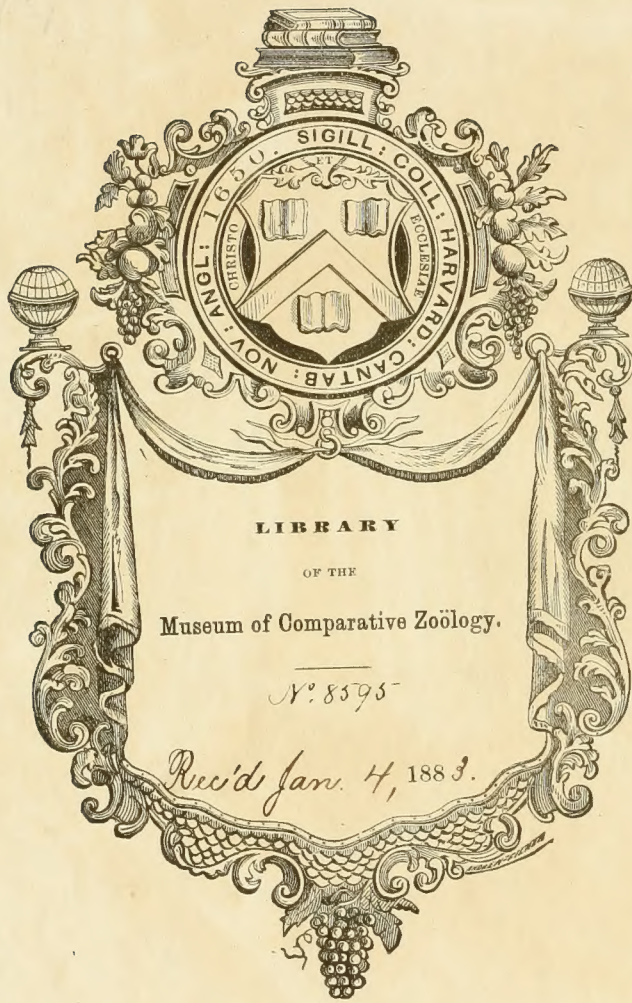


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THE
POWERS OF THE CREATOR

DISPLAYED IN THE CREATION;

OR,

OBSERVATIONS ON LIFE AMIDST THE VARIOUS FORMS

OF THE

HUMBLER TRIBES OF ANIMATED NATURE:

WITH

PRACTICAL COMMENTS AND ILLUSTRATIONS.

BY

SIR JOHN GRAHAM DALYELL,
KNIGHT AND BARONET.

IN TWO VOLUMES,

CONTAINING

NUMEROUS PLATES OF LIVING SUBJECTS, FINELY COLOURED.

VOLUME II.

(Posthumous Volume),

COMPREHENDING FORTY-SIX PLATES.

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P R E F A C E.

DURING the time in which the first volume of this work, published in 1851, was passing through the press, its estimable author was in a very delicate state of health. So reduced, indeed, was he by a lingering illness, that he felt himself unequal to the task of compiling an Analytical Index, according to the plan which he had followed in the two volumes on "RARE AND REMARKABLE ANIMALS OF SCOTLAND;" and a few weeks after the publication of the volume, his disease terminated fatally.

Sir JOHN DALYELL had contemplated proceeding immediately with the preparation of the second volume, if his life had been spared, and, towards the accomplishment of his object, he had, to some extent, arranged his notes of descriptions of species, intending to correct and transcribe the whole for the press. Several Plates had likewise been executed, and many drawings were in some measure assorted as materials ready to be placed in the hands of the engraver.

In this state of things, it was considered by his Sister, who always lived with him, as a duty, to make an effort and save for the public benefit a large amount of valuable information, the result of the continuous labour, through many years, of an acute, patient, and intelligent observer. This zeal to promote the author's fame, and advance at the same time the interest of science, was naturally to be looked for from the individual referred to in the 2d volume of "Rare and Remarkable Animals of Scotland," p. 99, where, in reference to the *Cristatella*, he says, "I am indebted to

the sedulous care of an affectionate relative, the companion of all my excursions, the encourager of all my exertions, in so tedious, laborious, and difficult a work, for the finest of any—that exhibited to the British Association, taken by herself from the garden pond at Binns House, in Linlithgowshire.” Another passage, dictated by the same grateful considerations, occurs in the same volume, p. 124, under *Plumatella repens*. “Of these an admirable example occurred near a ruinous mansion called Fenton Tower, in the county of Haddington, about twenty-one miles east of Edinburgh, for which I was indebted to that same affectionate companion of my excursions already noted, who takes the liveliest interest in all my pursuits, and who values the beauties of Nature as demonstrations of the Divine essence vouchsafed to the gaze of admiring mankind.”

When this affectionate relative had somewhat recovered from the bereavement which deprived her of a valued companion, she resolved to undertake the task which he had contemplated. Difficulties, however, of a formidable kind at once presented themselves. The state of the manuscripts was such, that, independent of their almost illegible character, which the intelligent printers of the former volume could alone decypher, there were so many erasures and changes of nomenclature, as to render much caution requisite in judging of the latest views intended to be expressed. Many of the references to the Plates, in consequence of the numerous alterations which had taken place in the text, required to be corrected. The unfinished Plates, and the Figures which had not been engraven, stood in need of assortment, and a careful revision. Much of this indispensable labour she only could perform, and here her efforts were above all praise. But there were portions of the task in which some assistance was needed. This Sir JOHN DALYELL foresaw, should the work prove a posthumous one, and had expressed to his relative a hope that I might, perhaps, endeavour to give her the requisite aid; especially as I had for many years previous to the publication of the “Rare and Remarkable Animals,” urged upon him the propriety of giving to the world those observations, in the making of which he had expended so much successful labour. In proof that such efforts

had repeatedly been made to rescue important results from private obscurity, and render them available to naturalists in general, the following note, which accompanied the presentation of the first volume of that work, may here be inserted :—

“ MY DEAR PROFESSOR,

“ Have the goodness to accept a copy of my humble commentary on the Works of Providence.

“ Though endowed with my own share of perseverance and resolution, I confess that the iniquitous obstructions I suffered in its progress had nearly compelled me to abandon the prospect of completion.

“ But your kind indulgence always encouraged me to advance, therefore I may say the existence of my work is mainly owing to you.

“ Believe me ever yours, with infinite regard,

“ JOHN GRAHAM DALYELL.”

“ 14 GREAT KING STREET, 21st August 1847.”

In these circumstances, I willingly furnished the little aid in my power towards the completion of the volume, interfering, however, in the smallest possible degree, with the style, the nomenclature, and the phraseology of the descriptions, so as not to destroy the identity of the materials employed. The publication, being a posthumous work, will, of course, be regarded with all the tenderness and generosity usually displayed on such occasions ; while the numerous highly interesting and original observations which it contains, will be read with delight and gratitude by all philosophical naturalists.

As several Plates, in a finished state, have been found in the author's repositories, together with descriptions of their contents, which are considered by his relative worthy of publication, it is intended to form these into a Supplement, to contain at the same time an Analytical Index of the two volumes, with a Biographical Sketch and Portrait of the Author.

JOHN FLEMING.

NEW COLLEGE, EDINBURGH,
15th July 1853.

CHAPTER I.

HIRUDO—THE LEECH.

AMONG the numerous tribes of the lower animals distributed throughout the universe, none has attracted equal notice perhaps as the Leech, and that from periods of the most remote antiquity. Its form, its motions, its habits, are well adapted to excite the curiosity of the illiterate beholder, and, above all, its utility in alleviating the afflictions of mankind, have gained a distinction for it which is denied to all the rest.

Though widely known of old, in general, the detailed investigation of the history of the Leech has been reserved for the latest era of scientific observers, and the most advanced state of science.

Doubtless the noted peculiarities of the Medicinal Leech led to the study of others, whether from motives of mere curiosity, or from the hopes of finding them endowed with similar properties. Such expectations however have been disappointed; for among a genus, abounding sufficiently in the variety of its species, I believe that no one is yet discovered which can be so satisfactorily employed in relieving human distress.

It is true that in this country there are leeches that will suck the blood, and eat the flesh of animals; and that in some distant regions others prove a kind of pest to man, but none seem as yet habituated to the same office wherein the Medicinal Leech is so useful at home.

Independently of the practical value of this animal, wherever it can be found, certain singular facts are exposed by various species of the

genus *Hirudo*, which cannot but be interesting to the physiologist, and assuredly deserve to be farther known and suitably appreciated.

I might have been deterred from offering farther observations on this, a very interesting subject in Natural History, considering the valuable treatises already published by such distinguished authors as Dr James Rawlins Johnson, Professor Stefano Delle Chiaje of Naples, M. Moquin Tandon of Montpellier, and many others, wherein a historical and descriptive view of the whole is taken, especially by the last. But certain species, both marine and fresh-water, have occurred to me, which seem rarely distributed. Besides, my endeavours to preserve all animals alive, afford opportunities of presenting several new facts in the history of some, and accurate representations of the form of others.

There is nothing in the whole circle of literature which has hitherto experienced so total a failure as the last. I cannot specify a single treatise containing even tolerable figures of the Leech; and although very familiar with various species named by different authors, it is very rarely that I have derived any assistance from the figures offered in illustration, or have been able to identify them with my own. This defect, however, must be ascribed equally to the imperfection of the creature, which is not selected while vigorous, and to the deficiencies of the artist.

Many doubts have been expressed regarding the just position of the Leech in the *Systema Naturæ*, and sometimes by those who apparently question whether there is any specific order or arrangement of things manifested by the Creation. Yet the *tribe of leeches* is, if I may so express it, absolutely *sui generis*; none other has been hitherto shewn in close approximation. It seems to stand apart. At present it is brought nearer to the simple *Vermes* than either its general formation or its general habits sanction. But there being many reputable works, which I have not been able to procure, on the subject, probably they contain sufficient illustrations.

The Leech is a soft bodied, elongated, annulose animal, of the most variable form. Both extremities dilate, in each constituting a sucker, affixing it firmly to any foreign substance. It cannot advance unless the

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Cnidines. : Per Lecanis

sucker in front is relieved, carried forward, and secured, when the posterior is relieved, carried forward, and secured in like manner, whereby the animal has taken its step. This process is repeated, while adhesion constantly prevails. The Leech also swims quickly by undulations in the water. It feeds on animal and vegetable substances; and it multiplies by means of ova.

§ 1. HIRUDO MURICATA—*The Skate Leech*.—Plate I. fig. 1.

Length eight inches; extreme diameter seven lines. Body round, tapering slightly from the middle towards the two extremities, each of which dilates as a large circular sucker. The whole body profusely tuberculated; the tubercles rising about a line, disposed in regular circles, and susceptible of being flattened. A portion of the neck near the head differs somewhat from the rest, in forming a broad belt of lower tubercles. Neither eyes nor ocular specks are to be discovered.

The body is annulated, as may be discovered from young specimens, for this becomes imperceptible with their growth. Between seventy and eighty distinct circles were enumerated in one extending about two inches in length, by a line in thickness, the tubercles seeming to be arranged in about eight longitudinal rows.

During quiescence the animal adheres firmly by the posterior sucker; it forms in its extent a logarithmic curve, with the oral disc expanded or otherwise in the centre. Now the disc appears as a hollow hemisphere, which unfolds as a flattened surface, to be applied to neighbouring objects when the animal commences its progression. While altogether disengaged, the lip of the hemisphere contracts so as to render it spherical. When employed, it is unfolded flat; the mouth appearing in the centre, environed by concentric rings of different lines. The exterior ring was in one specimen greenish, the next white, very narrow, within a broad grey ring. Eight low tubercular prominences are disposed on the margin of this oral sucker; sometimes four, as were on the disc just described. There is a considerable contraction of the diameter of the

body where the posterior sucker joins it ; and here is the orifice of the intestinal canal, as demonstrated by a continuous sanguinary stream sometimes discharged from it.

This animal is always of a dull or dingy colour, varying from oil green to brownish, or in young specimens reddish-brown, bluish, or greenish, but on the whole generally tending to oil green. A lighter spotted stripe sometimes runs down the back ; and some of the young have appeared reddish, encircled by lighter belts.

Certain authors have ascribed two short horns in front to the *Skate Leech* ; but I have never seen any of the genus *Hirudo* with prominent external appendages, nor can I find that any such are known to the Scotch fishermen. The aspect of the animal however is so peculiar, and the skin being rough while all others are smooth, that it cannot be mistaken.—Plate I. fig. 1.

I have not learned that any variety, such also as some authors speak of, dwells in our seas.

The *Hirudo muricata* has received a name most appropriate, as indicative of its appearance, which no prudent practical naturalist would have proposed to change.

This animal preys on the living skate, and it is said also on some other flat fish. The fishermen, who are not particularly voracious, affirm, that they are to be found in dozens on a single skate, excavating the very flesh. They say likewise, that they are very numerous about the beginning of June ; and certain it is that at no time are they rare.

The Skate Leech cannot ever be induced to feed in confinement, though offered various animal substances, among which was a young skate, extracted from its capsule. If cavities be actually seen in the surface of adults, it is highly probable that the flesh has been consumed to reach the blood, which seems to be the chief subsistence of the Leech. Some species of fresh-water leeches are greedy of flesh, as we shall see afterwards ; for it is an error to believe, as has been frequently asserted, that the animals of this genus live entirely by suction. The streams of blood discharged in confinement by the Skate Leech prove the quality of its sustenance.

The firm adhesion of the sucker to the skin of its prey must render this animal a cruel and inveterate enemy. It is seldom detached by the fishermen without suffering injury; but when adhering to hard substances, by inverting, it may be removed with comparative facility, by inserting the edge of the thumb nail gradually under the sucker.

During the day this singular leech reposes in absolute quiescence, but towards evening, its wonted coil relaxes in wider curves, and it rears itself erect on the plane of position, with the head turned inwards. The quiescence of a solitary specimen, however, is interrupted by the introduction of stranger leeches of its own kind; their society is evidently gratifying. Five having been collected in the same vessel, all began to intertwine their necks together after fixing the sucker; they stretched and curved, or contracted the body, yet without shifting from their respective spots of adhesion. Such movements continued for hours.

Meantime, small and almost transparent vesicles, as it appeared, each formed like a grain of oats, were observed protruding from the neck of the animal. These extended about three lines; each being connected to the neck by a slender filament, also transparent. Two milk-white parallel oblong substances were exposed within.

The number of these vesicles is variable, according to the specimen. In each of two a vesicle issued from that ring of the neck which was next the lowest; each of two others had three.—In one of the leeches, two vesicles, in near approximation, issued from the fifth or sixth row of tubercles, lower than the neck. At first three appeared in the second leech: and six or seven, some days later, whereof four then issued from the neck. On the day subsequent, they seemed to have increased to nine or ten. About five such objects were protruding from the neck of a middle-sized specimen of the leech, on the day after being committed to the vessel of a previous occupant; and from the neck of its companion, two of the same kind, appearing flaccid, which might have been mistaken for two short horns.

Authors have ascribed two short horns to the *Skate Leech*, under which specific character, indeed, it stands in the Linnæan *Systema Naturæ*. Farther, it is thus represented in BARBUT'S *Genera Vermium*,—

Plate II. fig. 8 ; which work professes to contain certain figures delineated after Nature. I have never seen either fresh-water or marine leeches with appendages of any kind ; and although one foreign animal has been incorporated with them, I apprehend that it should be removed to another genus. But, in treating of the *Hirudo muricata*, it is not improbable that some superficial observer has mistaken the vesicles for horns.

Among the various conjectures which I indulged on the subject, that seeming the most probable, centred in the vesicles being animals of parasitic, or some organic structure susceptible of protrusion, and retractile ; and thus I left them for many years.

But, after the facts above narrated in the history of the *Caligus curtus* occurred (Vol. I. p. 248), and having reverted to the subject, it appeared to me that the mysterious animal was to be identified as a variety of the same race. In this I was confirmed by observing figs. 2 and 3, among the various delineations which sometimes occur along with the *Udonella*. Such was the solution of the enigma.—Plate I., figs. 1-10.

The Skate Leech propagates by eggs or capsules, of very remarkable configuration, more or less numerous, according to the fertility of individuals ; and they appear either singly, which is rare, or in a considerable group,—perhaps fifty on the exterior or interior surface of a shell.—Fig. 11.

The capsule consists of a sole, a short stalk surmounted by a spheroid, with a distinct umbo on the side. The capsule altogether is about three lines, and the spheroid which contains the embryo, or leech, about two in diameter.

Such capsules are firmly agglutinated by the sole to the substance whereon they are deposited. They are originally white, or of the faintest carnation, of a fine soft downy aspect, with the neck orange or yellowish. They darken gradually from the time of production, and in four or five days, the original white is converted to olive-green, or dull wax-yellow. They are produced singly, free of all gelatinous matter.

The capsule is a very singular object, quite peculiar ; insomuch that it bears no resemblance to the ovum of any other animal. How many

varieties are found in this simple yet wonderful provision of Nature, for the perpetuation of living beings,—an egg, through the means of that which scarcely occupies definite space in its origin,—of that wherein susceptibility of receiving the vital spark may subsist during time incalculable ?

The capsule consists of a coriaceous, tough, thick integument, full of tenacious, albuminous, brownish matter. It contains only a single embryo, which penetrates the lateral umbo in issuing forth to the light. Then the young animal is about an inch in length.—Figs. 12, 13.

Thus, an aperture in the umbo always denotes its vacancy,—the state wherein most of them are recovered from the sea ; for the young has generally forsaken its interior.

The propagation of this species is not strictly confined to any season, though belonging chiefly to summer. On opening twenty capsules, on September 27, only one contained an embryo.

A snow-white capsule, very recently produced, was observed in a vessel containing a leech, on the 19th of January. Next day, the colour had darkened, but the centre of the sole still remained white, nor was its ultimate hue attained in a week. A different specimen produced a capsule on March 27, another next day, and a third on the 1st of April. Thus, the capsules are produced singly, one at a time, though the intervals may be short. Those of numerous groups, of forty, fifty, or more, being in immediate approximation, proceed from a single specimen. They form in an extraordinary manner, compared with the external capacity. Probably, therefore, they come successively to maturity in the ovarium. All may belong to the same animal. On the 10th of January, a leech occurred, adhering to the fragment of a shell, bearing seventeen capsules ; an eighteenth was produced on the morning of that day week, almost white when noticed ; a nineteenth appeared next day, and a twentieth on the 22d of the month. All seemed to be from the same parent.

The greatest number ever seen in a group was fifty-four, of which six were in a tier above the others. But all are usually in a single stratum, wherein the capsules are dispersed irregularly. There is little dis-

parity in the size of the capsules of the same group ; but the whole capsules of one group are sometimes much smaller than those in another. A general correspondence appears in the form of all. None produced by other leeches, or by any other animals, bear the smallest resemblance to them.

The Skate Leech is very patient of abstinence. Though most voracious in the natural state, all subsistence, as already observed, is rejected by it in confinement, although in such a condition it survives a long time.

It occasionally seems to die of repletion from previous excesses. A large specimen, taken in the end of June, had suffered a slight injury, probably from pressure in detaching it. In three days it sickened, and at the upper part rent asunder. The animal had burst ; when the whole cavity of the animal was discovered to be occupied by a mass of clotted blood.

Another specimen proved extremely turgid in autumn, when taken, which I ascribed to the blood which it had absorbed. But, the continued distension during four or five weeks, induced me rather to conjecture that it was owing to the enlarging of the ovarium. In a few days, however, the discharge of a quantity of blood, partly clotted, proved the true cause. The animal then lost its adhesive faculty : it died, and I found it quite straight and rigid, extending far over the edge of its vessel.

Two large specimens having been obtained on the 7th of July, were preserved for delineation, because there was a considerable difference in their appearance. One was so turgid that the papillæ of the surface were almost obliterated. Nevertheless, it remained in health, and discharged a copious stream of bloody matter eighty-four days afterwards.

The Skate Leech is not rare.

PLATE I.

- FIG. 1. *Hirudo muricata*—The Skate Leech ; head, *a* ; sucker, *b*.
2. Parasites, *Udonella* adhering to the neck.
3. The same, enlarged.
4. Another, natural size.
5. The same, enlarged.

PLATE I.

FIG. 6. Group of *Udonella* from the Leech, natural size.

7. A specimen magnified ; anterior, *a* ; sucker, *b*.
8. Another.
9. Anterior extremity of the *Udonella*, more highly magnified.
10. Supposed capsule pertaining to the *Udonella*, magnified.
11. Capsules of the *Hirudo muricata*, deposited on a shell.
12. Young Leech, bred from the capsule, extended.
13. Young Leech, bred from the capsule, coiled.
14. Capsule, recently produced in confinement, still almost white.
15. Capsule, produced in confinement, darkened with age.

§ 2. HIRUDO VITTATA—*The Belted Leech*.—Plate I. Fig. 16.

Length above two inches, breadth three lines, thickness one line ; body flattened, smooth upper surface, slightly convex. Anterior extremity formed as a cup, occasionally flattening, and applying like a disc to other substances ; posterior extremity broad, thin, and large in proportion to the animal, employed as a sucker. That of a very large specimen of the *Hirudo vittata*, one extending eight or nine inches, was of smaller diameter. The body is chiefly whitish and speckled, somewhat transparent, so as to expose ten pair of cells within. Ten projections, like hemispherical blisters, border each side of the animal, rising and falling as if by respiration ; no eyes could be found.

It generally remains erect on the broad or adhering sucker, often waving to and fro.—Plate I. fig. 16.

Four specimens were obtained on July 23. Next morning I observed what I supposed six capsules produced in the course of the night, and in three days, other three of larger size. In another vessel, containing two specimens, eight of a similar description were produced. Those subjects did not bear any resemblance to the capsule of the *Hirudo muricata*, being only a minute spherical segment, nearly a hemisphere, about the third of a line in diameter, and of dingy yellow colour. On another occasion, nineteen of the same subjects were produced in a vessel containing twenty-four leeches on the 20th of November. Their

appearance is limited to no particular season. The latter were larger than the others, being about the sixteenth of an inch in diameter. Though preserved a long time, they did not undergo any change; and as nothing tended to elucidate their nature, I ceased to consider them as connected with the propagation of the leech. Some are represented Plate I. figs. 17, 18, 19, natural size; and fig. 20, enlarged.

Some capsules, of an oval form, have been seen in vessels containing similar leeches.

Nothing of a particular interest has been disclosed by these animals; some are in more active motion than above described, though still adhering by the sucker, which has appeared very thin and transparent. In certain positions, the microscope discovers that the body consists of numerous annulations.

Some specimens being replete with blood on coming from the sea, the sustenance of those animals may be considered as probably derived from sources similar to that of the *Hirudo muricata*.

Their faculties are certainly very obtuse; or a particular state is attended with particular incapacity. If left dry above the surface of the water, they do not descend in quest of it, but remain on the spot to perish.

Fig. 2 represents a group of smaller leeches, which may be the same as the preceding in earlier stages; but their features were not equally definite, farther than in the appearance of the sucker.

An animal somewhat of the same character is represented in the Dictionnaire d'Histoire Naturelle. I can scarcely presume to identify mine with that represented by Chamisso and Eysenhardt in the *Nova Acta Physico-Medica, Academiae Leopoldino Carolinae Naturæ Curiosorum*, tom. x. p. 350.; tom. xxiv. fig. 4, Brusisæ, 1821.

PLATE I.

FIG 16. *Hirudo vittata*.

17. 18, 19. Supposed capsules, natural size.

20. Three capsules, enlarged.

21. Group of leeches, supposed the same as fig. 16.

§ 3. HIRUDO ANCEPS.

There cannot be any doubt of the genus to which the two preceding species belong. It is otherwise with the present subject, which is introduced here provisionally, for its place rather seems intermediate between the *Hirudines* and the *Vermes*—more nearly approaching the former.

Above sixty years have elapsed since the animal was introduced as a leech to his fellow naturalists by Otho Frederic Müller, under the name *Hirudo grossa*. It was received as such for a long time unchallenged, but M. Moquin Tandon proposed, more than twenty years ago, to exclude it from the genus.

I speak with diffidence, from having been able to obtain only a single specimen, probably a variety, as the reader who has an opportunity of comparing Müller's account with mine may allow.

Length, when extended, nine lines, breadth three; body tapering slightly to the anterior extremity, which is obtuse. The posterior extremity terminates in a sucker of considerable diameter, colour wax yellow.

A waving intestine down the centre is perceptible. Two dull red specks are indistinctly seen towards the anterior.

The whole animal is of a very gelatinous aspect. A specimen of the *Cyprina Islandica* and an *Ascidia* were among the same collection as the Leech. I did not discover the latter until vitiation of the water had ensued, when it was found somewhat weakened, adhering to the bottom of the vessel containing them. However it recovered by careful treatment.—Plate I. fig. 22, *Hirudo grossa* at rest; extended, fig. 23. I could not ascertain its food.

The animal was first observed by me on May 8. I cannot affirm when or on what it was taken.

On occasion of delineation, the artist thought internal spawn perceptible.

The creature became enfeebled on the 30th. Next day I believed it dead, but erroneously. It had lost the faculty of adhesion on the

12th of June. The orifice of the oviduct which, as in leeches, is near the anterior extremity, was greatly dilated on the 14th. And throughout the night of the 15th, a vast quantity of spawn was discharged.

This consisted of transparent albuminous matter, wherein the ova were imbedded, each containing a solid yellow globule, in a much larger transparent sphere, from the dimensions of which the ova appeared considerably apart from each other.—Spawn, fig. 24 ; a portion enlarged, fig. 25.

The animal was now much reduced ; and, on the 20th of June, had become greatly disfigured. Nevertheless a new mass of spawn was discharged ; and the parent was evidently dead.

The whole spawn subsequently disappeared.

PLATE I.

- FIG. 22. *Hirudo grossa* at rest.
 23. Extended.
 24. Spawn.
 25. Portion of the same, enlarged.

§ 4. HIRUDO CAMPANULATA—*The Bell Leech*.—Plate I. figs. 26, 27.

Two specimens of this animal occurred among a quantity of miscellaneous marine collections, but whether they were young or adult, no circumstances enabled me to judge.

Length, when extended, thirteen lines, body round, diameter about half a line. The anterior extremity dilates as a very broad disc, somewhat like a flattened hand-ball ; the posterior extremity dilates in the same manner ; sucker very large proportionally. Colour of the body dark olive, finely speckled with yellow. Disc and sucker very pale.

These animals were extremely restless. They perished in a fortnight from accidental impurity of the water.

PLATE I.

- FIG. 26. *Hirudo campanulata*.
 27. The same enlarged.

§ 5. UDONELLA CALIGORUM.—Vol. I. Plate LXVI. fig. 11.

Among those ordinances for which human reason cannot account, is that paramount decree of Nature prompting living animals to destroy each other.

Amidst such wonderful means to kindle the spark of life ; amidst the complex machinery to sustain it ; the care and precautions for its transmission, how can it be credited that there are countervailing agencies purposely devised for destruction ?

Yet certain it is, that one-half of the animated world will readily devour the other ; nay that one more powerful being will remain the only survivor among all its fellows.

Neither numbers nor dimensions distinguish the assailants ; some are mere atoms ; others bear along the most gigantic proportions. Myriads of diminutive creatures wage a deadly war against a single victim ; or myriads of victims fall an instantaneous prey to a single destroyer. The end is the same, the devoted must perish.

But the modes of destruction are different. Sometimes the flesh is consumed ; sometimes the blood is exhausted.

In all this the final object of Nature can be scarcely mistaken, as, unless for the purpose of destruction, the victim would not have been provided.

In as far as hitherto ascertained, all the species comprehended by the present genus fall within the class of destroyers. If doubts subsist of the fact, it is perhaps from the defects of history. Thus their sustenance is soft and succulent.

Among the crustaceous animals, or those with shelly integuments, recently described, we have spoken of a parasite, the Caligus, which infests various kinds of flattened fishes. This singular parasite is itself infested by another, of altogether a different nature, and of infinitely smaller dimensions.

My attention was directed to it between twenty and thirty years ago, when first observing the Caligus.

I was afterwards gratified to find that it had come under the notice of Dr George Johnston, who, considering it a leech, had named it *Udonella caligorum*.

This is a minute white cylindrical animal, with a sucker at the posterior extremity, whereon it rises erect, or swings the body in all different positions. The integument is too opaque to expose the contents distinctly. None of my specimens extended to more than two lines, those of Dr Johnston have equalled four, nor have they been alike opaque.

This animal is not always present on the *Caligus*, but it sometimes appears in great numbers. By gross enumeration about 150 were computed as adhering to a dead *Caligus*.

There are frequently present along with specimens on the *Caligus* numerous clusters of extremely minute capsules, as they appear; some full, and others of the same cluster empty. But whether these belong to the *Udonella* is uncertain.

Extremely minute specimens of the *Udonella* are occasionally seen on the neck of the *Hirudo muricata*, lurking among the prominences.

Though a longer series of observations, conducted under favourable circumstances, might be requisite to determine the precise position of the *Udonella caligorum*, it may safely receive a provisional place among the *Hirudines*.

§ 6. HIRUDO OCTO-OCULATA, SEU VULGARIS.—*The Eight-eyed Leech*.—
Plate II.

