sci. Nat., vol. lvii, p. 459.
1831. *Polynoe scabra*, Aud. and Ed. Ann., 87.
1839. *Polynoë viridis*, Johnston. Ann. Nat. Hist., vol. ii, p. 137.
1843. *Lepidonotus assimilis*, Œrsted. Annulat. Danic. Consp., p. 13, figs. 3, 6, 11, 32, 33, 37, 38, 45, 46.
,, ,, *scabra*, Ibid. Grönl. Ann. Dorsib., 164, pl. 1, figs. 2, 7, 10, 13, 17 and 18.
1850. *Lepidonote scabra*, Sars. Reise i Lof. og Finm., p. 209.
1851. *Polynoe scabra*, Grube. Fam. der Ann., 37 and 120.
1858. *Harmothoe scabra*, Kinberg. Eug. Resa, 21.

[1] The title *Nychia* had already been used by Stal for one of the *Hemiptera*, so that Malmgren's name (1865) lapses. The term Gattyana may accordingly be appropriately substituted, after the generous founder of the New Marine Laboratory at St. Andrews.

1861. *Polynoe scabra*, Sars. Vid. Selsk. Forh., 1860, p. 58.
,, ,, *scabriuscula*, Sars. Ibid., p. 61.
1864. *Lepidonotus cirratus*, var. *parasiticus*, Baird. Trans. Linn. Soc., 1864, p. 161.
1865. *Polynoe scabra*, De Quatrefages. Ann., vol. i, p. 235.
,, *Lepidonotus imbricatus*, Johnst. Cat. Brit. Annel., p. 118.
1867. *Nychia cirrosa*, Malmgren. Nord. Hafs-Ann., p. 58, Tab. viii, f. 1.
1871. ,, ,, Ehlers. Sitzunsb. phys.-med. Erlangen, 1871, p. 77.
1872. ,, ,, Sars. Nyt. Mag. f. Naturv., 19, p. 202.
1873. ,, ,, Sars. Bid. Christ. Faun., p. 2.
1874. ,, ,, Mobius. Die Zweite deutsche Nordpolarfahrt, ii, p. 253.
,, ,, ,, Malm. Göteborgs Kongl. Vet. o. Vitt. Samhalles Handl.; Ny Tidsfoljd, Häft. xiv, p. 87.
1875. ,, ,, McIntosh. Invert. and Fishes, St. A., p. 115.
,, ,, ,, Ehlers. 'Porcupine' Annel., 1869, op. cit., 32.
1877. ,, ,, Marenzeller. Öst.-ung. Nordpol Exp. Deutsch. d. k. Akad. Wiss., 39.
1879. ,, ,, Théel. Kongl. sv. Vet. Akad. Handl., 16, 3, p. 7.
,, ,, ,, Tauber. Ann. Danic., 79.
1883. ,, ,, Wirén. Chaetop., 'Vega' Exped., 387.
,, ,, ,, Levinsen. Nord. Annulat., 195.
1884. ,, ,, Webster and Benedict. Ann. Mass., 700.
1886. ,, ,, Giard. Bullet. Sc. Nord., Nos. 9, 10, p. 358.
,, *Iphione muricata*, Harvey Gibson. Verm. Liverp., 150.
1890. *Nychia cirrosa*, var. *Chætopteri*, Malaquin. Ann. Boulon., 15, pl. 1, f. 7 *a*—7 *d*.
1891. ,, ,, Hornell. Trans. Liverpool Biol. Soc., v, p. 230.
,, ,, Trantzsch. Polynoid. Spitzb., Jenaische Zeitsch., 24, 1 Heft, p. 75; and Arch. f. Naturges., 55 Jahrg., 1 Bd., 2 Hft., p. 143.
1896. ,, ,, Michaelsen. Polych. Faun. deutsch. Meere (Wiss. Meeresuntersuch., Bd. ii), p. 7.
1897. *Gattyana cirrosa*, McIntosh. Ann. Nat. Hist., ser. 6, vol. xx, p. 167.
1898. *Nychia cirrosa*, Michaelsen. Grönl. Annel., Bib. Zool., Heft 20, Lfg. 4, p. 120.

Habitat.—This species stretches from Greenland and the American waters to the shores of Northern Europe, but is numerically less abundant than many of the Polynoidæ. It occurs not infrequently in the deeper water off St. Andrews Bay, and is tossed on shore after storms. Specimens likewise come from Shetland (J. G. Jeffreys) in sixty fathoms, nine miles off Balta, from Southport Sands (Dr. Carrington), Hastings, between tide-marks, Channel Islands (Herm), Broadhaven Bay, Bantry Bay, and Berehaven Bay, in Ireland (A. G. More, Professor Haddon, and Dr. Scharff), the specimens found in the first-mentioned region being very large. Fine examples are not uncommon in the stomachs of cod and haddock at St. Andrews (E. M.). In Shetland it clings to the branched form of *Melobesia* in Bressay Sound. Malmgren pointed out that it was the form called by Baird *Lepidonotus parasiticus* in the tubes of *Chætopterus*, in the British Museum; and Hornell has confirmed this in the tubes of the same form, and in those of *Thelepus* in the Channel Islands, while at St. Andrews it is partial to the tubes of *Amphitrite figulus*, Dalyell.

It comes from the Gulf of St. Lawrence (Whiteaves), the Atlantic in 580—630 fathoms (Ehlers, 'Porcupine'), and Canon Norman frequently procured it in Norway and Finmark. Specimens also occur in Iceland.

Length.—A fine example from St. Andrews measured, exclusive of the processes, 47 mm.; and another, 12 mm. in spirit, comes from Broadhaven Bay, W. Ireland (A. G. More).

The *head* (Plate XXVII, fig. 5) differs from that in *Lepidonotus* in the relations of the median and lateral tentacles, since on each side of the median the head terminates in a pointed papilla (peak), the lateral tentacles being inferior. The outline of the head is somewhat ovate, and in life it is rose-red. A conspicuous pair of black eyes occur posteriorly on the dorsum, while a slightly larger pair are in front at the outer margin, and rather below the peak on each side of the tentacle. They are not well seen from the dorsum, and are fitted for anterior vision. The nuchal collar has a prominent boss or papilla in the centre. The median tentacle arises from a massive base, often of a slightly brownish tint, as a pale ciliated process about as long as the palpi in the spirit preparations, though of course the latter are much longer in life, and having a slight swelling below the filiform tip. The bases of the short lateral tentacles, which are beneath the massive base of the median, have a brownish bar. They are similarly ciliated, and have a slight enlargement below the filiform extremity. The cilia on the tentacles are elongate processes with a slightly bulbous tip, the centre of the latter and the column being granular.

The pale palpi have numerous small papillæ, which are shortly clavate in outline, with a truncated tip, which has a few minute papillæ. These are arranged in six rows—apparently two dorsal, two ventral, and a lateral on each side, the intervals between the rows being considerable. Malmgren simply says the surface is densely covered. They diminish in size towards the tip, and disappear from the filiform termination. Under a lens in life the organs appear to be smooth, but the minute papillæ are visible under a low power.

Body elongated, somewhat elliptical in transverse section, though more prominent dorsally than ventrally, gradually diminished in transverse diameter towards the head, and narrowed somewhat more abruptly towards the posterior end. Bristle-bearing segments 34—36, as Malmgren says for the Arctic forms. The dorsum is marked laterally by the papillæ for the scales, and the corresponding elevations in those feet bearing cirri. Moreover, each segment has a transverse bar, as it were, imprinted on its middle, the outer edge of the bar being especially depressed just as the surface of the segment rises towards the papillæ. These are continued to the fourth last segment posteriorly. On the other hand, the bulging of the body caused by the proboscis renders them less distinct anteriorly, though traceable in every segment. A tendency to separation of these bars at the anterior border of the segment is noticeable, while posteriorly the central half runs to the junction with the next segment. A median streak passes along the dorsum. Ventrally, the segments show a broader lateral band on each side, and a narrower median, which is opaque whitish in the centre. A little behind the line of each segment anteriorly an oblique streak passes to the nephridial process. The ventral surface of the body is iridescent, and in life it has a purplish sheen along the median region. In others the pinkish nerve-cords and ganglia form a well-marked moniliform median band, commencing behind the striated lower lip as a broad stripe. The feet are dull yellow.

The segmental papilla is directed between the feet, and is in the form of a slightly tapered process of some length. The northern forms agree with the British in regard to this structure.

Posteriorly, the body terminates in two elongated caudal styles, which have a similar structure to the cirri.

Proboscis.—When extruded, the organ shows on each edge nine terminal papillæ similar in shape to those of *Lepidonotus*. The horny jaws appear to resemble those of the genus named, and they are acutely pointed.

Two long, slender cæca pass forward into the peripharyngeal space.

Scales (Plate XXXI, fig. 1)—fifteen pairs. The first pair are somewhat circular and ciliated all round, the inner and anterior margins having short and somewhat clavate cilia, the rest being densely covered with similar cilia, which, as usual, are often thickened by parasitic growths. The surface has numerous small horny papillæ scattered over it, so that it is finely spinous. Such a scale, however, is in contrast with the Arctic examples or those from the Gulf of St. Lawrence, Norway, and Finmark, in which the sharp brown spines form prominent features in every scale of both large and small examples. Bifid tips also occur on many of the spines, as mentioned by Malmgren. It is not a question of size in regard to this difference between the British and the other examples, for in large representatives from the west of Ireland the same features are present as in the other British specimens. Moreover, the cilia are more prominent in the northern forms. These features, however, by no means indicate specific difference, for the general characters remain diagnostic.

The condition of the scales of the British examples is more like that of *Gattyana Amondseni*, Mrgn., though the spines are not so visible under a lens.

The scales of some have grains of sand and mud attached externally. Old and fine specimens have a dull olive hue on the dorsum, while the edges are flanked by the paler bristles and cirri, which are often, however, so coated with parasitic algæ and other structures, and grains of sand, that their normal hue is obscured. The scales of the large examples from the tubes of *Amphitrite* have a finely-streaked appearance from the dark growths on the spines.

Colour.—Dorsum of a pale yellowish-brown or sandy colour, the anterior scales being somewhat darker. In a considerable number (the majority of those tossed on shore at St. Andrews) a dark greyish-brown spot occurs at the point of attachment, and these form a somewhat regular row along each side. The prominent spines of the Arctic examples are brownish. The same dark spot at the point of attachment is present in some of these, and a dark touch at the inner border of each scale, so that an interrupted double band occurs along the middle of the dorsum. Tentacular processes pale. Head deep pinkish red, or only between the posterior eyes. In some the central process of the nuchal collar is bordered with dark pigment. Under surface pale, iridescent. Bristles pale yellow.

None of the British examples appear to show the dark median band of the dorsum from the nuchal fold backward, with fainter touches of colour in the median depressed parts of each segment to the tail, where darker pigment again appears, which characterises some Arctic examples (Godhaven Harbour). Flecks of pigment are also seen along the mid-dorsal line even when no distinct band is present anteriorly and posteriorly.

Feet.—The tentacular cirri agree with the median tentacle. The basal region has the usual small tuft of serrated bristles (corresponding to the dorsal) with a spine. They are somewhat short and rather stout bristles, with rows of short spikes towards the tip.

In the second foot the dorsal bristles are shorter and more roughly spinous than in the typical foot. The latter is probably partly due to their shortness and greater curvature. On the other hand, the ventral bristles have much more elongated tapering tips than in the typical foot. The ventral cirrus has a few short clavate papillæ throughout the whole series.

The third foot presents a considerable change in the dorsal bristles, which now show the strong series with curved, serrated tips next the body, and the slender series with tapering tips adjoining the ventral division. The dorsal cirrus is somewhat shorter and thicker than in the fully developed foot. Both shafts and tips of the ventral bristles are still much more slender than in the average foot.

In the fourth foot a near approach to the condition in the typical foot occurs, though both dorsal and ventral bristles are more slender.

In the typical foot the dorsal division is bluntly rounded and turned upwards (Plate XLII, fig. 27), the spine, which is sheathed in skin, passing out as a slender process towards the inferior edge of the bristles. The dorsal bristles are rather slender (Plate XXXVII, fig. 18), have a long tapering tip, with rows of spines, the extremity being hair-like. The ventral division, on the other hand, has a somewhat triangular edge, the spine, which is sheathed at the base, and forms an independent process posteriorly, passing outward at the apex of the triangle. The ventral bristles show tips increasing in length from below upward, the superior bristles (Plate XXXVII, fig. 16) having more delicate tapering tips and more numerous rows of spines, while the tips are slightly hooked, the intermediate series (Plate XXXVII, fig. 17) often having a slight enlargement below the hooked tip. In large examples from deep water beyond St. Andrews Bay the smooth tips of the ventral bristles are somewhat shorter and broader. In contrasting these with the bristles of Arctic examples, the tips (that is, the region beyond the spines) of the latter are longer, and the bristles, both dorsal and ventral, are in some cases rather stouter. In the Arctic forms also the cilia on the cirri are somewhat longer.

In the posterior feet the tips of the ventral bristles again become elongated and the shafts more slender. In the last foot, indeed, the tips are so attenuate that, leaving the shafts out of sight, the curve of this region is almost the only distinction by which they can be recognised. The ventral cirri also are more elongate.

A curious ochreous appearance occurs in certain forms from Godhaven, Greenland, in which the tips of the dorsal bristles are covered with a minutely granular reddish-brown deposit, probably derived from their surroundings. The same structure coats the cilia of the cirri and scales.

The figure of the foot in Malmgren's paper does not show the upper spine, and in the ventral division the conical process for this structure is absent.

Parasites.—*Loxosoma* is not uncommon on the bristles and feet of the Arctic forms and those from the Gulf of St. Lawrence.

In a specimen from Godhaven Harbour (Disco Island) the body was dotted with rounded or ovoid whitish structures beneath the skin. They consisted of a mass of well-defined granules, generally of a somewhat ovoid shape and a double outline.

The parasitic crustacean, *Sellius bilobus*, occurs on the dorsum under the scales in northern forms, and seems to be a large parasite for so small an annelid.

Fine specimens are procured in the tubes of *Amphitrite figulus* (Dalyell) under large stones near low-water mark of spring tides at St. Andrews. They occupy the anterior end of the tube. All the examples were large, but the alimentary canal of those examined showed no recognisable food. The species probably finds in this and other tubes a safe refuge and sufficient food. It is, moreover, phosphorescent, irritation causing a very pale greenish or yellowish light to illuminate the scales. The phosphorescence is less vivid than in *Harmothoë imbricata* and *Polynoe scolopendrina*. As a rule, *Gattyana* occupies a position close to the mouth of the long tube of the *Amphitrite* beneath large stones, so that it is well protected from marauders, even supposing they were attracted by its light. In the same way its opportunities for alluring animals are curtailed, so that the remarks formerly made in this connection still hold.[1]

To sum up, the British species differs in the softer and much smoother scales, the horny papillæ being microscopic, and in the shorter, smooth tips of the ventral bristles, which tips are likewise more attenuate in the Arctic forms. The innermost bristles of the dorsal series appear also to be stouter and shorter in the Arctic forms.

Pallas (1776) was somewhat in doubt about this species, which had been sent him in a rather softened condition by Gronovius from the northern seas, and thought it might be an older form of his *Aphrodita lepidota*, though the structure of the feet differed. Both description and figures are imperfect, and in fig. 6, Plate VIII, the foot is inverted, but Malmgren is right in identifying it with this species. The general pallor struck Pallas. He mentions the "scabrous" condition of the posterior margin of the scales, and the elongated yellowish dorsal bristles. The description given by Fabricius (1780) is quite recognisable, and the dull greenish colour dorsally, the pale ventral surface, with the hispid scales, are characteristic. Savigny (1820) added nothing to the remarks of Fabricius.

Johnston (1839), both in this paper and in the subsequent remarks in the 'Catalogue,' gives only Montagu's description. Œrsted's figures (1843), rather than his description, show that this was the species to which he referred in both publications. He also gives its habitat as in the deeps of Greenland. Sars (1861), in his account of the Norwegian *Polynoidæ*, gave descriptions of both a *Polynoë scabra*, Fabr., and *P. scabriuscula*, n. s.; but Malmgren has rightly decided that these refer to the same species, considerable variation occurring between the Arctic and the more southern examples. De Quatrefages (1865) seems to have had no personal acquaintance with *G. cirrosa*, but mentions that Linnæus gave twenty pairs of scales to his form, and that it requires re-investigation.

This species was procured at a depth of 230 metres on mud during the Austrian North Polar Expedition. Möbius states that it occurs in Greenland in 4—12 fathoms. In the account of the annelids of Nova Zembla, Théel (1879) says that forms 45 mm. in length come from the Kara Sea. Verrill (1879) includes it in his list from Cape Cod

[1] 'Ann. Nat. Hist.,' 4th ser., ix, p. 1, January, 1872.

to the Gulf of St. Lawrence. Finally, Malaquin (1890) describes a variety found in the tubes of *Chætopterus* at Boulogne.

Genus X.—Eunoa, *Malmgren*, 1865.

Lateral tentacles arising under the median—below and slightly internal to the peaks of the head. Palpi with six rows of short cilia; eyes large, visible from the dorsum. Three intestinal cæca directed forward into the peripharyngeal space, the ventral long and narrow, with two or more sacculations at its outer border inferiorly. The other two are clavate and short. Elytra, fifteen pairs, completely covering the dorsum, and occurring on the first foot, third, fourth, sixth, eighth, and so on to the twenty-second, twenty-fifth, twenty-eighth, and thirty-first. Dorsal bristles pointed at the tip (which is bare), then minutely spinulose in rows; ventral bristles somewhat longer, and resembling those of *Harmothoë*, with a smooth tip, which has a hook and transverse rows of spikes. External aperture of the segmental organ indicated by blackish pigment; no papilla.

Note.—This genus approaches *Harmothoë*, but the peaks of the head in the latter are close to the median tentacle, whereas an interval exists in *Eunoa*. The eyes in *Harmothoë* are smaller and less visible, the anterior pair being under the point of the peak, whereas the anterior pair of *Eunoa* are situated some distance backwards, and are lateral in position—not ventral. The bristles of the first foot in *Eunoa* are very distinct. The remarkable *Eunoa hispanica*,[1] procured by the 'Porcupine' in 1870 on the Channel slope, diverges from the other known forms by the great size of the eyes (with their corneal lens), which exceed by far those of any other example of the family, by the great length and smoothness of the palpi, and the great length of the ventral cirri and the foot. The dorsal cirri probably have no enlargement below the tip, if we may judge from a single lateral tentacle. *E. hispanica* is scarcely within the British area, but it is worthy of note in this connection, and may yet be found near the coasts.

1. Eunoa nodosa, *M. Sars*, 1860.

Specific Characters.—Body broad, flattened, slightly narrowed in front, but much more gradually and distinctly posteriorly; bristled segments, 36; head about as broad as long, with a deep notch in front, from which the peaks are clearly marked off on each side; eyes large, two anterior to the nuchal fold, and two just in front of the lateral projection of the head, and thus considerably behind the peaks; tentacle ciliated, slightly dilated below the slender tip, longer than the palpi—in preservation; lateral tentacles short, of similar shape; palpi subulate, with six rows of minute papillæ; tentacular cirri smaller than the tentacle, but of similar structure; scales, 15 pairs, completely covering the dorsum, with the exception of the first pair, elongate reniform and somewhat thick, external margin densely ciliated, exposed surface rather thickly covered with

[1] 'Trans. Zool. Soc.,' ix, p. 396.

small tubercles and occasional parasitic growths, while a little within the posterior margin is a row of larger, isolated, rounded tubercles; dorsal bristles distinctly shorter than the ventral. The dorsal cirri have the structure of the tentacular cirri, shorter than in *E. œrstedi;* ventral cirri smooth. Segmental papilla cylindrical, passing from the posterior border of the foot, and directed upward between the feet. A dilated process occurs at the base of the dorsal cirrus.

SYNONYMS.

1860. *Polynoe nodosa*, Sars. Vid. selsk. Forhandl., 1860, p. 59.
1865. *Lepidonotus pharetratus*, Johnst. Cat. B. M., p. 113, pl. 3, f. 17—19.
1866. *Antinoe zetlandica*, Ray Lankester. Trans. Linn. Soc., xxv, p. 377, pl. 51, f. 13, 17, 18, 22, and 23.
1867. *Eunoa nodosa*, Malmgren. Nord. Hafs-Ann., p. 64, Tab. viii, f. 4, and Ann. Polych., p. 6.
,, *Antinoe pharetratus*, Parfitt. Cat. Ann., Devon, p. 18.
1872. *Eunoë nodosa*, Sars. Nyt. Mag. f. Naturvid., 19, p. 202.
1873. ,, ,, Sars. Bid. Christ. Fauna, p. 2.
1874. ,, ,, Malm. Goteborgs Kongl. Vet. o. Vitt. Samhal.es Handl; Ny. Tid-foljd, Haft. xiv, p. 74.
1876. *Eunoa nodosa*, McIntosh. Trans. Z. S., ix, 374, pl. 67, f. 4—8.
1879. *Polynoe scabra*, Théel. Annel. Nov. Zemb., 7.
,, *Eunoa nodosa*, Tauber. Ann. Danic., 81.
1883. ,, ,, Wirén. Chæt Vega-Exped., 387.
,, *Harmothoë nodosa*, Levinsen. Nord. Annul., 193.
1884. *Eunoa nodosa*, Webster and Benedict. Ann. Mass., 700.
1886. *Eunoe scabra*, Marenzeller. Porif., &c., Jan Meyen, p. 11.

Habitat.—North Sea, Lieutenant Thomas; Zetlandic Sea, Dr. Gwyn Jeffreys; off Holy Island, Tynemouth, 25—30 fathoms, Professor G. S. Brady; stomach of the cod, St. Andrews, E. M.

A fine example, from the collection of the late Dr. D. Robertson, comes from Cumbrae, on the west coast of Scotland, but none have yet been received from the coast of Ireland.

It ranges to 690 fathoms on the Channel Slope. 'Porcupine,' and 125 fathoms off Cape Rosier in the Gulf of St. Lawrence (Whiteaves), and thence to Cape Cod (Verrill). Malmgren gives the shores of Spitzbergen, Greenland, Finmark, and Scandinavia.

Length $1\frac{1}{2}$ in. to $2\frac{1}{4}$ in. (Clyde). Some of the foreign examples are about $2\frac{1}{2}$ in.

Head (Plate XXVII, fig. 9).—Nearly as broad as long, with a median sulcus in front, the sides trending to the peaks, which are free from the base of the median tentacle, the base of which extends outwards from the sulcus. No specimen had a tentacle, but Malmgren observes it resembles that of *E. œrstedi*, which is covered with long cilia with clavate tips. Moreover, towards the swollen distal region, below the filiform tip, a few large conical papillæ with bifid tips are present—probably as an abnormality. This, however, may differ considerably from the organ of *E. nodosa*—which may be less elongate. and have shorter cilia. The lateral tentacles are short, with small clavate cilia and a filiform tip. The tentacular cirri are similar to the median tentacle, but shorter. The eyes are comparatively large, two being situated in front of the posterior border towards the lateral region, and two just in front of the lateral projection of the head. The palpi are subulate organs marked by six rows of conical papillæ, which become larger towards the tip of the organ.

Body large and broad, somewhat more rounded dorsally than ventrally, slightly tapered anteriorly, very gradually but much more tapered posteriorly. Dorsally, it is readily separated from other allied genera by the presence of the peculiar expansion at the base of the dorsal cirrus. The bristled segments are thirty-six in number. The shorter dorsal bristles at once distinguish the species when compared with *E. œrstedi*. Dorsally, the segments are generally marked by a transverse bar often dimpled at the outer edges, and by irregular papillæ internal to the scale-bearing process. Ventrally, the usual median groove marks the centre.

Posteriorly the body terminates in two caudal styles, which have a similar structure to the cirri.

None of the spirit preparations show colour along either dorsal or ventral surface, except a few touches on the area below the median and lateral tentacles; thus the species is in contrast with *E. œrstedi*. The only pigment visible consisted of a brownish hue on the lateral tentacles, and a brownish ring below the dilated region of all the cirri.

Proboscis.—No example of *E. nodosa* has an extruded proboscis. *E. œrstedi* shows nine dorsal papillæ and nine ventral, and the teeth are powerful. In *E. œrstedi* three gastric cæca pass forward to the dorso-lateral wall of the peripharyngeal space, the fourth being nearly transverse. The longest is the ventral, which forms a narrow tube anteriorly and extends to the fourth segment in front of the stomach. The posterior half, however, is widened by two or three sacculations at its outer edge. The second and third are shorter and wider clavate cæca, terminating in the corresponding spaces behind the first. The stomach, if we may so term the anterior dilated part of the intestine, has thick muscular walls, and its inner surface has a closely arranged transverse series of firm glandular lamellæ, interrupted at short intervals, so as to be crenate or papillose. These ridges become less and less distinct as we proceed backwards, until towards the vent the thin wall shows only the distinctly isolated papillæ as in *Halosydna gelatinosa*. It might be considered that the foregoing appearances of the stomach were due to the condition of the preparation, but such did not seem to be the case.

The external opening of the segmental organ has no papilla, but is marked in *E. œrstedi* by a blackish pigment-speck. In one example two specks were present on a posterior foot. The genus thus diverges from *Harmothoe*.

Scales.—The scales (Plate XXXII, fig. 3) of this form are distinguished from *E. œrstedi* by their more leathery consistence, by their characteristically reniform outline, by their longer and more abundant cilia on the outer edge, and by the divergent character of the tubercles, which are much more developed in *E. œrstedi*. The anterior scales, as usual, are rounded, but the typical scales are reniform with the free parts studded with small horny tubercles and a row of from six to nine much larger blunt horny tubercles, or short cones, some of which, a little within the posterior border, present a bluntly spinose condition at the tip. The anterior and inner margins are smooth, while along the posterior border a few isolated short cilia occur, gradually increasing in length till they terminate at the outer edge in the long cilia with the clavate tips. In

E. œrstedi, again, the anterior edge of the typical scale (anterior third) is smooth, but otherwise the entire margin has short clavate cilia scattered at intervals amongst the tubercles and spines, the outer edge having these no more prominent than the inner.

Considerable variation exists in regard to the size and distribution of the smaller spines over the surface. Thus in the figure from the specimen in the British Museum these are comparatively small both towards the inner border and along the anterior edge, but, on the general surface, the size increases while the number diminishes. The contrast between the outer and the inner borders is marked, the former having fewer and larger spines. The number of the large papillæ along the posterior edge is nine to eleven, which is more than usual, and some of them show spinous tips. The cilia are confined to the outer edge.[1] An increase in the size of all the spines takes place in an example from Spitzbergen, the larger forms on the general surface being proportionally few. Only five large tubercles are present, with traces of spines at the tip of one or two; some sparsely distributed cilia occur along the posterior border as well as the denser series of the outer edge. In fine specimens from the Gulf of St. Lawrence the proportions of the various spines agree rather with the British forms, but a few short cilia are found along the posterior border in addition to the longer outer series.

Colour.—No fresh example has been seen, so that all that can be said is that the scales are marked with reddish-brown or madder-brown touches, darkest in the anterior scales. Malmgren observes that the scales have a violet-brown hue, generally with a white spot in the middle.

Feet.—The first foot—bearing the tentacular cirri—has a few (about three) bristles which conform to the type of the dorsal, being stout, slightly curved, and spinous on the convex margin, with a short, smooth tip, which affords a contrast to the more elongate tip in *E. œrstedi*.

The second foot is distinguished, as usual, by its long ventral cirrus, and by the diminution and modification of its parts. The dorsal division has bristles of the ordinary type. The tip of these is short and smooth, and the curvature of the inner bristles is marked. The same foot in *E. œrstedi* has much longer and less curved bristles, and the smooth region at the tip is longer and has a different outline.

Ventrally is a group of much more slender bristles, with long spines on the distal region and a needle-like, smooth extremity (Plate XXXVII, fig. 20). The tip of the corresponding bristle in *E. œrstedi* is less elongate, and, instead of the finely-pointed tip, it has the outline of a narrow knife-blade (Plate XXXVII, fig. 21).

In the third foot the dorsal bristles are smaller than in the typical foot, but have the same structure. The ventral bristles, again, though slender, already show shorter tips, which, further, are less acute than in the first foot.

The changes in the bristles have considerably advanced in the fourth and fifth feet, so that the typical arrangement (Plate XLII, fig. 28), in which the longest dorsal bristles reach a little beyond the spine of the ventral, is soon reached. These bristles (Plate XXXVII, fig. 26) are shorter and more distinctly curved internally, the longer and

[1] A large Zetlandic example, the *Antinoë zetlandica* of Prof. Ray Lankester, corresponds in the main with the foregoing, though the large spines posteriorly extend along the outer border, and, like the former, the cilia are confined to the outer edge.

straighter forms being external, that is, next the ventral. The tips have the character shown in fig. 24, Plate XXXVII, viz. less tapered than in *E. œrstedi* (Plate XXXVII, fig. 25)—with a shorter smooth portion and more boldly marked spinous rows.

The ventral bristles (Plate XXXVII, figs. 22 and 27), on the other hand, have proportionately longer spinous regions superiorly than in *E. œrstedi*; the tips are more distinctly hooked, and the bare portion is broader on an average than in the species just mentioned (Plate XXXVII, fig. 23). The latter is not what might have been expected from the condition anteriorly. The ventral cirrus extends a little beyond the inferior border of the foot.

Posteriorly both dorsal and ventral bristles become more attenuate, as well as smaller, in conformity with the diminished feet, but they do not assume the elongate and slender condition observed anteriorly.

Two very large examples from the stomach of a cod agree with the fine Zetlandic specimen in having the smooth tips of the dorsal bristles somewhat shorter. On the other hand, young specimens (about ¼ of an inch) have longer tips to the dorsal and ventral bristles, and the scales are more rounded and have proportionally thicker cilia.

While the scales in the examples from Spitzbergen agree in shape and structure with those from the Gulf of St. Lawrence and Britain, the dorsal bristles have assumed a more elongated condition, so as to resemble those of *E. œrstedi*, being more tapered, and with a longer bare portion at the tip; yet the general curve of these bristles is more pronounced than in *E. œrstedi*. The tips of the ventral bristles are also proportionally longer than in the ordinary type. The typical characters of *E. nodosa* are seen in examples from the Arctic seas (Greenland), where the species attains a large size. The distinctions between the two forms are therefore evident, but whether two species should be formed may be to some an open question.

A parasitic sponge, with long processes, occurs on a scale of the example from Cumbrae.

Habits.—So far as can be ascertained, the present form is only found in deep water off the British shores, and that but rarely. It is more abundant in the northern seas of both Europe and America. *Loxosomæ* abound on the feet and bristles of those from the Gulf of St. Lawrence.

Reproduction.—The only example of the genus observed with fully developed reproductive elements is a large female of *E. œrstedi*, from Greenland, distended with ova, and probably procured in July.

This is one of the many forms that marine zoology owes to the industry and keen observation of the elder Sars, who patiently explored the shores of his native country for so many years and with such remarkable success.

It is difficult to know to what Sir J. Dalyell (1853)[1] refers under the name of *Aphrodita squamata*, from Shetland, unless it be this species. Théel (1879) noted that *Eunoa nodosa* and *E. œrstedi*, Malmgren, were the same species, viz. the *Lepidonotus scaber* of Œrsted, an opinion coinciding with the remarks made by myself many years previously. He procured large examples (70 mm.) at a depth of 90—200 metres in the Kara Sea (Nova

[1] 'Pow. Creat.,' ii, 166, pl. 21, f. 3, 4.

Zembla). The processes on the scales vary considerably in size, but he did not sufficiently discriminate between the forms.

The *Polynoë islandica* of Dr. Hansen (1882)[1] is probably either a variety of this species or *E. œrstedi*, in which the tentacles are smooth. His *P. arctica*[2] I would also be inclined to unite with the same form. Nor does any other conclusion seem to present itself with regard to his *P. assimilis*,[3] his *P. spinulosa*,[4] or his *P. foraminifera*.[5] From the inexperience of the artist, Dr. Hansen's figures are not reliable, the tentacular cirri, for instance, springing as a single trunk which becomes bifid, a condition which can only occur as an abnormality.

Wirén, in his account of the annelids of the 'Vega' Expedition, expresses the same view as Théel and the writer, and he gives notes on five varieties, with figures of three examples of scales, which differ considerably in regard to the papillæ.

2. Eunoa tritoni, *McIntosh*.

1898. *Eunoa Tritoni*, McIntosh. Ann. Nat. Hist., Aug., 1898.

Specific Characters.—Head somewhat pyriform, with the broad end posteriorly, a median furrow and two minute peaks close to the base of the median tentacle. Eyes equal, of moderate size, placed on each side of the lateral eminence. Lateral tentacles short and densely ciliated. Palpi with rows of minute clavate cilia. Body normal; segmental papillæ commence on the sixth foot and continue almost to the posterior end. Scales reniform in outline, densely fringed with long cilia on the outer edge. The surface of the scale has a series of capstan-like tubercles with a minutely nodular surface towards the posterior border, the general surface being studded with minute spines. Dorsal and ventral divisions of the foot have each a long process for the spine. The dorsal bristles are long, little tapered at the tip, which forms a short blunt cone invaded by the spinous rows so closely that the tip of the bristle is almost reached. Ventral bristles with slender shafts, spinous tips of the average length, and a long and rather broad terminal region, with a well-marked hook.

Trawled on board H.M.S. 'Triton,' at Station 8 (Faroë Channel?), 22nd August, 1882, in 640 fathoms.

A comparatively large species, about 34 mm. long.

Head.—Somewhat pyriform, with the broad end posteriorly, a median furrow in front, and two minute peaks close to the base of the median tentacle. Eyes of moderate size, equal, visible from the dorsum, placed on each side of the lateral eminence, and thus towards the middle of the region. The anterior pair look slightly forward and outward. Median tentacle absent. The lateral are comparatively short and densely ciliated. The palpi have rows of minute clavate cilia. Tentacular cirri absent.

[1] 'Norweg. N. Atlantic Exped.,' p. 24, pl. i, figs 15—21.
[2] Ibid., p. 27, pl. iii, f. 1—5.
[3] Ibid., p. 27, pl. i, f. 22—26.
[4] Ibid., p. 28, pl. i, f. 6—10.
[5] Ibid., p. 29, pl. i, f. 11—14.

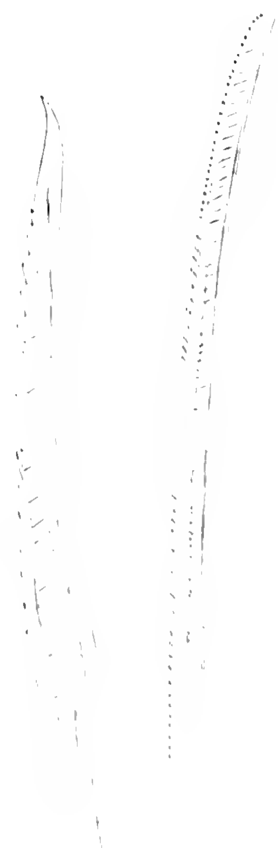
Body.—Convex dorsally, flattened ventrally, slightly tapered anteriorly, and more gradually posteriorly. Bristled segments about 40. The bases of the dorsal cirri show an expansion. The markings on the dorsum correspond with those of allied species. The segmental (nephridial) papillae are visible on the sixth foot, and are directed upwards between the feet. They continue almost to the posterior end.

The scales are more nearly allied to those of *E. nodosa* than to those of *E. œrstedi*, being somewhat reniform in outline, densely fringed on the outer or narrower edge with long cilia ending in a probe-point (Fig. 21). Posteriorly these gradually diminish and run into

Fig. 21.

Outer edge of scale of *Eunoa tritoni*.

Fig. 22.



Eunoa tritoni.—Dorsal bristle to right and ventral to left.

the short cilia which occur at intervals along this border to the inner edge. Besides the cilia a series of eight or nine capstan-shaped tubercles, with a minutely nodular surface, project from the posterior border, besides others within it, and, in addition, two or sometimes three much larger tubercles of a similar shape are ranged a little within the posterior border. These larger tubercles are thus fewer in number and proportionally larger than in *E. nodosa*. Just within the densely ciliated outer border are a series of elongated papillae, with trifid or multifid tips (Fig. 21). They extend along the outer border, and also form a group in the neighbourhood—within the anterior edge. The anterior border of the scale is smooth, with the exception of an isolated group of one to five or more long cilia some distance from the outer edge. The entire surface of the scale is densely studded with minute spines, smallest in front and increasing in size posteriorly. The developing scales are of various degrees of smoothness, the youngest being quite smooth.

Both dorsal and ventral divisions of the foot bear a long pointed process for the spine. The dorsal division has characteristic bristles (right of Fig. 22), which somewhat approach those of *Harmothoë haliaeti*, though quite distinct. They are of considerable length, slightly curved, and not much tapered at the tip, which, indeed, ends in a short blunt cone, and in some shows a slight fold or differentiation on the spinous side. The short bare cone at the tip is much broader than that of *H. haliaeti*, and has a different character. The spinous rows so nearly approach the tips that they in some almost reach as far as the point of the bristle, and are as close as in the species just mentioned. The ventral bristles (left of Fig. 22) have somewhat slender shafts, spinous tips of the average length, and a long and rather broad terminal region with a well-marked hook. The ventral line of the smooth tip is slightly convex.

The dorsal cirri are of considerable length—with a filiform tip. They are densely covered with long cilia having probe-pointed tips. The ventral cirri have only a few scattered and very short clavate cilia.

This fine species appears to be confined to deep water.

Genus XI.—Lagisca, *Malmgren*, 1865.

Body rather narrow, attenuate posteriorly. Cephalic lobe produced into lateral peaks. Lateral tentacles attached below the median. Eyes four; two lateral just in front of the middle line, two in front of the nuchal border. Scales fifteen, covering the dorsum—except the last few. Bristles of the dorsal lobe with acute tips and finely serrated. Bristles of the ventral lobe simple superiorly and inferiorly, rest bidentate, and all with long spinous rows. Papillae of proboscis $\frac{9}{9}$. Two slender caeca go forward into the peripharyngeal space. Segmental (nephridial) papilla commences as a minute process on the fifth foot, and extends nearly to the last foot. It is much smaller than in *Harmothoë*.

1. Lagisca floccosa, *Savigny*, 1820. Plate XXVI, fig. 2.

Specific Characters.—Body rather narrow throughout, slightly diminished anteriorly, and much more so posteriorly. Median and lateral tentacles, and the tentacular cirri rather short, densely ciliated and with filiform tips; little or no enlargement below the latter. Eyes large, posterior in front of the nuchal border; anterior lateral in position, and just in front of the middle line. First pair of scales rounded, the others reniform or somewhat ovate, mottled greyish brown, often with a white spot in the centre, densely covered with minute spines (visible under the microscope), and having posteriorly a series of soft globular papillæ arranged at intervals just within the margin. Cilia on the outer border—very few and short. Dorsal bristles with acute tips and finely serrated; ventral bristles with the tips simple superiorly and inferiorly, rest bidentate. Alternate spinous rows long, though the bristle-tip is proportionally short. Dorsal cirri with numerous and rather short cilia. Ventral cirrus smooth.

SYNONYMS.

1820. *Polynoë floccosa*, Savigny. Syst. Annel., pp. 22, 23, and 27.
1828. *Eumolpe floccosa*, Blainville. Dict. de Sc. Nat., vers., 459.
1834. *Polynoe floccosa*, Aud. and M. Edw. Ann., 88.
1851. ,, ,, Grube. Fam. d. Ann., 37 and 120.
1865. ,, ,, De Quatrefages. Ann., 236.
,, ,, *semisculptus*, Johnst. Cat. Brit. Mus., p. 116, pl. v, f. 1—11, and pl. vi, f. 4—6.
1867. *Lagisca propinqua*, Malmgren. Ann. Polych., p. 9, Tab. i, fig. 3.
1870. *Polynoë floccosa*, Grube. Archiv f. Naturges., 287.
1873. *Lagisca propinqua*, Sars. Bid. Christ. Fauna, p. 3.
1875. *Polynoë floccosa*, McIntosh. Invert. and Fish., St. A., p. 116.
,, ,, ,, McIntosh. Trans. Z. S., ix, 380, pl. 68, f. 6, 8, 10.
1876. *Lagisca propinqua*, McIntosh. Trans. Z. S., 375, pl. 67, f. 12—14.
1879. ,, ,, Tauber. Ann. Danic, 81.
1880. ,, ,, Langerhans. Die Wurmfauna Madeiras, Zeit. f. w. Zool., xxxiii, p. 274. Taf. xiv, fig. 3c.
1882. *Polynoë semisculpta*, Hansen. Norweg. N. Atl. Exped., 26, pl. iii, f. 16—20.
1883. *Harmothoë propinqua*, Levinsen. Nord. Annul., 192.
,, ,, *semisculptus*, Ibid.
1886. *Lagisca propinqua*, Harvey-Gibson. Verm. Liverpool, 148.
,, ,, ,, Langerhans. Zeit. f. w. Zool., xl, 251, Taf. 15, f. 6.
,, *Polynoë floccosa*, Harvey-Gibson. Verm. Liverp., 150.
1891. ,, (*Lagisca*) *propinqua*, Hornell. Op. cit., p. 234, pl. 13, f. 1, 7, 9.
1896. *Lagisca propinqua*, var. *abyssorum*, Roule. Camp. d. 'Caudan,' 444.
1898. *Harmothoë semisculptus*, Michaelsen. Grönland. Annel., Bib. Zool., Heft 20, Lfg. 4, p. 121.

Habitat.—Everywhere on the British shores from Shetland to the Channel Islands, where it is the chief form between tide-marks. It also ranges from 600 fathoms to low-water mark. It extends to the Gulf of St. Lawrence in Canada, as well as to Norway and Sweden. It was procured likewise during the 'Vega' Expedition, and apparently also is found in Greenland.

Length $1\frac{1}{2}$ inches, breadth about $\frac{1}{4}$ inch.

Head (Plate XXVII, fig. 14) with a median furrow anteriorly, which passes on each side of the base of the tentacle to the peaks. The black eyes are comparatively large, the posterior pair being dorsal in position and somewhat nearer each other than the anterior pair. The latter are more or less lateral in position just in front of the prominent median region. They are slightly larger than the posterior pair. Both pairs show in some specimens a cuticular lens, like a central speck. The median tentacle is rather short, with a long filiform tip and a slight swelling below the latter. It has short clavate cilia. The lateral tentacles are also short with similar cilia, and a long filiform tip. They have a dark bar at the base, then a pale region with another bar below the filiform tip. If colour is to be relied on, the pale part would be homologous with the slightly swollen region in other forms. The tentacular cirri are similar to the median tentacle. All these cirri have the slightly enlarged part pale, with a brown band on each side, and the column below is brownish. The palpi show minute papillæ-like serrations along the sides under a high power, probably partly due to the rigid contraction. They thus differ materially from those of *Harmothoe imbricata* with the minute clavate cilia.

The *Body* is narrower than in *Harmothoe imbricata*, and the line of bristles on each side is straight and trim; moreover, it has a general firmness which is characteristic. The anterior end diminishes from the eighth or ninth bristled segment towards the head, while posteriorly the diminution, which is gradual, begins shortly behind the middle, and

FIG. 23.

Papillæ and teeth of the proboscis of *Lagisca floccosa*.

the body terminates in a process bearing the two caudal cirri beneath the vent. The number of bristled segments is about forty-two. Dorsally the latter are marked from the head backward by a median series of brownish touches, which posteriorly show a somewhat symmetrical arrangement in the centre of each segment, consisting of an anterior, narrow, curved bar, a fan-shaped region divided by a median streak and a short transverse bar posteriorly. A prominent dark patch also occurs on the papilla (homologue of scale-papilla) and a little pigment at the base of the dorsal bristles. The ventral surface is pale and iridescent; the nephridial papilla is smaller than in *Harmothoe imbricata*, and passes into the fissure between the feet. A considerable portion of the tail is devoid of scales, and it is this region which has the pigment on the dorsum best developed. The segmental (nephridial) papilla commences on the sixth foot, and extends to the posterior feet as a very minute process.

Proboscis.—The extruded proboscis (Fig. 23) has the usual teeth, the lower pair biting to the right of the upper, nine flattened conical papillæ dorsally, and nine ventrally at the margin. The skin-folds at the mouth are marked by brownish pigment. The pre-gastric cæca are short and small. The ventral alone is conspicuous in the preparations, for the second proceeds little beyond the stomach, and the third is nearly transverse.

Scales (Plate XXXII, fig. 5)—fifteen pairs. First pair rounded, the others reniform or ovate-reniform, the last pair being ovoid, of a brownish-red colour, or sometimes slightly purplish marbled with grey. They generally show a pale area over the scar for the pedicle, and from the depth of the colour this is best marked anteriorly, the pigment in the posterior scales being broken up into a series of touches and granules. The entire surface, with the exception of a small area at the anterior and inner border, is densely covered with minute spines, which are longest towards the outer border. The posterior edge, again, has just within the margin a series of soft globular papillæ arranged at intervals and visible under a lens. Some are slightly clavate in outline, while the tip in others is truncate or slightly nodular. They are few in number on the last scales. A few short slender cilia occur at the outer or posterior margin. The under surface is iridescent, and the scar for the pedicle is near the hilus or indentation, where it is present, on the outer border. The first pair of scales have a few short cilia on the inner border, and a well-marked series of clavate cilia on the outer and anterior margin. The large globular papillæ on these are from four to six in number. A variety procured by the 'Knight Errant' at Station 2 (1882) is pale, with few and small tubercles on the posterior border of the scales.

Feet.—The first foot has two dorsal bristles, one curved and less pointed, the other straighter and more acute. The spinous rows are more distinct than in the typical foot. The tip in both is minute.

The second foot has a dense tuft of dorsal bristles, generally more curved and with more distinct spinous rows than in the typical foot, and the bare portion at the tip is proportionally broader and better marked. The slender ventral bristles have rows of long spines and simple tips, those at the ventral edge of the series approaching the pinnate type seen in other forms. They do not project beyond the dorsal bristles.

The third foot has the dorsal bristles less curved and the tips more acute. In the ventral division the bristles have increased in strength, and, while the upper and lower series have simple tips, the rest have the secondary spur. The tip of the smooth ventral cirrus is long and filiform.

In the fourth foot the ventral bristles have become more prominent by the increase of the fleshy part of the foot, and some simple tips still occur superiorly, and a more numerous series inferiorly. The spinous rows are long. The dorsal bristles are elongating, the long outer ones having acute tips, the inner broader smooth tips.

In the typical foot the dorsal division has long and very slightly curved bristles with gently tapered acute tips throughout, the sharpest tips as usual being external (on a slide next the ventral). They are thus easily distinguished from those of *Harmothoë imbricata*, and also by the much closer spinous rows. Bristles of the same length are decidedly more slender than in *H. imbricata*. One of the longer forms is represented in Plate XXXVIII, fig. 2. The tip tapers to a smooth, blunt point, and immediately below the latter very fine and close spinous rows occur. A glance at the latter in rapidly examining specimens is one of the most satisfactory points in discrimination. The ventral division bears superiorly a series (Plate XXXVIII, fig. 1) with long spinous extremities, more slender and with longer spinous rows than in *H. imbricata*. In a few the smooth tips have no secondary process. The next series has a small secondary process, and the spinous border gradually diminishes in length. The bifid tip differs from that of *H. imbricata*, especially in regard to the minute size of the secondary process. Inferiorly the tips are again simple. Posteriorly the structure of the dorsal bristles remains nearly the same, but the ventral become attenuate, the bifid tip being visible, but the secondary process is minute. The dorsal cirri have a dark bar above and below the slight enlargement towards the tip, and the latter is attenuate. The cilia are numerous, rather short and clavate, and extend beyond the distal pigment-bar. They become more slender posteriorly, but have the same structure. In these translucent organs the areolæ of the hypoderm (epidermic granular layer) are very visible. The long first ventral cirrus is ciliated like one of the dorsal, and some of the succeeding ordinary forms show a few cilia. These gradually disappear and leave the cirrus smooth throughout the greater part of the body.

Some from Guernsey have the dorsal bristles covered with a reddish-brown or dull orange granular coating, from the surface of which minute algoid filaments project. Such would seem to be parasitic. A similar growth occurs on the dorsal bristles at St. Andrews.

In my notes of November, 1873, at St. Andrews, this species (and the preparation accompanies) is described as phosphorescent, but recent examination, both when laden with ova in January and in the warmer months, such as July, has not borne out this description. In the preparation the bristles, especially the dorsal, are covered with a parasitic granular growth.

Though this form is more plentiful in the south, the size of some dredged off Balta is quite as large as elsewhere.

In a specimen from Lochmaddy in which five of the posterior feet of the right side had been removed, long papillæ from the dorsal border (cirri?) and shorter papillæ from the ventral indicated regeneration.

Reproduction.—A specimen from St. Andrews in November was laden with ripe ova, so that the breeding season would seem to be in winter, as in the case of *Harmothoe*.

Variety.—A very distinct variety comes from the 'Porcupine,' 1869, 173 fathoms, on muddy sand, bottom temperature 49°6° ; from 45 fathoms, eight miles N.W. of Cape Sagres, 'Porcupine,' 1870 ; off the Hebrides, 1866, Dr. Gwyn Jeffreys ; West Sands, St. Andrews, 1867 (R. M.) ; and 90—25 fathoms, 30—50 miles west of Valencia, Ireland (Prof. Haddon). Abundant in various parts off Shetland, Dr. Gwyn Jeffreys, 1867–8.

The pigment on the scales is similar ; that on the naked segments posteriorly, however, diverges, for it forms a single fan with a posterior bar only. Moreover, the papilla for the dorsal bristles has black pigment. No appreciable change is observable in the structure of the scales. The distinguishing feature is the condition of the dorsal bristles, which, instead of forming the elongated tip so characteristic of the typical form, end bluntly, so that the whole tip is broad, with a very short, bare portion at the tip. The spinous rows are as closely arranged as in the normal form. The ventral bristles and cirri do not differ from the typical example.

A form dredged by the 'Porcupine' in 173 fathoms, 1869, and in 160 fathoms, 17th August, 1870 (No. 42), differs from *Lagisca floccosa* and its variety in having no distinct bosses or globular papillæ on the scales posteriorly, while considerable papillæ occur anteriorly ; the scales, moreover, having much larger spines, which show a tendency to be arranged in rows in the reniform scales, the largest being near the posterior border. In the first pair of scales the spines are larger, and the short cilia extend at intervals all round, while a few short cilia occur along the outer and posterior edge. The ventral cirri have a few clavate cilia. The bristles of the dorsal branch of the foot (Plate XXXVIII, fig. 3, an average form) have the spinous rows much more distinct than in *L. floccosa* or its variety, and the smooth portion at the tip is small and acutely pointed. The ventral bristles do not much differ. The anterior pair of eyes are proportionately much larger than in *L. floccosa*.

The *Polynoë foliosa* of Savigny (1820) seems to come near this species.

De Quatrefages (1865) describes it as having a small head, almost quadrate, a long thick median antenna, the lateral small and slender. Segments 40—42. Scales large, much imbricated and decussate, rounded, smooth, not ciliated, caducous. He procured it, 42 mm. long, on the oyster-banks at St. Vaast. When living it is of a brownish-white colour (reddish brown ?), and thus is readily distinguished from its congeners.

Grube found a species at St. Vaast, where De Quatrefages had met with his, with only fifteen pairs of elytra, which, however, had cilia on their border ("Am Aussenrande gefranzte Elytren besitzt"). If such be so, then the species differs from *Lagisca floccosa*, in which no cilia are present on the scales.

Hornell says his specimens possess fifteen pairs of elytra, with only subglobular processes on the margin (whereas *P. floccosa* has clavate). He thinks Malmgren's artist exaggerated the spikes on the dorsal bristles, making them too coarse. His specimens agreed in colour with Malmgren's *L. propinqua*, but differed from mine. He figures one of the globular papillæ near the margin of the scale.

L. Roule found what he thinks a variety at depths ranging from 650 metres to 1700 metres in the Atlantic, with small eyes and pale scales. Its relationship to other closely allied forms has yet to be determined.

2. Lagisca Elisabethæ,[1] *McIntosh*, n. s.

Specific Characters.—This species has 30—35 segments, but a considerable portion of the tail is absent. Head curiously mottled with black. Eyes black, nearly equal; a pair at the anterior border, and the other on the lateral prominence of the head. Tentacles and tentacular cirri ciliated, and the ventral cirri have also short clavate cilia. Palpi with a dense series of minute papillæ with enlarged tips. Scales, probably fifteen pairs, scabrous, greyish mottled with black, densely spinous, with one or two large conical processes posteriorly, and the outer and posterior edge fringed with club-shaped cilia. Dorsal bristles with well-marked spinous rows, and a minute bare portion at the tip. Ventral bristles mostly bifid. Akin to *L. floccosa*.

Synonyms.

1875. *Lagisca propinqua*, McIntosh. Invert. and Fish., St. A., p. 115.
1876. „ „ Ibid. Trans. Zool. Soc., ix, p. 375, pl. lxvii, figs. 12—14.

Habitat.—Procured from the débris brought by fishing-boats from the off-shore waters, St. Andrews, 1870 (E. M.).

Head (Plate XXVII, fig. 3).—The head is curiously marked, for a pale band of considerable breadth occurs posteriorly—boldly defined by the blackish collar. A pale

[1] Named after the best benefactress in Marine Zoology my museum ever had.

belt runs from this forward in the median line to the base of the tentacle, which is blackish; and the anterior areas of the head thus mapped off are brownish red, with dark grains along the edges. The anterior pair of eyes are lateral, lying in front of the brownish-red border of the region. The posterior pair are large, black, widely separated, and situated on the pale band of the region. The median tentacle is absent. The lateral tentacles are short, brownish at the base, with a filiform tip, and furnished with long clavate cilia. The palpi have a dense series of minute papillæ, with enlarged tips. The tentacular cirri have a blackish patch at the base, a light brownish one in the slightly dilated portion near the tip, then a whitish ring, and lastly, a dark brownish one at the base of the filiform termination. They possess long cilia with globular ends.

Body.—The body is typical, that is, slightly narrowed in front, more so posteriorly, about 13 mm. in length, and mottled with blackish pigment on the dorsum in a remarkable way. The dorsum of the first four segments is mainly blackish, then each segment presents near the posterior border a median bar, which by-and-by becomes a speck. Symmetrical touches of pigment mark the lateral regions of each segment, and two blackish specks occur on the base of the foot. A well-marked median band of black characterises the dorsal lip; the ventral surface is otherwise pale. The pale scale-pedicles are very distinct, and proportionally large.

The dorsal cirri agree in colour with the tentacular cirri, and besides the longer cilia with globular ends on the column of the organ, shorter cilia proceed upwards rather beyond the lower third of the extremity. The ventral cirrus is subulate, with sparsely distributed and short clavate papillæ. The first has a dense coating of cilia, with large globular tips.

Scales (Plate XXXII, fig. 6) probably fifteen in number, though the last pair had disappeared in the specimen. The first pair are rounded, densely spinous, and ciliated almost entirely round; the cilia being longest externally, and with characteristic globular ends. The rest of the scales are more or less reniform, becoming ovate posteriorly. The general colour of the scales is dark greyish with a blackish patch in the centre, the pigment being broken into fragmentary portions. The outer and posterior edge is ciliated, as indeed is the greater part of the circumference. They commence as short, almost baccate processes, and towards the outer edge are more elongate, the extremities being nearly globular, the series again diminishing to terminate in short papillæ. With the exception of the covered portion of the scale the surface is densely covered with minute and rather blunt spines, a few of which towards the outer and posterior edge become larger acute processes, or bluntly conical papillæ. A considerable portion of the inner region of the scale is curiously reticulated, so that the spines are grouped in areas—a condition visible under the lens as well as the microscope over the greater part of the scale. The anterior and outer border has larger spines than those on the general surface, as shown in the figure. From the extreme roughness of the scale, mud and débris lodge in the crevices.

Feet.—The first foot has two curved bristles which correspond in structure to the dorsal type, though the smooth tips are somewhat broader.

The dorsal bristles of the second foot are nearly typical, except that the smooth tips are larger. The ventral are more slender than the subsequent forms, but show a bifid tip.

The dorsal division in the typical foot bears a somewhat dense mass of rather short pale bristles with a slight curvature. The tips are short and by no means acute (Plate XXXVIII, fig. 4, representing one of the longer forms). The spinous rows are much more distinct and longer than in *Lagisca floccosa*, and the shape of the bristle differs. The ventral division has translucent bristles with moderately long shafts. The tips of the superior series (Plate XXXVIII, fig. 5) are long and somewhat tapered, with rather distant rows of long spines, the smooth terminal region being minutely bifid. The tips gradually become shorter and stouter inferiorly (Plate XXXVIII, fig. 6), the strongly curved terminal hook and the secondary process with its characteristic angle of incidence being noteworthy. Some of the latter bristles show traces of an outward curve between the secondary process and the first row of spines. Towards the ventral border the secondary process diminishes with the general size of the bristle, but a minute trace occurs in almost all.

The dorsal bristles in most feet are densely coated with débris and minute filamentous algoid growths, and in some cases the tips of the ventral are likewise encrusted with a parasitic structure showing minute rods.

This species approaches the *Polynoë aspera* of Hansen [1] from the Norwegian North Atlantic Expedition, and of Théel,[2] from Nova Zembla, but differs in regard to the palpi, which are smooth in the northern form, and also in the shorter tips (bare) to the dorsal bristles. It may be that further examination will show they are identical.

3. Lagisca Jeffreysii,[3] n. s.

Specific Characters.—Length 16 mm. or more. Head more elongate than in *Lagisca floccosa*, with blunt anterior peaks. Posterior pair of eyes just in front of the collar, anterior pair somewhat further forward than in *L. floccosa*, and lateral in position. Median tentacle absent; lateral subulate, and slightly beneath the base of the former. Tentacular cirri slender, and with a series of clavate cilia which commence only when the basal third of the process is reached. Palpi have rows of minute papillæ with nodular tips. First scales rounded and minutely spinous, rest ovate-reniform, with a distinct fold from the scar of attachment to the hilus at the anterior border, speckled throughout the posterior half with pale specks as if variolated. The outer border has long cilia. Dorsal bristles of moderate length, with well-marked spinous rows, and a very short smooth tip. They are nearly straight. Ventral bristles with rather short spinous rows, and a short bare tip with a strongly curved hook at the end, and a secondary process—directed nearly straight—distally. Ventral cirrus with clavate cilia.

Habitat.—Dredged in sixty fathoms, nine miles off Balta, in 1868, by Dr. Gwyn Jeffreys.

[1] 'Nat. Mag. f. Naturvid.,' 24, p. 4, 1877, and 'Norsk. Nordh. Exped.,' vii, p. 5, pl. ii, f. 11—15, 1882.

[2] 'Annel. N. Zemb.,' p. 10, pl. i, f. 1—4, 1879.

[3] After the late Dr. Gwyn Jeffreys, a veteran explorer of the Zetlandic seas. The name was formerly given to the succeeding species—now associated with *P. cirrhata*, Grube.

Length 16 mm., but the specimen had the posterior extremity regenerated, and therefore was probably considerably longer.

The head (Plate XXVII, fig. 10) is more elongate than in *L. floccosa*, and the peaks in front terminate bluntly. The posterior pair of eyes are of moderate size, and lie just in front of the collar; the anterior pair are somewhat further forward than in the species mentioned, are larger than the posterior pair, have a lens-like centre, and are more or less lateral in position. The median tentacle is absent. The lateral tentacles are short and subulate, being lateral in position, and only slightly beneath the bases of the former. They have a series of cilia with clavate tips. The tentacular, like the dorsal cirri, are rather slender, with a filiform tip and a series of clavate papillæ, which do not commence till the basal third of the process is reached, and extend within a short distance of the filiform tip. They are in moderate number, and diminish at each end of the series. The palpi are pale brown, and have rows of minute papillæ with expanded nodular tips. Two of these rows are dorsal.

The body is somewhat narrowed anteriorly, and posteriorly appears to have been recently regenerated after the twenty-fourth foot. The only colour exists in the dorsal fold of the mouth, which is brownish.

Scales (Plate XXXII, fig. 7).—The first pair of scales are rounded, and under a lens are minutely speckled as if variolated. This condition, however, is due to hypodermic structure, and does not affect the surface. The latter has a series of minute spines, which densely cover the outer and posterior part of the scale. Even in these scales a distinct fold occurs anteriorly, but no cilia on the edge. The other scales present are rather large, ovate-reniform in outline, and have a distinct fold from the scar of attachment to the hilus at the anterior border. They are faintly brownish in hue (in spirit), and on a dark surface—under a lens—are speckled throughout the posterior half with pale specks which simulate pustules. The outer border has a well-marked series of long cilia, which are not dilated at the tip. The smoothness of the edge of the scale, with this exception, is noteworthy.

Feet.—The second foot shows rather short and straight dorsal bristles, with distinct spinous rows as in *Lagisca floccosa*, var., from the 'Porcupine,'[1] with a very short smooth portion of a bluntly conical shape at the tip. The ventral bristles are slender, with elongate spinous regions and attenuate tips.

In the third foot the ventral bristles are stronger, and the bifid condition distinct in many—the secondary process passing nearly straight towards the tip.

In the typical foot the dorsal bristles (Plate XXXVIII, fig. 7) are of moderate length, with well-marked spinous rows and a very short smooth tip. They are nearly straight, with the exception of a few at the inner border of the tuft. *Loxosomæ* and algoid growths are common on these bristles. The ventral division has a dense group of pale bristles with elongated shafts, and, though the upper forms (Plate XXXVIII, fig. 8) have long tips, on the whole with rather short spinous regions, as shown in one from the middle of the foot (Plate XXXVIII, fig. 9). These bristles have very distinct spinous rows, a short bare tip with a strongly curved hook at the end, and in the majority a secondary process which is directed nearly straight distally, so that they differ quite from

[1] *Vide* p. 302.

those of *Lagisca floccosa*, which have longer spinous regions and a different curve at the tip. The ventral cirrus has well-marked clavate cilia. The segmental papilla is minute.

In the presence of the pale specks on the scales it resembles the rare *Polynoe nivea* of Sars,[1] but the absence of cilia in the latter species and other characters distinguish it.

4. Lagisca extenuata, *Grube*, 1840 (?).

Specific Characters.—Length about one and a quarter inches in spirit. Head with a deep median groove and two prominent peaks; eyes comparatively large, two in front of the nuchal collar, and two larger in front of the middle line, and lateral in position. Median tentacle somewhat long, scarcely dilated below the filiform tip, and with moderately long cilia. Lateral tentacles short, with attenuate tips. Tentacular cirri similar to the median tentacle. Palpi have rows of minute conical papillæ. Scales fifteen pairs, rounded in front, reniform posteriorly, densely covered with minute spines, and the free edge is profusely ciliated. Dorsal bristles strong, slightly curved, and closely spinous, with a smooth spear-shaped tip; ventral with a bifid tip and close rows of spines, the tips of some at the ventral edge being simple. Dorsal cirri somewhat slender, with numerous and slightly tapered cilia with bulbous tips. Ventral cirri stout, with short cilia. Segmental (nephridial) papilla scarcely distinct.

Synonyms.