I have not ascertained that more than four marine leeches, including the *H. grossa* and *Udonella*, belong to Scotland. But those inhabiting the fresh-water are perhaps more than in due proportion to the space which the whole territory occupies on the surface of the globe. If the number specified here have fallen under the notice of one individual, it may be readily presumed that more have occurred to others. I consider it fortunate when we can study the genera of animals without having recourse to those of foreign seas. If the matter be viewed philosophically,



Hydrocote oculata.

does it derogate from the interests of physiologists that the products of the creation are accessible ?

Authors seem to have been perplexed in finding a name for the *Hirudo octo-oculata* different from that by which it is thus distinguished. But I do not see that any of them merits preference. Therefore I mean to retain *Hirudo octo-oculata* or *vulgaris* in the little I have to say on the subject, trusting to render it sufficiently explicit.

The concomitant delineations will aid the description.

The principal distinctions that I have observed among many specimens consist in size and in colour. They are larger or smaller accordingly, lighter and darker, all tending to red or brownish-red, plain, or figured.

Length above two inches ; breadth above a line and a half ; body nearly linear, flattened, especially when in motion.—Plate II. fig. 1, quiescent ; fig. 2, extended.

This animal is divided into numerous segments, 99 or 100, according to M. Moquin Tandon ; the sides bounded by a clear margin, scarcely visible unless in a state of repletion. Eight minute black ocular specks are on the anterior extremity ; six of them distributed singly ; but the last on each side having a fellow, thus constituting a pair ; fig. 3, enlarged. One of the pair is in continuation of the ocular arc, as it may be called ; the other is inner or nearer to the medial line of the body.

Viewed from a distance, the animal is of smooth, plump, uniform aspect ; but narrower inspection shews it to be of reddish-brown colour, mottled with black, as if divided into compartments, whence another more expressive specific name might have been given perhaps—*Hirudo tapes*, the Carpet Leech. Considerable difference subsists in the intensity of colour, but the elements of all are reddish-brown, sometimes very dark, and rendering the aspect of certain subjects of much coarser appearance than others. The peculiar marking of the surface is not to be overlooked.—Fig. 4, enlarged.

This species is less impatient of the light than many others. It is very restless ; but, like all the rest, more tranquil in the morning.

It is a fierce, active, and voracious creature ; feeding greedily on flesh, and even waging a destructive warfare against its own tribe.

Seven having been taken and consigned to a vessel, I found one of them soon after attempting to swallow the *Hirudo stagnalis*, which, though of small dimensions, seemed too large for its gullet. The head of the prey is first absorbed; and, as all predacious animals apparently employ a definite mode of attack, this may be the best way of defeating resistance. As if in just retaliation, the eight-eyed leech is itself the victim of others of its more powerful kindred. In the natural state it seems to subsist also on the succulent plants, and on decaying wood, but always preferring animal substances. Though feeding copiously in confinement, its size declines progressively; the excretions are in the form of long thickish spiral threads.

This species is very extensively diffused in Scotland. It is found in lakes, ponds, streams, and marshes. The quality of the specimen depends much on the abundance of food, and the facility of retreat. Many dwell on aquatic plants, or occupy the under surface of stones. If a quantity of the former be pulled up, and heaped on the ground, the leeches soon quitting their haunts descend as if in quest of shelter, when they will be readily found on the earth below. They seem always to retreat downwards.

From the facility of procuring and preserving the Eight-eyed Leech it is particularly convenient for observation. But the labours of the naturalist are commonly abbreviated by casualties, especially the susceptibility of disease, which few specimens escape. The sucker and whole lower portion become motionless, and covered with mould, so that the upper half is living while the under is dead. Perhaps the temperature of an apartment is too high, or so different from its wonted dwelling as to prove pernicious.

No species is more adapted for shewing the progress of the embryo, from the moment it becomes visible until fair maturity, and issuing forth in perfection from the ovum of the parent.

This is properly a capsule, with an integument, not a shell, and of a brownish-yellow colour; the longitudinal segment of an ovoid, smooth and convex. The longest capsules extend about two lines and a half, by somewhat less in breadth. The longer axis is always parallel to the

corresponding axis of any cylindrical substance, whereon the capsule is deposited—for example a bulrush. Its position is frequently oblique, on substances of greater diameter. A red speck is readily seen at each extremity of those of lighter colour.

Some of the capsules are found vacant, and thence abortive in production. Others contain from one to twelve minute white specks, the elements of as many future embryos.—Figs. 5, 6, 7, 8, 9, capsules after nature; figs. 10, 11, enlarged.

The embryos are scarcely perceptible by the naked eye, and are dispersed like grains irregularly in the capsule. None are evidently confined by any peculiar involucre; nor are they arranged in any definite or reciprocal position. The form of the advancing embryo is so irregular as to occupy in appearance a great portion of the capsule.—Figs. 12, 13, 14, 16. If several embryos occur in the same capsule, there is scarcely room for their growth. The young leech at length escapes in proper season.

In a vessel containing two leeches, two capsules were deposited on August 27. Ten single specks seemed to be included in one of them, and apparently seven pairs, together with a single speck, in the other. The contents of the latter had, to my apprehension, resolved into single specks in a few days. But the capsule proved wholly abortive ultimately.

On the 1st or 2d of September six or seven of the ten in the other capsule were enlarged, as if inflated; and on the 13th of the month, six or seven pale, dingy leeches, ranged together longitudinally, were discovered occupying the capsule in common. Observation had been interrupted during the interval. The motion of these animals, sensible on the 14th, became gradually more evident on the 21st, when the body was curving and extending. Finally five of them escaped through one of the red spots above mentioned, on the 29th, though apparent maturity prognosticated an earlier exit. Two still within the capsule sometimes advanced from below, as if irresolute whether to attempt the same means of liberation. One adventured on it next day, and the other on that following.

Thus thirty-one or thirty-two days had intervened between deposition of the capsule and the maturity of its contents.

On the 13th of August several leeches had been committed to a cylindrical vessel of water, for the purpose of obtaining their capsules. One appeared in four days, which contained five specks. Two of these, however, proved either illusive or abortive; but three of them, enlarging circularly at first, had become oval in the course of development, as embryos, within a week. Eleven days subsequent to the production of the capsule they extended and contracted; yet neither external eyes nor internal organs were visible. They were of singular structure, the whole being formed as if by united vesicles or large globules; all having some rotundity,—nothing angular. It could not be determined whether they were hollow. Two of the embryos were nearly equal; the third, between them, smaller. In a fortnight they occupied nearly the whole capsule; and in eighteen days from its production very little of it remained free. In twenty days the lower half of the young appeared deeply corrugated, yet no segments were perceptible, neither could circulation of the blood be discovered. Quite a different character distinguished the upper half of the animal, in being perfectly smooth throughout, thus inducing me to conclude the dark portions of the other to be intestinal. The eyes appeared as minute specks across the front of the upper surface. The surface of the skin had a reticulated aspect, and there were slight remains of the vascular structure above described, fig. 14; one of the embryos enlarged, fig. 15. No other motion than simple contraction and extension was then sensible.

Two having attained maturity forsook the capsule thirty days after it was deposited; the third, testifying much activity, escaped two days later.

Thus, in August and September, the eight-eyed leech comes to maturity in thirty or thirty-two days after production of the ovum containing it.

The young leeches on exclusion extend to about the third of an inch, and are of pale amber colour, swim actively amidst the element, and adhere by the sucker in the course of the day.

It is of the deepest interest to the reflecting mind to watch the progressive evolution of matter from the moment the dormant spark of life

shall be elicited. Here the regular advance is completely disclosed by the transparency of the capsular integument. It is seen that life may subsist a considerable time; that the component parts may be greatly enlarged or refined before the attainment of such vigour by the embryo as enables it to demonstrate its own animation. Several days before the young leech adventures to escape, the eyes have become visible, a pair on each side, being situated at some distance behind the lunate series of four in front. Transparency of the capsule also exposes the great disparity of the brood, and that it is in every possible arrangement: farther, that the relative position of the young is altered, and that they traverse their prison in all directions previous to seeking another abode.

Several capsules are produced by the same parent, both prolific and abortive, and in various numbers, independently of which the embryos are also contained in various numbers. It is difficult, however, to attain accuracy, as the production of some capsules may precede the selection of specimens of the leeches for observation. One specimen, taken July 26th, produced four capsules from the 29th of that month until the 8th of August. The third was vacant of specks; the first, second, and fourth contained eight, six, and five respectively. Another, taken August 19th, produced the last of five capsules on the 25th of September. Each of the first two contained ten embryos, the third eight, and the fourth seven. The fifth proved abortive. Thirty-five young, therefore, had come from the same parent.

Where there are several embryos, some are generally abortive; but there is no definite proportion in this condition.

At first the capsule is almost transparent; and, it may seem singular, that there are no previous sensible indications of its presence in the body of so small an animal as the eight-eyed leech. Its actual production is rarely to be witnessed.

Some days after several specimens had been taken, it was observed that one of them, affixed by the sucker, exhibited an enlargement of the body, at about a third of the length from the anterior extremity. It continued twisting itself very slowly, in such a manner that sometimes the

back, and sometimes the belly, was next the side of the glass, to which it still adhered. The mouth of the animal was frequently directed towards the enlargement, which was bounded by two slight contractions of the body. The motions continued half an hour, no covering meantime investing the enlargement. But two small light brown glutinous drops having fallen down among the water of the vessel, a very thin pellicle seemed to be formed on the outside of the ovoidal part of the enlargement. This pellicle thickened over it, occupying the interval between the two contractions, which comprehend the orifice of the oviduct. Yet no sensible pellicle covered it, that is, the orifice. Tenuity might render the pellicle invisible. Perhaps we may conjecture that the pellicle forms a capsule, surrounding the body of the leech, which is withdrawn through the red specks seen at its extremity after receiving its complement of ova or the matter containing them from the oviduct. The capsule was evidently formed outside of the animal. While it became more and more conspicuous another leech in the vessel tore off a portion with its mouth; when the original leech around which it was formed having contracted and withdrawn the head, the ragged capsule slipped over like a sheath, and fell to the bottom.

The whole process was extremely singular, nor is it altogether very intelligible. Yet there seems no illusion. It rather indicated that the capsule was formed externally by some exudation of the body; and the leech apparently straining itself to bring up something, the embryonic matter produced the ovoidal form of that portion comprehending the orifice of the oviduct. The body having discharged its contents might be contracted and withdrawn from the capsule, which, if entire, would remain agglutinated to the vessel. If the exudation is from the oviduct, it is not evident how it can invest the body. The brownish drops fallen down shew the existence of fluid matter.

Two years preceding the incident above related, I had an opportunity of observing the progressive formation of a capsule. It first resembled a film, through which about a third of the animal's body protruded downwards. After remaining almost quiescent, the head being withdrawn, the capsule remained much disordered, and shapeless. But

the head having been again introduced, and also withdrawn several times, the capsule was in some minutes fashioned into a broad ovoid, the embryonic specks being shifted about by the pressure of its parts, while the leech seemed occupied in diffusing it on the glass, and after promoting its adhesion, it was forsaken.

Now the capsule was nearly transparent, exposing five white specks towards the centre. It underwent scarcely any change in an hour. With the lapse of five hours it had acquired the fine brownish colour of others.

It is evident, therefore, that the capsule is originally a film formed around the body of the leech, and through which a portion of the anterior, comprehending the orifice of the oviduct, passes. Farther, that it receives the embryonic specks directly from the oviduct itself; but whether in fluid matter, or in a common involucre, or separately, is uncertain.

There are only two obvious modes whereby the capsule can be produced; first, as an entire sac; second, as an exudation, like the protecting silk, or sheath so often quoted, from the surface of the skin.

The capsule is always pellucid originally, and great irregularity always subsists in the number, the position, and the progressive evolution of the embryos.

In the years 1803 and 1812 a leech occurred to me in the parish of Abercorn, which I was induced to consider a variety of the *octo-oculata*. Having no opportunity of afterwards revisiting the spot, which was a small marsh, I directed a quantity of its contents to be transmitted in a pitcher, being then fifteen miles distant, expecting to find some of the subjects resembling those previously obtained.

I was not disappointed; they confirmed my earlier observations, in as far as denoting that they had been made on a slight variety of the *Hirudo octo-oculata* or *vulgaris*.

This variety rather exceeds the dimensions of ordinary specimens. It is of a fine, smooth, uniform colour, of delicate aspect. The body, consisting of numerous segments, is wholly environed by a broader, clearer, and more distinct margin than the other. No speckling, mottling, or reticulation distinguishes the surface. But there is some irregu-

larity, though not sufficient to disturb the position of the animal as a variety.

A specimen fed on white-fish in preference to flesh.

This variety is also found in the city of Edinburgh, in a ditch or rivulet of a hollow, about fifty yards south of Athole Crescent, which has afforded the finest specimens, figs. 17, 18 ; head of another specimen enlarged, fig. 19.

PLATE II.

- FIG. 1. *Hirudo octo-oculata (vulgaris)*, the Eight-eyed Leech, crawling.
 2. The same, quiescent.
 3. Anterior portion, shewing the number and distribution of the eyes, enlarged.
 4. Section of a specimen, shewing the aspect of the surface, enlarged.
 5. Capsule.
 6. Capsule observed in the course of formation, as it appeared the day after production.
 7. Capsule produced on August 3.
 8. Capsule produced on August 3.
 9. Capsule containing eleven embryos.
 10. The same, enlarged.
 11. Capsule with embryos, enlarged.
 12. Development of embryos on August 9, in capsule produced August 3.
 13. Development of embryos on August 9, in capsule produced August 3.
 14. Development of embryos twenty days after production of the capsule.
 15. One of the embryos of the capsule fig. 14, more enlarged.
 16. Capsule containing embryos, 16th August 1843, enlarged.
 17. Variety of *Hirudo octo-oculata*, crawling.
 18. The same, at rest.
 19. Anterior portion or head of a specimen of the same, shewing the distribution of the eyes, enlarged.

§ HIRUDO SANGUISUGA—*The Horse Leech*.—Plate III.

This species being so familiar, by name at least, to most people, especially those dwelling in the country, and being so profusely dispersed



Leeches

throughout Europe, any notice of its peculiarities may here seem unnecessary. But it is notorious, that many of the less skilful are frequently embarrassed in distinguishing the Horse Leech from the Medicinal Leech, and that nothing is more common than the substitution of the one, which is of no medical use in human distempers, for the other, sometimes proving of special benefit. Thus a few general observations on some of the characteristics of each, may assist those in case of necessity, who have no better means of ascertaining the difference—premising, however, that on this, as on all other occasions, my remarks are applicable to those animals alone that have been in my own possession.

The Horse Leech presents a considerable diversity of aspect, according to the individual specimens. I do not know whether this may truly indicate the diversity of species ill-defined, whether variety, or to the want of uniformity among them, which may be identified. The whole tribe undergoes such extraordinary alterations and modifications of form, size, and colour, that the observer may be very readily deluded.

Length above five inches ; figure round ; at rest, or while swimming, it is flattened. The body is divided into numerous segments, amounting to ninety-eight, according to M. Moquin Tandon, exclusive of the suckers. Ten ocular specks are marginal on the anterior extremity, set with tolerable regularity. But these must be sought for in younger specimens only, for, in adults, they are either quite inconspicuous, or to be discovered with the greatest difficulty,—easily to be credited in endeavouring to apply the microscope to so restless an animal. Amidst the different shades of colour, green is always predominant. This is either uniform throughout on the back, or speckled with darker lines : it is lighter on the belly, which is sometimes yellowish, when the speckling becomes more conspicuous. Occasionally the belly is dark-blue. Several slight variations frequently occur, so that such modifications are perplexing.—Plate III. figs. 1, 2.

The observer may be farther embarrassed by the successive alteration of the aspect of some specimens. Leeches of full size are seen almost black ; but, if the light fall in a certain direction on the back, two variegated lines, still darker, may be discovered. A specimen extending

above two inches and a half, proved, appearing in general the soundest of any of the leeches, particularly embarrassing. The body was round, deeply annulated, of dusky reddish-brown, with ten marginal specks on the anterior. This leech fed readily on fish, and it devoured a specimen of the *Hirudo octo-oculata*. In common with all the specimens of the *sanguisuga*, it frequently left the water. With the lapse of seven months the colour had become dull green, with some black spots on the under surface; and in a year from the date of its capture, it had become quite green, the same spots still remaining.—Fig. 3, back; 4, belly; 5, head, enlarged.

This is an active, bold, and clever animal, frequently crawling out of the water, and apparently always ready to quit its vessel. None of the tribe surpasses it in voracity. Few animal substances are rejected. All kinds of fish, dead or alive, seem acceptable. Penetrating the cavity of the larger fresh-water shells, the Horse Leech takes up a permanent dwelling there, until emptying them of their contents, should it be able. Several of this and the preceding species, the *octo-oculata*, having been collected from the same place, one of the latter, half swallowed by a Horse Leech scarcely double its size, was discovered struggling for liberty. But its ferocious enemy, adhering firmly by the sucker, and undulating its body in the water, as if to aid deglutition, occupied three hours in finishing its task,—when it appeared much distended by so copious a repast. Another attempted to devour a dead leech of a different kind, absorbing the smaller extremity here, as the former did with its living companion; but the latter proved too large for its gullet. Considering the strength of the prey, indeed, and the adhesion, it appears a hardy effort of leeches to devour each other, unless under great disparity of size.

A quantity of sand and rocky pellets are often discharged by these animals when recently taken, which may be perhaps ascribed to the nature of the creatures swallowed entire along with them.

Leeches seem to be readily injured by excesses in feeding. Adhesion of the sucker becomes impaired; and knots or enlargements of the body, indicate a distempered condition. They are then benefited by crawling through clefts and crevices, or among stones, with which last, and with

mud, their natural habitation, the vessels of all should be provided. Likewise abundant replenishment with water at short intervals is essential, as the copious exuviation of such animals sometimes renders it turbid.

The Horse Leech is of easy preservation from its natural habits. Its appetite for fish, flesh, or vegetable matter, is very promiscuous; and it remains long out of the water uninjured, not only resting beneath stones on the margin of ponds or marshes near its native haunts, but in captivity, adhering to that portion of glass vessels above the surface of the water.

Favourable opportunities, and suitable treatment, might perhaps tend to establish those which I have considered only varieties, to be distinct species, as purposed by some of the continental naturalists.

Two small specimens, neither exceeding an inch and a half, were taken among others in May. A row of black spots of lighter hue ran down each side of the back.—Fig. 6. One of these two having crawled out of the vessel, its body had accidentally sundred. Ten spots were seen on the margin.—Fig. 7.

The specimen which had been mutilated survived two months, when I thought I observed a papilla prominent on the wound. But the subsequent disappearance of the animal, induced me to conclude that it had fallen a victim to some one stronger of its kind.

The restlessness of the Horse Leech is in proportion to the temperature of the atmosphere, and the effects of hunger. No creature is more susceptible of cold. In the middle of summer, specimens quite torpid, are found under stones beyond the margin of the waters.

Collectors sometimes attempt to palm the Horse Leech for the Medicinal Leech upon their neighbours. I once received half a dozen from an apothecary in Edinburgh, desirous to know of what species they were, as he had been offered about fifty. These were small, dark, with black specks on the belly.

The owners of lakes and marshes likewise very often conclude that they have discovered sources of profit from the presence of these animals, supposing them the medicinal species.

While at North Berwick, several years ago, I was informed that a small pool on the summit of a rocky islet, Craigleith, at some distance from the shore, abounded in the Medicinal Leech. Having obtained between twenty and thirty specimens, dwelling among thickish mud, all proved on examination, to be the Horse Leech. They were rather under middle size, none exceeding three inches in length, when animated by the heat, for, although taken in the month of July, they were almost torpid.

About the same proportion of the Horse Leech may be taken from under stones on the margin of a lake, as found in the water.

PLATE III.

- FIG. 1. *Hirudo sanguisuga*, The Horse Leech ; back.
 2. Belly.
 3. Young specimen subsequently becoming green ; back.
 4. Belly.
 5. Head with ocular specks.
 6. Variety? back.
 7. Head with ocular specks.
 8. Variety? quiescent.
 9. The same in motion.
 10. The same enlarged.

§ 6. HIRUDO MEDICINALIS—*The Medicinal Leech*.*—Plate III. fig. 11.

Perhaps no animal of the known universe has contributed more to alleviate the sufferings of mankind than the Medicinal Leech. Hence its utility as the principal remedy in many distempers has been high and permanent.

* Mr Brightwell, an accomplished naturalist, observes, that the Medicinal Leech is found occasionally in the neighbourhood of Norwich. Also that a dealer in leeches residing in Norwich, keeps a stock of about 50,000 in two large tanks of water floored with soft clay, wherein the animals burrow. Many capsules were found by Mr Brightwell deposited by the leeches in the tanks, which the owner had always neglected or destroyed from ignorance of their nature.—*Brightwell on Hirudo geometrica, and some other species of British Fresh-Water Leeches, Annals and Mag. of Nat. Hist.*, v. ix. p. 13.

Inexperienced observers, and even some medical practitioners, less accustomed to note the minutiae distinguishing the lower animals, may be aided in their knowledge of the Medicinal Leech, by the accurate figure of a fine specimen, Plate III. fig. 11.

Although this animal be very often confounded with the Horse Leech, which bears the greatest resemblance to it in form and habits, the difference between them will be sufficiently conspicuous on comparison.

The Horse Leech is of coarser aspect. Its colour generally of uniform green. If variegated, it is with darker spots or speckling, often different, being fainter or stronger, with sometimes a very narrow yellow marginal line down each side.

Fine specimens of the Medicinal Leech, also green, are distinguished by six yellow lines of peculiar form along the back, the four interior resembling a chain, which alone are enough of themselves to characterize the animal amidst all its kindred.

Much allowance must be made at all times, however, for the intensity and various shades of colour, partly derived, it may be, from the fluid matter lubricating the skin of such creatures.

The Medicinal Leech is alike restless, and as voracious, as any others of its kind. It can scarcely be confined, never failing to quit its vessel whenever opportunity permits. But none has been subject to more mistaken treatment from ignorance of its true nature, or has been the source of more notorious errors. From observing it survive a long time without any substantial aliment, many conclude that none is required,—that it may live in total abstinence. Because its position is often shifted in stormy weather, it is alleged to be an infallible barometer, not only for the present, but that it gives certain prognostications of wind or rain. But the gradual extenuation of the Medicinal Leech amidst pure water, proves its common nature with all other animals requiring food, and its thirst for blood indicates the quality of its sustenance. It is an animal which devours flesh greedily in confinement. The soft bodied tribes denominated *Vermes*, *Mollusca*, and their congeners, besides many others, are peculiarly susceptible of immediate external impressions, or

of such as are derived through the medium of fluids. Heat, together with the purity of the surrounding element, conjoined with hunger, form the principal stimulus to activity. Absolute torpor follows exposure to even moderate degrees of cold. Hence the secret, regarding which, reserve is sometimes practised—immersion of leeches in tepid water to facilitate their use on application. The size and vigour of all the tribe depend much on genial temperature, together with the frequent and copious renewal of their native element. Their survivance otherwise is only a testimony to the tenacity of life. Here, and in the greater and sudden atmospherical alternations, will be found the source of those barometrical demonstrations ascribed to the Medicinal Leech. These originate in its susceptibility of external impressions.

Like the former, this animal has ten marginal specks or eyes, and these are generally so obscure, that it is difficult to find them. There is little besides that is remarkable in its appearance. Its size is very variable, those being considered full-grown which extend three, four, five, or six inches. Some are even larger.

The Medicinal Leech is known to be indigenous in different parts of Scotland. I once received three from Lochleven, one of them a fine specimen, Plate III. fig. 11, which is represented rather above the natural dimensions. Two also reached me from Muthill, said to have been taken in Loch Fleury, described as on the summit of a hill near Blairn-lone, three miles south of Comrie, and six miles west of Crieff. A pool near the Loch of Menteith has been named as containing this animal, and also certain ponds belonging to John Burn Murdoch, Esq. of Gartincaber. A lady in the county of Fife, is the reputed owner of a pond containing Medicinal Leeches, which she reserves exclusively for the use of the poor. Likewise I have been told of a leech distinguished by yellow lines, but of more questionable identity, inhabiting Loch Turrit, about three miles west of Crieff.

Besides the preceding, various other places have been named, though I do not repose much confidence in the species reported, without seeing specimens.

The leeches from Muthill were very large. On carrying them to

an apothecary's for comparison, they proved at least thrice the size of any of his stock. They had been taken by a person accustomed to the capture of leeches as a source of emolument. Here, of late years, they had become scarce at the places previously affording them.

Speculative persons have suggested the expediency of attempting to breed the Medicinal Leech in sufficient numbers in Scotland, for the purpose of dispensing with foreign supplies. I recollect, during the Peninsular war, that they had become extremely scarce, and were sold at an extravagant price. I doubt not that the experiment might succeed to a certain extent, though it might be only one of curiosity.

Dr Fleming, a learned and zealous naturalist, the Professor of Natural Science in the New College of the Free Church of Scotland, lately apprised me of an interesting fact as within the sphere of his own knowledge. Above twenty years ago an apothecary, whose name I forget, dwelling in the town of Cupar in Fife, having a convenient rill of water, together with a pool in his garden, succeeded in breeding the Medicinal Leech. Penetrating the sides of the pool, the animals there deposited their ova or capsules, one of which Dr Fleming shewed me. It is of a singular nature, a perfect ovoid, of spongy texture, thick sides, and comparatively large diameter. It is of a greyish, brownish, or yellowish colour. Each of such capsules contains several young.

Breeding the Medicinal Leech is rendered the source of profit on various parts of the continent of Europe.

M. Moquin Tandon suggests the expediency of promoting its multiplication, and refers to a letter of the same year, from M. Chatelain, acquainting, that from 1140 adults he had obtained 7000 young.

Until recent years the Medicinal Leeches reached Scotland by rather a circuitous route. They were imported chiefly from Sweden through London, from dealers following that trade exclusively. An apothecary having commissioned ten thousand, as he informed me, they were packed among grass in two large bags, and sent by sea. Two hundred and fifty perished on the passage, which occupied ten or eleven days. Numbers of five hundred or a thousand are said to be conveyed in a bag without either

grass or humectation ; and they are distributed in Edinburgh and the neighbourhood, or even at some distance, in chip boxes.

Of late, however, an extensive dealer has established himself in this city, to the great convenience of the public.

A considerable traffic in leeches has recently sprung up between France and the province of Constantine in Africa. They are carried by the native Arabs in earthen vessels to the city of that name, and sold there at the rate of about half a guinea per thousand. The amount of this branch of trade is computed at £12,000 or £13,000 annually.

PLATE III.

FIG. 11. *Hirudo medicinalis*.

§ 7. HIRUDO COMPLANATA—*Glossipora tuberculata*.—Dr James Rawlins Johnson.—Plate IV. fig. 1.

It must be certainly accounted very absurd, though proposed by one of our most distinguished naturalists, to change the name, sufficiently established, of an animal, because some spot, wart, or tubercle, or a few additional stripes or hairs, happen to be observed which were previously unnoticed. Therefore I prefer as explicit enough, the name formerly bestowed on the present subject.

The *Hirudo complanata*, or flattened leech, extends an inch and a half in motion, and nine lines when at rest. It is comparatively thin, the body resembling the outer longitudinal section of a pear. Instead of the soft and flexible consistence of the preceding leeches, the body is rigid, and the skin somewhat hard, so that certain observers have ascribed a crustaceous character to it ; neither does the animal swim. It is remarkably quiescent, its motion always slow, and effected by bringing the sucker and the head in juxtaposition, when the head being relieved, is secured as a farther advance, and being secured again, the



Cont. des pl. I.

sucker is brought forward to complete the step. But the mode of progression will be better understood from inspection than by description. Six black eyes or ocular specks are disposed in three pairs on the surface of the anterior extremity, fig. 3. The posterior extremity has a very firm adhesion by the sucker. A margin of peculiar conformation, waved and tuberculated, environs the body. Three tubercles, susceptible of elevation and depression, rise from each convexity, fig. 5. The various hues of the animal are considerably modified according to habitation, age, and sustenance. Young specimens are dingy yellow. Grey is always predominant in adults; the back generally ash grey, with two rows of short dark streaks. Some are spotted white, many altogether greenish, or very dark. Such diversity appears in the disposal and the fashion of the colours, that it is probable they will afford sufficient means for establishing more than one variety.

Where transparency admits, the interanea of all leeches, filled with the blood of other animals, present a curious and interesting object. Here there are ten lateral cells diverging from each side of a main trunk in the middle, all connected with a common proboscis, and coloured according to the nature of the food absorbed by it. It was from the discovery of this tongue or proboscis, other leeches having only substances like indurated glands for teeth, that induced Dr James R. Johnson to constitute for this species the genus *Glossipora*.

The natural abode of this species is in lakes or ponds, on the under surface of stones, on decaying wood, or in the recesses formed by the folds of the Iris and other aquatic plants. It frequently assumes a supine position, remains a long time motionless, or affixed by the sucker, undulates its extended body like some others of its kind. It is often difficult to be removed without injury, but it always drops off spontaneously on very short exposure to the air.

The *H. complanata* feeds abundantly on both animal and vegetable substances. It is greedy of mussel, dwelling long over it, and absorbing a great quantity. From this quality of food the body is often stained of greenish hue, though the interanea be less conspicuously distinguished by repletion. But this indicates the dispersion of the sustenance through-

out the system, by means which merit the attention of those investigating the comparative anatomy of animals. The natural and favourite prey, however, seems to be the *Helix peregra*, within which, as an insidious and implacable enemy, it wages perpetual and destructive war. None of the leeches are deterred by disparity of size, or of strength, from the attack. The smaller, as well as the larger, assail their objects, regardless of the external safeguard provided by nature. The leech becomes quickly sensible of the introduction of its prey into the same vessel. Then relaxing from its wonted sluggishness, it begins to manifest symptoms of activity. Meantime the victim shews no apprehension at the advance of its deadly enemy, nor does it make any attempt to escape. One or two leeches now seat themselves on the shell, and as the tenant protrudes freely, they stretch their heads towards the opening, endeavouring to insinuate them within, whereby a lethal wound may be inflicted on some remote organ. The prey then struggles violently to free itself, but in vain. The assailant, adhering firmly by the sucker, cannot be dislodged; and these very exertions for liberation from its enemy, which might be most effectual in shaking off another invader, tend to expose the body still more to invasion. The creature seems to become incapable of retreating within the shelter of its impenetrable dwelling, and of closing up the entrance for protection. While ascending the sides of the vessel to free itself of such an oppressive incumbrance, its life is gradually wasting, the faculty of adhesion fails, and it tumbles to the bottom, overcome by its merciless foe.

Whether the victim perishes first by exhaustion of the fluids or consumption of its flesh, is uncertain; but the darkening of the intestinal pouches of the assailant shews that it has fed copiously on the prey. These pouches are rendered exceedingly conspicuous, displaying their regular distribution, and the peculiar conformation of the lowest pair.

Disparity of size is no protection to the *Helix*, for the largest of the prey seems unable to contend with the smallest of the enemy. On one occasion two leeches of inconsiderable size advanced to the attack, each endeavouring to insinuate its head under the victim's shell. The first retired without having produced any sensible effect; the second persisted perti-

naciously ; and now the animal protruding from its shell was evidently suffering. In this state I left them for several hours, finding the shell empty on my return, while the appearance of seven other leeches in the vessel plainly indicated that all had shared in the slaughter.

The margin of all ponds inhabited by the flattened leech and the *Helix peregra* is strewed by myriads of these shells. Before ocular demonstration of the preceding phenomena, I was inclined to ascribe the havoc among the latter to some kind of epizooty, such as that which is incident to every animal, according to its kind, from the highest to the lowest, rather than to a ferocious enemy. But this enemy has as little mercy on the *Patella fluviatilis* (*Ancylus*), a diminutive limpet, though the mode whereby the prey, more defensible, perishes, has not been observed.

The *Helix* above named seems to be preferred to all other food ; but the leech will sometimes devour mussel and other animal substances.

This species begins to propagate at an early period. There are prolific specimens under half an inch in length when extended. The chief season of breeding is March and April, and it continues throughout summer. Many are very prolific. Ten of eleven specimens, taken promiscuously for observation, produced ova in the course of a month. The mode of propagation is very remarkable, nor do I know that it has been sufficiently investigated, either by myself, or by other naturalists. Six or seven specimens were sent to me from the distance of fifty miles, and along with them some of their natural prey. What I considered an incipient ovarium was visible in some of the largest during the third week of March. Though not uniform in all, this resembled a regular collection of granules down the middle of the body. Where most distinct the under surface of the animal exposed the interior on March 20, as in fig. 11. Subsequent observation seemed to indicate that the granules occupied pinnate interanea, or were arranged in that form. Then they were yellowish, very conspicuous, and in certain specimens contrasting much with the grey colour of the belly. If truly the elements of originating ova or capsules, I was unable to follow their progress by slight gradations.

However, in a stratum of ova which appeared on the surface of the belly of two of the smaller leeches in the collection on March 22, and contained apparently in two somewhat circular compartments, I computed thirty-three in the larger leech. In both animals a few, seen less distinctly, seemed to be under the stratum. All the ova were quite opaque, not of equal dimensions, but of little sensible difference, and were computed to be about a quarter of a line in length.

It is thus that the ova appear externally on the body of the parent. Their number, as well as the number into which the whole are divided, is various, according to the individual producing them. On the 29th of March seventy-five appeared in four compartments, the smallest or highest with only eleven. This specimen, fig. 8, was delineated next day.

The compartments are generally about four in number, as seen with tolerable accuracy; by superposition there may be more. They are not superficial strata however, but seem upon being dislodged, to be contained in real transparent capsules, each probably invested by its own integuments. This displacement may be effected by insinuating the thumb nail suddenly under the sucker. Three capsules, containing twelve, thirteen, and fourteen ova respectively, separated entire, and fell to the bottom of the vessel on March 22. Instead of twenty-four ova, as I had computed in them, there were thirty-nine; one portion is represented as on March 26; fig. 13, enlarged. The parent made no search after them on separation, and affixed itself to a part of the vessel where none lay.

On the 5th of April nascent leeches were issuing from the preceding capsules; and the contents of one were entirely dispersed. Therefore those naturalists who affirm that the ovum does not hatch if detached from the parent are mistaken.

This ovum is of regular conformation, as may be discovered through the thin integument of the capsule. Herein the embryo reposes during the progress of evolution. At an early period it appears as a long obtuse ovoid, then the body is bent, and the head and tail in contact; and next they recede from each other, and the embryo straightens. The whole embryos are sometimes seen in motion within the capsules, and at length escape from an aperture in the side. They are then pale grey, and

cylindrical ; and although hatched in twelve or fourteen days after production of the capsule, they remain long attached to the body of the parent.

The whole brood of fig. 12 consisted of about one hundred young, all which had forsaken the parent in forty-three days after the capsule was produced, though some returned temporarily. They feed very soon, as may be discovered from the contents of the interanea.—Figs. 7 and 16, enlarged.

The young frequently assemble in numerous clusters on the side of their vessel after having quited the parent, and in a short time abandon it, each departing to provide for itself.

These animals have a tendency to dwell in society, especially towards the close of autumn. If a number be then introduced into a vessel, with one of the valves of some of the testacea reversed, all will crowd under it for shelter.

They are generally very inactive, and will remain entire days motionless among the mud.

This animal is an excellent guide to some obscurities in the history of the leech. Its history affords the following conclusions :—

1. The *Hirudo complanata* is dispersed in the greatest profusion in Scotland.

2. It appears in much variety of size, colour, and general aspect ; sometimes uniformly dull, sometimes speckled, sometimes with a margin formed of rectangular compartments.

3. It feeds on different animal and vegetable substances, but its natural prey is the *Helix peregra*.

4. It produces several capsules invested by a transparent integument, and the young, after production, remain attached to the under surface of the body.

5. Embryos, distributed in regular numbers, become visible in the capsules at a very early period.

6. The embryos attain maturity in twelve or fourteen days, and then issue from an aperture in the side of the capsule. But after quitting it, they remain for some time attached to the body of the parent.

7. A single adult may produce one hundred young.

PLATE IV.

- FIG. 1. *Hirudo complanata* ; the Flattened Leech ; adult, back.
 2. Another specimen.
 3. Head of fig. 1, enlarged, shewing the eyes.
 4. Head of fig. 2, enlarged, shewing the eyes.
 5. Margin of fig. 1, enlarged.
 6. Margin of fig. 2, enlarged.
 7. Interanea as displayed after feeding.
 8. Young specimen already propagating ; back.
 9. Belly of the same, with ova.
 10. Belly of an adult, with incipient ova.
 11. Belly of an adult, with numerous ova.
 12. Belly of another specimen, with numerous ova.
 13. Capsule or matrix with ova, enlarged.
 14. Group of young from the capsule.
 15. Young seventeen days old, from the capsule ; back, enlarged.
 16. Belly of the same ; the sucker yet inactive.

§ 8. HIRUDO STAGNALIS—*The Pond Leech*.—Plate IV. fig. 17.

This is an animal widely diffused throughout Scotland, though, perhaps, not in equal profusion as the preceding. It is smaller, not so broad in proportion, nor alike of varied colours. The largest specimens scarcely exceed an inch in length ; they are of more taper form, and more uniformly grey ; and they dwell in lakes, ponds, or ditches, and in places with but little water, lurking under stones, and especially beneath the bark of decaying trees and branches, where its abode is permanent. Two distinct large black eyes may be observed in the front of this leech, from which the name ordinarily assigned to it is derived. The margin of the body is of peculiar formation, being a series of convexities, forming that kind of border called *inverted* in the technical language of heraldry. It appears to me that in some perplexed cases regarding identity of species, and perhaps of genera, their solution might be aided by resorting to the margin of the subject.

On the whole, the pond leech is more slender, and testifies more activity, than the flat leech ; also its adhesion by the sucker is slighter in

power, though it does not drop as readily off branches, stones, or other substances on exposure to the air.

It feeds on the vegetable matter among which it dwells, and it likewise consumes fish.

Having accidentally committed a quantity of decaying leaves to a vessel containing eight or ten specimens, I saw them four or five hours afterwards on the side, with beautiful vivid red matter filling the interior, thus shewing the minute differences between the formation of these organs, and those of the *Hirudo complanata*, while corresponding in general arrangements. When compared with the animal itself, and contrasting their own peculiar conformation and colour, they proved among the most interesting appendages of animation.

In prosecuting my enquiries into the history of those creatures, I availed myself of certain facilities offered by a decaying boat which lay on the margin of a pond, and served as a receptacle for the leaves of trees on the progress of autumn.

Here the leaves macerating in the rain water, afforded a nidus for numerous larvæ of the musquito tribe wherein to undergo their metamorphoses. I was now in a condition to ascertain that one of these animals, of the brightest vermilion colour, was the natural prey of the leech. Yet none of the larvæ were in the pond, nor any of the leeches in the boat.

When the prey is introduced to vessels containing the leeches, they raised themselves on the sucker, as if surveying around ; then some one bolder than the rest advanced, endeavouring to affix itself to the victim, which having effected, the position is pertinaciously maintained in spite of its writhing and struggles. Should such an attack occur at night, an empty brown, transparent skin, scarcely visible, is all that remains of the prey in the morning, while the intestines of its enemies are seen replete with the red substance that constituted the body. It is singular how the fleshy matter of the prey is extracted, while the integument is left quite entire.

Besides repletion with the red larva, the viscera of the leech is often full of a darkish substance, either animal or vegetable, for it possibly consumes the softer portions of decaying plants. But the naturalist will

always obtain the most favourable and interesting inspection of them by supplying the favourite prey.

The pond leech breeds in the end of May or the beginning of June, and sometimes afterwards. I do not know that it is equally prolific as the preceding subject, the *complanata*; but their mode of propagation bears a narrow resemblance to each other.

An irregular cluster of ova is first seen indefinitely through the thin skin of the under surface, far down the animal, and rather towards the sucker. These daily grow more distinct, appear whiter and spherical, and may be enumerated as nine, or in greater number. But they are not external. Such was the aspect of a prolific specimen on the 15th of August.—Plate IV. fig. 23.

The breeding season may be earlier or later. On June 25, many of this species were taken from a small pond in Heriot Row garden, in the centre of Edinburgh, where they dwell in vast profusion. At that time all the young were hatched. Like those of the *Hirudo complanata*, not one was free from young ones.

The *Hirudo bin-oculata* and *complanata* dwell together in lakes, where they may be found at almost every season, but the preferable period for observation is generally between the beginning of April and the beginning of September.

PLATE IV.

FIG. 17. *Hirudo stagnalis*; *bin-oculata*—the two-eyed leech, adult, back.

18. Belly of the same.

19. Head and eyes enlarged.

20. Margin enlarged.

21. Larva whereon the *Hirudo bin-oculata* preys.

22. Fly from the same.

23. Prolific *Hirudo bin-oculata*, under surface, shewing a cluster of spawn.

§ 9. HIRUDO TESSELLATA—*The Chequered Leech*.—Plate IV. fig. 24.

I have been much perplexed in endeavouring to identify this animal with the *Hirudo tessellata*, or Chequered Leech, of the Linnæan sys-

tem, allowing that to be the interpretation ; nor are my doubts altogether dispelled.

Animals may be identified with others from general resemblance, or the peculiarities of their parts ; but it is the constant subject of regret that in too many descriptions and representations, the obscurities and the fallacies utterly preclude recognition of the truth.

It is quite obvious that the vast majority of the leeches offered in illustration have been delineated from dead, preserved, or rather decayed specimens, or from those half-starved by injudicious treatment.

The generic character may be said to consist in the presence of the posterior sucker ; the specific character, in the absence, the presence, the number and position of the eyes ; but of any one of all these the skilful naturalist will avail himself.

The anterior extremity is either a flattened disc, or merely a tendency to an obtuse triangle. Such a condition appears in the *octo-oculata*, the *medicinalis*, and *sanguisuga*, the *complanata* and *stagnalis*, but often very indefinite. Or the disc is lanceolate, as in those of which we have still to speak, the *tessellata*, *vitrina*, and *flava*.

I could not discover eyes in any of the four marine species, *udonella*, *grossa*, *muricata*, *vittata*.

In the fresh-water leeches, especially the subject of examination, the eyes have been as follows :—

Two on the front of the head—*Hirudo bin-oculata*—*Hirudo flava*.

Six in three pairs on the front of the head—*Hirudo complanata*.

Eight set around the margin of the head—*Hirudo octo-oculata*.

Eight set in four pair in the middle of the anterior surface—*Hirudo tessellata*—*Hirudo vitrina*.

Ten set around the anterior margin—*Hirudo medicinalis*—*sanguisuga*.

These are the only arrangements I have seen in twelve different leeches occurring to me in Scotland.

Although both extremities possess the faculty of fixture, it is chiefly predominant in the posterior organ, where the adhesion is generally very powerful if the subject be vigorous.

It seems to me that sufficient distinctions are afforded among leeches to constitute species, by very definite characteristics among the whole twelve enumerated. Yet authors have not been so fortunate as to seize those, and placing individuals beyond all doubt and difficulty.

The figure of the Chequered Leech, at rest, is the longitudinal half of a pear, between five and six lines in length, by about the same in width across the longest diameter; when extended, it stretches about two inches and a quarter, when the width at the base is three lines, and the diameter of the sucker one line. The anterior extremity when extended, is somewhat of a long lanceolate form, with four pair of black eyes down the middle, very distinct, the outer pair rather smaller than the others. The body is environed by a broad, thin, crenate, not chequered margin, with a row of yellow tubercles.

The body is divided into segments somewhat broad, and divided by narrow circles. Its substance is wholly gelatinous—quivering with the slightest motion.

This is infinitely the finest and most beautiful of the Scottish leeches, generally of a fine translucent green, speckled black and yellow. Sometimes there appear several longitudinal rows of yellow specks interspersed with black specks; sometimes all are disposed with less regularity.—Plate IV. fig. 24. *Hirudo tessellata*, quiescent, under surface; 25, in motion, upper surface; 26, eyes; 27, margin; all those figures somewhat enlarged.

The colour undergoes considerable variation. It fades as the water becomes stale, and revives in a deeper green when renewed. The belly is leaden-grey, minutely speckled.

The viscera of this leech are more numerous, and of different formation, from those of any others. When replete they are alike conspicuous, and probably less so, according as they are more or less empty. They seem constructed after the same general plan, however, as the viscera of the *complanata* and *stagnalis*. In a small specimen replete with food, they seemed to consist of eighteen pair diverging from right and left of the main trunk or stomach.—Fig. 28, back; 29, belly; 30, the same enlarged.

I have been unable to ascertain the nature of the food, which may

be animal and vegetable substances, possibly the inmates of the Testacea. I once thought some portions of the *Veronica beccabunga* in decay had been consumed, and at another, that a different leaf, the only substance accessible, had been also consumed. Yet the fact was not corroborated. Neither have any experiments with the Testacea proved satisfactory, chiefly, however, because they may not have been sufficiently made. It is only on discovering errors that we may hope to correct them. Yet the naturalist is very often, and very unexpectedly, disappointed. The food in the viscera has always seemed dark.

These animals are frequently in motion. I had one which could not be said ever to rest. It traversed its prison incessantly, as long as in my possession. During progression the two extremities are approximated, to enable the creature to take its step, wherein it resembles certain caterpillars. The body then rises in great convexity above the surface.

Being an animal rarely disseminated in Scotland, I have never had the good fortune to find specimens so early in the season as to expose immature ova. Perhaps they propagate at an early age, probably by ova borne in a transparent capsule, round the surface of the belly, or affixed to it, and that the embryos bursting thence in segments in the same way, affix themselves to the surface of the skin. This habit seems peculiar to the young of the flattened leeches, the *complanata*, *stagnalis*, and *tessellata*, or in other two of which we have yet to treat.

Here the observer is very liable to delusion in computing the young from a single parent in any of three species here named. Nor can he fix it with any certainty, without a previous enumeration of the capsules pertaining to each.

The young do not adhere permanently to the same adult, for they shift their position. Therefore no uniformity is seen in their number.

Early in July I observed at least 150 young adhering to the belly of a specimen, which appeared very careful of them,—folding its body longitudinally as if for their protection, while it crawled along. The brood attached to another still remained late in September.

When departing, the young animals cluster on the sides of their

vessel, sometimes as many as fifty being together, whence they disperse to establish themselves independently.

Six weeks after the preceding specimen, apparently so prolific, had been taken, the young began to desert it, transferring their abode to another specimen in the same vessel.

Both specimens were found dead two or three weeks subsequently ; but with the exception of a few stragglers, all the young had collected in a group on the side of the vessel. They thence dispersed themselves, and afterwards died in October.

The young are sometimes grey, finely speckled or green. They swim supine under the surface of the water, though ill adapted for moving in such a position. A cluster affixed to the parent has appeared bluish.

Some adults are greyish green, but their natural colour seems grass-green, speckled yellow, and somewhat changeable, and, as above said, the colours may be revived, by renewing the element.

I have found this animal in Coldingham Loch in Berwickshire, and in the counties of Edinburgh and Linlithgow. I was indebted to Sir Walter Trevelyan, Baronet, for several specimens from the island of Bute. Nevertheless the species is rare, and it seems to have disappeared entirely from some places where it dwelt a number of years ago.

PLATE IV.

- FIG. 24. *Hirudo tessellatata* (*seu gelatinosa*), the Chequered or Gelatinous Leech, quiescent, upper surface.
 25. The same active, under surface.
 26. Outline of the head, shewing the position of the eyes.
 27. Margin.
 28. Specimen having fed, back.
 29. The same, belly, shewing the interanea.
 30. The same, enlarged.

§ 10. HIRUDO VITRINA—*The Glassy Leech*.—Plate V. Figs. 20, 21, 22. 23.

Nothing can more favour the study of the naturalist, than an opportunity of inspecting the transparent animal, when he beholds the free



*Lunde
vitina & flava*

and unconstrained operation of the vital functions. Their play is without violence to the living being, or the suffering inseparable from artificial exposure of the parts. Neither convulsions, contraction, nor irritation impair or impede the due exercise of the peculiar functions pertaining to the respective organs.

But this is an advantage to be very seldom gained. We have just witnessed some approximations to it, which, in this particular race of animals, can be scarcely carried farther.

The peculiar form of the head, the number or arrangement of the eyes, and the consistence of the body, distinguish the preceding species. That which is before us is not quite so strongly marked, but it evidently belongs to the same division of the genus *Hirudo*.

I regret, however, that only a single adult specimen has come into my possession, discovered by the same affectionate relative, the companion of all my excursions and researches, as noted, when speaking of the *Cristatella* in a previous treatise.

The deficiency of adults, however, has been fortunately in a great measure compensated by a profusion of the young ; affording still another example of the benefit that may be eventually derived from preservation of a single specimen.

The subject in question extends above two inches, tapering slightly from near the sucker, where it is between two and three lines in breadth. The head is lanceolate, with four pair of black eyes, in the middle of the surface, disposed much as in the Chequered Leech, but the animal not being in as favourable a position, a less distinct view has been obtained. The body is divided into numerous narrow segments, so numerous, that at first sight I supposed it a small specimen of the *sanguisuga* or Horse Leech. The colour is universally dark green, and its appearance much of the character exposed on the fracture of a common dark green bottle. The surface is faintly speckled under the microscope ; and the belly somewhat paler. Like the *tessellata*, the substance is tremulous, though to a slighter degree than in that animal.—Plate V. fig. 20, *Hirudo vitrina*, back ; 22, belly ; 21, head irregularly contracted ; 23, young specimen.

When this subject was obtained on July 24, many of its young were adhering to the belly. They were of a faint purple colour, and I rather think that ova or capsules also were present, but I could not ascertain the fact. It is always very embarrassing when animals are concealed by each other.

The first of the young quitting position was on the 5th of August, when about a line in length, of a pale grey colour, with a head evidently lanceolate, like the *tessellata*, wherein eight black eyes were distinctly exposed, arranged in four pairs, fig. 23. This is an accurate representation of the animal.

The form of the viscera could not be precisely discovered, owing to opacity of the parts. But among the same collection two small leeches were found, with the same number of eyes, disposed in a similar manner. In these, numerous ventral sacs, nearly pinnate, stood across, and were of a very ornate form. These small animals, between two and three lines long, were probably of the same species, but both so restless, that to obtain drawings of them proved impracticable. Indeed, no creature can equal the leech in this respect; nor does it seem to me that the delineation of living specimens has been attempted at almost any time. The patience and perseverance of the artists employed on those represented here were admirable.

The parent was not observed to consume any kind of food; hence it was soon reduced in size, and much weakened. A few of the young continued to separate, but the presence of so many as remained, was evidently very injurious. The animal suffered much, and its sufferings were aggravated from the presence of such a multitude, entirely precluding the application of the belly, and its adhesion to any substance whatever.

All the young had forsaken the parent on the 8th of August, when they proved to be no less than sixty in number. But the parent scarcely survived; and contracting to the dimension of a quarter of an inch it died.

All the young were of a flattened figure, and adhered to the side of the vessel.

This creature is very rare. It dwells in some pools opposite Craigmuck Castle, three miles west of Edinburgh.*

PLATE V.

FIG. 20. *Hirudo vitrina*, back.

22. Belly, with young adhering.

21. Head irregularly contracted, enlarged.

23. Young leech bred from the parent, enlarged.

§ 11. HIRUDO FLAVA—*The Yellow Leech*.—Plate V. figs. 1–19.

This is one of the few leeches which we are enabled to distinguish by the form of the head.

These animals, which are incessantly variable in shape, seldom afford such permanent features as contribute to their distribution in natural order. Hence we are ready to combine more than one to obtain a sufficient aggregate of characteristics. Nor do those features depend on the external shape of the animal exclusively, for they may beneficially comprehend casual occurrences belonging to the animal.

The number of the eyes in the individual species of this genus are two, as in the *bin-oculata* and the present subject; six in the *complanata*, eight in the *octo-oculata*, eight in the *tessellata* and *vitrina*, ten in the *medicinalis* and *sanguisuga*. I have found no further varieties. But in

* A single specimen of this species was found by Mr Brightwell in the river at Costessey, in the county of Norfolk; which, with a query, he conjectures to be the *tessellata*. He observes that his specimen was nearly cylindrical, about an inch long, colour green, "with two indistinct whitish longitudinal series of spots above, and two spots underneath; the whole body magnified, appears studded with small dark irregular spots." He kept this specimen about two months. He now found that the young, which were attached to the parent, amounted to 143. The eyes of the parent could be scarcely discovered with a lens, those of the young were conspicuous.

It rather appears that this is not the gelatinous leech, though presenting some remote analogies in the longitudinal series of spots above.—*Ann. and Mag. of Nat. Hist.*, v. ix. p. 13.

those with eight, the eye is disposed in two different arrangements, being either marginal, or in four pairs.

The length of the specimens of this species when quiescent, was from six to more lines ; when extended about fourteen lines. General form not unlike the Medicinal Leech. Form of the head lanceolate or trout-shaped. Eyes two, black, in front. The viscera consist of thirteen pair of transverse sacs, sufficiently conspicuous in some specimens. The body is composed of numerous segments slightly indented.

The predominant colour is yellow, sometimes very vivid, sometimes dusky ; and there are specimens whose contrasting hues expose four longitudinal rows of beautiful yellow spots, running down the whole back to the sucker, which itself has a marginal circular row. Under the microscope these, so ornamental to the eye, prove to be only irregular transverse short marks.

Though the general form of the animal while quiescent corresponds with that of the *medicinalis*, it is not so thick, plump, and heavy as the *tessellata*, nor alike tremulous. Also some of the young at an early stage appear quite cylindrical.

Much of the beauty of this animal depends on the colour. Besides the four rows of yellow spots down the whole back, there is a marginal row on each side, which can be seen from below.—Plate V. fig. 1. *Hirudo flava*, young ; 2, the same, enlarged ; 3, head more enlarged ; 4, another specimen, natural size, back ; 5, the same, enlarged, sucker *a* ; 6, belly of the specimen fig. 4 ; 7, the same, enlarged, sucker *a* ; 8, head more enlarged, shewing the eyes.

It has not appeared what is positively the food of the yellow leech. The ponds wherein I have found it abound more with decaying leaves than with anything else which was likely to afford it sustenance, and it always reposes on or under them.

This species breeds chiefly from May until August, and is a fine example of what, in more important living beings, might be called a marsupial gestation. Hence a great correspondence is shewn with the nature of those with which it has been more associated, as with the *binoculata* and *complanata*.

About the 20th of May, a faint, dull, whitish patch appeared on the under surface of a specimen which had been taken in the course of spring. It seemed as if sunk in the flesh, and of indefinite form. But in a week it was so far advanced as to exhibit about forty ova, rather irregularly disposed. When viewed from below, they were much more distinct, and in two days appeared globular, and of a fine yellow.

Another prolific specimen was taken on June 5. Being committed to a glass vessel it adhered to the bottom, and continued to do so while the vessel was reversed. Now, a large portion of the belly was discovered to be invested by a stratum of eighty-three spherical ova, like beautiful minute pearls. They were arranged in six rows with tolerable regularity; but I could not determine whether they were contained in a pouch, or simply adhered to the belly of the parent.—Fig. 9. Next morning it had shifted its position. Twenty-seven of the ova having been detached, they lay at the bottom of the vessel.

More continued to separate, so that on the 19th, only three remained attached to the body of the parent. Many had also decayed.

Those in preservation were of a fine vivid yellow colour. But they were resolving into a different form, and becoming more plump and yellow, but not extending over above a line in length.

On the 21st a group of ova was delineated, the individuals apparently contained in a transparent segment. Unluckily they did not reach farther maturity; nor were any of them divested of the involucre.—Fig. 11.

On the same day, the 21st, the parent was entirely free of ova.

I regretted the loss of the young, from the difficulty of finding specimens to complete my course of observations.

However, another specimen exhibited brood on July 11, amounting, as I conjectured, to seventy or eighty spherical and ovoidal yellow ova or capsules. It may be here remarked, that the natural evolution of spherical ova with a flexible integument, is necessarily into an ovoidal form, as mere prolongation of two opposite parts must have this result.

This new specimen was rather under size, for there is a great and

frequent disparity in the dimensions of all soft animals ; and it was rather languid and contracted. Its eyes did not appear round, but somewhat irregular under the microscope.—Fig. 12,

The ova were expanding to vivid yellow young on the 23d, all still adhering to the belly of the parent.—Fig. 14 enlarged ; a cluster of ova more enlarged, fig. 15.

In two days longer, they seemed to be very deeply indented by a number of segments, and some as if a deep cleft had been received in front, though these appearances subsequently proved illusive. The young animals were slightly curved, and they lay close together. I rather impatiently expected them to be free in a few days, for they did not admit of convenient observation.

All the young were still *in situ* applied to the belly of the parent on the 28th of July ; several were liberated on the 29th.

The indenting segment had been computed as containing twelve or thirteen. But it was now evident, from the free application of the microscope, that the supposed annulations or segments, were thirteen pair of ventral sacs within the integument of the body, and exposed by its transparency ; farther, that the supposed cleft was only an interval near the sucker. Likewise, the yellow colour plainly resulted from the contents of the sacs ; and it was further discovered that the young animals had red eyes.

A favourable opportunity occurred of inspecting one which had quitted the parent, when it appeared that adhesion to the belly is not by the sucker, which is very large, but too weak to be effectually used for some time ; that the red eyes are very conspicuous ; and that the contents of the ventral sacs are speedily dissipated when they appear in greater number, as if composed of smaller compartments.—Fig. 18, enlarged ; more enlarged, fig. 19.

Thus a tolerably connected series of observations on the yellow leech was obtained, though some important points of its history still remain for elucidation.

The animal is rare.

PLATE V.

- FIG. 1. *Hirudo flava*, the Yellow Leech, young.
2. The same, enlarged.
 3. Head more enlarged, shewing its form, and the position of the eyes.
 4. *Hirudo flava*, adult specimen, back.
 5. Sketch of fig. 4 enlarged; sucker *b*.
 6. The same, belly; sucker *a*.
 7. Sketch of fig. 5 enlarged; sucker *a*.
 8. Head more enlarged.
 9. Prolific female slightly enlarged, with a stratum of ova or capsules, under surface.
 10. Early appearance of spawn in a prolific specimen.
 11. Intimate appearance of seven embryos, enlarged.
 12. Prolific female.
 13. Head of the same, enlarged.
 14. Under surface of fig. 12, more enlarged.
 15. Cluster of ova, more enlarged.
 16. Young still attached to the parent, enlarged.
 17. The same when further advanced, and free.
 18. One of the young farther advanced, most of the contents of the viscera being discharged, more enlarged.
 19. Head of the same, shewing the red eyes, enlarged.