1840. *Polynoe extenuata*, Grube. Actin., Echin., u. Würmer, p. 86 (?).
1861. „ *cirrata* (O. F. M.), Grube. Ausflug nach Triest, p. 81.
1865. *Lepidonotus Leachii*, De Quatrefages. Ann., p. 258?
„ „ *dumetosus*, Ibid. Annel., t. i. p. 259 (?).
1867. *Lagisca Ehlersii*, Malmgren. Ann. Polych., 9.
1868. *Polynoe extenuata*, Claparède. Ann. Nap., 70, pl. ii, fig. 2.
1870. „ „ Supp., p. 372.
1875. „ „ Marion and Bobretzky. Ann. Sc. Nat., 1875, p. 6.
„ *Lagisca extenuata*, Marenzeller. Zur Kennt. Adriat. Annel., p. 5, Taf. i, f. 1.
1876. „ *Jeffreysii*, McIntosh. Trans. Z. S., ix, p. 397, pl. lxxi, f. 8, 9, 11, and 12; pl. lxxiii, f. 17 and 18.
1884. „ *extenuata*, V. Carus. Fauna Medit., 202.
1888. „ „ De St. Joseph. Ann. d. Sc. Nat. (7), v, p. 180, pl. viii, f. 52—54.
1890. „ „ Malaquin. Ann. Boulon., 22
1891. *Polynoe (Lagisca) extenuata*, Hornell. Op. cit., 12, pl. xiii, f. 4 and 8.
1898. *Lagisca extenuata*, De St. Joseph. Ann. d. Sc. Nat. (8), v, p. 237.

Habitat.—A common Mediterranean form procured in the 'Porcupine' Expedition of 1869, in the tube of an *Eunice*, in 173 fathoms off the west coast of Ireland, and also in a free condition on the same ground—muddy sand. Next year (1870) it was dredged at the depth of 690 fathoms in the Atlantic (Channel slope).

It is also a tidal form on the eastern border of the Irish Sea.

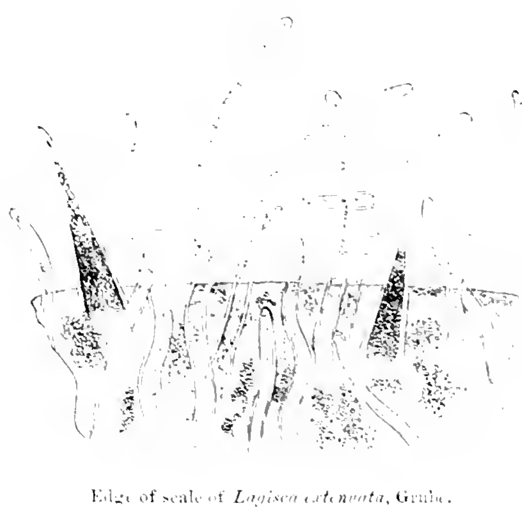
[1] 'Geol. og Zool. Reise,' 1862, p. 59.

Head somewhat hexagonal (Plate XXVIII, fig. 2), with a deep median groove at the base of the tentacle, and two prominent peaks, each of which is at a distance from the tentacles. The eyes are comparatively large, and, judging from the conditions of the largest example, increase with age and depth of water. Two slightly smaller are situated in front of the nuchal collar, and look dorsally, and two somewhat larger rather in front of the middle of the head, and lateral in position. In the example with the large eyes (from 690 fathoms) the anterior pair show traces of a corneal lens. The median tentacle is somewhat long, scarcely dilated below the filiform tip in the preparations, and covered with moderately long cilia having a slightly bulbous tip. The lateral tentacles are short, but also have attenuate tips. The tentacular cirri are similar to the median tentacle. None of these organs show any signs of pigment in the preparations. The palpi are of moderate length, and have rows of minute conical papillæ, as De St. Joseph also found, whereas Marenzeller observes that their upper surface is smooth. In the British forms one prominent papillose ridge occurs dorsally.

Body.—Somewhat narrow and elongated, slightly tapered towards the head, and very gradually towards the tail. Forty-five segments bear bristled feet, and the tail is not quite complete. Behind the distension caused by the included proboscis, the segments are boldly marked by the lozenge-shaped transverse bars which stretch between the bases of the scale-pedicles, or their homologues in the other feet. Each segment thus shows an anterior and posterior paler belt, and a median darker area. Traces of brownish pigment occur posteriorly at the bases of the feet and on the lozenge-shaped transverse bars. In some the brown pigment is broken into a number of symmetrically placed touches, two of which are on the bases of the feet, and the rest in interrupted bands across the segments. Ventrally traces of pigment occur on the lips, and the median iridescent depressed band is well marked. The conical segmental (nephridial) papillæ at the posterior border is directed upward between the feet. A considerable portion of the body posteriorly is uncovered by scales.

De St. Joseph states that there are only seventeen papillæ at the margin of the proboscis, but so far as can be seen there are nine in each half.

Fig. 21.



Edge of scale of *Lagisca extenuata*, Grube.

Scales (Plate XXXII, fig. 8) somewhat thin, in number fifteen pairs. They are rounded in front, reniform or irregularly rounded posteriorly, and of a uniform greyish hue in the preparations, though some are quite pale. Their surface is nearly smooth to the naked eye, but under a lens the whole is densely covered by a series of minute, pointed, slightly brownish spines, and the free portion of the edge is profusely ciliated (Fig. 24), the cilia being pellucid, tapering structures terminating in a bulbous tip. Marenzeller speaks of the network formed on the surface by the pigment; and Hornell mentions that the surface is mapped out into separate areas, each containing several spines. The under surface is iridescent, and the scar for attachment is situated near the outer and anterior border. Marenzeller shows, besides the spines on the edge of the scale, cylindrical papillæ, but these have not been observed in our specimens. The first scale is ciliated all round with the exception of the short covered portion.

De St. Joseph often found a white touch in the centre of the scales, which were marked with brown, grey, and whitish. Hornell's figure of the scale differs from the specimens referred to here.

Feet.—The base of first foot shows about two bristles, which conform to the type of dorsal tuft, though they are considerably smaller. In the next foot the dorsal bristles have attained great strength, though they are shorter than the typical forms, and much broader towards the tip, which is little tapered. The bristle is therefore proportionally more powerful than the typical form. They have a close series of spinous rows. The contrast between the massive dorsal and the slender ventral bristles is marked, and the tips of the longest of the latter extend only a very little beyond the extremities of the dorsal. Their tips seem to be brittle, and while the inferior are more elongated and slender, the upper forms present the characteristic short broad tips of the typical bristles.

In the third foot the size of the ventral bristles has largely increased, and they stand out nearly half their length beyond the dorsal. The tips now approach the normal, except that those of the inferior series are longer, and the upper slightly shorter.

In the typical foot (Plate XLII, fig. 30) the dorsal bristles form a powerful fan, the inner and outer borders of which have more slender forms, while the greater number consist of strong, slightly curved and tapered bristles, with somewhat closely arranged spinous rows, and a smooth spear-shaped tip (Plate XXXVIII, fig. 10), the latter having a tendency in some to follow the shape of the same region in the ventral bristles (Plate XXXVIII, fig. 11). Others, again, show a sharper tip, and at the inner border of the tuft are one or two with a slender tip. The ventral division commences with a series having very long spinous regions, and a short and characteristically shaped bare tip (Plate XXXVIII, fig. 12). The rows of spines are much finer and more dense than in *Harmothoe imbricata*—indeed, in this respect they approach *Acanthicolepis asperrima*. Those following the upper series show a distinct secondary process beneath the tips (Plate XXXVIII, fig. 13). The length of the spinous tips diminishes in the usual manner towards the ventral edge of the foot, the bare portion at the tip in several of the lowest showing no secondary process. The papilla above the spine is long and filiform, and the ventral cirrus extends beyond the bases of the adjoining bristles, and has sparsely distributed and short clavate cilia. All the bristles are of a pale yellowish hue.

Posteriorly the dorsal division diminishes in length, and disappears in some of the terminal feet. At the tail the tips of the attenuate ventral bristles become much elongated, some, however, maintaining the typical outline.

The dorsal cirri spring from the posterior border of the foot, and in those feet without scales a well-marked papilla, the homologue of the scale-peduncle, occurs at the inner border of the basal process of the cirri. They are somewhat slender, and have numerous and slightly tapered cilia with a bulbous tip. The cilia are shorter inferiorly above the base, and again distally, and they cease about the middle of the filiform tip. Posteriorly the cirri become longer and more slender, and the cilia more attenuate. The caudal cirri are also slender. The long first ventral cirrus is stout, with a distinct enlargement below the tip, which is much less filiform than the dorsal. The cilia, which are considerably shorter and more uniform in length than those on the dorsal cirri, extend from the base beyond the middle of the terminal slender region. They are slender processes with a bulbous tip.

Loxosoma occur at the bases of the bristles and algæ with other forms on them.

In Grube's original description of *Polynoe extenuata*[1] the scales are entered as smooth at the edge, and with minute warts. The inferior bristles are a fourth longer than the upper. Colour brownish grey above, bluish iridescent beneath. Elytra caducous. There is nothing to give certainty.

Baron de St. Joseph (1888) found one in the tube of *Serpula vermicularis*, but it may have simply crept there for temporary shelter. He is of opinion it is closely allied to *Lagisca floccosa*.

Hornell (1891) describes apparently the same form from the Liverpool district, though his figure of the dorsal bristles is rather indefinite. Its relation to *Evarne impar*, to which he refers, is less marked than to *Lagisca floccosa*. The figure of the scale given by this author differs from those procured by the 'Porcupine.'

This form would seem to be nearly allied to Grube's *P. extenuata* as described by Marenzeller in his 'Adriatic Annelida.'[2] He does not give the minute details nor describe the special condition in the tips of the upper bristles, which are longer in his figure and more distinctly bifid than in the British examples. On the whole the latter would seem to be a well-marked variety, in which the secondary process of the ventral bristles was less developed.

De St. Joseph (1878),[2] after Langerhans, would make *Lagisca rarispina* and *L. propinqua*, Malmgren, varieties of this species—a view which the preceding descriptions and figures will sufficiently criticise. He had the advantage of the specimens in the Parisian Museum in identifying *Lepidonotus Leachii* and *L. dumetosus*, both of De Quatrefages, with *Lagisca extenuata*.

[1] 'Actin., Echin., u. Würm.,' p. 86. 1840.

[2] Op. cit., 1898, p. 238.

Genus XII.—ACANTHICOLEPIS (*Norman* MS.);[1] DASYLEPIS, *Malmgren*, 1867.

Body elongate-oblong or sublinear. Head produced anteriorly into two pointed lobes on each side of the median tentacle, below the base of which the lateral tentacles spring. Eyes as in *Eunoa*. Scales eighteen pairs, coarsely spinous, overlapping each other and covering the entire dorsum. Dorsal bristles stronger than the ventral, tapering from the middle to the tip. Ventral bristles with short, bare, hooked tips, above the spinous rows, with a minute secondary process in some towards the upper third of the series. Segmental eminence distinct, papilla somewhat long and slender anteriorly, short posteriorly.

ACANTHICOLEPIS ASPERRIMA, *Sars*, 1860.

Specific Characters.—Body rather broad and thick, tapered slightly anteriorly, and still more posteriorly. Segments about forty-one. Eyes large, visible from the dorsum, two in front of the nuchal fold, and two somewhat lateral in position about the middle of the head, or perhaps a little anterior to it. Palpi of moderate length (in spirit), with minute cylindrical papillæ. The other appendages of the head have a slight enlargement below the long tapering tip, the region above and below the enlargement having long cilia. Tentacle and dorsal cirri similar. The ventral cirri are of moderate length, and have short cilia. Scales eighteen pairs; the first pair rounded, the rest more or less reniform, roughened, with long and strong horny spines, especially towards the free border. The tips of the spines are often bifid.

Habitat.—The only British locality seems to be the Frith of Clyde, where it was obtained by the veteran naturalist of that region, Dr. D. Robertson. It ranges to Norway, where it was procured by Sars, and lately by Canon Norman in his productive dredgings.

SYNONYMS.

1860. *Polynoë asperrima*, Sars. Forh. Vid. Selsk. Christ., 1860, p. 59.
1865. *Lepidonotus pharetratus?* Baird. Johnst. Cat., B. M. Suppl., p. 340.
1867. *Dasylepis asperrima*, Malmgren. Ann. Polych., p. 7.
1873. ,, ,, Sars. Bid. Christ. Faun., p. 2.
1876. ,, ,, McIntosh. Trans. Z. S., ix, p. 374, pl. lxvii, f. 9—11.
1879. ,, ,, Tauber. Ann. Danic., 82.
1883. ,, ,, Levinsen. Nord. Annul. Vidensk. Meddel. f. d. Nat. For. i Kiobenhavn. 188 and 195.

The length of the example in the British Museum is about an inch.

The *head* (Plate XXVII, fig. 6) is somewhat longer than broad, with a well-marked

[1] As the title *Dasylepis* has been pre-occupied by Pander for a Silurian Ganoid (1856), the name suggested by Canon Norman, viz. *Acanthicolepis*, may be substituted.

median groove, which trends outward in front to terminate in the peaks on each side of the median tentacle. The eyes are large and black, two being situated a little in front of the nuchal fold, and slightly lateral in position, and two in front of the lateral projection of the head, and also more or less lateral in position. Both pairs are thus only fully seen in side view. No example has a median tentacle. The lateral tentacles arise under its base, and are short organs with a trace of an enlargement below the slender tip, and somewhat closely ciliated. The palpi, which are of moderate length, show minute cylindrical papillæ in certain parts, but seem to be mostly smooth. Segmental papilla slender and somewhat long anteriorly, short posteriorly; directed upwards between the feet.

Body flattened and proportionally broad, slightly narrowed towards the head, and more distinctly posteriorly, where it is terminated by the two subanal cirri. The dorsum presents no feature of note. Ventrally the segmental papilla is slender and small, arising from an elevation close to the posterior border of each foot. These rounded elevations form a moniliform series along each side of the body. The cirri are comparatively slender and short.

The colour in the spirit-preparations has mostly disappeared, only one showing a few brownish transverse bars anteriorly on the dorsum, and a slightly brownish line on the anterior folds of the mouth. The palpi have a curious greenish-grey colour, while a trace of brown remains on the cephalic appendages, the dorsal cirri, and the first (long) ventral cirrus. The anterior scales are brownish grey, with the brown spines standing prominently outward.

Scales (Plate XXXII, fig. 1).—The first pair are more or less rounded, and studded chiefly at the margin with the horny spines, the intervening spaces being often coated with mud and parasitic growths. The scales generally are by no means thick, but are covered with the chitinous papillæ or bosses, small towards the anterior edge, but rising into the long spinous processes posteriorly (Plate XXXIII, fig. 3). These processes terminate in a bifid, trifid, quadrifid, or quinquefid tip. The central axis of each is cellulo-granular. From the inner to the outer margin also a few slender cilia with clavate tips are present. The majority of the scales are more or less reniform, but posteriorly the last pair become ovoid, with the same structure of spines and cilia. The under surface is smooth and iridescent, with the scar for attachment somewhat nearer the anterior than the posterior border, and more distant from the inner than the outer margin. The scales are easily removed.

Feet.—The first (with the tentacular cirri) has three bristles, which conform to the type of the dorsal bristles, only they are proportionally shorter and more curved.

In the second foot the dorsal bristles are stout and have boldly marked spinous rows which in lateral view follow slightly oblique lines across the shaft. They are formed by a thin chitinous plate split into the spines or teeth, somewhat after the fashion of the ctenidial rows in *Pleurobrachia*, and increase in size from the dorsal to the ventral surface of the bristle. The terminal region of the bristle is smooth. The ventral bristles are very slender, with long tips having alternate spinous rows, the extremities being slender and slightly hooked. The long ventral cirrus has moderately long clavate cilia.

The usual gradations occur till the typical foot is reached (Plate XLII, fig. 29).

It is characterised by the long and strong dorsal bristles (Plate XXXVII, fig. 28), which almost reach as far as the tips of the ventral. They are for the most part stiff, straight, and gently tapered bristles, those at the inner edge of the tuft being shorter and slightly curved. The spinous rows are well marked from a short distance above the free edge to the extremity, which is pointed and smooth. The ventral division of the foot is less acute than in front, the tip being almost fan-shaped, with the spine at the upper border. The bristles have long straight shafts, while the tips are slightly dilated at the commencement of the spinous region, have somewhat short bare tips of moderate breadth, a well-marked hook at the extremity, and in some, especially at the upper third of the series, a minute spur beneath (Plate XXXVII, figs. 29 and 30). The great density of the dorsal bristle-tufts gives the animal a woolly appearance, and in some they are tinted of a ferruginous hue from adherent growths. The ventral cirrus does not reach the tip of the fleshy part of the foot, and has short clavate cilia.

In the terminal feet a similar condition to that in front exists, though the dorsal bristles as a whole are more tapered. Their spinous rows are very distinct. The ventral bristles in the last foot are attenuate. Parasitic algæ are frequent on the bristles.

The segmental (nephridial) papilla becomes distinct about the sixth foot.

Reproduction.—One example (Canon Norman's) from Norway, in July, 1878, shows numerous ova in the perivisceral space.

The presence of a minute tooth below the tip of the ventral bristles shows the proximity of the present species to the genus *Harmothoë* and its allies. This spur had escaped the notice of Malmgren.

It is allied to *Harmothoë areolata*, Grube, but the latter differs in the more regular arrangement of the surface of the scale, the fewer though larger and less acute spines, the exquisite reticulation around them, and the much more numerous cilia of the outer and inner borders. It seems to be rare in Britain, though the example from the Clyde is of comparatively large size.

Acanthicolepis asperrima was first described by the elder Sars from specimens procured a few miles north of Bergen, a region which has been rendered classic to zoologists by his labours and by those of his successors. Recently no one has done more in collecting the annelids of the same region than Canon Norman.

Genus XIII.—Harmothoë (*Kinberg*, 1857).[1] char. em.

Body not much elongated. Lateral tentacles fixed below the median. Palpi with rows of minute truncate papillæ. Eyes four; two at the peaks in front, two posterior on the dorsum in front of the collar. Scales fifteen pairs, covering the whole of the

[1] Kinberg described the genus thus:—Cephalic lobe narrow anteriorly. Base of the tentacle occupying the fissure of the cephalic lobe. Bases of the antennae fixed under the base of the tentacle. Pharynx with 3 papillæ and jaws. Elytra fifteen, covering the dorsum to the end of the body. Body not long.

dorsum. Dorsal bristles strong, with well-marked spinous rows and a smooth portion at the tip. Ventral bristles with simple hooked tips, superiorly and inferiorly; rest with a well-marked secondary process. Segmental papilla long. Papillæ of proboscis $\frac{9}{9}$. Pre-gastric cæca long and slender.

1. HARMOTHOË IMBRICATA, *L.*, 1767. Plate XXVI, fig. 3.

Specific Characters.—Body elongate-ovate, narrowing more distinctly posteriorly than anteriorly. Head somewhat ovate, with the median furrow in front, and terminating on each side in a blunt peak. The posterior pair of eyes are of moderate size, dorsal in position, and are alone visible from above. The anterior pair lie under the peaks in front, are somewhat larger, and look outward and forward. A trace of a cuticular lens is occasionally seen in these. Tentacle of moderate length, arising from an enlarged dark-coloured base (ceratophore); the proximal part of the column (ceratostyle) brownish with a dark belt below the pale enlarged region, to which the filiform tip is attached. A few rather short clavate cilia occur on its surface, the filiform tip being smooth. The lateral tentacles are beneath the former, and are about half their length, with a very slight swelling below the filiform tip. They have proportionally more numerous clavate cilia than the median tentacle. The tentacular and dorsal cirri agree with the latter in outline, and have a considerable number of clavate cilia. Palpi elongated and tapering, with rows of somewhat truncate clavate papillæ. Ventral cirrus of moderate length, with a few short clavate cilia. Segmental (nephridial) papilla comparatively long. Scales fifteen pairs, and, with the exception of the rounded first pair, ovate-reniform or obliquely ovate. Though smooth to the naked eye, they are minutely spinous under the microscope, and the outer margin has somewhat short cilia. Only in large specimens is there a row of brownish subglobular papillæ within the posterior margin. Dorsal bristles strong, with rather distinct spinous rows, and a well-marked smooth region at the tip. Ventral bristles with an elongated spinous region superiorly, a short spinous region inferiorly, and a simple smooth tip with a hook. All the rest have a well-marked secondary process beneath the hook.

Habitat.—Distributed between tide-marks and the adjacent region everywhere round the shores of Britain, from Shetland to the southern coast of England, but it is comparatively rare in the Channel Islands (Guernsey), where its place is occupied by *Lagisca floccosa.* It extends also to the depth of 75 to 96 fathoms ('Porcupine' Expedition, 1869) and to 125 fathoms off the west coast of Ireland. It ranges to Spitzbergen, Greenland, Iceland and Scandinavia, to the Adriatic and Mediterranean, as well as to other European shores, and is also found in America (Verrill) from Cape Cod to the St. Lawrence. According to Marenzeller it extends to Japan, and Grube records it from northern and eastern Siberia, and from Sitcha and the Sea of Okhotsk, and various other parts of the Arctic Sea.

It is common in the stomach of cod and haddock (E. M.). It has also been found in the tube of *Terebella nebulosa*, Bressay Sound, and beside *Polycirrus* in an old shell in the same region.

Length.—On each side of $1\frac{1}{2}$ inches, and reaching 2.

SYNONYMS.

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" " *imbricata*, L. Syst. Nat., twelfth edit., vol. i, p. 1084.
1768. " *violacea*, Ström. Kongel. Norsk. Vidensk. Selskabs. Skrifter, Deel iv, p. 366.
1776. " *cirrata*, O. F. Müller. Prod. Zool. Dan., p. 218, n. 2641.
" " *violacea*, idem. Ibid., p. 218, n. 2645.
" " *lepidota*, idem. Ibid., p. 218, n. 2643.
" *Die flache Aphrodite*, Martini. Allgem. Geschichte der Natur, iii, p. 132.
" *Aphrodita imbricata* (Ziegeldrücken Aphrodite), Martini. Ibid., iii, p. 151.
1780. " *violacea*, Fabricius, O. Fauna Grönl., p. 308, n. 290, Tab. 1, fig. 7.
1792. " " Bruguière. Encycl. Méthod., vers. i, p. 89.
1800. *Die flache Aphrodite*, O. F. Müller. Naturges. einiger Wurm-Arten, p. 180, Tab. 14, figs. 1—5.
1820. *Polynoë cirrata*, Savigny. Syst. des Ann., 26.
1827. " *violacea*, Bory de St. Vincent. Reproduced in Tableau Ency. Méthod., p. 135, pl. lxi, f. 30—33.
1828. *Eumolpe cirrata*, De Blainville. Dict. Sc. Nat., vol. lvii, p. 459.
1830. *Aphrodita cirrata*, Bosc. Hist. des Vers., 169, 2nd edit., 183.
1834. *Polynoë cirrata*, Audouin and Edwards. Annél., p. 86.
1840. " " Johnston. Ann. Nat. Hist., ii, p. 434, Tab. 22, f. 2.
1843. *Lepidonotus cirratus*, Œrsted. Grönl., Ann. Dors., p. 14, f. 1, 5, 6, 11, 14, 15.
" " " idem. Annul. Dan. Consp., p. 13, fig. 13.
" *Polynoë cirrata*, Rathke. Fauna Norweg., 150.
1851. " " Maitland. Fauna Belg., 214.
1853. *Aphrodita varians*, Dalyell. Pow. Creat., ii, 168, pl. xxiv, f. 11, 12.
1854. *Polynoë cirrata*, Thompson. Fauna, Ireland, 173.
1860. " " Sars. Vid. Selsk. Forhandl., 1860 (sep. copy, 5).
1865. " " De Quatrefages. Ann., i, p. 232.
" *Lepidonotus cirrosus*, idem. Ibid., i, p. 261. (?)
" *Polynoë cirratus*, Johnston. Cat. Brit. Mus., 114, pl. viii, fig. 2.
" *Harmothoë imbricata*, Malmgren. Nord. Hafs.-Annul., p. 66, Tab. ix, fig. 8.
1867. " " idem. Ann. Polychaet. Spets., p. 154 (sep. copy, p. 9).
1871. " " Ehlers. Sitzb. phys.-med. Soc. Erlangen, Heft 3, p. 77.
1873. " " idem. Op. cit., Heft 5, p. 7.
" " " Sars. Nyt. Mag. f. Naturvid., 19, p. 203.
" " " idem. Bid. Christ. Fauna, iii, p. 3.
" *Polynoë cirrata*, Möbius. Jahresb. Com., 1871, p. 111.
" " " Kupffer. Ibid., p. 150.
1874. " " Möbius. Die Zweite deutsche Nordpolarfahrt, 1869, p. 253.
" *Harmothoë imbricata*, Malm. Göteborgs Kongl. Vet. och Vitt. Samhalles Handl., Haftet 14, p. 74.
1875. " " Ehlers. Annel. 'Porcupine,' 1869, op. cit., p. 32.
" " " McIntosh. Invert. and Fishes, St. A., p. 116.
" *Polynoe cirrata*, Möbius. Jahresb. Com., 1872, p. 166.
1876. *Harmothoë imbricata*, McIntosh. Trans. Z. S., ix, p. 398.
1877. " " Hansen. Nyt. Mag. f. Naturvid., 24.
1878. " " Lenz. Jahresb. Com., 1874–6, Anhang., p. 12.
1879. " " Marenzeller. Sudjapan. Annel. Denkschr. d. Kaiserl. Akad. Wiss. Wien, xli, p. 17, Taf. ii, f. 1.
" " " Tauber. Ann. Danic., 80.

879. *Polynoë imbricata*, Théel. Kongl. sv. Vet. Akad. Handl., Bd. xvi, 3, p. 9.
1881. „ *cirrata*, Horst. Niederland. Archiv Zool., 1881, Suppl. Bd. i, p. 5.
„ „ „ Pelseneer. Bull. Soc. Roy. Malacol. Belg., xix, p. lxxxix.
1883. „ „ Kallenbach. Inaugur. Dissert. Eisenach, 1883.
„ *Harmothoë imbricata*, Levinsen. Nord. Annulat., 194.
„ *Polynoë imbricata*, L. Wirén. Chaetop. 'Vega' Exped., &c., p. 389.
1884. „ *cirrata*, Carus. Fauna Medit., i, 204.
„ *Harmothoe imbricata*, Webster and Benedict. Ann. Mass., 701.
1886. „ „ Harvey Gibson. Verm. Liverp., 149.
1888. „ „ De St. Joseph. Ann. Sc. Nat., 1888, p. 161, pl. vii, f. 21.
1889. „ „ Trautzsch. Jenaische Zeitsch. f. Nat., xxiv, p. 66, and Arch. f. Naturges., 55 Jahr, Bd. i, Hft. 2, p. 136, pl. vii, f. 1.
1890. „ „ Malaquin. Ann. Boulon., 21
1891. *Polynoë (Harmothoe) imbricata*, Hornell. Polychaeta, Liverpool Dist., p. 231, pl. xiii, f. 2.
1896. *Harmothoe imbricata*, Michaelsen. Polych. Fauna, p. 11.
„ *Polynoë (Harmothoe) imbricata*, Roule. Camp. d. 'Caud.,' 143.
1897. *Harmothoë imbricata*, H. P. Johnston. Pacific Annel., Califor. Acad. Sc., 181, pl. vii, f. 37.
1898. „ „ Michaelsen. Gronl., Ann., p. 121.

The *head* (Plate XXV, fig. 6) is broader posteriorly than anteriorly, and shows only a single pair of eyes, which are of moderate size and just in front of the nuchal collar. The other and somewhat larger pair are placed under the anterior peaks, and present a trace of a cuticular lens. They look forward, outward, and slightly downward. Some specimens have the anterior eyes a little more lateral in position, so that they are partially seen from the dorsum, and occasionally an additional eye lies midway on one side, as in an example from the stomach of a haddock at St. Andrews and in another from Shetland (Fig. 25); while in a third from the latter region (Bressay Sound) the

FIG. 25.

FIG. 26.

FIG. 25. Head of *Harmothoe imbricata* with an additional eye on the right, and the anterior pair more than usually evident.

FIG. 26.—Head of *Harmothoe imbricata* with three posterior eyes, while only one anterior is visible from the dorsum.

anterior eye on the left has moved backward, so as to resemble the position in *Lagisca floccosa* (Fig. 26), and in another from Lochmaddy the right anterior eye approaches the posterior even more closely. A still more remarkable variation exists in a young example from the same region in which both anterior eyes have moved backwards, so that they occupy the position of those in *Evarne*. The median tentacle is of moderate length, with a brownish column, a dark belt below and often encroaching on the whitish enlargement, and another dark belt beyond it at the base of the filiform process. The lateral tentacles are only slightly enlarged below the filiform tip, and have a few short clavate papillæ on the surface. The tentacular cirri are similar in shape and colour to the median tentacle. The palpi have rows of short and somewhat truncate clavate papillæ, the terminal surface showing in many minute processes.

The *body*, which consists of thirty-seven bristled segments, presents the normal outline, viz. narrowed somewhat abruptly anteriorly, but very gently posteriorly. The dorsum is often boldly pigmented from the first to the last segment with dark touches, which stretch across each segment between the pedicles of the scales or the corresponding papillæ in the other feet. In the anterior segments two of these touches occur, viz. a large one in the transverse "mark" of the segment, the pigment even invading the scale-pedicle, and a narrow one behind the former. In some a narrow belt in front of the larger bar is also present. A pale longitudinal line cuts the large median bar just mentioned into halves, but the smaller anterior and posterior pigment-belts remain entire except in a few posteriorly. The dorsum of the foot has also a sprinkling of dark pigment extending to the bases of the bristles. In some the pigment of the dorsum is much increased, so that the entire surface between the peduncles for the scales is blackish, enlivened only by the lines of the segment-junctions, and the pale lines around the transverse central pigment-bar, for no median longitudinal stripe occurs. The ventral surface is pale, with the exception of the anterior folds of the mouth, which have bands of dark pigment. The large terminal anal cirri are similar in structure to the dorsal, which, again, agree with the tentacle.

In the British specimens of *Harmothoë imbricata* the segmental papilla is so long as to merit the name of a cirrus throughout the greater part of the body, the process diminishing anteriorly towards the sixth foot, where it commences, and posteriorly in the terminal feet. So far as could be observed no sexual differentiation of the organ occurs either at the breeding season or subsequently. It is similar in both sexes. The segmental organs (nephridia) were clearly described in the Polynoidæ of Prof. Haswell, and shortly afterwards by Prof. A. G. Bourne.

Digestive System.—*Proboscis.*—Nine papillæ occur dorsally and ventrally in the extruded proboscis, the lower teeth of which bite to the right of the upper. The dorsal papillæ are slightly tinted with dark pigment, and the dorsal wall joining the organ to the mouth is similarly coloured.

The first (dorsal) gastric cæcum is a long slender tube which passes forward to the body-wall, and terminates in a bulbous region composed of two or three lobes. The narrow part of the canal is whitish like the wall of the gut, while the bulbous terminal portion is slightly yellowish or buff, like the glandular cæca of the gut, with which it agrees in structure. The second is nearly as slender. The two succeeding increase gradually in size. The next passes nearly transversely out, and begins the series of deep yellowish lateral glandular cæca.

The contents of the gut show sponge-spicules, foraminifera, star-fish plates, bristles of annelids, sand, and mud. Occasionally, however, portions of other annelids, such as *Nereis pelagica*, occupy the intestine. It is a voracious form.

Scales (Plate XXXII, fig. 10) fifteen pairs. The first pair are rounded, minutely dotted all over with short blunt spines, and have at the posterior border a series of somewhat clavate papillæ of variable number (six to twelve), which are visible under a lens. The outer and posterior margin bears short clavate cilia. The minute blunt spines increase in size at the outer and posterior borders. The rest of the scales are reniform or obliquely ovate, minutely spinous, the outer margin being furnished with short clavate cilia, and in certain specimens with large and small subglobose or clavate papillæ. These papillæ were well marked in a series of comparatively small pale examples brought by Canon Norman from Finmark. The larger coloured specimens showed them less distinctly. The spines are larger in certain arctic examples, *e. g.* from Davis Strait. The cilia differ much in length even in large specimens. Some of the scales in spirit-preparations adhere with great tenacity; others separate readily. Their colour varies much, being, to take the order of Malmgren, bluish grey, greyish, brownish, or dark brown with a purplish or violet lustre, reddish brown (Vandyke brown), almost black, or greatly variegated. A striking variety has pale buff scales bordered with a narrow belt of dark brown. Others agree with the foregoing except that the scale is darker brown (Bismarck), with a small white patch in the centre and a few darker grains in front, the whole forming a beautiful series. Some have the outer half of the scales whitish, the inner blackish grey or brown, so that the animal has a broad blackish or brownish band down the centre. Occasionally the pale fawn-coloured scales are minutely and uniformly speckled with small brown touches. A few again are almost white. Some have a broad brownish-red belt, almost a third the breadth of the scale, curving within the posterior border, and as these are arranged symmetrically the effect is agreeable. A developing scale shows minute clavate cilia before the spines appear.

Development of the Scales.—These seem to be reproduced with considerable rapidity, forming miniature scales on the end of the peduncles, with a trace of brownish pigment over the scar. They consist of a superficial cuticle, which is quite smooth, and of a subjacent cellular layer within which the connective tissue rapidly proliferates.

Feet.—The first foot has often only a single bristle, conforming to the dorsal type.

The second foot has a short ventral lobe and a long ventral cirrus with clavate papillæ. The dorsal bristles are smaller, shorter, and more curved than usual, but are otherwise of the normal structure. The ventral are much more slender than the normal, and the spinous region is proportionally long and hispid, while the smooth tip is slender and simple.

The third foot has much stronger dorsal bristles than the second, and the ventral bristles have also increased in size. In these the upper and lower groups still have simple tips, while the median series have bifid tips, but the region is more slender than in the typical foot, and the secondary process small. The spinous rows are also more hispid (*i. e.* have longer spines) than in the typical foot.

As we proceed backward the characters of the typical foot are acquired (Plate XXX, fig. 1). It shows dorsally a strong series of somewhat straight or only slightly curved bristles with well-marked spinous rows, and a smooth spear-shaped tip of some length (Plate XXXVIII, fig. 14). In examples from Greenland the tips of these (dorsal) bristles are so elongated as to be almost sabre-shaped. In specimens from Cornwall, again, the spinous rows are finer, and the bare portion at the tip somewhat differs. In young examples the front edge is slightly bevelled. The ventral division bears a series of strong bristles, every one of which has a bifid tip. In the upper series the smooth portion at the tip is slightly curved outward, and the secondary process is short and sharp (Plate XXXVIII, fig. 15). The terminal hook is well marked. In those with short tips from the middle of the foot (Plate XXXVIII, fig. 16) the same relations of the secondary process occur, and thus they are easily discriminated from the bristles of *Lagisca floccosa*. The ventral cirrus has a series of short clavate cilia.

In the terminal feet the dorsal bristles remain stout, but their tips are more tapered. The slender ventral bristles, on the other hand, have the spinous region greatly elongated, but the delicate tips in most cases retain the bifid condition, only one or two at the ventral border being simple.

Varieties.—A variety procured by Canon Norman in Norway has shorter bristles, but though the rows of spikes on the dorsal bristles are somewhat finer, in all other respects it corresponds. In another from Loch Portan, Lochmaddy, the dorsal bristles immediately above the ventral are slender, and in this form also the scales have more numerous and longer cilia. The colours are brighter, and the under surface and sides pinkish.

A pale variety, having somewhat rougher scales with longer cilia, occurred between tide-marks at Lochmaddy.

The large arctic examples, such as those of Dr. Walker, have a distinct tendency to elongation of the tips of the bristles, both dorsally and ventrally; while a variety from St. Andrews presents more elongated dorsal bristles than in the typical example.

Few annelids are more abundantly distributed, yet the structural variation of the individuals is not great.

Habits.—*H. imbricata* lurks under stones in pools and moist places between tide-marks, among sponges and in their crevices, in tubes of *Terebella* and *Chætopterus*, in empty acorn-shells, and in almost any convenient crevice. It is one of the most plentiful forms between tide-marks, and is also dredged abundantly in the laminarian region and beyond it, in the crevices of old shells, tangle-roots, and stones. It clings closely to such surfaces, and apparently tries to escape observation. Young examples have been found in old shells with *Polycirrus*. It is most active and restless when disturbed, and wriggles violently, leaving fragments of the body or separated scales in the hands of the captor.

It is a somewhat delicate animal in confinement. Thus it suffers rapidly in a bottle with other marine animals on the collecting ground; indeed, if the search be prolonged few are alive, while other marine forms survive. Sir J. Dalyell, however, retained them until the discarded scales were reproduced, being scarcely distinguishable from the original scales in about six weeks or two months. It swims with an undulatory motion in the water, but, like the loach, soon sinks to the bottom. As in allied species, it often strikes the glass vessels with its jaws, making sounds heard at a considerable distance.

It is brilliantly phosphorescent, discharging bright bluish-green or greenish scintillations from the point of attachment of each scale, and thus under irritation the flashes are arranged in pairs along the body or in a double moniliform line. The separated scales also continue to gleam for some time, chiefly at the scar for attachment, that is near the great ganglion of the region. If severely pinched it wriggles through the water, emitting sparks of greenish or bluish-green light from the foregoing points. The phosphorescence appears to be less vivid during severe weather and when confined for a night or two in shallow vessels—a feature probably due to nervous prostration, or it may be associated with approaching maturity. Specimens placed in a weak solution of picric acid in sea water are not luminous, and the scales are not at first thrown off.

Parasites.—The crustacean parasite *Herpyllobius arcticus*,[1] Stp. Ltk. (*Silenium Polynoës*, Kr.), occasionally occurs in arctic examples attached to the dorsum. Levinsen also found another crustacean parasite, viz. *Selioides Bolbroei*, Lev., on one from Greenland.[2]

On the dorsum, under the scales of a specimen from the tidal region at Balta Sound, Shetland, numerous examples of a fine *Loxosoma* in various stages of growth are found.

A peculiar warty growth appears on the tentacular cirrus of an example from the Gulf of St. Lawrence, and a series of minute whitish tubercles in an arctic example from Bessels Bay.

The bristles harbour many parasitic algæ, besides mud, foraminifera, and sponge-spicules. At St. Andrews a small *Sabella*, *Syllis*, and *Pholoe* have been found amongst the bristles, and young mussels occasionally fix themselves to the dorsal bristles.

A translucent *Ascaris*, fully half an inch in length, occurred in the peri-pharyngeal space of a female. The slightly truncated snout showed one or two blunt papillæ, while the pointed posterior end had a few acute papillæ. Though outside the gut it had free access to the perivisceral fluid, and, moreover, the long anterior cæca passed forward on each side of the space.

Development.—The broad outlines of the development of this species have been known for a considerable time, and it may therefore form the type for the group. Comparatively small species are occasionally found mature, or carrying ova under the scales.

Michael Sars,[3] as early as 1845, described the occurrence of ripe examples of *Harmothoë* in February and March. He noticed the mature females exhibited a change of colour, becoming pale rose behind the anterior fourth. This was due to the eggs which covered the dorsum. He thought that the ova passed out by a small aperture above the feet. He watched the development of the egg from early segmentation to the movement of the embryo by cilia, and its slightly greenish coloration. The larvæ (monotrochous trochophores) escape after two weeks, swim freely, and bear two eyes, with a pre-oral band of cilia. Max Müller, Desor, and others have also described the development. Desor, however, fell into the error of supposing that the larva escaped from a similar ciliated investment to that of *Lineus obscurus*.

Max Müller,[4] in the young of either this or an allied form, pointed out that new segments were interpolated posteriorly. He described the dimorphism of the bristles,

[1] 'Kgl. Danske vidensk. Selsk. Skrifter naturv.-mathem. afd.,' Bd. v, 1861; and Kröyer, 'Naturh. Zidskr.,' 3 die R., Bd. ii, 1863, &c.

[2] 'Videnskab. Med. fra den nat., &c.,' i Kiobenh., 1887.

[3] "Zur Entwicklung der Anneliden," 'Arch. f. Naturges.,' 11 Jahrg., v. 1, 1845; and 'Ann. Nat. Hist.,' 1845, p. 188 (vol. xvi).

[4] "Ueb. d. Entwicklung u. Metamorph. d. Polynoën," 'Müll. Archiv,' Jahrg. 1851.

the condition of the alimentary canal, and the development of the feet. His species had two pairs of eyes.

Claparède[1] gives the early stages of a *Polynoë* up to the formation of feet and bristles. His example had eleven pairs of feet.

Viguier[2] refers to a pelagic *Polynoë* of sixteen segments, but which, he says, showed no larval appearance. The feet and the ventral bristles are comparatively long. It is in all probability a post-larval *Polynoë* from the Bay of Algiers, as Marenzeller also thinks.

Dr. W. Michaelsen[3] describes a pelagic polynoid from Ceylon (*Drieschia pelagica*), in which the foot is simple, with very long hair-like bristles, and only a few shorter thicker forms. These apparently represent the ventral division of the foot, and only a single spine is present. The tentacular cirri and dorsal cirri are very long.

Marenzeller[4] gives an account of a pelagic form of twenty-four segments procured by the Prince of Monaco, in 48° 50′ lat. N., and 21° long. E. of Greenwich, under the name of *Nectochæta Grimaldii*. It is characterised by the great elongation of the inferior bristles. Scales absent, palpi and cirri smooth.

Fewkes[5] described a young *Polynoë* with only three pairs of feet.

Too little is yet known of the pelagic forms described by Michaelsen and Marenzeller to speak with certainty of their precise relationships. The presence of only a single spine and the simple nature of the foot in *Drieschia* are features which diverge from the ordinary types.

Prof. V. Häcker of Freiburg gave in 1896[6] the results of his studies of the larvæ of Polychæta at Naples. In the Aphroditidæ he describes three stages of a *Polynoë*, viz. the trochophore, metatrochophore, and nectochæte[7] stages. In the Aphroditaceans the trochophore moves at first by aid of its cilia, and then the bristles develop secondarily and enable the post-larval stage to assume great activity during its pelagic life. His species was probably *Polynoë reticulata*.

The ovaries of *Harmothoë imbricata* form a series of lobulated organs stretching from the seventh foot (which has a segmental [nephridial] papilla, as has also the sixth) to the posterior end. They are small anteriorly in the region of the proboscis, though as a rule they do not reach this part, but attain in January a considerable bulk throughout the rest of the body, again diminishing posteriorly.

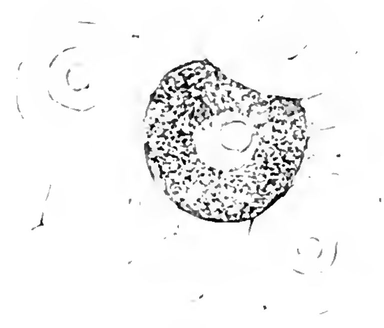
The eggs become prominent in November, being coarsely granular, with a distinct nucleus and nucleolus (Fig. 27). They seem to have a hyaline connecting substance, to which perivisceral corpuscles attach themselves. They vary in size, the smaller being

[1] 'Beobach.,' 1863, p. 80, Taf. viii, f. 1—11.
[2] 'Archiv. de Zool. expér.,' vol. iv, 1886, p. 416.
[3] 'Jahrb. d. Hamburg. Wiss. Anstalt,' ix, 2, 1892, p. 6, figs. 15—18.
[4] 'Bullet. de la Soc. Zoolog. de France,' 1892, p. 173.
[5] 'Bull. Mus. Comp. Zool. Harv. Coll. Camb.,' v, 11, 1883–5.
[6] 'Zeitsch. f. w. Zool.,' Bd. lxii, pp. 71—168, Taf. iii—v.
[7] Νήχειν, swimming or pelagic; and χαίτη, bristle.

about an eighth the size of the larger,—the latter, however, being nearly equal, and their nuclei contain several nucleoli.

Some females retain a considerable number of ova till the middle of May, though the body is by no means distended. Many have been discharged.

FIG. 27.



Developing ova of *Harmothoe imbricata*. × 280. November.

Besides the larger ova are many minute forms attached to the germinal tissue, so that the spawning period is prolonged, or the minute ova retained or absorbed.

About the middle of February specimens with masses of ova under the scales are common. The slightly pinkish eggs are attached to each other and the surface by a transparent mucous secretion, so that they do not readily fall off. They form a dense layer under the scales, and in some are almost invisible. The process would appear to be protective, giving them the shelter of the adult, and enabling them to escape the attacks of predatory crustaceans or other forms. They have a diameter of about ·56 to ·78 mm.; the zona is delicate and translucent, yet resists some pressure. In the perivitelline space are a few granular cells, such as those found in various eggs of fishes (*e.g.* the gurnard). In structure the yolk is minutely granular, the figure showing the

FIG. 28.

Segmenting ovum of *Harmothoe imbricata*.

egg cleft into two spheres (Fig. 28). The eggs are so opaque that section alone reveals the structure. In confinement the females carrying ova readily throw off their scales, a feature probably due to the absence of nourishment and the condition of the water.

The males have their spermatozoa fully developed at the end of January and beginning of February. These consist of simple tapering rods with a very attenuate filament from the broader end (Plate XXVI A, fig. 1). They thus differ in shape from those of *Lepidonotus squamatus* (Plate XXVI A, fig. 2). When punctured the tissues of a ripe male heal in a day or two, and the animal regains activity.

In the first week of March the trochophores swarmed in the vessels containing the adults, congregating like the copepods and *Nauplii* at the margin next the light. The early trochophores (Fig. 29) present a less developed ring of cilia, but soon (Fig. 30)

FIG. 29.

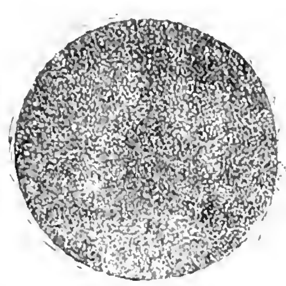


FIG. 30.

FIG. 29.—Early trochophore of *Harmothoë imbricata* viewed from the anterior end.

FIG. 30.—Trochophore of *Harmothoë imbricata* with fully developed pre-oral ring of longer cilia in rapid movement, viewed as in Fig. 29, from above.

these organs assume a characteristic appearance, and the larvæ are very active. They are bluntly conical at both ends, and devoid of eyes. When compressed under a cover the ring of cilia (pre-oral) (Plate XXVI A, fig. 3) has a very regular rotular aspect. Those captured by the bottom tow-net in the Bay at this time were somewhat larger.

On the 28th March the larvæ in confinement had for the most part gone to the bottom, and, moreover, had assumed a greenish appearance, as indicated in the figure. In the same plate (XXVI A) the older trochophores with a pair of eyes are shown in various positions in figs. 4, 5, and 6. In the first-mentioned figure the mouth forms a projection to the left.

On the 25th April the intermediate stages occur in the bottom tow-nets, viz. larger and more advanced forms having a bluntly rounded anterior end, a prominent ventral surface, and minute feet, with or without traces of bristles, the feet being marked only by crenations. The head is bluntly rounded, with two or three pairs of eyes, and the body is somewhat pear-shaped (Plate XXVI A, fig. 7). The digestive apparatus is indicated by the opaque granules in front and the paler posterior region.

Very soon (indeed, in the nets of the same date) the bristles make their appearance in the feet (Plate XXVI A, figs. 8 and 9), though the head still remains blunt. In the first-mentioned figure the foot-papillæ are minute, and project very little in lateral view, but as transparent objects they show traces of the bristles. The latter project by degrees from the ventral division of the foot, and present a somewhat broad spinous tip with distinct spinous rows and a well-marked terminal hook, but no secondary process. When they become more elongated, so that the shaft is clear for a considerable distance, a trace of a secondary process occurs below the hooked tip. Minute scales have also made their appearance. No anal papillæ (cirri) are yet visible, though in front the tentacular cirri are represented by papillæ. A line of pigment occurs at the ciliated ring, and the eyes present a rudimentary lens.

As shown in Plate XXVI A, fig. 9, the feet by-and-by assume a lobate form, and the bristles lengthen, while two rounded papillæ mark the anal cirri. The body is comparatively broad and short, and the anterior end truncated.

At a stage a little subsequent to the foregoing the head is better differentiated, and the lateral tentacles appear as two rounded papillæ on each side of the median dimple. There were ten feet in the example, and the scales were well formed. The tentacular cirri had a single large (the largest in the animal) curved dorsal bristle projecting at the base, with prominent rows of spines, and one or two smaller bristles just appearing beyond the surface. The organs themselves showed indications of developing cilia, as also did the dorsal cirri. Inferiorly the palpi formed two large rounded discs on each side of the head, projecting laterally, but not yet reaching the front. No trace of a median tentacle was observed in this specimen. The dorsal bristles were all curved, with prominent rows of spines, and the tips of the ventral had also very distinct spinous rows. The bristles project prominently (nectochæte stage). No caudal styles were present.

In Plate XXVI A, fig. 10, the next stage is represented. The head is less bluntly conical, and the two tentacular cirri are leaf-shaped, and soon the tip of the powerful dorsal bristle at their base projects nearly straight outward. The body is more elongated, the feet more prominent, and the bristles project more than half the diameter of the body on each side. The caudal cirri are now broadly lanceolate. Minute scales are present.

The dorsal bristles resemble the ventral more closely than in the adult. Moreover they approach those towards the posterior end of the adult rather than the median, a fact which may be connected with the growth of new segments between those adjoining the head and the tail. Thus it is that the anterior and posterior segments of the adult show the primitive condition of the bristles, the most modified and the most typical being those in the region between them.

In the stage shown in Plate XXVI A, fig. 11, the median tentacle (which may have been lost in the previous preparation) projects conspicuously in front, and the caudal cirri with tapered extremities are distinct.

In early stages, in which eight feet and four pairs of scales occur, the eyes on each side are nearer each other than subsequently, and a smaller third black speck is observed on each side in front of the rest on the under surface near the site of the adult eye, though the peaks are not yet formed.

In the stage figured in Plate XXVI A, fig. 12, the head is still further defined, the eyes being arranged obliquely on each side (the posterior pair nearer each other than the anterior). The median and lateral tentacles are distinct, and the palpi project prominently forward, with tapering extremities. Their margins are crenated, but distinct papillæ were not observed. The tentacular cirri show short clavate cilia. The scales are larger, and have short clavate papillæ projecting from the outer border, the last pair of scales having the largest cilia. The feet are deeply cleft and prominent, and the slender shafts of the bristles have become greatly elongated, so that they project far outwards on each side. There were nine bristled feet in the example. In this instance the caudal cirri were absent (had fallen off), and a distinct papilla occupied the centre of the caudal region.

When fourteen feet are present a great advance has been made in regard to the head, cirri, and feet. The head shows a blunt peak on each side, and the median tentacle is proportionally large and long, while the palpi have not yet attained full development, though they show the rows of minute papillae. Two large black eyes are situated posteriorly, and two occur on the mid-lateral region, and are well seen from the dorsum. A considerable interval occurs between the eyes of each side. All the cirri have large clavate cilia. The posterior scales show large clavate papillae with palpocils at the tip. The bristles at this stage are long, but they do not show distinctive characters, though the attenuate condition of some of the dorsal suggests an approach to *Gattyana* (*Nychia*). The specific identity of those captured in the tow-nets could not, of course, be absolutely determined.

A different trochophore appears in the nets in June, characterised amongst other things by its black and brown pigment-belts at the ciliated ring, the former tint being in front of the latter (Plate XXVI A, fig. 15). This form closely approaches Dr. Häcker's species (Taf. iii, fig. 2) from Naples, though certain points of difference are present.

In this species the tips of the bristles seem to be less elongated, and the pre-oral lobe is curiously marbled with black pigment. When scales form, the body is marked in a somewhat tessellated manner, with transverse bars of reddish-brown pigment. At this stage also the anterior end (ventrally) has two rounded, pigmented, lateral regions, with a patch of black in the centre. A little later the black pigment bounds a median central region in front, and there are six eye-spots, two large rounded eyes on each side, and a black crescentic eye to the outer side of the anterior.

The body is shorter, the feet more closely arranged, and the scales more persistent. The latter have traces of low papillae on their outer edge, and the surface is roughly areolated, probably from papillae, as might occur in the young of *L. squamatus*. When the bristles are viewed from behind the spikes are alternate. The tips are much shorter than in the previous form, and the shafts stouter. Large diatoms often occur in the intestine.

In the stage (Plate XXVI A, fig. 18) with the developing palpi the head is rounded in front, and there are often three or four additional eye-spots besides the four normal. The single spine of the first foot is prominent, and also two curved bristles. A band of black pigment bounds the anterior border of the snout.

There are eight feet, the dorsal bristles of which present very fine serrations, and thus differ wholly from the previous forms. The ventral bristles have short tips with rather closely arranged spinous rows. The caudal end terminates in a pointed pygidium without cirri. In the early stages the bristles of the first foot are largely developed in proportion, and must be especially useful in protecting the head. The cirri in this form present a somewhat ovoid outline.

As soon as the palpi have developed (Plate XXVI A, fig. 19) the head shows a deep notch in the centre, the two large black eyes on each side being situated far back, the anterior eye being behind the middle line. From the first foot three strong curved bristles project forwards at the side of the palpi. These bristles have well-marked spinous rows. The palpi have tapering extremities. The dorsal bristles are slender and tapering, with distinct rows of spines, which from the dorsum appear as opposite. The tips of the ventral bristles are simple, and the spinous region shorter than in the first species, and from the dorsum the spinous rows seem to show an alternate arrangement.

When eight pairs of feet are present, and the tentacles, palpi, and the anal cirri fairly formed, the dorsal bristles show a tendency to finer rows of spines, so that they approach the condition in such as *Lepidonotus* and *Gattyana*.

At the stage in which the two caudal cirri appear as two broad short processes there are at least four scales, and the tentacular cirri are present.

The head is truncated in front, and has a curious spectacle-mark ventrally (Plate XXVI A, fig. 16), a black spot being situated in each lateral dilatation. The spectacle-mark is outlined with black and touched with reddish brown, the rest of the head (in spirit) being pale. It is bounded by the black belt at the ciliated ring, while behind is the reddish-brown pigment, followed by streaks of black, which also occur at the segment-junctions. The caudal cirri are yellowish. On the dorsal surface (fig. 15), again, are two black eyes, obliquely situated on each side anteriorly, a long interval occurring between them and the black belt of the ciliated ring. Behind the black is a definite reddish line. The bristles project considerably on each side, so that the stage is a nectochæte one.

At a slightly later stage (Plate XXVI A, fig. 17) the palpus arises on each side at a black spot, which at first marks the budding organ. The growth of the various appendages, however, is irregular, since in this instance the caudal cirri were less advanced than in those without elevation of the area of the palpus. Coincident with the projection of the palpus is that of the median tentacle, which forms a rounded boss.

Pallas (1766) made his description of *Harmothoë imbricata* (his *Aphrodita lepidota*) from an incomplete and probably young specimen (as Malmgren says) with fourteen pairs of scales, the latter being partly ciliated, though in the description this is not alluded to, and the ventral view mistaken for the dorsal (pl. v, fig. 2). He thought it might readily be distinguished by its longitudinal black band on the dorsum. It occurs, he says, frequently in the North Sea, between Britain and Belgium.

The *Polynoë fulgurans* of Ehrenberg,[1] one third of a line long, may be the pelagic young of this or an allied form.

De Quatrefages considered the *Polynoë fasciculosa* and the *P. maculata* of Grube[2] as pertaining to this species, but the descriptions are so vague that doubt exists.

This was the only member of the group procured in the Siberian Expedition of Gerstfeldt, as described by Grube. De Quatrefages, in his work on the 'Annelés'

[1] 'Das Leuchten des Meeres,' 1835.

[2] 'Actin., Echin., u. Würm.,' p. 87, 1840.

(1865) says it has forty-two to forty-four segments, but adds nothing of interest. H. Lenz (1878) agrees with Möbius in considering that this form included *Lænilla glabra*, *Antinoë Sarsii*, and *Evarne impar*; but, as already mentioned, this was due to insufficient acquaintance with the group.

Théel (1879) observes that while it is common on the west of Nova Zembla, he found none in the Kara Sea. He also records his dissent from the view of Möbius and Lenz, who included under this species *Evarne impar*, *Antinoë Sarsii*, and *Lænilla glabra*, the second being supposed to be the young stage of *H. imbricata*. I have already alluded to this in the 'Challenger Report.'[1] The habits, for instance, of *Evarne impar* quite differ from those of *H. imbricata*, the former being much more irritable and active.

Kallenbach[2] gives an account of the minute structure of the scales of this species.

Hornell (1891) alludes to the varied coloration of *Harmothoë imbricata*, *e. g.* as striped with a median black band edged with pale border. He considers Théel is correct in stating that only the largest examples possess any notable rounded processes on the scales.

2. Harmothoë spinifera, *Ehlers*, 1864.

Specific Characters.—Body narrow and elongate. Head elongated from before backward, and the anterior peaks produced at the sides of the broad base of the median tentacle. The anterior pair of eyes lie under these peaks, but are also seen from the dorsum. Posterior eyes at the nuchal collar, dorsal, and nearer each other than the anterior pair, from which they are separated by almost the entire length of the head. Palpi of average length, brownish, with rows of small truncate papillæ, which are sometimes bifid at the tip. Median tentacle with a broad base (ceratophore), a brownish column (ceratostyle), a pale tip with little or no enlargement beneath, and numerous clavate papillæ. The lateral tentacles are inferior, subulate, and brownish. Tentacular and dorsal cirri (which are short) brownish, furnished with a few clavate papillæ, and slightly enlarged below the pale tip. Ventral cirrus with a few clavate papillæ. Scales fifteen pairs, almost smooth at the margin, only a few small clavate cilia occurring in some. A limited area towards the inner edge shows a series of spikes. First pair nearly circular, brownish; succeeding anterior scales reniform, blackish, with a metallic lustre; posterior scales mottled like granite. Bristles comparatively short, the dorsal slightly curved, finely serrated, and with a short broad tip like a paper-scraper; ventral bristles with short spinous regions, and the smooth terminal part boldly bifid.

Synonyms.

1864. *Polynoe spinifera*, Ehlers. Die Borstenwürmer, p. 96, Taf. iii, figs. 1—4 and 6.
1875. ,, *crassipalpa*, Marenzeller (?). Sitzb. d. k. Akad., 1875, p. 6 (sep. Abdr.).
1876. *Harmothoë Sibbaldii*, McIntosh. Trans. Zool. Soc., ix, p. 378, pl. lxviii, f. 1—3.
1880. *Polynoe spinifera*, Langerhans. Zeit. f. w. Zool., xxxiii, p. 275.
1888. *Harmothoë spinifera*, De St. Joseph. Ann. des Sc. nat. 7e, v, p. 171, Taf. xiv, f. 1.

[1] P. 58.
[2] 'Inaug. Dissert.,' Jena, 1883, p. 23.

Habitat.—Several examples were dredged in 6 to 10 fathoms, amongst tangle-roots, in Bressay Sound, Shetland, classic ground to marine zoologists since the days of Edward Forbes. A form apparently identical occurs in the British Museum, from chinks in the rocks, Polperro, Cornwall. The same form is found in the Adriatic.

Length about seven-tenths of an inch.

The *head* (Plate XXVIII, fig. 3) is elongated from before backward, and since the large anterior pair of eyes are carried outward, almost at the tips of the peaks, beneath which they are placed, and are visible from the dorsum, the condition is diagnostic. They are, moreover, wider apart than the posterior pair, and look forward and outward. The smaller posterior pair are dorsal, situated near each other, and almost touch the nuchal collar (in spirit). The two pairs of eyes are thus separated by a long antero-posterior interval. The median tentacle has a broad base, a brownish column, a pale tip with little or no enlargement beneath, and well-marked clavate cilia. The lateral tentacles are inferior in position, small, subulate, and with similar clavate cilia. The tentacular cirri are also brownish, furnished with numerous clavate cilia, and slightly enlarged below the filiform tip. The palpi are brownish, with rows of small blunt papillæ, which are sometimes bifid at the tip.

The *body*, which consists of thirty-seven segments, is comparatively short and of more uniform diameter than usual, being only a little narrowed anteriorly, and somewhat more posteriorly. Transverse markings occur on the dorsum between the scale-pedicles and their homologues. No pigment remained on the dorsum in the preparations, though it is probable traces of such were present during life. On the ventral surface traces of brownish pigment occur at the sides of the prominent fold in front of the mouth. The lateral prominences at the bases of the feet are well marked, but the segmental processes are minute.

Scales (Plate XXXIII, fig. 4), fifteen pairs. The first are small, nearly circular, and their light brownish colour contrasts strongly with the succeeding. The surface is studded with short blunt spines, which are especially distinct at the outer border, where there are also a few short clavate cilia. The rest of the margin is smooth. The second pair are reniform, the exposed parts being almost uniformly black, with a silky sheen and a smooth margin, except at the outer border, where five or six very short clavate cilia occur at intervals. The short blunt spines are distributed over the posterior two thirds of the surface. The third scales are also blackish with the same metallic sheen, but have a few minute pale points besides the microscopic blunt spines. The pale specks increase in size in the succeeding scales, and the pigment becomes paler, the posterior pair, indeed, being mottled like granite. The general shape of the posterior scales is irregularly rounded or ovoid, with the scar for attachment towards the anterior and outer border. The penultimate and last pairs are much elongated from before backwards. The number of the minute blunt spines diminishes posteriorly, so that they are chiefly confined to the outer border, where an occasional short clavate cilium is observed. The definite pale areas are due to the absence of pigment in the areolæ of the epiderm (hypoderm), while in the dark parts each areola is deeply pigmented. If the *P. spinifera* of Ehlers is the same form the scales had a greyish-violet sheen.

Feet.—The first foot shows dorsal bristles, which are little altered from the typical form.

The second foot has dorsally a series of short broad bristles, the tips especially being characteristic. Ventrally the shafts of the bristles of the region are stout, and the spinous tips well marked. The superior bristles have very short smooth tips, which are bifid. There is thus less change than usual in the foot.

In the typical foot the superior branch bears a short cirrus, the tip of which (in spirit) reaches the extremity of the bristles. It is almost cylindrical, except near the tip, where a gradual diminution occurs. The surface has rather numerous stout clavate cilia, which are best developed on and near the slight enlargement below the filiform tip. The ventral cirrus has an enlarged base, reaches a little further than the insertion of the inferior ventral bristles, and has a few stout clavate cilia.

The dorsal branch of the foot has comparatively short and not very stout bristles, slightly curved, and finely serrated. The smooth tips are peculiar, being fashioned like a blunt Esquimaux harpoon or paper-scraper, as represented in one of the larger examples (Plate XXXVIII, fig. 17). The spinous rows at the distal part project characteristically at a greater angle than usual, but are generally obscured by dense granular parasitic growths and mud.

The ventral bristles have comparatively stout shafts and short spinous regions. The smooth tip is also short. Every bristle is boldly bifid. The superior series (with longer spinous rows) have a very short smooth region (Plate XXXVIII, fig. 18), the longer terminal part being only diminished on its dorsal edge—not hooked, while the secondary process is stout and goes straight to a point, thus differing from the attenuated divisions of *Parmenis ljungmani*. The smooth tips of the middle and inferior bristles (Plate XXXVIII, fig. 19) are somewhat longer and have a slight hook, but the secondary process is straight. The spinous regions in these are proportionally short.