The leech is an animal of very peculiar habits, and the more likely to attract notice, on account of its being brought into such immediate contact with mankind,—extremely restless in its nature, most voracious in its appetites, greedy of blood, and patient under protracted abstinence,—these are sufficient, with its real properties, to render it an object of interest, without resorting, as in fabulous eras, to imaginary virtues for embellishment. Its utility in assuaging human calamity ought to be of itself sufficient.

The leech exhibits many peculiarities. It is social, or it is solitary; dwelling under cover, and numbers clustering together, protected by stones, shells, and other solid coverings, or descending among the mud on the approach of winter.

Though active in the finer season, these animals generally shun the light ; its presence seems to create uneasy sensations. But it must appear somewhat remarkable, that in the *Hirudo muricata* or Skate Leech, no organs of vision have been as yet discovered.

Leeches are extremely dependent on the temperature of the atmosphere. What is genial to most other animals is refrigerating to them, and at a very moderate degree torpor succeeds activity. All are extremely voracious whenever opportunity offers, greedily devouring fish, flesh, and other animal substances. Nor are the succulent parts of vegetables always rejected. Their voracity is such that they obviously perish of mere repletion. The *muricata*, *medicinalis*, and *sanguisuga* absorb blood in great quantities, but it does not seem to be the aliment of some others. We have seen how bold and insidious an enemy one may be, from which there is no escape, and which nothing less than the life of its victim can satisfy.

A few breed readily in confinement, but rarely those the most valuable to mankind. Of others it seems almost impracticable to obtain the progeny. The propagation of a few, however, discloses some interesting facts in physiology.

It is a cruel and a common error, to believe that the Medicinal Leech can sustain life on water alone, and that without renewal. Unequivocal symptoms demonstrate that emaciation is inseparable from abstinence, and that nothing is so grateful as general warmth and the renovated element.

It does not appear that the history of the leech has advanced in proportion to the number of the literati who have rendered it the subject of discussion.

CHAPTER II.

VERMES.

Nothing promotes the advance of learning equally as approbation and encouragement. Nor can the ardent student of Nature receive a more chilling reproof, than by finding the subjects of his predilection treated with contempt.

If the Author of the Universe deemed the whole animal portion of it worthy of creation, how can that production exist which may be rationally despised of man ?

But ignorance, prejudice, or presumption, are too ready to attach qualities to mere external aspect, to deny properties unseen, or to deride as worthless what they do not comprehend.

Yet true it is, that the rarest virtues often lurk unseen, whence the earliest duty of the wise, the liberal, and the just, is to probe diligently and deeply those marvellous works of Nature continually exhibited to our half-frozen senses.

It was peculiarly unfortunate that so distinguished an author as Linnæus, a naturalist of the highest order, and the first who founded an improveable system, should have comprehended an immense class of animated productions under the general denomination of Worms. Not only does it include a vast variety of living beings void of any common features appreciable by ordinary observation, whether in relation to form or habits, but because the appellation Worms, however justly applicable

to a great part of the creation, summons an host of the animal world into special notice, represented both in sacred and profane writings as utterly worthless, to be regarded with abhorrence, and fit to be destroyed without mercy.

Mankind, the willing instruments of prejudice, and yielding to their destructive propensities, have avoided the investigation of many interesting phenomena of living nature, and have failed in the precepts of reason, as well as the moral principle of humanity, to inculcate the duty of preserving life.

Have they heedlessly forgotten the will of the Divine Author, who saw it good that they should be ?

Opposed by discouragement so great, less surprise must be excited, when it appears that this ample division of the animal world has been neglected, and even despised. Few, indeed, cared for such beings, unless those who were superior to vulgar prejudices, or who, by penetrating a little farther into the history of some of these curious subjects, found inexhaustible sources of admiration.

The mysterious origin and abode of worms in the human body, and in that of various animals, and their generation amidst decay and putrescence, augmented the aversion entertained against them. Nor had the lights of science, until later eras, divulged the metamorphosis which many such loathsome creatures were destined to exhibit, as they passed into beautiful insects, decked in the gayest colours.

Every modern naturalist is disposed to admit how little this particular field has been cultivated—not from being unworthy of cultivation, but from being difficult, obscure, and neglected, insomuch, that scarcely more is known than some of the Linnæan genera, and those proving noxious to the human frame. In all attempts at delineation, also, they are commonly exhibited after the rudest fashion, with a few exceptions, from the labours of the more accomplished authors.

Let us reflect, however, on the obscurity of their abode, on their variable form, on their liability to perish, whereby even simple exposure to the light is often destructive.

The absence of prominent parts renders it difficult to impose the

characters of discrimination ; the ductile, flexible, and variable body precludes determination of its true extent and figure. Neither can it be told whether the specimen is young or adult ; mutilated or entire. The position of the mouth is frequently concealed during life from the most acute observer ; and if there are ocular specks or eyes, they are hid in the dingy hue of the skin. The food is for the most part unknown ; and the mode of perpetuation is seldom within the hope of discovery.

Worms are soft, smooth, naked, round or flattened animals, void of external organs, of variable form and dimensions, with a sliding, sinuous, or serpentine motion, and dwelling chiefly in animated bodies, or in the waters.

In a general sense, worms are smooth, and void of external organs, nor, strictly speaking, is the body distinguished by conspicuous segments.

But in a special sense, worms are animals with smooth bodies, of variable form, extent, and dimensions.

From the late institution of the various sections and genera, and the subdivision of the great family of Worms, many considerable portions are withdrawn from what was long understood to constitute the whole. A new vocabulary, also, has been invented, which it will probably take a long time to interpret and rectify. There seems too great a propensity for the adoption of whatever is offered as a novelty in phraseology, whence it is embarrassing to declare that the subjects of our investigation are identified with those which are the study of our fellows.

In the hope and expectation, therefore, of shunning both collision and confusion, frequently concomitants of each other, and perhaps as leading ultimately to simplification, I shall be content with specifying general descriptions of some individual specimens which have occurred to me. The true scientific arrangement of the subject will remain for those better skilled than I am, and who contemplate a wider range. The indulgent reader may still consider these efforts as contributing to the promotion of knowledge.

Great latitude must be permitted here, for if we consider worms as divided into, 1. Those with smooth, simple, elongating bodies ; 2. Those

which are obviously hispid, or bearing external organisation ; and, 3. The segmentive or Annelide kinds, much is still wanting. It is not clear where one genus terminates, and another begins, or where, in numerous instances, the subject has the precise characters of integrity or mutilation.

It is self-evident that the great embarrassment to forming a suitable and permanent arrangement of worms, originates from the mutability of form, and the absence of external organs. The latter are most important features, whether from shape or position. And as neither the site of the mouth can be discovered in many during life, nor have they visible eyes, what effectual substitutes shall be chosen by the naturalist ?

Worms are smooth, soft animals, inhabiting the sea, fresh-waters, the flesh or intestines of living creatures, and elsewhere, susceptible of various form by extension, contraction, or inflation,—all under extraordinary modifications.

By a peculiar provision of Nature, a copious secretion lubricates the body, apparently designed as a preservation from abrasion by the harder substances amidst which they dwell, and to facilitate their motion amongst them. Perhaps it is present in all.

This substance, which belongs to the hispid as well as the smooth, to the Annelides alike with the simple worms, is produced of very unequal quantity and quality. Sometimes it is abundant, ropy, and transparent, and secreted from the whole surface, from certain parts of it, or partially from organs for peculiar portions only. In some it is consolidated as a silken sheath, wherein the tenant has a permanent dwelling ; in others it is the lining of a covering framed of indurated materials, and mixed up with other elements, such as mud, sand, or stones. It is an ingredient in the paste, compounded by a few for their protection, and it is bountifully provided as a testaceous dwelling for the Serpulæ, and others of the vermicular tribes.

The real distinction, position, and faculties of the organs secreting a viscid matter for the lower animals, and the solid, hard, resisting shell of those considered far above them, is yet but insufficiently understood. But it is produced in such a manner as to be only an addition to what



Cordius rugulosus

already exists, or the covering is totally cast off when several new and durable integuments may be generated, either speedily within short, or leisurely at long intervals.

In the following observations regarding form or appearance, I do not aim at any thing more than recognition of the subject from external aspect.

I. GORDIUS.

Body smooth, round, or flattened, sometimes very long, and casting itself in a knot. Mouth a longitudinal slit in the under surface, somewhat behind the anterior extremity. Sides of the head cleft by a groove.

This genus, which seems sufficiently definite as, 1. *Gordius fragilis*; 2. *Gordius spinifer*; and, 3. *Gordius simplex*.*

The chief external characters of the genus, therefore, are a groove on each side of the head, and a slit in the under surface for the mouth.

1.—GORDIUS FRAGILIS.—Plate VI. figs. 1, 2; and VII. fig. 1.

Having received the subject of this paragraph in the dusk as a fish from its captor, I was induced at first to consider it as a kind of eel; nor would any ordinary spectator have probably thought otherwise. In appearance, in colour, and in motion, it bore an intimate resemblance to many specimens of the most common species.

But this creature is one of the rarest, and among the most remarkable animals of Scotland; which, from certain external characters, seems intimately allied to the *Gordius* race.

It is infinitely the largest of any among the whole vermicular tribes with which we are now engaged, that is, those void of obvious articulations, and prominent external appendages.

* *Lamarck* comprehends the genus *Gordius* under a section of the Planarian tribe. But the definition proposed by him will not apply to those distinguished here by the generic name.—Tom. iii. p. 610.

The length of the specimen was fifteen or sixteen inches, breadth an inch, and thickness about a quarter of an inch ; the whole of a flattened form, nearly linear, diminishing slightly both in breadth and thickness towards the posterior extremity, which, like the anterior, is obtuse. A thin border environs the body, which, sundered transversely, is elliptical.

The anterior margin of the animal is cleft horizontally in front by a shallow groove, deepening as it descends some way down each side of the head ; and there is a dilatable slit, a quarter of an inch long in the under surface, near the extremity of the head, denoting the mouth. Colour universally grey, darker on the upper surface ; the thin border and under surface lighter.

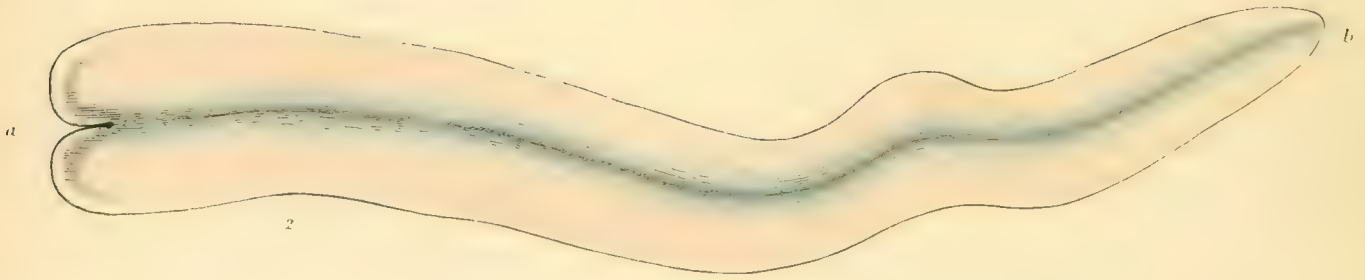
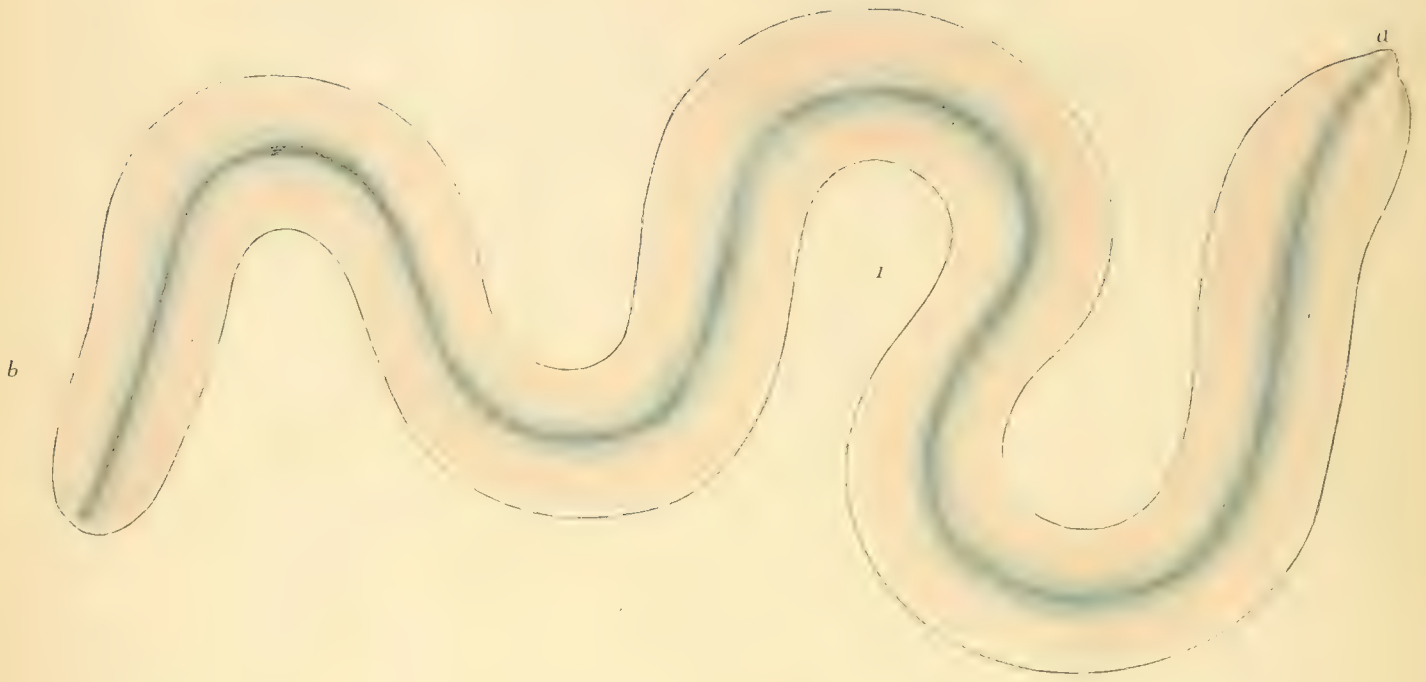
No specks or eyes were perceptible.

This animal swims very actively in long, smooth undulations, the edge or margin of the body being uppermost during its course around the interior of its vessel, which will sometimes continue for hours. But I cannot speak of its precise position, either in a vessel of large capacity, or in the sea, not having witnessed it in either.—Plate VI. fig. 1. *Gordius* in motion ; fig. 2. transverse section, shewing the figure of the body. Plate VII. fig. 1. under surface of anterior portion, shewing the form and position of the mouth, and the marginal groove.

After its lively exercise on the second evening, I found the animal contracted, motionless, and apparently dead next morning, which was the subject of no little regret, from not having had an opportunity of obtaining a correct delineation, always so important in illustrating natural history. It allowed itself to be lifted by the hand without the least resistance ; yet, when committed again to recent sea water in another vessel, all its activity was resumed, which continued till a late hour of the night, when both then, and from subsequent observation, I concluded it to be of nocturnal habits.

The alternate activity and quiescence of this creature are alike singular. Instead of the languid exertions and tardy motions common to the vermicular genera, the gradual unwinding of the sluggish bodies of some, and the extension of others from their secret retreats, the *Gordius*

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Scydus pinguis

fragilis pursues a speedy course amidst its element, occasionally protruding its snout on the side of the vessel above the surface of the water.

Naturalists are aware that the peculiar attitudes, motions, and habits of animals, may aid them in determining the position of those whose proper place is obscure in the *Systema*. On this occasion, nevertheless, I must speak with much reserve, having neither beheld any such appearances as just described protracted among the worms properly so denominated, nor having any certainty that the specimen under observation was entire.

Its state is very different during quiescence. Then, contracting to about a third of the original length, it flattens and broadens, and appears quite inanimate.—Plate VII. fig. 2.

The intestinal canal runs through the whole body, from the mouth to the posterior extremity. At some distance from the anterior extremity, a large portion of the animal was full of a yellow substance, partly exposed by a section, but of the nature of which I could not form any satisfactory conjecture.—Plate VI. fig. 1. Indeed, my anxiety for preservation, prevented me from taking the necessary means of ascertaining this fact.

Several species of the *Gordius* feed ravenously. Lamarck is mistaken in affirming that they subsist by the suction of liquids only. The present specimen was evidently distended at times by water. It refused the animal substances offered, either from being unsuitable, or because the temperature of the atmosphere was too low, which precludes the feeding of many creatures of the lower orders.

Notwithstanding the gigantic proportions of this specimen, considered as a worm, I am ignorant whether it was entire—whether it was not originally twice as long, a fact extremely probable, and that for various reasons.

While full of life and vigour, the creature being exhibited to an ingenious naturalist, sprung so far up the side of its vessel, as to be in danger of coming over. But having been prevented at the time, I felt apprehensive that the body was strained.

My fears proved too true, for within the space of fifteen minutes,

three inches of the posterior extremity were observed sundering from the remainder, the animal at the same time becoming quiescent. The fractured parts being connected only by means of the intestine, I separated them with scissors.

The sundered portion contracted next day to an inch and a half on transference to another vessel.

Now the mutilated trunk remained at rest, but when committed to recent sea water, its wonted gambols commenced as if nothing had happened.

The preceding facts led me to conclude that the animal was a *Gordius*, or nearly allied to the race; for rupture of the body is incident to that genus, and the parts frequently remain contracted, flattened, and still, after it has taken place.

The portion thus sundered did not perish, it continued either quiescent, as seen, Plate VII. fig. 3, or extended and crawling as fig. 4,—on October 15, after losing a fragment, fig. 10, on the preceding day. The same having generated a papilla at the lower extremity, was seen on December 19, as fig. 5.

This large sundered portion, fig. 3, which had separated on October 12, was carefully preserved, in hopes of its reproducing the parts defective at each extremity. For a considerable time its dimensions continued almost stationary. Nevertheless the wounds healed, the anterior part shewed an incurvature, and the posterior extremity was prolonged into a more regular shape, with the lapse of sixty-eight days, or on 19th December, as exhibited by fig. 5.

Four months subsequent to the mutilation, the form had undergone still greater improvement. But neither was a marginal groove to be discovered in front, nor a slit below, denoting the mouth, as in perfect animals.

This was not the only mutilation of the trunk of this specimen. Other three portions had separated from it on October 19, and these being followed by more, only five inches of this trunk or original animal remained entire. In three weeks from the date of its acquisition, symptoms of decay were indicated, it became disfigured; yet when reduced farther to only two inches in length on October 25, life was not extinct, though no animation could be recognised on the subsequent day.

This creature literally fell to pieces, whereof there were nine in whole, of various dimensions, counting the subdivisions of some of them. All, excepting two, decayed soon after separation.

Of these let us denominate one A, already described, being originally fig. 3, and now follow its history, meantime reserving that of the other to be denominated B.

The portion A made no conspicuous advance farther than healing of the wounds, and, in the end of March, it did not appear as vigorous as previously. On April 14, I found it subdivided into three portions, being figs. 6, 7, 8; and on May 3, another portion was separating from the lower extremity, fig. 9. A fragment had separated considerably earlier, on 14th October, fig. 10, reducing it to the shape represented fig. 4. On May 11, that subject A had decayed, which exhausts its history.—Plates VI. fig. 1.; VII. fig. 2.

The second surviving portion of fig. 1, is represented by fig. 11, as on November 27, and now denominated B. A small white papilla from the lower part of it was discernible on November 3, which had now resembled a stout white horn, the upper margin being of a deeply indented heart shape, thirty-eight days after separating. This regeneration advanced much more rapidly than that of the surviving portion A, and appeared as fig. 12, on December 19, the unusual mildness of the season having probably promoted increment.

At this time (and afterwards), I was induced to conjecture that both A and B had some means of absorbing food, from black slender rolls occasionally seen in their vessels.

In 100 days this portion B somewhat exceeded an inch in length, but still without any indication of a marginal groove, or of a slit below. The upper surface appeared, on January 28, as fig. 13, two months later than fig. 11. It extended just an inch and an eighth when crawling; and the form of the newly generated part was very regular, thick, and convex, with a lighter colour, and a margin bordering the thick and darker portion. The original part was remarkably thick, swelling like two bluff cheeks, with a kind of dark grey-yellow tinge, and a light pale grey margin.

This portion B had separated on or about the 20th October ; therefore 100 days had now elapsed.

Although still more satisfied there were excretory rolls, three weeks later I introduced some mud into the vessel, though uncertain whether it was available in any shape.

B continued augmenting, it was very vigorous when delineated for the last time with the newly generated part, on April 14.—Plate VII. fig. 14.

After considerable agitation on April 30, B lost a portion then separating from the upper part, whereby it was greatly disfigured. The separating portions delineated May 3, as fig. 15.

Minute fragments only remained, which were still surviving on the 25th of June, fig. 16, but had disappeared on the 2d of July.

Such is the history, as nearly as I could follow it, of the specimen represented.

It had been obtained on the 2d of October, and the latest survivance of a fragment was known to be on the 25th of June.

Just about a year afterwards, namely, on the 5th of October, another specimen, broken into four portions, reached me, which had been taken the preceding evening, not far from the same place as the former.

The largest portion was about six inches long, but it afterwards extended to ten or eleven ; and I concluded that the specimen, if entire, must have been twice the dimensions of the other.

As far as entire, it was the same in formation and in colour, grey above, the margin light, a portion of the edge of one of the parts reddish, as if from weather. The groove was conspicuous on the sides of the head, while the mouth, as a large slit, appeared in the under surface.

The second largest portion ruptured in two while lifting it on the first day of acquisition, and another into several parts in the course of the same afternoon.

The anterior division, which had extended ten or eleven inches, bending and curving with vigorous action, exhibited some undulatory motions, resembling those of the first specimen, and I entertained expectations of its survivance.

But in this I was disappointed. The animal became broken up into at least ten portions, and none of these lived above a week.

A considerable quantity of thick creamy matter was discharged by most or by all of them.

The ruptured parts of the first portion exposed internal contents, resembling an immense immature yellow ovarium; and some yellow pellets appeared on the bottom of its vessel, which soon decayed. This may be seen in a portion, Plate VII. fig. 17. I felt uncertain, however, as to its real nature, and I was rather disposed to consider as ova many thousand whitish spherical globules discharged on the 1st day of May.—Fig. 18, enlarged.

I am confident, that had the ruptured portions of these animals survived, complete reproduction of the defective parts would have ensued. It is singular that the same tendencies were manifested by all the small parts after subdivision, as by the largest portions before it. It is singular also, that such active regeneration downwards, and a growth at the same time tending upwards, should have occurred simultaneously.

Had mutilations of a vigorous specimen taken place in summer, reintegration might have been promoted by the more favourable temperature of the atmosphere.

This animal is extremely rare. Very few of the fishermen are acquainted with it. Nor do I know that any entire specimen has come under the inspection of any naturalist. Mr Henry Goodsir, one of pre-eminent abilities, observes, in a brief notice,* that the largest portion of three specimens which came at various times into his possession extended about a yard; and in a sketch, probably designed to represent it, the posterior extremity is defective. Mr Goodsir does not say where, or when, this specimen was found. But a fisherman acquainted me that he had given him a specimen in 1843; and Mr Goodsir shewed me a portion of the anterior, extending to a few inches, comprehending the mouth, which he had preserved in spirits.

* Annals and Magazine of Natural History, v. xv., Plate XX. figs. 1, 2.

PLATE VI.

- FIG. 1. *Gordius fragilis* in motion.
 2. Transverse section, shewing the shape of the body.

PLATE VII.

- FIG. 1. *Gordius fragilis* quiescent.
 2. Anterior part; under surface, shewing the site and appearance of the mouth.
 3. Portion sundering from the body, October 11.
 4. The same in motion, October 15, having previously lost the fragment, fig. 10.
 5. The same, having generated a papilla at the extremity. In motion, December 19.
 6. The same (denominated A), as appearing April 14, after losing two portions.
 7. One of these portions separated from fig. 6.
 8. Another of these portions separated from fig. 6.
 9. Appearance of fig. 3, A, as on May 3.
 10. Fragment, which had separated from fig. 4 on the preceding October 14.
 11. Portion B, as appearing 27th November, or thirty-eight days after having sundered from the *Gordius*.
 12. The same as advancing, December 19.
 13. The same, with its generated appendages, 100 days old, January 28.
 14. The same, as advancing April 14.
 15. Spontaneous mutilation having followed the preceding representation; the remainder as appearing May 3.
 16. Final appearance of B, fig. 3.
 17. Sundered portion, exposing the yellow interior of the *Gordius*.
 18. Ova.
 19. Ova, a little enlarged.

PLATE VII.*

- FIG. 1. Upper surface of another specimen in motion—the anterior extremity.
 2. A broken off posterior extremity.
 3. The mouth.



Pterodactylus fragilis

B.—GORDIUS MAXIMUS—*Sea Long Worm*.—Plate VIII. fig. 1.

Though the history of the *Gordius fragilis* be involved in a considerable degree of perplexity, by its rarity, and by certain peculiarities of habit, together with my reluctance to destroy any part of what I had so little prospect of replacing, no hesitation can restrain the free examination of the present subject, which may be considered the type of the genus, assigning only a provisional place to the other.

The ignorant spectator of the Sea Long Worm, might at first sight precipitately conclude, that here is an animal designed by Nature only to be rendered an inconvenience to itself. But were we aware of all the works, and of what was designed by the wisdom of Providence, we should find some marvellous examples of Omnipotent Power, instead of simply wondering at the exhibition of immoderate and disproportioned dimensions.

If the elephant be the most gigantic among the modern terrestrial quadrupeds, so may the Sea Long Worm be deemed in relation to all its fellows among the vermicular tribes of the deep. We behold the elephant as an entire and perfect animal, or, if having undergone accidental mutilation, we can determine the defective parts; we can know the loss, and can compute the precise effect of restoration. But who can affirm that he has ever beheld the Sea Long Worm entire? That he had before him this giant of the race, perfect in its simplicity, or that he can conjecture what is truly wanting? Or who can presume that those apparently of largest size shall grow no more?

To credit the fishermen of the regions where this creature dwells, it is found twelve yards in length; nay, some even describe it as double that extent. But none of many falling under my notice, have exceeded ten feet, or little more.

A specimen six or eight feet long is about a quarter of an inch broad when extended, and somewhat less in thickness. But it is, indeed, most difficult to judge of the actual and relative dimensions of an animal whose size and proportions are varying every moment.—Plate VIII. fig. 1.

A groove in the margin of the anterior forms it into two lips of about equal thickness, and descends some way down each side of the head, which is a distinctive feature.—Plate VIII. fig. 2. The mouth, a longitudinal slit, extending four lines, is in the under surface, at a short distance from the anterior margin, but seldom perceptible, and varies in length with the extension and contraction of the body. No other external organization is sensible, for although ocular specks, if such is their character, be recognisable in the young specimens, as afterwards explained, they are obscured by the subsequent alteration of the adult.

As the body of the adult, at some distance above the lower extremity, begins to taper downwards, it probably terminates in a point.

The whole body is of a fine uniform dark purple colour, sometimes verging on black, presenting a beautiful velvet-looking surface. The anterior margin is pure white.

A great proportion of the length is traversed by a vivid red intestine, diminishing near the lower extremity to the diameter of a hair. When this organ was extracted from a specimen ten feet long, it extended between five and six feet.—Plate IX. fig. 1. But it is difficult to say what it may be when distended with food, its office being perhaps alimentary.

This animal is subject, as the former, to separate into fragments, while these are sometimes divested of the whole intestine. Thence we may presume, that the extremities of this organ are attached to places which have little resistance. Vitality is preserved by it for a considerable time after separation from the other parts of the animal.

I was a long time perplexed regarding the food of the *Gordius maximus*. A creature so unwieldy and unmanageable in itself, appeared to be very ill adapted for overcoming any resisting prey. In the natural state, it certainly enters the tube of the *Amphitrite* to devour the tenant. And in one instance, it seized and devoured a *Terebella* before me, which had lost its protective dwelling, and this, too, in spite of the size and apparently superior strength of the prey. It feeds on mussel also.

The *Gordius* wraps itself up in an intricate knot; whence the derivation of its race. Perhaps the prey entangled amidst the folds falls an

easy victim. It is greedy after what is readily got. Portions of mussel are acceptable, and then the mouth, distending widely, gradually absorbs them. If the valves of a small shell be sundered, the animal fastens on one of them, drags it away, and consumes the contents at leisure. The dimensions of the intestinal canal admit the absorption of a great quantity of food, whereby the subject appears very different on repletion from its aspect under abstinence.

Many other circumstances, combined with the preceding facts, prove the necessity of preserving specimens from their earlier stages.