Reproduction.—The specimens procured in July had the ova well advanced, so that their spawning period would seem to be in autumn at latest. It is interesting that the examples of Ehlers and De Saint-Joseph also carried eggs. The latter found a specimen of 7 mm. in the same condition.

This species presents considerable differences from *Parmenis ljungmani*, Malmgren. The body is larger and broader, the segments thirty-seven instead of thirty-five or thirty-six; the head is more elongated, and the arrangement of the eyes different. Thus, for instance, the smaller anterior eyes in the northern form are situated at an incurved region of the head just in front of the middle. The dorsal bristles are thicker than the ventral, and have the peculiar tips indicated, whereas in *P. ljungmani* the tips are simply tapered. The ventral bristles have short spinous regions in both, but in the Zetlandic form the tip is less hooked, and the secondary process is short, stout, and straight. There are points of similarity between the forms, but there is no warrant for uniting them.

The *Polynoë spinifera* of Ehlers approaches this species very nearly, and he probably overlooked the papillae on the palpi. It is possible the small size of his example (7 mm.) may have been the cause of certain variations. The figures and remarks of Langerhans[1] point to the same conclusion. In the southern forms the pallor of the first pair of scales is characteristic. The *Polynoe crassipalpa* of Marenzeller from the Adriatic is a very closely allied form, but, if the author's figures and descriptions are to be relied on, the British form is distinct, the tip of the dorsal bristles alone being characteristic. In Marenzeller's specimen also the large anterior eyes are not so near the tip of the peak as in the British form. Levinsen (1883) seems to think this closely approaches *Harmothoe ljungmani*, but the foregoing remarks demonstrate the differences.

3. Harmothoë zetlandica, *McIntosh*, 1876.

Specific Characters.—Body sublinear, narrowed anteriorly and posteriorly; bristle-bearing segments thirty-five to thirty-six. Head elongated from before backwards, with two acute peaks in front. Tentacles and cirri without apparent enlargement below the tip, and with sparsely distributed short clavate cilia; lateral tentacles inferior. Palpi minutely papillose. Eyes all visible from the dorsum, the larger anterior pair at the base of the peaks. Scales fifteen pairs, covering the dorsum, ovate or oval with the exception of the first pair, which are rounded, with few and indistinct papillæ. Dorsal bristles strongly curved, sharp-pointed, and with distinct rows of spines, the sharp tip being bare; ventral bristles with short spinous regions and smooth tips, the latter being hooked and having a long straight secondary process, which is parallel and closely applied to the other division,—that is, no gap is present.

Synonym.

1876. *Harmothoe zetlandica*, McIntosh. Trans. Zool. Soc., ix, p. 379, pl. lxviii, f. 4 and 5; pl. lxix, f. 1.

Habitat.—Dredged in 5 fathoms amongst the tangle-roots in Bressay Sound, Shetland, July, 1871.

The specimens are about half an inch in length.

Head (XXVIII, fig. 1) somewhat elongated from before backwards, terminating anteriorly in two pointed lobes on each side of the median tentacle. The eyes are all visible from the dorsum; the smaller posterior pair lie in front of the nuchal collar, while the larger anterior pair are situated at the base of the peaks and look laterally and dorsally. They are not so far forward as the anterior eyes of *Harmothoë spinifera*. The cephalic appendages are somewhat short. The median tentacle is not much, if at all, enlarged below the filiform tip, and is furnished with a few clavate cilia. In some it is deeply pigmented at the base. The lateral tentacles are short, enlarged at the base, but tapering at the tips after the manner of the ventral cirrus, and with sparse but distinct clavate cilia. The palpi are gently tapered from base to apex, and, while smooth or only wrinkled under a low power, show minute papillæ under a high power. The tentacular cirri taper from base to apex, have no enlargement below the latter, and have clavate cilia like those of the median tentacle.

[1] 'Zeit. f. w. Zool.,' xxiii, p. 275.

Body elongate and somewhat narrow, consisting of about thirty-five bristle-bearing segments. The segments dorsally present no peculiarity, while inferiorly the depressed median region proceeds from the buccal fold to the tail. The segmental papillæ seem hardly to project beyond the elevation. The body is of a pale or dull straw-colour, the translucent scales showing only a few pale touches. Posteriorly the anus projects on a median process.

Proboscis.—The extruded organ presents nine papillæ along each edge, and the teeth are pale brown.

Scales (Plate XXXII, fig. 15).—The species was formerly stated to have fourteen pairs of scales, but a re-examination of the broken specimens points to the probability that fifteen pairs are present. They cover the dorsum, are rather thin, translucent, and soft, and seem to be smooth under a lens; but under a high power short clavate papillæ occur sparsely along the outer and posterior border, and over the usual area externally. The papillæ along the outer and posterior border are not to be confounded with the appearances found in the granular area of the epiderm. They are much more minute than those of allied species. Only a microscopic papilla here and there on the same border projects beyond the smooth outline. The first pair are small and round, the size increasing posteriorly to the twelfth, when a diminution again occurs in those behind. Only a few show a slightly reniform outline, the majority being more or less ovoid.

Feet.—The first foot shows bristles of the dorsal type.

In the second foot the dorsal bristles are curved, and have well-marked spinous rows. The ventral bristles, again, differ from the typical forms in the proportionally longer and more finely spinous regions, and in the simple tip, which is but little hooked.

The third foot has more or less become typical, except that the ventral bristles are more slender.

The typical foot (Plate XXX, fig. 2) presents dorsally a series of divergent, stout, sharp-pointed, and brittle bristles, with well-marked transverse spinous rows. The spinous region has a distinct curve. The smooth portion at the tip is of considerable length, has a slight bend, and tapers gently to the point (Plate XXXVIII, fig. 20, and front view, Plate XXXVIII, fig. 20 *a*). The ventral bristles (Plate XXXVIII, fig. 21) have superiorly a short spinous part of five or six rows, and a smooth terminal region which forms a well-marked hook. The secondary process is remarkably long, and passes straight outward parallel with the former, and in the upper bristles reaches as far as the terminal hook.

In the terminal feet the dorsal bristles alter little, except that they become smaller and the spinous rows more prominent. The ventral bristles, again, have shorter shafts and much more slender and elongate spinous regions and simple tips.

The bristles throughout are pale yellowish, and the dorsal are often loaded with algoid and other parasitic growths.

The dorsal cirri, like the tentacular cirri, taper from base to apex, which is filiform, and reaches the extremity of the ventral bristles (in spirit). Their surface has sparsely distributed short clavate cilia. The ventral cirri are tumid above the basal region, then taper to the extremity, and have a few clavate cilia.

When contrasted with the young of *Harmothoë imbricata* the head of this form is much more elongated antero-posteriorly, and the four eyes are visible from the dorsum, whereas in *H. imbricata* the posterior pair only are generally seen. The tentacles and other cephalic processes are different. The body is narrower and longer, and the bristles are much smaller, so as to alter the outline; and their structure, as well as that of the scales, is essentially different. From the *Parmenis ljungmani* of Malmgren,[1] to which it is allied, it differs in the structure of both dorsal and ventral bristles as well as in that of the scales.

Allied forms to both this and the succeeding species (*Parmenis ljungmani*) are the *Polynoë vasculosa* of Claparède,[2] and the *Polynoë crassipalpa* of Marenzeller.[3] They, however, differ in regard to the shape of the head and the structure of the bristles.

This species takes the place of the closely related *Parmenis ljungmani* of the Outer Hebrides, and the representatives of both appear to be few. It is probable that, like allied forms, it may be commensalistic.

4. Harmothoë ljungmani, *Malmgren*, 1867.

Specific Characters.—Body small, sublinear, bristled segments thirty-five to thirty-six. Head elongated antero-posteriorly, somewhat narrower in front, and with two short peaks. Eyes visible from the dorsum; two at the posterior border, and two larger at the side in front of the middle line. Tentacles and tentacular cirri short and tapering, with sparsely distributed clavate cilia. Palpi elongate, subulate, with minute papillæ. Tentacular and dorsal cirri alike. Ventral cirri enlarged at the base, similarly ciliated. Scales fifteen pairs; first pair suborbicular, the others obliquely ovate or ovoid, increasing in size till the two last pairs, with very few minute papillæ along the outer and posterior border, while the tubercles on the surface are larger and more numerous than in *H. zetlandica*. Dorsal bristles stouter than the ventral, rather short, curved and little tapered, with close rows of spines which extend to the tip. The ventral bristles have short spinous tips ending in a smooth and characteristically curved claw, while the secondary process leaves a gap between it and the base of the hook.

Synonyms.

1867. *Parmenis ljungmani*, Malmgren. Ann. Polychæta, p. 11, pl. i. fig. 2.
1875. *Harmothoë Macleodi*, McIntosh. Invert. and Fish., St. A., p. 116.
1876. ,, ,, Ibid. Trans. Zool. Soc., ix, p. 382, pl. lxix. f. 2, 3.
1888. ,, ,, De Saint Joseph. Ann. d. sc. nat. (7), v, p. 168, pl. vii, f. 37—40.

Habitat.—Between tide-marks under stones at Lochmaddy, North Uist, and in the stomach of the cod, St. Andrews (E. M.). Shores of France—Dinard.

Length about 14 mm.; breadth across bristles 3 mm.

[1] 'Annulat. Polychæt., &c.,' p. 11, pl. i, fig. 2, 1867.
[2] 'Annél. Chétop. Nap., Suppl.,' p. 12, pl. i, f. 4.
[3] "Zur Kenntniss d. Adriat. Annel.," 'Sitz. der k. Akad. Wissensch.,' April 1, 1874, p. 6, Taf. ii.

Head (Plate XXXVIII, fig. 1) elongated from before backward, terminating in two peaks anteriorly, and with eyes similarly placed to those in *H. zetlandica*, viz. a pair of smaller eyes on the dorsum in front of the nuchal collar, and a larger pair on the sides anteriorly in front of the middle line of the head, and at the base of the peaks. All are visible from the dorsum, though the main vision of the anterior eyes is lateral. The palpi have rows of minute papillæ, and are similar to those of *H. zetlandica*, as also are the tentacles and tentacular cirri—which have clavate cilia. All are comparatively short, and taper gently to the extremity without an evident enlargement below the tip (in spirit).

Body elongated, rather narrow, slightly tapered in front, more so posteriorly, and with comparatively short bristles, the segments bearing these being from thirty-five to thirty-six. In regard to external structure and coloration it agrees with the foregoing form.

Scales (Plate XXXII, fig. 11) amount to fifteen pairs, are thin and semi-translucent, have a very few minute cilia along the outer and posterior border, while the papillæ, which are generally scattered over the surface, are larger and more numerous than in *H. zetlandica*. Along the anterior edge somewhat smaller papillæ occur in rows. In shape they correspond with those of the latter, the first pair being circular, the rest more or less ovoid and increasing in size to the twelfth or thirteenth.

Feet.—In the first foot the upper division bears a few short dorsal bristles similar in type, though more curved than the succeeding.

In the second foot the dorsal bristles are already numerous and of considerable length. The curvature is well marked, especially at the tip, which shows no smooth portion, the spinous rows passing quite to the extremity. The bristles of the inferior division present superiorly almost the typical structure with the somewhat broad short tip, and the long secondary process. The bristles of the middle division have longer tips, very slightly bifid, while in the inferior series the tips are elongated, simple, and with long spinous rows, which in some views are more or less pinnate.

As we proceed backwards the bristles gradually assume the typical form, the dorsal becoming longer and stronger (Plate XXXVIII, fig. 22) as well as less curved. Moreover the tip is but slightly tapered, and the spinous rows pass to the extremity and are closely arranged, except in a few of the short forms next the body. The ventral division has boldly bifid bristles (Plate XXXVIII, fig. 23) throughout, the entire tip being rather broad and the spinous region short. The inner line of the hook forms a different angle from that in *H. spinifera*, and leaves a wider gap distally. The secondary process diminishes in length from the superior to the inferior series of bristles, so that in the latter it scarcely reaches to the middle of the peculiarly curved terminal hook. The spinous region of the tips of the inferior bristles is very short. The bristles generally are faintly yellowish, and the dorsal form a favourable site for the development of parasitic growths.

The dorsal cirri are comparatively short, and taper almost from the base to the slender tip. Sparsely distributed clavate cilia occur on the surface below the latter. The ventral cirri are enlarged at the base, and have also a few clavate cilia.

When the species was described in 1876 it was thought to differ from the *Parmenis ljungmani* of Malmgren, on the grounds of the proportional strength and structure of the dorsal bristles, and in the pale semi-translucent scales, but the ventral bristles approached each other closely. A re-examination of all the characters and of Malmgren's description now inclines me to unite them, especially as in the generic characters he states that the dorsal bristles are shorter and thicker than the ventral, while in the specific he says they are much shorter and a little more slender than the inferior bristles. Moreover, if his figure of the dorsal bristle be supposed to be that next the ventral series (always the most slender and elongate), the distinctions more or less disappear. The only doubtful point is the possible existence of a species agreeing in all respects with that from Lochmaddy, but having more elongated dorsal bristles. Levinsen seems to be of the same opinion.

Few individuals of this form would seem to exist. Only a single example was obtained at Lochmaddy, and one in the stomach of a cod at St. Andrews. Baron de St. Joseph found one in the tube of *Lanice conchilega* at Dinard. With the two foregoing it forms a special series—closely approaching each other and such forms as the *Polynoë crassipalpa* of Marenzeller.

5. Harmothoë antilopis, *McIntosh*, 1876.

Specific Characters.—Length about three-quarters of an inch or a little more. Head broad behind, peaks truncated in front, two widely separated eyes posteriorly, and a larger pair laterally and below the short peaks, not visible from the dorsum. Median tentacle and tentacular and dorsal cirri moderately long, slightly enlarged below the filiform tip, and covered with numerous cilia with slightly bulbous tips. Lateral tentacles inferior. Palpi of average length—with clavate papillæ. Body, moderately elongated, of considerable breadth, bristled segments 33—35. Scales fifteen pairs, mostly reniform, entirely covering the dorsum, with long cilia externally and posteriorly and shorter on surface, which also has large horny papillæ ending in spines with hispid tips. Dorsal bristles elongated, with smooth tips and very distinct spinous rows (resembling the horns of an antelope), ventral with bifid tips, scarcely hooked, and in some the distal part of the spinous region is narrower than the smooth tip. Ventral cirri rather slender and tapering, with short clavate cilia. The segmental papillæ are but slightly marked.

Synonyms.

1876. *Harmothoe antilopis*, McIntosh. Trans. Zool. Soc., ix, p. 383, pl. lxix, f. 4—6.
1877. *Evarne marioni*, Marion. Rev. des Sc. nat., April 15th, 1877.
1879. „ *antilopes*, Marion. Ann. des Sc. nat., 1879, p. 13, pl. xv, f. 1 to 1 *f*.
1884. *Polynoë antilopes*, Carus. Faun. Medit., p. 200.

Habitat.—First procured at Lochmaddy, North Uist, in 1865; off the Hebrides (J. G. J.); on muddy sand at 173 fathoms, 'Porcupine,' 1869; 'Porcupine,' 1870, 576 fathoms, on the Channel slope; 227 fathoms outside Gibraltar; and 358 fathoms in the Atlantic. It is included in the Mediterranean fauna also by Professors Marion and Carus.

Its range is thus extensive, but the numbers hitherto have been few, generally a single example at each station.

Length from three quarters to nearly an inch.

Head (Plate XXVIII, fig. 13) somewhat broad behind, with the anterior angles ending in very short peaks. Two comparatively large and somewhat widely separated eyes occur near the posterior border. The larger anterior pair are not visible from the dorsum, being situated laterally and below the truncated angles of the snout. In most specimens in spirit the pigment of the eyes has become very faint. The median tentacle is moderately long, slightly enlarged below the filiform extremity, and covered with numerous cilia with very slightly enlarged tips. The lateral tentacles are inferior, have a slight enlargement below the tip, and are also supplied with clavate cilia. The tentacular cirri are similar to the median tentacle, the cilia being continued about a third up the filiform termination. The palpi are of moderate length, with rows of minute clavate papillæ, which toward the termination are dilated and then constricted below the slightly granular tip.

The *body* is moderately elongated, of considerable breadth, not much tapered anteriorly and only a little more so posteriorly, and with the usual markings dorsally and ventrally. Bristled segments from thirty-three to thirty-five. The segmental papillæ do not appear to be produced as tubular processes, only the projecting "boss" or elevation indicating this structure.

The *scales* (Plate XXXII, fig. 16) amount to fifteen pairs, and entirely cover the dorsum. The first pair are more or less rounded, the rest reniform, the outer lobe being larger than the inner. They are fringed on the outer and posterior borders as well as studded over the surface with cilia, which become very long on the former border, and the tips are slightly bulbous. They are often coated with a granular parasitic growth. The horny papillæ or tubercles on the surface are large and boldly marked, the dilated tips forming blunt processes or spines truncated at the tip, which is hispid with sharp processes, and in favourable specimens they resemble a rosette of spikes. The appearance is thus characteristic. A pale brownish coloration occurs on the dorsal surface where the scales overlap, but otherwise they are pale with the exception of the minute brownish spines. The under surface is smooth and iridescent.

Feet.—The first foot has a few short bristles of the normal dorsal type, and very slightly curved. The second foot has a considerable tuft of short dorsal bristles, only the inner being curved, those next the spine being more or less straight, with the well-marked spinous rows from which the name of the species is derived. The ventral series of slender bristles has long spinous regions superiorly and shorter inferiorly. All have simple tapering tips. These bristles are proportionally shorter and stouter than the typical series. The bristles gradually elongate and the ventral series become bifid, so that in the typical foot (Plate XXIX, fig. 11) the dorsal division carries a conspicuously long and strong series, the inner bristles being shorter and more curved as well as more abruptly pointed at the tip, which has a short smooth portion; while the outer and inferior series are long, very gently tapered, and slightly curved, with a short, conical, bare portion terminally. All are distinctly marked by transverse spinous rows at rather wide intervals, whence the name of the species, from the resemblance of these organs to the horns of certain antelopes, such as *Hippotragus oryx*. One of the larger bristles is represented in Plate XXXVIII, fig. 24. The ventral series again forms a dense tuft of fine and by no means long bristles, commencing superiorly with a group of about three, with elongate spinous regions, tapering to an acutely pointed simple tip. The adjacent series has also long, slender, spinous regions, but the tips are bifid, the part which is usually hooked having scarcely a trace of a curve, and the secondary process being closely applied (Plate XXXVIII, fig. 25). The tips become shorter and stouter inferiorly, and the secondary process more apparent. Though a slight curve is present the tip is scarcely hooked (Plate XXXVIII, fig. 26, representing one of the stoutest forms). The upper third of the spinous region is even narrower than the bifid part behind the hook at the tip, a peculiarity seldom seen. Inferiorly the simple tips as well as the bristles themselves become shorter.

Posteriorly (in the last feet) both dorsal and ventral bristles become much more slender as well as smaller. The dorsal, however, show even in the least developed the well-marked spinous rows. The ventral bristles have long and finely tapered spinous regions and simple tips.

The dorsal bristles are often loaded with parasitic growths, one of the most beautiful being a handsome stalked infusorian.

The dorsal cirri stretch beyond the bristles, and have a similar structure to the median tentacle. The ventral cirri are rather slender and elongate, with a filiform tip.

Reproduction.—All that can be said about the reproduction of the species is that in an example procured in early autumn (August) numerous ripe eggs occurred between the feet and on the dorsum under the scales. Though the body was ruptured it is probable these escaped, at least in some cases, naturally. A ripe form also was dredged in the Minch in July.

This species approaches *Evarne*, but a glance at the head and the arrangement of the eyes at once differentiates it, while the structure of the scales and the characters of the dorsal and ventral bristles still further emphasise the distinctions. The *Polynoë spinifera* of Ehlers is a closely allied form, but the anterior pair of eyes, if the figure is to be trusted, quite differ, since they are visible from the dorsum. The details of the bristles are not given. In the same way, while admitting the relationship between the species and *Evarne* as above mentioned, I do not think with my esteemed colleague, Prof. Marion, for the reasons indicated, that it should be placed in that genus. It is true that in the French naturalist's figure the anterior pair of eyes are dorsal, but such was not the case in the examples observed here. The character of the spinous rows of the dorsal bristles differs from that of either *Evarne impar* or *E. Johnstoni*.

6. Harmothoë Haliaëti, *McIntosh*, 1876.

Specific Characters.—No complete example has yet been found. The dorsal bristles are rather long, slender, and slightly curved, with conspicuous rows of spines, and a very short, bare portion at the tip. The ventral bristles have slightly hooked tips, and the secondary process is either straight or bends outward a little at the tip. The ventral cirrus is somewhat enlarged at the base, filiform at the tip, and with rather long papillæ sparsely distributed.

SYNONYMS.

1876. *Harmothoe Haliaeti*, McIntosh. Trans. Zool. Soc., ix, p. 381, pl. lxix, f. 7—10.
1885. ,, ,, idem (partim). 'Challenger' Annel., p. 96.
1886. ,, ,, Harvey-Gibson. Verm. Liverp., 119.
1891. *Polynoe (Harmothoe) Haliaeti*, Hornell. Op. cit., 232, pl. xiii, f. 5.

Habitat.—The first specimen was procured in the Minch in July by Dr. Gwyn Jeffreys, who did so much in dredging examples of the British Annelids.

In a posterior foot the dorsal branch bears a series of rather long, slender, slightly curved bristles with conspicuous rows of spines (Plate XXXVIII, fig. 27). Such bristles, when viewed antero-posteriorly, present a much narrower aspect than when seen in profile. The arrangement of the spinous rows is alternate, as in the ventral bristles. Only a very small portion of the tip is smooth—a feature of moment when it is contrasted with the larger and longer tip of *H. Fraser-Thomsoni*. The dorsal bristles are often coated with a brownish granular substance and algoid growths. The superior ventral bristles have elongate spinous portions and slender tips (Plate XXXIX, fig. 1). At first the bifid tips are almost straight or very slightly curved, but they soon become more characteristic (Plate XXXIX, fig. 2). The *facies* of the tip is even more diagnostic in the inferior series (Plate XXXIX, fig. 3), where the spinous region is distinctly curved. In the superior group the secondary process is nearly straight, but in the others it bends outwards at the tip, which has a distinct hook.

The inferior cirrus is enlarged at the base, slender and filiform distally, and furnished with rather long papillæ sparsely distributed.

Hornell found an allied form at Port Erin, Isle of Man, in fifteen fathoms. He describes the scales as densely fimbriated round the border after the manner of *Lepidonotus squamatus*, so that there is need for further investigation as to the condition in this respect. Unfortunately this specimen could not be found in the collection at Liverpool, and the others are incomplete.

7. HARMOTHOË FRASER-THOMSONI,[1] *McIntosh*, 1896.

Specific Characters.—Head somewhat resembles that of *Lagisca*, having a pair of widely separated eyes posteriorly, and a larger pair on the lateral eminence. Median tentacle absent. Palpi of moderate length, with rows of minute papillæ. Body of considerable length and breadth; bristled segments thirty-nine to forty. Dorsum has touches of brown pigment posteriorly as in *Lagisca*. The lateral segmental eminences are prominent, but there is no process. Scales mottled brown, fifteen pairs, covering the dorsum; first small and rounded, rest more or less ovoid; border smooth, anterior

[1] Named after my early and valued friend, the late Dr. Fraser Thomson, of Perth.

and inner half studded with small horny papillæ, outer and posterior areas have sparsely distributed, large tubercles, with an interrupted row along the posterior border. Dorsal bristles stout, moderately long, and slightly curved, with closely arranged spinous rows and a short, smooth tip. Ventral bristles bifid, the secondary process coming off at an angle. Dorsal cirri appear to be fusiform—from the gradual nature of the dilatation and the long filiform tip, and have clavate cilia. Ventral cirri slender, with a few clavate cilia.

SYNONYMS.

1885. *Harmothoë Haliaeti* (partim), McIntosh. 'Challenger' Annel., p. 96.
1896. „ *Fraser-Thomsoni*, McIntosh. Sc. Proceed. R. Dub. Soc., vol. viii, n. s., p. 101.

Habitat.—Dredged in the 'Knight Errant' in 1880, in the Atlantic, at a depth of fifty-three fathoms, and procured by Prof. Haddon in the Royal Irish Academy's Expedition, July 15th, 1886, in ninety-three fathoms off the south-west coast of Ireland—along with *Malmgrenia castanea*, which occurred on *Spatangus raschii*.

The *head* (Plate XXVIII, fig. 7) somewhat resembles that of *Lagisca*, having a pair of well-marked and widely separated eyes posteriorly, and a larger pair still more widely separated on the anterior lateral prominence, looking laterally and dorsally. Both pairs are conspicuous from the dorsum. The head terminates anteriorly in sharp peaks on each side of the median tentacle. The lateral are brownish, subulate, and with a long filamentous tip. The palpi appear to be of moderate length, and to have rows of minute papillæ, but they had been dried.

The *body* is of moderate breadth and of considerable length, narrowed abruptly in front, but—from the middle—gradually diminishing posteriorly. The bristled segments seem to amount to thirty-nine or forty. The brownish pigment of the dorsum posteriorly is very prettily arranged in lozenges and touches, as often seen in species of *Lagisca*. The lateral eminences for the segmental apertures are well marked, and a small papilla projects between the feet.

The *scales* (Plate XXXII, fig. 11) number fifteen pairs, and are thin, translucent, and cover the dorsum. The first pair are small, rounded, and studded with minute spines and tubercles. Few seem to be reniform, the majority being ovoid. The border is smooth throughout. The anterior and inner half is densely covered with small horny papillæ or tubercles, while the outer area and that behind the scar for the pedicle have large tubercles sparsely distributed. The small tubercles are grouped with a few larger spines along the outer edge, while the posterior border is marked by about eight large blunt spines or tubercles. Some of the latter under pressure project a little beyond the posterior border, but no trace of cilia exists. Such scales thus differ quite from those mentioned by Mr. Hornell, so that two species are involved. The scales are mottled with brown, best marked round the scar for attachment.

Feet.—The first foot is not in a condition for description.

The second foot presents a dense tuft of short, strong, and very slightly curved dorsal bristles with smooth tips, and distinct though closely arranged spinous rows. Ventral cirri somewhat tumid at the base, and with a few comparatively long cilia.

The ventral bristles form two groups, a stronger upper series and a more slender inferior group, both with longer and more tapered tips than the typical. The tips of most of the upper series are spear-shaped, though in one or two a double contour is seen. The rows of spines are boldly marked. The inferior group has very long tapering tips, which are hair-like in their attenuation, and the spinous rows are finer than in the superior bristles.

In the third foot the dorsal bristles have increased in size and strength, and the terminal bare region is more distinct. While the upper and lower ventral bristles have simple tips, the median show bifid tips. The feet gradually assume the typical condition as we proceed backwards.

In the fully formed foot (Plate XXIX, fig. 15) the dorsal branch bears a series of moderately elongate and stout dorsal bristles with closely arranged spinous rows, only a short portion at the tip being smooth. The curvature is slight (Plate XXXIX, fig. 4). The ventral bristles are of average length, the upper series with long spinous regions and simple tips, the next with shorter spinous rows and bifid tips (Plate XXXIX, fig. 5). The tips in the stouter forms are slightly hooked, and the secondary process comes off at an angle. Only in the upper forms with the longer distal regions does the secondary process form a small angle. At the ventral edge of the series the spinous region becomes much shorter, but almost all are bifid.

These bristles differ from those of *Harmothoe Haliaeti*.

The dorsal cirri are somewhat slender and elongate, with a slight swelling—marked on each side by a brown bar below the long filamentous tip. They are sparsely covered with clavate cilia, the longest of which scarcely attain half the diameter of the thickest part of the cirrus. The posterior cirri are very slender throughout. The ventral cirri are rather small and slender, and have a few short clavate cilia.

Loxosomæ occur on the skin of the dorsal division of the feet, and also on some of the dorsal bristles (Plate XXXIX, fig. 6).

8. HARMOTHOË MARPHYSÆ, *McIntosh*, 1876.

Specific Characters.—Head elongated, rounded in front, widest posteriorly. Eyes small, the larger anterior pair further apart and situated laterally in front of the middle line. Posterior pair in front of the nuchal collar. Median tentacle short, with clavate cilia; lateral short, with filiform tips and a few clavate cilia. Palpi (in spirit) short and stout, with delicately tapered tips. The tentacular and dorsal cirri are comparatively short and slender, and the tips finely pointed. A few clavate cilia occur on the surface. Body somewhat elongate, about three quarters of an inch, and with thirty-two to thirty-three bristle-bearing segments. The feet increase in bulk after the twelfth (sexual). Scales thirteen or fourteen pairs (it may be fifteen), smooth under a lens, but under a high power showing widely separated horny papillæ. In shape they are rounded in front, reniform or ovoid posteriorly. Dorsal division of the foot little developed, and the tuft of bristles minute. Ventral bristles with short spinous regions and mostly with bifid clavate cilia. Colour pale brownish inclining to buff, with a red patch on the head and a purplish hue over the proboscis. Under surface pinkish with a broad streak of carmine.

SYNONYMS.

1876. *Harmothoe marphysæ*, McIntosh. Trans. Zool. Soc., ix, p. 384, pl. lxix, f. 11—14, and pl. lxx, f. 7.
1890. ,, ,, Malaquin. Annel. Boulon., 21.

Habitat.—In the galleries of *Marphysa sanguinea* in Guernsey, and from chinks in the rocks, Polperro (British Museum).

Head (Plate XXVII, fig. 11) rather elongated from before backward, rounded in front instead of having the usual peaks, and with the widest part behind the middle. Eyes small; the larger anterior pair wider apart, and situated laterally in front of the middle line at the edge of the red patch on the head. The small posterior pair lie in front of the nuchal collar and behind the red patch. A slight median groove runs forward to the base of the median tentacle, the column of which is absent. The lateral tentacles are inferior (*i. e.* below the rounded anterior border of the head), short, with filiform tips, and have a few short clavate papillæ. The palpi are short and stout, with delicately tapered extremities. No papillæ were visible, but they may be present in section. The tentacular cirri are comparatively short and slender, with finely tapered points. On the surface are a few clavate cilia.

Body somewhat elongate, with the feet greatly developed posteriorly. Bristle-bearing segments thirty-two to thirty-three. The segments after the twenty-third (bristled), however, are in process of renewal. The markings on the dorsum are less distinct than usual, as the feet are separated by deep clefts. The feet increase in bulk after the twelfth bristled pair, becoming larger and longer, a feature which may be connected with reproduction. An elevated line occupies the middle of the dorsum in the preparation, while ventrally the median region has a depressed line at each side with a cushion-like ridge between. The segmental eminence is well marked, and a distinct conical process extends between the feet. The process is evident about the seventh foot, and continues almost to the posterior end.

The colour is pale brownish inclining to buff, with a red patch (from the ganglia) on the head, and a purplish hue just behind (due to the proboscis), while a faint median streak occurs on the dorsum. The cirri are pale brownish, pellucid, the two caudal styles being darkest. The under surface is pinkish, with a broad streak of carmine in the centre.

The *scales* (Plate XXXII, fig. 13) appear to be thirteen or fourteen pairs (possibly fifteen), covering the dorsum and easily separated, but the specimen is not in a condition to give accuracy in this respect. In front they are rounded, then reniform, and even somewhat quadrate posteriorly. They are rather thin, apparently smooth and pellucid, the anterior only having a pale brownish patch on a whitish portion. Under the microscope, however, a belt of small papillæ (spines) occurs within the anterior bay of the scale, in front of the scar. Other pale points which resemble these (by transmitted light) are dotted over the lateral area, but they seem to be the end-organs in connection with the numerous nerves.

Feet.—The first foot has a strong spine and a bristle or two like the dorsal.

The second foot has a considerable number of short dorsal bristles, little tapered. In the ventral division is a group of comparatively short, strong bristles, with short spinous regions, and a somewhat elongated smooth portion at the tip which ends in a probe-point. The length of the spinous region diminishes in the usual manner from above downwards.

Gradually the feet assume the complete form, many of the ventral bristles, indeed, in the third foot being bifid, but the dorsal division, instead of becoming more prominent as in the majority of the Polynoidæ, increases very little.

In the fully formed foot (Plate XXIX, fig. 16) the dorsal division is marked by a long bluntly conical process bearing the spine, above which a short tuft of comparatively few bristles projects from a small eminence. These bristles (Plate XXXIX, fig. 7, one of the longer) are slightly curved, delicate, and translucent, with minute rows of spines. The ventral division consists of a somewhat long and obliquely truncated foot, the spine occurring at the upper angle in a pit between two fleshy lobes—a larger upper and a smaller inferior. The bristles have moderately long shafts and short spinous regions. The upper examples have more elongated spinous regions and simple tips (Plate XXXIX, fig. 8), while a distinct secondary process is observed in the succeeding forms (Plate XXXIX, figs. 9 and 10, the latter being seen from the front). Toward the ventral edge of the group the spinous regions become very short and the tip simple (Plate XXXIX, fig. 11). In large examples from Polperro the dorsal edge of this division of the foot is curiously wrinkled in the preparations. The spinous region of the ventral bristles is often coated with parasitic growths.

Posteriorly both dorsal and ventral bristles become more slender and elongate, the tips of the ventral forming long hair-like processes.

The dorsal cirri are pale brownish and pellucid, the caudal styles being darker. The cirri are simple tapering processes, with sparsely distributed clavate cilia, which are longest towards the base of the filiform tip. The ventral cirrus is somewhat tumid at the base, and has a very few comparatively long clavate cilia.

Reproduction.—The specimen procured in July at Guernsey carried nearly ripe ova.

Habits.—A single specimen occurred in each gallery of *Marphysa sanguinea*, and the examples from Polperro, "from the chinks of rocks," may have had a similar relationship. When placed in an open vessel beside *Marphysa* it clung to the body of the latter near the head.

Baron de Saint-Joseph procured his *Harmothoe picta*,[1] an allied species, in the tube of *Lanice conchilega* at Dinard, on the French coast. Another species (*H. arenicolæ*) he found clinging to a lobworm. It is curious that this also was a ripe female. His figures of the bristles are not so strictly drawn as is necessary for accurate diagnosis, but the species closely approaches *H. spinifera* and *H. ljungmani*. It is, however, larger, viz. 25 mm. long.

[1] 'Ann. d. Sc. nat.' (7), v, p. 172, 1888.

9. HARMOTHOË LUNULATA, *Delle Chiaje*, 1841.

Specific Characters.—The head approaches that of *Harmothoë marphysa*, only it is less elongated and the eyes are larger. The tentacles and tentacular cirri are brownish; palpi smooth. Body about three quarters of an inch long; ventrally, with a series of brown spots, which, as a rule, commence as four rows somewhat behind the middle. Occasionally by union they form bars at the junction of each segment. A prominent segmental eminence and papilla. Scales fifteen pairs, smooth round the margin, but with a dense cluster of minute horny papillæ on an area in front of the scar. Brown pigment variously arranged—some having a ring of brown or a V-shaped pattern on the scale, while the outline of the pigment in others has the shape of the shell of *Pandora*. Dorsal bristles are better developed than in *H. marphysa*, being long, tapering, slightly curved, and finely spinous. The ventral bristles, again, form a fan, and the tips of almost all have a secondary process. The dorsal cirri are comparatively short tapering organs, with sparsely distributed short clavate cilia. The ventral cirri have similar cilia, and are slender, their tips reaching beyond the base of the nearest bristles.

SYNONYMS.

1841. *Polynoe lunulata*, Delle Chiaje. Descriz. e not., vol. v, p. 57, pl. cxliv, f. 5, 6.
1865. ,, *maculosa*, Carrington. Proceed. Lit. and Phil. Soc., Manchest., iv, p. 177.
1867. *Monocolea tessellata*, Costa. Ann. d. Mus. Zool. d. v. Univ. d. Napoli, i, p. 82.
1868. *Polynoe lunulata*, Claparède. Annél. Chét., Naples, p. 63, pl. ii, fig. 1.
1875. ,, ,, Panceri. Atti R. Accad. Napoli, vol. vii, p. 13, Tav., f. 1—3.
,, *Harmothoe lunulata*, McIntosh. Invert. and Fish., St. A., p. 116.
1876. ,, ,, idem. Tr. Z. S., vol. ix, p. 385, pl. lxix, f. 16—20.
1884. *Polynoe lunulata*, V. Carus. Faun. Medit., i, 200.
1886. *Harmothoe lunulata*, Harvey Gibson. Verm. Liverp., 148.
1891. *Polynoe* (*Harmothoe*) *lunulata*, Hornell. Op. cit., p. 236.

Habitat.—Very generally distributed throughout British waters—from Shetland to the Channel Islands, and from the west coast of Ireland to the east coast of Scotland. It ranges from the tidal rocks in the Channel Islands to 120 fathoms off the south-west coast of Ireland. It extends to the Mediterranean.

Head (Plate XXVII, fig. 8) resembles that of *H. marphysa*, only it is less elongated and the eyes larger. The median tentacle is brownish, has a filiform tip and sparsely distributed clavate cilia. The lateral tentacles are subulate, with a filiform tip and clavate cilia. The tentacular cirri have the same form as the median tentacle, and also the same brownish colour. The palpi are smooth.

Body about three quarters of an inch in length, slightly tapered anteriorly, and much more so posteriorly. The chief feature of moment is the presence, in the majority, of a series of brown spots, which commence as four rows somewhat behind the middle. In some the sets are united so as to form two rows of bars at the junction of each segment; and this confluence sometimes occurs posteriorly even when the four rows are distinct in front. The segmental eminence is well marked, and a small cylindrical papilla projects between the feet.

Scales (Plate XXXII, fig. 12).—Fifteen pairs, somewhat thin, and entirely covering the dorsum. The first pair are rounded with a broad transverse bar of brown pigment in front. The succeeding are reniform, and the posterior more or less ovoid. They are finely veined, and as smooth under a lens as in *H. marphysa*, but show a dense group of horny papillæ in front of the scar, that is, near the hollow of the reniform kinds. The coloration of these scales is varied. Thus some of the Zetlandic examples are faintly tinged with brown toward the posterior border; in others each scale has a brownish ring, or the brown pigment forms a bold border on the inner third, and sends a process, in some cases enlarged near the termination, toward the centre of the scale, so as to simulate a **V**. The spot or enlargement is at the scar. In the forms from St. Andrews the pigment assumes the shape of the shell of *Pandora*, with a spot (over the peduncle) corresponding to the hinge anteriorly. The colours are for the most part retained after immersion in spirit. The persistent attachment of the scales is not a feature characteristic of the Zetlandic forms, for they readily fall off.

Feet.—The first foot has the usual spine and a few bristles resembling the dorsal.

The dorsal division of the second foot bears a larger group of bristles than in *H. marphysa*, with similar fine rows of spines, and the bristles are generally larger and stouter. The ventral series are fairly developed, the upper and lower with simple, the median with distinctly bifid tips, though the secondary process is slender.

In the third foot both dorsal and ventral bristles are longer and approach more nearly to the typical forms. They are also more numerous.

In the typical foot (Plate XXX, fig. 4) the dorsal division is more developed than in *H. marphysa*, and the bristles attain a size never seen in that species, though it has to be borne in mind that the environment may have considerable influence in modifying these and other parts. They are long, tapering, slightly curved, and finely spinous bristles (Plate XXXIX, fig. 12, in profile, and Plate XXXIX, fig. 13, antero-posteriorly, so as to show the alternate disposition of the spines, both representing the longer and more tapering forms next the ventral). Some, however, are even more finely tapered than the forms shown. The spines proceed almost to the tip, a mere trace of a terminal smooth portion being present. Those next the body are much shorter and less tapered (Plate XXXIX, fig. 14). Parasitic infusoria and slender algæ are common on these bristles. The ventral division of the foot is somewhat less elongated than in *H. marphysa*, and the bristles form a more regular fan. Superiorly the spinous region is longer, and the tips more finely tapered (Plate XXXIX, fig. 15); the secondary process, which appears to be present in all at this edge, being very closely applied to the larger division, which is scarcely hooked. In a variety from Guernsey some of these bristles have simple tips. The fissure between the divisions becomes more evident as the spinous region diminishes in length, but it again is less distinct ventrally, some at the extreme verge having a mere trace of this process. A bristle from the middle of the ventral group is drawn in Plate XXXIX, fig. 16. Their colour throughout is very pale yellow. Microscopic filamentous algæ occur on them.

The dorsal cirri are rather short, tapering organs, with scarcely a trace of an enlargement below the filiform tip, and the short clavate papillæ are sparsely distributed. The ventral cirri are comparatively slender, and the tips reach considerably beyond the bases of the nearest bristles. They have the same sparsely distributed short cilia.

Habits.—*Harmothoë lunulata* is a very active species amongst the laminarian roots, and displays as much irritability as *Evarne impar*. It is also sometimes found as a commensalistic form in the tube of *Polycirrus*. It is brightly phosphorescent, glowing when irritated at the bases of the feet for a considerable time, and giving off flashes when immersed in spirit, as well as generally breaking in pieces.

The Zetlandic examples of the species are somewhat elongated, have longer feet, and longer and more delicate pale bristles; moreover the dorsal and ventral cirri are longer than in the southern forms.

It is evident that the species approaches *H. marphysa* very closely, though the cirri of the latter are shorter and smoother, the bristles of the dorsal branch much shorter and less conspicuous, and those of the ventral division shorter and more slender. Moreover those of the superior ventral series have no bifurcation at the tip, the closest approach to the latter condition being in a variety of *H. lunulata* from St. Peter Port, Guernsey, which had an indistinctly bifid tip in one or two of its superior bristles.

I have united it, after Claparède, with Delle Chiaje's form, though in his original description of the species he gave it a single caudal style and fourteen pairs of scales—characters also illustrated in his somewhat stiff figure, which shows the middle line of the dorsum quite bare from end to end.

Claparède, who studied the species at Naples, correctly described it as having fifteen pairs of scales, and pointed out the pinkish line of the ventral median line anteriorly—from the nerve-cord—on which he found no ganglia. He gives the total number of segments as thirty-seven, and shows that the last bears two large terminal cirri. At the bases of the feet are vibratile rosettes as described by Ehlers, and they are about four in number. In the preserved examples the two whitish masses he mentions on the feet are not visible. He also notes the apparent absence of blood-vessels, and describes the nerve-cord as having a median and two lateral bands corresponding to the nerve-cells, of which he gives some further details. He is of opinion that Costa's *P. tessellata* is the same species. He describes the scales as finely granular and without horny papillæ, but in his figure the greater part of the surface (all but the anterior third) shows such papillæ. This, therefore, is a point on which further evidence is required, especially as the distribution of these horny papillæ in the British examples is so well defined. Should the evidence prove that the Mediterranean form is different, then Dr. Carrington's name, *H. maculosa*, stands. He first found the species in this country stranded on Southport sands.

Prof. Panceri[1] experimented with this species and others in regard to luminosity, and came to the conclusion that it emanates entirely from the scales, and that it is connected with the remarkable terminations of the nerves in the subcuticular granular layer of the epiderm.

Grube's *P. maculata*[2] seems to be an allied form, but the description of the cirri differs.

[1] 'Atti R. Accad. di Napoli,' 1875, p. 13, Tav. 304.

[2] 'Actin., Echin., u. Würm.,' p. 87, 1840.

10. Harmothoe setosissima, *Savigny*, 1820. Plate XXV, fig. 1.

Specific Characters.—Head somewhat short and broad. The posterior eyes are nearer each other than in *H. imbricata*, while the anterior are larger and more visible from the dorsum. Median tentacle rather long, with just a trace of a dilatation below the filiform tip, and its surface has sparsely distributed short clavate cilia. Palpi apparently smooth, but show minute papillæ under a high power. Body somewhat elongated; segments thirty-eight, either pale or variegated rather prettily with brown. Segmental eminences and papillæ distinct. Scales somewhat adherent, thin, but fairly tough; first pair rounded, rest reniform-ovate, their surface densely covered with minute papillæ; colour pale or brownish, sometimes with a broad ring. Feet with a long acute process above the spine. Dorsal bristles long, gently tapered, with very close rows of short spines, and the point rather blunt except in the external forms. Ventral slender, with a long spinous region and a very short, smooth, bifid tip. Dorsal cirri elongated, tapering, and with sparsely distributed short clavate cilia; ventral slender and rather elongate, also with a few short clavate cilia.

Synonyms.

1820. *Polynoe setosissima*, Savigny. Syst. Annel., p. 25.
1828. *Eumolpe setosissima*, Blainville. Dict. de Sc. nat., lvii, p. 459.
1834. *Polynoe setosissima*, Audouin and Edwards. Annél., 90, pl. i, f. 18.
1836. ,, ,, De Quatrefages. Règ. an. illust., pl. xix, f. 2.
1863. ,, *longisetis*, Grube. Archiv f. Naturges., xxix, p. 37, taf. iv, f. 1.
1864. ,, ,, idem. Die Insel Lussin, &c., p. 78.
1865. *Lænilla glabra*, Malmgren. Nord. Hafs-Ann., p. 73, Tab. ix, f. 5; and Ann. Polychæt., p. 136.
,, *Polynoë setosissima*, De Quatrefages. Ann. I, 229, pl. vi, f. 17.
,, *Antinoë semisculptus*, Baird (partim). Journ. Linn. Soc., viii, p. 192 (?).
1869. *Harmothoe Malmgreni*, Ray Lankester. Tr. Linn. Soc., xxv, p. 375, pl. li, f. 11, 25, 28.
,, *Polynoe longisetis*, McIntosh. Trans. R. S. E., xxv, p. 406, pl. xv, f. 3.
1870. ,, *lævigata*, Claparède. Ann. Nap., Sup., p. 14, pl. i, f. 3 (?).
1875. *Lænilla glabra*, Ehlers. 'Porcupine,' 1869, op. cit., p. 32.
,, ,, *setosissima*, McIntosh. Invert. and Fishes, St. A., p. 116.
1876. ,, ,, idem. Trans. Z. S., ix, p. 387.
1882. ,, *glaberrima*, Hansen. Norweg. N. Atlantic Exp., 29, Tab. iii, f. 6—11.
1886. ,, *setosissima*, Giard. Bullet. Sc. Nord, 339.
1890. ,, ,, Malaquin. Ann. Boulon., 23.
1891. *Polynoe (Lænilla) setosissima*, Hornell. Op. cit., 235.
1898. *Harmothoe longisetis*, De St.-Joseph. Ann. d. Sc. nat., viii, sér. v, 254, pl. xiii, f. 21.

Habitat.—Not uncommon between tide-marks, under stones at Herm, and also in the tubes of *Chætopterus*; tossed on shore amidst sponges, sea weeds, and corallines at the west sands, St. Andrews (E. and R. M.), in the stomach of the cod and haddock at the same place (E. M.), at Plymouth, Moray Frith, and various parts of the British coast. Ehlers found it ranging in the 'Porcupine' to 767 fathoms on *Holtenia*-ground with mud and globigerina-ooze. Extends to the Mediterranean.

Length one and a half to one and three quarters inches.

Head (Plate XXVIII, fig. 5) somewhat like that of *Harmothoe imbricata* in outline, only the anterior peaks are less acute and the widest region is further forward, so as to give the head a more distinctly ovate form. The posterior pair of eyes are nearer each other, and the larger anterior pair are more visible from the dorsum. The median tentacle is of moderate length, with just a trace of a dilatation below the filiform tip, and furnished with sparsely distributed short clavate cilia. The lateral tentacles are short and tapering, and have a very few of the same small clavate cilia. The palpi are smooth under a lens, but show very minute papillæ under a high power. The toughness and extensibility of these organs are well seen in this species. The tentacular cirri also show a trace of an enlargement below the filiform tip, and have sparsely distributed short clavate cilia. These and the tentacles are sometimes tinted brownish.

Body rather elongate, slightly tapered in front and more distinctly from the anterior third backward, and having thirty-eight bristled segments. In some the dorsum is pale, but in others, as in the drawing, it is barred with brown throughout, the pattern in each segment posteriorly being beautifully defined. The under surface is pale. The segmental prominence is distinct, and a considerable papilla projects between the feet. The body terminates in two long, tapering, caudal styles.

The pre-gastric cæca agree with those in *Harmothoe imbricata*.

Scales (Plate XXXIII, fig. 5) fifteen pairs, entirely covering the dorsum; the first pair rounded, the succeeding reniform-ovate. The anterior cling somewhat firmly to the pedicles. The surface is densely covered with minute chitinous papillæ (really minute spines), so that it appears like shagreen under the microscope. Towards the outer border a few short clavate cilia project from the edge and also appear on the neighbouring surface. The scales are comparatively thin, but of considerable toughness. They increase in size posteriorly. Their colour is often pale, but in some it is brownish, and in the coloured figure the papillæ of the scales and other organs are infested by a blackish parasitic growth which greatly alters the aspect.

In two fine examples procured after a storm on the west sands at St. Andrews (E. M.), the scales had a broad marginal belt in the exposed portions, leaving a large ovoid pale region in the middle. The dorsum besides was richly tinted with brown. Coloured examples, indeed, are more common in the north than in the south.

Many *Loxosomæ* occur on the scales of a specimen from the Moray Frith.

Feet.—The first foot has a very strong spine and a group of about four short bristles of the dorsal type.

In the second foot the dorsal bristles form a dense tuft, the closely arranged spinous rows and the rudimentary bare portion at the tip being diagnostic, though the bristles have not attained the length of the typical forms. The ventral division consists of a series of slender bristles with long, tapering, spinous regions, and simple slender tips. Moreover the shape of the foot is peculiar, the dorsal division in lateral view forming a high crest, while the ventral is distinguished by its long, acute cone projecting horizontally above the spine.

In the third foot the bifid condition of the ventral bristles is more evident, and the dorsal are longer. The conical process of the ventral division is larger. By easy stages the typical foot (Plate XXX, fig. 12) is soon reached, showing a ventral division terminating superiorly in a long conical process above the spine. The dorsal bristles (Plate XL, fig. 5) spring from an oblique eminence, and are characterised by their great proportional length, slight curvature, and gently tapered extremities, those next the body having somewhat blunt tips, those next the ventral being more acute. The tips of the blunt forms scarcely show a bare portion, the rows of spines being continued to the tip, but the acute bristles next the ventral have a minute bare portion which sometimes presents a slight keel. The spines are short and the rows very close, so that the bristle is at once distinguished from that of *Harmothoë imbricata*, irrespective of the length of the tip. The ventral bristles are numerous, long, and slender, the spinous region of the upper forms being of great length, the rows closely arranged, and the spines rather short. The tips are bifid, the terminal hook is small, and the secondary process makes a very slight angle. Moreover the smooth region is remarkably short, the spines passing up to the fork (Plate XL, fig. 6). Both sets of bristles are of a lustrous pale yellow, almost like those of *Chloeia*, and thus afford a contrast with the dull straw-coloured organs of *Harmothoë imbricata*. In shape the ventral lobe of the foot is peculiarly pointed, the base being bevelled superiorly, and with a projecting fold inferiorly.

In the terminal feet the dorsal bristles are few in number, more slender and elongate, the tip pointed, and the rows of spines distinctly wider. The ventral are also few in number, slender, with long, tapering, spinous regions, and attenuate, simple tips.

The dorsal cirri present scarcely any enlargement below the filiform tip, are pale throughout, have short clavate cilia sparsely scattered over the surface, and they are longer distally than proximally. The ventral cirri are long subulate organs, the tip extending considerably beyond the bases of the bristles.

The dorsal bristles are the seat in some of a peculiar blackish fungoid growth, as indicated in the coloured figure. This minutely granular structure finds a suitable site on the spiny ridges of the dorsal bristles, and thus both shaft and tip are barred with black in a characteristic manner. This coating can readily be removed by pressure, and no evident change is apparent in the bristle. It is rendered brown by hydrochloric acid, while caustic potash does not seem to alter it much. This growth also affects the spinous region of a few of the ventral bristles.

Habits.—This is another example of the fact that species which frequent off-shore waters in the north are found between tide-marks in the south, as in the Channel Islands. It is a comparatively hardy form, and the example from which the coloured drawing was made lived for weeks in the centre of Perthshire, though towards the termination of the period many of the ventral bristles were shed.

After careful consideration this form has been associated with Savigny's *Polynoë setosissima*.

Audouin and Milne Edwards (1833) assigned forty segments to this species, and they and Savigny found their examples at Havre.

De Quatrefages (1865) included it under his fourth group, in which the body is more or less elongated, and covered by fifteen pairs of scales. He describes the species as provided with a simple triangular head; the median antenna large, about as long as the tentacle. The lateral antennæ small. Forty segments. Scales whitish, obliquely ovoid; sometimes spotted, with the entire margin ciliated. He points out that Savigny and M. Edwards described individuals devoid of scales. Moreover he readily distinguished it by its pale colour; he thinks that Cuvier was wrong in saying Savigny found it at Havre.

Baird found it in tube of *Chætopterus insignis* from Beaumaris.

This species was carefully described by Grube[1] from specimens procured at the larger and smaller Lussins and at Crivizza. He noticed its relationship to *P. setosissima* of Savigny, but the latter had shorter palpi and two additional papillæ, viz. twenty, to the border of the proboscis. He[2] says the specimens so named in the Parisian Museum were *Lænilla glabra*, Mgrn., and *Evarne impar*.

Malmgren's artist represents the anterior pair of eyes on the dorsum, and of the same size as the posterior pair.

The *Polynoë lævigata* of Claparède, from Naples, approaches this form; indeed, there is little to differentiate it. Claparède considered the *P. tentaculata* of De Quatrefages as closely allied.

In Prof. Ray Lankester's early remarks on this species the essential points were omitted.

Ehlers alludes to the variations of the scales exhibited by the specimens from different depths in the 'Porcupine' Expedition of 1869.

Dr. Hansen's (1882) *P. glabrocrinita* appears to be this species. Unfortunately, while placing comparatively little weight on the minute structure of the bristles, the diagnostic characters relied on by this author would not appear to have been of much avail.

It is difficult to make out to what species Audouin and Milne Edwards' *Polynoë lævis* is to be referred. Malmgren includes it under his *Lænilla alba*. Prof. Giard (1886) considers that *Polynoë lævis* is not a variety of *Polynoë setosissima*, since the scales in the former are smooth, whereas in the latter De Quatrefages distinctly says they have a margin fimbriated all round, but he corrects himself in a subsequent communication.[3] He does not think the *P. lævigata* of Claparède is this species.

Hornell (1891) considers that it is the *Lænilla glabra*, Mgrn., and found it invariably present in the tube of *Chætopterus* in Herm.

Baron de Saint-Joseph[4] (1898) in a recent paper doubts if Prof. Giard and I are warranted in connecting this species with Savigny's form, which had lost its scales. The description given by MM. Audouin and Edwards, however, though imperfect, comes nearest this species. He also is doubtful about the inclusion of Claparède's *P. lævigata* as a synonym, but there is no valid reason for altering the view already expressed.

[1] "Beschreibung neuer oder wenig bekannter Anneliden," 'Arch. f. Naturges.,' 1863, p. 37.

[2] 'Arch. f. Naturges.,' 1870, p. 287.

[3] 'Bullet. Sc. Nord,' pp. 340, 341.

[4] Op. cit., 1898, p. 236.

11. HARMOTHOE AREOLATA, *Grube*, 1860.

Specific Characters.—Body elongate, slightly tapered anteriorly, more so posteriorly, and terminating in two caudal cirri. Bristled segments 37 to 39. Head somewhat ovoid, with two elongated peaks in front, and clearly separated by an interval from the base of the median tentacle. Posterior pair of eyes on the dorsum and in front of the nuchal fold, while the anterior pair under the peaks are almost invisible from the dorsum. The median tentacle is of moderate length, gently tapered, little if at all dilated below the filiform tip, and densely ciliated. The lateral tentacles are short, and similar in structure. The tentacular cirri agree with the tentacle. Palpi of moderate length, gently tapered from base to near the apex, which is short and filiform. They have rows of short clavate papillæ, which diminish in size from base to tip, which is bare. Scales fifteen pairs, imbricate, covering the dorsum and extending over the bristles. They vary in shape from the rounded first pair to the reniform kinds, and the D-shaped posterior pair are studded with horny papillæ of various sizes, from the small rounded processes to the elongate forms which rise into bluntly conical spines posteriorly. Margin ciliated posteriorly from the inner to the outer border. Those on the outer border are densely grouped and long. Dorsal cirri of moderate length, tapered and densely ciliated almost to the tip. In many the distal half of the process is dilated, so that the organ is broadly spathulate, with the filiform tip projecting at the distal region. Feet have a dorsal tuft of curved bristles which are densely spinous, with a smooth tip, which has a streak as if a rudimentary tooth were present. The ventral bristles are rather slender, with tapering bifid tips and well-marked spinous rows. The ventral cirrus reaches beyond the base of the bristles, and has somewhat short clavate papillæ.

SYNONYMS.

1857. *Polynoe areolata*, O. G. Costa. Annel. Nap., Tav. ii, figs. 2—2 *j*.
1860. „ „ Grube. Arch. f. Naturges., 1860, 72, pl. iii, f. 2.
1861. „ „ idem. Ein Ausflug n. Triest u. Quarnero., p. 139, Taf. iii, fig. 2.
1864. „ „ idem. Die Insel Lussin, p. 78.
1865. „ „ De Quatrefages. Ann., i, 232.
1866. *Antinoe nobilis*, Ray Lankester. Trans. Linn. Soc., xxv, p. 375, Tab. li, f. 1—9.
1868. *Polynoe areolata*, Claparède. Ann. Chét. Nap., 71, pl. ii, f. 5.
1876. *Harmothoe areolata*, McIntosh. Trans. Z. S., ix, 381, pl. lxviii, f. 3, 12, 14
1884. *Polynoe areolata*, V. Carus. Fauna Medit., i, 200.
1886. *Evarne areolata*, Giard. Bullet. Sc. Nord, 341.
1888. *Harmothoe areolata*, De St.-Joseph. Ann. d. Sc. nat. 7), v, p. 169, pl. vii, f. 41—43.
1890. „ „ Malaquin. Ann. Boulon., 18, pl. i, f. 1, 2.

Habitat.—First found by O. G. Costa in the Mediterranean, afterwards by Prof. E. Grube in the same sea and the Adriatic, and in Britain by Prof. Ray Lankester close to and in the tubes of *Terebella nebulosa* in Herm, by Mr. Cooper in the tubes of *Chætopterus*, and by the author frequently under stones at Herm.

The *head* (Plate XXVII, fig. 15) of this species is distinguished by its somewhat ovoid outline and the prominent peaks in front. The eyes are of moderate size—two on the dorsum posteriorly in front of the nuchal fold and quite within the margin of the head, and two at the outer and under surface of the peaks, so that they look forward and slightly outward. The median tentacle is of moderate length, and tapers from the base towards the tip, which is filiform and densely covered with rather long cilia having slightly bulbous tips. Scarcely a perceptible swelling in the preparations occurs below the tip. The cilia diminish in length distally, but extend along part of the filiform tip. The lateral tentacles arise below and somewhat external to the median, are short, and taper from the base to the filiform extremity. Short cilia occur on the surface and on the filiform extremity as small papillae.

The tentacular cirri are similar to the median tentacle. The palpi are of moderate length, gently tapered from the base to near the apex, which is filiform, though short. They have densely crowded rows of clavate papillae—more slender than in *Harmothoë imbricata*, and which gradually diminish from below upwards.

The *body* presents the usual slight convexity dorsally with the transverse depression in each segment—especially marked behind the proboscidian region. Moreover much of the body is of uniform breadth. Ventrally a central depressed area occurs in spirit, with lateral elevations, from which the rather small segmental processes project between the feet. Posteriorly it terminates in the caudal cirri.

Proboscis.—The proboscis is less massively muscular than in *Lagisca* or *Harmothoë imbricata*, and the horny teeth are smaller; indeed, they may be called minute. The horny ridges are also less prominent. The terminal papillae of the organ agree with those in *Harmothoë*.

In the peripharyngeal space only one short pregastric caecum goes forward to the second segment in front of the stomach. The second is nearly transverse. The reduction of the caeca is thus a marked feature.

The *scales* (Plate XXXII, fig. 17) are somewhat stiff and leathery, especially in front. The first pair are more or less rounded, and thickened by the numerous large chitinous areas terminating in the blunt spines, which are minutely nodular with short chitinous spikes. The surface of the scale is further cut into definite areas by a series of chitinous reticulations which enclose the space occupied by each bluntly conical spine, and consequently in this (the first scale) irregular hexagons, pentagons, or similar figures occur in the central region round the large bosses, while the margin is cut into longer areas with intermediate small triangles—for spines—at the edge. Moreover the right or upper differs from the left or under scale, the former corresponding more particularly with the description, while the latter in the region overlapped by the former is thinner, and has numerous smaller reticulations enclosing a diminishing series of horny papillae from the central region of larger spines to the edge. The latter is also smooth, but, with this exception, the edge has cilia all round, and of considerable length as well as more numerous at the outer margin. The right or upper first scale shows a continuous series of marginal cilia. The succeeding scales are more or less reniform or somewhat ovate, according to their position, while the last are almost D-shaped. Their general structure is similar, viz. the anterior and inner edge, that overlapped, being more or less thin and smooth; then the small papillæ stud the surface, and gradually increase in size towards the posterior and outer edges. The border is formed of the long ridges terminating in the marginal, blunt, spinous papilla. The smaller rounded bases of the chitinous papillæ internally are so closely arranged that they resemble the shields in certain regions of an armadillo. Moreover, whereas in the first scales the chitinous lines which bifurcate to form the triangular areas of the margin are simple, in the rest they form a complex and continuous series of reticulations somewhat resembling those in the skins of holothurians (Plate XXXIII, fig. 3). The minutely nodular or caespitose condition of the chitinous spines is a marked feature throughout. The posterior border has cilia of considerable length internally, then they diminish along the posterior edge, again elongating on approaching the outer border, where they form a long, dense fringe. The bulbous tip is minutely granular in its centre, and is continuous with the central axis of the cilium. The under surface of the scale is iridescent, with a well-marked scar for attachment somewhat nearer the outer than the inner border. The scales separate readily. Occasionally a small patch of *Cellepora* is found on a scale.

Colour.—The dorsum has a light brownish or amber hue from the scales, the posterior part of each of the latter being somewhat darker. The pinkish hue of the body occasionally shines through these. The cirri are pale. The under surface is iridescent bluish-pink, as in *Polynoe scolopendrina*. Ray Lankester speaks of the head as being violet, and the palps deep madder-brown. In spirit they are dark greyish, streaked with the lines of cilia. Towards the posterior end the dorsum has various transverse streaks of dark greyish (in spirit). In rather more than the posterior third also a dark touch occurs on each side of the base of the dorsal cirri, and there is a tendency for the elevations in a line with the tubercles for the scales to have a touch of the same colour. The pigment thus seems to be connected with the cirrigerous feet, and consequently is best developed behind the last scale-tubercle. On the ventral surface the posterior third presents dark pigment touches on the segmental eminences, and the tint increases in depth posteriorly, spreading outward on the bases of the feet. A touch or two of pigment also occur on the anterior folds of the mouth.

Feet.—The modified dorsal bristles of the first foot have smooth tips. The second foot is small, with a flipper- or paddle-shaped fleshy region dorsally, the inferior margin terminating in the long papilla for the spine. The bristles, though short, are typical in structure. The ventral division is somewhat conical, terminating in the pointed region for the spine, and from the tip of this process a long cutaneous papilla projects. The bristles are slender with elongated curved spinous tips.

The third foot shows a considerable increase in the size of both dorsal and ventral bristles. The ventral are still proportionally slender, but the majority have bifid tips, only the lower short forms having simple tips. The ventral cirrus has large clavate cilia. The papilla beyond the spine is present.

The fourth foot approaches the typical condition except that the number of simple bristles inferiorly is greater.

In the typical foot (Plate XXX, fig. 3) the superior division has a somewhat conspicuous tuft of elongate, slightly curved bristles externally, and shorter and more curved forms internally (Plate XXXIX, fig. 17). The spinous rows are dense. The tip has a short smooth portion with, in many, a slight though distinct streak, best marked in the shorter bristles, in which it forms a groove at the extremity. The external bristles (those next the ventral division) form a contrast to the inner from their sharp tapering tips and slight curvature. In the older specimens these bristles are often densely coated with parasitic growths, such as algæ and infusorians, besides mud. The ventral branch has a series of rather elongate slender bristles with tapering tips, which, as usual, diminish in length from above downward. The tips superiorly are attenuate, and one or two show no secondary process, but this soon appears, again to disappear, in the shorter inferior forms. One of the attenuate superior bristles with a bifid tip is shown in Plate XXXIX, fig. 18. The spinous rows are rather prominent. A shorter bristle again, with a slightly abraded tip, is given in Plate XXXIX, fig. 19. Inferiorly the bristles have slender, short, spinous extremities with a minute secondary process, and, at the ventral edge of the series, the tips are simple. The nearly cylindrical papilla above the ventral spine is well marked; and the ventral cirrus reaches beyond the base of the bristles, and has somewhat slender clavate papillæ.

Comparatively little change ensues in the bristles of the terminal feet. The dorsal are more slender and proportionally longer, so that they extend almost to the tip of the longest of the ventral division. The ventral division has the same type of bristles as in front, except that they are more slender. The elongated forms usually found in this region were not observed, but the specimens may have been recently injured. The papilla above the ventral spine continues to the last foot.

The dorsal cirri are of two types, viz. those of the usual kind, with just a trace of a dilatation below the elongated filiform tip, and densely coated with cilia, which are long except at either end of the series; and secondly, those with a greatly enlarged distal half, so that the organ resembles a tennis-racket with the filiform tip appended to it, and coated with cilia as in the first form. This condition of the cirri was first noticed by Ray Lankester in specimens from Herm, for Grube's original ones had only the slender cirri. No connection between the sexual or other condition of the specimens and this state of the cirri has yet been observed. In one instance these enlarged cirri were found in the tubes of *Chætopterus*, and were forwarded as parasites.

Reproduction.—A specimen of good size from Herm carried ova at the end of July and beginning of August.

Habits.—Ray Lankester, who placed it as a new species under the genus *Antinoë*, thought it fed on *Terebella nebulosa*, and I found some procured in Herm had fed on *Eunice* and other forms. It would not always seem to be an inhabitant of tubes of other annelids, but occurs in a free condition under tidal stones. De Quatrefages gave this form a position near *Harmothoë imbricata*, but added nothing to Grube's remarks.

Giard (1886) includes it under the genus *Evarne* on account of the form of the head, and the presence of chitinous protuberances on, as well as on account of the structure of, the elytra. Yet the proboscis, the margin of the elytra, and the cirri present certain characters which are almost sufficient to give generic distinction.

De Saint Joseph (1888) seems to doubt my diagnosis in regard to Ray Lankester's *Antinoë nobilis*, but it rests on a careful examination of specimens kindly sent me by Lankester himself, and a survey of the same collecting grounds on the Channel Islands. There is no doubt on the subject.

Genus XIV.—EVARNE, *Malmgren*, 1865.

Body rather small, ovate-oblong, attenuate posteriorly. Lateral tentacles fixed under the median, head deeply incised in front, and with prominent lateral peaks. Eyes four, generally large, the anterior pair on the projecting lateral region; the posterior in front of the nuchal collar and widely separated. Palpi densely covered with minute papillæ. Scales, fifteen pairs, spinulose, ciliated or smooth at the edge. Dorsal bristles shorter than the ventral, and with wide rows of spines; ventral bristles very long, with minutely bifid tips. Segmental papillæ well marked, but not long.

1. EVARNE IMPAR, *Johnston*, 1839. Plate XXVI, fig. 5.

Specific Characters.—Head wider than long, with prominent peaks anteriorly. Eyes large; posterior pair in front of nuchal collar, widely apart; anterior pair on projecting lateral region. Median tentacle strong and moderately long, densely ciliated, madder-brown, with a slightly dilated whitish region, marked off by bars, below the filiform tip. Lateral tentacles inferior, subulate and tapering, with short clavate cilia. Tentacular cirri similar to, but more slender than, the median tentacle. Palpi of average length, with tapered extremities, and densely covered with minute clavate papillæ. Body somewhat thin and flattened, broadest at the anterior third, thence tapering to the tail. Segments thirty-eight to forty, greenish-brown on the dorsum, darkest in front, the pigment forming somewhat regular bars and touches. Arch of pigment in the cirrigerous segments terminates laterally in two small touches of dark olive, besides other touches at base of cirri. Ventral surface pale or brownish. Segmental eminence and papilla well developed, commencing on the sixth bristled segment. Two long caudal styles. Scales, fifteen pairs, mottled with brownish pigment, often with a yellowish speck in the centre. First pair subcircular, rest reniform and then ovoid; external margin densely ciliated; surface mostly covered with small horny papillæ, with larger ones towards the outer and posterior borders, while along the latter are a few large pyriform or globular papillæ. Dorsal bristles translucent, rather acutely pointed, with wide rows of spines which cross the shaft at right angles; ventral bristles with elongate tapering spinous regions and minutely bifid tips; the latter diminish in length inferiorly, and some at the ventral edge have simple tips. Dorsal cirri like tentacular cirri; ventral cirri subulate, the slender tips reaching the ventral bristles, and with numerous short clavate cilia.

SYNONYMS.

1839. *Polynoe impar*, Johnston. Ann. Nat. Hist., ii, 436, pl. xxii, f. 3—9.
1840. *Lepidonote impar*, Oersted. Annul. Dan. Consp., 13.
" " " Grube. Fam. Annel., 36.

1863. *Polynoe impar*, Claparède. Anat. u. Entwickel., 60.
1864. ,, ,, Kölliker. Kurz. Bericht., p. 15, pl. ii, f. 4—6.
1865. *Lepidonotus impar*, Johnst. Cat. B. M., 112, pl. viii, f. 3—9.
,, *Evarne impar*, Malmgren. Nord. Hafs-Ann., 71, Tab. 9, f. 7
,, ,, ,, De Quatrefages. Annelés, 226.
1873. ,, ,, Sars. Bid. Christ. Fauna, p. 4.
1875. ,, ,, McIntosh. Invert. and Fishes, St. A., p. 116.
1876. ,, ,, idem. Trans. Zool. Soc., ix, 386, pl. lxx, f. 1—3; ibid., p. 398.
1879. ,, ,, Tauber. Ann. Danic., 81.
1886. ,, ,, Marenzeller. Poriff., &c., Jan Meyen, p. 11.
,, ,, ,, Giard. Bullet. Sc. Nord, i, 16, with figs.
1888. *Harmothoe impar*, De St.-Joseph. Ann. d. sc. nat. 7, v, p. 162.
1890. ,, ,, Malaquin. Ann. Boulon., 18.
1891. *Polynoe* (*Evarne*) *impar*, Hornell. Op. cit., 232, pl. xvi, f. 3 and 6.
1896. *Harmothoe impar*, var. *Pagenstecheri*, Michaelsen. Polych. Fauna, p. 7, pl. i, f. 1.
1898. ,, ,, ,, ,, De St.-Joseph. Op. cit., 1898, 231, pl. xiii, f. 14—20.

Habitat.—Everywhere distributed round the British shores—from Shetland to the Channel Islands, and ranging into the Atlantic to the depth of 690 fathoms, as well as extending (*fide* Verrill) to the shores of America, from Cape Cod to the St. Lawrence. It occurs not only in purely salt water, but in such lochs as Loch Portan, Lochmaddy, which receive a stream of fresh water, small examples are likewise found.

Length about an inch. The finest examples in my collection are from the west coast of Ireland and the Irish Channel.

Head (Plate XXVII, fig. 13) somewhat wider than long, with the usual median groove, which widens out anteriorly to join the prominent lateral peaks. The eyes are large and visible from the dorsum, the posterior pair widely apart, and situated immediately in front of the nuchal collar; the anterior pair, which are scarcely larger than the posterior, being on the projecting lateral region, and thus little removed from the former, while they are separated by a considerable interval from the peaks. In an example from Whalsay, Shetland, the anterior pair of eyes were nearer the posterior than usual. In those from deep water the eyes are somewhat larger, but forms between tide-marks show considerable differences in this respect, some having large, others small eyes. Again, a young specimen 6 or 7 mm. long, procured on a thick mass of *Flustra* off Fermain Bay, Guernsey, had no eyes. The median tentacle is of considerable length and strength, generally of a madder-brown colour, and with a pale dilatation marked off by bars below the filiform tip. It is rather densely covered with clavate cilia, some of which equal in length the diameter of the process. The lateral tentacles are inferior, subulate and tapering, and have numerous short clavate cilia. The tentacular cirri are similar to, though smaller than, the median tentacle. Palpi of average length—with a tapered extremity, and densely covered with minute clavate papillæ, which occur from the base to the commencement of the filiform tip. These papillæ are proportionally large.

Body moderately elongate, somewhat thin and flattened, the broadest part being about the anterior third, and thence tapering to the tail. The hue of the dorsum is greenish-brown, darkest in front, and forming somewhat regular bars and touches along the back. Some, again, have the dorsum very prettily and symmetrically barred with brown after the condition in *Lagisca*. In the cirrigerous segments the arch or band of pigment in the middle of the body terminates in two small touches of dark olive-green, and other touches occur at the base of the cirri. Nine or ten of the terminal segments show these specks on every foot. The proboscidian region is often deeply pigmented. The ventral surface is pale and iridescent, only a tinge of brown occurring on the ridge in front of the mouth. A variety from Bressay Sound, Shetland, has the ventral surface dull olive throughout, with lighter bars, while the dorsum is much variegated with brownish-olive and dark touches. Rarely the anterior half of the mouth is dark olive, and a double row of dark touches occurs at each side of the median depression, while the dorsum is pale madder-brown. In some large examples the elevated ridges posteriorly show pale olive pigment, which in each segment presents two transverse bars and a pale centre. The median longitudinal region is pale. In others similar pigment extends forward to the proboscidian region. The segmental papilla is evident on the sixth foot, and continues nearly to the posterior end. In size it is comparatively large, though it is not long, and points between the feet. The body terminates posteriorly in two long caudal styles, which are much larger than the adjoining dorsal cirri.

Proboscis.—The extruded proboscis shows a range of nine papillæ of the usual dactylozoid shape dorsally and ventrally. No pigment occurs in the centre of these organs. The pregastric and other cæca follow the arrangement in *Harmothoë*.

Scales (Plate XXXII, fig. 18) fifteen pairs, in the smaller thirteen to fourteen pairs, somewhat rough in aspect, mottled with brownish pigment and often with a yellowish speck in the centre, best marked posteriorly. The first pair are suborbicular, the succeeding reniform, and the posterior more or less ovoid, though angles are occasionally formed. The external margin is densely ciliated, the cilia having bulbous tips and varying in length. Moreover many occur on the neighbouring surface of the scale, and a few are scattered within the posterior margin. With the exception of the inner and anterior area the entire surface is covered with small horny papillæ, which often increase into small spines widely scattered towards the outer and posterior borders, while along the latter are the large pyriform or globular papillæ so characteristic of this species. Some of these occur even on the first scales. The summit of each is occasionally roughly papillose, or with a series of large conical spines. These large papillæ are sometimes absent,—as, for instance, in those from the tidal region at Lochmaddy, in an example from 690 fathoms (Station 1, 'Porcupine,' 1870), and in others from Station 6 and outside Gibraltar, while the cilia along the border are longer. Young specimens, as a rule, have smaller processes along the posterior border. Malmgren's figure shows the low rounded bosses very well. The scales are somewhat thin, and the under surface is smooth and glistening. The cilia on the scales are frequently overgrown with a granular parasitic structure.

In a large specimen dredged by Dr. Gwyn Jeffreys off Valencia the scales were devoid of tubercles. Considerable variation, indeed, exists, for some of those from Herm have shorter cilia with more distinctly globular heads, a feature accompanied by smaller dorsal bristles.

Feet.—The first has a few comparatively short dorsal bristles, slightly curved, and with closer and finer serrations than the typical form. A very short conical portion at the tip is smooth.

The second foot has a dense tuft of dorsal bristles which, though shorter than the typical forms, already show the chief characters in regard to the rows of spines. They have a more distinct curvature and less tapered tips than the succeeding forms. One or two at the inner side (next the body) have the finer rows and aspect of those at the base of the tentacular cirri. The ventral bristles have elongated spinous regions, the upper and middle with slender bifid tips, the lower with simple tips.

The foregoing, therefore, requires little change to assume the typical form (Plate XXX, fig. 7), which has dorsally a fan-like group of translucent bristles, springing from a prominent process, with rather acutely pointed tips, the bare portion being short. The smooth tip is formed like a knife, the dorsal edge being bevelled to the ventral (next the spines), and this shows in some a differentiation as in the figure. In lateral views the somewhat wide spinous rows pass nearly at right angles across the long axis and stand out prominently at the edge (Plate XXXIX, fig. 20), a condition probably due to the nearly opposite condition of the rows. The aspect is thus different from the more powerful bristles of *Harmothoe antilopis* with the curved and oblique spinous rows, which project very little at the edge. Such groups of bristles (dorsal) form a gradational series under pressure, those next the body being proportionally thicker and shorter—with more closely arranged spinous rows, the series rising to the much longer and more tapered central, and then declining to the more slender forms adjoining the ventral. Some of the latter are very slender—with finely tapered tips. Occasionally these bristles are more curved and less tapered than usual.

The ventral bristles are moderately elongate, and superiorly have a long, slender, tapering spinous region—the rows appearing as oblique bars—and a minutely bifid tip (Plate XXXIX, fig. 21). The spinous region becomes shorter and stouter, and the rows of spines more delicate, while the tip is more distinctly hooked, and the secondary process, which passes nearly straight out or with a very slight angle, is more evident (Plate XXXIX, fig. 22, representing one of the lower median). Inferiorly the bristles diminish in length, have a well-marked hook at the tip, and delicate oblique lines from the fine spinous rows. The bristles throughout are pale, with a faint straw-colour. The shape of the fleshy part of the foot is characterised by the length of both dorsal and ventral processes for the spines.

Posteriorly the bristles become shorter and more slender, the dorsal being proportionally long and nearly straight, with well-marked rows of spines which are nearly opposite, so as to differentiate these bristles from others. The ventral are also very slender, and the tips in the terminal feet are so attenuate that it is difficult to make out the bifid condition. Thecate infusoria are common on the dorsal bristles.

The dorsal cirri are finely tapered, and present a slight enlargement towards the filiform tip in life, whilst in spirit-preparations this is very evident, and more opaque than the rest; and they are densely covered with long cilia with bulbous extremities, visible under a lens. The ventral cirri are subulate, and also have a filiform tip which reaches the bases of the ventral bristles. They have numerous short clavate cilia on the surface.

A curious appearance occurs in both dorsal and ventral bristles of a specimen procured by Canon Norman in 1879 in Norway (Lervig Bay, three to twenty-five fathoms), and is probably due to imperfect or peculiar preservation. Crystalline masses are present in the centre of the bristles, and in the case of the ventral distend in some the bases of the spinous region.

Reproduction.—Specimens procured in Norway in summer (Canon Norman states) bear large ova. Small examples (about 6 mm.) from Loch Portan, Lochmaddy, had advanced ova in August. A little larger example had advanced ova in Whalsay on July 17th. A ripe male again occurred at ninety fathoms off North Uist in July.

No ripe forms have been seen at St. Andrews, though numerous small ova are present in the middle of May.

Habits.—The haunts of this species are similar to those of other Polynoidæ. It occurs under stones between tide-marks, in the crevices of tangle-roots, and in the cavities of shells—both bivalve and univalve. It was also included in the annelids procured from holes in the telegraph cables in 1876, and which were thought by Dr. Carpenter to be borers in the gutta-percha. It is of course free from suspicion on this head.

It presents a rougher aspect than *Harmothoë imbricata*, from which it likewise differs in colour, and it is much more tapered posteriorly. It is also more lively, being active and irritable, as well as frequently breaking in pieces if molested. The movements are more graceful than usual in the group, and the long caudal styles are generally carried nearly in contact. It is likewise brilliantly phosphorescent. Like others of the family, it bears confinement well, and can be transmitted inland and kept for months in a small vessel of sea water.

In this, as in other forms, palpi and other appendages as well as the posterior part of the body are readily reproduced.

Parasites.—Levinsen mentions *Herpyllobius crassirostris*, Sars, as a Crustacean parasite fixed to the body of *Evarne impar* in Norway.

Dr. Johnston's *Lepidonotus pellucidus* may be a young example of *Evarne*.

Claparède (1863) drew special attention to the palpocils on the cilia of the cirri, and showed how general these organs were in the annelids.

De Quatrefages (1865) followed Johnston in assigning only thirteen pairs of scales to this species. Prof. Giard (1886) does not think that the *P. articulata* of Claparède is identical with this form, as I did in the 'Zoological Transactions.' He also says *P. spinifera*, Ehlers, is an allied but not identical form, since the position of the eyes is different, and the elytra are not fringed as in *E. impar*. Remarks on these forms are made elsewhere.

Hornell (1891) records examples from Southport of 33 mm. in length, and thirty-seven segments, whereas Malmgren gives only thirty-five and De St.-Joseph thirty-eight.

Varieties.—A variety from 358 fathoms in the 'Porcupine' of 1870 shows some shorter ventral bristles, the dorsal being pointed. It is a female.

In young specimens procured in the 'Triton' in 1883 by Dr. Gwyn Jeffreys only the intermediate horny papillæ occurred on the scales along with the cilia. The eyes were invisible in the preparations.

Dr. Michaelsen describes a variety from Heligoland, *Harmothoe impar*, var. *Pagenstecheri*, of which he gives a special description. By his courtesy a careful examination of the microscopic preparations has been made. The form agrees with the typical British examples. Malmgren's artist had omitted the cilia on the ventral cirrus, while in the description they are not mentioned. Baron de St.-Joseph, in a recent publication,[1] alludes to the same form, and appears to agree with the original author in thinking it necessary to make a variety.

Another well-marked variety was procured between tide-marks, Herm, under a stone in August, 1868, and also at Lochmaddy, North Uist. While in regard to the general outline, the shape of the head, the position of the eyes, and the arrangement of the pigment on the dorsum, it agrees with the ordinary form, the dorsal bristles are shorter, though they do not deviate from the typical structure; and the same may be said of the ventral. The scales, however, vary, since the cilia on the outer border are shorter than usual, and have large ovate heads containing granular epidermic elements; some of these also occur within the posterior border, while along the whole of the latter is placed a short series of cilia with large globular heads and short stalks, the terminal ones only towards the inner border becoming ovoid instead of globular. The general surface of the scale is studded with larger tubercles; and few of the others, except towards the inner region, and one or two of those near the posterior border, assumed considerable proportions, while none were so large as usual. A similar variety in regard to scales was procured by Dr. Gwyn Jeffreys in 1868 in ninety fathoms off North Unst, Shetland, but the ventral bristles were more slender, both somewhat approaching those of *E. Johnstoni*, though the dorsal were more tapered towards the tip. The specimen was a male.

2. Evarne Johnstoni, *McIntosh*, 1876.

Specific Characters.—Distinguished from *E. impar* by the deep brownish hue of the dorsum, and the brownish-purple proboscis; eyes more minute, the anterior pair not visible from the dorsum. Scales with fewer and larger horny papillæ, longer, fewer, and more delicate cilia along the posterior and outer borders. Dorsal bristles more slender and less tapered distally; ventral more slender, and with longer bifid tips.

Synonym.

1876. *Evarne Johnstoni,* McIntosh. Trans. Z. S., ix, p. 398, pl. vii, f. 13—18.

Habitat.—Dredged at Station 3, 'Porcupine,' 1870, in 690 fathoms in the Atlantic; Station 115, West Ireland, August 20th, 1890 (Mus. R. Coll. Science, Dub.). Ranges to Norway.[2]

Length about 9 mm.

[1] 'Ann. d. sc. nat.,' viii sér., v, p. 231, 1898.
[2] Canon Norman, 1879, Stat. 30—34, 41 and 44.

The *head* (Plate XXVII, fig. 7, from a large example, and fig. 12, small example), has the same form as in *E. impar*, and is pale throughout in the preparations, the absence of pigment at the base of the tentacle being noteworthy. The eyes appear only as minute black points; two lie at the posterior border of the head, almost hidden by the collar; two laterally in front of these, as in the ordinary species. A variety dredged by the 'Porcupine' in 1870 at 690 fathoms has very large eyes (Plate XXVII, fig. 7), the anterior pair having a lens-like corneal thickening. Adult Norwegian examples show still further increase in these organs.

Body apparently similar in shape to *E. impar*, viz. abruptly diminished in front and gently narrowed from behind the anterior third. The dorsum has a deep brownish hue, with a tinge of purple in front—from the proboscis. Behind the latter the pigment is cut into bars by the pale belt at the junction of each segment. The ventral surface is pale, the margins of the oral aperture alone being deeply tinged with brown. The segmental eminence is distinct, but the papilla is minute.

In the examples the proboscis is more or less extruded, and the usual number of conical papillæ (nine) fringe each lip.

Scales.—A single reniform scale occurred in the vessel, and from what is observed in the examples from Norway it would seem to belong to the specimen. The surface, with the exception of the inner fifth, has rather large conical horny papillæ, often with blunt spinous tips, while the adjoining external and part of the posterior border have a few long and very slender cilia, with a somewhat fusiform tip. The contrast, therefore, with the more densely and minutely spinous scale of *E. impar* is marked; the cilia, moreover, on the outer edge of the scale of the latter are more numerous, larger and longer, and globose at the tip.

Feet.—As in *E. impar*, the second foot presents shorter dorsal bristles with less tapered tips, but otherwise they are of similar structure to the succeeding. The ventral bristles of this foot do not project more than the dorsal, and hence are short as well as slender, the long attenuated spinous region ending in a hair-like tip.

In the typical foot (Plate XXX, fig. 6) the dorsal division bears longer and more slender bristles than in *E. impar*, the slight tapering towards the tip being a noteworthy feature, and the rows of spines are even more distinctly marked. The smooth terminal portion is decidedly shorter than in the latter, and in some cases it presents a slight mucro at the extremity, then a shallow notch, and another elevation a little above the first row of spines. A long clear shaft projects beyond the foot before the rows of spikes appear, so that the bristles are comparatively long. One of the stronger bristles is represented in Plate XXXIX, fig. 23, while the tendency to differentiation of the tip is observed in fig. 21, Plate XXXIX. The superior ventral bristles have tips so attenuate that it is difficult to make out their structure; but the bifid condition is present, with the exception perhaps of the first. The next series have much longer and stronger distal regions, with extremely delicate and translucent bifid tips; the terminal hook is short and very slightly curved, and the secondary process is rather short and broad, and passes far up, while the rows of spines are distant and well marked. The tips of the succeeding (lower) bristles become broader and shorter, but the character of the termination remains the same. Toward the inferior edge the tip is simple, only a faintly developed hook being present. All are very translucent and delicate. One of the elongated forms near the dorsal edge of the fascicle is shown in Plate XXXIX, fig. 25, and a more highly magnified tip in Fig. 27, the arrangement of the spines and the short bifid tip being characteristic. The bristles from the middle of the foot are exceedingly translucent and very faintly serrated (Plate XXXIX, fig. 26, and a tip more highly magnified in Plate XXXIX, fig. 28). In large examples from Norway the dorsal bristles show more acutely-tapered tips, but otherwise the characters closely approximate.

The dorsal cirri have a filiform tip without enlargement, and rather long clavate papillæ sparsely distributed. The ventral cirrus is slender and elongate with a finely tapered tip, which in the preparations ends in a slight enlargement. Short clavate papillæ—sparsely distributed—occur on the surface. The tip reaches considerably beyond the base of the lowest bristles.

The species is broadly distinguished from *E. impar* by the deep brownish hue of the dorsum and the brownish-purple proboscis, by the structure of the scales, which have only large horny papillæ and few and slender cilia, by the longer, more delicate, and less tapered dorsal bristles with shorter tips, and by the more slender ventral bristles with much more finely tapered tips.

The capture of a variety during the 'Porcupine' Expedition of 1870 at 690 fathoms, in which the eyes are large—especially the anterior pair, which have a lens-like corneal thickening—and still more the presence in Norwegian waters of a form closely resembling *Evarne Johnstoni* in colour, but differing in having very large eyes and in other minute particulars, raise the question as to how far such species vary with age, sexual conditions, and environment. The younger Norwegian forms agree with the description of *E. Johnstoni*, except that some have larger eyes (without a lens-like thickening). In the larger and older forms, however, the eyes still further increase in size, the lens-like corneal thickening of the anterior pair leaving only a rim of black pigment round the edge. The posterior pair are also provided with the central lens-like thickening. The dorsal bristles are broader, more acutely pointed, as well as somewhat more closely spinous; and the smooth portion at the tip is longer, so that it is dagger-shaped. In the ventral bristles the tips are bifid even to the ventral edge of the foot. Age, therefore, considerably alters the foregoing organs. The scales differ from those of *E. impar*, and agree with those of *E. Johnstoni*.

The prominent question therefore is, can *Evarne impar* pass insensibly—by epigamy, for instance—into *E. Johnstoni*, as in many other groups of annelids? So far as present observations go, a negative reply would seem to be most in harmony with the structure of the scales, the eyes, bristles, and the geographical range. Further knowledge may show the propriety of union, but at present it is better to leave the question as it is.

Prof. Giard (1886) finds a third and closely allied species of *Evarne* commensalistic on *Cucumaria pentactes* off Brittany and the neighbouring shores of France.

3. Evarne Hubrechti,[1] *McIntosh*, n. s.

Specific Characters.—Head comparatively small, and in the adult the eyes are very large; both pairs more or less lateral in position. Median tentacle long, tapering,

[1] Named after the distinguished Professor of Zoology at Utrecht.

smooth, and the tentacular and cirriform appendages are also smooth. The palpi are large, slightly tapered, and smooth. Body rather short and broad, about thirty-one bristled segments, much tapered posteriorly, and furnished with a caudal rudder in the shape of a thick style with a membranous flap, tapered from base to apex. In structure it is delicate and brittle, and is tinted of a deep madder-brown both dorsally and ventrally. Segmental eminence marked, but no distinct papilla is visible. Scales, fifteen pairs, thin but tough, rounded in front, rest large and ovate, completely covered with minute spines, but with a smooth edge; some cling firmly to the peduncles. Feet of considerable length, dorsal division rudimentary; bristles translucent, large, long, and acutely pointed, with wide rows of spines like an *Equisetum*; ventral division large, ovate at the tip, and having a broad fan of very long slender bristles with long spinous regions and acute tips, mostly bifid. Ventral cirrus comparatively long and slender.

Habitat.—Procured by the 'Triton' in August, 1882, at 600 fathoms; at Station 2, 500 fathoms; in the tow-net at 300 fathoms, and again at the surface.

Length about 14 mm.

Head (Plate XXVIII, fig. 6) comparatively small, broadly ovoid, with a median groove and two prominent anterior peaks. Both pairs of eyes are dorso-lateral in position, their largest surface in the preparation being lateral. Their large size and the limited area of the head leave little of the lateral region free, viz. a small portion at the peaks, the narrow line of separation between the pairs, and the brief space between the last and the nuchal collar. No distinct trace of a corneal opacity is present. From the contour of the head the anterior pair look forward and outward, the posterior outward and upward. Both pairs are partially seen from the dorsum. In young examples the eyes are considerably smaller. The long median tentacle is pale, slightly enlarged immediately above the basal region (in spirit), then it tapers to the filiform tip. Its surface is quite smooth, the median nerve-trunk being readily seen through its translucent granular layer. The lateral tentacles are pale, subulate, and small, with a filiform tip and a madder-brown basal region. They likewise are quite smooth. The palpi are smooth, of moderate length, and somewhat thick, with comparatively short tapering tips. They have a faint tinge of madder-brown at the base. The tentacular cirri, the upper of which is, as usual, larger than the lower, have a similar form to the median tentacle.

Body covered by the large scales; of about thirty-one bristled segments, and comparatively short and broad. It is slightly narrowed in front, and tapers somewhat rapidly posteriorly. The dorsum has a madder-brown hue, with transverse elliptical markings in the middle, paler on the feet. Posteriorly the segments have very beautiful patterns, the madder-brown ellipse being surrounded by a pale and somewhat crenate line. The entire under surface is madder-brown, with a pale median band, and iridescent, the darker region in front showing fine metallic lustre. The feet are also slightly tinted of the same brownish hue, the ventral cirrus being thus rendered conspicuous, and between its base and the body a pale transverse line occurs. The segmental eminence is marked, but no distinct papilla is visible—a feature perhaps associated with the pelagic habits of the species.

Posteriorly the body terminates in a single comparatively thick style, which arises beneath the anus and to the left. It remains nearly cylindrical from base to tip—which is somewhat bluntly rounded. The remarkable feature about it, however, is the presence of a broad web or lamina attached to its lower surface, and which tapers from base to tip. The organ, therefore, forms an efficient rudder. The body is delicate and brittle, and the length of the bristles still further adds to the characteristic appearance.

Scales (Plate XXXIII, fig. 1), fifteen pairs, thin but tough, entirely covering the back, comparatively large and apparently smooth to the naked eye, but minutely granular under a lens. The first pair are rounded, the succeeding more or less ovate, and all with a smooth border. The entire surface is studded with minute horny spines, which increase in size from the inner to the outer border, and especially posteriorly. No part of the scale is free from them. It sometimes happens that a few of the larger conical spines project beyond the posterior border under examination, but otherwise the edge is smooth. In shape almost all the spines are acutely conical. The scales are pale, and the scar for the pedicle has an unusually large area behind it, from the great development of the posterior region. The scales, as a rule, adhere firmly. In a mounted scale a number of rounded bodies of various sizes, with a distinct capsule and granular contents, occurred, along with certain rectangular bodies composed of two halves, like Desmids. Their nature is enigmatical.

Feet.—The first bears a short, slightly curved bristle or two of the dorsal pattern, and resembling the shorter forms next the body in the typical foot.

The second foot presents a double ellipse—one for each division—with the projecting papilla for the spine, the inferior having in addition a fleshy digit-like process above the spine. A few of the inner bristles of the dorsal tuft are short and curved like those of the tentacular cirrus, each, however, having a smoothly pointed tip. The chief bristles are long, translucent, and tapering, with a long bare tip marked by wide and slightly oblique spinous rows, so that in some views it resembles an Equisetum of glass. The ventral bristles are slender and elongate, with long spinous regions tapering to a delicate tip, which is bare, and provided with a terminal hook. The filiform tip of the long ventral cirrus extends beyond the bristles.

The next foot leads to the typical shape, which is peculiar, since in a ventral view the tip is rounded. In profile, again (Plate XXX, fig. 10), the outline of the ventral division is comparatively deep and rounded, with the spine near the middle, and the bristles project as a broad fan. Dorsally the bristles (Plate XL, fig. 1) are remarkable for their great length, diaphanous nature, and brittleness—conditions pointing to a pelagic habit. The dorsal lobe itself forms only a small boss or eminence, and is thus in marked contrast with the same region in *Evarne impar*. From the inner side of this eminence spring a few short, slightly curved tapering bristles, with closer rows of spikes, next which are some shorter straight ones (Plate XL, fig. 3). The rest are large straight bristles (Plate XL, fig. 2), tapering almost from the base to the smooth and sharp tip. The spinous rows are short, slightly oblique, and very wide, as in an *Equisetum*, the appearance of the whole being diagnostic. The ventral series consist of elongated and slender bristles (Plate XL, fig. 4), with long and finely tapered spinous regions superiorly. They terminate in a long smooth tip, which is bifid and slightly hooked. The bifid condition, however, is difficult to detect in some, and inferiorly the tips are simple. The bristles can be followed in the diaphanous foot inwards to the muscular boss at the spine.

Posteriorly the dorsal eminence disappears, and the bristles become more slender, but still retain their characteristic structure. The tips of the slender ventral series are extremely elongate, but traces of the bifid condition are still to be found in many. The foot is thus practically formed of the ventral lobe.

In young examples the bristles, especially the ventral, are proportionally longer, and at this stage—5 to 6 mm.—two were pelagic at the surface.

In the development of these bristles the tip is practically complete on issuing from the foot, and additions are made posteriorly as it pushes out.

The dorsal cirri have the form of the tentacular cirri, and their filiform tips extend beyond the bristles. The ventral cirri are slightly brownish (madder), elongate, subulate organs, the slender tips of which extend beyond the fleshy part of the foot. They are perfectly smooth.

The delicacy of the body, the structure of the feet and bristles, as well as the rudder-like caudal style, show that this species has peculiar habits, probably more or less pelagic. What relation it may hold to other forms is unknown, and epigamy, or the epitocous condition, may yet be clearly demonstrated in the family.

I. EVARNE ATLANTICA, *McIntosh*, 1897.

Specific Characters.—Head like that of *Evarne impar*, but the cilia on the tentacles and the papillæ on the palpi seem to be smaller. The cirri generally are more slender. Dorsal bristles longer and less curved than in *E. impar*, and their rows of spines closer. Ventral bristles have longer tips than in *E. impar*.

SYNONYM.

1897. *Evarne atlantica*, McIntosh. Ann. Nat. Hist., ser. 6, xx, p. 168.

Habitat.—Dredged at Rockall (Station 3A) by the Royal Irish Academy's Expedition, June 15th, 1896.

A fragment of about fifteen segments of the anterior end.

The head resembles that of *E. impar*, Johnst., in general outline, but differs in having somewhat smaller eyes. The tentacles and palpi also are similar, though the cilia on the former and the minute papillæ on the latter are less bold. The cirri generally are a little more slender.

The *body* is thicker and more massive than in *E. impar* of the same size, and both dorsally and ventrally in the preparation has a pinkish skin-colour. The arrangement of the bristles at the side of the body is more trim. No segmental papilla is observable, though the eminence is distinct. In this respect it agrees with *E. impar* of the same size, in which the papilla only becomes noticeable about the twelfth bristled foot. In large examples it is evident on the seventh bristled foot.

Feet.—The first foot (bearing the tentacular cirri) has a few short bristles conforming to the dorsal type, though with somewhat closer rows of spines. In the second foot the dorsal bristles are longer and less curved than in *E. impar*, and while there may be room for doubt concerning the proportionate distances of the spinous rows, there can be none about the length of the smooth portion at the tip, which is diagnostic of this form and also of *Evarne Normani*.[1] The present species differs from the latter, again, in the more tapering extremities of these bristles, and in the closer rows of spines. The spinous tips of the ventral series are somewhat longer than in *E. impar*, and in this respect approach *E. Normani*.

In the typical foot the lower lobe is more pointed and the ventral cirrus longer than in *E. impar*, so that it projects as far as the tip of the foot. The translucent dorsal bristles (Fig. 31) are considerably longer and less curved than in the typical species, and their rows of spines much closer, the latter character also distinguishing them from *E. Normani*. The ventral bristles (Fig. 32) approach those of the latter species more closely than those of *Evarne Johnstoni*, being somewhat shorter than those of *E. Normani*, which, again, have stronger tips than those of *E. Johnstoni*.

FIG. 31.

FIG. 32.

FIG. 31.—Tip of a dorsal bristle of *Evarne atlantica*. × 350.
FIG. 32.—Tip of a ventral bristle of *Evarne atlantica*. × 350.

No scales are present. In all probability they approach those of *E. Normani*.

By the lengthening of the tips of the ventral bristles and their general slenderness this species and *E. Johnstoni* come near *Antinoë* and allied forms.

[1] Op. cit., 173, pl. iii, fig. 13.

Genus XV.—Antinoë, *Kinberg*, 1857.

Lateral tentacles arising under the base of the median tentacle; cephalic lobe with lateral peaks anteriorly. Palpi subulate, densely covered with minute papillæ. Dorsal bristles long and tapering, with well-marked spinous rows. Ventral bristles long and slender, with elongated spinous regions and hair-like tips. Segmental papillæ distinct though not large.

This genus approaches *Harmothoë*.

1. Antinoë Sarsi (*Kinberg*), *Malmgren*, 1865.

Specific Characters.—Head about as long as broad, with two acute anterior peaks. Two posterior eyes, nearer each other and smaller than the anterior, which are situated within the dorsal margin of the widest part of the head, and considerably removed from the anterior peaks. Median tentacle brownish, tapering, with a long filiform tip and numerous long clavate cilia. Lateral tentacles with short clavate cilia. Palpi long and tapering, with minute clavate papillæ, often with processes on the blunt tips. Tentacular cirri with very long slender tips and numerous clavate cilia of moderate length. Body somewhat broad, most distinctly tapered posteriorly, segments thirty-eight; dorsally of a brownish hue—in various transverse belts posteriorly. Scales, fifteen pairs, ovoid or rounded, soft, rather opaque, and with cilia of moderate length on the outer and posterior borders, while some show minute conical spines on the surface. Dorsal division of the foot with a prominent spine, and rather long, slightly curved tapering bristles with well-marked spinous rows, which in profile occupy half the bristle, only a minute portion of the tip being bare. The ventral division has a very prominent spinigerous lobe, and a series of slender bristles—with long spinous regions and hair-like tips. Dorsal cirri long, tapering, with a filiform tip, and the surface has numerous short clavate cilia. The ventral cirrus is subulate, rather long, and with short clavate cilia. Segmental papilla begins on the fifth foot.

Synonyms.

1865. *Antinoe Sarsi* (Kbg.), Malmgren. Nord. Hafs-Ann., p. 75, tab. 9, fig. 6.
1871. ,, ,, Ehlers. Spitzb. Annel., Ann. Nat. Hist., 4th ser., viii, p. 53 (transl. from Sitzb. d. Phys.-med. Soc., Erlangen).
1873. ,, ,, Sars. Bid. Christ. Fauna, p. 5.
1874. ,, ,, McIntosh. Ann. Nat. Hist., April, 1874, p. 263.
1875. ,, ,, Ehlers. Annel. 'Porcup.,' 1869, p. 33, Taf. ii, f. 3 and 4 (Zeitsch. f. w. Zool., xxv, p. 53).
1879. *Polynoe Sarsi*, Théel. Annel. Nova Zemb., p. 16.
,, *Antinoe Sarsi*, Tauber. Ann. Danic., 80.
1886. ,, ,, Marenzeller. Porif., &c., Jan Meyen, p. 12.

Length of largest about $1\frac{3}{4}$ inches.

Habitat.—In the 'Porcupine' Expedition of 1869 it occurred at No. 28 (July 5th, 1869), in 1215 fathoms on mud.

It extends to various parts of the Arctic Sea, to the Gulf of St. Lawrence (where it is common), and to the shores of America (Verrill).

Head (Plate XXVIII, fig. 10) about as long as broad, with two acute peaks in front. The two posterior eyes are much nearer each other and smaller than the anterior pair—which are situated within the dorsal margin of the widest part of the head, and therefore considerably removed from the anterior peaks. These eyes in the Canadian forms are further forward, more lateral in position, and present in some a lens-like central thickening, and both they and the posterior pair are larger than in the European forms, which have eyes of moderate size. The median tentacle is brownish, with a slight swelling below the very long filiform tip. It has numerous long clavate cilia. The lateral tentacles are small and subulate with a tapering tip, and have short clavate cilia. The palpi are long and tapering, furnished with minute and somewhat clavate papillæ, which often have processes at the tip. A few of the papillæ occur on the tapering extremity. The tentacular cirri have very long slender tips and numerous clavate cilia of moderate length, a few shorter forms occurring on the filiform region distally. These organs are boldly areolar, and, like the tentacle, are tinted brownish.

Body.—Somewhat broad, tapered a little in front, and more distinctly so posteriorly; bristled segments thirty-eight. The colour is brownish dorsally, generally arranged in belts across the segments, which posteriorly show a broader belt in the middle and a narrow one in front and behind. The Canadian preparations are darker, the tubercle on the cirrigerous segments being dark olive, so that the tints are striking. As usual, the pigment is broken up in the terminal segments, and a pale band occupies the median line. The under surface is pale. The segmental elevations are well marked and project posteriorly as distinct processes, while the papillæ are directed nearly straight backward instead of between the feet. A marked feature ventrally is the prominence of the spinigerous lobe of the ventral division of the foot.

Proboscis.—The extended proboscis has nine conical papillæ dorsally and ventrally.

Scales (Plate XXXIII, fig. 17).—All the Norwegian examples show that the ovoid or rounded scales have their surface covered with small conical spines; indeed, in the Arctic examples these are visible under a lens. The spines in the posterior scales (those alone present) attain larger dimensions externally and anteriorly, and three or four larger conical processes are found on the posterior border. Cilia, of considerable length in the latter case, occur on the outer and posterior borders and invade the neighbouring surface. They are slender and translucent, with clavate tips.

On the other hand, the scales of the Canadian examples were more or less smooth, soft, somewhat reniform, and furnished with cilia of moderate length on the outer and posterior borders and on the neighbouring surface. The opacity of the scale, however, may hide the spines if they are few. At any rate, in the specimen from Barent's Sea numerous conical papillæ were present. Unfortunately many have no scales, and at best they are few in the preparations.

Feet.—The first foot bears a strong spine and about three bristles of the dorsal type, very slightly curved, and with boldly marked spinous rows. The spine forms a powerful projecting process in large specimens.

The second foot is also marked by the great prominence of the dorsal spine, and has a series of somewhat strong slightly curved bristles with well-marked spinous rows, which in profile occupy only about half the bristle, the inferior half being thus smooth and translucent. Only a minute portion of the tip is bare. Ventrally are a series of slender bristles, with long spinous regions and capillary extremities.

In the typical foot (Plate XXXI, fig. 2) the dorsal spine is still very prominent, and the bristles are long, slightly curved, and with a moderately acute tip. The spinous rows are distinct, and leave only a very short portion of the tip bare (Plate XL, fig. 7). The ventral are slender, elongate, with long spinous regions and remarkably attenuate tips, which form long hair-like processes (Plate XL, fig. 8). The foot has a long process for the spine superiorly. In the terminal segments the character of the bristles alters little, except as regards size.

In the Canadian examples thecate Infusoria are common on the dorsal bristles, and, in some, *Loxosomæ*. Infusoria also frequent the British form, and a cluster occurs in one on the projecting spine of the ventral division of the foot.

The dorsal cirri are long and tapering, with a filiform tip, while the surface has numerous short clavate cilia. The ventral cirrus is subulate and rather long and tapering, with numerous short clavate cilia.

In certain respects, *e. g.* the slenderness of the ventral bristles in comparison with the dorsal, and in the clearly separated rows of spines, *Antinoe* approaches *Evarne*.

Reproduction.—None of the specimens give any light on this process.

Habits.—So far as present knowledge goes, this species would seem to frequent deep water only.

Ehlers (1871), in his account of the Spitzbergen annelids, gives a very interesting description of two well-marked colour-varieties of this species. The more abundant form presents the brown coloration which Malmgren states distinguishes the Spitzbergen from the Baltic form. In the other the scales are bordered with greenish-grey on the inner and posterior margins, with a darker spot at their junction, the ventral surface and feet being colourless. The dorsal surface of each segment is banded with greyish-green, the pigment being variously developed in different examples. This variety attains even larger dimensions than the first, viz. 46 mm. in length and 24 mm. in breadth, as against 35 mm. and 17 mm. He contrasts these two varieties with that now living in the Baltic, which is smaller, possesses a greenish dorsal coloration, and scales with brownish margins,—that is, it has an intermediate position. He is of opinion that it has retained, since the glacial period (when the Baltic was united with the Arctic Sea), the original coloration, from which the two races in the Spitzbergen Sea have been developed by differentiation.

Ehlers found a *Nucula* 8 mm. by 6 mm., and 4 mm. in thickness, in the intestine of one of the largest greyish-green varieties. The same author (1875) describes it from the 'Porcupine' Expedition of 1869 at 1215 fathoms, and gives good figures of the bristles. His specimens had respectively twenty-nine and thirty-five segments.

Hansen found it in the collection made by the Swedish Expedition of 1876.

Marenzeller (1877) includes this form also in the annelids of the Austrian North Polar Expedition from a depth of 240 metres on mud.

Verrill (1879) enters it in his list from Cape Cod to the St. Lawrence, where Mr. Whiteaves dredged it in 1873.

Several specimens occur along with *Evarne Johnstoni* in Norwegian collections (1870) by Dr. Merle Norman. Whether any relationship of an epitocous kind exists with this or other forms is unknown.

Möbius records it under the name of *Polynoe cirrata* on the authority of Théel, who gives *P. cirrata* as a synonym of the species, but the latter has since seen that there are no grounds for this arrangement*.

2. ANTINOE FINMARCHICA, *Malmgren*, 1867; an var. *A. Sarsi*?

Specific Characters.—Head as in *Antinoe Sarsi*, and the body has a similar outline, with thirty segments in the largest example (less than ½ inch in spirit). Scales with short and sparse cilia on the outer and posterior borders, and the minute spinous papillæ are chiefly distributed on the anterior half of the scale as well as externally and internally. Feet similar to the foregoing in general structure, but the dorsal bristles have slightly narrower intervals between the rows than in *Antinoe Sarsi*, and they are longer, less curved, and more acutely tapered at the tip. The ventral bristles are decidedly stouter; the tips, instead of being capillary, have a long delicate portion of appreciable breadth, with a slightly curved point.

SYNONYMS.

1865. *Antinoe finmarchica*, Malmgren. Ann. Poly., p. 13.
1876. " " McIntosh. Trans. Z. S., ix, pp. 387 and 400, pl. lxx., f. 1, 2.

Habitat.—Dredged off the west coast of Ireland (Donegal) during the 'Porcupine' Expedition of 1869 in 20 to 420 fathoms; and also by the Expedition of the Royal Irish Academy in 1886 at 93 fathoms.

Head differs from that of *A. Sarsi* in that the eyes are proportionally larger, and the anterior pair are more lateral in position. The other organs present no feature of moment in the preparations.

Body of similar outline to the foregoing species, and of thirty segments, but, as the largest specimen is under ½ inch in spirit, it may be immature.

Scales (Plate XXXIII, fig. 8) show a definite structure in contrast with *A. Sarsi*, but changes may occur in course of growth. They have a similar outline, but the cilia on the outer and posterior borders are short and sparse, and the minute spinous papillæ are chiefly distributed in the anterior region in front of and on each side of the scar for the pedicle. The rest of the area posteriorly seems to have less distinct papillæ, but towards the posterior margin the cilia appear on the surface. Some of the papillæ have the summits curiously truncated. Small Norwegian examples of *A. Sarsi* show the same arrangement of the horny papillæ, so that the question is still open.

Feet.—The general structure of the fleshy part of the foot (Plate XXX, fig. 13) is the same as in the previous species. The dorsal bristles are long, translucent, sharply tapered from the commencement of the spinous portion to the tip, and with slightly narrower intervals between the spinous rows than in the former (Plate XL, fig. 9), the latter figure representing one of the straighter forms next the ventral, while an outer curved one is given in Plate XL, fig. 10. In contrast with those of *A. Sarsi* they are longer, less curved, more acutely tapered at the tip, and with more closely arranged spinous rows, and this is the case whether we compare them with adult or with young of the same size. The ventral bristles, again, are decidedly stouter than in *A. Sarsi*, and superiorly, instead of those with capillary tips, are bristles with a very long and delicate portion of appreciable breadth, distinctly spinous, and ending in a slightly curved point. The spinous rows continue nearly to the latter. The tips gradually (Plate XL, fig. 11) diminish in length toward the inferior edge, and the spinous rows are closer. Some, *e. g.* those from the south-west coast of Ireland, show a tendency to have long spines at the tip as in *Antinoë mollis* (Plate XL, fig. 13), but the feature is indistinct. Young specimens of *A. Sarsi* of the same size show the fine hair-like tips of the adult.

The dorsal cirri have somewhat fewer cilia than in *Antinoë Sarsi*.

This form seems to frequent deep water. It is probable that further observations may show that it is only a variety of the foregoing, the points of difference between them, and it may be other forms, being due either to epigamy or other sexual variation. In the meantime the distinctive characters will ensure its ready identification.

3. Antinoë mollis, *G. O. Sars*, 1871.

Specific Characters.—Head somewhat broader than long (in spirit), with blunt anterior peaks. Eyes larger than in *A. finmarchica*, the anterior pair being situated laterally at the base of the peaks, and thus are not visible dorsally. The posterior pair are separated by a wide interval from the anterior pair. The palpi show minute papillæ under a high power. Lateral tentacles with short clavate cilia. First pair of scales rounded, rest ovoid; outer and posterior borders with slender clavate cilia, which are longest externally; entire surface closely covered with short, blunt, and rather soft spines. Dorsal bristles rather large, long, slightly curved, less acutely tapered than in *Antinoë finmarchica*, and with close rows of spines. Ventral cirri with short clavate cilia.

Synonyms.

1871. *Lænilla mollis*, G. O. Sars. Vidensk.-selsk. Forhandl., 1871, p. 406.
1873. „ „ idem. Bidrag Christ. Fauna, p. 7, pl. xiv.
1876. *Antinoë mollis*, McIntosh. Trans. Zool. Soc., ix, p. 400, pl. lxxii, f. 3, 4.
1879. *Lænilla mollis*, Tauber. Ann. Danic., 81.
1883. *Harmothoe mollis*, Levinsen. Nord. Annul., 191.

Habitat.—Dredged on a bottom of muddy sand at a depth of 20 fathoms off Donegal, and 370 and 120 fathoms at various points of the Irish coast in the 'Porcupine' Expedition of 1869. Dredged at 257 fathoms in the Expedition of 1870, in the Atlantic. A similar form occurs in Norwegian waters, and Verrill includes it in his American list.

Head (Plate XXVIII, fig. 11), in spirit, somewhat broader than long, with blunt anterior peaks. The eyes are larger than in the previous form, the anterior pair being situated at the base of the peaks laterally, and thus are not visible from the dorsum, as well as separated by a wide interval from the posterior pair, which are smaller.

and placed in front of the nuchal collar. The palpi appear to be smooth under a low power, but when magnified 350 diameters are minutely papillose. The median tentacle is absent. The lateral are small, somewhat enlarged at the base, and with a filiform tip. They have a few short clavate cilia. According to Sars the tentacular cirri also have a few clavate cilia.

Body has forty-three bristled segments (Sars). The only available British example is fragmentary. The segmental eminence is distinct, but the indifferent preparation showed no differentiated papillae.

Scales have, so far as present, a somewhat ovoid outline (Plate XXXIII, fig. 9), with the exception of the first pair, which are rounded. The outer and posterior borders have slender clavate cilia, which are longest externally, becoming short and sparse as we proceed inward. Their entire surface is closely covered with short, blunt, and rather soft spines, and thus they differ in certain respects from the figure and description of Sars.

Feet.—The first foot has a sharp spine and a group of four small bristles conforming to the dorsal series.

The typical foot presents dorsally a series of rather large, long, yellowish bristles, which, though as conspicuous in size as those of *A. finmarchica*, are much less acutely tapered, and have closer rows of spines. They are slightly curved (Plate XL, fig. 12). The superior ventral bristles have somewhat shorter tips than in *A. finmarchica*, and the rows of spines are not so distinctly separated. The tip is similar, viz. slightly hooked; but the spines become so elongated towards the tip that they project on each side like a series of filaments (Plate XL, figs. 13 and 14).

No dorsal cirri are present, but the ventral cirri are long and filiform with short clavate cilia.

This form appears to present the following differences from the species described by Sars:—The anterior pair of eyes lie in front of the middle of the head, and are not visible from the dorsum, whereas in the Norwegian form they are situated on the median lateral eminence, and therefore considerably removed from the front. They are also seen from the dorsum. The posterior pair of eyes are less widely separated in the British form. It is difficult to compare the bristles, since some of the finer characters are lost in the kind of plate adopted by Professor Sars, but they closely approach each other. The scales, on the other hand, present certain divergences, *e.g.* in the presence of only minute cilia in the northern form.

Genus XVI.—Phyllantinoë, *McIntosh*, 1876.

Head short and broad; base (ceratophore) of the median tentacle passing far backward between the prominent anterior peaks. Anterior pair of eyes much larger than the posterior; pairs separated by a brief interval.

Dorsal bristles short, stout, translucent, with prominent and close rows of spines, and a short, acute, smooth tip. Ventral bristles extremely slender; spinous region long and tapering, tips simple.

In the absence of accurate information concerning the relations of such rare forms to the epitocous condition of species perhaps elsewhere described, it has been deemed prudent to continue the generic distinctions. The large size of the eyes and the slenderness of the ventral bristles may be associated with sexual changes.

PHYLLANTINOË MOLLIS, *McIntosh*, 1876.

Specific Characters.—*Head* short and broad, the base of the median tentacle passing far backward between the prominent and acute anterior peaks. Eyes large, especially the anterior pair, the pigment in which is crescentic in the preparation, and placed on the median lateral prominence. The posterior pair are smaller, and lie in front of the nuchal collar. The pairs are separated by a brief interval. The fragmentary example has about forty bristled segments, the body being elongate, and tapering much posteriorly. The dorsum has brownish pigment, which posteriorly is regularly arranged in the segments. Segmental eminence prominent, but papilla minute. Dorsal bristles short, stout, translucent, considerably curved, with prominent and somewhat close rows of spines, the tip having a short, acute, smooth region. Ventral bristles translucent, extremely slender; the spinous region rather long and tapering, with a short smooth portion at the tip, which is simple and slightly bent. The spinous rows are distinct but somewhat close.

SYNONYM.

1876. *Phyllantinoë mollis*, McIntosh. Trans. Z. S., ix, vii, p. 401, pl. lxxii, f. 5 and 6.

Habitat.—Dredged in 539 fathoms in the Atlantic during the 'Porcupine' Expedition of 1870.

Length.—The fragmentary specimen measured about ¾ inch.

Head (Plate XXVII, fig. 18) in the preparation is shorter than broad, the base of the median tentacle passing a considerable distance backward between the prominent and acute anterior peaks. The four eyes are visible from the dorsum. The anterior pair are unusually large, crescentic in form, and situated on the median lateral prominence of the head. Their form would suggest the occurrence of a lens-like corneal thickening in the concavity in front, but the preparation is uncertain on this point. These eyes look forward, outward, and slightly upward. The posterior pair are smaller, but still of comparatively large size, and lie in front of the nuchal collar. They are more or less rounded, with traces of lenses. The pairs of eyes are separated by a brief interval, as in *Evarne*. All the cephalic appendages are absent.

Body.—The fragmentary example showed about forty segments, besides head and tail. It is characteristically elongated, and tapers much posteriorly. The whole body is soft and delicate, and the feet comparatively short. The dorsum has a brownish colour throughout, and the pigment posteriorly is somewhat regularly disposed in the segments. The segmental eminence is prominent, but so far as could be made out the papilla is short and small. The ventral surface has the usual pale iridescence.

No scales are present.

Feet.—The structure of the feet could not fully be made out, as the condition of the specimen was unfavourable, but they seem to have proportionally short fleshy lobes.

Anteriorly the pedicle for the scale is large, the ventral branch of the foot projecting further than the dorsal as a soft process. Few bristles occurred in any of the feet. The dorsal bristles (Plate XL, fig. 15) are short and stout, translucent, considerably curved, with prominent yet somewhat close rows of spines, and an acute, smooth portion at the tip. The ventral bristles (Plate XL, fig. 16) are translucent and extremely slender both as regards shaft and tip, the latter being long and tapering to the bare region at the point, which is simple, and in some is slightly bent. The spinous rows are distinct, but somewhat close.

So far as ascertained, no form approaches this species.

Genus XVII.—Scalisetosus, *McIntosh*, 1885.

Anterior border of the head smoothly rounded. Eyes placed close together on each side, while the right and left pairs are widely separated and placed far back. Palpi smooth. Proboscis somewhat thin. Body of moderate length. Scales cover the dorsum in front, but leave the centre bare posteriorly. Segmental eminence distinct, but the papilla is small. Bristles transparent as crystal; dorsal slightly curved, and with 5—8 very distinct rows of spines. Ventral bristles slender, elongate, with close spinous rows, and hooked and bifid tip. Longitudinal ventral muscles present a well-marked convexity in section. The ventral area is of considerable width, nerve-cords flattened and indefinite. Cuticle and subjacent granular layer attenuate. A strong band of fibres connects the insertions of the powerful oblique muscles, and thus bounds the cords internally.

Professor Giard[1] gave an amended description of Kinberg's genus *Hermadion* to suit the present forms, but the name *Scalisetosus* had already been published. It is perhaps well to remove them altogether from Kinberg's genus.

1. Scalisetosus communis, *Delle Chiaje*, 1841. Plate XXVI, fig. 6.

Specific Characters.—Head touched with yellowish or whitish pigment, anterior lobes smoothly rounded; eyes of each side placed close together, while the right and left pairs are widely separated and placed far back; anterior pair larger, and wider apart. Median tentacle long, slightly dilated below the filiform extremity, and with rather numerous short clavate cilia. Lateral tentacles long, with filamentous tips, and similarly coated with cilia. Palpi smooth. Tentacular cirri resemble the tentacles. Body $\frac{1}{2}$ to $\frac{3}{4}$ inch long; segments twenty-two to forty-two. Colour pale yellowish, faintly marked with brown towards the posterior end—especially between the feet; or speckled with brownish spots arranged transversely, and numerous yellowish or whitish specks. Occasionally the dorsum is blackish, interrupted by numerous transverse lines. The ventral surface is pale. Segmental eminence prominent, but papilla minute. Scales fifteen pairs, rounded or ovate, minutely dotted on the ventral surface, outer and posterior portions

[1] 'Bullet. scient.,' No. 1, 1886, p. 7.

dorsally studded with a series of small papillæ or short cilia, and, besides, with a smaller number of much larger clavate processes. The outer and posterior borders of the scale have a close series of short cilia with globular extremities. The transparent scales show the nerve-distribution minutely. They have numerous yellow patches, or are dotted with white specks, or are of a purplish-brown hue, especially at the inner border. The bristles are crystalline in their transparency. The dorsal bristles are slightly curved and not much tapered, have about eight rows of spines, and the tip is notched. The ventral bristles are slender and elongate, the shaft dilated superiorly, and with a spinous frill. From this the spinous region passes with a slight bend to the dorsum, and ends in a well-marked hook with a secondary process apart from its base. The dorsal cirri are rather long, with a slight dilatation beneath the long filiform tip. They have similar cilia to the median tentacle. The ventral cirrus is also rather long, but smooth.

Synonyms.

1841. *Lysidice communis*, Delle Chiaje. Descriz. e not., iii, p. 104, tab. 103, f. 1.
1853. *Aphrodita velox*, Dalyell. Pow. Creat., ii, 169, pl. xxiv, f. 13.
1864. *Polynoë pellucida*, Ehlers. Die Borst., p. 105, taf. iii, f. 5, 7—13; taf. iv, f. 1—3.
1868. *Hermadion fragile*, Claparède. Ann. Chét. Nap., 73, pl. v, f. 2.
1869. *Lepidonotus pellucidus*, McIntosh. Trans. R. S. E., xxv, p. 408, pl. xv, f. 2.
1870. *Hermadion fragile*, Claparède. Supplém., Ann. Chét. Nap., p. 16, pl. ii, fig. 2.
1875. " *pellucidum*, McIntosh. Invert. and Fish., St. A., p. 117.
" " *fragile*, Marion and Brobretzky. Ann. sc. nat., 1875, p. 6.
" " *pellucidum*, Marenzeller. Sitz. der k. Akad. (sep. Abd.), 13.
1880. " " Langerhans. Z. f. w. Zool., xxxiii, p. 271.
1884. " " V. Carus. Fauna Medit., 203.
1886. " " Giard. Bullet. sc. Nord, i, p. 12.
1888. " " De St.-Joseph. Ann. d. sc. nat. (7), v, p. 177, pl. viii, f. 51.
1890. " " Malaquin. Ann. Boulon., 22.
1891. " " Hornell. Op. cit., p. 237.

Habitat.—Though not abundant it extends from Shetland to the Channel Islands in deep water, in the latter region between tide-marks, and on both the eastern and the western coasts. It ranges to the Mediterranean and Madeira. It is commensalistic on star-fishes (Hornell).

Head (Plate XXVII, fig. 12).—Yellowish in some, or with white pigment-specks posteriorly and at the eyes; somewhat trapezoidal, the anterior lobes being smoothly rounded instead of forming the usual peaks. The eyes of each side are placed close together, while the right and left pairs are widely separated and placed far back. The anterior pair are considerably larger than the posterior, and are wider apart. In the British examples no lenses are present in them, but Claparède shows such in the Neapolitan. The median tentacle is somewhat long, slightly dilated below the filiform tip, and with rather numerous short clavate cilia. The lateral tentacles are long with slender filamentous tips, and the column has the same short cilia. The palpi are smooth. The tentacular cirri resemble the median tentacle. The ganglia form two distinct ovoid masses in the head.

Body somewhat elongated, narrowed posteriorly, from $\frac{1}{2}$ to $\frac{3}{4}$ inch in length, though sometimes longer. Segments from twenty-two to forty-two. Colour pale yellowish throughout, in some faintly marked with brown towards the posterior end, especially between the feet. In others the dorsum is speckled with brownish spots, arranged transversely, and numerous yellowish specks. The naked portion behind the scales (including the bases of the feet) is speckled with yellowish and whitish. In some Scotch examples the dorsum is of a blackish hue, interrupted by numerous fine transverse lines, most marked at the segment-junctions. In others a distinct band of dark pigment, interrupted by numerous pale striæ, most marked at the segment-junctions, passes along the dorsum. The ventral surface is pale. The segmental eminence is prominent, but the papilla is very small. Posteriorly the body terminates in two caudal styles.

Proboscis.—In extension this organ in the preparation shows apparently thinner walls than in the ordinary forms. A wide canal thus exists in the centre, and the teeth of the dorsal and ventral arches are widely separated. The usual nine papillae occur on each arch. The teeth are pale brown (amber-coloured).