A small and slender animal, involved in a knot, lay among some corallines; when removed to a moistened glass slider, it extricated the head, and unfolded the body, now extending three inches by about only half a line in breadth. Two black specks, of considerable size, were exposed amidst the white of the anterior extremity under the microscope; the cleft, forming two lips, was sensible, and the whole body appeared striated longitudinally with lighter and darker lines. Thus it was seen in October, Plate VIII. fig. 3; head, enlarged, fig. 4. In three months it extended five inches. At this period I observed, for the first time, that it was wont to enter the tube of the *Amphitrite ventilabrum*, and concluded that it devoured the tenant. This conjecture was strengthened by the speedy disappearance of several of these animals from the vessel. Other food, likewise supplied, was dragged down among the mud and consumed.

Owing to the great difference in the appearance of this specimen from adults, I had supposed it another species of the *Gordius maximus*, the one being of a uniform purple colour, but that under view, distinctly striped as a ribband. Some months later, however, their identity seemed probable. At the period of a second delineation, half a year subsequent to the first, the specimen extended twelve inches. Its growth had been rapid.—Fig. 5. To this its voracity greatly contributed. The anterior surface broadening much after a copious meal, exposed lighter lines; and in fifteen months from the date of the acquisition of the specimen, they became very conspicuous on feeding. Sometimes such distension attending a greedy repast, made me apprehensive that the body would burst.

It had thus undergone an extraordinary change from its meagre, lank, and empty form in abstinence. Now it was rather of a greyish-green colour.

Stones or clean shells should be always stored in the vessels of such animals, for they never fail to encircle them as the knot wherein the body is involved gradually unfolds, which prevents rupture, either on account of unmanageable length, or of immoderate repletion. A glass cylinder was here substituted, which the animal encircled for want of another hard substance. In a year and ten months from the date of acquisition, it extended two feet and half, when it was delineated for the third time.—Fig. 6.

Owing to accidental impurity of the water nearly a year afterwards, the body of this growing specimen ruptured into several parts, some of them surviving for about another year. Thus the animal lived entire towards four years in captivity, during which time it had attained completely three feet or more in length; and, including the separated portions, its survivance extended towards five years. Though enlarging rapidly, if we take the preceding facts as the ordinary course of nature, this creature's life should be of long duration.

In examples originally of considerable size, rupture into parts of all different dimensions soon after being taken frequently occurs, when a very remarkable process follows in the eversion of the interior. The intestinal organ having separated spontaneously, the portions are so many tubes, when the purple velvety outside becomes the inside. How this ensues can be explained only by presuming, that one extremity of the hollow tube folding inwards is followed by the rest, until the inversion is complete.

Though I do not recollect to have witnessed the permanent preservation of such ruptured animals or their parts, amputation of the ragged extremities of specimens will save them, when vigorous reproduction will sometimes ensue. Indeed, this is a precaution to be adopted with many of the lower and simpler animals; removal of the injured flesh or skin, leaving only that which remains unhurt or entire, commonly proves beneficial. One having ruptured the day after arrival, I severed about six inches of the anterior part of the body for preservation. From the great lubricity of the surface, it is ready to elude even the sharpest

scissors, leaving the section ragged or oblique. Here the wound being clean it healed completely. In about seven weeks, this specimen extended about twelve inches, when it was delineated, fig. 7. The computed dimensions of such animals, so variable, however, are somewhat arbitrary. In eighteen months from the time of this experiment, its length had augmented to about eighteen inches, when it perished accidentally.

Similar experiments have chiefly failed of success. The portion, designed to be preserved, has gone to decay, though deprived of the injured parts. I endeavoured thus to save two sections of a ruptured specimen, one being an inch and a half of the anterior extremity, the other about three inches of the body below it. The wound of the former seemed to heal in about a week, and both those of the latter appeared to be so in three or four weeks. But although the thicker end was always in advance while crawling, it had not acquired that peculiar configuration distinguishing the head of the genus during the course of seven months, when both sections perished accidentally like the former.

As light is commonly pernicious to the vermicular tribes, those portions supplied with mud were kept chiefly in the dark.

The intestinal tube is so tenacious of life, that it moves for several days after separation from the body. When small, or seen in sections, it much resembles a distinct animal, and hence have expert naturalists been apparently deceived. Probably of two subjects, called *Vibri marini* by Delle Chiaje as other species, one represented, tom. iii. tab. xliii. fig. 1, may be identified as a portion of fig. 1, Plate IX. of this volume.

The intestinal canal has been of a vivid red in all my specimens except one, wherein, what I considered the same organ, was white.

It is said by Mr Davies, in the *Transactions of the Linnæan Society*, v. xi. p. 294, that he had a specimen of the *Gordius maximus* measuring twenty-two feet long when dead. Having previously poured spirits on it in a bottle, a proboscis, eight inches in length, was projected from the emarginate part of the front. This, also, I conjecture, may have been a portion of the intestinal tube, for I am not aware that the creature has a proboscis.

The dimensions and real aspect of such an animal are extremely de-

lusive ; nor should the observer hastily determine that what he beholds is permanent. The upper portion of a specimen having been sundered for preservation, it soon appeared like a black leech, in contracting to fifteen lines in length, and enlarging to twice its natural breadth. No one could have easily told what it was.

The actual dimensions of the Sea Long Worm being doubtful, so is it difficult to ascertain the number and position of the specks or eyes on the head. A young specimen, one extending only an inch and a half, had two distinct large round specks in front, as in the striped specimen just described, and other three at intervals in a straight line behind each, being eight in whole. These were very conspicuous, because there was more white than usual in the front of the head. But in all animals of the kind, others, though present, may be lost in the darker colour behind. This last specimen resembled the former in the body, having been striated longitudinally.

Whether such specks, common to a multitude of the lower animals, be only rudimentary ocular organs, or actually endowed with visual functions, must remain a very obscure point in physiology. But the *Gordius* is quite sensible of the presence of light ; nor does this seem confined to the anterior extremity. Sometimes while the head is in concealment, the body hangs down in folds, from a higher position, and then evident uneasiness is testified on the approach of a candle, and an exertion to withdraw from its influence.

The natural dwelling of a creature so little adapted for long excursions or predatory attacks, should be in the vicinity of those softer animals constituting its prey. Specimens coiled up within the double valves of old oyster shells, are dredged from the bottom of the sea in various parts of Scotland. I was indebted for the largest and finest ever in my possession to Dr Duguid, who sent it from the Orkney Islands to Edinburgh. Others found among miscellaneous collections, may have forsaken their retreat on disturbance. I once procured two specimens, each some feet in length, by splitting off the slab of a soft shelving rock near low water. Very small specimens thus coiled up, are sometimes seen floating, which is owing less to specific levity, than to the repulsion of



Gordius Maximus

the lubricating matter investing the body. Its abundant secretion is essential to protect the animal, or to facilitate the progress of so unwieldy a creature among the indurated substances.

Length and lubricity combine in endangering removal amidst miscellaneous collections. The specimen not only slips readily from among the fingers, but in proportion to the quantity extricated, the hazard of rupture is augmented. It will generally free itself gradually, rising up to the side of a vessel, especially if some impurity be imparted to the water. But force is never to be employed, or more than sweeping the whole parts together with a feather when liberated.

The Sea Long Worm obviously lives a number of years. Its extraordinary dimensions, independently of direct evidence, would be a strong presumption of the fact. Yet the slightest abrasion of the skin seems incurably fatal.

When clean hard substances, empty shells, stones, glass cylinders, and the like, are introduced into their vessels, these creatures quickly take advantage of their vicinity by encircling them, and thus preserving their body from injury, as security against abrasion and rupture. It is always wound around very firm and solid substances.

A large specimen of a brownish or greyish colour, not of the fine velvet black, first occupied the valves of an empty oyster shell. Innumerable white ova, almost like dust, appeared in its vessel, on the 21st of May; but I know not whether mature, as the animal was ruptured. A group from the rent was delineated, fig. 8, and several free, fig. 9; both figures enlarged. They were white and perfectly spherical, and in myriads, so that their multitude had probably effected the eruption of the parent.

The delicacy of all the aquatic vermicular tribes, exposes them to destruction from very slight vitiation of their element. They endeavour to escape by ascending the side of the vessel, so as to be nearer the surface. Some, without any impurity of the water, are induced, by the smoothness of the glass, to crawl so far as to be scarcely able to recover the place they have quitted, and frequently become agglutinated to the spot, where they perish.

PLATE VIII.

- FIG. 1. *Gordius maximus*, the Sea Long Worm; adult.
2. Anterior part of an adult, shewing the marginal cleft.
 3. Young specimen.
 4. Anterior portion of the same, shewing two black specks on the surface of the front, enlarged.
 5. The same specimen half a year after its delineation, as fig. 3.
 6. The same after having been kept twenty-two months from the first.
 7. Anterior portion, which, for preservation, had been severed from the body of a specimen, and subsequently regenerated the lower extremity.
 8. Cluster of ova, enlarged.
 9. A few detached ova, enlarged.
 10. Ova, of the natural size.

PLATE IX.

- FIG. 1. *Gordius maximus*, intestine.

C.—GORDIUS TENIA—*The Ribband Gordius*.—Plate X. Figs. 1, 2.

Length sixteen inches or more; breadth of the anterior above a line. The head and sides of the anterior cleft; mouth a slit below, very conspicuous. Colour from dull reddish-brown to pale red; belly paler. A white stripe traverses the whole length of the back, which is divided in the centre by a dark line, thus rendering the animal very like a ribband.—Plate X. figs. 1, 2.

The colour of the back consists of five lines, the two exterior stripes being the broadest, having a white line within each, and the central dark line between them. No specks or eyes have been discovered. The extremity of the anterior is white.

This animal takes shelter in empty shells, or in the tubes of other tenants of the deep, from which it may be dislodged by vitiating the water. But it is the last of all that I have seen, which, yielding to the offensive medium, quits its haunts.

On June 1, a vast quantity of spawn, consisting of innumerable minute spherical white ova, figs. 3, 4, amidst a thin glairy matter, ap-



1



4

5



12



1



14

8

13

3

Handwritten text in a cursive script, possibly a signature or name, written vertically.

6

7



15



11



16



17

9

10

Continuata

peared in the vessel containing fig. 1. This animal is not rare, but seldom seen above four inches long. The finest specimens I have had were from Alexander Wood, an intelligent fisherman at Cellardyke.

The resemblance of the *Planaria dorsalis* of Müller to this *Gordius*, renders it probable that he has mistaken a mutilated portion of the anterior for an entire specimen; not an uncommon error among naturalists.

Specimens have survived many months in my possession.

PLATE X.

- FIG. 1. *Gordius tenia*.
 2. Another specimen.
 3. Ova.
 4. Group, enlarged.

§ 2. GORDIUS MINOR.—The features of the two preceding species are sufficiently distinctive in the position and form of the mouth, the anterior portions, and in their extraordinary dimensions. Yet it must be allowed, that we are ignorant whether the form of the posterior extremity of the first has been ascertained. But the characters of all the species comprehended in this paragraph are not equally strong,—and although some of them may be thought prominent enough, probably we are deficient as to others, either to determine their varieties, or to assign them with confidence to their proper place. Accidental mutilation may have removed a part essential for shewing form, size, or colour, while the observer believes his specimen entire and perfect. Patience, time, and numbers are perhaps his surest safeguard here. However, he can scarcely expect any protection against the constant delusion of varieties.

The only permanent characters of the animals of this paragraph, are the form of the head, and position of the mouth. They are of various colours, especially white, green, brown, reddish, and purple. A fine specimen, eight inches long, occurred of pale purple. They dwell under stones, in fissures of the rocks, and they take shelter under any miscellaneous mass that may be in their vicinity. The elasticity of the body renders all computations of the true dimensions equivocal.

A.—GORDIUS MINOR VIRIDIS.—Plate IX. Figs. 2, 3, 4, 5, 6, 7.

This is a littoral animal, dwelling chiefly under stones on the shore within the flowing tide. Length seven or eight inches ; breadth a line or more. The head is distinguished by a groove, as that of the *Gordius maximus*, and, like it, the mouth is a longitudinal slit in the under surface of the anterior. Colour universally green ; darker on the upper surface, paler below.—Plate IX. fig. 2, head, shewing the groove ; slightly enlarged, fig. 3.

This animal feeds voraciously on mussel. It reposes frequently on the side of its vessel, sometimes so high as to be partly out of the water.

Ropes of spawn, containing numerous white ova or capsules, are produced by this species in February, March, and April, or other seasons. A specimen taken in September, spawned in the middle of March, and others continued spawning throughout that month in surprising quantities.

The specimen, Plate IX. fig. 2, spawned profusely in March and April, and in different quantities, of very remarkable appearance and arrangement on different occasions. The first rope exceeded two inches in length, by above a line in diameter, fig. 4. ; a portion of the spawn deposited a month later, fig. 5.

The former consisted of a double row of somewhat spherical, perfectly transparent, ova or capsules, with an apex directed inwards to the longitudinal axis or centre of the rope, each ovum containing two white germs, as discovered by the microscope, fig. 6. The second portion, fig. 5, consisted of a rope of the most transparent albumen, with ova or capsules amidst it, each containing from three to seven pure white germs. The capsule or integument was almost invisible from extreme transparence. These capsules being so disposed, that four of them occupy the diameter of the rope, the long rows, with their white contents, form a rich and interesting microscopical object, fig. 7.

A specimen lived some time in familiarity with the *Gordius maximus*, apparently apprehending no danger.



Sordus lania etc

A 1.—GORDIUS GESSERENSIS—*Planaria Gesserensis*.—*Müller*.

Probably the *Planaria Gesserensis* of Müller should have a place here, for it does not seem to belong to the genus selected for its reception.

Length three inches and a half; figure nearly linear; extremities obtuse; six or more black specks around the anterior margin. A slit below indicates the mouth. Colour universally different shades of green; sometimes tending to brown or pale carnation. Numerous lighter narrow circles, at considerable intervals, with a minute pale speck on the side of each, environ the body, resembling faint annulations.

A considerable quantity of glutinous, or almost silky matter, is secreted by the body. This secretion diminishes in abundance, proportionably to the duration of confinement.

The animal sometimes feeds on mussel. It dwells under stones on the shore.

In confinement it reposes thus, or among mud during the day; and if several be together, they associate at night on the side of their vessel, above the surface of the water.

Specimens have survived two years.

PLATE X. FIG. 5.

A. 2.—GORDIUS ALBICANS—*Whitish Gordius*.—Plate XII. Figs. 5 a, 6.

I speak with diffidence of this, which is a littoral animal, assigning it also only a provisional place, for I have not succeeded in ascertaining such features as are sufficiently prominent.

Length two inches and a half; breadth the sixteenth of an inch; form linear, somewhat flattened; extremities obtuse.—Plate XII. fig. 5 a. On the anterior margin are numerous black specks, and behind them, at some intervals, two clusters of specks, also black. All these are very minute, and scarcely to be examined without decollation, fig. 6. Colour of specimens universally from dingy white to dark grey. Sometimes a lighter line runs down the back, and a waved intestine may be discovered.

Motion smooth and gliding, the body being completely extended. If reversing its course, the animal folds on itself.

While crawling, occasional swellings of the body are seen, with proportional reductions which disappear as the linear form is resumed.

PLATE X.

FIG. 5 a. *Gordius albicans*.

6. Head, enlarged; shewing the superficial specks.

B.—*GORDIUS GRACILIS*.—To preserve some connection in this subject, I shall here advert to another animal of this tribe, though it may not prove to be exactly in its place, under the denomination of *Gordius gracilis*.—Plate IX. fig. 8.

This animal extends three inches in length, in a roundish form, scarcely above the twelfth of a line in breadth or diameter. In motion it becomes as slender as a fine white horse hair, the extremity scarcely visible. The anterior part, when contracted, is reddish, fading gradually downwards to white. The whole, if coiled up, is faint carmine; but extended, it seems white.

No specks or eyes could be discovered. This species feeds greedily on mussel, sucking it by the mouth, which is below, near the anterior extremity; and drags the food to the place of its own retreat.

Five or six specimens were taken on June 11, one of which, on the 20th, emitted a rope of spawn proportionally as large as that of the species just described. It was in a fold half an inch long, therefore an inch if extended: the breadth of the fold nearly half a line. Under the microscope the ova were white, opaque, not quite spherical, immersed in a transparent substance; all as seen two days afterwards, fig. 9. In a few days a number of animalcula were produced by the ova. I could ascribe them to no other origin, and that such was the case, was proved by the identity of those contained in the ova, and such as were free. Those creatures appeared mere specks in the water, swimming with considerable expedition. Keeping chiefly below, both in a vessel and in a watch-glass, they congregated towards the side farthest from the light, which induced me to

conclude that they avoided it. There was some disparity of size among those of a group viewed by the microscope, fig. 10.

Subjected to higher magnifying powers, they were in general of a fine regular, broad, oval form, apparently soft, with the oval slightly variable in its proportions; the body flattened, and begirt by a fringe of cilia. Two black specks like eyes stood in front, on the margin, somewhat behind the anterior extremity, fig. 11.

I could not discover any black specks corresponding to what I considered such, in the parent animal, which seemed to be invited from its retreats by the light.

Prosecuting the history of the animalcula was impracticable, for various reasons. I should have even hesitated to speak of incidents so anomalous, but for the hopes of attracting the notice of practical naturalists, who may wish to avail themselves of opportunities to illustrate the species farther.

This animal seems to contain a double ovarium, one portion towards each side of the body, wherein the ova are disposed in clusters, unless this be some part of its individual organization. But this is to be seen only in the most transparent specimens.

On July 7, animals were produced from spawn of June 30.

C.—*GORDIUS ALBUS*.—Certain peculiarities lead me to assign this a provisional place. I cannot affirm that all the specimens I have had were entire, or that they had the whole features to be held characteristic of the *Gordius*, though exhibiting some of them.

Length three inches or more; breadth under two lines; body flattened, almost linear; both extremities somewhat acute; colour palest carnation, almost white, with a slight red speckling on the upper surface of the head. The presence of eyes could not be detected by the microscope.—Plate IX. fig. 12, ; head, fig. 13.

This animal feeds voraciously on mussel, projecting a pure white proboscis from the under surface of the anterior, and absorbing large portions.

A specimen protruded the proboscis when touched with a feather.

I then endeavoured to free it from the mud, which seems its natural bed, when the proboscis protruded again, and was discharged along with the whole intestinal organ, also white, connected with it.

The portion thus separating extended as a cylinder three inches long, especially towards the anterior, where the tubular part constituting the proboscis was evidently of stronger texture, and half a line in diameter. It displayed much action and contortion for a considerable time, not being quite inanimate during three days, as is seen of the intestinal organ of the *Gordius maximus*.

The animal now retreated among a quantity of mud introduced into its vessel along with a shell for protection. It was crawling about four or five months afterwards, and in seven or eight had possibly repaired its loss, from appearing equally full and plump as originally. Indeed it had never been extenuated.

Accidental exposure to the sun proved fatal to this specimen ultimately. The body ruptured into several portions, which could not be preserved.

It survived nine months, exhibiting no other peculiarities, unless the formation of a very slight sheath of glutinous and earthy matter.

A second specimen had been mutilated.

PLATE IX.

FIG. 12. *Gordius (minor) albus*.

13. Head slightly enlarged, shewing the groove.

D.—GORDIUS AQUATICUS—*The Hair Worm*.—Plate IX. Fig. 14.

All the preceding species of the *Gordius* dwell in the sea; the subject of the present paragraph is an inhabitant of the fresh-waters of Scotland.

I am ignorant of its extreme dimensions, nor, owing to particular circumstances, have I been able to preserve the detail of the habits of the specimens falling into my possession.

This animal extends seven or eight inches in length, by scarcely the

third of a line in thickness. It is of a cylindrical form, the head deeply indented by a groove; the posterior extremity obtuse. The whole is of a dark liver-brown colour, almost black.

The *Gordius aquaticus* is extensively dispersed. I have found it in greatest numbers in a small spring well in Linlithgowshire, a few feet in diameter, and not above three feet deep, where it lay at the bottom, and could be easily brought up with the decaying leaves. It occurred in Coldingham Loch, besides various other places.

But after having obtained numerous specimens with facility from the well, a subsequent search there, after an interval of several years, was unsuccessful.

A vulgar prejudice ascribes whitlow to the bite of the Hair Worm, which has no means of inflicting a wound. Likewise there is little doubt that the like prejudice, crediting this animal's metamorphosis to an eel, arises from its appearance.

A person in Edinburgh, belonging to the establishment of the Royal Bank, alarmed by an unusual sensation in his throat after a copious draught of water, contrived to free himself quickly in extracting one of these animals. Two days afterwards, it was brought to me and delineated while in a lively condition.—Plate IX. fig. 14.

Specimens remain very long plain and entire amidst the water wherein they die.

§ 3. *GORDIUS SPINIFER*.—The subjects of the preceding paragraph are definitely characterised by a deep indentation of the head, a slit in the under surface indicating the position of the mouth, and an obtuse extremity, terminating the gradually diminishing body.

Here we are presuming that such subjects are perfect, and that neither anterior nor posterior extremity has been mutilated.

There is another section, corresponding in general character, but distinguished by the termination of the body in a spinous or cartilaginous process.

The specimens I have had of the former, invariably wanting this

latter feature, have rendered it difficult to credit that all were mutilated, and that none were entire.

Nevertheless, with animals so readily exposed to mutilation, and whose reproductive faculties are so energetic, it is impossible to avoid perplexities regarding their integrity.

Some of the preceding specimens were preserved a long time without any symptoms of regeneration ; yet their resemblance to the subjects of this paragraph, with a spinous prolongation, is so close, that I must almost consider the description of both only as provisional.

Specimens distinguished by the caudal process, however, are not nearly so common as the others, on the contrary, they may be accounted rare.

a.—GORDIUS VIRIDIS SPINIFER.—Plate XI. Fig. 1.

Length about three inches ; head and body resembling those of the *Gordius minor viridis* already described, the groove being very distinct. The posterior extremity terminates in a retractile, spinous, or cartilaginous prolongation, and equalling about a sixth of the length of the body. Colour mountain green.

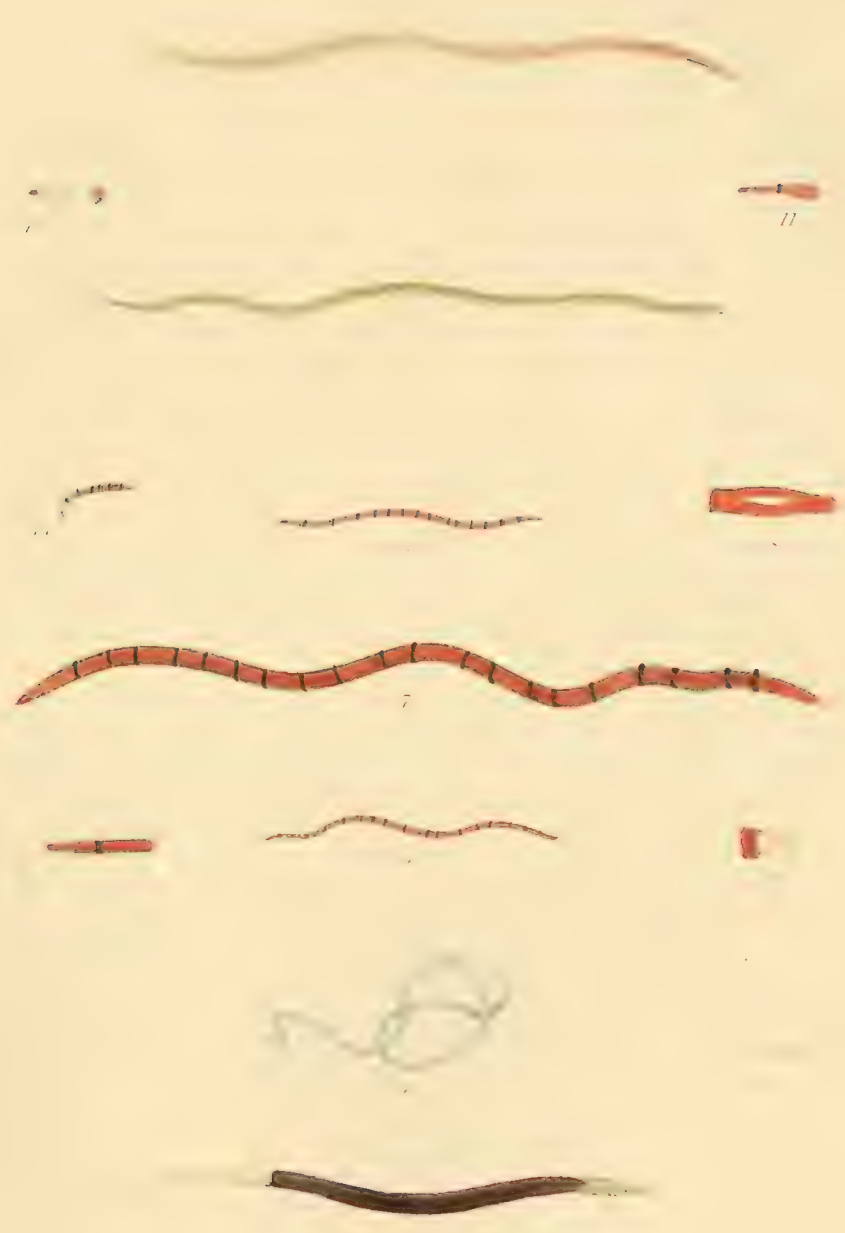
The spinous prolongation is a spontaneous protrusion, that is, it can be retracted completely, especially when the animal is at rest, and when gliding along it is drawn out to the slenderness of a human hair, actually becoming invisible from extreme tenuity without a lens, or being placed on a black ground. This prolongation is very flexible, forms various curvatures, and displays peculiar action independently of the body.

PLATE XI.

FIG. 1. *Gordius viridis-spinifer*.

b.—GORDIUS PURPUREUS SPINIFER.—Plate XI. Figs. 2, 3, 4.

Among several specimens there has been scarcely any other distinction than colour ; nor can I venture to specify what may be the dimensions of the species.



Gordius spinifer

A fine specimen, about eight inches long, had the spinous prolongation extending about a quarter of an inch. This prolongation appeared somewhat muricate under the microscope. Another specimen, four inches long, was of a deep red purple, all except the anterior margin, which appeared yellowish. Its prolongation rather exceeded a quarter of an inch.

A thin specimen extended about three inches, and the prolongation half an inch more. The colour of the anterior part was dark purple, but about fifteen lines of the posterior, including the prolongation, pure white. This latter portion had been undoubtedly a reproduction, as its commencement proved somewhat smaller than the dark part, which was nearly two lines thick. The specimen came from Shetland. It must have been large originally.

Very faint circles were just perceptible on the body at considerable intervals. In certain positions there is an indistinct appearance of annulation in some of this flattened race.

PLATE XI.

FIG. 2. *Gordius purpureus spinifer*.

3. Head of the same, slightly enlarged.

4. Posterior extremity.

c.—*GORDIUS FRAGILIS SPINIFER*.—Plate XI. Fig. 5.

Total length three inches and half, of which the spine equals half an inch; breadth two lines. Colour universally reddish-orange, unless a small portion of the posterior extremity, which alone with the spine was white. This probably indicates reproduction of a mutilated specimen, which must have been of more ample dimensions, especially when we allot above half an inch to the spinous prolongation.

This specimen shewed some peculiarities which I had not observed of others; such as forming a very slight silken sheath, and the head tapering almost to a point when the animal was in motion. In quiescence, the lower portion was much broadened. One or more enlarge-

ments seemed often passing down the whole body from the anterior extremity.

In five weeks a fragment, along with the spine, separated from the extremity, and crawled about the vessel. Twelve other portions, of various dimensions, also separated in the course of the same and the succeeding day.

As the specimen seemed falling to pieces, I removed it to another vessel, where no mutilations followed for three or four days. A small fragment was then detached from the extremity, and next day another, not the sixteenth of an inch, on replenishing the vessel with water, which continued crawling. But the animal itself betrayed symptoms of suffering, in its endeavours to protect the mutilated extremity.

In six weeks from the date of acquisition, its whole length while crawling, did not exceed five-eighths of an inch. Two deep constrictions towards the posterior extremity, also threatened the further loss of a fragment equalling an eighth of an inch, so that the portions of the body actually remaining entire, hardly extended half an inch, or the seventh part of what was originally the whole animal. Accordingly, the two portions separated, one on the subsequent day, the other on that following.

Thus the creature literally fell in pieces; and it died when only a quarter of an inch of the anterior extremity subsisted.

Considering the first mutilation, which was evidently replaced by the white extremity and prolongation, the subject unimpaired must have been of considerable dimensions.

PLATE XI.

FIG. 5. *Gordius fragilis spinifer*.

d.—GORDIUS FASCIATUS SPINIFER—*The Belted Spine Gordius*.—Plate XI.

Figs. 6, 7, 8, 9.

Length two inches and a half, or more; breadth under the sixteenth of an inch; figure semicylindrical; anterior extremity obtuse, cleft by a groove; posterior extremity terminating in a spinous prolongation.

Mouth a slit in the under surface of the anterior extremity. Upper surface, with two large black specks in front, and several smaller ones behind them. Colour from light orange to reddish; the body encircled by a number of white belts. Margin of the anterior extremity white.

In this species the spinous prolongation bears a great proportion to the length of the body, sometimes being equal to a fourth part of it; and it is so flexible, that small specimens seem almost capable of casting a knot on it. The number of belts is irregular, nor do I know that they indicate anything but merely a diversity of colour.