Scales (Plate XXXIII, fig. 7) cover the dorsum in front, but leave the centre bare posteriorly. The normal number seems to be eighteen pairs, but few examples are complete in this respect. They are more or less rounded or ovate translucent organs, so that their minute structure is readily shown. The entire scale is minutely dotted, and its areolæ so arranged that the whole has the aspect of a transparent plate. The dots, as Ehlers stated, appear to be in the cuticular layer of the under surface of the scale. The outer and posterior portions of the scale, moreover, are studded dorsally with a series of small papillæ (modifications of cilia) of a cylindrical or clavate outline, many of which run in the lines of the finely branched nerves. In life these structures have minute papillæ or palpocils at the top, so that they probably perform the function of special tactile organs, as indeed the able description of Ehlers would lead us to expect. Only a small portion at the anterior and inner area of the scale is devoid of them, and the nerves seem to terminate there in special end-organs. In addition, a series of much larger clavate processes occurs thinly scattered over the same region (outer and posterior), the largest sometimes projecting at the posterior border. They are readily seen under a lens, standing out like minute pillars from the surface of the scale. These receive nerve-twigs from the main branches, as shown by De St.-Joseph. The outer and posterior borders, further, are beset with a closely arranged series of short globular cilia, which also occur on the surface adjoining the edge. Many of these have microscopic papillæ (modifications of palpocils) at the tip, and all show a minutely granular central area—connected by the pedicle with the central connective tissue.

The nerve-supply of these organs is clearly outlined, as originally described by Ehlers, and subsequently by Langerhans. At the posterior border of the scar for the pedicle an enlargement (ganglionic) occurs, from which a main stem, rapidly breaking up into branches, proceeds posteriorly, giving off twigs in a somewhat dichotomous manner to the greater part of the scale, while a considerable branch goes forward, or obliquely forward and outward, to complete the distribution. The smooth pale area at the anterior and inner border has the smallest branch, probably because its functions are less prominent. The nerve-twigs terminate in peculiar granular swellings—mentioned by Ehlers. Every little papilla has its nerve-twig, and the granular enlargement are connected with the system like fruit on the tips of a much ramified wall-tree.

In life the scales are quite translucent, sometimes presenting towards their anterior and posterior borders numerous yellow patches at the papillae, or, as in the figure, simply dotted with white specks. In others they have a faint purplish-brown tinge, enlivened by orange and yellowish specks. The brownish tinge in some is towards the inner border.

This active and irritable annelid frequently throws off its scales, but, as in other cases, they are readily reproduced, an interesting account of their development having been given by Ehlers.

De St.-Joseph found a number of specimens of *Pedicellina belgica*, van Beneden on the under surface of the scales.

Feet.—The first foot has a spine, but no bristles in the available specimens. De St.-Joseph thinks this is the normal condition, but it is uncertain.

The dorsal division of the foot (Plate XXX, fig. 9) forms a short and broad process bearing a series of translucent slightly curved bristles (Plate XL, fig. 17), which are not much tapered distally. The rows of spines (or frills), about eight in number, are wide apart inferiorly, while the tip of the bristle is notched as if from a minute claw or secondary process. So homogeneous are these bristles that the usual longitudinal striae have disappeared, and they resemble crystalline structures. In the ventral division the spine forms the apex of a somewhat conical lobe, the upper slope, however, being the shorter. The bristles (Plate XL, fig. 18) are equally transparent, but are slender and elongate, the shaft terminating superiorly in a dilatation with a spinous frill, which, like those of the dorsal, seems to be continuous. From this part the spinous region passes with a slight bend towards the dorsum, and ends in a well-marked hook with a small secondary process—apart from its base beneath. The tip is flattened and not much tapered, while the oblique rows of spines are somewhat adpressed. Little change takes place in their structure in the posterior feet. The bristles seem to have few parasites.

The dorsal cirri (Plate XL, fig. 19) are comparatively long, with a slightly dilated portion beneath the long filiform tip. A yellowish belt, or in some a white ring, marks the dilated portion. A few minute clavate cilia occur on their surface, and to these nerve-twigs proceed. The nerve in the centre of the cilium appears to form an enlargement in the opaque region at the base of the filamentous tip, and then continues onward to the extremity. The posterior cirri are longer and more slender, and the dilatation below the filiform tip is distinct.

The ventral cirri are rather long, smooth and tapering, their tips extending beyond the bases of the bristles.

Reproduction.—Specimens procured in Bressay Sound in July showed ripe eggs, and they were extruded in masses on rupture of the body. A male captured off Peel, in the Irish Sea, bore ripe spermatozoa the same month.

Development.—A young form measuring a little over 1 mm. occurred amongst the

[1] De St.-Joseph calls it roseate.

débris from the haddock-hooks on the 16th September, 1889. The injured specimen had nine or ten bristled feet. The head showed two broad lobes in front, with a deep median notch. Only the ceratophore of the median tentacle remained. The lateral tentacles formed two short subulate organs. The palpi were fairly developed, with tapering tips. The tentacular cirri had long slender tips, readily distinguished from those of allied forms, and all these organs were smooth. A pair of black eyes—very widely separated—were situated at the posterior part of the head. The teeth of the proboscis were clearly visible as four hollow, pointed chitinous processes, with a small spur near the base, and with long horny limbs for the attachment of muscles. The dorsal bristles were recognised by their characteristic scalariform structure, from three to six or seven rows of spines being present. They were more slender than in the adult, and tapered to a delicate tip. The ventral bristles had the prominent basal spur, and the long slightly curved and more finely spinous tip. They projected considerably on each side, as became the nectochaete stage.

The *Aphrodita velox* of Dalyell (1853) is in all probability this form, its translucency, irritability, and general aspect being characteristic. His example was scarcely half an inch long.

Kinberg's *Hermadion* (1857) had the following characters :—Head broader posteriorly. Posterior eyes distant from the anterior. Elytra fifteen, not covering the posterior part of the body. Inferior bristles serrate below the apex. Foot elongate. There is little that is diagnostic in this, and certainly the present genus requires a more precise definition. His species were quite different from the British, and came from the Straits of Magellan.

Ehlers (1864) gave a long and careful description of the species from Quarnero in the Adriatic, detailing the essential characters, though his figures of the bristles and scales needed improvement. His specimens were small, only from 7 to 9 mm., and of twenty-two segments. The ciliated processes on the dorsum of the foot he considered the external part of the segmental organs; and as his examples bore reproductive elements (summer), he was the more certain of the function of these organs. Haswell and Bourne have both pointed out, in other species, the true segmental organs, which are on the ventral surface. Ehlers thought the species had relationship with Kinberg's genus *Hermadion*.

Claparède (1868) published a fairly accurate account of this species from Naples, pointing out the palpocils on the cilia of the cirri, and the ciliated cushions on the dorsum of the feet. He also describes the remarkable facility with which the distribution of the nerves can be followed. Its irritability struck him, and it cast off both scales and cirri. He, like Ehlers, placed it under Kinberg's genus *Hermadion* mainly because the scales only overlapped in the anterior region of the body.

In his supplement to the 'Annelids of Naples' (1870), the same author recognised that his *Hermadion fragile* was Delle Chiaje's *Lysidice communis*, which that author had represented with only the anterior pair of scales, and to which his artist had added a pair of cirri on every segment—of which the figure shows no less than about sixty. In this communication Claparède describes the segmental papilla at the inner border of the foot ventrally, and shows a membrane investing the developing ova. He could not say that this membrane represented the wall of the segmental organ; indeed the absence of cilia inclined him to think it did not. He also drew attention to certain cell-masses, with yellowish concretions in the centre, in the intestinal diverticula—which he thought excrementitious. Prof. Giard agrees with me in considering the distinctions of this form and *S. communis* insignificant.

Marenzeller (1876) found *S. communis*—in the Bay of Muggia at Trieste at a depth of 18 metres, on *Ophiothrix alopecurus*—with thirty-three segments, and measuring 10 mm. His example had fourteen pairs of elytra. He also mentions the advantages of the species for the study of the nerves of the elytra, and alludes to the characteristic structure of the bristles.

Langerhans (1879) records large examples (2 cm.) from Madeira. In connection with the scales he discourses on tactile hairs and rudimentary organs of various animals.

Hornell (1891) found all his specimens as commensals on Echinoderms—one in the ambulacral groove of *Astropecten irregularis*, another on *Crossaster papposa*, and the third on *Ophiothrix rosula*. In one the pellucid scales had posteriorly a crescent of orange, while the first pair had an orange belt all round.

2. Scalisetosus assimilis, *McIntosh*, 1875.

Specific Characters.—Head similar to that of *S. communis*, the eyes occupying the same position, and the larger anterior pair having lenses. Median tentacle long, smooth, slightly dilated below the filiform tip; lateral tentacles short, also slightly dilated below the tip. Palpi smooth. Tentacular cirri similar to the median tentacle. Body narrow and elongated, with a brownish-black median band from the nuchal collar to the posterior end. It is widest at the posterior part of the proboscidian region, though even there less than a third of the breadth of the dorsum. Segmental eminence prominent, but a special papilla could not be made out. Scales even more delicate and transparent than in *S. communis*, minutely punctate on the under surface. The outer and posterior borders and neighbouring surface have short clavate cilia—less numerous than in the former species. The finely branched nerves and nerve-endings are similar. From the dorsum the tips of the feet are blunt, and viewed laterally the dorsal eminence for the bristles is large, while the spine has a broader border of granular epiderm. The dorsal bristles are smaller than in *S. communis*, slightly curved, the spinous rows being less prominent and covering a shorter region of the bristle. The tip is bluntly rounded, bearing a minute terminal claw and a small secondary process with a notch between. The ventral division shows a broad terminal lobe with a bluntly rounded margin in front of the tuft of bristles. The latter, as in *S. communis*, has the distal end of the shaft expanded, with a small spinous collar, and from this the spinous region, with a slight bend to the dorsum, tapers to the tip, which turns bluntly round to the spiked side and ends in a small hook; then, after an edge directed obliquely backward, a secondary process, lateral in position, occurs. The rows of spines are extremely fine. The dorsal cirri are apparently shorter than in the previous species, but of a similar shape—smooth, with a long filiform process at the tip. Only one was observed.

SYNONYMS.

1875. *Hermadion assimile*, McIntosh. Invert. and Fish., St. And., p. 117.
1876. ,, ,, idem. Trans. Zool. Soc., ix, 387 and 400, pl. lxx, f. 4—6.
1886. ,, ,, Harvey-Gibson. Verm. Liverp., 151 and 348.
1891. ,, ,, Hornell. Op. cit., 237.

Habitat.—First found at St. Andrews, by my sister; afterwards on the west coast of Ireland, in 80 fathoms, eighteen miles west of Skellig, by Dr. Gwyn Jeffreys; south of England and off the Spanish coast in the 'Porcupine' Expedition. Commensalistic on *Echinus esculentus* (Harvey-Gibson).

Head has a similar outline to that in the former species, and in the preparations is about as long as broad. The anterior lobes are smoothly rounded, and the eyes have the same position and proportions, the larger anterior pair showing lenses. Both are visible from the dorsum, and have a long portion of the head in front. The median tentacle arises between the rounded anterior lobes, is long, smooth, slightly dilated below the filiform tip, and minutely dotted under a low power, though this seems to disappear in the mounted preparations. The lateral tentacles are short (in spirit) and slightly enlarged below the filiform tip. The palpi are quite smooth. The tentacular cirri are also smooth, slightly enlarged below the extremity, and are shorter than those of *S. communis*.

Body somewhat narrow, about $\frac{3}{4}$ inch or upwards in length, very slightly tapered in front, and very gradually diminished posteriorly. It is distinguished by a brownish-black median band, which commences behind the head and continues to the tail. It is widest towards the posterior part of the proboscidian region, though even there occupying less than a third of the arch of the dorsum. In the preparations a darker band occurs at the segment-junction, and a pale belt just in front. The ventral surface is pale. The segmental eminences are prominent, but special papillæ could not be made out.

Attached to the ventral surface were several long Pedicellariæ, probably from an *Echinus*, and some were also fixed to the feet.

Proboscis.—The proboscis seemed to agree with the preceding in structure, but in the preparation the papillæ were somewhat clavate instead of acute.

Scales (Plate XXXIII, fig. 6), fifteen pairs, even more delicate and transparent than in the previous form, and similar in shape. The cuticle of the inferior surface is minutely dotted throughout as in *S. communis*. The outer and posterior borders have short clavate cilia, less numerous than in the latter, and they also occur on the neighbouring surface. The finely branched nerves arise from a similar ganglion at the posterior border of the scar.[1]

Feet.—In looking at the feet of the two species from the dorsum a decided difference is observed in the terminal region of the ventral division, which in *S. assimilis* (Plate XXX, fig. 15) is somewhat blunt and rounded, whereas it is acute in *S. communis*. In profile this divergence is more pronounced, since the fleshy part of the dorsal lobe is larger in *S. assimilis*, and the spine has a broader covering, and instead of the acute cone

[1] The thickenings observed in these scales do not appear to indicate papillæ in all cases.

in the ventral division of the other species, it is here a broad terminal flap or lobe with a bluntly rounded margin in front of the tuft of bristles.

The bristles are as translucent as in the former species, but are scarcely so long in proportion. The dorsal are smaller than in *S. communis*, and slightly curved, the spinous rows being less prominent, and covering a much shorter region of the bristle (Plate XL, figs. 20 and 21). About seven or eight are visible. The tip is bluntly rounded, with a minute terminal claw and a small secondary process—with a notch between.

The ventral division has a fan-shaped series of slender bristles, which, as in the former case, expand at the end of the shaft, where a small collar of spines occurs, the finely spinous region, with a slight bend to the dorsal edge, tapering to the tip, which turns bluntly round to the spiked side and ends in a small hook; then follows an edge directed obliquely backward between this and the secondary process, which is lateral (Plate XL, fig. 22). So fine are the spines on the terminal region that they are scarcely visible, but the oblique lines in lateral view are distinct. The whole bristle thus characteristically differs from that of *S. communis*.

Habits.—This is evidently a commensalistic form on an *Echinus*, for Pedicellariæ frequently adhere to the skin and processes.

What relationship the *Hermadion echini* of Professor Giard[1] has to this species remains to be seen. It is evidently a closely allied form, but the minute characters of the bristles are not given with that distinctness which is necessary for critical diagnosis. It is interesting in this respect, that *S. assimilis* was found by Harvey-Gibson near Port Erin, Isle of Man, coiled round the peristome of *Echinus esculentus*, protected by the peristomial spines. This author gives some interesting structural details. Hornell also (1891) found one on the spines of *Echinus esculentus* near Liverpool Bar.

Genus XVIII.—MALMGRENIA, *McIntosh*, 1876.

Head somewhat pyriform, with the narrow end in front, devoid of peaks, the median and lateral tentacles springing from the front as in *Lepidonotus*. Eyes large, nearly forming a square. Palpi, tentacles, and cirri smooth. Body of moderate length and breadth. Segmental eminences fairly developed, but without papillæ. Scales, fifteen pairs, smooth with the exception of a small group of papillæ at the anterior curve. Dorsal bristles translucent, short, and with faint spinous rows. Ventral bristles translucent, with rather short distal regions and five rows of spines; the tip hooked, and a secondary process beneath.

1. MALMGRENIA CASTANEA, *McIntosh*, 1876.

Specific Characters.—Head somewhat pyriform with the narrow end in front, without peaks, the lateral and the median tentacles springing from the front as in *Lepidonotus*. Eyes large, nearly forming a square; anterior pair in front of lateral

[1] 'Bullet. sc. Nord,' i, 1886, p. 8.

prominence, posterior in front of collar. Median tentacle of moderate length, smooth, as are also the lateral tentacles, tentacular cirri and palpi, which are of moderate length. Body about $\frac{3}{4}$ inch long, of thirty-six to forty-one segments, with madder-brown pigment posteriorly on the dorsum, and more sparingly on the ventral surface. Segmental eminences fairly developed, but without evident papillæ. Scales, fifteen pairs, adherent, smooth, with the exception of a small and somewhat triangular group of papillæ at the anterior curve in those of a reniform shape; variously bordered with madder-brown. Dorsal bristles translucent, somewhat short, slightly curved, little tapered, and with a rather abrupt point; spinous rows faint. Ventral bristles translucent, with short spinous regions; fine rows of spines, a well-marked hook at the tip and a secondary process after an interval.

SYNONYMS.

1868. *Eunoa*. Report Brit. Assoc., 1868, p. 337.
1876. *Malmgrenia castanea*, McIntosh. Trans. Zool. Soc., ix, 376, pl. lxvii, f. 15—19.
1886. *Malmgrenia castanea*, Harvey-Gibson. Verm. Liverp., 149 and 345.
„ *Lænilla castanea*, Giard. Bull. Sc. Nord, i, 3.
1891. *Polynoe (Malmgrenia) castanea*, Hornell. Op. cit., p. 235.

Habitat.—Dredged by Dr. Gwyn Jeffreys off North Unst, Shetland, in 1867, in 90 and 96 fathoms, on *Spatangus purpureus*, and again in 1868, attached near the mouth of the same Echinoderm, lying on a bottom of shell-sand in 85 fathoms, twenty-five miles north-north-east of Unst. The same veteran explorer of our seas found it in 80—125 fathoms, fifty miles west of Valencia, and in 110 fathoms, thirty miles west of the Blasquet, south-west Ireland, in 1870. It was also dredged off St. Peter Port, Guernsey, in 5—7 fathoms, in 1868. Mr. Hornell procured a few on the same host in the Liverpool district in 20—22 fathoms, and Professor Herdman at the Isle of Man. The Royal Irish Academy's Expedition of 1886 also procured a small example in 480 fathoms. Professor Giard found it on the shores of France on the same Echinoderm.

Head (Plate XXVIII, fig. 15) somewhat like that of *Lepidonotus* and *Halosydna* in so far as the anterior border of the head runs into the base of the lateral tentacles. The head is pyriform, broad and rounded behind, and narrowed in front. A pair of large eyes lie in front of the nuchal collar, and a still larger anterior pair in front of the lateral prominence, looking forward and outward. They are thus separated by a considerable interval, and in the preparations nearly occupy the corners of a square. A trace of a lens appears in the centre of the anterior pair, which are only partially visible from the dorsum. The smooth median tentacle is moderately developed, and has a slight swelling below the tapering tip (in spirit). The lateral tentacles are short and subulate, with brownish pigment above the base. The palpi are smooth and of moderate length. The tentacular cirri have a similar structure to the tentacle, most being somewhat fusiform in outline.

Body about $\frac{3}{4}$ inch in length, and having from thirty-six to forty-one bristled segments. In most of the preparations it is pale anteriorly, but marked with madder-brown pigment on the posterior segments. The colour varies considerably. The under surface of the body is iridescent pinkish. In some a considerable amount of brown pigment occurs posteriorly on each side of the median groove, and on the segmental eminences, the site of the papilla being indicated by a darker speck. On the whole the body is rather firm and broad, tapering a little anteriorly and more so posteriorly. It terminates in two tapering caudal cirri, often of a deep brownish hue. The segmental eminences are fairly developed, but no distinct elongation of the papillæ occurs.

Scales (Plate XXXIII, fig. 10), fifteen pairs, covering the dorsum, only a brief portion of the tail being uncovered. The first pair are rounded, the succeeding reniform, then ovoid, while the large posterior scales are irregularly quadrate. They are smooth glistening organs under a lens. Under the microscope they present a somewhat triangular group of papillæ on the anterior concavity of the reniform scales, but in the posterior scales these almost disappear. They are surrounded by a madder-brown belt, with a tendency to the development of a denser portion in the anterior band. In addition to broader marginal belts, the posterior scales have a general sprinkling of the brown pigment. In some, especially those near the mouth of *Spatangus purpureus*, all the exposed portion of the scale is tinted of a deep madder-brown. The scales seem to adhere with considerable tenacity. The nerve-supply is similar to that in *Scalisetosus communis*, but it is considerably obscured by pigment.

Feet.—In those examined only a spine occurred in the first foot.

In the typical foot (Plate XXX, fig. 5) the dorsal lobe is not much developed, forming a small process from which the somewhat short bristles project. They are very slightly curved, and taper a little towards the tip, which ends in a short point (Plate XL, fig. 23). They are translucent, finely striated longitudinally, and with faint spinous rows which go almost to the point. The dorsal spine projects in its sheath only a short distance towards the lower edge of the bristle-bundle. The ventral bristles have slender translucent shafts with a median axis, and striæ distally as well as in the spinous region. The ordinary appearance of one of the superior ventral bristles is shown in Plate XL, fig. 24, scarcely a trace of the secondary process being visible below the well-marked hook at the tip, and it altogether disappears ventrally (Plate XL, fig. 25). In the developing form the secondary process is clearly indicated. The spinous rows are close, and leave only the short terminal region bare. In specimens from Valencia (south-west of Ireland) this process is very distinctly seen, for instance, when the bristle is slightly turned round (Plate XL, fig. 26). The secondary process is less marked in specimens from the Channel Islands and Shetland, though indications are present in all. In viewing the body from the ventral aspect the feet after the thirteenth become considerably larger, and continue so till the thirtieth. This, as in *Harmothoë marphysæ*, may be associated with reproduction.

The dorsal cirri are of moderate length, smooth, slightly enlarged towards the end of the column (in spirit), and with a filiform tip. They increase in length (as usual) posteriorly. The ventral cirri extend to the bases of the bristles, and are subulate and smooth.

In a small example dredged at 180 fathoms off the south-west coast of Ireland both dorsal and ventral bristles are shorter and proportionally thicker, the former being little tapered, and the latter with shorter spinous regions. The structure of the scales corresponds with the typical form. The body is purplish throughout.

Habits.—They cling to the test near the mouth of *Spatangus purpureus*, and are thus commensalistic forms.

Prof. Harvey-Gibson and Mr. Hornell found them on *Astropecten irregularis*—between the rows of pedicels—at a depth of 20 fathoms in the Liverpool district.

The former gives an account of various structural features of this species.

2. Malmgrenia andreapolis, *McIntosh*, 1875.

Specific Characters.—Head less pyriform than in *M. castanea*, with anterior peaks more or less adnate. Eyes smaller than in *M. castanea*; anterior pair wider apart than the posterior. Median tentacle incomplete in all; lateral tentacles small and subulate, with two brown rings at the base. Palpi smooth. Tentacular cirri brownish, with a few clavate cilia. Body elongate. Scales, fifteen pairs (?); first pair rounded, rest reniform or irregularly rounded. Those after the second pair with a brown ring more or less complete, and at the sixth or seventh pair a V-shaped mark and a spot become distinct. A belt of small papillæ (microscopic) occurs along the central region of the anterior border and extends to the inner corner in the reniform scales. Tips of feet are blunt and bifid; dorsal division less developed than in *M. castanea*; bristles slender, slightly tapered, with a probe-like tip, and minute serrations on the edge. Ventral bristles long, translucent, with a tapering spinous region which is simple superiorly—ending in a distinct knob, the next series with a secondary process beneath the claw-like tip, and inferiorly a single knob. A few clavate cilia occur on the stout, brownish, and tapered dorsal cirri. The ventral cirri are slender and tapering, reaching only a little beyond the bases of the bristles, and have a few short clavate cilia.

Synonyms.

1875. *Malmgrenia andreapolis*, McIntosh. Invert. and Fishes, St. A., p. 117.
1876. " " idem. Trans. Zool. Soc., ix, p. 377, pl. lxvii, f. 20—23.

Habitat.—Not uncommon in the débris of the fishing-boats from the off-shore (E. and R.), on the west sands after storms (E. M.), and in the stomachs of cod and haddock at St. Andrews (E.).

Head (Plate XXVIII, fig. 8) tinted with brown on each side in the preparations, the pale median groove marking off the symmetrical coloured areas on each side. The anterior peaks are more or less adnate, but still visible at the origins of the lateral tentacles. The head is less pyriform than in *M. castanea*, the eyes are smaller, and the anterior pair are wider apart than the posterior pair. The anterior eyes look forward and outward. The median tentacle is incomplete in all. The lateral are small and subulate, with two brown rings at the base; they are not in a condition to show cilia if they are present. The palpi are smooth. The tentacular cirri are brownish, and have a few clavate papillæ. The pigment under the median tentacle is better marked than in the former species.

Body rather elongate, more than an inch in length, and having about 36—37 bristled segments. In some the posterior region (about a dozen segments) is prettily mottled in the preparations with dark brown pigment both dorsally and ventrally. Occasionally the brown bars, sometimes with a pale centre, are best marked on the ventral surface. Very little tapering of the body occurs anteriorly. The ventral surface is for the most part pale and finely iridescent. The segmental eminence is prominent, but a special papilla cannot be made out.

Scales (Plate XXXIII, fig. 11) probably fifteen pairs, but no specimen is complete. The first pair are rounded, with a broad belt of madder-brown round the edge and a spot in the centre, though in some the latter joins the outer portion of the ring. The rest are reniform or irregularly rounded. The second scale in some has a brown ring round the exposed part, and a patch near the outer border anteriorly, representing the spot in the centre of the first pair and that of the scales behind. Those after the second pair have a brown ring more or less complete, the broadest part being toward the inner margin, and the spot at the anterior leg of the V-shaped mark gradually becoming more evidently separated. About the sixth or seventh pair the V-shaped mark and the spot become distinct. Posteriorly a tendency to the obliteration of the ring is observed, and the spot becomes connected with the remnant of it at the inner border. In a few the pigment in the posterior scales occurs in detached specks.

The scales appear to be smooth under a lens, but under the microscope a belt of small papillæ occurs along the greater part of the anterior and outer borders (where the curve is). This belt is continued in the reniform scales round the anterior and inner corner.

Feet.—As in the former species, the specimens seem to have lost the bristles in the first foot.

In looking at the feet from the dorsum it is observed, in contrast with *M. castanea*, that the tips are blunt and somewhat bifid, though the posterior process is less prominent than the anterior flap. In profile, again (Plate XXXI, fig. 3), the foot has a greater depth from above downward in proportion to its length, and thus the terminal cone is shorter. The dorsal division is less developed than in the former species, and bears a series of slender, slightly tapered, inconspicuous, translucent bristles, with a peculiar tip, which forms a kind of rounded knob (Plate XL, fig. 27, representing one of the larger bristles), of much interest when contrasted with the ventral forms, since it demonstrates how closely the same type holds in both divisions. The serrations are minute, and leave only a short portion of the tip bare.

The superior bristles in the ventral branch are long and translucent, have a long, tapering, spinous region, with a distinct knob, like a probe-point, at the tip (Plate XL, fig. 28). The spinous region quickly shortens in the succeeding forms, which show a most interesting series of gradations from the first appearance of the secondary process, the shortening of the probe-point and its gradual modification into a claw and a knob-like tip with an oblique edge between it and the secondary process (Plate XL, fig. 29). The spinous region in these is comparatively broad and short. Then, as the spinous region diminishes inferiorly, the secondary process shortens and disappears, the bristles at the ventral edge, with short spinous regions having a marked dorsal curve, presenting only a short knob, smoothly rounded, at the tip (Plate XL, fig. 30).

The dorsal cirri are stout, shorter than in *M. castanea*, brownish, and, in spirit, taper from base to tip, a few short clavate cilia occurring on the surface. The ventral cirri are slender and tapering, and only reach a little beyond the bases of the nearest bristles. A few short clavate cilia are present.

Habits.—This species is probably commensalistic on another form, probably an echinoderm, but hitherto it has occurred at St. Andrews only in the free condition, viz. as thrown on the beach after storms.

Genus XIX.—Halosydna, *Kinberg*, 1857.[1]

Body linear-oblong; head continuous anteriorly with the bases of the median and lateral tentacles. Eyes large. Palpi smooth. Nuchal collar with a prominent flap. Segmental eminences distinct and the papillæ long. Proboscis with twenty-two frilled papillæ along each border. Only two short, wide, and glandular gastric cæca pass forwards into the peripharyngeal space. Scales eighteen pairs, large, soft, and with a frilled outer border, not covering the dorsum. Dorsal division of the foot minute, with slender, simple, and finely spinous bristles. Ventral division rather long, with numerous somewhat slender bristles with tips of varying breadths.

Halosydna gelatinosa, *M. Sars*, 1860. Plate XXV, fig. 5.

Specific Characters.—Head ovoid, pinkish, running into the bases of the lateral tentacles. Transverse diameter greatest. Eyes large, furnished with lenses, close together, the larger anterior pair on the lateral prominence, and the posterior close behind. The median tentacle is long, smooth, and tapering, with a filiform tip, and the lateral tentacles are also long. The tentacular cirri agree with the median tentacle in length and structure. The palpi are of moderate length, and smooth. Most of these organs are tinted pale madder-brown. Body elongated, bristled segments forty-three, barred transversely with pale greyish-brown belts between the pedicles for the scales. The nuchal collar has a prominent flap, which covers the posterior part of the head. Segmental eminence distinct, and the papilla long. The proboscis is characterised by about twenty-two frilled papillæ along each border in extrusion, and a muscular fold at each side. Scales eighteen pairs, not covering the dorsum completely, large, soft, and rounded, with a folded or frilled outer border in spirit. The outer region is studded with minute trifid papillæ, but the margin is quite smooth throughout. The dorsal division of the foot is minute, with slender simple and finely spinous bristles. The

[1] Kinberg, in his description of the genus, gives little to discriminate it from *Lepidonotus* except the numerous elytra and the elongated body.

ventral division is rather long, and has a long cone for the spine superiorly. The bristles are somewhat slender, with the spinous region of varying breadth, the superior simple and long, the middle and inferior broad and bifid. Dorsal cirri rather long, slender, and smooth, with a slight swelling (and a dark belt) below the filiform tip. The ventral cirrus does not reach the adjoining tip of the fleshy part of the foot.

SYNONYMS.

1820. *Polynoë foliosa*, Savigny. Syst. des Ann., p. 23.
1826. *Polinoe* „ Risso. L'Europ. Mérid., 414.
1834. *Polynoe* „ Audouin and Edwards. Annél., 89.
1835. „ *gelatinosa*, Sars. Beskr. og Iagtt, p. 63, Tab. 9, fig. 25.
1851. „ *foliosa*, Grube. Fam. d. Ann., 37.
1853. *Aphrodita cirrosa*, Dalyell. Powers Creator, ii. 161, pl. xxiv, f. 1 and 2.
1858. *Halosydna gelatinosa*, Kinberg. Freg. Eugen. Resa, Zool., p. 19, Tab. 5, fig. 26.
1860. *Polynoë gelatinosa*, Sars. Christ. Vid. Selsk. Forhandl., 1860, p. 58.
1865. „ „ De Quatrefages. Ann., i, p. 249.
„ *Lepidonotus imbricatus*, Baird. Johnston's Cat. Brit. Mus., p. 340.
„ *Alentia gelatinosa*, Malmgren. Nord. Hafs.-Annul., 81.
1866. *Halosydna* (*Alentia*) *Jeffreysii*, Ray Lankester. Trans. Linn. Soc., 25, p. 377. pl. li, figs. 12, 19—21, 26, 27.
1867. *Alentia gelatinosa*. Malmgren. Ann. Polychaet., 11.
1869. *Halosydna gelatinosa*, McIntosh. Trans. R. S. E., 25, p. 408, pl. xv, f. 6.
1870. *Polynoë foliosa*, Grube. Archiv f. Naturges., 1870, p. 288.
1875. *Alentia gelatinosa*, Ehlers. Annel. 'Porcup.,' op. cit., p. 31.
„ *Halosydna gelatinosa*, McIntosh. Invert. and Fishes St. A., p. 117.
1876. „ „ idem. Trans. Z. S., ix, p. 388.
1879. „ „ Tauber. Ann. Danic., 82.
1883. *Alentia gelatinosa*, Levinsen. Nord. Annul., 196.
1886. „ „ Langerhans. Zeit. f. w. Zool., 40, p. 251, Taf. 15, f. 6.
1888. *Halosydna gelatinosa*, De St.-Joseph. Ann. d. sc. nat. (7), v, p. 154, pl. vi, f. 6—21.
1891. „ (*Alentia*) *gelatinosa*, Hornell. Op. cit., 237.

Habitat.—Everywhere distributed round British shores—from Shetland in the north to the Channel Islands in the south. It is generally found under stones and in crevices, in laminarian roots between tide-marks, or in the valves of old shells in deeper water. It ranges also to the Scandinavian coasts, as well as to Madeira. A small specimen, 13·5 mm. long, is described by Ehlers (1875) from the 'Porcupine' Expedition of 1869, from the great depth of 1366 fathoms, on a bottom of fine mud. This, so far as my experience goes, is a rare habitat, and no station or date is given—only the position of 54° 54′ N. and 10° 59′ W.

Head (Plate XXVIII, fig. 11) with the transverse exceeding the antero-posterior diameter, so that it forms an ovoid. Anteriorly the prominent base of the median tentacle takes origin between the lateral lobes, and thus well within the anterior margin, while the bases of the lateral tentacles are continuations of the head, no peaks being present. The eyes are proportionally large and prominent, and have lenses. The larger anterior pair occupy the projecting lateral region; the smaller posterior pair are situated immediately behind, and, from the rapid narrowing of the region, are thus nearer each other. In an example of medium size from Bressay Sound in July the eyes were larger than usual, and those of each side in contact. The lenses were also larger. The reproductive elements did not appear to be much developed. Sir J. Dalyell mentions that a large one, also from Shetland, had apparently only two eyes, but it is possible they were confluent. In life the head is pinkish, and in the preparations iridescent. In the majority the head is prettily mapped out by a pale median belt running forward to the tentacle. The prominent lateral regions on which the eyes are situated are pale; while in front are two pinkish or brownish-pink smoothly rounded areas—indicating the brain. The median tentacle is somewhat long and tapering, with a filiform tip. In spirit it is slightly enlarged below the latter. The surface is quite smooth. The lateral tentacles, the bases of which are lower than the median, are remarkable for their length, being only a little shorter than the median,[1] and this is confirmatory of the nomenclature adopted in the group. They are tinted brownish. The tentacular cirri agree with the median tentacle in structure and length. The palpi are of moderate length, brownish, tapering, and quite smooth.

Body upwards of 2 inches, sometimes $3\frac{1}{2}$ inches in length, slightly tapered in front and much more distinctly tapered posteriorly; rounded dorsally and flattened ventrally. The dorsum is somewhat regularly banded across with greyish or greyish-brown granular belts, and occasionally touches of white occur in the middle line of the coloured belts. These alternate with a pale belt between the pedicles of the scales. Between each pale belt there is thus a central band bordered with pale lines—extending between the papillæ on the cirrigerous foot, and a belt in front and behind, each of which extends to the neighbouring segment. The segment-junction is, therefore, in the middle of each band. No pale band occurs opposite the first pair of pedicles, but the second and third, as well as the succeeding, have them. In some the pale belts are more or less invaded by pigment. The caudal region behind the scales is continuously grey. In front the nuchal collar forms a free flap, which is sometimes bifid and crenate, but it is not papillose. The under surface is pale or slightly yellowish and iridescent. The proboscis in many tints, the anterior region to about the sixth foot, the rest being iridescent bluish with a red line in the centre. The segmental eminence is distinct, and the papilla is evident at the fifth bristled foot, and continues to the posterior end of the body. It is longest and largest about the beginning of the posterior third.

The *proboscis* and *digestive system* differ from that of the previous genera in having a muscular fold at each side in extrusion immediately below the angle, and divisible into two halves, so that a doubly papillose aspect is given in certain views. Moreover all the papillæ at the tip of the extruded organ are more or less lobed. The six central are large, and when viewed from the exterior do not differ very much from the ordinary forms, except that they are more slender. On their inner aspect, however, they send off a frill sloping towards the aperture. The succeeding eight on each side form a diminishing series with frilled and lobed ends. The total number of papillæ is thus twenty-two. Each of the upper sharp horny jaws bites to the left of the corresponding ventral in

[1] Kinberg states that the antennæ are only about half the length of the palpi, and that the scales are rugose.

extrusion. Both are sharply ridged. A comparatively large number of the preparations, including those from the stomachs of fishes, have the proboscis extruded.

Only two gastric cæca, proportionally short and wide, pass forwards into the peripharyngeal space. They are glandular throughout. The tip seems to end in a series of diverging fibrous processes which fix it in the dorso-lateral space. The glandular lining of the stomach is arranged in a series of trumpet-like processes projecting inwards.

The alimentary canal is generally empty, but in some it contains muddy *débris* with spicules of sponges and other organic materials, together with the skin, bristles, and hooks of Terebellæ. De St.-Joseph says that it feeds on minute crustaceans. Sir J. Dalyell gave a graphic account of its rapacious habits.

The *scales* (Plate XXXIII, fig. 12) are eighteen pairs, large—but do not quite cover the dorsum, have a translucent greyish or slightly purplish aspect, or translucent brownish anteriorly, and dull bluish or greyish posteriorly. A pale spot in each marks the scar for attachment. In some of the anterior scales a few dark specks occur along the posterior border. They are soft and more or less irregularly rounded, the first pair having a marked fold at their outer and anterior border. They are devoid of cilia at the margin, and present a minutely cellular aspect by transmitted light. Moreover along the inner and anterior border the surface is densely studded with minute papillæ, which are short and broad—generally with a trifid end, two stronger spines laterally, and a smaller and more acute median, as Langerhans pointed out. They extend over a considerable surface of the region indicated. Most of the scales have frills or folds on their outer margin. The finely branched nerves radiate from the scar of attachment throughout the entire scale. They are highly sensitive, so much so that when irritated the annelid will sometimes turn on its back to avoid interference. The scales are fixed to the following bristled feet: 1, 3, 4, 6, 8, and so on to 22, 25, 28, 31, 34, 37, and 38.

A curious solid rounded body of minute size occurred in the substance of one scale. Its contents were granular. In some also minute opaque white specks were present behind the scar.

Feet.—The first foot has a spine, the tip of which projects beyond the region in a sheath of cuticle and granular epiderm. No trace of a bristle was present in any specimen examined, and in this it agrees with *Malmgrenia*.

In the second foot the dorsal division is marked chiefly by the tip of the spine, which projects a short distance from the dorsum of the long ventral division. Behind the spine is a small tuft of straight, slender, tapering bristles—finely spinous. The combined lobe is comparatively long, nearly cylindrical, and ends in a long conical process for the spine. The ventral bristles are short and slender, extending beyond the conical process at the tip of the foot. They are slightly enlarged at the commencement of the spinous region, and then taper to a hair-like extremity. Their tips, which have a dorsal curve, diminish in length from above downward. The ventral cirrus of this foot extends as far as the tips of the bristles.

In the third foot the dorsal division is marked only by the projection of the long process enclosing the tip of the spine, and a tuft of similar bristles to those in the previous foot, only the tips are less acute. The ventral division is proportionally shorter and thicker, and the upper border of the process for the spine is now continuous with the dorsal margin of the foot. The bristles are somewhat stronger and the spinous regions shorter. The tips of the upper series are less acute, and those of the stouter inferior show traces of the expansion. The backward curve of the lower series is marked. The ventral cirrus reaches only to the tip of the adjoining fleshy part of the foot.

In the next (fourth) foot a slight elevation internal to the long sheath for the spine exists, as an indication of the dorsal division. The tips of the ventral bristles are now shorter and wider.

In the typical foot (Plate XXX, fig. 11) the dorsal division forms a small process on the upper and anterior border, and is best seen in the elytrophorous feet, since the enlarged base of the dorsal cirrus in the others obscures it. The inconspicuous tuft consists of slender translucent bristles with faint serrations, and tapering to a fine point (Plate XLI, fig. 1). The bristles of the ventral series are comparatively slender and translucent, while the tips are flattened out in varying degrees. The superior series (Plate XLI, fig. 2) have elongated spinous regions, and simple, slightly blunt tips; while the broader middle series (Plate XLI, fig. 3) have a strong curved hook at the tip, with a secondary process immediately beneath. The flattened spinous region is marked by the oblique lines from the rows of spines as in *Malmgrenia*. Langerhans specially refers to the changes in the bifid tip of the ventral bristles. The ventral cirrus does not now reach the tip of the fleshy part of the foot.

Posteriorly the bristles become extremely slender, with a capillary tip. The ventral, however, retain a trace of the enlargement at the base of the spinous region. The bristles on the last foot are stout. The ventral cirrus extends almost as far as the tip of the inferior division of the foot.

Parasites on the bristles are rare.

The dorsal cirri are rather long, slender organs, with a filiform tip, and a dark belt at the slight swelling immediately below. Their surface is smooth. A considerable nerve passes up the centre of the organ nearly to the tip, giving off branches as it proceeds.

Habits.—This species is fond of clinging to the under surface of stones in pools near low-water mark, from the north of Scotland to the Channel Islands, and no marked difference in size is found on contrasting specimens from the extremes. In Bressay Sound it is very abundant in old bivalve shells, in crevices in the "roots" of the tangles, and on the surfaces of the valves of the "horse"-mussels bound together by the foregoing "roots." Sir J. Dalyell many years previously procured it from this region—under shells. He gives an interesting account of the rapacity of one in confinement which devoured its fellow, the teeth of the proboscis audibly striking the glass as it darted it out to conclude its meal. In various Polynoidæ this tapping on the glass occurs occasionally in confinement. Fishes seem to find it out readily in deep water, for large examples are frequent at St. Andrews in the stomach of the cod and haddock.

It is active and irritable, and frequently ruptures its body if held by the middle, or when put in spirit. Sir J. Dalyell found it timid and nocturnal, yet watchful for prey.

Reproduction.—Ripe males occur at St. Andrews towards the end of November. A large female, again, was laden with fairly advanced ova in July in Herm, so that the period of deposition could not be distant, probably in autumn. They were somewhat less advanced in a large female during the same month in Shetland, no free ova occurring in either case. In August the condition of the ova was very similar to the last (*e. g.* in one sent from Arran by Dr. Howden). Sir J. Dalyell, again, found that in the middle of July a large specimen produced in confinement about 10,000 eggs, the mass having a reddish hue as it lay on the bottom of the vessel. De St.-Joseph found ripe specimens with the ova and sperms within a membrane, as shown by Claparède in *Hermadion fragile*, but he omits to mention the date.

De Quatrefages adds nothing new to the account of the species. Grube found that this author's *Polynoë foliosa* in the museum at Paris agreed with the present species, as Malmgren had hinted.

Ehlers gives a somewhat detailed description of the small specimen (13·5 mm.) from the 'Porcupine.'

Genus XX.—POLYNOË, *Savigny*, 1820.

Head elongated antero-posteriorly, with a somewhat indistinct peak on each side, beneath which is the lateral tentacle. Anterior and posterior eyes widely separated. Palpi with dense rows of clavate papillæ. Body linear-elongate, with many segments (over 100). Segmental papillæ long. Scales fifteen pairs, with a broad belt of papillæ on the surface anteriorly. Dorsal division of the foot minute, with small spinous bristles truncated at the tip. Ventral division has a single strong hastate bristle superiorly, and, below, strong bifid bristles with short spinous regions.

The median area for the nerve-cords is comparatively wide, the oblique muscles having a broad attachment to its exterior border. A firm membrane bounds the area internally, and a symmetrical longitudinal muscle runs above it on each side of the median line.

Commensalistic.

POLYNOË SCOLOPENDRINA, *Savigny*, 1820. Plate XXV, fig. 7.

Specific Characters.—Head pinkish, with the long diameter antero-posterior; a somewhat indistinct peak on each side. A pair of distinct eyes in front of the nuchal collar, and a larger pair with lenses, scarcely visible from the dorsum, near the anterior part of the peak, and directed forward and slightly outward. Median tentacle larger than the palpi in spirit, with a slight enlargement below the filiform tip, and densely clothed with short clavate cilia having truncated tips. Lateral tentacles of moderate length. Palpi have dense rows of minute clavate papillæ. Body linear-elongate, 2 to 5 inches long, bristled segments from 80 to over 100, reddish brown, or brown on the dorsum, the pigment being arranged in various touches and bars. The posterior ventral region has also brown bars and touches, especially on the segmental eminences. The papillae of the latter are long. Scales fifteen pairs, dappled brownish, with a dark patch over the scar and surrounded by a pale ring. The larger examples have a dark metallic lustre from the pigment. They have a series of minute papillae as a broad belt along the anterior region, and the outer edge shows very minute rounded or short clavate papillae —the homologues of the cilia. The dorsal division of the foot is minute, and bears rather small, spinous, truncated bristles. Ventrally, as a rule, a single strong hastate bristle occurs superiorly, and, below, a series of strong bifid bristles with short spinous regions. The dorsal cirri are somewhat short, with a filiform tip, and with the same short cilia as on the median tentacle. The ventral cirri are short, ciliated, and tapering —not reaching the tip of the fleshy part of the foot in spirit. Commensalistic.

SYNONYMS.

1820. *Polynoe scolopendrina*, Savigny. Syst. des Ann., p. 350.
1834. ,, ,, Aud. and Ed. Annél., p. 92, pl. i. f. 17 and 19
1840. ,, ,, Johnston. Ann. Nat. Hist., v, 307, Tab. 5, f. 1—9.
1851. ,, ,, Grube. Fam. Annel., 37.
,, ,, ,, Sars. Vid. Selsk. Forh., 1860, p. 62.
,, ,, *variegata*, Grube. Annel. Oersted., 19.
1860. ,, *scolopendrina*, Sars. Vidensk. Selskab. Christ., 1860, p. 62
1865. ,, ,, Johnston. Cat. B. M., 119, pl. xi, f. 1—9.
,, ,, ,, Malmgren. Nord. Hafs-Ann., 82, Tab. 10, f. 11; and Ann. Polych., 15.
,, *Lepidonotus scolopendrinus*, De Quatrefages. Ann., i, p. 263.
1873. *Polynoë scolopendrina*, Marenzeller. Sitzb. der k. Akad., vol. lxix, p. 119.
,, ,, *crassipalpa*, idem. Ibid., p. 112, pl. xi, f. 1.
,, ,, *Johnstoni*, idem. Ibid., p. 120.
1874. ,, ,, idem. Sitzb. d. k. Akad., 69 (sep. Abd.), p. 14.
1875. ,, *scolopendrina*, Grube. Jahrb. Schles. Gesells. (fide De St.-Joseph), 1875 Breslau. 1876, pp. 53 and 68.
1876. ,, ,, McIntosh. Trans. Z. S., ix, 389.
1879. ,, ,, Tauber. Ann. Danic., 82.
1883. ,, ,, Levinsen. Nord. Annul., 196.
1888. ,, ,, De St.-Joseph. Ann. d. sc. nat. (7), v, p. 183.
1891. ,, ,, Hornell. Op. cit., p. 235.

Habitat.—In the tubes of *Terebella nebulosa*, between tide-marks, Herm, and between the chinks of rocks (gneiss) in muddy sand in the burrows of *Lysidice*. The large race abounds on the eastern shores of North Uist in the tubes of *Terebella nebulosa* and other Terebellids attached to the under surfaces of stones close to low-water mark. Not uncommon also off the east and west coast of Ireland (Prof. Haddon and Dr. Scharff) and in the English Channel (Hornell). It extends to the shores of France and to the Mediterranean.

The pinkish *head* (Plate XXVIII, fig. 9) forms an ovoid, the long diameter being antero-posterior. A central groove terminates in front at the basal process (ceratophore) of the median tentacle, and on each side is a somewhat indistinct peak, which, however, is differentiated from the lateral tentacle beneath. A pair of distinct eyes lie in front of the nuchal collar. The considerably larger anterior pair are scarcely visible from the dorsum, and are situated in the smaller southern forms on the outer border near the end of the peaks, a long interval thus existing between the anterior and the posterior pairs. In the large Hebridean examples these large eyes occupy almost the whole peak, and their direction is more forward than outward. The anterior eyes, as a rule, look forward and slightly outward, and are very conspicuous from the front. A minute lens, less distinct in the larger than in the smaller forms, appears in the centre of the anterior pair. In the preparations the brownish median tentacle is longer than the palpi, tapering from the base to the slight swelling below the filiform tip. It is somewhat densely clothed with short cilia, most of which have truncated tips, only a few being clavate—the latter shape being due to an ovate rather than a rounded tip. The lateral tentacles are of moderate length, and have a slight enlargement below the filiform tip. They are similarly clothed with truncated cilia. The palpi are of average length, and have rows of closely arranged clavate papillæ with truncated tips. These are longest and most cylindrical inferiorly, shorter and more markedly clavate superiorly. Smaller forms extend on the tapering extremity of the organ. The tentacular cirri resemble the median tentacle in regard to form and cilia.

Body linear-elongate, $1\frac{3}{4}$ to $4\frac{3}{4}$ inches or even more long, and having from 80 to 102 bristled segments. The iridescent dorsum in the larger examples is mottled with reddish brown, which, behind the proboscidean region, is somewhat regularly arranged between the lateral eminences, and by-and-by divided into two by the dark median tubercle which commences about the twentieth bristled foot. These three distinct sets of elevations (two lateral and a median) continue to the posterior end of the body. A ridge-like fold forms a buttress in front and another behind the lateral tubercle, and each bounds the seal-like brownish mottling. Brownish pigment also occurs on the elevations at the bases of the dorsal cirri. The median tubercle is situated towards the anterior part of the segment, the lateral towards the posterior part. In the large forms the reddish hue of the dorsum shines through the scales, and tints the entire region, relieved by the steel-like glitter of the darkly pigmented portions of the scales. In the smaller forms the dull yellowish back is minutely flecked with brown. Every alternate foot in front has a dark brown patch on the eminence for the cirrus. The ventral surface is iridescent, pale brown or dull yellowish in the specimens from the Channel Islands, and posteriorly marked by touches of brown—chiefly on the segmental eminences, which are distinct, and have a large and somewhat clavate papilla which projects backwards between the feet. The segmental papillæ become distinct on the sixth foot, and continue nearly to the posterior end. In the centre of the body is a reddish streak. In the large Hebridean forms the under surface and feet are of a dark orange—with the reddish central line and iridescent. Moreover, in some, broad bars of pigment occur on the ventral surface throughout in more than the posterior half. Two races thus occur, the smaller yellowish-brown southern form, and the reddish-brown Hebridean.

The body terminates posteriorly in two anal styles, which, like the cirri, are proportionally short.

Digestive System.—The pre-gastric cæca are two in number, both being short and broadly club-shaped. The third is transverse. All go deeply into the intermuscular spaces at the feet. The movements of muscles and feet must thus have considerable effect on the contents of the cæca.

Scales (Plate XXXIII, figs. 13—small example, and 14—larger example) fifteen pairs. They vary in appearance according to the condition of the specimen; thus the smaller race from the Channel Islands has the anterior scales dappled brownish with a dark patch over the scar for attachment, and surrounded by a broad pale ring. In the larger specimens from the Hebrides they have a dark metallic (steel-like) iridescence. When removed they are translucent, pale anteriorly, marked by a dark belt, speckled with translucent spots round the inner three-fourths of their circumference, and with a pale centre. They vary, in any given specimen, in size according to state of development, covering the dorsum in some nearly as far as they extend, whereas in others with developing scales an interval occurs between the pairs. In the large forms the first five pairs cover the dorsum completely, the rest leave a space in the centre. The first pair are rounded—with minute cilia anteriorly, the succeeding somewhat reniform, and the rest more or less rounded ovoid. Though smooth under a lens they have a dense series of minute papillæ as a broad belt along the anterior region, and at the outer border a series of minute papillæ or cilia, and one or two also occur along the posterior border. Finely branched nerves ramify throughout the scale from the scar for the pedicle. In the small specimens from the Channel Islands the papillæ (spines) on the scales are proportionally large, as observed in the sketch.

Feet.—The dorsal division of the first foot presents a single small dorsal bristle with about seven or eight spinous rows, and a smooth tip.

The second foot has dorsally a group of somewhat tapered, short, slightly curved bristles with well-marked spinous rows. Ventrally the slender bristles are also short, the spinous regions being bent dorsally, and tapering to smooth bifid tips. The rows of spines are well marked,—that is, are at moderate distances from each other. The tips of one or two of the inferior bristles are simple. The large ventral cirrus of this foot has numerous cilia with clavate and truncate tips. The bristles in the succeeding feet gradually approach the typical form, which is found about the twelfth or thirteenth bristled foot. In shape the typical foot (Plate XXIX, fig. 17) presents dorsally the comparatively short tapering cirrus, then the eminence for the dorsal bristles. The inferior division is bifid, with a long anterior process and a shorter posterior cushion, the margin beneath having an inward slope from above downward. Even in the second foot the upper ventral bristle is stouter than the others, with strongly bifid tip and spinous rows. It increases in strength and becomes more boldly bifid as we proceed backward, attaining a large size in the fifth and sixth, and then becoming simple about the tenth bristled foot, while only traces of the spines remain. As a rule only one strong bristle occurs in the typical foot, which has below the dorsal cirrus the tuft of short, slightly curved, and little tapered dorsal bristles arising from a small eminence (Plate XLI, fig. 4). These bristles taper a little from the base, but end in a blunt tip (Plate XLI, fig. 7), which is curiously wrinkled so as to appear bifid. The spinous rows are somewhat close, yet fairly distinct. A careful examination of various specimens, however, shows that this condition of the dorsal bristles is due to external influences, probably connected with commensalism. The tip has evidently been destroyed, so that only the lower part of the bristle remains. The stump, indeed, is often slightly thickened, and presents a furrow, giving the bifid appearance already adverted to. In an example dredged off the Hebrides by Dr. Gwyn Jeffreys the dorsal bristles are unusually complete, yet even in these the extreme tip has disappeared and a probe-pointed end remains. This specimen shows, however, that the normal condition of such a bristle is finely tapered to a filiform tip. The causes of this remarkable change, which does not seem to affect the ventral bristles, may be the secretions of the *Terebella*, or the friction of the bristles against the walls of the tube or tunnel, the latter the most probable.

The ventral division forms a short triangular lobe, the process for the spine being at the apex. In some a bar of dark pigment occurs near the tip of the foot, just at the base of the bifid region. Above the spine is the single large bristle, the shaft of which is about twice the diameter of those adjoining. The tip is hastate and the point acute (Plate XLI, fig. 5). As already indicated, this bristle is formed from a bifid one, the secondary process disappearing as we proceed backward, and likewise the spines—traces of which, however, even far backwards, are left in the faint transverse lines on the dilated region. The relative proportion of the two kinds of bristles is shown in figs. 4 and 5. All the bristles which follow are bifid, with short spinous regions and moderately stout shafts (Plate XLI, fig. 6, representing one of the superior forms with a longer tip, and fig. 8 showing the tip more highly magnified).

Toward the posterior end the large superior ventral bristle disappears. Before this change takes place, however, two strong bristles occur on the foot as in front. The dorsal tuft becomes minute posteriorly, and in the terminal feet the bristles are slender and tapered—with very distinct spinous rows.

The dorsal cirri, which in life are pale, extend in the preparations only a little beyond the bristles, and gently taper to the slight swelling below the filiform tip. They have numerous short cilia with clavate and truncate ends, and a few small cilia occur on the base of the slender extremity. The ventral cirri are small and tapering, with similar cilia. They do not reach the tip of the fleshy part of the foot. In some they are rendered conspicuous by dark pigment at the base.

Nerve-cords.—In transverse section nucleated cells are found externally and beneath the cords, especially at the ganglionic enlargements. Strands from the exterior fibrous layer also passed into the area of the cord in section, and in many such fibres seemed to join the nucleated cells lying in the median line below the cords.

Reproduction.—Females with well-developed eggs were found in the tube of *Terebella nebulosa* at Herm in July, 1868, and in the chinks of rocks in tracks of *Lysidice*. In the latter case males well advanced were also observed.

Habits.—This form is more sluggish in its habits than *Harmothoë imbricata* or other ordinary type. It is difficult also to conceive how the *Terebella* can be comfortable with such a large commensalistic form in its tube, especially when the powerful bristles of the *Polynoë* are considered. So far as observed it keeps its head towards the anterior end of the tube, and thus its ordinary position is in agreement with that of the *Terebella*. It is brittle, breaking into several pieces in lifting from one vessel to another.

Its food consists of cellular substances with a few sponge-spicules.

It is phosphorescent. On placing it in spirit luminous flashes were emitted from the bases of the feet, and the same emissions were caused by irritating the posterior end with the forceps.

The remarkable difference in size and coloration between the southern forms from the Channel Islands and those from the Outer Hebrides is an interesting feature, but one in the British Museum from Falmouth is between four and five inches, so that caution in making deductions is necessary.

The most marked variety is that from the chinks of the hard gneiss of the Channel Islands—in the burrows of *Lysidice*. It is less than two inches, very narrow, and there is a tendency to have dark brown pigment at the mouth and anterior ventral region. It thus approached in bulk *Lysidice* itself, and the tints anteriorly were not dissimilar.

The species was first found by d'Orbigny at La Rochelle, and by Savigny and Audouin and Edwards on the shores of the Channel. The latter authors state that it lodges in tubes of sand and shells agglutinated by a secretion, though they also found it in company with *Terebella*. No instance of its occurrence in an independent tube, manufactured by itself, is known in this country, and it is possible Audouin and Milne Edwards may have met with it only in an empty tube of *Terebella*.

De Quatrefages points out that Johnston's species diverges from that of Audouin and Milne Edwards, since it has 110 segments. Further, that the appendages of the head differ in proportion. Thus the median antenna is much longer than the inferior tentacles, which are very large and conical; the lateral, again, are proportionally small. The superior tentacles differ correspondingly. For the rest, the figures of the bristles given by the respective authors diverge much. This author, however, laboured under a misapprehension on the subject.

Marenzeller in 1874 distinguished this from Savigny's species by the fact that the tentacle was longer than the palpi, while the tentacular cirri were shorter than the palpi: there are three rows of wart-like papillæ on the dorsum of the segments. Moreover, his *P. crassipalpa* comes near it, and may be the same form. I have not seen any reason to think that Savigny's species differed from Johnston's, though two varieties exist; and it is satisfactory to find that Baron de St.-Joseph agrees with me in this respect as well as with regard to the *P. crassipalpa* of the able naturalist of Vienna. Mr. Hornell observes that nearly every haul of the dredge off Anglesey brought up at least one specimen, and in one case it emerged from the tube of *Thelepus cincinnatus*.

In the recent remarks[1] of Dr. H. F. Johnson on the Pacific annelids it would have been very interesting to find the results of a comparison of such commensalistic species as *Polynoë reticulata*, sp. nov., or *P. gigas*, sp. nov., with the well-known *P. scolopendrina*.

[1] 'Annel. of the Pacific Coast,' Californ. Acad. Sci., 3rd ser., i, No. 5, 1896, p. 170 *et seq.*

Genus XXI. ENIPO, *Malmgren*, 1865.

Head subcircular without peaks. Eyes rather small, two posterior, two median and lateral. Palpi thick, subulate, and, like all the tentacles, smooth.

Body much elongated (about 100 segments). Segmental papillæ distinct. All the segments have dorsal cirri.

Scales fifteen pairs, minute, smooth, subcircular, only occurring anteriorly.

Feet well marked and long. Dorsally is a minute tuft of slender serrate bristles. Ventrally are slender bristles with tapering, boldly spinous regions and a capillary tip, while a few are bifid.

ENIPO KINBERGI, *Malmgren*, 1865.

Specific Characters.—Head subcircular without peaks. Eyes rather small, two at the posterior border and two on the lateral prominence. Lateral tentacles subulate, short. Palpi thick, subulate. Tentacular cirri of moderate length. All these appendages are smooth. Body much elongated, of about 100 segments. Segmental papilla distinct. Scales fifteen pairs, minute, subcircular, pellucid, smooth, leaving the posterior part of the body uncovered. Feet well marked, long, bearing dorsally a minute tuft of slender serrate bristles. Ventral bristles mostly slender, with a tapering boldly spinous region ending in a capillary extremity, but a few have hooked tips with a secondary process. All the segments have dorsal cirri, which reach only a little further than the bristles. Ventral cirrus subulate, of moderate length—sparsely ciliated (*fide* Malmgren).

SYNONYMS.

1865. *Enipo Kinbergi*, Malmgren. Nord. Hafs-Ann., p. 83, Tab. x, f. 12.
1867. " " idem. Ann. Polych., p. 15 (sep. copy).
1873. " " Kupffer. Jahresb. der Com. der Deutsch. Meere, 1871, p. 150.
1875. " " McIntosh. Invert. and Fishes, St. A., p. 116.
1876. " " idem. Trans. Z. S., ix, 388, pl. lxx, f. 7–10.
1879. " " Tauber. Ann. Danic., 83.
1883. " " Levinsen. Nord. Annul., 196.

Habitat.—Deep water off St. Andrews Bay. The examples have occurred in the stomachs of cod and haddock (E. M.). It ranges to Christiania Fjord, to Drobak, to Bahusia (Malmgren), and the Baltic.

Head.—The only British specimens hitherto procured have been from the stomachs of cod and haddock caught off St. Andrews Bay, and the head has been so injured that no description could be made. Malmgren observes that the head is subcircular, without anterior peaks, the base of the median tentacle occupying the region. Eyes apparently rather small; two in front of the nuchal collar, and two on the lateral cephalic prominence. Lateral tentacles short, subulate. Palpi thick, subulate. Tentacular cirri about the length of the palpi in spirit. All these cephalic appendages are smooth.

Body.—Much elongated, narrow, of about 100 segments, and about 65 mm. long. Segmental papilla distinct (*fide* Malmgren).

Scales.—Fifteen pairs, minute, subcircular, pellucid, smooth, leaving the posterior region of the body uncovered (*fide* Malmgren).

Feet.—The feet are rather elongate, carrying dorsally a minute tuft of slender hairs, finely serrated (Plate XLI, fig. 9). The ventral bristles are described by Malmgren as of one kind only, but this form shows two kinds, viz. (1) that indicated by Malmgren, and represented in Plate XLI, fig. 10, the rows of spines in all the examples being apparently less numerous and wider apart than in Malmgren's figure; and (2) a few with characteristically hooked tips and a secondary process beneath (Plate XLI, fig. 11). The rows of spines in the first series are not opposite, but alternate—as observed in end views (Plate XLI, fig. 12). A slight enlargement occurs at the commencement of the spinous region.

All the bristled segments, as in *P. scolopendrina*, are furnished with smooth dorsal cirri, which extend only a little further than the bristles. Ventral cirrus subulate, of moderate length, sparsely ciliated.

The appearance of this northern form only in the stomachs of fishes shows how readily such may escape the various instruments of capture used by naturalists.

I have placed this under Malmgren's genus and species, supposing that he had overlooked the ventral bristles with the bifid tip. Should they be absent in his form, then the species from St. Andrews should bear the specific name of *Elisabethæ*, from its discoverer.

Kupffer (1873) shows that the antennæ are three-ringed in examples from the Baltic, but this and other features require careful re-investigation in connection with possible specific differences.

Genus XXII.—ACHOLOË,[1] *Claparède*, 1870.

Head elongated from before backward, and running into the bases of the tentacles. No peaks. Four large equidistant eyes. Palpi smooth and short. Body sublinear, flattened, segments numerous. A segmental eminence but no distinct papilla. Cirri on every foot, and a T-shaped branchial process. Scales numerous. Feet short. Dorsal division minute; bristles few and small, with a minute hook at the tip. Ventral division bearing bristles with long and strong shafts and short spinous regions having a sharp hook at the tip. The nerve-cords seem to be comparatively large, ovoid in section, and have the cuticle and granular epiderm externally. Internally a firm membrane separates them from a well-marked layer of longitudinal muscular fibres in the median line, as in *Polynoë scolopendrina*.

[1] One of the Harpies.

Acholoe astericola, *Delle Chiaje*, 1823.