Specimens are liable to rupture; and it is rather in the vicinity of the belt that the separation ensues. This incident is the consequence of injury, when a white fluid matter, thicker and heavier than water, escapes.

A specimen, with twenty-four white belts, ruptured in many parts after secretion of a quantity of glutinous matter, and perhaps the rudiments of a speck. The ruptures were principally at the belts. By this means the intestinal canal, about half the length of the animal, was liberated.—Fig. 10, enlarged.

Another specimen, encircled by seventeen white belts, ruptured into six portions, all which enlarged in nine weeks, but their size diminished in five or six weeks longer.—Figs. 11, 12, enlarged.

Of two fine specimens, figs. 6, 13, neither large, the latter, accidentally washed out of its vessel, fell on the carpet, where it was found to have ruptured in two. The sundered portion healed in twenty days by a prominence on the anterior; but although surviving six months, until lost accidentally, no specific indications of what would be considered a head were shewn. It moved, yet from some contraction, never in a straight line. Sundered extremity of fig. 13, fig. 14. Symptoms of regeneration were early manifested by the mutilated trunk, which, in nine months, was terminated by a white spinous regeneration of considerable extent, restoring the integrity of the specimen, fig. 15.

The regenerating cartilaginous or spinous organization is originally pellucid.

This animal involves itself in a knot. It is rare.

The tendency of the species to rupture into fragments is very singular. I doubt not that regeneration as perfect beings would ensue with all in the progress of time.

Herein is found a definite analogy, establishing the kindred of worms of the *Gordius* tribe, indented by a marginal groove of the anterior, and distinguished by a slit as the mouth in the under surface.

Unless for this latter character, the last species described might be comprehended in the genus *Polia*, proposed by Professor Delle Chiaje.

PLATE XI. *Gordius spinifer*.

- FIG. 1. *Gordius viridis spinifer*.
 2. *Gordius purpureus spinifer*.
 3. Head of another specimen, enlarged.
 4. Posterior extremity and spine of fig. 2.
 5. *Gordius fragilis spinifer*.
 6. *Gordius fasciatus spinifer*.
 7. Another specimen, enlarged.
 8. Mouth in the under surface, enlarged.
 9. Head with black specks, enlarged.
 10. Intestine, discharged on spontaneous division, enlarged.
 11. Fragment.
 12. Fragment.
 13. Specimen, mutilated of the lower extremity.
 14. Lower extremity of fig. 13.
 15. Extremity, as regenerated by fig. 13.

§ 4. GORDIUS INTEGER.—We have seen that different sections may be formed of the group we have named *Gordius*, though the external distinctions of the animals be faint and few. Yet, if we be not mistaken in the perfection of the parts, which in some respects is problematical, they are sufficient.

Still a third section remains, which, should it not have been necessary to introduce the subject the more intelligibly, ought properly to have stood the first.

It would seem enough for distinctive arrangement, that the anterior margin of an animal is cleft; and another, in addition, terminates by a

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Ascaris suum

retractile spine. If a third animal exhibits neither of those features, it must be placed in a separate group. Therefore I shall avail myself of that distinction.

It would require time, accidental observation, and opportunity, to determine whether all varieties of the vermicular tribes under consideration do not involve their long, slender, unmanageable bodies, if truly such, in a knot.

a.—GORDIUS FUSCUS.—*The Brown Gordius.*—Plate XII.

Length eighteen inches ; breadth an eighth of an inch ; body flattened ; extremities obtuse, anterior generally somewhat angular. Back mottled brown, belly pale. Motion smooth and gliding.

This animal involves itself in a knot. Here there is no sensible cleft or groove of the anterior, nor any spinous prolongation of the posterior extremity.

The mouth is apparently in the anterior part. In pale specimens, specks are perceptible on the margin. Being extremely minute, they will be sought in vain on those that are dark. Head of a specimen shewing the specks.—Plate IX. fig. 15.

Three of those animals, being all entwined as in a common knot, first one protruded its head to the right, then another to the left, and the third unfolded itself between them. The whole three, as if by common consent, extricated themselves, while the anterior portion of each advanced.

Sometimes several individuals remained a long time thus implicated. I have seen at least half a dozen, of different shades and dimensions, all protruding the head from their complicated assemblage in different directions. Other animals, such as the *Nereids*, occasionally take refuge among them with impunity.

As long and unmanageable animals are frequently entangled among corallines, or the refuse of miscellaneous matter, the mass should be deposited on an ordinary earthen or china white plate, with a clean flattish shell in the vicinity, which, being discovered, they will crawl under it for shelter.

While a specimen forms itself into a knot, it will often remain in that state for a considerable time ; nor does this species seek concealment as much as the *Gordius maximus*.

Two specimens, in separate vessels, spawned in April. The ova occupied a thin albuminous matter, which was in great profusion ; that from one of them, almost entirely covering the bottom of a vessel two inches in diameter ; that of the other less abundant. A vast number of white ova escaped from a third specimen verging to decay, also in April. None of all these proved prolific.—Plate IX. fig. 16, mass of spawn, enlarged ; fig. 17, group of ova, more enlarged.

I have never possessed a specimen entire exceeding eighteen inches in length. But one reached me in June from the Shetland seas, which, judging from the portion preserved, must have been quite three feet long, and a third of an inch broad. Very few specimens exceed seven or eight inches. Most of the colour of the back of so large a specimen had been effaced by abrasion ; the belly was pure white.

Specimens have survived many months in confinement.

PLATE IX.

FIG. 15. *Gordius fuscus*, head.

16. Ova amidst the albuminous matter, enlarged.

17. Group of ova, more enlarged.

PLATE XII. *Gordius fuscus*.

b.—I have never seen any variety or diversity of colour on the preceding species. All the examples were marked with precisely the same uniformity, unless, perhaps, in some slight lesser or greater intensity of colour.

There are other *Vermes*, which may be possibly of the same section of the *Gordius*, whereof colour, though I admit it is too often a fallacious guide, may be a true distinction, and which we are compelled to receive, at least provisionally, from want of other features.

Let it be observed, that many worms have no external prominences rising above the smoothness of their skin, or depressions sinking into it.

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Cordius anguis

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.

Thus, until enabled to ascertain the structure and habits of the living products of the creation, we are compelled, for convenience, to assign them an equivocal position in the *Systema*; destined, we hope, to be rectified by time, experience, and the united labour of naturalists.

GORDIUS ANGIUS.—*The Snake-Worm*.—Plate XIII.

The subject of this paragraph is one of the most remarkable among the tenants of the deep. It is a genuine snake in miniature, of delicate form and proportions, decked in lively colours.

The length of the snake-worm is thirty inches or more, its diameter little exceeding that of a crow-quill, or under the eighth part of an inch. It forms itself into various graceful folds, and can fabricate a silken case for its own reception, which is always shorter than the body.

When dislodged from the sheath, the body is seen to be round, tapering towards an obtuse lower extremity ; the head obtuse, originating from the rudiments of a frill on the neck, where there are four notches. The mouth is in the extremity of the anterior part, as appeared from several specimens.

I have not observed any dark specks or eyes as in many of the other worms, nor have I seen any specimen implicated in a knot, notwithstanding its apparent inconvenient extent ; nevertheless, if several be in the same vessel, they are intertwined, and seem entangled among themselves, though each can free itself speedily.

The colour of the animal is usually red and white, finely contrasted.—Plate X. fig. 7. The red, for the most part, scarlet or vermilion. But the creature must be subjected to ocular inspection, and in more than one specimen, for enabling the observer to discover how the colours are disposed.

The body is environed throughout by a number of pure white circles, commencing at the head.—Fig. 8. A longitudinal dorsal line, a ventral line, and two lateral lines, all nearly equidistant, and pure white, also traverse the length of the body. Many of the circles are double. A row of minute white specks, beginning at some distance from the head, interposes between each of the lateral and the dorsal lines.—Fig. 9. Some specimens have no white specks; and, when present, they give the whole a very ornamental appearance.

This animal adheres to substances but slightly in the course of its motion, whence, combined with its figure and specific gravity, it has difficulty in ascending the side of a glass vessel.

The mouth of this animal is in the very extremity. It opens with a wide horizontal gape, as if the creature had an upper and under jaw. This was well exposed by a very fine specimen—not inferior to any I have ever had brought to me—on the 27th June 1850.

Ova.—This specimen has ruptured into several pieces. A number, perhaps 1000 or 1500 most minute reddish-brown ova, appeared in the vessel to day (June 29.), of which I set some apart in watch-glasses.

The *Gordius anguis* forms a pale grey thick glossy silken sheath, of considerable tenacity, reflecting the prismatic colours even in artificial light. Although of ample width, the sheath does not exceed a sixth part of the animal's length. Herein it reposed in unequal parallel longitudinal folds.

The sheath is sometimes abandoned, either transiently or permanently, or its occupant wanders about the vessel, and returns to lie there during weeks, protruding the head occasionally. This covering is probably formed by an exudation, very profuse, from the whole or part of the body. Not only do its sides appear to be thickened by successive augmentations, but the tenant repeatedly forsakes the old sheath to form a new one, which in turn is deserted also.

The fine specimen, Plate XIII., had originally concealed itself in the empty sheath of the *Terebella conchilega*, of which I was ignorant until it spontaneously issued forth. It survived three months, and then perished from the excessive heat of the weather—others have survived a long time.

One specimen, if not a variety, extending eighteen inches, was universally chocolate-red, with the wonted white. The four longitudinal white lines were present as usual; and the body was encircled by about 200 narrow white belts. A transverse section of the body would have been elliptical. No evident distinction indicated the head, and the posterior extremity was quite flat and obtuse. The skin, like that of the others, was perfectly smooth, with a fine soft velvet aspect. This animal formed a very transparent sheath. Once, on replenishing of the vessel with recent sea-water, a pellucid new sheath appeared in a few hours.—Plate X. fig. 10.

A very fine specimen of this kind occurred on April 18th, said to be brought from the deep-sea fishing. It was of a delicate chocolate colour, with innumerable pure white circles. I cannot affirm that it was entire, but it was of very considerable dimensions, perhaps little inferior to those of the former.

Among the same collections were large portions of the full-grown *Gordius anguis*, of the ordinary colour, and such as were alive, appeared of superior size.

In the end of April and beginning of May, large specimens appear plump and full, as if occupied by a growing ovarium.

Two very fine large specimens were sent to me on the 3d October.

There also appeared, on extricating them, a small fragment of another specimen, nearly half an inch in length, which, delineated, slightly exceeded the natural size on the 8th.

PLATE XIII. *Gordius anguis*.—The Snake Worm.

PLATE X.

FIG. 7. *Gordius anguis*—The Snake Worm.

8. Head, enlarged.

9. Section of the body, enlarged.

10. Anterior portion of a different specimen.

II. VERMICULI.

The contents of the present section being merely accumulated notes, scarcely forming a definite history of any particular tribe of worms, and several species being associated together for want of prominent characters and sufficient information, let me be permitted to introduce these miscellaneous observations, under the title of Vermiculi, to the notice of naturalists. Had I enjoyed sufficient opportunities on the occurrence of specimens, more ample notes might have aided their description and classification, and accurate delineations might have guided both myself and other enquirers.

But such desiderata were often impracticable, therefore the subject is necessarily very imperfect.

All observations require confirmation from several or from successive specimens, which alone can prove the uniformity of structure or appearance.

Few conclusions are deducible from injured specimens, sickly subjects, or such as have faded colours.

I have sometimes thought of an arrangement by which might be distinguished, 1. Those wanting specks or eyes ; 2. Those where specks of indefinite number were evidently present ; 3. Those with two eyes ; 4. Those with four eyes. Although examples of all these may be given, I do not know that they are satisfactory. Besides, we always require the perfect animal, being aware that it is so ; and to be assured that this uniformity of such distinctions prevails along with the other general features, whether of form or of habits.

Certain animals may be brought provisionally within the scope of these paragraphs, from inability to find a better place for them ; and to such they may be transferred when favourable opportunities offer.

a.—VERMICULUS CRASSUS.—Plate X. fig. 11.

Only one specimen, in a feeble state, and possibly having suffered some mutilation, has occurred, so that the subject is introduced here from

the hopes of recognition by a more fortunate observer ; for I cannot affirm that it afforded me a satisfactory view.

But, in as far as I could judge, during its presence here for three or four weeks, the body is thick, fleshy, smooth, round, tapering to each extremity, extending twenty-one lines by four in diameter. The mouth appeared to be a short slit, widening upwards below the anterior extremity ; and what I was induced to consider as the opposite extremity was surrounded by a row of cylindrical fleshy spines of moderate length.

The body, apparently round, has a flat narrow belly, whereon the animal crawls, like the narrow sole of the *Doris*, and of which the edges close and broaden in the same manner. Its adhesion is slight ; the belly occupying about a fifth part of the circumference. The skin was smooth and uniform, without segments, or the least indications of them.

This animal seemed sufficiently vigorous at first, and next morning, was swimming on the surface of the water. Its form was extremely variable ; and it is not impossible that it may belong to some genus unknown to me.—Plate X. fig. 11.

On September 29th, it produced about 150 very minute ova, from the extremity of the lower portion, of a dull yellowish-green. Some were dull, while other specimens were quite transparent, spherical under the microscope, or nearly so, and with an opaque solid nucleus. This was large in proportion to the surrounding albumen, either ovoidal or pyriform, the latter, perhaps, denoting incipient evolution.—Fig. 12. A fortnight later, it produced more ova, in a thin transparent jelly ; at which time it had taken shelter under some stones.

PLATE X.

FIG. 11. *Vermiculus crassus*.

12. Ova.

Examples have been already given of worms with specks on the head, combined with other, and perhaps more predominant features.

b.—VERMICULUS RUBENS.—Plate X. figs. 13, 14, 15, 16, 17, 18.

Length, two inches and a half, or more ; breadth, two lines ; body

linear, flattened. Head obtuse, with ten or twelve black specks on its surface.—Plate X. fig. 13, specimen; 14, head enlarged. A white proboscis is darted from the anterior extremity. The predominant colour is red, with short vivid red or yellow streaks. A stripe, generally yellowish, runs down the back, and a broader stripe down the belly.

I have had various specimens, mutilated, and some with obtuse extremities, believed to be entire. None would feed, nor did they manifest any prominent features.

One, which died in June, was full of spawn, apparently nearly mature.

These animals take shelter in shells and other cavities. I conjectured that a specimen had formed a slight silken sheath.

PLATE X.

FIG. 13. *Vermiculus rubens*.

14. Head, enlarged.

15. Another specimen; back.

16. Belly.

17. Anterior portion of the same.

18. Minute specimen, supposed the same.

c.—VERMICULUS LINEATUS—*The Line Worm*.—Plate X. figs. 19, 20.

Of Vermiculi with two distinct eyes, the *Vermiculus lineatus* extends to thirteen lines, and is very slender. Anterior extremity obtuse, with two black eyes on the surface, near the front. Posterior extremity tapering. Colour universally dark grey, with a white line down the back; anterior extremity, wherein the eyes are seated, white. Motion smooth and gliding.

A smaller specimen, with similar eyes, but the anterior portion ruddy, I conjectured might be a young animal of the same species.

From the motion of these creatures, the eyes are not readily observed.

PLATE X.

FIG. 19. *Vermiculus lineatus*.

20. Head, enlarged.

d.—More than one of the Vermiculi have occurred with four distinct eyes in definite position and arrangement.

VERMICULUS COLUBER—*Serpent-headed Worm*.—Plate X. figs. 22, 23.

So many worms resemble serpents in miniature, that to find distinctive corresponding names, expressive of their figures, would be a precarious attempt.

1. Length, an inch and a half; breadth, a line. Body flattened; anterior extremity obtuse, posterior tapering to a point. Head enlarging from the narrower neck, with a dark quadrangular spot on the surface, towards the front, a small black eye being at each angle. Body universally cream colour. Motion smooth and gliding. Marine and littoral.

PLATE X.

FIG. 22. *Vermiculus coluber*.

23. Head, enlarged.

2. A variety, or distinct species, of small dimensions, occurs also as a littoral marine animal. This extends above two lines, by less than the third of a line in breadth, and is rather of a ruddy colour. Figure flattened; eyes large, black, and distinct, and set in the same arrangement as the former. The enlargement of the head is less definite. Motion gliding.

PLATE X.

FIG. 24. *Vermiculus coluber?*

e.—VERMICULUS VARIEGATUS—*Variegated Worm*.—Plate X. figs. 25, 26.

Length, eight lines; thickness, about the fifteenth part of its length; form, cylindrical; extremities rather obtuse. Towards the front of the upper surface are four black eyes, set in long quadrangular arrangement; the two posterior are difficult to be seen. Colour universally variegated red and white, with a white line down the back.

This animal always ascends the side of its vessel, where it uniformly establishes itself in a horizontal silken tube, close to the surface of the water.

It is rare, and it survives readily. Marine.

PLATE X.

FIG. 25. *Vermiculus variegatus*.

26. Specimen enlarged.

Note.—The authors of observations on the *Vermes* have devoted themselves greatly to the Entozoa, whereof, very few being offered to me, I cannot say anything interesting of their nature. But there is one, the *Ascaris*, which, if I mistake not, has been always considered intestinal, which occurs frequently in very different situations, as well as in the places ascribed to it.

1.—ASCARIS FLUSTRÆ.—Plate X. fig. 27.

Length, half a line ; body slender, nearly cylindrical ; extremities acute. Colour, dark grey or brownish, with a darker line in the centre of the anterior extremity, denoting an internal organ. Extremities pellucid. Two very conspicuous black specks, resembling eyes, are seated just at the origin of the anterior pellucid part.

Some of these animals appeared among a number of the decaying corpuscula from the *Flustra carbacea*, which they frequently penetrated, as if in quest of food.

It may be questioned, perhaps, whether this is truly one of the *Ascarides*.

PLATE X.

FIG. 27. *Ascaris flustræ*, magnified.

2.—ASCARIS GADI.—Plate X. fig. 28.

Ten or a dozen of these animals were sent to me by Mr Mather, a skilful miniature painter in Edinburgh. They had been just taken from the stomach of a cod, which contained two middle sized haddocks besides. I have seen none exceeding their dimensions, the largest extending two inches and a quarter, by about the third of a line in the middle, where thickest. The body tapers to each extremity, the head being the smaller. Externally, they seemed quite smooth, and of a yellowish or cream colour throughout. Their vivacity precluded the use of the microscope. But, under a lens, some internal organization was obscurely perceptible through the skin.

None survived the eighth day in sea-water.

PLATE X.

FIGS. 28, 29. *Ascaris gadi*.

3.—ASCARIS LEONIS.—Plate X. figs. 30, 31.

A fine young lion, promising to be of docile disposition, in the Edinburgh Zoological Gardens, apparently quite healthful, was seized with convulsions, September 1. 1840, in which it died on the subsequent day. No obvious cause could be assigned for its death. But on dissection, multitudes of *Ascarides* were found in the intestines, for some of which, while alive, I was indebted to Dr Dumbreck, who has always paid much useful attention to the wild animals of that establishment.

These *Ascarides* extended fifteen or sixteen lines; the body cylindrical, about the fourth of a line in diameter, and tapering to either extremity. They were quite smooth, of a brownish-yellow colour, exhibiting no peculiarities, but the wonted rigidity of the genus. Some consigned to spirit of wine were converted to pure white next day.

None of the various *Ascarides* I have seen have been distinguished by any noted or conspicuous difference.

PLATE X.

FIGS. 30, 31. *Ascaris leonis*.

It is not improbable that sufficient reasons may be found for removing some of the animals comprehended in this chapter from the place assigned to them. The subject is extremely obscure. Indeed, nothing can render it more obscure than the presence of equivocal, and the absence of definite characters, whereon alone we can rear a system ; and to this may be added, the want of additional specimens, whereby to solve our doubts.

From the preceding detail, however, the reader will discover how much remains to be done for reducing the Vermes to some useful arrangement ; although I might have augmented the number of animals described, it is unsatisfactory to dwell on what must be very imperfect. Nor do I pretend to more than offer a few materials, to aid the undertaking of systematic naturalists.

Herein I feel confidence, that much assistance will be derived from the drawings of the living specimens.

No part of the flesh of animated beings seems to be exempt from parasite worms of many different kinds, whose presence is generally extremely pernicious ; but it seems doubtful whether any but such larvæ as undergo metamorphosis to other stages prey on the dead.

CHAPTER III.

PLANARIA.

FROM the earliest periods of history, various animals of the lower orders have attracted notice, either on account of singular conformation, for their useful properties, or from their noxious nature. But others, equally deserving observation, have been overlooked, despised, and neglected, as if quite unimportant among the nobler works of the creation.

Formerly the credulous were more ardent in quest of marvels, than of the undisguised simplicity of truth. Nor did they seek those marvels which bounteous nature is always prepared to disclose to them, for the purpose of mental elevation, or in adoration of the Omnipotent Architect. Rather than pursue knowledge for their own improvement by discovery, they descended to the baser objects of imposture and deception, whether active or passive, to hold their fellows in controul. Had they been exalted, by the purity of intellectual contemplation, to a due estimate of the religion of nature, by the structure of the animated universe, unspeakable sources of admiration would have opened before them.

It does not belong to mankind to pronounce the perfections or the imperfections, the use or the uselessness, of what has come from the hands of the Creator, or that the aspect or dimensions of one creature has rendered it more worthy a place in the scale of beings. These are points inscrutable.

But this does not repress our desire to become still better and better

acquainted with all the phenomena of nature, and especially of animated nature, as far as our limited faculties will admit, seeing we are ourselves one great portion of it ; and as the farther we go, so shall the mind be exalted higher.

The stimulus thus given to inquiry, has induced the later study of naturalists to rescue from oblivion many of those beings unknown to the superficial, or contemned by the ignorant ; and now they prove alike interesting as those familiar for centuries. Some of them also serve to replenish the void which seemed to be interposed between the various animal tribes of the earth and of the waters.

Among them, perhaps, may be ranked the race of *Planariæ*—one that had been totally overpassed until a very recent era.

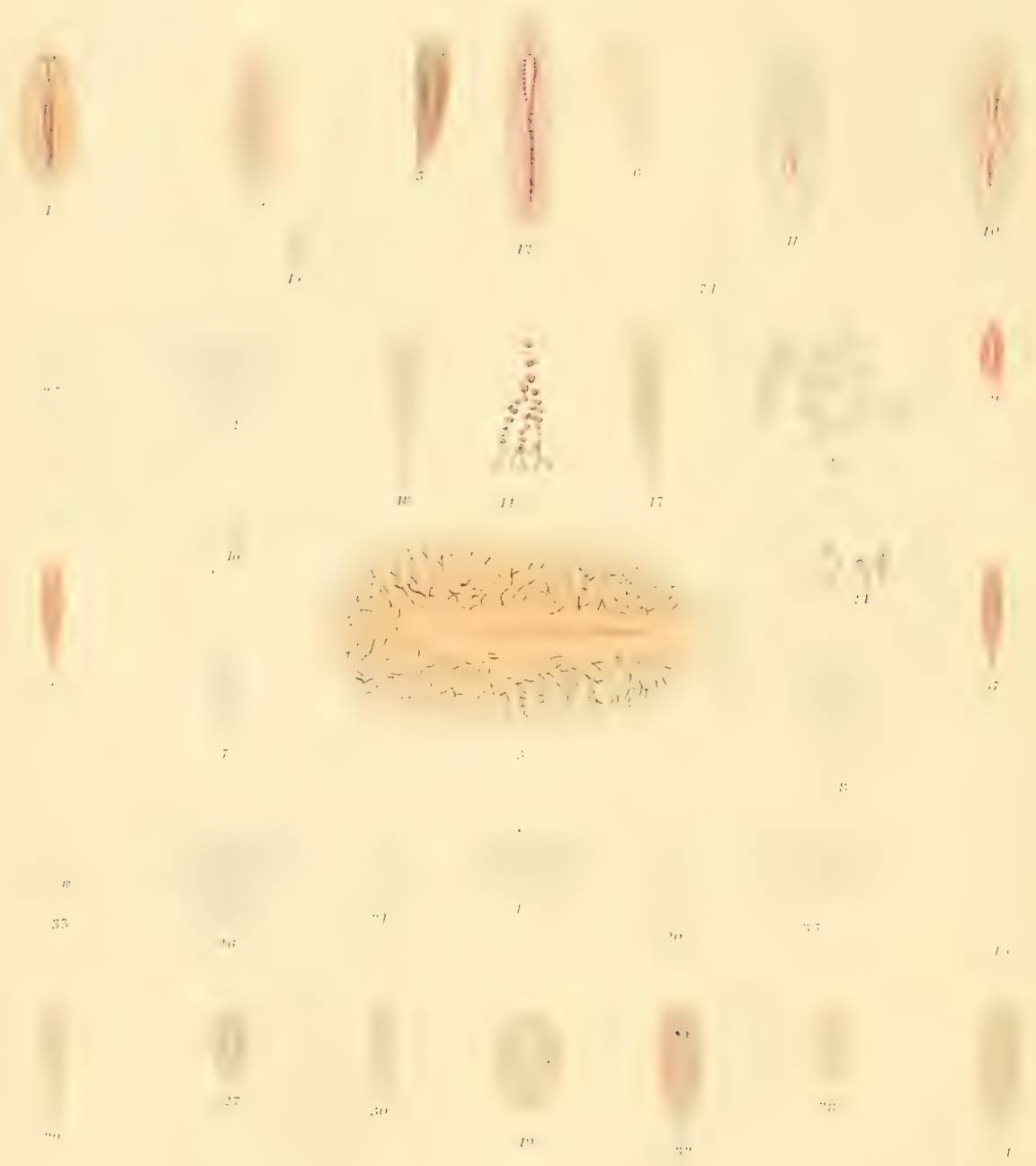
But having previously submitted my earlier observations on several species to the learned, and the subject having been since infinitely better treated in the works of Dr James Rawlins Johnson, Professor C. Baër of Königsberg, and M. Duges, only a few supplementary remarks and figures shall be inserted here.

Enumeration of species, under the correction which may be effected with time and observation, will add to the Fauna of Scotland.

Transition from the simple *Vermes* to the *Planaria* seems to be direct and immediate, whether from those comprehended in the genus *Gordius*, or from those associated under the less definite name of *Vermiculi*. In the present state of knowledge, I believe that it can be scarcely determined where they meet.

It is not only difficult to give a satisfactory definition of the genus *Planaria*, but to specify the subdivisions into which it may be partitioned, their perishable, soft, unmanageable, and generally opaque bodies, prove a formidable barrier to the operations of the microscopist and the anatomist. Thus the ordinary observer, in default of better guides, has often to rely on the external form and habits of his subject.

This, however, will not protect him from erroneously adopting the young of many *Vermes* as adult *Planariæ* ; nor from classing as inmates of the tribe the planulæ of Zoophytes destined to undergo a remarkable metamorphosis.



Colony

The genus *Planaria* is susceptible, perhaps, of the subdivisions which some naturalists propose to establish from the form of the body, the position of the mouth, and the nature of the intestines.* These might be useful, were it expedient to adopt the principles found to be practically applicable only in a few species.

One obvious section may comprehend a *Planaria* with a flattened body, specks or eyes on the upper surface, and an extensile proboscis from the under surface.

Another section might comprehend those with bodies not flattened, and two or more distinct eyes on the front of the upper surface.

But we are in fact scarcely prepared with materials sufficiently definite for systematic arrangement, whence we must still submit to be occupied with rather a heterogeneous collection, selecting such specimens for classification as expediency points out.

§ 1. *a.*—PLANARIA CORNUTA—*The Horned Planaria.*—Plate XIV.
Figs. 1, 2, 3, 4 ; Plate XV.

This is the largest of the Scottish *Planaria*, one specimen having occurred fifteen lines long, nearly half as much in breadth, a line thick, and of a fine ruddy orange hue. But specimens only two-thirds of its size, are the usual dimensions of full-grown adults.

The Horned *Planaria* is of an oval shape, comparatively thin and flat, the posterior part rounded, the anterior or head peaked, with two stout obtuse horns, tending to a triangular form, rising from the back of the neck. At the root of, and partly ascending each horn, are several black specks, together with a few more somewhat behind them. Both sets vary in numbers and distribution in different specimens, a remark applicable to most of the soft-bodied animals, where specks are present. A milk-white strong cartilaginous cylindrical proboscis, directed downwards,

* *Duges*, Recherches sur les Planaries, ap. Annales des Sciences Naturelles, tom. xv. p. 139 ; tom. xxi. p. 72.

issues from the anterior part of the under surface ; and at some distance further down is seen the stomach, distributing its numerous *cæca* to the very margin of the body. Finer specimens are speckled red above—paler below. Many are of plain, uniform, cream yellow. But the colour depends greatly on the nature of the food, by which the aspect of the animal is entirely changed. Most of those vividly speckled when taken from the sea, become quite pale on protracted confinement.—Plate XIV. fig. 1. back ; fig. 2, belly.