Specific Characters.—Head somewhat elongated from before backward, with four large equidistant eyes—all visible from the dorsum. Anterior peaks absent or indistinct, the head running into the bases of the lateral tentacles. Median tentacle of moderate length, subulate, with a very few clavate cilia. Similar cilia occur on the short lateral tentacles. The palpi are smooth and rather short. Body sublinear, flattened, segments numerous and of a peach-blossom or flesh colour. Segmental eminence, but no distinct papilla. Scales forty-five pairs, rounded or ovate, smooth, with a very few minute papillæ at the anterior and inner border. The feet are somewhat short, the dorsal division minute, the ventral bevelled from below upward. In the cirrigerous feet a T-shaped branchial process. Dorsal bristles few and small, gently curved and tapered, with a minute hook at the tip, which is smooth. The spinous region is short, and the spines minute. The ventral bristles have long and strong shafts, a slight dilatation at the commencement of the very short spinous region, and a smooth boldly marked sharp terminal hook. Dorsal cirri somewhat short, tapered, and with a very few clavate cilia. The ventral cirri are short, smooth, subulate, and tapering.

SYNONYMS.

1823. *Nereis squamosa*, Delle Chiaje. Mem. s. g. Anim., ii, pp. 368, 400, 425, Tav. 19, f. 7.
1841. *Polynoe astericola*, idem. Descriz. e notom., v, 57, 106, Tav. 129, f. 7.
1855. „ *malleata*, Grube. Archiv f. Naturges., Bd. xxi, 81, Taf. iii, f. 1.
1857. „ *astericola*, Sars. Bid. til Kundsk. om Middelhav. Littoral-Fauna, Christiania, p. 101.
1865. „ *asterinæ*, Carrington. Proceed. Lit. and Phil. Soc., Manchester, iv, p. 176.
1870. *Acholoe astericola*, Claparède. Suppl. Ann. Chét., Nap. (sep. copy), 18, pl. ii, f. 1.
1875. „ „ Marenzeller. Sitzb. der k. Akad. (sep. Abd.), 11.
„ „ „ Panceri. Atti Accad. Sc. Napoli, vol. vii, p. 13, Tav. 3, f. 3—5.
1876. „ „ McIntosh. Trans. Z. Soc., ix, 389, pl. lxx, f. 11, 12.
1884. „ „ V. Carus. Fauna Medit., 202.
1891. „ „ Hornell. Op. cit., p. 236.

Habitat.—It was first procured in Britain by the late Dr. Carrington on Southport Sands clinging to *Astropecten irregularis*; while Prof. Percival Wright got it at Galway. Abroad it ranges to the Mediterranean, occurring on various star-fishes of the genus mentioned.

The *head* (Plate XXVII, fig. 17) is somewhat elongated from before backward in the softened preparations, of a roseate hue from the ganglia, and Claparède shows four large equidistant eyes—all visible from the dorsum.[1] The anterior peaks are absent or very indistinct, the head on each side running into the base of the lateral tentacles, while in front of the median groove is the base of the median tentacle. The trilobed processes

[1] The eyes had disappeared from the rather softened preparations which represented the species. For these I am indebted to the late Dr. Carrington, of Eccles, near Manchester.

alluded to by Claparède seem to be the result of compression. The tentacle is subulate, with a few clavate cilia. The lateral tentacles are short and subulate, with a few clavate cilia. The palpi are smooth, rather short (in spirit). The tentacular cirri are also short, with a few clavate cilia. Claparède observed that the dorsal base of the latter has a band of vibratile cilia on its upper surface, and he considered that such was the homologue of the branchial processes of the feet.

Body sublinear, flattened, and ranging from one to two inches in length. It is very little tapered in front—much more so posteriorly. The segmental eminence is distinct, but no papilla is visible in the preparations. Dr. Carrington describes the general aspect as peach-blossom or flesh coloured.

Scales (Plate XXXIII, fig. 15) are forty-five pairs (Claparède[1]), rounded or in front somewhat reniform, apparently smooth, but having a series of minute papillæ along the anterior and inner border, and with finely branched nerves. They are rather thin and translucent, and have a blackish belt round the border, the centre being pale. In some the blackish belt is confined to the posterior and outer border. On the anterior aspect of the pedicles for the scales is a band of vibratile cilia.

Feet.—Only the spine remains in the preparations in the first foot, and Claparède shows the same condition from life. In this respect it agrees with *Malmgrenia* and *Halosydna*.

The second foot has a few short dorsal bristles—slightly curved, and with a short spinous region, which does not quite reach the smooth and pointed tip. The ventral series are stout and somewhat short, with a distinct curvature at the upper part of the shaft, and a short spinous region tapering from a basal enlargement to an acute and slightly hooked tip. The spinous rows are well marked. The chief change in the third foot is the increase in the strength of the ventral bristles, and in the more distinct hook of the smooth extremity. A ciliated band occurs along the upper and anterior edge in this and other anterior feet without elytra.

The typical foot (Plate XXXI, fig. 4) in those segments which have cirri has a **T**-shaped branchial process on the dorsum—figured by Claparède from life, and showing a diverticulum of the intestine, and ova from the perivisceral chamber in the interior. Its inferior surface is richly ciliated. Such a process may fairly be called branchial. The foot is comparatively short, with a small dorsal papilla for the bristles, and a short ventral division sloping from below upward to the spine, and slightly bifid at the tip—when viewed from above. The dorsal bristles (Plate XLI, fig. 13) are short, somewhat curved, and little tapered distally below the bare region at the tip, which is acute and slightly hooked. The spinous rows are minute. The ventral bristles have long and strong shafts—the middle exceeding the superior and inferior in bulk, a slight dilatation at the commencement of the very short spinous region, and a smooth boldly marked sharp hook at the tip (Plate XLI, fig. 14). The spinous rows gradually diminish from below upwards, and no larger process occurs at the base of the hook, as in several forms.

The dorsal cirri are comparatively short, apparently devoid of an enlargement below the tips, and with a few clavate cilia. The ventral cirri are smooth, subulate, and

[1] Carrington says twenty pairs or more of white scales.

tapering. They do not reach the tip of the fleshy part of the foot (in spirit), though they pass beyond the bases of the bristles.

Nerve-cords.—At the sides of the nerve-cords are numerous nucleated cells, and the cords themselves in section present a peculiar areolar or reticulated appearance—a feature, however, which may be due to the mode of preparation. The granular epidermic layer seems to be largely developed.

Habits.—The late Dr. Carrington, of Eccles, found it at Southport in considerable numbers, along with *Harmothoë lunulata*, in the ambulacral grooves of *Astropecten irregularis*, his attention having been attracted by the bluish phosphorescence when the star-fishes were put in fresh water. It is very fragile, so that it is difficult to obtain an entire example; yet it is sluggish. Claparède, again, procured it on the same star-fish at Naples in company with another Annelid, *Stephania flexuosa*.

Reproduction.—Dr. Carrington observed ova in his examples from Southport, but no date is given, though it is probable that they were obtained during the storms of winter. The ova were seen through the dorsal papillæ. M. Claparède procured those with ova and sperms at Naples in the winter of 1868–9.

Delle Chiaje first found this species in the ambulacral grooves of *Astropecten aurantiacus* and *pentacanthus* at Naples, and gives a figure of the entire animal, which is of a pinkish hue.

Amongst allied forms, Webster, in his 'Annelids of the Virginian Coast,' describes *Lepidametria commensalis* with scales extending the whole length of the body, viz. 50 to 90 mm., and living in the tube of *Amphitrite ornata* (Verrill). Moreover he also describes a minute form (which he terms "*Antinoë parasitica*") parasitic under the scales. It has peculiar hooks in the posterior segments (ventral series)—he thinks for holding on.

This species is apparently that referred to and figured by Delle Chiaje in 1823, but his reference to the previous note by Baster could not be verified. It has been thought best to retain the specific name *astericola* subsequently given to it by the Italian author, the original one of *squamosa* being less characteristic.

Family IV.—ACOETIDÆ, *Kinberg*, 1857.

Head without a facial tubercle. Median tentacle arising from the middle of the anterior lobe; bases of the lateral tentacles covered by the ocular peduncles. Palpi long and tapering. Body elongate, flattened. Scales numerous. Scale-bearing segments alternating with those bearing cirri. Pharynx exsertile, with numerous papillæ on the margin—the median dorsal and ventral tentaculiform. No pregastric cæca. A segmental eminence, but no distinct papilla.

Genus XXIII.—Panthalis, *Kinberg*, 1857.

Scales smooth, flat, rounded or campanulate, covering the dorsum anteriorly, leaving the rest bare in the middle. Foot with a dorsal process in front, a trilobed median and a small ventral process. Dorsal bristles brush-like at the tip; median spinous on one side, and terminating in a long whip; ventral with curved tips—finely tapered and spinous.

Panthalis Œrstedi, *Kinberg*, 1857.

Specific Characters.—Head somewhat urn-shaped, with the rounded bosses for the eyes (ommatophores) in front, and the small median tentacle extending a little beyond them. Posteriorly it runs smoothly into the body. The median tentacle springs somewhat behind the bases of the pinkish ocular peduncles. The lateral tentacles arise close together beneath the ocular peduncles, and their tips extend further than the median. The palpi are long, flesh-coloured, and tapering, with minute conical papillæ towards the extremity. The tentacular cirri are longer and stronger than the median tentacle, and like the latter, smooth. Body $3\frac{1}{2}$ inches in length, tapering in front and more distinctly posteriorly. The pearly white or flesh-coloured dorsum is finely streaked transversely. Inferiorly a ventral ridge and then a median groove stretch from the shield-shaped area behind the mouth. Proboscis cylindrical, with $\frac{13}{13}$ papillæ, the upper median forming a long smooth tentacle, the inferior a shorter process with an arch at its base. Maxillæ elongate, with a strong dorsal ridge ending in a hook, and a flattened blade with six to eight teeth. Scales thirty-nine pairs, rounded or campanulate, smooth, the first three pairs covering the dorsum, the rest leaving the centre bare. Foot with a dorsal process in front, a trilobed median and a small ventral process, and with two spines. The dorsal bristles are long and brush-like at the tip (bipennato-penicillate, Kinberg), the median stout and with short broad tips, spinous on one side, and terminating in a long whip (aristate, Kbg.), and ventrally a series of long slender bristles with curved tips finely tapered and spinous (subulato-serrate, Kbg.).

Synonyms.

1857.	*Panthalis Œrstedi,*	Kinberg.	Eugen. Resa. Zool., ii, p. 25. Tab. vii, f. 34.
1859.	,, ,,	Danielssen.	Norske Vid. Selsk., Skrifter., Bd. iv, Hefte 2, p. 115.
1861.	,, ,,	Sars.	Nyt. Mag. Natur., xi, Hefte 3, p. 253.
,,	,, ,,	idem.	Forh. Skand. Naturf., viii, Kjöbenh., 1860, p. 625.
1863.	,, ,,	,,	Nyt. Mag. Naturv., xii, Hefte 3, p. 628.
1863.	,, ,,	,,	Geol. og Zool. Reise, 1862, p. 46.
1865.	,, ,,	Malmgren.	Nord. Hafs.-Ann., p. 85.
1867.	,, ,,	idem.	Ann. Poly., 16.
1869.	,, ,,	McIntosh.	Rept. Brit. Assoc., 1868, p. 338.

1876. *Panthalis Œrstedi*, McIntosh. Trans. Z. S., ix, 389, 401, 405.
1879. „ „ Tauber. Ann. Danic., 83.
1883. „ „ Levinsen. Nord. Annul., 197.
1893. „ „ Marenzeller. Polychaet. des Grundes, 5, Taf. I, f. 2.
1895. „ „ Arnold Watson. Trans. Liverpool Biol. Soc., ix, 1895, 169, pls. ix and
„ „ *Lacazii*, Pruvot and Racovitza. Arch. Zool. expér., 3rd série, iii, 128, pl. xi, f. 84—104.
„ „ *Marenzelleri*, idem. Ibid., 142, pl. xix, f. 105; and pl. xx, f. 106—110.

Habitat.—First dredged in Britain by Dr. Gwyn Jeffreys in 78 fathoms, 35 miles off Skerries, Shetland, in 1868; 358 fathoms in the Atlantic (station 6) during the 'Porcupine' Expedition of 1870; by the 'Triton' at 516 fathoms; and recently in the Irish Sea by Prof. Herdman and Mr. Arnold Watson. It stretches to the Mediterranean, medium-sized examples having been procured in 40 to 80 fathoms off Jigeli in Algiers, in 40 to 80 fathoms during the 'Porcupine' Expedition of 1870; while Marenzeller obtained it in the eastern part of that sea off Jaffa. It is also found off Norway and Sweden. Its distribution is thus extensive.

The *head* (Plate XXVIII, fig. 16) is somewhat urn-shaped in the preparations, with the rounded bosses for the eyes in front laterally, and the median tentacle in the centre, then dilating from the bases of the former, and again narrowing posteriorly where it runs into the body, without a nuchal collar. The smoothly rounded tips of the ocular peduncles retain no pigment in the preparations; but in life, besides the ocular pigment, the peduncles are reddish. Pruvot and Racovitza consider them the homologues of the lateral peaks of the Polynoidæ—a supposition to which little objection can be taken, since they occupy the whole anterior region of the head. The median tentacle arises rather behind the bases of the ocular peduncles, and thus is behind the middle of the entire region (including the ocular peduncles). Its basal region is short, while the tentacle itself is a somewhat small subulate organ with a tapered tip which extends beyond the peduncles. The lateral tentacles arise close together beneath the ocular peduncles; and their tips reach a little further than that of the median. The palpi are flesh-coloured, long, tapering, and with minute conical papillæ which commence a little above the base and extend almost to the extremity, only a very short portion of the filamentous tip being bare. They are very minute inferiorly, but increase in size distally. Moreover each papilla has a basal granular region, and a clear tip like a jewel in its setting. The tentacular cirri are longer and stronger than the median tentacle, though much shorter than the palpi.

Body 3½ inches and upwards in length, tapering a little in front and more distinctly posteriorly. The dorsum is pearly white in front, flesh-coloured posteriorly, the red dorsal blood-vessel enlivening the general hue of the finely and transversely striated integument. Inferiorly is the deep median furrow and two lateral ridges, the former terminating in front in a broad shield-shaped area. The ventral surface in life is opalescent, with a golden shade towards the sides. Mr. Arnold Watson describes the posterior extremity as being broadly forked from the backward direction of the last pair of feet. No complete specimen, perhaps, has been seen. Anteriorly the segmental eminence is very slightly indicated, but it forms a distinct elevation posteriorly. No papilla is visible.

Proboscis (Plate XXXIV, figs. 3 and 4) exsertile, cylindrical, furnished with $\frac{13}{13}$ papillæ, the median—upper and lower—longer, especially the superior. In the British forms it projects from the mouth like a tentacle, and tapers from base to apex. The inferior, also conical, is much less, and has an inwardly projecting hood or arch at its base. The four maxillæ are elongate, brownish, strongly hooked at the tip, which is a process of the dorsal rib, and with an attached flat blade, the inner edge of which has six teeth (Kinberg says six to eight teeth, while Marenzeller shows in his figure traces of six).

No pregastric cæca occur, and in this respect it agrees with the Sigalionidæ. The stomach is very muscular. The lateral intestinal cæca are large and elliptical, with a narrow neck.

Scales (Plate XXXIV, fig. 5) thirty-nine pairs (*Kinberg*), in life pearly white, semi-transparent, the first three pairs flattened, covering the dorsum, the rest campanulate, and about one-third the breadth of the dorsum on either side, the centre being bare. "During life these do not rest upon the body, but in front are tilted up, so as to meet at an angle above the prostomium, the last few pairs of elytra also assuming a similar position. . . . A constant rising and falling of the elytra, as though to facilitate the passage of water for the purpose of respiration, was observable" (Arnold Watson). They are perfectly smooth, of fair thickness, and richly supplied with nerve-trunks, as in the Polynoidæ. Mr. Watson found in a living example that posteriorly the last two pairs only met in the middle line, whereas in a specimen in the British Museum, dredged by Sir John Murray in 11 fathoms, the last six pairs did so.

Feet.—The dorsal division of the first foot bears two long and rather slender spines, and several long slender bristles, finely spinous from a short distance above the base to their capillary extremities. The slenderness of these hairs is in contrast with the condition of the homologous organs in the Polynoidæ. The spines are minute.

The second foot is somewhat complex, and is specially interesting in connection with the action of the parts in the formation of the tube, as recently described by Mr. Arnold Watson. The foot is essentially bilobed,—that is, divided primarily into a dorsal and a ventral division, the latter, it is true, being again subdivided. The dorsal division has its spine, and forms an even ridge dorsally—terminating in a projecting globular or clavate knob—directed downwards and projecting as far as the ventral division. Beneath are a series of stiff bristles of the type seen in the foregoing process, but much stronger. They taper from the base to the slender apex, and the short but distinct spines begin a little above the former. The main ventral division is trilobed. The uppermost bristles spring rather above the lobe, point upwards and outwards, and have stout shafts ending in a spinous region dilated at the base and tapering to a slender tip. As we proceed downwards the spinous region becomes more slender and tapering—the enlargement at the base of the region gradually diminishing, and the shafts also becoming more slender. An accessory lobe (bract) occurs at the ventral border, and in it the bristles, though retaining the same type, become more slender, and the tapering spinous region shorter. The ventral cirrus of this foot agrees with the homologous organ in the Polynoidæ, and is apparently used in the same manner. Though certain modifications exist in this foot, yet the general structure is so much in accordance with the type in others that the functions in all probability are not very diverse.

The third foot presents a short subulate dorsal cirrus and a somewhat clavate dorsal lobe, with finely serrated slender bristles. The ventral is a massive but short lobe, having superiorly a small group of bristles of the type of those in the foregoing foot, the spinous regions being slightly bent backward and downward, with prominent rows of spines at the commencement. Beneath are about six short and strong bristles with spear-shaped tips, slightly curved and quite smooth,—in short, the extremities of the typical series without the spines, but with the accessory process at the tip. These cover the main or central region of the foot, with intervals between. From the accessory process at the ventral edge of the foregoing lobe springs a group of more slender bristles of the type of the superior series, with well-marked alternate spines. In ordinary views (in spirit) the serrated concavity of these bristles is directed upward. As Pruvot and Racovitza observe, one or two simple serrated bristles occur at the inferior border of this foot. They probably indicate the original condition of the series. The subulate ventral cirrus extends beyond the fleshy part of the foot.

The fourth foot has the short slender dorsal bristles under the lobe superiorly. In the ventral division the bristles preserve the same type superiorly, but they have spread a little downward. The tips of the great spines beneath are somewhat longer, and the upper has a slender terminal whip. In like manner the slender inferior bristles have spread upward beyond the two lower strong bristles, their structure, however, showing no marked difference from those of the previous foot. The accessory ventral lobe is a mere notch.

The fifth foot exhibits no noteworthy change except the increased distinctness of the dorsal lobe, and the same may be said of the sixth.

The seventh foot agrees with the foregoing, and shows very well the series of globular warts or papillæ along the dorsal ridge above the cirrus. There are about eight of the stout median bristles with the enlarged tips and terminal brush.

The eighth foot inaugurates a change, for, superiorly, the slender bristles with the brush-like tips have appeared in the ventral lobe, while the dorsal division is only indicated by an elevation without bristles. There are about five of the strong median bristles with the filiform brush, while the inferior group of slender forms with the curved spinous tips remain as before. The glandular apparatus for the peculiar secretion commences in this foot.

The foot and bristles gradually assume the typical condition (Plate XXX, fig. 8), but the foot varies little from the foregoing, presenting a smaller superior and a larger inferior spine projecting in the centre of the median lobe, a rounded process superiorly, then the more prominent median lobe, and an inferior process. The brush-shaped bristles superiorly have very long slender shafts, which slightly dilate distally, then taper and terminate in a point. From the sides of the tapering part a series of long hair-like spines project like a brush (bipennato-penicillatæ, Kinberg), the enlarged region at the base having a shorter series (Plate XLI, fig. 15). The hair-like bristles either form a hair-pencil, as in the figure, or a broader brush at the tip. These bristles occupy about the upper third of the median lobe. Eight or nine strong aristate bristles then follow.

and their shafts are considerably longer than in front; they dilate in a spindle-shaped manner (in antero-posterior view, Plate XLI, fig. 16) at the end of the shaft, and then taper to a blunt point. In lateral view (Plate XLI, fig. 17) this region is somewhat spathulate in outline, the tip being broad, with the end of the shaft slightly bent backward, and finely striated. More than the distal half is covered with fine spines (pinnately arranged), which increase in length distally, and finally terminate at the dorsal edge in a long slender whip of such fibres, one being stronger and far longer than the others, and projecting from the midst of a basal series of large hairs (Plate XLI, fig. 17). These bristles (Grannenborsten of Marenzeller) appear to be capable of repair, one presenting two fractures below the tip, yet quite stiff and useful, the callus in each case being more coarsely striated than the normal bristle. In one small example from 358 fathoms in the Atlantic these bristles have shorter and more acutely tapered tips, and the spines cover three-fourths of the edge, commencing just above the base. Another and larger example from 516 fathoms (H.M.S. 'Triton') shows similar features. The terminal whip is a true prolongation of the shaft, with lateral spines.

At the ventral edge is a group of bristles with long shafts as slender as the superior brush-like forms, a well-marked shoulder or curve as in the anterior bristles (which they closely resemble), and a long tapering curved finely spinous tip (subulato-serratæ, Kinberg). The spinous rows of the curved region are prominent, while the long tapering region beyond has its spines somewhat longer just after its commencement, and thus in antero-posterior views presents a broader feathered arrangement (Plate XLI, fig. 18).

The feet retain the fundamentally bifid condition to the posterior end, both spines being present, though the dorsal lobe is only marked by a slight eminence (devoid of bristles), to which the spine goes. All the bristles are greatly elongated, but they preserve for the most part the characters seen in front. Thus the smoothly rounded ventral division has superiorly long slender bristles with the dilated and serrated tip. The shafts of the strong median series are also much elongated, and the dilated tips are densely spinous like a stiff brush, and closely akin to the condition of certain forms in *Aphrodita aculeata*. No filamentous terminal brush occurs, but the sides of the club-shaped tip are densely bristled, and the spikes project beyond the tip. The filamentous tip may have been abraded in these cases, but this is uncertain.

An elaborate account of the golden yellow fibrous secretion by the spinning glands in *Polyodontes maxillosus*, with numerous finely drawn figures, is given by Dr. Hugo Eisig in his beautiful 'Monograph on the Capitellidæ,'[1] and the arrangement seems to be very similar to that in *Panthalis*. Dr. Eisig considers the fibrous golden yellow secretion as homologous with the spines and bristles of these and other Annelids, and enters into a lengthened description of the structure of similar glandular secretions in both Vertebrates and Invertebrates. The glands are long tubular structures which pour their secretion externally by an aperture in the dorsal papilla above the foot. The threads thus secreted are mingled with mud in the formation of the tube, and Mr. Arnold Watson has described the mode by which the animal ruptures the anterior end, and, throwing it outward, adds layer upon layer in this manner, so as to constitute a massive tube.

[1] Naples, 1887.

Pruvot and Racovitza's view that the spinning glands are the homologues of the dorsal setigerous glands, forming the material for the tube instead of the dorsal bristles, is not free from doubt.

Reproduction.—In a large example procured in July, 1868, in Shetland (78 fathoms), a series of large ova occurred in the perivisceral chamber. The embryo must therefore attain considerable size before extrusion.

Habits.—Like others of the group, *Panthalis Œrstedi* inhabits a tube of mud, about 3½ inches long and about 1½ inches in diameter, with loose extensions of mucus at either end, thus concealing the entrances, and for an example of which I am indebted to Prof. Herdman. The estimated internal diameter of the tube is usually about ⅜ inch, while the thickness of the walls in the centre is about ¼ inch. The tube is composed of a number of layers of the thread-like secretion interspersed with mud, these layers not being parallel, but curving outwards, since, according to Mr. Arnold Watson, from whose interesting account[1] of the habits of the species the foregoing is taken, rupture of the anterior end frequently takes place.

The animal crawls along the surface of the ground, can reverse itself in its tube, and can also swim a little in the water.

The American *Euarche tubifex* described by Ehlers[2] makes a curiously ringed arrangement of the anterior end of the tube, probably due to the gradual narrowing of the calibre of the tube at this end.

Kinberg in 1857 described the species thus:—The cephalic lobe with the peduncles equal to a fifth part of the length of the palpi, tentacular cirri longer than the tentacle; bristles of three kinds, subulate, serrulate, bipennato-penicillate, bearded. No foot papillæ.

Marenzeller published an excellent account, with good figures, of the bristles, as well as pointed out the functions of the spinning-glands in regard to tube-making.

Pruvot and Racovitza give two new species of this genus from Banyuls with accurate and beautiful figures, viz. *P. Lacazii* and *P. Marenzelleri*. After a careful study of the first-mentioned as given in the authors' descriptions and figures, I have doubts as to the need for specific distinction from the British form, though there are a few minor variations, such as the increased size of the so-called branchial papillæ in front. It would also appear to be a question whether the French authors have not placed too much weight on the mere curvature of the ventral bristles of their *Panthalis Marenzelleri*,[3] especially as Kinberg's artist may have had a mounted preparation for illustration, and thus the curves would disappear. The twist or double curvature referred to is present in all the examples of *Panthalis Œrstedi* that have come under my observation, and the bristles of the first pair of feet (bearing the tentacular cirri) are likewise present. The comparative length of the tentacle is not always to be relied on, though in young specimens the tentacle seems to be about the same length. The same remarks apply to the median papilla of the proboscis. The absence of the ceratophore is remarkable. The bristles in young forms show the finer characters better than in the adults—in which

[1] Ibid., pp. 170, 183, &c.

[2] 'Annelida of the "Blake,"' &c., p. 54, Taf. 12, 13.

[3] "Faune des Annél. de Banyuls," 'Arch. Zool. expér.,' 1895, p. 454.

they have been subjected to considerable friction. The most noteworthy distinctions of the French authors are the condition of the second foot, which is exceptionally large, and the commencement of the spinning-glands on the ninth foot instead of the eighth. Further investigation will probably clear up the doubtful points. It has to be stated, however, that considerable variations exist in the common form (*P. Œrstedi*) in regard to the length and bulk of the second pair of feet. Thus, for instance, these were unusually large in an example procured by the 'Triton' in 516 fathoms; and the median tentacle was also much longer than usual, though it did not reach the tips of the lateral tentacles. The spinning-glands began in this on the eighth foot as in the ordinary examples.

Family V.—SIGALIONIDÆ,[1] *Kinberg*, 1857.

Cephalic lobe rounded, often with a nuchal collar posteriorly. No facial tubercle. Median tentacle, when present, generally long, produced from the median part of the cephalic lobe, and with ctenidia at the sides of the base (ceratophore). Lateral tentacles fused with the base of the tentacular cirri, the tips only emerging. Eyes four, occasionally only two, or absent. Palpi long, attenuate and smooth, with buccal ctenidia at the bases.

Body long and narrow. Pharynx with $\frac{9}{9}$ $\frac{11}{11}$ $\frac{13}{13}$ papillæ and teeth. No pregastric cæca. First pair of feet carried in front of the head. Dorsal bristles spinous and tapering. Ventral bristles compound, the terminal region being often long, multiarticulate and bifid. Ctenidia on all the feet. Elytra and cirriform gills alternate in the anterior segments up to the twenty-sixth; those of the middle and posterior part furnished with both elytra and cirriform gills.

Granular epidermic area for the nerve-cords deep, the upper arch being covered by the insertions of the vertical and oblique muscles, the latter attached below the former —on each side of the nerve-area—without intermingling to any extent.

The genus Sigalion was established by Audouin and M. Edwards in 1834, and adopted by Cuvier in the second edition of the 'Règne animal'[2] for two species, remarkable for their general organisation amongst the Aphroditaceans by the simultaneous presence of superior cirri and elytra on all the feet. They did not see eyes in the spirit-preparations, and no branchiæ, the fringes of the elytra perhaps taking the place of the latter. They grouped the Sigalionidæ under the *Aphrodisiens vermiformes* along with the Acoëtes.

Kinberg's fifth family of the Aphroditea is the *Sigalioninæ*, which he characterises as having a long narrow body, the cephalic lobe rounded, occasionally elongate. No facial tubercle. Tentacle not always present, and generally long, the basal region

[1] Dr. George Johnston observes, "Perhaps formed from σιγαλόεις, curiously or anomalously made; but *Sigalion* is a name of Harpocrates, the companion of Esculapius and Hygeia, by whom physicians were obliged to swear that they would observe a religious silence in their profession."

[2] T. iii, p. 207.

produced from the median part of the cephalic lobe. Antennæ, when present, arising from the anterior part of the cephalic lobe. Eyes four, occasionally only two or none. Near the base of the tentacle are two fossæ covered with a membrane—perhaps auditory organs. Palpi long, attenuate, smooth. Tentacular cirri furnished with many bristles. Pharynx with $\frac{9}{9}$ $\frac{11}{11}$ $\frac{13}{13}$ papillæ and teeth. Dorsal bristles serrate, ventral compound. Elytra and cirri alternate in anterior segments, those of the middle and posterior part furnished with both elytra and cirri. He gives four genera—*Sthenelais*, n., *Sigalion*, Aud. and Ed., *Leanira*, n., *Psammolyce*, n. He split up the old genus Sigalion into *Sthenelais* and *Sigalion*. *Sthenelais* he characterised as having a cephalic lobe rounded anteriorly, except where marked by the base of the tentacle. Antennæ short, affixed to the base of the tentacle. Dorsal and ventral divisions of the foot of equal length, the former with serrate bristles, the latter with superior subulate-serrate—occasionally bidentate, and with inferior articulate, the apex being bidentate or serrate. Elytra covering the entire dorsum.

Ehlers, in his 'Annelids of the United States Expeditions' (1887), follows Grube's arrangement of this group with Kinberg's subdivisions.

Genus XXIV.—Sthenelais, *Kinberg*.

Cephalic lobe rounded anteriorly, with a nuchal collar posteriorly in the preparations. A pair of ctenidia at the base (ceratophore) of the median tentacle; lateral tentacles fused with the first foot; tentacular cirri more or less separate. Palpi long, subulate and smooth, springing from the ventral surface of the cephalic lobe, but fusing with the first foot. A pair of scoop-shaped ctenidia at the base. Scales covering the dorsum; fringed. Dorsal and ventral divisions of the foot of equal length. Segmental eminence at the base of each foot, and a ciliated funnel-shaped process on the foot. A well-developed branchial process on every foot, and on the dorsal ridge beneath it three T-shaped ciliated organs. Dorsal bristles long, stiff, finely tapered, and spinous. Upper ventral bristles with simple tips—boldly spinous; next come compound bristles, at first with a terminal region of three segments, then with one joint, and at the ventral edge with one to four joints—all with bidentate tips. They are arranged in the foot after the outline of a horseshoe (in transverse section). Nerve-cords in a deep area, almond-shaped in section.

Grube, in the 'Annulata Semperiana,' defines the genus thus:—Body vermiform, segments more or less numerous, alternating. Elytra on the second, fourth, fifth, and on the unequal segments to the twenty-third, the intermediate segments bearing branchiæ, the rest furnished with both organs. Scales covering the entire dorsum. One frontal (median) tentacle. Two palpi (his subtentacula). First foot thrown forward with the cephalic lobe, and furnished with bristles and short tentacles. Other feet biramous and with ventral cirri. Superior bristles simple, barbed; inferior bristles compound or with other kinds. Elytra thin.[1]

[1] *Vide* previous brief description in 'Sitz. Schles. Gesell.,' 1871.

Carus in the 'Prodromus Faunæ Mediterraneæ' gives the following:—Head with median antenna and generally two short lobulated or fleshy-membranous organs at the base; maxillæ well developed; feet all furnished with branchiæ, and the anterior pair turned to the front, so that the cirri and setæ form part of the cephalic apparatus; body elongate, vermiform.

Pruvot and Racovitza[1] have recently drawn attention to the homologies of the head-processes in *Sthenelais*, and express the view that the subulate cirrus which springs from the inner side of the bristle-tuft of the first foot (bearing the tentacular cirri) is the lateral tentacle (their lateral antenna). In their descriptions they further point out the exact arrangement of the dorsal and the ventral bristles, the latter forming a horseshoe with the opening in front, and with a spur dorsally and ventrally, each of the latter being characterised by a change in the structure of the bristles.

1. Sthenelais boa, *Johnston*, 1833. Plate XXVI, figs. 7 and 8.

Specific Characters.—Head crimson, broadly ovate, bounded by a nuchal collar posteriorly. Median ridge passes in front into the broad basal process (ceratophore) of the median tentacle, which is short and subulate. Two flap-like organs (ctenidia) occur at each side, the anterior the longer. Two eyes on each side, the larger anterior pair almost hidden by the latter processes, and looking forward and outward. The posterior pair are on the dorsum, a little behind the bases of the processes. A truncated papilla at each side of the head posteriorly. Head fixed to the massive parts of the first feet, which bear externally two tapering cirri of considerable length. Behind the dorsal tentacle is a T-shaped ciliated process. To the inner side of the ventral cirrus of the first pair of feet is a sickle-shaped blunt appendage (ctenidium)—richly ciliated, and probably branchial. A short subulate cirrus (lateral tentacle) exists superiorly on the inner side of the bristle-tuft. The long, subulate, and smooth palpus springs from this basal process, which also carries a double series of long, tapering, slender, spinous bristles. Body elongated, little tapered anteriorly, but gradually diminishing posteriorly. It is rounded dorsally and flattened ventrally, greyish or bluish-green, the latter or flesh-colour characterising the iridescent ventral surface. Segmental eminence at the base of each foot, and a ciliated funnel-shaped process on the foot. Scales 156 pairs; mostly reniform, and with numerous minute papillæ, while the outer border bears a series of large simple papillæ. A well-developed branchial process exists above each foot, and on the dorsal ridge beneath it are three T-shaped ciliated organs (ctenidia). The dorsal bristles are long, somewhat stiff and finely tapered, as well as spinous from a little above the base to the apex. Upper set of the ventral bristles with simple tips, boldly spinous; then some with a tapering bifid appendage of about three joints, the end of the shaft having a few rows of spines. The main part of the division, forming the large curve of the horseshoe, has stout bristles with bevelled ends to the shafts, and a short beaked appendage of one segment. Inferiorly the lower spur of the horseshoe has

[1] 'Archives Zoolog. expér.,' p. 452, 3e Sér., iii, 1895.

more slender forms, with a few rows of spines on the slightly expanded distal regions of the shafts, and an appendage of one to four joints. A group of long papillæ occurs at the anterior edge of the superior division, one above the spine of the ventral division, and a ciliated or papillose frill is found at the base of the lowest slender bristles. Ventral cirrus elongate, subulate, barely reaching the tip of the fleshy part of the foot.

SYNONYMS.

1833. *Sigalion boa*, Johnston. Lond. Mag. Nat. Hist., vi, 322, f. 42.
1839. ,, ,, idem. Ann. Nat. Hist., ii, 139, pl. xxiii, f. 6—15.
1843. ,, *Idunæ*, H. Rathke. Nova Act. Acad. Cæsar. Nat. Cur., xx, 150, Tab. ix, f. 1—8.
1851. ,, ,, Grube. Fam. Annel., p. 38.
,, ,, *boa*, Williams. Rept. Brit. Assoc., 1851, p. 201.
,, ,, *Idunæ*, Sars. Nyt. Mag. Natur., xi, 3, p. 254.
1861. ,, ,, idem. Vid. Selsk. Förh., 1861. p. 1 (sep. copy).
1865. ,, ,, Malmgren. Nord. Hafs.-Ann., p. 86.
,, *Sthenelais Idunæ* and *S. boa*, De Quatrefages. Ann., i, p. 276.
,, *Sigalion boa*, Johnston. Cat. Brit. Mus., 121, pl. 13, f. 6.
1867. ,, ,, Parfitt. Annel. Devon., p. 19.
1873. *Sthenelais Idunæ*, Sars. Bid. Christ. Faun., p. 14.
,, *Sigalion Idunæ*, Willemoes-Suhm. Zeit. f. w. Zool., xxii, p. 347.
1875. ,, ,, Ehlers. Annel. 'Porcupine,' 1869, op. cit., p. 18.
1876. *Sthenelais boa*, McIntosh. Trans. Zool. Soc., ix, p. 390.
1879. *Sigalion Idunæ*, Tauber. Ann. Danic., 83.
1880. *Sthenelais Idunæ*, Langerhans. Zeit. f. w. Zool., xxxiii, p. 276, Taf. xiv, f. 6.
1883. *Sigalion Idunæ*, Levinsen. Nord. Annul., 199.
1884. ,, ,, V. Carus. Faun. Medit., p. 205.
1888. *Sthenelais Idunæ*, De St.-Joseph. Ann. d. Sc. Nat. (7), v, p. 187, pl. viii, f. 55.
1890. *Sigalion Idunæ*, Malaquin. Ann. Boulon., p. 23.
1891. ,, *boa*, Hornell. Op. cit., p. 238.

Habitat.—Ranges from Shetland to the Channel Islands, being procured by the dredge in the former and between tide-marks in the latter. It appears to be a generally distributed species, frequenting both shores of Ireland, and extending to Norway and Sweden. Ehlers gives a depth of 60 to 80 fathoms in the Minch during the 'Porcupine' Expedition of 1869. Shores of France.

Head (Plate XXIX, fig. 1) of a fine crimson hue, somewhat broadly ovate, and separated from the body by a nuchal collar. Anteriorly a median ridge terminates in the broad basal process for the pale median tentacle, which is comparatively short. At the sides of the basal process (ceratophore) are a pair of flap-like organs (ctenidia), the anterior being the longer, the posterior the shorter. Both are rather flattened, and move freely with the broad tentacular base (first foot) on the head—which is fixed. At their base externally on each side are the eyes, the anterior and larger pair of which are almost hidden under these processes—when viewed from the dorsum, especially as they are also placed on the front of the head so as to look forward and outward. The posterior pair lie a little behind their bases on the dorsum. At the posterior border on each side is a well-marked process or papilla with a truncated tip (one of the "organes nucaux"). The head is fixed inferiorly to the massive bases of the tentacular cirri (first foot). Externally two tapering cirri of considerable length occur, one, the longer, from the dorsal edge, and another a little shorter from the ventral edge above the palpi. Behind the dorsal tentacle is a **T**-shaped ciliated process (ctenidium). To the inner side of the ventral cirrus is a sickle-shaped blunt appendage (cuilleron céphalique, or buccal ctenidium), richly ciliated and continuous with a well-marked ridge on the inner surface of the basal process. On the inner side of the bristle-tuft superiorly, again, is another short subulate cirrus, the homologue of the lateral tentacle (Pruvot and Racovitza). The long subulate and smooth palpus springs from the middle of the ventral face of the basal process, and has a scoop-shaped flap (ctenidium) ensheathing it internally. The first foot carries a double series of bristles directed forward and inward, and consisting of somewhat stiff, long, slender, curved bristles closely spinous towards the tip. The upper series of bristles had many-stalked infusoria like *Rhabdostyla*.

Body four to eight inches in length; elongate, not much tapered anteriorly, but gradually diminishing posteriorly; rounded dorsally and flattened ventrally, composed of 170 to 200 or more bristled segments. The dorsal surface is marked anteriorly by transverse lines, and the median region forms an elevated ridge, and sometimes has a bluish-green or ochreous colour. The post-cephalic ridge has at its sides small ciliated processes, which at first sight resemble parasites. The ventral surface is of an iridescent flesh-colour, or bluish-green (from eggs) marked by the red central vessel, and with a raised transverse line between the centres of the feet. Posteriorly the body terminates in two tapering caudal styles.[1] A segmental eminence occurs at the base of each foot, and on the adjoining region is a little funnel-shaped papilla, but apparently unconnected with the former. In the anterior feet the funnel is in the centre of the base of the foot, but it by-and-by moves forward, so that throughout the rest of the body it is near the anterior edge of the foot. The funnel-shaped papillæ are continued from the fourth bristled feet to near the tip of the tail; about twenty segments, however, are devoid of them. In the males this funnel-shaped organ does not appear to be present, but the segmental eminences are very prominent, and have an oblique crest. In spirit the sperms sometimes form masses of a rope-like character externally, as if they had issued (on immersion in spirit) from a minute pore. The cuticle is considerably thickened over the nerve-area.

The *proboscis* has eleven papillæ on each half (dorsally and ventrally). These are large and somewhat conical, slightly constricted at the base, and with a projection internally about the middle. The teeth do not seem to bite alternately, as in the Polynoidæ, but the lower pass in front of the upper pair (Plate XXVI A, fig. 21).

No pregastric cæca are present, but short intestinal cæca occur laterally.

Scales (Plate XXXIII, fig. 16), 156 pairs, covering the entire dorsum, of a greyish hue, the anterior especially showing numerous dark brown grains; all however possess them, unless when recently reproduced. Towards the posterior end they have a broad band of dark grey or brownish grey along the posterior border internally, and occasionally externally a dappled condition or grains of the same dark grey colour. A

[1] Body terminated by four small cirri (De Saint-Joseph).

very pretty and symmetrically tinted arrangement thus pertains in this region. The first pair of scales are somewhat ovate, the rest more or less reniform, and they are tough,—adhering, moreover, with considerable tenacity to the tubercles. Their surface is entirely covered with minute papillæ, which are often tinted brownish, and along the anterior and neighbouring part of the outer border are a series of massive and simple cilia, somewhat constricted at the base, then dilating and tapering to a blunt tip. Some show a branch or knob near the base. In the other scales a portion of the outer and anterior region is devoid of the minute papillæ, whilst amongst the cilia of the outer border are numerous minute globular papillæ. Both extend here and there within the border. The inner or rounded anterior lobe of the scale has the papillæ up to its border. The scales occur on the first bristled foot, third, fourth, sixth, eighth to twenty-fourth, twenty-sixth, twenty-seventh, &c., to the end of the body. In the terminal region the small scales retain the same characters, though a patch devoid of papillæ occurs on the anterior part of the rounded inner lobe, and the cilia along the external border are smaller, more slender in proportion, and more numerous. The minute papillæ on the surface occasionally project beyond the border posteriorly in all the scales, and the gradual elongation of the cilia externally shows that they are modifications of the same organs. The largest papillæ occur on the exposed part of the scale. Finely branched nerves supply the entire organ. The scales often have a blackish or brownish deposit of granular matter on their surfaces. It seems to be the same as that which occurs in the Polynoidæ. In young examples the papillæ on the scales are proportionally large, and occasionally sand-grains adhere. The cilia also are somewhat larger.

Feet.—The second foot shows dorsally two ciliated lobes. It has two powerful spines. The dorsal division is indicated by the nature of the bristles and by the issue of the spine beneath them. The dorsal bristles consist of the same slender, elongated, finely spinose forms seen in the previous process, the tips of most being broken. They have the infusorial parasites formerly indicated and fine filaments of an alga. The ventral division bears much stronger bristles, the stout shafts of which merge into the distal spinous region without evident change. The slightly alternate rows of spines are prominent, and this region ends in a long, tapering, articulated appendage terminating in a bifid tip, the dorsal process being hooked. Just above the lower edge of the ventral region a series of large, lobate papillæ project, and below the bristles are a curved series of minute papillæ The ventral cirrus, as in the previous groups, is large and tapering, its tip extending considerably beyond the fleshy part of the foot. The funnel-shaped papilla external to this organ is absent.

The third foot shows a T-shaped ctenidium dorsally. The dorsal division of the foot is more clearly indicated by a fissure, and its lower border is furnished with large clavate papillæ. The bristles curve upward and inward, their convexity being thus external. The bristles of the ventral division have already a tendency to form groups. Thus the upper six of the ventral series consist of moderately stout shafts with simple tapering tips which are coarsely spinous inferiorly and finely spinous distally, the tip being smooth. Then follow the stouter forms, as in the second foot, with spinous regions distally and a jointed, tapering, bifid appendage. Amongst these, however, are some with an unjointed terminal appendage, a powerfully hooked tip, and a strong secondary process, so that the end is like a bird's beak. Those at the ventral edge again are much more slender, have a slightly dilated spinous region, and a five-jointed bifid appendage. Two groups of clavate papillæ occur on the edge of the foot above them and a row of smaller papillæ at their bases ventrally. The ventral cirrus extends fully as far as the fleshy part of the foot, and internal to it is a funnel-like, ciliated process.

The typical foot (Plate XXXI, fig. 5) presents dorsally a richly ciliated branchial process somewhat subulate in outline, and which is evident at the fourth foot. Beneath, on the dorsal curve, are three T-shaped ctenidia. Another ctenidium lies on the posterior border of the foot deeply placed in the interpedal fissure. In the middle of the body others occur on the dorsum of the foot and behind the elytrophore. Pruvot and Racovitza observe that they all have the same structure, viz. conical epidermic cells with their bases at the broad end and their points at the pedicle of the organ; they are richly ciliated distally. The dorsal lobe is considerably less than the ventral; the bristles (Plate XLI, fig. 19) are long, slender, and boldly spinous from a little above the base to the tip. Viewed from the side they form a beautiful fan directed laterally with the digit-like papillæ at the anterior border of the base. Though slender they are somewhat stiff and curved—with the concavity upward (Plate XLI, fig. 20). The spines form even transverse rows, thus differing from the alternate series so common in this group and in the Polynoidæ. The transverse arrangement, however, may render them more brittle. The dorsal lobe is separated from the ventral by a deep fissure, and has a series of long papillæ at its tip. The ventral lobe is massive, with a truncated extremity which bears the spine in its middle, and usually a single digit-like papilla. A fold of skin, arising at the upper part of the lobe, passes down posteriorly and curves to the front, separating the more slender ventral bristles from the stout series. In the posterior part of the body the commencement of this ridge of skin forms a free flap. The upper group of the ventral series consists of the moderately stout forms with the simple spinous tips (Plate XLI, fig. 21), and also a few with about three joints to the tapering, bifid appendage, the tip of the shaft having a few rows of spines. The centre of the foot is occupied by a series of stout shafts bevelled at the tip, and with a short appendage of one segment (Plate XLI, fig. 22), and the beak-like, bifid extremity. In some, transverse striæ indicate traces of spinous rows. These of the upper series have longer and more slender appendages. Ventrally is a group of slender bristles forming a row directed forwards and outwards, then downwards and outwards, each with a few rows of spines on the expanded distal end of the shaft and appendages of one to four joints (Plate XLI, fig. 23). These spring from a notch at the ventral edge and within the tip of the foot, the inner border of the notch being marked by a series of small papillæ. In the region of the spine, which pierces the middle of the foot, is a long and somewhat fusiform papilla. So far as the structure of the bristles is concerned, the type remains the same in the terminal feet, though the bristles diminish in size. The median stout bristles have longer and more slender hooked appendages, and the backward curve of the end of the shaft is more marked. The papillæ are fewer. The ventral cirrus is subulate and tapering, extending to about the tip of the fleshy part of the foot. A spur or process occurs at its inner border above the basal segment. A well-marked ctenidium is placed a little internal and anterior to the cirrus. The dorsal hairs are prone to deposits of mud, algoid growths, and stalked Infusoria, their colour thus being often brownish or greyish; while *Loxosomæ* abound on the feet, under the scales, and other parts.

Pruvot and Racovitza give a good figure,[1] showing the arrangement of the lobes, papillæ, and bristles in a typical foot. Dorsally the papillæ (stylodes) occupy the anterior region and pass beneath the division. Ventrally, the flaps, which they call parapodial bracts, envelop the foot above and beneath, as well as superiorly in front, the antero-inferior being scolloped, each process being terminated by a sensitive palpocil.

Reproduction.—Large specimens in the Channel Islands were laden in August with fairly advanced greenish eggs in enormous numbers. The males had also the perivisceral chamber charged with sperms, which issued, after immersion in spirit, from the bases of the feet.

Development.—Larval forms occurred, towards the end of October, with bluish anterior digestive organs in the metatroch stage, with two kinds of bristles,—viz. long, curved, serrated bristles, somewhat like those of *Polynoë*, and shorter compound forms. Viewed from the front superiorly (Plate XXVI A, fig. 22), two eyes lie on each side. An oblique lateral view shows the feet of one side and the caudal cirri. The first and last bristle-tufts are simple and short, and about seven pairs of feet are visible. Only a single, long, and comparatively strong, swimming bristle occurs in each foot, the curved tip being distinctly and somewhat widely serrated on the convex edge. Such, therefore, would appear to be a modification of the serrate dorsal bristle, which is functional at this stage. The ventral bristles had dilated ends to the shafts—with the usual oblique termination and a distal region of two segments. It is uncertain whether these young forms pertained to this genus or to *Sigalion*.

Habits.—They are somewhat sluggish animals, usually lurking under stones between tide-marks, where they rest on a sandy bottom, though occasionally small examples are found in pure sand as at Southport. They form curious coils in vessels in confinement, and appear to be nocturnal. So far as my specimens go, the finest are those between tide-marks, Herm, while next to these, and only a very little less, are those between tide-marks at St. Andrews. Those procured in the sand of the Zetlandic voes are much smaller, and the same may be said of those from the outer Hebrides. Average examples come from the west coast of Ireland.

This species was introduced, in 1833, to science by Dr. G. Johnston, who found it in Berwick Bay under stones near low-water mark. He says it is somewhat sluggish, but burrows in sand with rapidity. Moreover that it is the Goliath of its race, and preys on its fellow-worms. It is probable that Rathke, in 1843, referred to this species under the title mentioned (*S. Idunæ*). The *Sthenelais Edwardsii* of De Quatrefages (1865) seems to be this species. He placed next the foregoing the *Sigalion Mathildæ* of Audouin and Edwards, for he thought they included two species under that title. He entered the *Sthenelais Idunæ* of Rathke, and the *S. boa* of Johnston as separate species.

Langerhans (1880) describes *Sthenelais Idunæ* from a depth of twenty fathoms off Madeira. He points out the reddish colour of the head (from the brain), the ringed base of

[1] Op. cit., p. 463, fig. 12.

the tentacle (his antenna), the ciliated rosette of the first segment, chitinous papillæ, and fringed scales (simple papillæ), and gives the detailed structure of the feet with figures. De Saint-Joseph (1888) observed many examples of *Halacarus olivaceus* on the body of one. He agrees with me in thinking that *S. idunæ*, Rathke, is identical with *S. boa*, Johnst.

2. Sthenelais zetlandica, *McIntosh*, 1876.

Specific Characters.—Head absent, and body fragmentary. Scales somewhat reniform or irregularly rounded, densely covered with low flat papillæ, the outer and part of the posterior edge bearing a closely arranged series of minute clavate cilia. Dorsal lobe of the foot rather long, and obliquely bevelled from above downward, bearing a tuft of bristles that are longer and more finely spinous than in *S. boa*. Beneath the spine are a series of small papillæ with truncated and papillose extremities. Ventral lobe irregularly conical, with numerous papillæ, at the tip of which are the secondary processes or warts. Along the ventral border is a series of globose warts. The upper ventral bristles have proportionally strong shafts, with four or five rows of spines at the distal end, and a terminal bifid appendage usually of two joints. The slender inferior ventral have three divisions in the terminal appendage—all with a hooked tip, and a secondary process beneath.

Habitat.—Dredged off the Shetland Islands by Dr. Gwyn Jeffreys in 1867. Mr. Harvey-Gibson found a fragment (?) off Port Erin, Isle of Man.

Synonyms.

1876. *Sthenelais zetlandica*, McIntosh. Trans. Zool. Soc., ix, 390, pl. lxx, f. 15—17.
1886. " " Harvey-Gibson. Verm. Laver., p. 151.
1891. " " Hornell. Op. cit., p. 238.

Head.—Absent in the preparation, and the anterior end injured. The proboscis appears to have the ordinary structure—with the horny teeth, and the dorsal and ventral rows of conical papillæ.

Body.—About the size of *Sthenelais limicola*, and having a similar appearance. The *scales* are somewhat reniform, or irregularly rounded anteriorly, and the entire surface densely covered with flat papillæ, which on the folded edge of the scale form low, smooth warts, larger in proportion than in *Sthenelais boa*. The outer and part of the posterior edge again bear a somewhat closely arranged series of minute clavate cilia (Plate XLI, fig. 24), almost globular at the commencement on the posterior border, and with minute processes or palpocils on the summit, those on the outer edge being more slender than those on the posterior border.

The *feet* (Plate XXX, fig. 14) have dorsally a branchial process and three ciliated T-shaped organs beneath. The superior lobe is rather long, and obliquely bevelled from above downward. It bears beneath the spine a series of rather small papillæ, which have truncated extremities provided with several accessory papillæ. The superior bristles are longer in proportion than in *S. boa*, but do not form so broad a fan when viewed laterally. They taper to a delicate extremity, and their rows of spines are distinctly marked, though somewhat finer than in *S. boa*. The inferior lobe is irregularly conical, and has numerous papillæ, the largest near the spine, and just above the inferior group of bristles. Moreover below the latter is a cluster of smaller papillæ furnished with the secondary processes or warts at the tip. After a brief interval, a series of globular warts occurs along the ventral border of the foot. The superior ventral bristles (Plate XLI, fig. 25, in calcium chloride, and with the basal part of the terminal appendage slightly folded) have comparatively strong shafts, with four or five rows of spines at the dilated distal extremity, visible, however, only at its edge. The terminal appendage as a rule consists of only two divisions, occasionally a more slender form at the upper border having three. In those with two the terminal portion is only one fifth the length of the basal. The claw at the tip is distinct and much curved, and the secondary process projects at a slight angle, the point often touching the tip of the claw. The basal joint is finely striated, as is likewise the dilated end of the shaft. As we proceed downwards these bristles become less robust, and the shaft has a more distinct dorsal curvature, but the terminal region of two divisions remains. Each of the more slender ventral groups, again, has three divisions in the terminal appendage (Plate XLI, fig. 26, which represents one of the larger forms). The bristles throughout are tinted of a light brownish hue.

The ventral cirrus is subulate, and it reaches nearly as far as the fleshy part of the foot (in spirit). The terminal region, which is elongate-ovoid, is marked from the succeeding by a distinct shoulder, as if articulated.

The absence of the head makes the generic relations of this species doubtful, but in the meantime it may be placed under *Sthenelais* until a more complete example is obtained. It is one of the many rare forms which the persevering explorations of Dr. Gwyn Jeffreys in the Zetlandic seas brought within our knowledge.

The *S. fuliginosa* of Claparède[1] is an allied form, and the *S. minor* of Pruvot and Racovitza[2] also approaches this species in regard to the structure of the papillæ and the general character of the bristles, but differs in the presence of papillæ along the ventral edge of the foot, and it has fewer papillæ on the scales than in the British form.

3. STHENELAIS ATLANTICA, *McIntosh*, 1876.

Specific Characters.—Head somewhat ovoid. Median tentacle subulate, and with a terminal joint. A pair of eyes close together on each side, near the base of the tentacle. Palpi long, smooth, and tapering. Tentacular cirri show a terminal differentiation, as in the median tentacle. Body as in *S. zetlandica*. Scales thin, rounded or ovoid in front, reniform throughout the rest of the fragment, covered with sparsely distributed but clavate cilia, and having a fringe of short clavate cilia, which are only absent from a portion of the inner and adjoining anterior margin. They are longer and more numerous than in *S. zetlandica*. Dorsal lobe of the feet bevelled from above

[1] 'Ann. Chét. Naples,' p. 91, pl. iv, f. 2.

[2] 'Archives Zool. expér.,' 1895, p. 465.

downward, and with papillæ like those of *S. zetlandica*. The bristles are similar, though in the smaller specimen finer. The ventral lobe is conical, with long papillæ,—as in *S. zetlandica*. The upper ventral bristles have about six rows of spines at the dilated distal region of the shaft, and the terminal process has three or four segments. The tips are slender and bifid, the secondary process having no appreciable angle to the axis. The next lower forms are stouter, with a beak-like extremity. The inferior bristles are slender, with about two rows of spines at the end of the shaft, and a tapering terminal appendage of two or four divisions, bifid at the tip. Apparently three ciliated pads (ctenidia) occur on the dorsum. The ventral cirrus is slender, and rather shorter than the fleshy part of the foot.

SYNONYM.

1876. *Sthenelais atlantica*, McIntosh. Trans. Zool. Soc., vol. ix, p. 405, pl. lxxii, f. 16, 17.

Habitat.—From the entrance of the British Channel to the Atlantic deeps in 305 fathoms, Station 2, 'Porcupine,' 1870. The ground seemed to have been sandy.

Head (Plate XXIX, fig. 2) somewhat ovoid in outline, a small subulate tentacle with a terminal joint in front, and a pair of eyes situated close together on each side near the base (ceratophore) of the organ. The palpi are very long, smooth, and tapering, and the tips of the tentacular cirri show a terminal joint as in the median tentacle.

Body.—Slightly narrowed in front, but as the feet project laterally and forward, the outline anteriorly is really broad and gently curved laterally. Only about 10 mm. of the body remain, and the specimen appears to be small.

Scales (Plate XLI, fig. 27) somewhat thin, rounded or ovoid in front, reniform throughout the rest of the fragment, covered with sparsely distributed but distinct clavate papillæ, and having a fringe of short clavate cilia, which are only absent from a portion of the inner and adjoining anterior margin. Four of the longest, indeed, occur on the outer lobe of the anterior margin near the hilus. They are longest anteriorly. The cilia (Plate XLI, fig. 27) are decidedly longer and more slender, as well as more numerous than in *S. zetlandica*, and palpocils occur frequently on the extremity.

Feet (Plate XXX, fig. 14) resemble those of *S. zetlandica*, having a projecting dorsal lobe bevelled from above downward, and the papillæ have similar dimensions. The bristles are somewhat finer, and the serrations or spinous rows closer, but the specimen is smaller. The ventral lobe is conical, with similar long papillæ, the secondary processes or warts at the tip of these being distinct. The superior ventral bristles (Plate XLI, fig. 28) have about six rows of spines at the dilated distal regions of the shaft; and the terminal appendage has three or four segments, the basal, in the case of those possessing four, being about as long as the three distal. The tips are slender and bifid, the secondary process having no appreciable angle to the axis, so that it lies close to the hook. The next lower series are stouter, with about four distinct spinous rows on the distal end of the shaft, and a terminal appendage of one or two segments, the tip resembling the beak of an eagle. The inferior are slender, with about two rows of spines at the dilated end of the shaft, a terminal appendage of two or four divisions, and a tapering, delicately bifid tip. The shafts of all the ventral bristles have a backward curve distally. A branchial process, and apparently three ciliated pads (ctenidia) occur on the dorsum, but the specimen is not in a condition to speak decisively. The ventral cirrus is slender and rather short, the tip being shorter than the fleshy part of the foot. The preparations would seem to indicate a joint at the tip. In a former note it was mentioned that some minute warts appear along the ventral margin of the foot, but the preparations are now doubtful on this point.

The species comes near *S. zetlandica*, yet the points indicated seem to warrant separation. Both species approach Claparède's *S. ctenolepis* from the Mediterranean,[1] but yet are sufficiently distinct.

4. STHENELAIS LIMICOLA, *Ehlers*, 1864.

Specific Characters.—Head ovoid with the long diameter transverse, and median space bounded by a brownish crescentic line on each side. Anterior and larger pair of eyes often scarcely visible from the dorsum, being situated under the lateral processes at the base (ceratophore) of the median tentacle, and looking forward. Posterior pair of considerable size, a little behind the base of the median tentacle. Both occasionally show a pale speck in the centre, as if from a lens. Base of the median tentacle (ceratophore) somewhat conical (in spirit); tentacle of moderate length, the filiform tip being slightly enlarged, and with a trace of an articulation. On each side of the base is a flattened spathulate process (ctenidium). First foot fused ventrally with the base of the long, tapering, smooth palpus, with a small sheath-like process (ctenidium) at its base internally; then come a filiform ventral tentacular cirrus and a much larger dorsal cirrus, and internally to the ventral cirrus a broad scimitar-shaped process (ctenidium). Above and behind the latter is the small terminal region of the lateral tentacle. Proboscis trumpet-shaped in extension, with eleven conical papillæ dorsally and ventrally. The teeth appear to bite as in *S. boa*. Body elongate, more than two inches long, and having about 128 segments. It tapers to a slender tail with two styles. Segmental eminence opposite each foot; no papilla. Scales smooth, translucent, brownish, covering the back. First pair rounded, each with short clavate cilia along its outer border, and a few larger digit-like forms at its anterior and outer margin. The others are more or less reniform, the outer margin thin, folded, and having irregular processes—simple, bifid, or irregularly divided. In the posterior scales the outer margin is bilobed, and in those near the caudal region a belt of large round vesicles occurs in the hypoderm in front of the scar: a touch of brown is present in some scales. Feet with branchial process, and three ciliated pads (ctenidia) dorsally. The dorsal lobe is prominent, somewhat clavate in outline, and has anteriorly four or five long papillæ (stylodes) from its upper end, the spine projecting inferiorly. The bristles are long, slender, tapering, and finely spinous. The ventral lobe is shorter and broader, somewhat conical at the tip, and bears one leaf-like lobe above the spine, and a smaller lobule at the ventral edge, a long papilla (stylode ?) likewise being attached to the former region. Upper bristles like those in *S. boa*, with simple spinous tips, only more slender. The next have slender shafts with long tapering tips of twelve or more segments, and minutely bifid. A

[1] 'Ann. Chét. Naples,' 88.

stouter series follows, also with long bifid tips, the shafts becoming more slender in the lower group. Lastly is a more delicate group at the ventral edge, having bifid distal appendages of from five to ten articulations. The ventral cirrus is long and tapering, with a terminal segment.

SYNONYMS.

1853. *Aphrodita arcta*, Dalyell. Pow. Creat., ii, p. 170, pl. xxiv, f. 14.
1864. *Sthenelais limicola*, Ehlers. Borstenw., 120, Taf. iv, f. 1—7; Taf. v.
1868. ,, *leiolepis*, Claparède. Ann. Chét. Nap., 96, pl. iv, f. 3, and pl. vi, f. 1
1869. ,, *limicola*, McIntosh. Trans. R. S. E., xxv, 110.
1875. ,, ,, idem. Invert. and Fish., St. A., p. 118.
1876. ,, ,, idem. Trans. Z. S., ix, pp. 390, 176, pl. lxx, f. 13.
1884. ,, ,, V. Carus. Faun. Medit., p. 205.
1891. ,, ,, Hornell. Op. cit., p. 238.
1895. ,, ,, Pruvot and Racovitza. Arch. Zool. expér., p. 473, pl. xx, f. 122, 123.

Habitat.—First dredged by Dr. Gwyn Jeffreys in sixty to eighty fathoms off North Unst, in St. Magnus Bay, and the Outer Haaf, Skerries, in Shetland in 1867. It is very abundant off St. Andrews, probably in sand, and is tossed on shore in large numbers during certain storms. While it is not common in the dredge, the cod seems to find it readily, and so do the flounder and other fishes. In the 'Porcupine' Expedition of 1869 it occurred in 30 to 370 fathoms off the Irish coast, and a small eyeless variety in 420 fathoms. It ranges from Shetland to Cornwall, and has been found chiefly in water of some depth,—never, at any rate, between tide-marks. It extends likewise to Norway (Canon Norman), to Quarnero in the Adriatic, to the shores of Canada, and the United States of America.

Head (Plate XXIX, fig. 3) somewhat ovoid in outline, with the long diameter transverse. The median space is marked by a brownish crescentic line on each side, which Ehlers compares to an H. The posterior pair of eyes are situated a little behind the base of the median tentacle, are of considerable size, and sometimes show a pale speck in the centre, as if from a corneal lens. The anterior pair are scarcely visible from the dorsum (indeed, they escaped Ehlers), being situated under the lateral processes (ctenidia) at the base (ceratophore) of the median tentacle, and looking straight forward. They are somewhat larger than the posterior, and also occasionally show a pale speck in the centre. The ceratophore of the median tentacle is somewhat conical in spirit, but Ehlers says cylindrical in life, and from it a tapering tentacle (ceratostyle) of moderate length passes. The filiform region shows a slight enlargement at the tip in spirit, and a trace of an articulation at its commencement. On each side of the base is a flattened spatulate process (ctenidium) with long cilia. The frontal lobe carries ventrally the very long, tapering, smooth palpus, with a small sheath or membranous collar at its base internally, then a slender filiform ventral cirrus; dorsally a much larger dorsal cirrus, and internally to the ventral cirrus a broad scimitar-shaped process (cuilleron céphalique, Pruvot and Racovitza). A little behind and internal to the dorsal cirrus is the tip of the lateral tentacle, which Racovitza followed backward to its attachment to the head. In his description Ehlers omits the scoop-like process at the base of the palpus. His view of the parts, indeed (Taf. iv, fig. 6), differs from what our specimens would have exhibited in life.

Proboscis.—The teeth are similar to those of *S. boa*, the lower pair apparently biting in front of the upper; but preparations are not always to be relied on in this respect. The number of conical papillæ dorsally and ventrally is eleven. It is curious that few or none eject the organ in spirit, whereas the gastric juice of the stomach of the cod causes full protrusion, the broad end of the trumpet-shaped structure being distal. Moreover a pair of oblique elevated ridges occur dorsally and ventrally near the tip.

Body.—The body is elongate, some of the imperfect specimens being nearly two inches in length. Ehlers gives 57 mm. and 128 segments, and one of the contracted perfect forms is larger than Ehlers' examples. Pruvot and Racovitza record a length of 95 mm., and a total breadth of 4 mm. It tapers posteriorly to a delicate tail which has two caudal cirri. The body is rounded dorsally, flattened ventrally. A segmental eminence occurs at the base of each foot, but no distinct papilla.

Scales numerous, translucent, rounded in front, irregularly ovate or somewhat reniform posteriorly, and cover the back. They are of a light brownish hue, best marked in front. They occur on segments 2, 4, 5, 7—25, and on all the others (Ehlers). The first scale, which has the scar for attachment behind its centre, presents a series of short clavate cilia along its outer border, and a few longer digit-like cilia at its anterior and outer margin.[1] Finely branched nerves pass from the scar throughout the scale. Its surface is quite smooth. The typical anterior scale (Plate XXXIV, fig. 9) has externally a thin folded margin possessing irregular processes, either simple, bifid, or divided into several flaps. The surface is smooth, though often crossed in the preparations by fine lines, probably creases or folds. Between the elytrophore and the anterior curvature, and stretching on each side beyond, is a series of rounded bodies like papillæ (the "petit tubercles irréguliers" of Pruvot and Racovitza), but they do not project from either surface of the scale, and appear therefore to be internal, as a reference to the condition in the posterior scales more clearly demonstrates.

The posterior scales (Plate XXXIV, fig. 10) are bilobed externally, each lobe forming a rounded process, which either approaches its fellow over the T-shaped fissure or slightly overlaps. Moreover in the terminal scale a belt of large vesicular organs occurs in the granular layer of the epiderm, in front of the scar for attachment. They consist of a large pale central region surrounded by a ring of smaller bodies. Each of the large circular vesicles has a cell with a nucleus and nucleolus, and the ring seems to be composed of nucleated granular cells. They indeed resemble papillæ with a ring of secondary processes at the tip, but they appear to be internal, and a further development of the structures noted anteriorly. These continue to the posterior extremity.

At Banyuls Pruvot and Racovitza found a large transverse touch of brown on the posterior region of the scales, and between the elytrophore and the anterior curve a few minute tubercles, best marked and most numerous in the posterior scales. As above mentioned, however, these structures project neither from the dorsal nor the ventral surface of the scale; they are vesicular and internal rather than tubercular and external.

[1] Neither Ehlers nor Pruvot and Racovitza mention these.

Feet.—The tufts of bristles from the first foot project somewhat outward dorsally, obliquely inward ventrally. They all appear to belong to the dorsal type, consisting of long, slender, finely serrated bristles with hair-like tips. The dorsal tuft is the longer; the inferior, moreover, presenting proportionally more of the smooth shaft at the base. The dorsal group alone possess a spine, and Pruvot and Racovitza consider the inferior group as representing the ventral tuft.

The second foot has its dorsal lobe only slightly separated from the ventral, but the spine has a special free papilla. Just above it three extremely elongated papillæ (stylodes) project from a common base. A long tuft of dorsal bristles—very finely serrated—arises from this lobe. They are directed forwards and inwards. The ventral division of the foot is bluntly rounded, extends further outward than the dorsal, and bears three groups of long papillæ, each springing from a basal process. The first arises from the tip above the spine, and has attached to it about four long papillæ, the longest of which projects further than the dorsal, since its basal process is carried out by the ventral division. The knob enclosing the spine gives attachment also to four, while a prominent peduncle just above the group of slender inferior bristles carries three. All these processes are somewhat translucent, granular, and with a cellulo-granular and almost transparent tip. The upper ventral bristles have tips of great length and tenuity, no less than about twenty divisions occurring in the terminal appendage, which is capillary at the tip, and, if fringed with minute algæ, it resembles a pinnate hair.

The feet gradually merge into the typical form (Plate XXXI, fig. 6), which dorsally below the branchial process shows three ciliated pads (ctenidia), and a few small clavate papillæ on the region between them and the bristles. This (dorsal) lobe is somewhat clavate in outline, and has four or five long papillæ (stylodes) from its upper terminal region, the spine passing out inferiorly. The bristles are slender, long, finely spinous, tapered, and form a fan directed upwards, outwards, and slightly backwards. Parasitic structures are common on these bristles.

The ventral division is shorter and broader than the superior, and is somewhat conical at the tip, while a large flattened and leaf-like lobule projects above the spine, and a smaller lobule at the ventral edge. The large lobule shows a process or papilla extending beyond it, and in its granular epidermic layer are large glandular areolæ. The superior ventral bristles have the type of those in *S. boa*, only more slender. They are simple tapering bristles with bold spinous rows at first, and then more minutely spinous towards the slender tip (Plate XLII, fig. 1). Beneath are a few with stout curved shafts, a short bifid terminal region, and a single articulation (Plate XLII, fig. 1), an arrangement which also occurs in the following three or four segments. The next are rather slender bristles with long tapering tips, having from nine to nearly twenty segments (Plate XLII, fig. 2) with a minute hook at the tip. Then follows a stouter series (Plate XLII, fig. 3) with long tips, also bifid, the shafts becoming more slender as we proceed downward; and lastly, a much more delicate group at the ventral edge, with from five to ten segments in the terminal region, which also has a minutely bifid tip.

The ventral cirrus is long and tapered, with a terminal segment (Plate XLII, fig. 4), or occasionally two.

In the posterior feet little change takes place in the dorsal lobe, except a diminution in the number of papillæ. In the inferior division the flattened lobe becomes a much smaller rounded process above the spine, and has a large papilla attached to it superiorly. The simple spinous bristles of this lobe disappear, and a few bearing three rows of spines on the end of the shaft and a terminal division of three segments occur, the tip being simple. Others show four articulations. Above and below the spine are stouter bristles having tips of a single joint, or of two or three, strongly bifid, and this condition holds in front in certain Norwegian examples.

The slender inferior series show very delicate tips, with about four joints and simple hair-like extremities. The lobe beneath the spine in these feet does not diminish so much in proportion as that above it.

Reproduction.—Specimens tossed on the beach at St. Andrews in February had numerous large ova, so that the reproductive period would seem to be early spring.

Habits.—It appears to be a dweller in sand, and is somewhat sluggish in confinement. The finest specimens in my collection came from St. Andrews, but those from Shetland and Polperro are also of considerable size.

Dalyell's *Aphrodita areta* may be this species, or an allied form. Unfortunately no distinctive feature is given.

The *Sthenelais leiolepis* of Claparède, from Naples, approaches this species in the form of the scale, as pointed out by the Swiss author. It is distinguished from it by the occurrence of only one ciliated mammilla below the branchia. Pruvot and Racovitza unite them, and consider the distinctions rested on imperfect observations.

5. Sthenelais Jeffreysii, *McIntosh*, 1876.

Specific Characters.—Head broadly ovate, with a median ridge running forward to the base of the tentacle, which is longer and thicker than in *S. limicola*. Lateral regions of the head form smooth ovoid lobes. No eyes in the preparation. The massive first foot carries dorsally the lateral tentacle internal to the bristle-bundle, and the dorsal cirrus externally, both extending beyond the tips of the bristles. Just beneath the former is the lamellar process, while ventrally is the shorter and more slender ventral cirrus. The long, smooth, tapering palpus, with its sheath-like lamella at the base—superiorly and internally—arises below the process. Body narrow, probably about two inches in length, and with numerous segments. Scales smooth, translucent, and devoid of pigment in the preparation; first pair probably rounded, rest reniform. On the external border are long, slightly tapered papillæ, perhaps more numerous in the anterior scales, and they may disappear posteriorly. The foot has a branchial process, and three ciliated pads (ctenidia) along the upper edge. The dorsal lobe is somewhat clavate, bevelled at the tip, with three long papillæ, and a tuft of tapering bristles bearing fine and rather closely set rows of spines. The ventral division has a conical tip, with one or two papillæ at the apex, and one on each of the lobes. The upper ventral bristles have four rows of spines on the distal end of the shaft, and a most delicate tapering terminal process of twelve to fifteen articulations ending in a hair-like tip. Below the spine the shafts are stronger, and with less delicate and less numerously jointed tips. Some have one or two rows of spines at the distal end of the shaft, and a bifid tip, with a claw and secondary process, the joints ranging from one to three, the latter kind being inferior. The delicate inferior group (below the lobule) have also one or two rows of spines on the distal end of the shaft, a long tapering terminal process of six or seven joints, and a bifid tip. The subulate ventral cirrus extends nearly to the tip of the fleshy part of the foot.

SYNONYM.

1876. *Sthenelais Jeffreysii*, McIntosh. Trans. Zool. Soc., vol. ix, p. 406, pl. lxxii, f. 18, 19; pl. lxxiii, f. 1 and 2.

Habitat.—Dredged in the Atlantic off the west coast of Ireland (Galway) in lat. 53° 16′ N., and long. 12° 12′ W., in 165 fathoms. Station 9, 'Porcupine,' 1869.

Head (Plate XXIX, fig. 1) broadly ovate, with a median ridge running forward to the base of the tentacle, which is a tapering organ, longer and thicker than that of *S. limicola*. The lateral regions of the head form smooth ovoid lobes. No eyes are visible in the preparation. The first foot carries the following organs: dorsally the lateral tentacle (of some length) inside the bristle-bundle, and externally the dorsal cirrus, both reaching in spirit beyond the tips of the bristles. Just beneath the former is the lamellar process, while ventrally is the shorter and more slender ventral cirrus. The long, smooth, tapering palpus with the sheath-like lamella at the base—superiorly and internally—arises from the ventral aspect of the process. The structure of the parts thus diverges from that in *S. limicola*, and leans to those with more numerous processes, as for instance *S. boa*.

Body narrow, probably about two inches long, and with numerous segments.

Scales (Plate XXXIV, fig. 13).—First pair rounded, the rest more or less reniform, and all smooth, translucent, and devoid of pigment in the preparations. On the external border are long, slightly tapered papillæ, perhaps more numerous in the anterior scales, becoming fewer as we proceed backwards, and finally in the posterior scales disappearing altogether,—that is to say, if the first form agrees with the closely allied Norwegian species. The number of cilia (Plate XLII, fig. 5) on the external border thus varies, ten being a usual number anteriorly, and their great length is in contrast with those of *S. boa* (Plate XXXIII, fig. 16). In the latter the edge of the scale has been doubled, so as to show (somewhat out of focus) the smaller papillæ on the surface.

Feet (Plate XXXI, fig. 7).—Superiorly is the long branchial process, and three ciliated pads (ctenidia) along the dorsal edge. The dorsal lobe is somewhat clavate, bevelled at the tip superiorly, and bears three papillæ, one at its tip, one projecting from the upper bevelled region, and another near it—the two latter springing from the anterior aspect of the foot, and a tuft of the usual slender bristles with fine and rather closely set rows of spines. The ventral division is somewhat conical at the tip, and has one or two mammillary papillæ at the apex to which the spine goes, and one on each of the lobes—superiorly and inferiorly. These are generally constricted at the base. The superior ventral bristles are somewhat slender, have four rows of spines on the enlarged distal ends of the shafts, and a most delicate tapering terminal process with a hair-like tip, and comprising fourteen or fifteen segments, the basal being much longer than the others (Plate XLII, fig. 6, which shows a bristle somewhat compressed by others). Below the spine are some with shafts considerably stronger, and with less delicate and less numerously jointed tips, which, however, end in a fine point. From the spine to the inferior lobule of the foot somewhat strong shafts of similar character are distributed, the inferior especially showing one or two rows of spines on the dilated distal region, while the terminal processes are of several kinds. The upper have a single terminal division consisting of a segment with a well-marked claw and secondary process which fills up the concavity. Just above the inferior lobule of the division are some with three segments in the terminal region, viz. a basal two thirds the entire length, and two short distal articulations, the last with a claw. A few have only two segments (Plate XLII, fig. 7). The inferior series, arising below the lower lobule, are delicate translucent bristles, having one or two rows of spines on the distal part of the shaft, and a long terminal process of six or seven articulations (Plate XLII, fig. 8), the secondary process filling up the hollow. Ventrally three series thus occur: (1) the stronger superior with tapering filiform tips; (2) the stout shafts with the short tips, of one, two, or three articulations; and (3) the slender inferior with long, tapering, bifid tips. All are very delicate and translucent, and the basal region of the terminal process is often wrinkled.

The necessity for carefully regarding the nature of the bristles is well illustrated in a very closely allied form brought by Canon Norman from Norway, and which in almost all its characters corresponded with the present species. A glance at the bristles of the Norwegian form showed that the dorsal series were much denser; the upper ventral series had nine or ten rows of spines at the distal end of the shaft, and a short acutely pointed terminal region of nearly a dozen segments. A series with more numerously jointed (eighteen to twenty articulations) and finely tapered tips followed, the shafts having two or three articulations in the upper examples, the rest being smooth; then a group with a single distal segment ending in a well-marked claw and secondary process; below was a group with similar shafts, but with tapering jointed terminal pieces ending in a hair-like tip; finally, the ventral series consisted of delicate bristles, with a slender terminal region of about five articulations and a bifid tip. The differentiation thus at every step was made clear.

The ventral cirrus is subulate, with an articulation at the tip, and extends nearly as far as the end of the fleshy part of the foot.

Habits.—Only a single example has been obtained, so that it would not seem to stretch to shallower waters. Where so much difficulty exists in capture and examination it is unsafe, however, to make statements on this head. The species is sufficiently defined, and should easily be identified. It probably frequents a sandy bottom.

This form clearly leads through *Eusthenelais* to *L. unica*.

6. Sthenelais ? sp.

Specific Characters.—Head unknown. Body long and narrow. Scales on every foot in the posterior region, large, covering the dorsum, reniform in outline, with a notch externally as well as at the hilus, perfectly smooth on surface and border. Branchial process unusually long and straight; three ciliated pads (ctenidia) beneath it along the dorsal curve. The dorsal lobe of the foot is clavate, with a long, slender papilla stretching from the apex. Dorsal bristles boldly spinous, and rather long. Ventral lobe forms an irregular spear-head, the longer slope being inferior. Above the spine is a prominent hump bearing a papilla. Inferiorly behind the lower bristles is another elevation. The superior bristles are slender, ends of shafts with eight or nine whorls of spikes and apparently simple tips, with many articulations. Some with stronger shafts and shorter tips occur below, others being slender with a minutely bifid tip. Ventrally are bristles with a few spines at the tip of the shaft, and long six- to eight-jointed tips. Ventral cirrus long and subulate, and reaching as far as the apex of the foot.

Synonyms.

1896. *Sthenelais*, n. s., McIntosh. Sc. Proceed. R. Dub. Soc., vol. viii, n. s., p. 403.

Habitat.—South-west Ireland, long. 15°, 325 fathoms (R. I. A. Exped., 1886).

Head absent.

Body seems to be long and narrow, with prominent feet. Only the posterior region remains.

Scales (Plate XXXIV, fig. 12) on every foot in the posterior fragment, large, covering the dorsum of the narrow body, and reniform in outline. They are perfectly smooth on surface and border, and thus differ from the other British species. A shallow notch occurs at the external margin, and a more acute one at the hilus. The distribution of the nerves is well seen.

Feet (Plate XXXI, fig. 8) with an unusually long straight branchial process dorsally, and three ciliated pads (ctenidia) beneath it on the dorsal curve. The dorsal lobe is clavate (narrower at the base), much bevelled dorsally at the tip, and with a long slender papilla stretching from the apex. The dorsal bristles form a long tuft of rather boldly serrated bristles superiorly, and they diminish towards the ventral edge. The ventral lobe resembles an irregular spear-head, the longer slope being inferior, and the apex from which the spine projects is prominent, and bears a papilla. Above the spine is a prominent hump, which also possesses a papilla. Inferiorly is another prominence behind the lower group of bristles. The superior ventral bristles are slender, the distal ends of the shafts having eight or nine whorls of spikes, the end apparently simple—in the form of a tapering acicular process, with a needle-like tip—a condition probably due to repair, since others show a many-jointed needle-like tip. Bristles with stronger shafts follow—with shorter simple tips, numerously jointed. Some of the more slender shafts at the ventral border of the stout series present many-jointed tips, with a minute claw. Then follow a large fan-shaped group of most slender bristles, with a few spines at the tips of the slightly curved shafts, and long (six- to eight-) jointed hair-like tips.

The ventral cirrus is long and subulate, and its tapering tip reaches to the apex of the ventral lobe.

As far as can be observed this is the nearest approach to *Leanira*, only the more slender forms of the stouter series of bristles in the ventral division showing very finely bifid extremities. Unfortunately the condition of the single specimen leaves much to be desired.

Genus XXV.—Eusthenelais, *McIntosh*, 1876.

Characters as in *Sthenelais*, but the scales are unknown. Dorsal bristles slender, elongate, and finely spinous, tapering to a hair-like point. Upper ventral bristles slender, the distal end of the shaft having seven to nine whorls of spikes, and a terminal tapering process of fifteen to eighteen articulations ending in a hair-like tip. The stouter bristles at and below the spine have shorter divisions to the terminal whip. The slender group at the inferior edge has long (fifteen- to eighteen-) jointed terminal processes with a minutely bifid tip.

Eusthenelais hibernica, *McIntosh*, 1876.

Specific Characters.—Head broadly ovate, with a median region and two well-marked ovoid lobes at the sides. Eyeless in the preparations. Median tentacle similar to that of *Sthenelais Jeffreysii*, with a filiform tip. At its base are two small processes (ctenidia) which do not reach the tip of the ceratophore. The appendages springing from the first foot agree with those of the species mentioned. The dorsal cirrus proper (external) is slightly shorter than the median tentacle, and the tip is filiform. The shorter and more slender lateral tentacle lies to the inner border dorsally. Beneath are two processes; an inner, short, broad, and blunt (cuilleron); and an outer, slender, tapering, ventral cirrus, less than half the length of the dorsal. Palpi long, smooth, and tapering, with a scoop-shaped lamella at the base superiorly and internally. Body about two inches long, with numerous segments. Scales absent. Dorsal lobe of the foot somewhat clavate, and bevelled at the tip. It has three or four long papillæ. The bristles are slender, elongate, finely spinous, and tapered to a hair-like point. Ventral lobe conical, with a rounded lobule in front bearing a long papilla—stretching beyond the tip of the dorsal lobe. At the spine is another somewhat fusiform papilla, and on the inferior lobule a longer and more slender papilla. Upper ventral bristles with slender shafts, the distal region having from seven to nine whorls of spikes, while the terminal tapering process has from fifteen to eighteen articulations. Near the spine are bristles with stouter shafts, devoid of spines distally, and with shorter divisions in the terminal process. The slender inferior series have in some a few spines on the end of the shaft, and a numerously jointed (fifteen to eighteen) bifid tip. Ventral cirrus long and subulate, almost reaching the tip of the fleshy part of the foot.

SYNONYM.

1876. *Eusthenelais hibernica*, n. g. and s., McIntosh. Trans. Zool. Soc., vol. ix, p. 407, pl. lxxiii, ff. 4 and 5.

Habitat.—Dredged in the 'Porcupine' Expedition of 1869 at Station 8, off the west coast of Ireland (Galway) in 106 fathoms, and again in the Expedition of 1870 off Cape Sagres in the Mediterranean, in 45 fathoms.

Head (Plate XXIX, fig. 5) as in *Sthenelais Jeffreysii*, broadly ovate, with a median region and two well-marked ovoid lobes at the sides. Eyeless in the preparations. The median tentacle is similar to that of the species mentioned, and has a filiform tip. At its base are two small processes (ctenidia), which do not reach to the tip of the basal segment. The appendages springing from the first foot agree with those of *Sth. Jeffreysii*. The external process, corresponding to the dorsal cirrus, is slightly shorter than the median tentacle, and has a filiform tip. The shorter and more slender lateral tentacle lies to the inner border dorsally. Beneath are two processes,—an inner, short, broad, and blunt (cuilleron), with the flattened tip extending beyond the peduncle; and an outer, slender, tapering, ventral cirrus, which is not half the length of the dorsal. The palpi are long, smooth, and tapering, with a scoop-shaped lamella at the base superiorly and internally.

Body probably about two inches in length, and having numerous segments. It is rounded dorsally and flattened ventrally.

Scales absent. In all probability the scales will be found to present long papillæ on their external border—if we may judge from its close resemblance to *Sthenelais Jeffreysii* and its Norwegian ally, as well as to *Sth. fuliginosa*, Claparède.[1]

Feet.—The second foot bears a scale and a long ventral cirrus, and the third a dorsal cirrus of considerable length, while the fourth has a branchial process arising from the homologous base. The bristles in the second foot have already mapped themselves out more or less as they occur behind, though of course less distinctly. The branchia is short anteriorly, but gradually increases in length till about the middle of the body. A single large ciliated pad (ctenidium) exists on the dorsal edge of the foot, and three smaller in the curve below the cirrus. In the typical foot (Plate XXXI, fig. 9) the dorsal lobe is somewhat clavate, and bevelled at the tip superiorly. It bears three or four long papillæ. The dorsal bristles are slender, elongate, and tapered to a fine hair-like point. All are finely spinous, one series more distinctly, and another less distinctly so. The ventral lobe is conical at the tip, has a rounded lobule in front, bearing a very long papilla, which extends beyond the tip of the dorsal lobe. At the spine is another somewhat fusiform papilla, and on the inferior lobule a longer and more slender one. The superior ventral bristles have rather slender shafts, and the distal ends are furnished with from seven to nine whorls of spikes. The distal region is a slender tapering process of from fifteen to eighteen joints, ending in a capillary tip. These resemble the bristles of *Sthenelais* and *Sigalion* rather than those of *Leanira*, since the necklace-like canaliculi are absent. The figure (Plate XLII, fig. 9) represents a bristle adjoining the superior lobe, the spinous rows on the tip of the shaft being more numerous, while the jointed terminal region is shorter.

[1] 'Ann. Chæt. Nap.,' p. 94, pl. iv, fig. 2.

At and below the spine are a series of bristles having stouter shafts, without spines at the distal ends, and bearing shorter divisions to the terminal whip. The slender group at the ventral border of the foot, that is below the inferior lobule, have in some cases one or two spines at the end of the shaft, and long tapering and numerously (fifteen to sixteen) jointed terminal regions, with a minute claw and secondary process at the tip (Plate XLII, fig. 10). These bristles also lean to the two forms mentioned, and not to *Leanira*.

The ventral cirrus is long and subulate, reaching almost to the tip of the fleshy part of the foot. It has an articulation at the extremity.

Habits.—This species would seem to frequent sand in deep water, but it may yet be found inshore.

It is closely allied to Claparède's *Sthenelais fuliginosa*.

Genus XXVI.—Sigalion, *Audouin and M. Edwards*, 1830.

Head elongate from before backwards. Median tentacle absent; lateral tentacles short and papilliform, fixed to the anterior part of the cephalic lobe. Scales covering the dorsum; processes pinnate or with long papillæ from the axis. The feet resemble those of *Sthenelais*. Dorsal division clavate and furnished with a papilla. Bristles as in *Sthenelais*. Ventral division somewhat truncate, and with a papilla internal to the bristles, which are all bifid. Branchiæ on every foot[1] (in *S. Mathildæ*). Nerve-trunks rounded in section, and the granular epidermic area enclosing them is expanded inferiorly. Segmental eminence placed ventrally at the base of each foot.

1. Sigalion Mathildæ, *Audouin and M. Edwards*, 1834.

Specific Characters.—Head elongate from before backward, with a truncate anterior border, having a slight peak at each side. Behind the border are two pairs of small black eyes, the anterior nearer each other and larger. Body elongate (three to five inches), little tapered anteriorly, and gradually diminishing posteriorly. Segmental eminence situated ventrally at the base of each foot. Colour greyish-brown or pinkish. Proboscis with seventeen to eighteen papillæ on each lip. Scales about sixty-four pairs, adherent, somewhat quadrate or rhomboidal, with the posterior and inner corner rounded off. The processes along the external border are pinnate, with long cylindrical papillæ (about twenty on each side), and at the base these are irregularly distributed around the central axis. Foot with a club-shaped dorsal division, which has a single subulate papilla, and simple, tapering, finely spinous bristles—increasing in strength externally. The inferior

[1] Carus, in his 'Prod. Fauna Medit.,' states that in the anterior part of the body the branchiæ alternate with the elytra, but that posteriorly they occur on all the feet.

division is somewhat truncate, sloped from above downwards and inwards, and has a small papilla internal to the bristles, which superiorly are whorled, then finely serrate at the tip. Next follow larger bristles, with the distal end of the shaft curved and spinous. The distal region is segmented, and tapers to a fine bifid point (minute beak). Ventrally is a dense group of similar forms, but without spines at the end of the shafts. They are most slender at the ventral edge.

SYNONYMS.

1830. *Sigalion Mathildæ*, Cuvier. Règne An., 207.
" " " Rathke. Fauna Norweg., 151.
1834. " " Aud. and Edwards. Annél., 105, pl. ii, ff. 1—10.
1840. " " Grube. Actin., Echinod., &c., p. 81.
1848. " " Gervais. D'Orbigny, Dict. d'Hist. Nat., xi, p. 601.
1851. " " Grube. Fam. d. Ann., p. 38.
1855. " " Peters. Archiv f. Naturges., vol. xxi, p. 38.
1857. " " Kinberg. Eugen. Resa, vol. ii, Zool., 2, p. 9.
1865. " " De Quatrefages. Ann., i, p. 279.
" " *Carringtonii*, Carrington. Proceed. Lit. and Philos. Soc. Manchest., vol. iv, p. 179.
1875. " *Mathildæ*, McIntosh. Invert. and Fishes St. Andr., p. 118.
1876. " " idem. Trans. Zool. Soc., vol. ix, p. 408.
1881. " " V. Carus. Faun. Medit., p. 204.
1898. " *squamatum*, De St.-Joseph. Ann. d. sc. nat., Zool. 8e, vol. v, pp. 239, 241, pl. xiii, ff. 22—29.

Habitat.—Generally distributed round the British shores. Of large size and rather abundant between tide-marks in the Channel Islands and at St. Andrews, while those from Shetland are small. Most of the specimens are littoral, generally under stones, though occasionally small pale specimens occur in sand, as at Southport. It extends, however, to some depth in the adjoining waters. It is occasionally tossed on the sands at St. Andrews in considerable numbers after storms, and is also not uncommon in the stomachs of cod, haddock, and flounders (E. M.). The first two are especially partial to this species. They sometimes take refuge in tubes of *Terebella* when cast ashore. The species seems to be partial to sand. In the 'Porcupine' it occurred off the Algerian coast between Capes Falcon and Tenez.

Head (Plate XXIX, fig. 6) somewhat elongated from before backwards, oblong or cylindrical in outline. The anterior border is truncate, with a slight peak at each end. Behind the latter are two pairs of small black eyes, situated close together on each side of the middle line, the pairs not far apart. The anterior pair are nearer each other and also somewhat larger than the posterior pair. From the elevation of the head they look forward and upward. Posteriorly only a transverse furrow marks the boundary of the head. The head bends downward in front, and has soldered to it the two short and somewhat conical lobes of the first feet, which bear externally (dorsally and ventrally) short subulate cirri, and dorsally and internally a tuft of very slender, tapering bristles, most minutely serrated and directed upwards and inwards. Beneath is the long, tapering palpus, the tough cuticle of which is usually thrown into fine transverse wrinkles, so that it resembles in a decayed specimen the trachea of an insect. The head is thus raised above these processes, and is confined to the dorsal region. A short conical process on the inner and upper border of the foot may indicate the lateral tentacle.

Body three to five inches in length, and with segments about as numerous as in *Sthenelais boa* (180), elongate, very little tapered anteriorly, so that in the preparations it is almost truncate, and gradually diminishing posteriorly, though terminating in by no means a slender tail, from the tip of which a remarkably long and slender caudal style or cirrus extends. The functions of this delicate appendage would appear to be sensory, and it is curious that the tail is often specially modified in sand-dwellers, such as *Nephthys*, certain *Opheliidæ*, and *Spionidæ*. The dorsal arch is slightly rounded laterally, flattened in the middle when the scales are present, the prominent papillæ for the latter occupying most of the surface, and in the ripe forms showing ova through the walls. The ventral surface is in life flattened, and in the preparations usually presents the aspect of a long riband with rounded edges. A segmental eminence occurs at the base of each foot, but no distinct papillæ could be made out.

In life the colour of the dorsum is greyish-brown with a central bluish-green mark, or dull greyish-white or pale pinkish in front with a dark grey stripe from the proboscis. In some a pale brown streak marks the inner margin of each scale. The ventral surface is iridescent, bluish-green or pale pinkish, with the red central vessel.

Proboscis.—The number of papillæ on each side (dorsally and ventrally) is about sixteen, though from overlapping one or two more may occur, *e.g.* seventeen or eighteen. The teeth bite alternately, the lower passing to the right of the upper.

Scales (Plate XXXIV, fig. 14) about sixty-four pairs, and of the hue already mentioned. They are firmly adherent. The surface is smooth, and they have the external border supplied with a series of pinnate processes. The first pair are smaller and somewhat triangular in outline, with a series of the typical pinnate processes along the outer border. Moreover at the bases of these are a few simple papillæ, and in some, instead of the pinnate process, a group of long, simple papillæ occur at one end of the series. The scales gradually assume a quadrate outline, the outer border bearing the papillæ being nearly straight, while the posterior and inner corner is rounded off. The processes[1] (Fig. 33) have a stout central stem, which tapers to a slender point. The axis is granular. The pinnæ or papillæ arise on the scale even below the process, and are continued on it somewhat irregularly at the base, but by-and-by assume a more uniformly pinnate arrangement. The papillæ are pale throughout. Occasionally one of the processes is bifid. In vertical section the dorsal and ventral coverings of the scale are joined by a close series of fibrous strands. Both surfaces are remarkably smooth. As we proceed backwards the scales become more elongated transversely, but again diminish posteriorly.

The first scale shows no branchial process, but all the rest are provided with such, the organ being long and sickle-shaped as well as richly ciliated.

Feet.—The second foot is bifid, presenting an elevated dorsal lobe with a tuft of simple, tapering, finely serrated bristles as in the first foot, the spine issuing at their

[1] 'Ann. Nat. Hist.,' August, 1898, pl. ii, f. 14.

lower border, and dorsally having a papilla for the scale. The inferior lobe is irregularly conical, the upper slope ending in a rounded process pierced by the spine, and the margin trending downward and slightly backward from this to the abrupt angle inferiorly. The upper bristles have slender shafts with slightly dilated extremities and an oblique edge, and present only traces of rough processes, the long tapering distal region having numerous

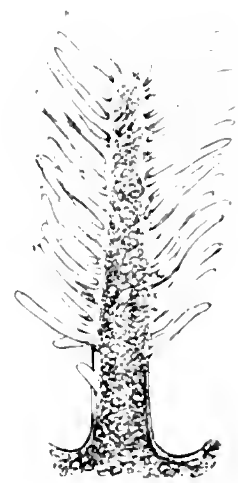


FIG. 33.—Papilla of scale of *Sigalion Mathildæ*, Aud. and Edw. × 280.

segments, the tip apparently being simple. The group below the spine is similar, except that the ventral series show a distinct spine or two towards the end of the shaft. The ventral cirrus is subulate, and projects beyond the tip of the fleshy part of the foot.

The third foot has a similar form, but papillæ occur dorsally (a conical upper and two boss-like inferior), and ventrally is a rounded papilla internal to the cirrus. The ventral bristles now present a claw at the tip.

A typical foot (Plate XXXI, fig. 10) shows dorsally three ciliated pads (ctenidia) along the dorsal edge. The dorsal lobe projects somewhat further outward than the ventral, is club-shaped, with a sinus superiorly, and a long, slightly tapered papilla a little below the dorsal bristles. The normal extremity of the division seems to be tilted upwards, the bristles standing obliquely upwards and backwards from the dorsal edge. Internally they commence as extremely fine hair-like forms, with very minute spikes. Towards the outer edge these simple bristles become much stronger, show slight longitudinal striations of the shaft, and a curvature where the spinous distal region commences. They then taper to a very slender extremity. De Saint-Joseph[1] states that these bristles end in a bifid point, an error of interpretation probably due to imperfect specimens. The minute spikes project upwards and outwards when the bristle is in position (Plate XLII, figs. 11 and 12). Fine transverse or oblique lines indicate the rows of spines. The spine passes out below the bristles and above the papilla.

The inferior division of the foot presents superiorly a small papilla internal to the bristles, a somewhat short series of bristles (Plate XLII, fig. 13), the tips having proximally a series of longer spines in whorls, five or six of which are very distinct, and

[1] Op. cit., 1898, p. 239.

a tapering tip with finer spines. The bristles below these have larger shafts—dilated and slightly curved towards the extremity (Plate XLII, fig. 14), with numerous rows of spines on the convex edge. The distal region is jointed, and terminates in a beak or claw. Then follows a dense tuft of similar compound bristles without spines at the tip of the shaft, and a long, jointed, tapering, terminal region with a minute claw (Plate XLII, fig. 15). They become more slender at the ventral margin (as in Plate XLII, fig. 16).

Besides these slender forms there are, below the spine, one or two somewhat stouter bristles, which show a single segment in the terminal bifid region (Plate XLII, fig. 17). The ventral cirrus is long and slender—reaching to the tip of the fleshy part of the foot —in spirit.

The foot at the posterior end retains much of the foregoing structure, both as regards the fleshy parts and the bristles. Those at and above the spine of the ventral division are somewhat stronger, and the ventral cirrus is proportionally longer than in front.

The branchiæ commence on the fourth foot, and occur apparently on every foot. The statement of Carus, therefore, that in *Sigalion* the branchiæ alternate with the scales anteriorly is not borne out in this species.

Reproduction.—A fragmentary specimen procured off the Algerian coast had well-developed ova on August 27th ('Porcupine,' 1870).

Habits.—In confinement its habits are similar to those of *Sthenelais boa*.

This Annelid, which formed the type of the family, was found by Audouin and Milne Edwards at the islands of Chausey, and measured about five inches long by three or four lines broad, and with 180 segments.

The scales of this species and the general characters approach very closely the *Sigalion squamatum* of Delle Chiaje, even closer than Claparède—the able interpreter of some of the more doubtful Annelids described by the Italian naturalist—supposed, especially since the difference in regard to the eyes has now been removed. Neither Delle Chiaje nor Claparède, however, show the ciliated mammillæ on the dorsal edge of the foot, so that this doubtful distinction alone remains. In his supplemental volume Claparède specially refers to the distribution of the nerves in the papillæ for the scales, and also in the periphery of these organs, thus giving them extreme sensibility. He mentions the occurrence of certain spicules or rod-like bodies on the pinnæ of the papillæ, probably of a parasitic nature; but such have not occurred in the British species. The males of *S. squamatum* were whitish, the females of a fine rosy hue—due to the eggs. Leidy's[1] *S. Mathildæ* from New Jersey is a *Sthenelais*.

2. Sigalion Buskii, *McIntosh*, 1869.

Specific Characters.—Head somewhat pear-shaped, broad in front and narrow posteriorly. Body stouter than in *S. Mathildæ*, pale greyish in spirit. Scales more or

[1] 'Marine Invert.,' &c., p. 148, pl. ii, f. 53.

less quadrate anteriorly, with the inner edge rounded. The straight external edge has a series of about sixteen pinnate processes, besides a few simple papillæ posteriorly. Each process has a granular stem, to which is attached a series of lanceolate granular lamellæ with a narrow papillary tip. In the typical foot the inferior lobe is shorter than in *S. Mathildæ*, broadly clavate, and with a single papilla on its tip. The bristles are attached to the whole tip (*i. e.* superiorly, terminally, and inferiorly), and are long and minutely spinous. The ventral lobe is devoid of the superior papilla seen in *S. Mathildæ*, and has a more prominent process for the spine. The compound bristles (with jointed tips—below the forms with the short tapering spike) have the terminal portion of the shaft covered with whorls of somewhat sparse spikes, which are more numerous than in *S. Mathildæ*, while the stouter bristles beneath have close rows of minute spines on the same portion of the shaft. One or two below the spine-papilla have short tips of one or two segments. The slender ventral series have only about two whorls of spikes on the end of the shaft, and the long jointed tips have, as in the upper series, minute beaks. The ventral cirrus is long, slender, and subulate, extending beyond the fleshy part of the foot.

SYNONYMS.

1869. *Sthenelais dendrolepis?* McIntosh. Trans. R. S. E., vol. xxv, p. 409, pl. xii, f. 12; pl. xv, f. 4, 5.

1876. *Sigalion Buskii*, McIntosh. Trans. Zool. Soc., vol. ix, p. 391, pl. lxx, f. 14.

Habitat.—Dredged in 90 fathoms off North Unst, Shetland, by Dr. Gwyn Jeffreys, in 1867.

Head (Plate XXIX, fig. 7) somewhat pear-shaped in outline, broad in front and narrow posteriorly, where it is only separated from the nuchal collar by a slight furrow. The anterior border is smoothly rounded, and abuts on the conical first foot. It is quite pale, no eye-specks being visible in the preparation. In the example a small and somewhat clavate papilla (tentacle) projected from the centre of the anterior border of the head—a remarkable condition in *Sigalion*.[1]

Body somewhat stouter than in *Sigalion Mathildæ*, and in this respect resembling *Sthenelais boa*, but having the same general shape both dorsally and ventrally. The example is incomplete, but it would seem to reach a similar length to the species first mentioned. The segmental eminences exist at the bases of the feet posteriorly, but no distinct papilla is visible. The general colour of the dorsum is pale greyish.

Scales.—The first pair of scales are almost ovoid, only the outer border is broader than the inner, and has eight pinnate processes besides a smooth projection in front, and some isolated papillæ posteriorly. Except at the latter part the margin is quite smooth. At the bases of the processes, however, isolated papillæ occur as in *S. Mathildæ*, one or two of which are attached to the central axis as in the species just

[1] The head had been injured, so that the question might be raised as to whether this was not one of the lateral tentacles pushed out of position. After careful examination, however, the view above mentioned was held.

mentioned. No branchial process occurs on the papilla supporting this scale,—indeed, it only appears on the papilla of the fourth scale on each side.

Passing backward the scales assume a somewhat quadrate outline, which in a typical example anteriorly has the inner end rounded, while the external border has about sixteen beautifully pinnate processes, besides a few simple papillæ at one end (Plate XXXIV, fig. 15). The pinnate processes have a tree-like figure—more robust than in *S. Mathildæ*, and the pinnæ, instead of being hyaline cylindrical processes, are lanceolate granular lamellæ with a narrowed papillary tip (Plate XXVI, fig. 9). The posterior scales are longer transversely, and have fewer pinnate processes, but the structure is essentially the same. The granular epiderm (hypoderm) of the curve between the processes is denser, more opaque, and in this condition extends up the stalk to the first pinnæ.

Feet.—The first pair project forward just beneath the head, and are bluntly conical with a single spine, which passes forward and upward near the dorsal cirrus—a slender and subulate organ, with a slightly dilated tip in the preparation. It springs from the outer and upper lateral region of the foot. The ventral cirrus arises from the lower part of the foot, somewhat internal to a vertical line from the former, to which it is similar in outline. The tuft of slender simple bristles is directed forwards and upwards; they are minutely spiked. The palpus is fused with the base of the foot inferiorly, and is shorter proportionally in the specimen than in *S. Mathildæ*. It is finely tapered and quite smooth. Only a blunt papilla occurs in the region of the lateral tentacle.

The second foot agreed with that in the former species, presenting a well-marked though short dorsal lobe, with a spine and a tuft of simple bristles, and a somewhat trifoliate ventral lobe with a series of bristles. These have long slender shafts with a few spikes on the dilated distal end, and a long jointed and finely tapered distal region, with a slight trace of a bifid (beak-like) tip.

In the typical foot (Plate XXXI, fig. 11) the superior lobe is shorter than in *S. Mathildæ*, and broadly clavate, the expansion of the tip in lateral view being greater than in the former species. It bears a brush of simple minutely spinous bristles, which spring from the superior and inferior borders as well as the tip. The stronger and longer forms arise above the spine; the more slender occur for the most part below it, and especially the inner group. The papilla at the tip of the superior lobe appears a short distance behind the front. Three ciliated pads (ctenidia) exist on the superior border between the branchial process and the tip. A stalked infusorian is present on the bristles.

The ventral division is devoid of the superior papilla observed in *S. Mathildæ*, and has a more prominent papilla for the spine. The ventral bristles are characterised, in contrast with *S. Mathildæ*, by having rather longer terminal processes with bifid tips. The superior series which adjoin the forms with the short tapering spinous region have the terminal portion of the shaft covered with whorls of somewhat sparse spikes (Plate XLII, fig. 18), which are much more numerous than in *S. Mathildæ*, while the stouter bristles below have close rows of minute spikes on the same portion of the shaft (Plate XLII, fig. 19, and in some the rows are closer than in the example figured). One or two below the spine-papilla have only a single articulation in the terminal region, while others have two, and the ends of the shafts in these are smooth, or in the former with only traces of spinous rows. The slender ventral bristles have generally about two distinct whorls of spikes at the end of the shaft, and the basal division of the terminal process is broader than the latter.

The ventral cirrus is slender and subulate, and the tip extends beyond the fleshy part of the foot.

Reproduction.—The species is a female with a few ova, the majority probably having escaped either before or after capture in July.

This seems to be a deep-water species. It is named in honour of the late Prof. G. Busk, whose patient and accurate investigations in various groups are so well known, and whose genial interest in many a young worker in science will long be gratefully remembered.

An allied form is the *Sigalion Edwardsi* of Kinberg[1] (1858), from the Atlantic—off La Plata.

Genus XXVII.—Leanira, *Kinberg*, 1857.

Anterior border of the head fixed to the bases of the feet above the palpi, furnished with a somewhat slender median tentacle, usually with a short process at each side of the base; lateral tentacles minute; tentacular cirri unequal.

Scales not covering the dorsum anteriorly, smooth. Ciliated pads (ctenidia) along the dorsal arch above the feet. Dorsal lobe of the foot rather more prominent than the ventral, papillose, and with long spinous bristles. Inferior division has compound subulate bristles, with the tapering terminal region pectinate-canaliculate. Branchiæ commence in front, and are attached to the scale-peduncle on the dorsum of each foot. Nerve-cords somewhat flattened or ovoid in section, and the area covered by the oblique and vertical muscles. Segmental organs as in the group.

The genus was established by Kinberg in 1857, while Grube produced additional features in his 'Annulata Semperiana.'

V. Carus, again,[2] includes *Leanira* under *Sthenelais*, but does not allude to the condition of the bristles.

Leanira hystricis, *Ehlers*, 1874.

Specific Characters.—Head smoothly rounded. The awl-shaped median tentacle is remarkably short and small. No eyes in the preparations. The anterior border of the head is fixed to the bases of the feet above the palpi, which are long, tapering, and smooth, with scoop-shaped lamellæ at their bases. The foot above the palpus bears three processes: superiorly a tentacular cirrus about a fifth the length of the palpus; inferiorly a minute organ of the same nature, extending only a short distance beyond the peduncles; and a minute awl-shaped process (lateral tentacle) attached to the base of the peduncle superiorly. The body is small and slender, and between two and three inches in length. Scales rounded, translucent, and perfectly smooth in outline and

[1] Op. cit., p. 30, Taf. 9, f. 41, &c.

[2] 'Fauna Mediterraneæ' (1884).

surface. The foot presents a superior lobe rather more prominent than the ventral, and bears long, simple spinous bristles and two papillæ. The inferior division of the foot has two somewhat larger papillæ, and the characteristic bristles with the tapering extremities and moniliform markings. The branchial process begins as a minute organ on the twenty-fourth foot.

Synonyms.

1874. *Leanira hystricis*, Ehlers. Ann. Nat. Hist. (4), vol. xiii, p. 292.
1875. " " idem. Annel. 'Porcup.,' 1869, Zeitschr. f. wiss. Zool., xxv, p. 35, Taf. 2. f. 5—11.
1876. " " McIntosh. Trans. Zool. Soc., vol. ix, p. 408, pl. lxxiii, f. 6—8.
1885. " " idem. Ann. 'Chall.,' vol. xii, p. 155, pl. xxiii, f. 9.

Habitat.—Dredged in the 'Porcupine' Expedition of 1869, off the south-west of Ireland (Station 2), at a depth of 808 fathoms on a bottom of soft sticky mud; also at Stations 23, 87, and 20, the last at a depth of 1443 fathoms, generally on mud and Globigerina ooze. In the 'Challenger' it was got off the Azores at depths of 900 and 1000 fathoms, and in the 'Knight-errant' in 530 fathoms. Verrill enters it in his list from Cape Cod to the St. Lawrence.

Head (Plate XXVIII, fig. 17) smoothly rounded, little elevated, and slightly dusky from the presence of pigment along the anterior border. The median tentacle is remarkably short and small, shaped like the handle of an awl—narrow at the base, dilated in the middle, and tapering to a blunt tip. No eyes are visible in the preparations. The anterior border is fixed to the bases of the feet above the palpi, which arise close together on each side of the middle line inferiorly. They are long, tapering, and smooth, and at the base of each, towards the inner and ventral surface, is the scoop-shaped lamella. Immediately above and soldered with the base of the palpus is the first foot, bearing three processes, viz. superiorly a tentacular cirrus about a fifth the length of the palpus; inferiorly a minute organ of the same nature, and extending only a short distance beyond the peduncle; and a minute awl-shaped process (lateral tentacle) attached to the base of the peduncle superiorly. The latter is similar in form to the median tentacle near which it is placed. Inferiorly the oral aperture has prominent rugose lips, with a blunt papilla on each side of the median fissure in front. None showed traces of the bristles usually present in allied forms on the bases of the tentacular cirri.

Body comparatively small and slender, none of the incomplete specimens from the 'Porcupine' measuring more than an inch; but an example from the 'Challenger' reached about two inches, and was also incomplete. The external appearance of the body agrees with that in *Sthenelais*.

Scales.—The first and second scales are small and rounded. The rest are also more or less rounded, translucent, and perfectly smooth in outline and surface.

Feet.—The second foot is directed forward, its dorsal division being represented by a rounded process, which bears about a dozen digit-like papillæ and a series of fine bristles resembling those of the ordinary foot (Plate XLII, fig. 20). The ventral lobe has superiorly and inferiorly a papilla larger than those of the dorsal lobe. The bristles have whorls of spikes on the distal region of the shaft and tapering extremities (Plate XLII, fig. 21), the stoutest being next the spine, and the more slender forms with spines at the distal end of the shaft occurring at the ventral border.

The superior lobe gradually increases in size until, in the typical foot (Plate XXXI, fig. 12), it projects about as far as the ventral, and the bristles become stronger and longer. A few smooth hairs occur in each bundle. The digit-like papillæ, however, diminish in number as a rule, only two occurring in each division of the foot in the middle of the body, those of the inferior lobe being the larger. Posteriorly (Plate XXXI, fig. 13) the superior division has three or four papillæ above the bristle-bundle, the inferior frequently only a single large, pedunculated, clavate process. The ventral cirrus is also reduced in size. The inferior bristles of the ventral series of the same region have a more distinct enlargement at the distal end of the shaft (Plate XLII, fig. 22).

No branchial process occurs until the twenty-fourth foot, and then it is minute. Posteriorly it gradually elongates, so as to extend outward as far as the tip of the foot.

The bristles are somewhat shorter and proportionally stouter than in *Leanira Yhleni*, Mgrn.; no ciliated pad exists on the dorsal edge of the foot, and the papillæ of the latter do not show the disparity in size characteristic of *L. Yhleni*. The ventral cirrus is also shorter, and in the preparation shows no process at the base.

The species diverges from *L. tetragona* in regard to the tentacle, bristles, and other parts.

Habits.—A deep-water species.

At the anterior end of a fragmentary specimen a crustacean parasite was fixed in the dorsal muscles.

Ehlers gives a detailed description [1] with figures of this species, his largest example being only 19 mm. long. He shows the tentacle of three segments, or at least it is thus figured and described. Eyes absent. He adds nothing novel to the description in the 'Transactions of the Zoological Society.' He observes that the species approaches the *L. Quatrefagesi* of Kinberg from the Atlantic, off the La Plata.[2] A more minute investigation of Kinberg's specimen, indeed, is necessary before all doubts as to the specific separation are removed. They closely agree in regard to the structure of the scales, bristles, and general condition of the head and its processes, and seem to differ chiefly in the structure of the feet and in the absence of eyes in the British form.

Genus XXVIII.—Pholoë,[3] *Johnston*, 1839.

Head furnished with a single short median tentacle. Two pairs of eyes, more or less connate. Body linear-oblong. Scales on alternate segments in the anterior part of

[1] 'Zeitsch. f. w. Zool.,' 1875.

[2] 'Freg. Eugen. Resa,' p. 30.

[3] Carus, in the 'Prodromus Faunæ Mediterraneæ,' includes this genus under the sub-family Sigalioninæ, *Pholoë* being characterised by having a linear-oblong body, elytra on alternate segments

the body; posteriorly a pair on each segment. First foot with two tentacular cirri; without bristles. Dorsal lobe of the foot with slender, tapering, spinous bristles. Inferior division with stout, falcate, compound bristles. Nerve-cords forming triangular flattened areas in section on each side of the median line, the oblique muscles passing to their insertion above them.

De Quatrefages (1865) gave the group three "antennæ," a facial tubercle, and two tentacles, the upper of which was bifid. Alternate scales anteriorly, while posteriorly all the segments had scales. No dorsal cirri. He thus had an imperfect acquaintance with the genus. Grube's account [1] was more accurate.

Pholoe minuta, *O. Fabricius*, 1780.

Specific Characters.—Head somewhat rounded, bearing a short subulate median tentacle, with a few papillæ on its surface. Two eyes on each side—connate, the anterior being the larger. There are two short tentacular cirri, also with a few small papillæ on their surface. Two prominent papillæ project behind the eyes, and sometimes overlap them. The palpi are somewhat massive, short, tapering organs, with a smooth surface. Body small, forty-five to seventy segments, and about three-quarters of an inch long as a maximum. It has two slender styles posteriorly. Scales ovate or reniform, with a series of cilia having moniliform tips along the outer border, and more sparsely along the posterior border; while the surface, especially at the inner region, is areolated. Dorsal lobe of the foot forms a prominent process with a convex margin externally for the dense tuft of bristles, which are slender, tapering, and spinous. Ventral lobe an oblique cone with numerous papillæ over the surface. The shafts of the bristles are stout, the distal convexity having numerous spikes. The terminal piece is short and falcate, and the edge is generally spinous. The ventral cirrus is short and tapering.

SYNONYMS.

1776. *Aphrodita longa*, O. F. Müller. Prod. Zool. Dan., p. 218, n. 2646.
1780. „ „ O. Fabricius. Fauna Grönl., p. 313, n. 293.
„ „ *minuta*, idem. Ibid., p. 314, n. 294.
1820. *Polynoe minuta*, Savigny. Syst. des An., p. 26.
1828. *Palmyra ocellata*, Johnston. Zool. Journ., vol. iii, p. 329.
1834. „ *minuta*, Aud. and Ed. Ann., p. 95.
1839. *Pholoë inornata*, Johnston. Ann. Nat. Hist., vol. ii, pp. 437, 438, Tab. xxiii, f. 1—5.
1843. „ *minuta*, Oersted. Grönl. Annul. Dorsib. (Danske vid. Selsk., Afh. x., p. 169, Tab. i, f. 3, 4, 8, 9, 16.
„ „ *baltica*, idem. Annul. Danic. Consp., p. 14, f. 21, 34—36, 40.

in the anterior part of the body; posteriorly a pair on each segment; rami of the feet connate; superior bristles capillary, inferior falcate. He includes also *Sigalion*, *Psammolyce*, and *Sthenelais*, in the order given, under the Sigalioninæ.

[1] 'Sitz. d. Schleisch. Gesell.,' 1874.

1844. *Pholoe assimilis*, Oersted. Kroyer Nat. Tidskr. Anden Række, Bd. i, p. 404.
1851. ,, *minuta*, Grube. Fam. d. An., 38.
1865. ,, *inornata*, Johnston. Cat. B. M., p. 121, pl. xiii, f. 1—5; and Baird, p. 340.
,, ,, *minuta*, Malmgren. Nord. Hafs-Ann., p. 89, Tab. xi, f. 13, and An. Poly., 17.
,, ,, ,, De Quatrefages. Hist. Nat. Annelés, vol. i, p. 188.
,, ,, *inornata* and *baltica*, idem. Ibid., p. 190.
1873. ,, *minuta*, Möbius. Jahresb. Com., 1871, p. 112.
,, ,, ,, Metzger. Ibid., p. 175.
,, ,, ,, Ehlers. Sitzungsb. Phys.-med. Soc., Erlangen, vol. v, p. 8.
1874. ,, ,, Malm. Göteborgs Kongl. vet. o Vitt. Samhalles Handl. Ny Tidsfoljd, Häftet xiv, p. 76.
1875. ,, ,, Mobius. Jahresb. Com., 1872, p. 167.
1878. ,, ,, Lenz. Jahresb. Com. Anhang, 1874, p. 12.
1879. ,, ,, Théel. Annel. Nov. Zemb. Kongl. Sv. vet. Akad. Handl., vol. xvi, p. 24.
,, ,, ,, Tauber. Ann. Danic., p. 84.
1883. ,, *inornata*, Levinsen. Nord. Annul., p. 199.
1884. ,, ,, Webster and Benedict. Ann. Mass., p. 701.
1886. ,, ,, Marenzeller. Porif., &c., Jan Meyen, p. 12.
1891. ,, ,, Hornell. Op. cit., p. 239.
1896. ,, *eximia*, Michaelsen. Polych. Fauna, p. 12, pl. i, f. 2.
1897. ,, *minuta*, McIntosh. Ann. Nat. Hist., ser. 6, vol. xx, p. 169.
1898. ,, ,, Michaelsen. Grønland. Ann., p. 122.

Habitat.—Everywhere on the shores of Britain from Shetland to the Channel Islands, where it attains the maximum size, and from the tidal region to the coralline ground. It lurks under stones between tide-marks, especially in pools. It is somewhat difficult to find, and perhaps is best obtained by placing suitable stones in vessels of sea water overnight, and then examining the water-line next day.

The variety *inornata* is more common on the eastern coast, whilst the variety *eximia* is more frequent in the west and south.

The species extends to Jan Meyen and to the shores of America (Verrill). Lenz found it in the grass-wrack region of the Baltic, and Michaelsen in the tubes of *Sabellaria spinulosa* at Heligoland.

Head (Plate XXIX, fig. 8) somewhat rounded and comparatively small, having anteriorly a rather short median tentacle with a few papillæ on the surface. The eyes are four in number; but as the pigment of the pairs touches on each side, they are connate.[1] Lateral tentacles absent. Two prominent papillæ project immediately behind the eyes. The palpi are somewhat massive, short, tapering organs, with a smooth surface. Two short, tapering, tentacular cirri occur on each side, with small papillæ sparsely distributed on the surface.

Body of forty-five to seventy segments, and about three-quarters of an inch as a maximum length, small, elongated (almost linear), but slightly more diminished posteriorly than anteriorly in young specimens. The dorsum is convex, the ventral surface flattened, with a median groove in the preparations. In life the dorsum is of a pale pinkish colour, slightly grained with brownish on some of the scales. A reddish mark occurs in front, with a dark greyish patch a little behind. Some, as Dr. Johnston

[1] Malmgren observed that in *P. minuta* the eyes were four, and approximated.

observes, are of a yellowish-brown colour, dusky along the sides. The centre of the dorsum is uncovered by the scales. Posteriorly are two slender, subulate styles.

Proboscis[1] forms a short muscular organ with teeth, as in the Sigalionidae (biting to the left), and nine short but distinct papillae along each arch. Moreover in extrusion, just behind the lateral furrow separating the dorsal and ventral arches, are two papillae. A median and two lateral bosses (elevations) are also present in the basal segment when viewed from the dorsum.

Scales (Plate XXXIV, fig. 17).—The first pair in the variety *inornata* are somewhat rounded, as if an isosceles triangle had its angles smoothly removed. The scar for attachment is situated nearer the posterior than the anterior border. The latter has numerous short clavate cilia along its edge—to the number of about fifteen, while the posterior border has about nine longer cilia, somewhat moniliform in outline from constrictions. The surface of the scale anteriorly has also a row of cilia internal to that along the border, and a few are scattered in the area in front of the scar. All the cilia have traces of palpocils at the tip. Only the inner border of the scale is smooth.

In contrast with the first scale of *Pholoë minuta*, Fabr., from Greenland, the foregoing has fewer cilia. Thus there are upwards of forty along the anterior border of the arctic form, and twelve, proportionally shorter than in *P. inornata*, along the posterior edge. Moreover these organs are more numerous on the surface in front of the scar.

The shape in the second pair becomes transversely elongated with an anterior incurvation. The moniliform cilia along the posterior border are more numerous, while the smaller along the outer edge are fewer; and the same may be said of those on the surface.

The succeeding scales are irregularly rounded, with a somewhat even external border, which has moniliform cilia, while those along the posterior edge are few and widely separated. The scale is areolated, especially towards its inner border, which, along with the anterior, is smooth.

The posterior scales are more elongated transversely and have fewer cilia (about six of the large moniliform kind), both on the abbreviated external border and on the posterior edge. The scar is nearer the anterior than the posterior edge.

In comparing the larger broad anterior scales with those from Greenland and Canada (Plate XXXIV, fig. 18) comparatively little difference is observable, both having from eighteen to twenty-three moniliform cilia externally.

On the whole, therefore, the view that *P. minuta* and *P. inornata* are the same forms is borne out by the scales.

In the variety *eximia* the first pair of scales have a similar shape to those of the type, being irregularly rounded, and, from the size of the examples, smaller than in the latter. The outer border has a series of longer cilia, fewer in number but similar in structure. They encroach somewhat on the anterior border, or rather some of the isolated cilia scattered over the surface near the edge project beyond it, but none of the smaller clavate cilia so characteristic of the type *minuta* are present on this edge. These large isolated cilia occur both external and posterior to the scar for attachment.

[1] Described from an arctic example.

The second pair are elongated transversely as in the other form, but are distinguished by the great length of the cilia on the outer border. A few cilia also occur along the posterior edge.

The succeeding scales in the anterior third do not differ much in shape from those of *P. minuta*, but the cilia are much longer and stand stiffly out. They occur on the external margin and the outer half of the posterior edge. They are less numerous than in the large examples of the typical form, but agree with the smaller in this respect.

The posterior scales have about the same number of cilia, but they stand stiffly out like rays.

This form is distinguished from the preceding in spirit by an olive spot on the scale, with a pale centre at the scar for attachment. Occasionally, as in an example of this variety from Lochmaddy, the cilia on the scales are fewer and longer, being filiform tapering processes without the terminal enlargement.

In both varieties the areolæ, especially towards the inner edge, are well marked.

Feet.—The second foot is bifid, with two well-developed spines. The dorsal lobe forms a rounded eminence with a smooth surface. The bristles are comparatively short, slender, and taper to a very fine hair-like tip, minutely spinous. The inner forms taper more abruptly than the outer, and the tips are often bent nearly at right angles to the base. The ventral lobe is longer than the former, bluntly conical, and with numerous small papillæ on its surface. The ventral bristles have stout shafts dilated at the tip, and with numerous rows of spines on the convex margin, thus differing from those of the arctic examples (*P. minuta*, Fabr., typical), which have few. The distal region forms an elongated process—hooked at the tip, and with a series of spikes along the ventral edge. The tip in the arctic forms is more robust and proportionally shorter.

In the typical foot (Plate XXXI, fig. 14) the dorsal lobe presents a prominent process and a broad, slightly convex margin externally for the bristles, the spine piercing the apex of the convexity. The bristles (Plate XLII, fig. 23) form a dense tuft, directed outwards and downwards, and are slender and tapering, with well-marked spinous rows.

The ventral lobe has the shape of an oblique cone, with the spine issuing from the apex and with numerous papillæ over the surface. The shafts of the bristles (Plate XLII, fig. 24) are somewhat shorter and stouter than in the northern form (*P. minuta*, typical), and the convex edge of the tip has more numerous spikes. The falcate tip is shorter, more curved (the hook more pronounced), and the spines along the edge are often absent. Indications of these, however, are seen.

Posteriorly, the dorsal bristles have finer spikes, and the ventral have fewer rows of spines at the convex distal region of the shaft, while the terminal portion is more slender and proportionally longer. The papillæ on the ventral division are fewer and somewhat longer. The ventral cirrus is short and tapered.

In examples from Lochmaddy only three or four spikes occur on the distal end of the shafts of the ventral bristles. Some from Bressay Sound show more numerous though finer spikes at the distal end of the shafts, as in those from St. Andrews. In a small one from St. Magnus Bay they were too indistinct for determination, though they appeared to be smooth. In a small example from Herm no spikes were present on the distal pieces of the ventral bristles. In specimens from the St. Lawrence, Canada, the bristles agreed more with the arctic forms, and one had a translucent granular deposit on them. The spikes at the end of the shaft were indistinct, but this also occasionally occurs in the British examples.