It is only on repletion with food of peculiar quality, that the beautiful interanea can be discovered. Nor is it easy to describe the difficulty of representing them accurately, from the size, motion, and opacity of the subject. An expert artist, Mr Daniel M'Culloch, succeeded only after the labour of many hours, and the exercise of extraordinary patience. Their appearance in an enlarged view is exhibited at fig. 3. Their horns may be computed at a sixteenth of the length of the body, perhaps elongating more in proportion to the increase of size. It is doubtful whether their office is in any respect tentacular, because they are always carried upright, or incline a little when the animal is in motion.

But this is a sluggish inactive creature, unless when stimulated by heat or hunger. It is very impatient of any, unless the gentlest, augmentation of temperature.

The body is smooth ; it is protected from abrasion by a glutinous secretion, which, perhaps, is also instrumental in its agglutination to the same spot, should it remain long motionless.

All the Planariæ feed on animal substance, and many eat voraciously.

The natural habitation of the Horned Planaria is at the depth of some fathoms in the sea. In confinement, a shell or stone should be provided for its retreat, as it is induced by the smoothness of a glass vessel to crawl so far above the surface of the water, that the glutinous matter is exhausted, when it becomes incapable of returning, and perishes. Also, if the vessel be brimful, it glides over the edge.

The regenerative properties of the animal are great. Desperate wounds and lacerations heal speedily. It survives extraordinary mutilations, whether accidental or experimental. A specimen having lost the

head and horns, together with much of the anterior portion of the body, recovered the whole. This animal was of considerable size and of variegated colour originally, but the renovated parts were pale, and the horns small. The cartilaginous proboscis of another, after separation, the effect of some injury, testified vitality during three or four days. It would appear that the peculiar texture of this organ is adverse to its indissoluble union with this softer, more gelatinous, and perishable substance of the body.

This is a prolific species of *Planaria*; several hundred ova are produced in April, May, and other seasons, by a single individual. These ova are minute, originally white, then dingy yellow, and ultimately yellowish-brown. They are always deposited in a single stratum, irregularly disposed, but the stratum frequently tends to a rectangular figure, and it is probably augmented at intervals. The side of a vessel is commonly preferred.—Fig. 1, spawn, enlarged.

Notwithstanding the prospect of progeny from many parents I was uniformly disappointed, and my disappointment so often reiterated, that I despaired of success.

Nevertheless my observations and researches were protracted during two and twenty years, because perseverance can sometimes attain what is denied to all other and more artificial modes of enquiry.

On April 29, I procured a fine specimen of the *Planaria cornuta*, which spawned soon afterwards. The spawn had been breaking up for two or three days preceding May 24, when multitudes of extremely minute yellowish specks were swimming in the water. Their motion was sufficiently active, without being very quick; it was pursued in all directions; and the spawn being contained in a small cylindrical jar, the specks crowded to the side next the light, whereon numbers remained almost stationary.

Subjected to the microscope under a power magnifying sixty diameters, they proved of very singular formation. About five short, obtuse, rudely fashioned yellow rays, bordered a solid, compact, central, reddish portion. Two of these rude like fingers seemed to belong to one part, and three to that opposite. But the whole shape underwent variation.

These animals left the field of the microscope so expeditiously, that

it was only by taking advantage of their predilection for the light, which attracted many to the side of a watch-glass, that an accurate drawing of a group could be completed.—Plate XV. fig. 1. In five days these animals were evidently farther advanced, though still furnishing a very imperfect view, from altering their position, and tumbling over in the water in an irregular manner. Now, however, they had about six marginal fingers projecting, and these were completely bordered by active cilia. The middle was of deeper red than previously ; and not very remote from the centre, two dark specks like eyes, appeared on the upper surface, fig. 2.

I could discover only two on June 3, which seemed to be unchanged. All had disappeared on the 5th, on which day the parent also had perished from the excessive heat.

From all these circumstances I was induced to conclude, that these animals are the larvæ which metamorphose to the *Planaria cornuta*. But many parts remain for investigation, always difficult where the subjects are either minute or rare. And we have already seen that it has been impossible for us to follow the various stages of their development.

From various other examples not so scrupulously investigated, the spawn was apparently hatched in twelve or fourteen days, at which time a multitude of animalcular specks swam amidst the water.

The size and vigour of the parent decline after spawning, and the colour fades to dingy white.

The Horned Planaria lurks in the crevices of empty shells ; or, for the most part, lies buried in mud, when recovered from the sea ; whence it may be dislodged by imparting some impurity to the water.

Specimens survive readily for a considerable time. Between forty and fifty have afforded the substance of the preceding observations.

PLATE XIV.

FIG. 1. *Planaria cornuta*, back.

2. Belly.

3. Specimen viewed from below, shewing the distribution of the inter-
anea, enlarged.

4. Spawn, enlarged.

PLATE XV.

- FIG. 1. Supposed larvæ of the *Planaria cornuta* from the spawn.
 2. Larvæ farther advanced.
 3. Empty capsules.

Note.—The preceding is the only species of *Planaria* known to me with large and distinct horns towards the front of the head. But a number of years ago another occurred, to which I shall be content with a general allusion, having been unable to resume my littoral researches when most likely to be successful, and that also was horned.

Length about eight lines ; extreme breadth three ; body thin, flattened, dingy yellow, and, on the whole, much resembling the *Planaria flexilis*, both in aspect and motions. Two very short obtuse white horns, projecting not the fourth of a line, rose perpendicularly from the upper surface, in nearly the same position occupied by the ocular specks of the *flexilis* ; and on the interior of the root of each horn, were eight or ten minute specks, disposed irregularly. Spawn, consisting of spherical ova or capsules, was deposited in September. When farther advanced, each capsule seemed to consist of four compartments.

Whether this was a specimen disfigured by some monstrosity, or whether the organs were natural, I cannot presume to determine. The artist had no hesitation regarding its form.

PLATE XIV.

- FIG. 5. *Planaria (corniculata)*, back.
 6. Belly.
 7. Spawn.
 8. Portion of the same, enlarged.

b.—PLANARIA ELLIPSIS.—Plate XIV. Figs. 9, 10, 11, 12, 13, 14, 15, 16.

As many of the lower animals gain an important accession of parts with age, I mistook this species for a long time as the young of the *Planaria cornuta*. Further experience proved their difference.

Length four or five lines, or somewhat more ; breadth half an inch ;

body thin, flattened, nearly oval, especially in earlier stages; anterior margin even; numerous black specks, arranged irregularly towards the edges of the front, and an irregular cluster behind them. Twenty of the former were enumerated in a specimen extending only three lines. The colour of the body is either wholly red, speckled red, or with a red line over the site of the proboscis. Some specimens are cream-yellow, with red and white lines intermingled on the back.

The nature of the food seems to have much influence on the colour, which, if brighter, always fades with time.

Under the microscope, all the vascular interanea are seen terminating in a fork near the margin.

This animal spawns in June. The spawn is deposited in irregular quadrangular patches, which are perhaps successively enlarged.

PLATE XIV.

FIG. 9. *Planaria ellipsis*.

10. The same, back, enlarged.
11. Belly.
12. Another specimen, enlarged.
13. Head of a specimen, shewing the specks magnified.
14. Arrangement and appearance of the coloured interanea, enlarged.
15. Spawn.
16. Spawn.

c.—PLANARIA FLEXILIS—*The Flexible Planaria*.—Plate XIV. Figs. 17, 18, 19, 20, 21, 22, 23, 24.

The occurrence of numerous examples since the publication of my former observations, enables me now to add a few essential illustrations to the history of the *Planaria flexilis*.

Specimens generally attain six or seven lines in length, by half as much in breadth. But under favourable circumstances, perhaps attaining larger dimensions. A large specimen once reached me from a distance, which in vigour must have been at least ten lines in length, and of a pure white colour. The body is extremely thin and flexible, scarcely

exceeding the thickness of ordinary writing paper. On the upper surface, towards the anterior, are four clusters of black specks. The orifice, whence the proboscis protrudes, is situate far down the under surface. In form, the animal gradually tapers downwards from its broad rounded anterior.—Plate XIV. fig. 17., *Planaria flexilis*, back ; 18, belly ; 19, site of the specks magnified, shewing their appearance and position.

This *Planaria* does not yield to any of the tribe in voracity. It can extract a *Limnea* of considerable size from the shell ; or sometimes involving the living prey in the folds of its flexible body, carries it off to be devoured at leisure. It feeds so greedily as to endanger its own life, a hump rising above with replenishment within. But all *Planariæ* can endure protracted abstinence, as is not uncommon among the *Carnivora* in general, and their hunger is sated at indefinite periods.

The chief season of propagation is in August, or during the preceding and subsequent months. But it spawns occasionally at other times, even in December. A single individual deposits a dull yellow stratum, which tends to a quadrangular shape, and which consists of 300 or 400 ova, figs. 20, 21. Under the microscope, the ovum seems a spherical capsule, divided into four compartments, as if investing four embryo *Planariæ* ; and some contain two or three globules besides, figs. 22, 23. This division is less conspicuous in many ; and to judge by the progeny, I have conjectured it to be an optical illusion. The embryo attains maturity in about fourteen days, and when only one exhausts the whole contents, and quits the ovum, it is not to crawl below like the parent, but to swim at large in the surrounding element.

Patches of spawn, the ova being imbedded in slight albuminous matter, were produced on the 1st of July. When subjected to the microscope, two cross lines apparently divided the ovum into four compartments. On the ninth day, however, each ovum was discovered to be occupied by only a single embryo, pursuing a slow horizontal course around the interior circumferences. On the 14th, the ova had broken up, when a multitude of corpusculæ, or young *Planariæ* swam rapidly through the water. These beings were of yellowish colour, broader and more obtuse proportionally than the adult, fig. 24. A high magnifying

power could discern two pair of eyes in each, possibly the rudiments of the four clusters belonging to full-grown animals, fig. 25. When withdrawn from the dark, the young Planariæ rose in great numbers towards the surface of the water, congregating on the side next the light—and, as mere atoms they were just visible.

Without equal regularity to the cells of a honeycomb, the vacant spawn bore much resemblance to them, fig. 26.

The *Planaria flexilis* lives in society, occupying the lower side of stones, the crevices of loose shelving rocks, or the cavities of shells, and sometimes sinking entirely amidst mud. It must be considered littoral, being found rather lower than half tide on a soft muddy bottom.

The body is extremely thin, and lies close to the substances preferred, from which it may be carefully washed off with a feather while kept under water ; or by vitiating the surrounding element, it is forced from its haunts to seek a purer medium, and ascending to the surface, it often lies there supine.

PLATE XIV.

FIG. 17. *Planaria flexilis*, back.

18. Belly.

19. Anterior surface, shewing the site and appearance of the specks, enlarged.

20. Patch of spawn.

21. Another.

22. Portion of spawn, enlarged.

23. Portion of spawn, farther advanced.

24. Young *Planaria* from the spawn.

25. Young *Planaria* from the spawn, with two pair of eyes.

26. Empty capsules left by the young, enlarged.

d.—PLANARIA MACULATA (ATOMATA ?).—Plate XIV. figs. 27, 28, 29, 30, 31, 32.

The preceding three species of *Planariæ* can be satisfactorily recognised as quite distinct. But the tribe is numerous, and the distinguish-

ing characteristics of some others are more feebly imprinted, so that it is frequently doubtful whether they are not merely varieties. Thus, I would be rather understood to offer the following observations as general illustrations of the nature of the genus ; at least until better opportunities shall enable the observer to ascertain the complete and absolute distinction of species.

The *Planaria maculata* extends six lines in length, by nearly three in breadth ; both extremities very obtuse. Four clusters of minute black specks are on the upper surface, at some distance behind the anterior extremity. The posterior clusters consist of about ten specks each ; the anterior clusters are more diffuse, and the specks sometimes so much dispersed as to lose that character. The former are not seated on a lighter ground, as in the *Planaria flexilis*. This Planaria is wholly spotted or speckled with chesnut-brown, on a ground of wood-brown.

The only difference I have been able to recognise between it and the *Planaria flexilis*, consists in the uniformly greater obtuseness of the extremities, especially of the lower extremity ; and if there be any distinction between this species and the *atomata*, it seems to consist in the finer and more minute speckling of the latter. There is no speckling of the *flexilis*, that of the *maculata* is occasionally very dark.

Spawn is deposited from August until December, and always in quadrangular patches of ova, amidst slight adhesive albuminous matter. A patch produced in December, consisted of about 100 ova, each rather a flattened sphere, including a single embryo, which, in advancing towards maturity, performs a very slow revolution around the interior of its prison, such as, with some, to require ten or twelve seconds to complete the circle, and with others half as long. This will recall, very forcibly, a similar revolution or circuit, beheld in some of the embryonic Gasteropodes. August is the chief breeding season. The spawning is not confined to a single patch ; and after the first, a considerable interval may elapse before the second appears.

These creatures dwell under stones, especially if of considerable size, at about half tide. I have not observed them seek to lodge under any of small dimensions. They prefer a flat smooth surface.

I have had numerous specimens, but without being able to identify them with either the *Planaria tremellaris*, or *Planaria atomata*. However, this is not on account of the scalloped margin with which these species are represented, for I doubt if any of the marine species shew any marginal irregularity, unless from constraint, so that such distinctions are delusive.

PLATE XIV.

- FIG. 27. *Planaria maculata*, back.
 28. Belly.
 29. Another specimen, back.
 30. Another specimen, belly, enlarged.
 31. Back, slightly enlarged.
 32. Another specimen, somewhat enlarged.
 33. Anterior surface, shewing the position of the specks, enlarged.
 34. Patch of spawn.
 35. Spawn, more enlarged.

e.—PLANARIA HAUSTRUM—*The Scoop Planaria*.—Plate XIV. Figs. 36, 37, 38.

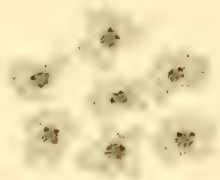
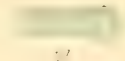
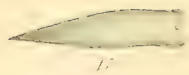
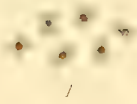
Length above a line ; breadth about a third of the length ; snout straight, body flat, flexible, the sides often folding so as to resemble a scoop. The body tapers from about the middle to the posterior extremity, which is pointed, whereon the animal rises erect ; also adhering by it. Colour brown, speckled. Motion swift, being the most active of any of the Planariæ.

No specks or eyes perceptible. Marine.

This species dwells in the pools among the rocks at Eyemouth, at somewhat within half tide. Specimens may be obtained by washing a quantity of marine plants, especially the Fuci, in a white basin, or a large white saucer.

Some have survived nine months.

The *Planaria convoluta* of Müller, has considerable analogy to this species.



Alumina

PLATE XIV.

- FIG. 36. *Planaria haustrum*—the back,
37. The same enlarged, belly

§ 2. All the preceding Planariæ are inhabitants of the seas ; they have a certain correspondence of figure, being thin, flat, scarcely thicker than writing paper, and swimming with violent action in the water. But these characters chiefly apply to the first four ; the diminutive size of the last impeding observation. They are fierce and voracious animals. I have never seen any resembling them in the fresh-waters of Scotland.

There are some marine Planariæ, however, of different aspect and habits, participating more of the general features of such as dwell in lakes, ponds, and marshes, which merit a few observations.

a.—PLANARIA HEBES—*The Sluggish Planaria.*—Plate XVI. figs. 3, 4.

Length above three lines ; breadth above half a line. Body plump above, flattened below ; anterior extremity even ; eyes, two in the middle of the neck. Colour universally wax-yellow ; when emaciated cream-yellow or dingy white. The colour is somewhat dependent on the quality of the food.

The whole figure of this, which is a marine *Planaria*, bears much resemblance to the *Planaria panniculata* of fresh-waters.

Two specimens survived eight or nine months.

PLATE XVI.

- FIG. 3. *Planaria hebes*.
4. The same, enlarged.

b.—PLANARIA LACTEA—*The Milky Planaria.*—Plate XVI. figs. 5, 7, 8, 9.
Plate XV. figs. 4, 5 6.

This being the type of the genus *Planaria* usually selected by naturalists, greater interest may be, perhaps, felt in its history. But there

is none of which I was longer disappointed of finding specimens, year after year, yet always unsuccessfully, and only in two places has it hitherto occurred to me. One of these is Philipston Loch, twelve miles west of the City of Edinburgh ; the other, a pond in Red Braes garden, within a mile of this our northern metropolis. There it dwells in the greatest profusion.

Full-grown specimens extend nine lines, by nearly a line and a half in breadth. Body almost linear, with the front even, and posterior extremity rather acute ; slightly convex above in repletion, and flattened in abstinence. Naturalists assign two black eyes to this species towards the anterior margin of the upper surface. In two subjected to the microscope, I found four eyes, two larger towards the angles of the head, and a black speck, not a fourth part as large, in front of each. The natural colour of the animal, which can be discovered only when it is in a state of abstinence, is pure white. This is affected by every kind of food.—Plate XVI. fig. 5.

But when replete with sustenance, whether red or dark, the curious and beautiful arrangement of the interanea is displayed. The food is absorbed by a proboscis, the site of which, and that of the stomach, are denoted by a clearer elliptical portion in the centre of the under surface, prolonged downwards. Almost the whole body is occupied by fine pinnate interanea, being so many cæca, as I conclude, distributed from around these organs, and reaching to the marginal belt.—Plate XV. fig. 4. The form of these internal organs will be better understood from an accurate enlarged view of a specimen. The upper and under portion are represented on a scale still larger, figs. 5, 6.

I cannot speak positively of the propagation of this *Planaria*. Dr James Rawlins Johnson, a very acute naturalist, sent me along with a number of preparations of various Planariæ, what he considered the ovum. About fifteen years ago I procured a fine specimen, and next day observed the ovum, Plate XVI. fig. 9, on a leaf in the vessel, on July 3. It was a perfect ellipsoid, of a brownish colour. But I was disappointed of progeny. I have had at least 500 of these animals taken at different seasons of the year, and still none were prolific ; therefore, if



Manaria

propagating by ova, as I presume is the case, some short intervals have been accidentally omitted. Many of the largest survive readily during several months.

These creatures feed alike on animal and vegetable matter, particularly, as I think, on decaying leaves, when the intestines seem to be coloured very dark. But the animal, on the intestines being emptied of their contents, always becomes pure white.

The *Planaria lactea* lives in society. Both in the natural and artificial state, it lurks among decaying leaves. I have seen between eighty and ninety huddled together on the under surface of a large decaying beech leaf.

It is an animal of nocturnal habits. Let a large collection of miscellaneous matter be made from the places where it dwells, and emptied into a capacious vessel holding a gallon and a half, by adding such a quantity of fresh-water that a fourth or fifth part of the vessel above remains clear and free, the Planariæ beginning to move in the evening, and gradually ascending the sides, may be observed in multitudes floating supine on the surface. But many will be found to have descended in the morning.

PLATE XVI.

FIG. 5. *Planaria lactea*, abstinent.

6. Another specimen having fed, back.
7. Belly.
8. Head, enlarged.
9. Ovum.

PLATE XV.

FIG. 4. *Planaria lactea* having fed, and the interanea full, enlarged, to shew the distribution of the vessels.

5. The same, anterior portion, shewing the eyes and the formation of vessels, more enlarged.
6. Posterior portion on the same scale. It will be observed that here the middle part is omitted, and only both the extremities represented.

Note.—The genus *Planaria* has received much embellishment from the pursuits of two naturalists, M. Duges of Montpellier, who has endeavoured to divide it into sections, founded chiefly on the position of the principal organs—and Mr Darwin.

The latter has discovered no less than twelve terrestrial species, ten of which he describes. Mr Darwin also describes five new marine species. Most of those animals belong to South America, and to some other distant regions visited by Mr Darwin.—*Annals and Magazine of Natural History*, v. xiv. p. 241.

c.—PLANARIA FODINÆ—*The Quarry Planaria.*—Plate XV. Figs. 7, 8, 9, 10.

Length a quarter of an inch or more ; body full, plump, diminishing towards the anterior extremity, and obtuse behind.—Plate XV. fig. 7 ; the same, enlarged, fig. 8. Two yellow eyes are very conspicuous near the anterior extremity, fig. 9. The mouth, apparently below, also near the anterior extremity. This *Planaria* feeds greedily on mussel. Colour pale, dingy yellow. Motion swift.

On crawling up the side of a glass jar, they readily drop from their position on a slight shock, being apparently timid. Their natural dwelling is among mud.

This animal propagates in August and September, producing spherical yellow ova.

Specimens were taken in July from an old quarry at Fenton Tower, in the county of Haddington. On August 14. two of them appeared on the side of a jar, each with a large ovum, considerably higher than the middle of the body. A month later, an ovum was also seen occupying the body of several, seemingly full-grown individuals, though appearing in some, which are in an earlier stage. The ovum is best seen from below, as the belly is paler, and the parts thinner, fig. 10, slightly enlarged ; fig. 11, more enlarged. I have not observed more than one ovum at a time in a specimen. Probably it is generated from the posterior extremity, and ascends upwards.

About the middle of September, I selected five prolific Planariæ, which were isolated in watch-glasses. An ovum was visible in each. In three days three were free of the ovum, and after three days, I observed two ova in each of the two watch-glasses. But it appears that in general the ovum is deposited within twenty-four hours of the time the Planaria is isolated. When produced, such ova are of a reddish-orange colour, fig. 12.

During the progress of such experiments, the Planariæ had multiplied greatly in the vessel, and many white, minute, animalcular subjects, about half a line long, which I conjectured to be the young, were crawling on its sides.

The adults lurk below among mud. This animal is rare.

PLATE XV.

FIG. 7. *Planaria fodinæ*—Quarry Planaria.

8. The same, enlarged.

9. Head, shewing the eyes, enlarged.

10. Prolific specimen (with an ovum), slightly enlarged.

11. The same, more enlarged.

12. Ova.

d.—PLANARIA ARETHUSA—*The Fountain Planaria*.—Plate XVI. Figs. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19.

Nothing is more perplexing to the naturalist than slight and indefinite distinctions, and the natural and accidental changes incident to the lower animals. He may be thence led to constitute new species from simple varieties, or to admit as permanent what is only transient. It is scarcely possible to guard against such errors, which are of perpetual occurrence.

The *Planaria arethusa* occupied my attention a number of years ago, when some general points distinguishing its nature were established. But the diversities occurring among a number of specimens dwelling seventy miles apart from the subjects previously under investigation, suggested that the latter might be a new species. It will not be void of

utility to shew other naturalists the fallacies to which they may be exposed.

In as far as I can judge, this Planaria is not to be identified with the *Planaria torva*, as described and represented by authors.

Of above 100 specimens, collected from what is called the Dropping Well at Foulden, in Berwickshire, the largest exceeded seven lines in length, by a line in breadth. They were of various colours. Some almost white, cream-yellow, brownish-yellow, blackish, grey, and other hues, not excepting greenish. Many seemed sparsely speckled with whitish tubercles. In all the back was the darker surface.

These creatures feed readily on animal substances, also on the mucilaginous softer parts of decaying vegetables. In a state of repletion, the distribution of the interanea, somewhat lower than the second ventral pore, becomes visible. The aperture for protrusion of the proboscis, is a little higher. The margin of the body, both here and in several other species, remains always transparent, thus denoting extraordinary delicacy of the vessels if any pervade it.

Among the favourite substances most accessible, is the snow-white pupa, dwelling in the same place with the Planariæ. Of this they are so greedy, as actually to devour it alive. If divested of the covering wherein it reposes awaiting its metamorphosis, the creature is beset on all sides by a ravenous multitude of these diminutive enemies. In vain it wrestles and struggles to be free of such contemptible assailants, those which apparently are incapable of protecting themselves. But the proboscis of the Planaria, now a formidable weapon, sheathed in the vulnerable parts of the abdomen, absorbs the softer matter, and the predacious host retreat gluttoned with the contents, leaving only an empty skin behind, with the thorax and limbs entire.

The colour, size, and whole aspect of the animal, are materially affected by the quantity and the quality of the food. One of large dimensions, from dingy white, became slate-grey in ten days. The specimens, Plate XVI., figs. 10, 11, were blackish-grey and brown. The position of two eyes is very distinct in the head, enlarged, fig. 12, and they become still more conspicuous when compressed between two glass plates, as practised by some naturalists, fig. 13.

This animal, in common with its kind, is protected from abrasion by a superficial glutinous secretion investing the body, whereby it may, perhaps, find the means of its suspension in the water, as if by a thread, which is frequently practised. If truly so, we need not seek for any secretory organ near the posterior extremity, as appearances might lead the observer to conjecture. Many having congregated on a plant hung in the vessel containing them, some detached themselves successively in order to descend, but several individuals, at once, taking advantage of a thread belonging to their neighbours, which was discernible by a magnifier, broke it from their accumulating numbers, and the load, precipitated amidst the fluid, dispersed below. The glutinous matter may be drawn off the body of the animal on quitting its hold or adhesion to any surfaces.

The propagation of this animal remains still as obscure to me as it did many years ago ; when, from numerous specimens, I could never obtain any progeny, though most anxiously desired. Then it was not uncommon that a portion of the extremity separating became a new and active animal by regeneration of the higher parts. In the course of his interesting treatise on the genus,* M. Duges remarks, that he could not discover any sexual organization in the *Planaria subtentaculata*, which bears some analogies to the *Fountain Planaria*.

It is alike singular that the spontaneous division of the body witnessed in the course of my earlier observations, never occurred in those of later date, among 150 or 200 *Planariæ* taken, as above, in several successive years. At the time of making them, I did not entertain any doubt regarding the identity of the species.

The animal nevertheless enjoys a vigorous reproductive faculty, whereby those portions violently sundered from its body are restored by new evolutions. The specimen, fig. 10, being divided into three parts on September 14, the tail alone survived. Here a new head advanced far in three weeks, fig. 14, and in other three, had become nearly symmetrical, fig. 15, after which it survived long as an entire animal.

* *Duges*, Recherches sur l'Organisation et les Mœurs des Planaries, 1828, ap. *Annales de Sciences Naturelles*, tom. xv. p. 69.

Only the head of fig. 11 survived mutilation, also on September 14 ; it had become nearly symmetrical on October 24, by acquiring a new tail. But the brown colour of the original was now converted to grey, fig. 16.

Of a third specimen, subdivided into three portions, all had become entire and nearly symmetrical animals in twenty-eight days. The middle portion had regenerated both a head with its two eyes, and a tail. The lowest section had regained a head and eyes ; and the highest, preserved by its ova, had acquired a tail. Thus the more prominent parts of the external organization were multiplied from the original two to six, by experiment.—Fig. 17, head, with a regenerated tail ; fig. 18, middle section, regenerating both head and tail ; fig. 19, tail, having regenerated a head.

That similar redintegration would restore the integrity of mutilated animals, I had ascertained many years ago. These observations, together with the skilful and successful experiments of Dr James Rawlins Johnson, render the farther prosecution of the subject, to which I personally feel peculiarly averse, altogether unnecessary.

These Planariæ dwell in springs or fresh-water rills, under stones, or involved in leaves. They are exceedingly sensitive of atmospherical alterations. When the thermometer fell suddenly from 65° to 56°, they scarcely continued moving.

Though numbers inhabited the well above specified, and a rill at a short distance from it, none could be found in a pond within 100 yards of the former. Several of the lower tribes, however, abounded there.

Desirous of ascertaining what changes might have taken place among these animals after an interval of twenty-five years, whether in aspect or properties, I took some from the same spring-well that had formerly supplied me in Linlithgowshire. Now, I hardly recognise the precise spot from the numerous changes the neighbourhood had undergone. But the appearance of the animals I succeeded in procuring was the same, chiefly slate-grey, of various intensity, a few brownish. Food seemed very scanty in their vicinity. The details of my purposed object were accidentally defeated.

PLATE XVI.

FIG. 10. *Planaria arethusa*, adult, dark grey.

11. Adult specimen, brown.
12. Head of a grey specimen from the General's Well at Binns, shewing the position of the eyes, enlarged.
13. Specimen from the Dropping Well at Foulden, compressed between two flat plates. From the elegant pencil of the lady of Dr George Johnson, no less accomplished in the arts than her husband in the sciences.
14. Lower extremity of fig. 10, severed September 14, regenerating a head on October 4.
15. The same, having become an entire and symmetrical animal, October 24.
16. Anterior extremity of fig. 11, severed September 14, regenerating the rest, as on October 24.
17. Anterior section of a specimen, as on October 24, which had been partitioned in three on September 26.
18. Middle section of the same specimen, as on October 24, now regenerating both extremities.
19. Posterior section of the same specimen, as on October 24, having regenerated a head.

f.—PLANARIA VARIEGATA.—Plate XVI. Fig. 20.

Awaiting some future opportunity of verifying a few observations made on a single specimen, a place is here assigned provisionally to this animal.

Length, an eighth of an inch ; extreme breadth, the twelfth of an inch. Figure of the body somewhat resembling that of the *Planaria arethusa*, but proportionally shorter and broader, like that which I formerly denominated the *Planaria panniculata*, being enlarged in the middle. The head obtuse. Subtentaculated, lower extremity acute. Two large black eyes on the neck, considerably apart. Colour, alternate black and yellow belts. Motion smooth and gliding.

This is a beautiful animal, plump and heavy, the belly flattened.

In crawling up the side of a vessel, it is liable to drop to the bottom, but its descent seems to be retarded by an invisible thread. Marine.

The specimen survived several weeks.

PLATE XVI.

FIG. 20. *Planaria variegata*, enlarged.

g.—PLANARIA ALBA.—Plate XVI. Figs. 21, 22.