In considering the two varieties (*inornata* and *eximia*) it is clear that no reliable distinction can be drawn from the structure of the bristles, and this is probably more important than the condition of the cilia on the scales. It is true the end of the shaft is most spinous—that is, has a longer series of spines from above downwards—in var. *inornata*, and that the dorsal bristles are more distinctly spinous, and the ventral warts or papillæ more conspicuous, but the characters are not new, and only vary in degree, and are probably due to the surroundings, with which we are, perhaps, not fully acquainted. The steps from var. *eximia* to var. *inornata*, and thence to the typical *minuta* from the arctic seas, are easy, both as regards scales and bristles.

After a careful consideration of all the facts it has been thought best to unite the varieties into a single species.

Reproduction.—Male elements as minute granules occurred in August at Lochmaddy. At St. Andrews ripe males are common at the end of June, so that the breeding period would seem to be in July. The spermatozoa have globular heads and long tails, and resemble those of *Lepidonotus squamatus*, a species with the same breeding period. The examples of *P. minuta* from Greenland present ova in July.

Development.—Trochospheres, apparently of this species, occur near the bottom on September 12th, presenting only four crenations posteriorly to indicate the segments.

On September 10th the youngest stage has a bluntly conical prostomial region, which appears to occupy about half the bulk of the animal. Two small black specks are situated posteriorly. At each side are the short tentacular cirri. Four bristled feet follow, with stout bristles having the typical structure. Two spines occur on the dilated end of the shaft, the most prominent being inferior. Besides these stout bristles each foot has one or two much more slender forms, with a long, tapering, diaphanous terminal piece, evidently a larval ventral bristle. The dorsal bristles have the adult structure, being slender, tapering, hair-like, serrated bristles. The dorsal cirrus is much enlarged at the base, but with a slightly tapered tip.

What appear to be three pairs of scales have the aspect of globular organs on a pedicle, each with several large truncate papillæ projecting from the edge. These papillæ are out of all proportion to the condition in the adult. Viewed from below the ventral cirrus shows a basal swollen region (ceratophore) and a two-jointed cirrus, while some distance inwards is a globular papilla. The body, which is marked by transverse lines at this stage, terminates posteriorly in a broad pygidium.

In the next stage (which, however, is of the same date—September 10th, 1888) the snout is truncated, and the caudal process has a dimple in the middle. Then the head becomes defined as an oblong mass, rounded in front and flanked by the two tentacular cirri, which now are directed forward on each side. There are still only four bristled feet. The cilia on the scales are longer, and two short, broad, caudal cirri have appeared under the pygidium.

The bottom tow-net procured, on February 4th in four to five fathoms, a young example of *Pholoë* having thirteen feet on each side. The head bears in front two closely approximated median eyes, and two more widely separated towards the posterior border. Both pairs of eyes have a rounded, lens-like differentiation. The median tentacle is well developed and subulate, while three smaller and the stump of a fourth (making two tentacular cirri) project in front. These are minutely but sparsely papillose. The palpi have enlarged basal regions, and taper to a blunt point. The body is flattened and nearly of uniform diameter, though tapered a little in front and more distinctly posteriorly, where it terminates in a rounded "boss" on each side of the vent, the globular cirri of the last pair of feet generally projecting on each side a little in front. The proboscis is furnished with well-marked teeth.

The feet show dorsal and ventral divisions, each with a spine and the characteristic bristles, besides the cirri. At least four pairs of scales were present, most with five cilia on the outer border, though one (probably the first) had seven. Lines radiating from the centre of the scale to the base of the cilia probably indicated nerve-strands.

Habits.—They break, when lifted with the forceps, like the Polynoidæ, but are sluggish, lurking under stones between tide-marks. The best way to obtain them, indeed, is to chip fragments from the under surfaces of stones covered with various growths in pools near low water mark, and immerse them in sea water for a day or two. The Annelids either occur at the water-line of the vessel or are found by examining the débris at the bottom.

P. minuta was first found by Otho Fabricius on the shores of Greenland, and afterwards by Oersted in the same region.

Dr. Thomas Williams [1] (1858) credited this species with the only vascular system he had been able to see in the Aphroditaceans in the form of a vessel, carrying a colourless fluid in contact with the nerve-cord, and slowly undulating with pulsations.

The *Pholoë synophthalmica* of Claparède seems to be a closely allied if not identical form.[2] Marion and Bobretzky,[3] who agreed with this author as to the specific distinction of *P. synophthalmica*, point out the proper interpretation of the cephalic appendages, and that the first segment is fused with the cephalic, so that the first scale is borne on the second segment. De Saint-Joseph likewise follows Claparède in separating *P. synophthalmica*.

Marenzeller [4] (1893) describes a new species from the African shores of the Mediterranean (Santorin), in which the dorsum of the body is covered with papillæ, and the scales have more numerous cilia. The bristles seem to approach closely those of the common form.

Dr. Michaelsen lately (1897) regarded the variety *eximia* as a distinct species, but he relied chiefly on the divergence of the scales and other points already alluded to. It is sufficient to consider *eximia* a variety, and chiefly a smaller variety. He kindly sent me slides for examination, so that no dubiety might exist.

[1] 'Philos. Trans.,' 1858, p. 135.
[2] 'Annal. Chét. Naples,' 79, pl. iii, f. 1.
[3] 'Ann. Sc. Nat.,' 1875, pp. 8, 9.
[4] 'Polychäten des Grundes,' 1893, p. 6, pl. i, f. 3.

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(Not including the Introduction.)

ADLARD AND SON, IMPR., LONDON AND DORKING.

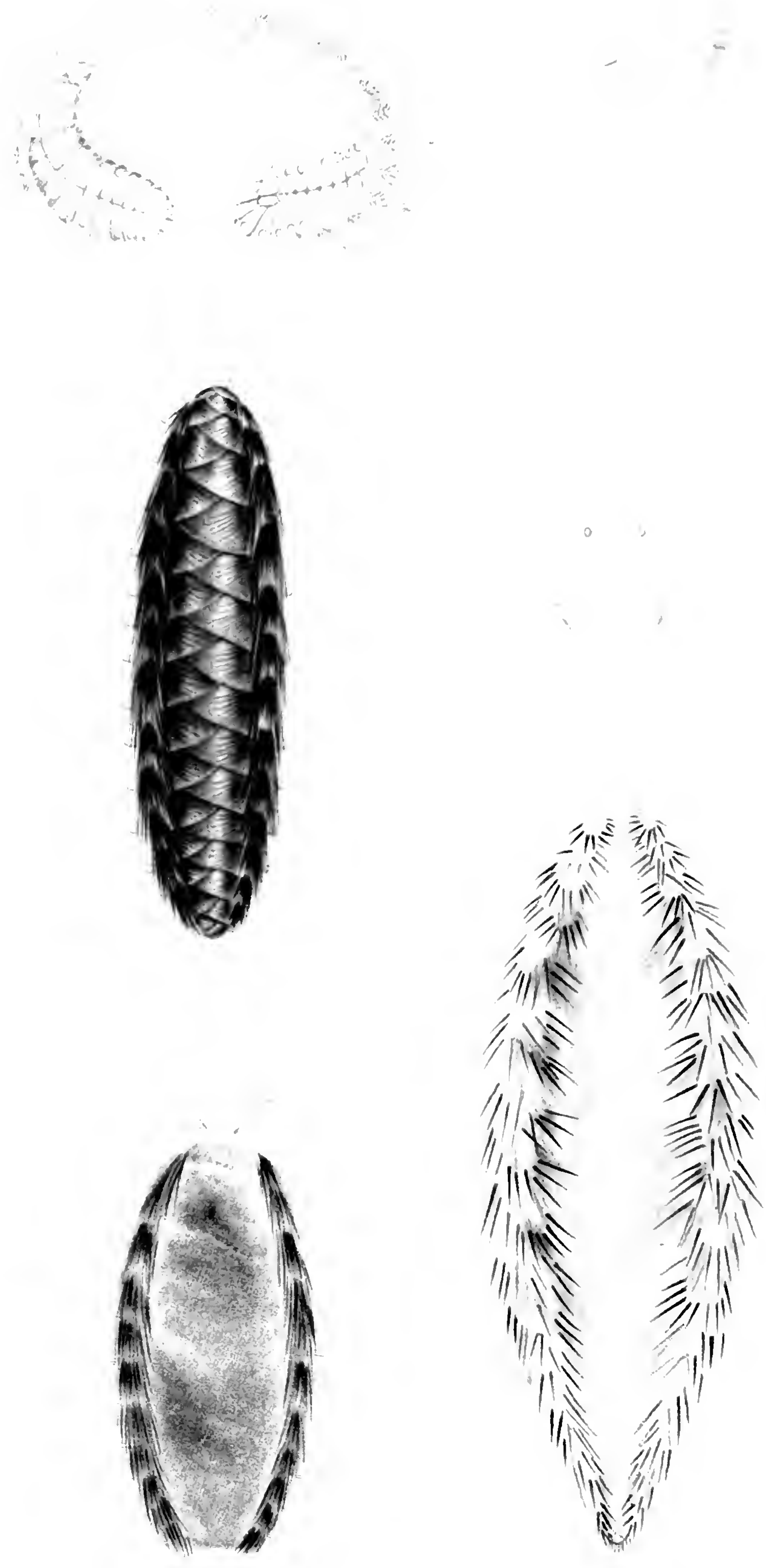

PLATE XXIV.

Fig.

1. Dorsal surface of *Spinther miniaceus*, Gr. Enlarged.

2. Ventral surface of the same. Enlarged more highly.

3. View of a reddish example of *Euphrosyne foliosa*, Aud. and Ed., showing both dorsal and ventral surfaces. Enlarged.

4. *Aphrodita aculeata*, L., from the dorsum. Slightly enlarged.

5. Ventral view of the same. No median furrow occurs in this specimen.

6. Head and anterior region of the foregoing. Enlarged.

7. Dorsal view of a dark variety of *Hermione hystrix*, Aud. and Ed. Enlarged.

8. Cephalic region of the same. Enlarged.

9. Dorsal view of *Laetmatonice filicornis*, Kbg. Enlarged.

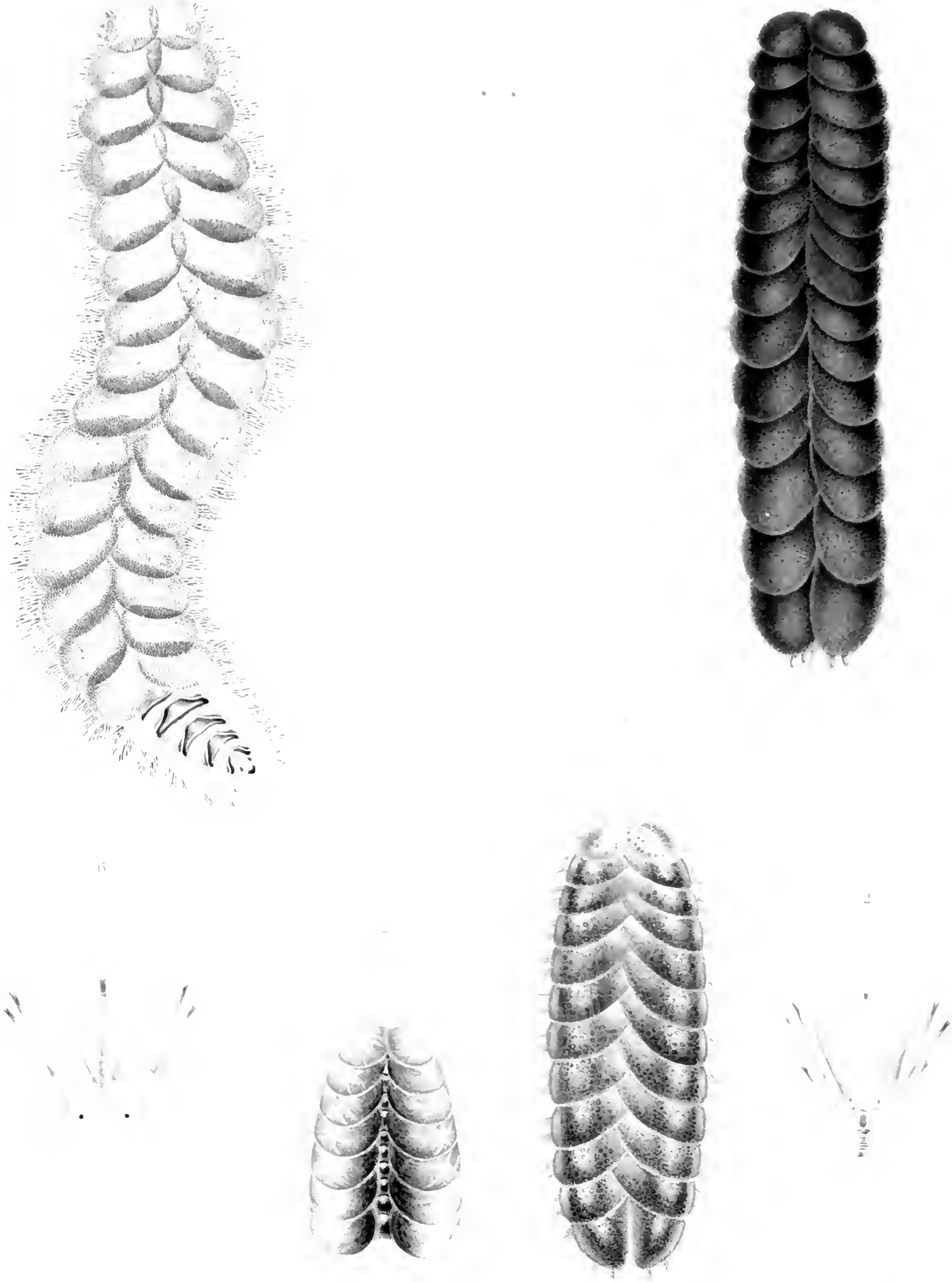

PLATE XXV.

Fig.

1. *Lepidonotus squamatus*, L., from the dorsum. Enlarged.

2. Head of the foregoing in life. Enlarged.

3. A large specimen of *Gattyana* (*Nychia*) *cirrosa*, Pall., from the dorsum. Enlarged.

4. *Harmothoë longisetis*, from the dorsum. Enlarged.

5. Dorsum of a living example of *Halosydna gelatinosa*, Sars. Enlarged.

6. Head of *Harmothoë imbricata*, L. Enlarged.

7. Anterior end of a large example of *Polynoë scolopendrina*, Sav., from North Uist. Enlarged.

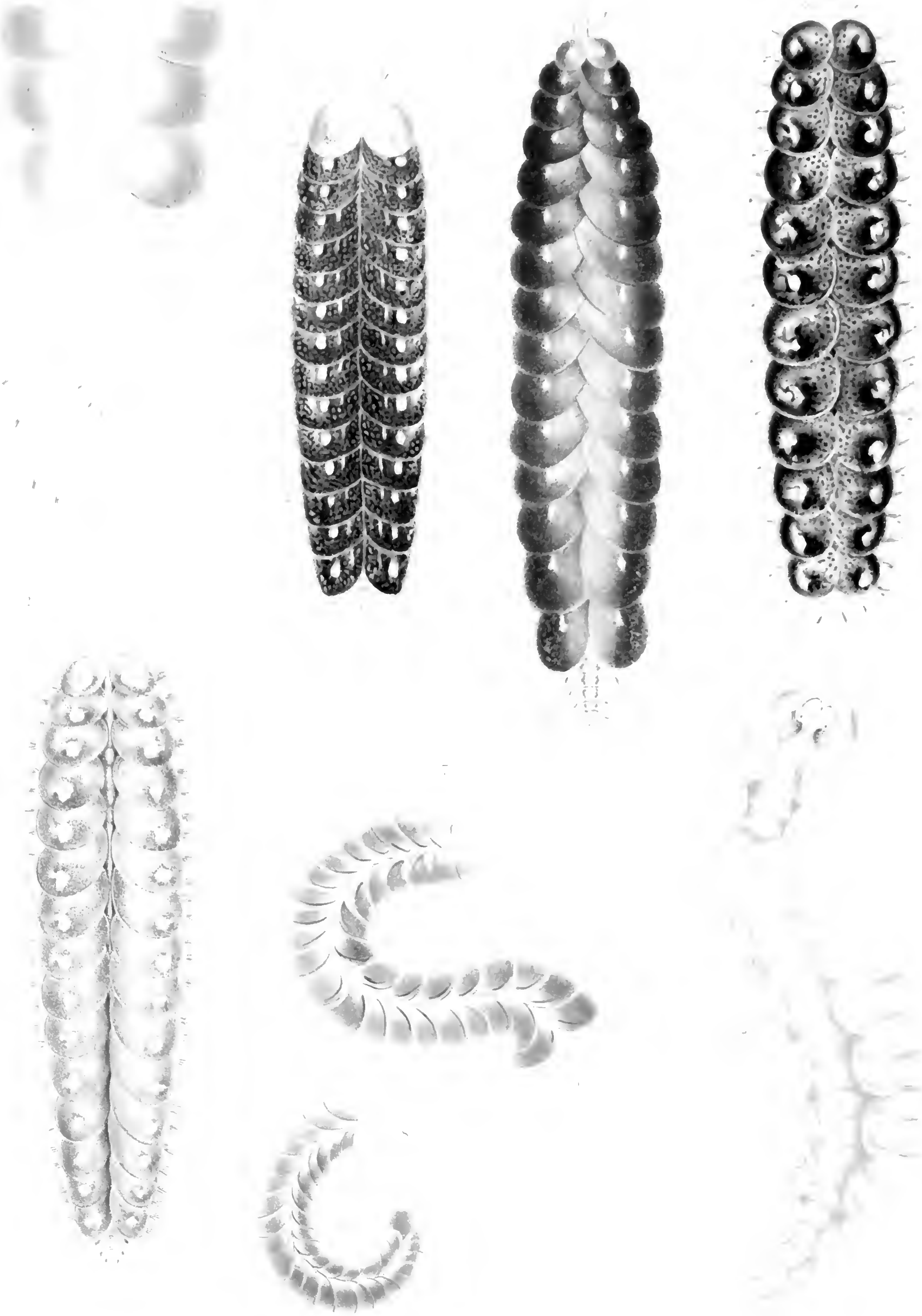

PLATE XXVI.

FIG.

1. *Lepidonotus clava*, Mont., from the dorsum. Enlarged.

2. *Lagisca floccosa*, Sav. (*propinqua*, Mgrn.), from the dorsum. Enlarged.

3. *Harmothoe imbricata*, L., from the dorsum. Enlarged.

4. Posterior end of an example of the same, from which three pairs of scales have been removed to show the ova on the dorsum. Enlarged.

5. *Evarne impar*, Johnst., from the dorsum. Enlarged. A very dark example.

6. *Scalisetosus pellucidus*, Ehlers, with regenerating scales; Channel Islands. Enlarged.

7. Anterior end of *Sthenelais boa*, Johnst. Enlarged.

8. Posterior end of the same. Enlarged.

9. Process from the edge of a scale of *Sthenelais Baskii*.

PLATE XXVIA.

FIG.

1. Spermatozoa of *Harmothoë imbricata*. × Zeiss, I oc., D obj.
2. Spermatozoa of *Lepidonotus squamatus*. × idem.
3. Trochospheres of *H. imbricata* assuming a greenish hue. Magnified.
4. View of a more advanced trochosphere of March 28th, with the projecting mouth to the left. × 116.

5 and 6. Lateral and dorsal views of other examples. × 52.

7. More advanced larva with traces of feet, but without bristles, or with such only indicated.
8. A further stage in which the feet have minute bristles. (June 26th.) × 82.
9. Larval *Polynoë* with well-marked feet and bristles, minute scales, and anal cirri. × 52.
10. Nectochæte stage of *Harmothoë*. (April 20th.) × 52.
11. Nectochæte stage of a Polynoid (June 28th), with median and lateral tentacles and anal cirri. × 52.
12. Nectochæte stage of *Harmothoë*, sp. (April 27th.) × 50.
13. Nectochæte stage of *Polynoë*, sp (July 18th.) $\frac{1}{35}$ inch long. × 50.
14. More advanced nectochæte conditions in a form approaching *Lagisca* or *Evarne*. (October 25th.) × about 40.
15. Dorsal view (in spirit) of nectochæte stage of a form approaching *Lepidonotus squamatus*. (June.) × 40.
16. Ventral view of the foregoing. Similarly magnified
17. A slightly later stage. Similarly enlarged.
18. Stage with developing palpi, and with additional eye-spots. Similarly magnified.
19. Stage of the same form with distinct palpi, median and lateral tentacles. × about 35
20. Dorsal view of *Panthalis Œrstedi*, from a figure kindly sent by Mr. Arnold Watson.
21. Proboscis and jaws of *Sthenelais boa*. Enlarged under a lens.
22. Metatroch stage of *Sthenelais* or *Sigalion* seen from above. (October 22nd. × 50
23. Post-larval *Sigalion*, pelagic condition. (October 28th.) × 50.
24. Dorsal view of *Pholoe minuta*. Enlarged.
25. Spermatozoa of *Pholoe minuta*. (June 24th.) × 350.

A. Walker del. figs. ... E. Burnet F. Huth Lith^r Edin^r

PLATE XXVII.

Fig.

1. Oral region of *Aphrodita aculeata*, L., in contraction and from the ventral surface. Enlarged.
2. Head of *Laetmatonice filicornis*, Kbg. Enlarged.
3. Head of *Lagisca Elisabethae*, n. s. Enlarged.
4. Head of *Lepidonotus clava*, Mont. Enlarged.
5. Head of *Gattyana cirrosa*, Fabr. Enlarged.
6. Head of *Acanthicolepis asperrima*. Enlarged.
7. Head of *Evarne Johnstoni*, McI. (large example). Enlarged.
8. Head of *Harmothoë lunulata*, D. Chiaji. Enlarged.
9. Head of *Eunoa nodosa*, Sars. Enlarged.
10. Head of *Lagisca Jeffreysii*. Enlarged.
11. Head of *Harmothoë marphysae*, McI. Enlarged.
12. Head of *Scalisetosus pellucidus*, Ehlers. Enlarged.
13. Head of *Evarne impar*, Johnst. Enlarged.
14. Head of *Lagisca floccosa*, Sav. Enlarged.
15. Head of *Harmothoë areolata*, Grube. Enlarged.
16. Anterior end of *Eurythoë borealis*, Sars, dorsal view. Enlarged.
17. Head of *Acholoë astericola*, D. Chiaji. Enlarged.
18. Head of *Phyllantinoë mollis*, McI. Enlarged.


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PLATE XXVIII.

FIG.

1. Head of *Harmothoë zetlandica*, McI. Enlarged.
2. Head of *Lagisca extenuata*, Grube. Enlarged.
3. Head of *Harmothoë spinifera*, Ehlers (*olim Sibbaldii*). Enlarged.
4. Head of *Harmothoë Ljungmani* (= *H. Macleodi*). Enlarged.
5. Head of *Lænilla setosissima*, Sav. Enlarged.
6. Head of *Evarne Hubrechti*, McI. Enlarged.
7. Head of *Harmothoë Fraser-Thomsoni*, McI. Enlarged.
8. Head of *Malmgrenia andreapolis*, McI. The median tentacle is imperfect. Enlarged.
9. Head of *Polynoë scolopendrina*, Sav. Enlarged.
10. Head of *Antinoë Sarsii*, Mgrn. Enlarged.
11. Head of *Halosydna gelatinosa*, Sars. Enlarged.
12. Head of small example of *Evarne Johnstoni*, McI. Enlarged.
13. Head of *Harmothoë antilopis*, McI. Enlarged.
14. Head of *Antinoë mollis*, McI. Enlarged.
15. Head of *Malmgrenia castanea*, McI. Enlarged.
16. Head of *Panthalis Œrstedi*, Kbg. Enlarged.
17. Head of *Leanira hystricis*, Ehlers. Enlarged. The specimen was somewhat imperfect.


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PLATE XXIX.

FIG.

1. Head of *Sthenelais boa*, Johnst. Enlarged.
2. Head of *Sthenelais atlantica*, McI. Enlarged.
3. Head of *Sthenelais limicola*, Ehlers. Enlarged.
4. Head of *Sthenelais Jeffreysii*, McI. Enlarged.
5. Head of *Eusthenelais hibernica*, McI. Enlarged.
6. Head of *Sigalion Mathildæ*, Aud. and Ed. Enlarged.
7. Head of *Sigalion Buskii*, McI. Enlarged.
8. Head of *Pholoë minuta*, Fabr. Enlarged.
9. Anterior foot (about twelfth) of *Lagisca extenuata*, Grube. × 24.
10. Anterior foot of *Lagisca floccosa*, Sav. (= *propinqua*, Mgrn.) × 24.
11. Twelfth foot of *Lagisca Elisabethæ*, McI. × 40.
12. Tenth foot of *Harmothoë spinifera*, Ehlers. × 24.
13. Anterior foot of *Harmothoë Ljungmani*, Mgrn. × 28.
14. Anterior foot of *Harmothoë antilopis*, McI. × 24.
15. Anterior foot of *Harmothoë Fraser-Thomsoni*. × 26.
16. Anterior foot of *Harmothoë marphysæ*, McI. × 40.
17. Anterior foot of a large example of *Polynoë scolopendrina*, Sav., from North Uist. × 15.

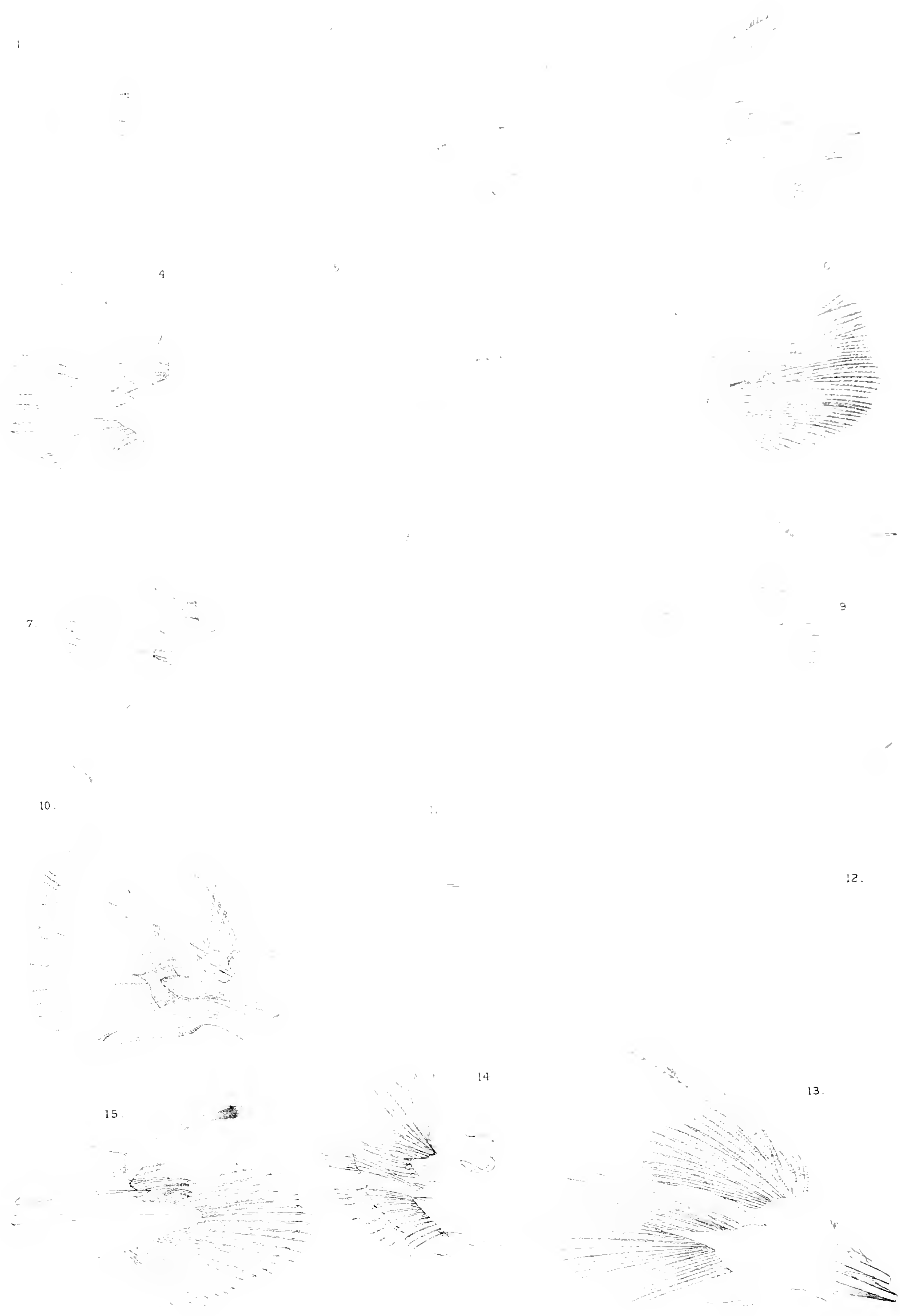

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PLATE XXX.

FIG.

1. Foot (about twelfth left) of *Harmothoë imbricata*, L. × 12
2. Anterior foot of *Harmothoë zetlandica*, McI. × 24.
3. Anterior foot of *Harmothoë areolata*, Grube. × 24.
4. Seventh foot of *Harmothoë lunulata*, D. Chiaje. × 10.
5. Anterior foot of *Malmgrenia castanea*, McI. × 24.
6. Anterior foot of *Evarne Johnstoni*, McI. × 20.
7. Anterior foot of *Evarne impar*, Johnst. × 30.
8. Foot of *Panthalis Œrstedi*, Kbg. × 15.
9. Foot of *Scalisetosus pellucidus*, Ehlers. × 10.
10. Anterior foot of *Evarne Hubrechti*, McI. × 20.
11. Anterior foot of *Halosydna gelatinosa*, Sars. × 18.
12. Anterior foot (about eleventh) of *Lænilla setosissima*, Sav.
13. Anterior foot of *Antinoë finmarchica*, Mgrn. × 10.
14. Foot of *Sthenelais zetlandica*, McI. × 32.
15. Anterior foot of *Scalisetosus assimilis*, McI. × 10.

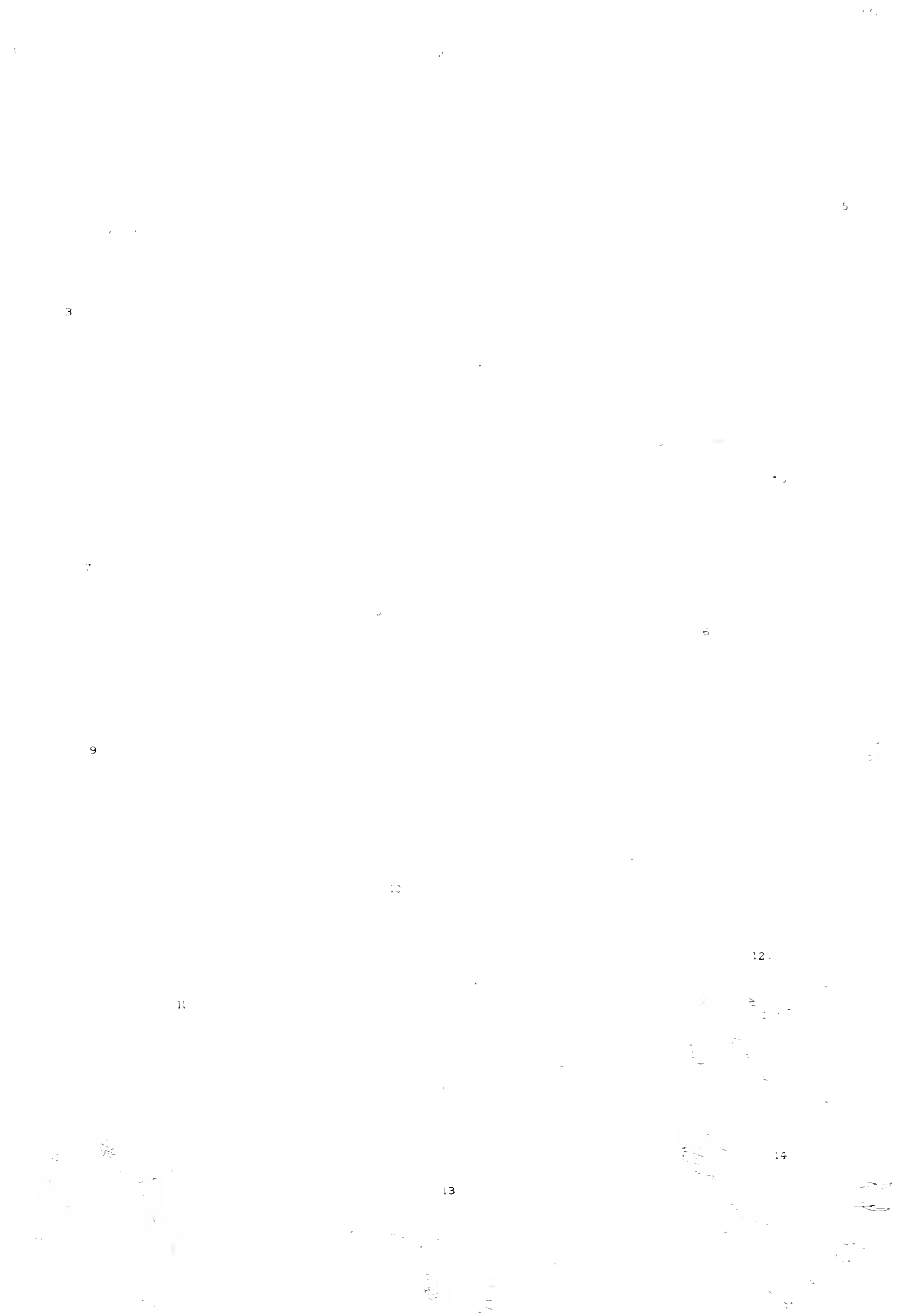

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PLATE XXXI.

Fig.

1. Scale of *Gattyana cirrosa*, Pall., from St. Andrews. × 12.
2. Anterior foot of *Antinoë Sarsi*, Mgrn., "Knight-Errant," 558 fms. × 20.
3. Foot of *Malmgrenia andreapolis*, McI., St. Andrews × 24.
4. Foot of *Acholoë astericola*, D. Ch. × 28.
5. Anterior foot of *Sthenelais boa*, Johnst. × about 15.
6. Anterior foot of *Sthenelais limicola*, Ehlers. × 30.
7. Anterior foot of *Sthenelais Jeffreysii*, McI. × 24.
8. Foot of *Sthenelais*, Z. × 30.
9. Foot of *Eusthenelais hibernica*, McI (Imperfectly preserved.) × 24.
10. Anterior foot of *Sigalion Mathildæ*, Aud. and Ed. × 24
11. Anterior foot of *Sigalion Buskii*, McI. × 24.
12. Anterior foot of *Leanira hystricis*, Ehlers. × 40.
13. Posterior foot of the same. × 40.
14. Foot of *Pholoë minuta*, Fabr., from St. Andrews. × 90.

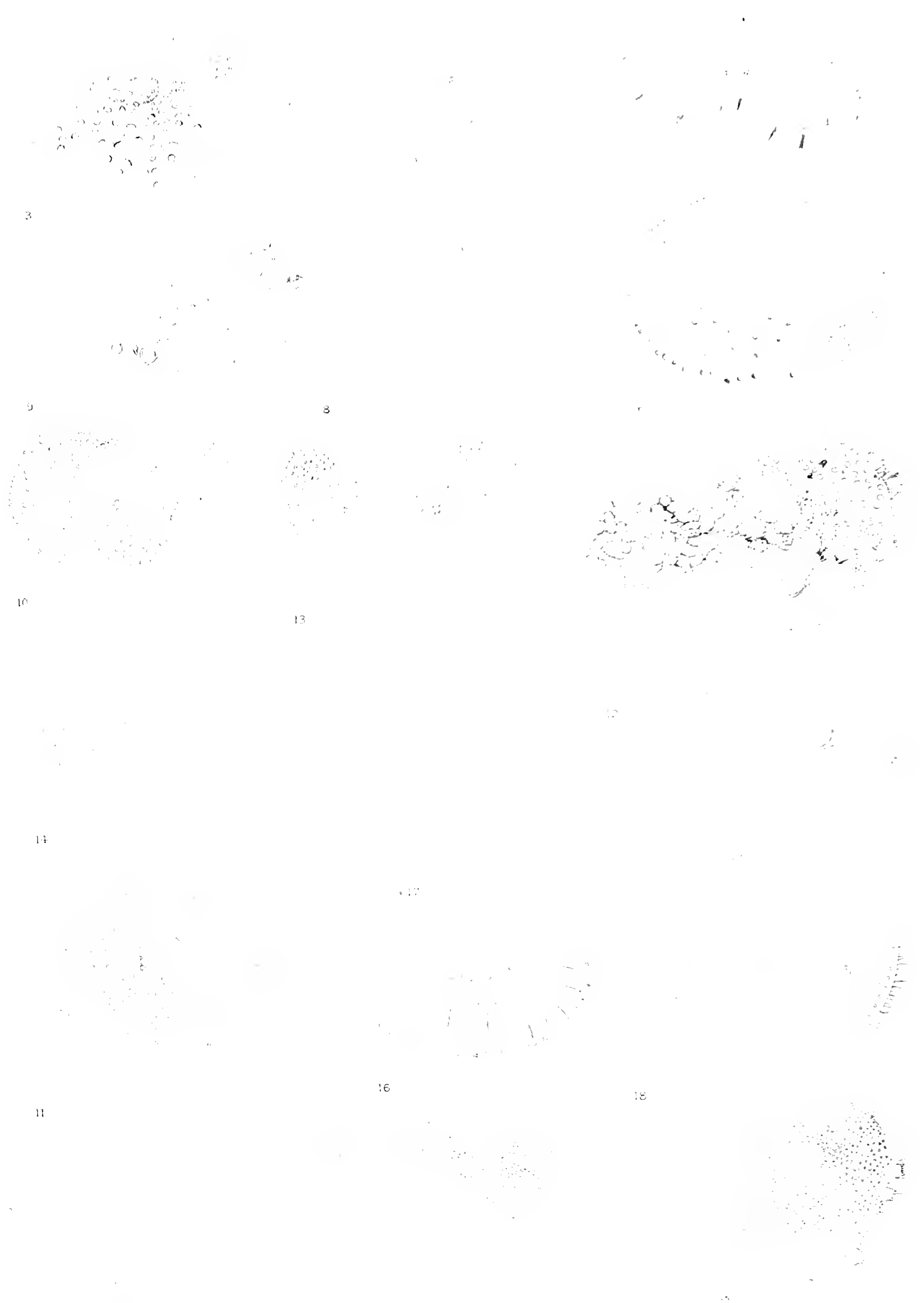
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PLATE XXXII.

FIG.

1. Anterior scale of *Lepidonotus squamatus*, L. × 12.
2. Anterior scale of *Lepidonotus clava*, Mont. (spirit). × 12.
3. Scale of *Eunoa nodosa*, Sars (dried), British Museum. × 12.
4. Anterior scale of *Acanthicolepis asperrima*, Sars. × 12.
5. Eighth scale of *Lagisca floccosa*, Sav., from Baltic. The spines are rather distinct. × 20.
6. Anterior scale of *Lagisca Elisabethæ*, McI. × 40.
7. Anterior scale of *Lagisca Jeffreysii*, McI. × 20.
8. Anterior scale of *Lagisca extenuata*, from 680 fathoms in the "Porcupine." × 12.
9. Scale of *Lagisca floccosa*, var. "Porcupine," No. 12 (p. 302). × 50.
10. Anterior scale of *Harmothoë imbricata*, L. × 12.
11. Anterior scale of *Harmothoë Fraser-Thomsoni*, McI. × 24.
12. Anterior scale of *Harmothoë lunulata*, D. Ch. × 24.
13. Anterior scale of *Harmothoë marphysæ*, McI. × 14.
14. Anterior scale of *Harmothoë Ljungmani*, Mgrn. × 30.
15. Anterior scale of *Harmothoë zetlandica*, McI. × 24.
16. Anterior scale of *Harmothoë antilopis*, McI. × 28.
17. Anterior scale of *Harmothoë areolata*, Grube. × 12.
18. Anterior scale of *Evarne impar*, Johnst. × 20.
19. Anterior scale of *Evarne Johnstoni*, McI., from a Norwegian example. × 28.

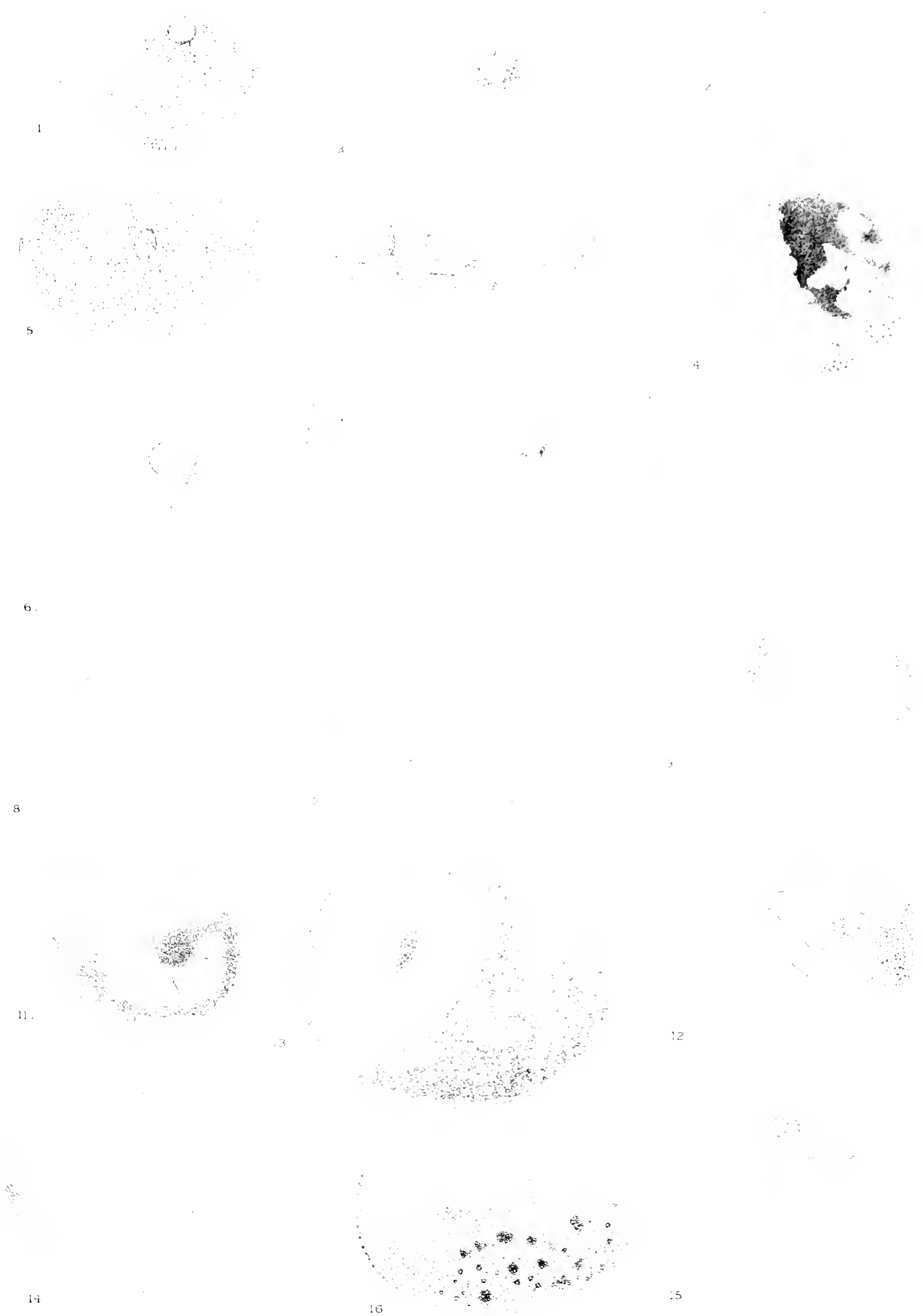
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PLATE XXXIII.

FIG.

1. Anterior scale of *Evarne Hubrechti*, McI. × 20.
2. Portion of the scale of a small example of *Halosydna gelatinosa*, Sars. × 210.
3. Portion of the inner edge of the first scale of *Harmothoë areolata*, Gr. × 90.
4. Anterior scale of *Harmothoë spinifera*, Ehlers. × 20.
5. Anterior scale of *Lænilla setosissima*, Sav. × 20.
6. Anterior scale of *Scalisetosus assimilis*, McI. × 38.
7. Anterior scale of *Scalisetosus pellucidus*, Ehlers. × 45.
8. Anterior scale of *Antinoë finmarchica*, Mgrn. × 30.
9. Anterior scale of *Antinoë mollis*, McI. × 18.
10. Anterior scale of *Malmgrenia castanea*, McI. × 40.
11. Anterior scale of *Malmgrenia andreapolis*, McI. × 24.
12. Scale of a small example of *Halosydna gelatinosa*, Sars. × 15.
13. Scale of small example of *Polynoë scolopendrina*, Sav. (from Herm). × 40.
14. Scale of the large form of *Polynoë scolopendrina*, Sav. (from North Uist). × 24.
15. Scale of *Acholoë astericola*, D. Chiaje. × 28.
16. Tenth scale of *Sthenelais boa*, Johnst., from St. Andrews. × about 30.
17. Anterior scale of *Antinoë Sarsi*, Kbg. × 20.


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PLATE XXXIV.

FIG.

1. Proboscis of *Scalisetosus pellucidus*. × under a lens.
2. Proboscis of *Lagisca floccosa*. × under a lens.
3. Lateral view of the proboscis of *Panthalis Œrstedi*. × under a lens.
4. Antero-posterior view of the same. × under a lens.
5. Anterior scale of the same form ("Triton," 1882). × 21.
6. Anterior scale of *Sthenelais boa* (adult). × 17.
7. Scale of *Sthenelais zetlandica*. × 32.
8. Anterior scale of *Sthenelais atlantica*. × 55.
9. Scale from the anterior third of *Sthenelais limicola*. × 12.
10. Posterior scale of the foregoing. × 30.
11. Proboscis of *Sthenelais limicola*. × under a lens.
12. Scale of *Sthenelais*, Z. × 18.
13. Anterior scale of *Sthenelais Jeffreysii* ("Porcupine," off Ireland). × 17.
14. Anterior scale of *Sigalion Mathildæ* with branchial process. Enlarged.
15. Anterior scale of *Sigalion Buskii*. Enlarged.
16. Dorsal view of the anterior end of *Pholoë minuta*. × under a lens.
17. Anterior scale of *Pholoë minuta*, var. *inornata* (Lochmaddy). × 90.
18. Anterior scale of *Pholoë minuta*, var. (St. Lawrence, Canada). × 40.

PLATE XXXV

FIG.

1. Dorsal cirrus of *Euphrosyne foliosa*. × 310.
2. Branchial processes of *Euphrosyne armadillo*.
3. Tips of branchial processes of *Euphrosyne foliosa*. × 236.
4. Tips of branchiæ of *Euphrosyne Robertsoni*, Frith of Clyde. × 90.
5. Bristles of *Spinther miniaceus*.
   - *a*. Ventral bristle. × 90.
   - *b*. Tip of a somewhat shorter and stouter form. × 350.
   - *c*. Hook from the ventral region. × 350.
6. Upper bristle of *Euphrosyne Robertsoni*, n. s. (Clyde), with shorter tip. × 210
7. Lower bristle of *Euphrosyne Robertsoni*, n. s. (Clyde), with longer tip. × 210.
8. Bristle of *Euphrosyne armadillo*. Oc. 1, obj. D, Zeiss.
9. Dorsal bristle of *Euphrosyne armadillo* (Norway). × 350.
10. One of the slender bristles of *Euphrosyne armadillo* (Norway). × 350.
11. The same. × 350.
12. The same. × 350.
13. Bristle of *Euphrosyne armadillo*. × 350.
14. Bristle of *Euphrosyne armadillo*. Zeiss, oc. 1, obj. D
15. Dorsal bristle of *Euphrosyne foliosa*. × 236.
16. Bifid bristles of *Euphrosyne foliosa* (seen on edge). Zeiss, oc. 1, obj. D.
17. Slender serrated bifid bristle (dors.). Zeiss, oc. 1. obj. D
18. Profile view of curved bifid bristle. Zeiss, oc. 1. obj. D.
19. Bristles of *Paramphinome pulchella*, *a*, from the inferior lobe; *b*, *c*, from the superior lobe. × 700.
20. Dorsal bristles of *Eurythoe borealis* from a posterior foot. × 350.
21. Bifid dorsal bristles of *Eurythoe borealis* (Channel Islands) × 350
22. Slender bristles of *Eurythoe borealis* (Channel Islands) × 350.
23. Ventral bristle of *Eurythoe borealis* (Channel Islands) × 350
24. Bristle of first ventral series of a typical foot of *Aphrodita aculeata* × 55.
25. Bristle of the middle of the second row of the ventral series. × 55
26. Tip of posterior hair (lower series) near last foot (*Aphrodita aculeata*). × 360
27. Tip of dorsal hair forming felt (*Aphrodita aculeata* × 350
28. Bifid (serrated) dorsal bristle of *Euphrosyne Robertsoni* × 300

PLATE XXXVI.

Fig.

1. Palpus of *Laetmatonice filicornis*, a little beyond the middle. × 90.
2. Strong bristle from the upper (third) ventral series in the foot of *Aphrodita aculeata* × 55.
3. Bristles from a posterior foot of *Aphrodita aculeata*. × 360.
4. Tip of a dorsal spine of a British *Laetmatonice producta*. × 55.
5. Ventral bristle of *Laetmatonice producta*, var. × 40.
6. Tip of dorsal spine of *Laetmatonice filicornis* with four hooks on one side × 55.
7. Tip of ventral bristle of *Laetmatonice filicornis*. × 55.
8. Lateral view of a dorsal spine of *Laetmatonice filicornis*. × 55.
9. Tip of bristle on the dorsum of an anterior foot of *Hermione hystrix*. × 90.
10. Tenth foot (about) of *Aphrodita aculeata*, viewed from the ventral surface. Enlarged under a lens.
11. Tip of one of the attenuate spines on the dorsum of an anterior foot of *Hermione hystrix*. × 210.
12. Tip of dorsal spine of *Laetmatonice filicornis*. × 90.
13. Foot of *Hermione hystrix*. Enlarged under a lens.
14. Tip of dorsal spine of *Hermione hystrix* with shield. × 90.
15. Tip of spine of *Hermione hystrix* with shield removed, lateral view in balsam. × 90.
16. Foot of *Eurythoe borealis*, Channel Islands. × 90.
17. Pinnate ventral bristle of the second foot of *Aphrodita aculeata*. × 90.
18. Stout smooth bristles of *Aphrodita aculeata*. × 90.
19. Bristle (spinous) from the posterior end of *A. aculeata*. × 55.
20. *a* front, and 20 *b* lateral view of a bristle from the same region of *A. aculeata*. × 55.
21. Tip of the palpus of *Laetmatonice filicornis*. × 55.
22. Anterior foot of *Aphrodita aculeata*, from the posterior face. × under a lens.
23. Papillae of the facial tubercle of *Aphrodita aculeata*. × 90.
24. Outline of three papillae of the facial tubercle of *Laetmatonice filicornis*. × 90.

PLATE XXXVII

FIG.

1. Papillæ of the tip of the proboscis in *Aphrodita aculeata*. × 55.
2. Papillæ of the proboscis of *Laetmatonice filicornis*. × 55.
3. Papillæ of the proboscis of *Laetmatonice producta*. × 10.
4. Papillæ of the proboscis of *Hermione hystrix*. × 55.
5. Tip of tentacle of *Hermione hystrix*. × 55.
6. Second bristle of the second foot of *Hermione hystrix*. × 90.
7. Ventral bristle (at ventral edge) of the same foot of *Hermione hystrix*. × 90.
8. Smaller bristle from the posterior foot of *Hermione hystrix*. × 90.
9. Ventral bristle of *Lepidonotus squamatus*. × 80.
10. Ventral bristle from the middle of the twelfth foot of *Lepidonotus squamatus*. × 210.
11. Ventral bristle from the middle of the twelfth foot of *Lepidonotus clava*. × 210.
12. One of the short dorsal bristles of *Lepidonotus squamatus*. × 180.
13. One of the longer bristles of *Lepidonotus squamatus*. × 280.
14. Group of bristles at the base of the tentacular cirri (first foot) of *Lepidonotus clava*. × 210.
15. Dorsal bristle of *Lepidonotus clava*. × 210.
16. Superior ventral bristle of *Gattyana cirrosa*. × 258.
17. Ventral bristle from the middle of the foot of *Gattyana cirrosa*. × 258.
18. Dorsal bristle of the middle of the foot of *Gattyana cirrosa*. × 210.
19. Bristle from the base of the tentacular cirri of *Gattyana cirrosa*. × 210.
20. Tip of upper bristle of the first foot of *Eunoa nodosa*. × 210.
21. Tip of the upper bristle of the first foot of *Eunoa Œrstedi*. × 210.
22. Ventral bristle of the first foot of *E. nodosa*. × 210.
23. One of the smaller ventral bristles of the first foot of *Eunoa Œrstedi*. × 210.
24. Tip of a dorsal bristle (average example) from an anterior foot of *Eunoa nodosa*. × 350.
25. Tip of a dorsal bristle (average example) from an anterior foot of *Eunoa Œrstedi*. × 350.
26. Dorsal bristle of *Eunoa nodosa* (coast of Durham). × 210.
27. Ventral bristle of *Eunoa nodosa* (coast of Durham). × 210.
28. Tip of a dorsal bristle of *Acanthicolepis asperrima*. × 210.
29. Ventral bristle of *Acanthicolepis asperrima*. × 210.
30. Tip of another example in *Acanthicolepis asperrima*, showing minute process. × 350.
31. Tip of one of the longer dorsal bristles of *Lagisca floccosa*. × 350.
32. Tip of a median ventral bristle of the same. × 350.
33. Tip of a bifid dorsal bristle of *Euphrosyne Robertsoni*. × 350.

PLATE XXXVIII.

FIG.

1. Superior ventral bristle of *Lagisca floccosa*. × 350.
2. Dorsal bristle of variety of *Lagisca floccosa*. × 350.
3. Dorsal bristle of *Lagisca floccosa*, var. (p. 302). × 350.
4. One of the longer dorsal bristles of *Lagisca Elisabethæ*. × 350.
5. Superior ventral bristle of *Lagisca Elisabethæ*. × 350.
6. Inferior ventral bristle of *Lagisca Elisabethæ*. × 350.
7. Dorsal bristle of *Lagisca Jeffreysii*. × 350.
8. Superior ventral bristle of *Lagisca Jeffreysii*. × 350.
9. Bristle from the middle of the ventral series of *Lagisca Jeffreysii*. × 350.
10. Dorsal bristle of *Lagisca extenuata*, Gr. × 90.
11. Tip of the same bristle. × 350.
12. One of the longer (not longest) ventral bristles. × 210.
13. Tip of another ventral bristle, showing the secondary process. × 350
14. Tip of a dorsal bristle from a large specimen of *Harmothoë imbricata*. × 350.
15. Superior ventral bristle of *Harmothoë imbricata*. × 350.
16. Median ventral bristle of *Harmothoë imbricata*. × 350.
17. Dorsal bristle of *Harmothoë spinifera*, Ehlers. × 350
18. Tip of superior ventral bristle of *Harmothoë spinifera*, Ehlers. × 350.
19. Inferior ventral bristle of *Harmothoë spinifera*, Ehlers. × 350.
20. Front view of a dorsal bristle of *Harmothoë Zetlandica*. × 210.

20 *a*. Lateral view of the same. × 350.

21. Superior ventral bristle of *Harmothoë Zetlandica*. × 350.
22. Dorsal bristle of *Harmothoë Ljungmani*, Mgrn. (*olim H. Macleodi*) × 350.
23. Superior ventral bristle of *Harmothoë Ljungmani*. × 350.
24. One of the larger dorsal bristles of *Harmothoë antilopis*, McI. × 350
25. Superior ventral bristle of *Harmothoë antilopis*. × 350.
26. One of the stouter ventral bristles from the neighbourhood of the spine × 350.
27. Dorsal bristle of *Harmothoë haliæti*, McI. × 350.

PLATE XXXIX.

FIG.

1. Superior ventral bristle of *Harmothoë haliaeti* viewed antero-posteriorly. × 350.
2. Another of the same form seen laterally. × 350.
3. Inferior ventral bristle. × 350.
4. Dorsal bristle of *Harmothoë Fraser-Thomsoni*. × 350.
5. Ventral bristle of *Harmothoë Fraser-Thomsoni*. × 350.
6. Dorsal bristle of *Harmothoë Fraser-Thomsoni* with parasitic *Loxosoma*. × 210.
7. One of the longer dorsal bristles of *Harmothoë marphysae*. × 350.
8. Superior ventral bristle of *Harmothoë marphysae*.
9. Median ventral bristle (in profile) of *Harmothoë marphysae*. × 350.
10. Antero posterior view of one of the same. × 350.
11. Inferior ventral bristle. × 350.
12. Profile view of one of the longer dorsal bristles of *Harmothoë lunulata*, D. Ch. × 350.
13. Antero-posterior view of another dorsal bristle. × 350.
14. One of the shorter dorsal bristles. × 350.
15. Superior ventral bristle. × 350.
16. Median ventral bristle. × 350.
17. Tip of a dorsal bristle of *Harmothoë areolata*, Grube. × 350.
18. Superior ventral bristle. × 350.
19. One of the most characteristic median ventral bristles. × 350.
20. One of the stouter dorsal bristles of a large *Evarne impar*, from Herm. × 350.
21. Superior ventral bristle. × 350.
22. Lower median ventral bristle. × 350.
23. One of the stronger dorsal bristles of *Evarne Johnstoni*. × 350.
24. Tip of a dorsal bristle. × 700.
25. Superior ventral bristle. × 350.
26. Bristle from the middle of the ventral group. × 350.
27. Tip of a superior ventral bristle. × 700.
28. Tip of a bristle from the middle of the ventral series. × 700.

PLATE XL.

FIG.

1. Dorsal bristle of *Evarne Hubrechti.* × 60.
2. The same. × 60.
3. Tip of dorsal bristle. × 210.
4. Tip of ventral bristle. × 350.
5. Dorsal bristle (average) of *Lænilla setosissima*, Sav. × 350.
6. Ventral bristle (average) of *Lænilla setosissima*, Sav. × 350.
7. Tip of dorsal bristle of *Antinoë Sarsi.* × 200.
8. Tip of ventral bristle of *Antinoë Sarsi.* × 200.
9. A nearly straight dorsal bristle of *Antinoë finmarchica.* × 210.
10. An outer slightly curved bristle from the same group. × 210.
11. Median ventral bristle (South-west Ireland). × 210.
12. Dorsal bristle from posterior region of *Antinoë mollis.* × 210.
13. Median ventral bristle of *Antinoë mollis.* × 210.
14. The same. × 700.
15. One of the largest dorsal bristles of *Phyllantinoë mollis.* × 350.
16. Ventral bristle. × 350.
17. Dorsal bristle of *Scalisetosus pellucidus.* × 700.
18. Ventral bristle. × 700.
19. Distal region of a dorsal cirrus. × 90.
20. One of the larger dorsal bristles of *Scalisetosus assimilis* × 350.
21. One of the shorter dorsal bristles. × 350.
22. Ventral bristle. × 350.
23. Dorsal bristle of *Malmgrenia castanea.* × 350.
24. Superior ventral bristle. × 350.
25. Inferior ventral bristle. × 350.
26. Tip of a ventral bristle from Valencia, showing secondary process. × 350.
27. One of the larger dorsal bristles of *Malmgrenia andreapolis.* × 700
28. Superior ventral bristle. × 350.
29. Median ventral bristle. × 700.
30. Inferior ventral bristle. × 700.

PLATE XLI.

FIG.

1. Dorsal bristle of *Halosydna gelatinosa*, Sars. × 180.
2. Superior ventral bristles. × 180.
3. Median ventral bristle. × 180.
4. Dorsal bristle of *Polynoe scolopendrina*. × 350.
5. Large bristle above the spine of the ventral division of the foot. × 90.
6. Bristle of the other series adjoining the spine. × 90.
7. Tip of a dorsal bristle. × 350.
8. Tip of one of the series represented in fig. 6. × 350.
9. Dorsal bristle of *Enipo Kinbergi*. × 350.
10. Ventral bristle with simple tip. × 350.
11. Bifid ventral bristle. × 350.
12. Antero-posterior view of a large ventral bristle with a simple tip × 350.
13. Dorsal bristle of *Acholoe astericola*. × 350.
14. Ventral bristle. × 350
15. Brush-shaped bristle from the superior border of the foot of *Panthalis Œrstedi* × 350.
16. Antero-posterior view of a bristle from the upper third of the median lobe of the foot × 210.
17. Lateral view of the same bristle. × 210.
18. Bristle from the ventral edge of the foot. × 210.
19. Dorsal bristle of *Sthenelais boa*. × 90.
20. Fragment of the former, showing spinous rows. × 350.
21. Superior ventral bristle with simple spinous tip × 350.
22. Stout bristle from the centre of the ventral division with a single appendage × 350.
23. Bristle from the inferior series. × 350
24. Portion of the edge of a scale of *Sthenelais Zetlandica*. × 350.
25. Superior ventral bristle in calcium chloride × 350.
26. Inferior ventral bristle. × 350.
27. Edge of a scale of *Sthenelais atlantica*. × 350.
28. Superior ventral bristle. × 350.

PLATE XLII.

Fig.

1. Second series of ventral bristles with single terminal joint in foot of *Sthenelais limicola*. × 350.
2. Slender bristle beneath the former. × 210.
3. One of the stouter bristles following the preceding. × 210.
4. Tip of a ventral cirrus. × 210.
5. Papillæ on the edge of a scale of *Sthenelais Jeffreysii*. × 350.
6. Superior ventral bristle. × 350.
7. Bristle from the inferior lobule, with two divisions in the terminal process. × 350.
8. Bristle from the ventral edge of the group. × 350.
9. Superior ventral bristle of *Eusthenelais hibernica*. × 350.
10. One of the slender bristles at the ventral border of the foot. × 350.
11, 12. Portions of a dorsal bristle of *Sigalion Mathildæ*. × 280.
13. Superior ventral bristle. × 280.
14. One of the series below the former. × 280.
15. One of the next series without spines at the end of the shaft. × 280.
16. A more slender form at the ventral margin of the foot. × 280.
17. One of the stronger bristles of the ventral lobe, with a single terminal process. × 280.
18. Portion of the end of the shaft (with its whorls of spikes) of one of the superior bristles of *Sigalion Buskii*. × 350.
19. Similar region of one of the next series. × 350.
20. Dorsal bristle of *Leanira hystricis*. × 350.
21. Anterior ventral bristle. × 350.
22. Ventral bristle from the posterior region. × 350.
23. Dorsal bristle of *Pholoe minuta*. × 280.
24. Ventral bristle. × 280.
25. Foot of *Lepidonotus squamatus*. × 20.
26. Tenth foot of *Lepidonotus clava*. × 12.
27. Tenth foot of *Gattyana cirrosa*. × 40.
28. Foot of *Eunoa nodosa*. × 18.
29. Foot of *Acanthicolepis asperrima* behind the middle of the body. × 24.
30. Anterior foot of *Lagisca Jeffreysii*. × 24.

Date Due