Length nearly three lines ; thickness the fifth or sixth of the length ; body roundish ; extremities obtuse ; anterior extremity the smallest. Two circular very black eyes, at about the fifth of the whole length, behind the anterior margin ; colour pure white ; motion smooth and gliding ; intestinal organ not pinnate. Marine.

PLATE XVI.

FIG. 21. *Planaria alba*, enlarged.

22. Anterior portion, shewing the position of the eyes, enlarged.

h.—PLANARIA GRACILIS—*Slender Planaria*.—Plate XVI. fig. 23.

Length a third of a line ; body rather linear, flattened ; eyes two, black towards the upper surface ; mouth apparently below, under the eyes ; colour white ; motion swift, swimming through the water. Several specimens taken during June in Lochend.

PLATE XVI.

FIG. 23. *Planaria gracilis*, magnified.

i.—PLANARIA EXIGUA.—Plate XV. Figs. 13, 14.

Length a third of a line ; form a double cone when in motion ; two black eyes on the surface of the neck ; colour of some specimens reddish in the middle, and when crawling too near the edge of the water, they contract into a reddish spot and perish ; motion swift. A dark globular

ovum appeared in a specimen during September. Taken among weeds in Redbraes Pond.

PLATE XV.

FIG. 13. *Planaria exigua*.

14. *Planaria exigua*, more enlarged.

k.—PLANARIA ALGÆ—*Sea-weed Planaria*.—Plate XVI. Figs. 24, 25.

Length four lines; thickness about the eighth of the length. Body nearly cylindrical; the anterior part larger than the posterior. Four eyes, in quadrangular arrangement, on the surface of the head. A proboscis protrudes from the anterior extremity. Colour siskin-green, tending to yellow, or to brownish. Motion very swift, with all the characteristics of a Planaria.

This animal dwells among the marine Algæ.

PLATE XVI.

FIG. 24. *Planaria algæ*, enlarged.

25. Head, more enlarged.

In examining the appearance of various Planariæ, I have concluded that eyes either do not exist, or they have escaped observation. This may be easily accounted for, either from the colour of the parts wherein, if present, they are seated, or from other causes.

a.—PLANARIA FALCATA—*Crescent Planaria*.—Plate XVI. Figs. 26, 27.

Length a line; breadth a fifth or sixth of the length. Body flattened, thick, and fleshy. Two red crescents apart on the extremity of the head, in a circular position, but under considerable magnifiers, appearing red streaks, sometimes consisting of one or two confluent pair indistinctly seen. The mouth seems in front; and the intestine a longitudinal series of cavities, with some enlargements in their course. Crawls on the belly, or swims swiftly through the water.

Specimens were taken in Lochend, a small lake, during July and August.

Some individuals of the species extend two lines.

It is not improbable that this will prove an intermediate species between the *Planaria* and some other genus.

PLATE XVI.

FIG. 26. *Planaria falcata*.

27. Head enlarged, shewing the position of the crescent.

28. Another specimen, shewing the intestinal organ.

29. Another specimen.

b.—PLANARIA STAGNI.—Plate XVI. Fig. 30.

Length half a line ; breadth a sixth of the length. Body flattened, nearly linear ; extremities obtuse. No eyes visible. Colour white ; motion swift. A specimen taken in August in Blackhall Pond.

PLATE XVI.

FIG. 30. *Planaria stagni*.

c.—PLANARIA FÆCUNDA.—Plate XVI. Fig. 31.

Length half a line ; body flattened, nearly linear, but the middle broader. No eyes discernible. Colour white in the general aspect. Twelve or fourteen, almost spherical ova, occupied nearly the whole body of a specimen taken in Lochend during June.

PLATE XVI.

FIG. 31. *Planaria fœcunda*, enlarged.

e.—PLANARIA FLUSTRÆ—*Sea Mat Planaria*.—Plate XVI. Fig. 32.

Length nearly two lines ; breadth a sixth or seventh of the length. Body convex above, flattened below. A dark spot on the neck. Colour white. Motion very swift. Apparently sustained by an invisible thread

when falling through the water. Dwells on the *Flustra hispida*, where it is not rare, in July and August. Marine.

PLATE XVI.

FIG. 32. *Planaria flustræ*, enlarged.

e.—PLANARIA VORAX.—Plate XVI. Figs. 33, 34.

Length an eighth of an inch, greatest thickness a third of the length. Body round, tapering downwards; head obtuse, tail acute. No eyes visible. The mouth is apparently in front. The animal feeds readily on fish, and when replete, resembles an inflated vesicle, tapering downwards, the food occupying a capacious ovoidal stomach.

From one to five ovoidal brown ova are lodged towards the posterior part. But none of those which were produced afforded any progeny. Two continued visible for twenty-four or twenty-five days in a specimen, when it perished accidentally.

The *Planaria vorax* dwells in fresh-water marshes, along with the *Planaria graminea*, which it devours when dead. There is some correspondence between the figure and habits of both; in them the anterior appears greenish. Numbers of each congregate together after a similar fashion, at the bottom of their vessel, where, also, the *vorax* prefers abiding, amidst mud and decaying vegetables. Rare.

PLATE XVI.

FIG. 33. *Planaria vorax*.

34. The same enlarged.

f.—PLANARIA GRAMINEA—*The Grass Green Planaria.*

Having previously given several illustrations of the history of this species, I shall now restrict myself to a few observations made long afterwards, but for the repetition of which no recent opportunity has occurred.

Its history in the Treatise on Planaria in 1814, left numerous interesting questions unnoticed, therefore, in the hopes of verifying facts, and of correcting errors, a rigorous search was not only renewed in the very place where they were formerly not difficult to be taken, but extended over the neighbouring districts for several years, yet not a single specimen could be discovered.

A favourable opportunity at length conducted me to the original sites of these animals in the year 1822. My search was resumed, and it proved successful. I collected fifty with great facility on the 8th of May.

However, some other animals, sufficiently numerous in the same place on former occasions, did not now appear, either having been extirpated, or from still lurking in their retreats, as the weather was chill. There are conditions, yet mysterious to mankind, regulating the preservation and multiplication of animated beings. They cease to exist in particular places for a time without absolute extirpation from the district. Their numbers may be so reduced that they escape farther observation.

All the preceding Planariæ were of a beautiful grass-green ; they seemed nearly of equal size ; and almost the whole contained ova grouped in every possible arrangement. At least ten or twelve could be enumerated in several ; sometimes in the right, sometimes in the left of the body : one or two were advanced a little before the rest. Their position was so much diversified, that it was never alike in any two specimens.

From May 17, shining corpuscula, together with what seemed decaying animal fragments, appeared in the vessels containing the captive animals. The former proved so many ova liberated on decomposition of the Planariæ, numbers perishing daily from the great heat of the season, which suddenly changed. Such was the mortality, that not one Planaria remained in a week.

These creatures are very prolific, forty ova lay in a vessel which had contained only three.

About 100 ova were now transferred to a place deemed suitable for exclusion of the young. But none came forth.

Greater inequality, than previously, prevailed among a second colony

of the same year, taken from the marsh, September 22. Few were large. Fertile specimens contained four, five, or six brown ova, seldom more, dispersed through the body, and many had none. Where only a single ovum appeared, it was on the right or left side of the body indifferently. None of the Planariæ survived above a month, nor were any of the ova productive of young. Thus I was disappointed again.

This Planaria inhabits few districts.

g.—PLANARIA CUNEUS—*The Wedge Planaria.*—Plate XV. Figs. 15, 16.

This is a minute fresh-water Planaria, somewhat representing the side of a wedge, inhabiting Blackhall Pond. Length not exceeding a third of a line. Head obtuse, the corners rounded as it advances, and the portion between them depressed. Body thick, flattened; tail acute. Colour greyish-brown. No eyes visible. Taken in August.

PLATE XV.

FIG. 15. *Planaria cuneus*, enlarged.

16. The same, magnified.

17. The same, more highly magnified,

h.—PLANARIA PRASINA—*Grass-Green Planaria.*—Plate XV. Fig. 21.

Length of the largest about half a line; thickness about the fifth of the length. Body roundish; head obtuse; tail tapering to a point. Colour beautifully grass-green. Motion active. Several congregate on the side of the vessel containing them. If in a watch-glass they be subjected to the microscope, they will be observed to pass at the edge of the water on the side next the light. One or two brown ova seemed to be in one or two specimens. No eyes visible.

Drawn up with the roots of the Water Plantain in Blackhall Pond, in August.

Great disparity of size observable among a group.

PLATE XV.

FIG. 21. *Planaria prasina.*

PLANARIA NIGRA.—Ova, Plate XV. Figs. 18, 19.

The history of this animal is detailed in the Treatise on Planariæ, 1814.

The ova are deposited chiefly on the neighbouring vegetable productions during September, and other seasons of the year.

PLATE XV.

FIG. 18. *Planaria nigra*, ova, as deposited on a blade of grass.

19. Group of ova, enlarged.

Note.—The practical naturalist engaged in a course of observations, is frequently embarrassed by the appearance of animals having some resemblance to the Planariæ in several particulars, but without being able to identify them with the genus.

a.—PLANARIA SERPENTINA, Plate XV. Fig. 20.

Length between one and two lines; body flattened; head obtuse, enlarging towards each side, and somewhat depressed in the centre of the front, where there seems a circular orifice, probably the mouth. The interaneæ, occupying much of the body, of a dark colour, and resembling curving or circular sacs. Colour of the animal white, or grey under the microscope. Motion smooth and gliding as that of other Planariæ. No eyes visible. Specimens were taken in July from the pools at Fenton Tower.

PLATE XV.

FIG. 20. *Planaria serpentina*, enlarged.

b.—PLANOIDES FUSCA.—Plate XVI. Figs. 35, 36.

I have been at different times disposed to consider this minute marine animal allied to the *Aplysia*, or some other genus, always presuming that none of the specimens occurring were full-grown. But as

all were nearly of the same size, the conjecture was probably erroneous ; therefore, until its proper place be ascertained, let it be named, provisionally, *Planoides fusca*.

Length a line and a half ; breadth and thickness nearly half the length. Body compact, solid ; the anterior extremity divided horizontally into two lips, wherein is perhaps the mouth. This extremity is fashioned somewhat as a scoop by the fold of a membranaceous edge, apparently reflected on the back. A dark red internal organ is situate towards the centre of the body. Neither eyes nor marginal specks have been discovered, nor any prominent parts of external organization. Colour brownish, speckled. Motion smooth and gliding.

This animal has always a tendency to crawl upwards, whence it is allured, by the smoothness of the glass, to quite the water, and is lost, which may be prevented by filling a small vessel to the brim, and covering it with an inverted, loaded, watch-glass. Marine.

PLATE XVI.

FIG. 35. *Planoides fusca*.

36. The same, enlarged.



Notwithstanding the tender and delicate consistency of the Planarian race, and their liability to perish, they seem to survive longer with care than might be anticipated. Some of the *Planaria Edinensis*, taken in October 1813, exhibited internal ova a year later, and still survived in March 1815. Also some of the same colony, or their progeny, were found alive during September 1819, in the vessel originally appropriated for their reception, five years earlier.

The preceding list of species does not by any means exhaust the whole which are to be found in the Scottish waters. Besides several of more ample dimensions, many very minute specimens appear transiently, especially during the summer months, among the water taken from ponds, lakes, or marshes. When this has been sometime introduced into vessels,

various minute beings of Planarian form and habits, may ordinarily be seen crawling on the glass, and frequently containing one or more ova. In general they suddenly disappear, or perish. But I have not been able to discover that they undergo any metamorphosis ; besides, were it into fresh-water Zoophytes, these are so very few, that many would remain unaccounted for.

It is not improbable, however, that some may be the young of such worms as attain much larger dimensions, both in the fresh and in the salt waters, for until much better acquainted with the subject, and in particular, with the history of individual specimens, which constitute the main elements of Zoology, there is no absolute test whereby to discriminate them.

I doubt not that I may have erred by comprehending a few animals among the Planariæ, which do not actually belong to them ; but, at the same time, the reader is provided with the means of detection, and occasionally of correction, by the best figures that could be procured, being presented to him, with such descriptions and explanations as experiment and observation warranted.

In a genus with external characters so scanty and obscure, and with an internal conformation to be so seldom discovered, there will be long an opportunity afforded of improving any group into which naturalists may attempt to associate them. Nor do I presume to assert that any of the preceding will remain for permanent adoption.

There must be some unknown secret principle promoting the multiplication of this race of animals. Specimens of one kind are remarkably rare, for example, in places not far distant from others where they are remarkably abundant. While particularly occupied by the subject from the year 1802 downwards, I could not by any means discover a specimen of the *Planaria lactea* ; and at the same time the *Planaria paniculata*, a brown species, was hardly to be seen. At this present period, so many years after, I find the latter in multitudes in a pond called the Marl Pits, I believe, which is near Craigcrook, about three miles west of Edinburgh, but not one of the *Planaria lactea* among them. On the other hand, I find corresponding multitudes of the *Planaria lactea* in a pond

three miles east of it, with very few of the *panniculata* among them. The largest and finest black Planariæ are in Duddingston Loch, at the base of Arthur's Seat, but in the preceding two places they are comparatively rare and small. Nor have I observed either the *lactea* or *panniculata* along with them.

On the whole, I view all that is said only as so many materials in aid of the construction of some system on a solid basis.

But from these and other observations, it may be deduced that,—

I. The genus *Planaria* is common to the seas and the fresh-waters of Scotland ; but the proportional numbers in the former much smaller than in the latter.

II. That the genus is distinguished by groups of considerable diversity of shape, some being thin and flattened individuals ; others almost cylindrical, and some approaching a conical or double conical form.

III. That their distinction is also seen in indefinite external organs, such as subtentacula or cornicula, and the appearance of specks more or less numerous, or of what resembles eyes, while in many none such can be discovered.

IV. Some are distinguished by the form and position of the mouth, being an aperture in front, a slit in the under surface, near the anterior margin, or a proboscis far behind, protruding from the under surface.

V. The food, for the most part consisting of animal substances, is received into an ovoidal stomach, and in some is distributed in numerous pinnate interanea, extending nearly to the margin of the animal. Planariæ are in general carnivorous ; some seem to consume the succulent parts of vegetables.

VI. Planariæ feed greedily, and some to such excess as to burst the integuments. They are proportionally capable of long abstinence, which diminishes their size, and impairs their colour.

VII. Planariæ are of different sexes, or they are androgynous. They propagate by ova, containing one or several embryos.

VIII. Certain young Planariæ apparently undergo metamorphosis in advancing to maturity.

IX. Some Planariæ multiply by spontaneous division of the body, a fragment becoming an entire animal after separation.

X. Many species are endowed with a powerful reproductive faculty, whereby each of many parts into which a specimen may be mutilated becomes an entire animal.

XI. Redundances of important organs to subsist at once is obtained by artificial laceration of a specimen.

PLATE XIV.

- FIG. 1. *Planaria cornuta*, back.
 2. The same, belly.
 3. Under surface of a specimen, shewing the distribution of the vessels. enlarged.
 4. Spawn, enlarged.
 5. *Planaria corniculata*, back.
 6. The same, belly.
 7. Spawn.
 8. Ova, or capsules of same, enlarged.
 9. *Planaria ellipsis*.
 10. Another specimen, enlarged, back.
 11. The same, belly.
 12. Another specimen, shewing the appearance of the vessels, enlarged.
 13. Surface of the head, shewing the distribution of the specks, enlarged.
 14. Internal vessels, magnified.
 15. Spawn.
 16. Portion of the same, enlarged.
 17. *Planaria flexilis*, back.
 18. The same, belly.
 19. Surface of the anterior portion, shewing the position of the ocular specks, enlarged.
 20. Spawn.
 21. Spawn.
 22. Ova or capsules of the same, enlarged.
 23. Ova or capsules, enlarged.
 24. Nascent Planaria from the same ova or capsules, enlarged.
 25. Nascent Planaria from the capsule, shewing the position of the four clusters of ocular specks, enlarged.

PLATE XIV.

- FIG. 26. Empty capsules left by the young Planaria, enlarged.
 27. *Planaria maculata*, back.
 28. The same, belly.
 29. Another specimen, back.
 30. The same, belly.
 31. Another specimen, back, slightly enlarged.
 32. Another specimen, mottled; back, slightly enlarged.
 33. Anterior surface, shewing the position of the ocular specks, enlarged.
 34. Patch of Spawn.
 35. The same, enlarged.
 36. *Planaria haustrum*, back, enlarged.
 37. The same, belly.

PLATE XV.

- FIG. 1. Larvæ, supposed to have issued from the spawn of the *Planaria cornuta* enlarged.
 2. The same, farther advanced.
 3. Empty capsules.
 4. *Planaria lactea*, shewing the internal vessels, enlarged.
 5. Anterior portion, shewing the position of the eyes, and precise form of the vessels, more enlarged.
 6. Posterior portion of the same. [The middle portion is omitted purposely].
 7. *Planaria fodinæ*.
 8. The same, enlarged.
 9. Head, more enlarged, shewing the position and appearance of the eyes, more enlarged.
 10. Specimen containing an ovum, enlarged.
 11. The same, more enlarged.
 12. Ova, enlarged.
 13. *Planaria exigua*, enlarged.
 14. The same, more enlarged.
 15. *Planaria cuneus*, enlarged.
 16. The same, more enlarged.
 17. The same, more enlarged.
 18. *Planaria nigra*, ova on a blade of grass.
 19. Group of the same, enlarged.
 20. *Planaria serpentina*, enlarged.
 21. *Planaria prasina*.

PLATE XVI.

- FIG. 1. *Planaria gravata* ?
 2. The same, enlarged.
 3. *Planaria hebes*.
 4. The same, enlarged.
 5. *Planaria lactea*, abstinent.
 6. The same, having fed, back.
 7. Belly.
 8. Head, enlarged.
 9. Supposed ovum.
 10. *Planaria arethusa*, adult, dark grey.
 11. Specimen, adult, brown.
 12. Head of a grey specimen.
 13. Specimen, compressed, enlarged.
 14. Extremity of fig. 10, regenerating the anterior part.
 15. The same, become an entire animal.
 16. Anterior section of fig. 11, regenerating the part defective.
 17. Anterior section of another portion, regenerating the posterior part.
 18. Middle section of the same specimen, regenerating the defective anterior and posterior parts.
 19. Posterior section of the same specimen, having regenerated the defective anterior.
 20. *Planaria variegata*, enlarged.
 21. *Planaria alba*, enlarged.
 22. Head, more enlarged.
 23. *Planaria gracilis*.
 24. *Planaria algæ*, enlarged.
 25. Head, more enlarged.
 26. *Planaria falcata*, enlarged.
 27. Anterior portion, more enlarged.
 28. Another specimen, shewing the internal organization, enlarged.
 29. Another specimen, enlarged.
 30. *Planaria stagni*, enlarged.
 31. *Planaria fœcunda*, enlarged.
 32. *Planaria flustræ*, enlarged.
 33. *Planaria vorax*.
 34. The same, enlarged.

CHAPTER IV.

NAIS.—LUMBRICUS.

NATURALISTS have frequently chosen very delicate features for the purpose of dividing the different tribes of animals into groups ; such, too, as are often difficult to recognise, and not, perhaps, the most obvious actually existing. For this selection there are as yet no positive rules laid down, and sometimes, therefore, very equivocal principles are adopted. In proportion to the minuteness of the subject, and the complexity of organization, the uncertainty is augmented. But unexpected transparency, and microscopic aid, occasionally render that structure explicit which it would be fruitless to search after by ordinary methods.

§ 1. A distinction has been attempted of worms into smooth and hispid, and a genus constituted out of the latter, denominated *Nais*. But there are many of the *Vermes* whose precise formation is of such difficult observation, that we are actually puzzled to discover whether they are hispid or not.

By *hispid*, I understand that the body is characterised by hairs or bristles, single or fasciculated on the surface, or which may be protruded so as to project above the skin.

This subject has none of the facilities which attend many others ; and I am much surprised to see some of those naturalists who offer their works to the world, overlook the embarrassments obstructing the true

practical observer in composing original treatises on rare subjects, and filling numerous plates with a profusion of the finest representations possible to be executed of them. Not only are the subjects themselves of the rarest occurrence, insomuch, that the observations on a single specimen of to-day may never be corroborated from want of opportunity, because a second specimen may not be found for ten, nay for twenty years afterwards. Such a specimen may not be perfect, neither may it survive, or a superior artist may not be every instant at command, and hence we may easily conclude how little of the whole nature of an animal can be disclosed, even under the most favourable circumstances, on seeing an object twice. Hence, I cannot hesitate to affirm, that no single individual is capable of composing the complete and entire history of any one animal, or race of animals, for this must be the work of many. Should any one chance to confirm the notice of peculiarities ascribed to any animals in this volume, I hope that naturalists will permit him to enjoy his own share of the merits his skill and patience may deserve,—recollecting that I make no claim to priority. How could I, unless I were familiar with the pursuits and investigations, present and past, of all the world. The best promotion of the science of natural history, and the justest correction of observations, will be effected by the accurate delineation, aided by the description of living subjects in the vigour of life.

I have had little opportunity of studying the aspect and habits of the hispid worms, whereof two, belonging to the genus *Nais*, are inhabitants of the fresh-waters of Scotland.

But one principal reason for introducing them, originates from the desire of proving this fact, because the disappointment attendant on long and frequent research, made me begin to doubt whether either of them could be numbered in the Fauna of this country.

I. NAIS.

§ 1. NAIS LACUSTRIS.—Plate XVII. Figs. 1–5.

Length an inch ; body round ; extremities obtuse ; the anterior



Car. L. ...

smooth and cylindrical, the portion behind it provided with a double row of thin tufts or prickles, some of them composed of several bristles. The extremities contain the mouth, and the termination of the excretory canal.

In some a yellow globule is seen, towards the anterior, and in one or two white spherules have appeared.

The mouth seems a dilateable cylinder, without a proboscis. The food may be the minute Entomostraca, as a specimen of the *Cypris* appeared in the intestine. This last organ is of variable form, being divided into several sacs, of alterable appearance and numbers.

The transparence of the animal completely exposes the internal conformation.

M. Duges affirms that propagation takes place by means of ova or capsules, and that he has witnessed redintegration of the animal after being sundered transversely.

It dwells among the roots of the Iris and Equisetum, not very far from the surface of lakes and ponds. Owing to its impatience of exposure to the light, it is somewhat difficult to obtain delineations of any specimen.

PLATE XVII.

FIG. 1. *Nais lacustris*.

2. The same, enlarged.
3. The same, more enlarged.
4. Another specimen, shewing the internal organization, enlarged.
5. Another specimen, shewing a different appearance in the internal organization, enlarged.

§ 2. NAIS PROBOSCIDEA.—Plate XVII. Figs. 6, 7.

Length nine lines ; body very slender, slightly flattened throughout, the anterior prolonged into a very flexible process, terminating in a point ; the posterior extremity obtuse. Near the origin of the proboscidal process is a small jet-black eye, on each side of the head, at some dis-

tance behind the root of that organ, and at the root appears what is the mouth.

About sixty pencils, composed of *three* bristles, two of them long, border each side of the body. There is considerable disparity between the length of the second and the third. But these pencils do not seem to indicate articulations. The course of the intestinal organ is exposed throughout the whole body by the transparence of the parts. It is considerably enlarged near the origin.

The motion of this animal narrowly resembles that of the *Nereis*, being undulatory, serpentine, or executed only by contortions. It appears like the most minute eel to the naked eye, the setaceous pencils being invisible. The bristles are in no degree recurved or hooked, as some have supposed.

After the weeds and aquatic plants, about the roots of which those animals lurk, have been withdrawn from the water, they quit the grosser materials, and swim above.

PLATE XVII.

FIG. 6. *Nais proboscidea*.

7. The same, enlarged.

II. LUMBRICUS.

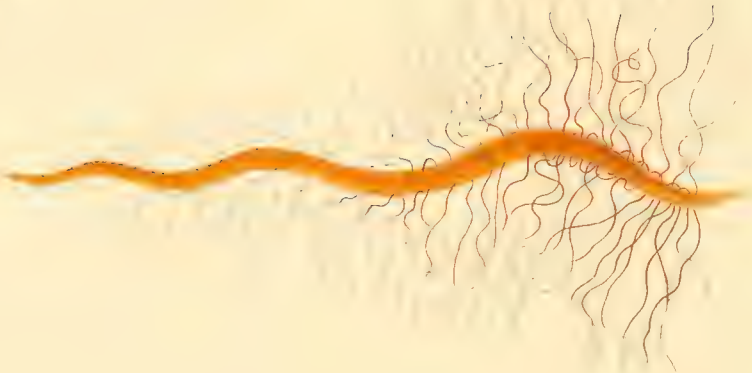
Recent naturalists, subdividing the overgrown portion of the Systema, comprehending animals of all common features, have introduced a new and numerous class under the name of *Annelides*. In this it is proposed that those of the verminal tribes, distinguished by the partition of their bodies into segments or articulations, a sanguiferous system, and certain other specialties, shall be included, all combining to denote a higher position in the animal scale.

Herein numerous animals of very opposite conformation and habits are associated, which, to take the subject generally, impairs the value of the section. But every one must be glad to avail himself of any ostensible place where he can record the subject of his observations.

A few species shall be described, by such as seem their prominent



70



Cirratulus - P.

features, accompanied by delineations. It is probable that some of them may be withdrawn, on farther examination, for the purpose of being placed in more suitable positions.

Segments, and hairs or bristles, are assumed as the most prominent features commonly distinguishing individuals of the genus.

In some, however, neither of these characters predominate over others, their presence being somewhat equivocal. Nor shall I rigidly reject what most naturalists have to accept as species.

§ 1. LUMBRICUS CIRRATUS—*The Medusa Worm*.—CIRRATULUS BOREALIS, *Lamarck*.*—Plate XVIII. Figs. 1, 2, 3, 4.

Length four inches, greatest thickness three sixteenths of an inch ; body composed of numerous segments, and tapering toward each extremity. Numerous long and flexible cirri invest the whole body, apparently somewhat cartilaginous, and consisting of an infinite number of rings. These cirri originate from every second segment, no one being free of them. Two rows run down the back, and continue nearly to the posterior extremity. All are longest towards the anterior extremity, shortening as they descend. Many are necessarily omitted in the figure, Plate XVIII. fig. 1, which would be otherwise confused and indistinct. A section of one is represented as enlarged, fig. 2. A pencil of bristles, very difficult to be observed, is placed on each side of each segment, sometimes appearing as if only two of unequal length. But the incessant motion of the animal, and their position, rendered the part of difficult determination by the microscope. When the animal crawls, the cirri lie above each other along the back, presenting a very singular aspect. The mouth is in the anterior extremity, and the sustenance of the animal is probably derived from mud.

* *Lamarck* places this animal among the *Annelides*, but he thinks it does not belong to the genus *Lumbricus*. Other authorities endeavour to constitute a different place for its reception. The work of *Andouin* and *M. Edwards*.—*L'Histoire Naturelle du Littoral de la France*, tom. ii. p. 271, Pl. VII. may be profitably consulted.

The colour of the *Cirratulus* is wholly reddish, sometimes tolerably vivid ; or it is brownish, and apparently variegated, from the quantity of mud absorbed.

Much of the appearance of the animals seems dependent on age, size, and the place they inhabit. Their natural and favourite dwelling is the muddy fissures of rocks, under tufts of marine vegetable products, considerably above low-water, or where protected by any other soft covering. They are distributed very profusely throughout Scotland, but I have found none among sand. While the animal lurks in retreat, its cirri are spread like so many minute worms over the neighbouring surface.

A slight glutinous secretion exudes from the body.

The *Cirratulus* retreats from the light. If kept in a white saucer, covered with a shell or a stone, it will creep out at night ; or, by filling the vessel containing it so high that the tips of the cirri cannot reach the surface of the water, it will abandon its concealment, and crawl up the side, thus affording a satisfactory view of its form to the observer. But if forcibly removed, the whole creature contracts into a confused bunch, preventing sufficient inspection of the parts.

Though the animal is seen under considerable diversity of aspect, I am unable to pronounce any of numerous specimens as belonging to different species.

After a specimen had been preserved throughout winter, a number of what I conjectured to be ova, appeared in its vessel in May, and ten days subsequently, many very minute vermiculi, not half a line in length. Unfortunately my observations were interrupted until July, when all had perished.

Several years afterwards, three small specimens were lodged in a vessel on the 21st of June. In two days I found 300 or 400 very minute white opaque spherical ova on the bottom, of considerable disparity in size. About 200 additional ova, of exactly the same character, appeared in the watch-glass, which had been transferred, along with the specimens, to a different vessel, fig. 3. There were now at least 500 ova in the watch-glass.

Soon after the first deposit, a very minute, microscopic animalcule, was visible in the watch-glass. A consider number appeared then and subsequently. The form of these creatures was rather the parallelogram flattened, begirt with cilia. Their length three times their breadth ; their colours faint dingy yellow ; the body generally opaque, but with lighter portions on some specimens. Their motion was rather slow towards the end of June, and sometimes a tendency to revolve horizontally on the centre of the body as an axis. A deep constriction of the middle was seen in several, as if they were about to sunder.

Under a high magnifier, the cilia distinctly formed a fringe or border on the margin. A longitudinal channel occupied much of the body, which I was inclined to think commenced by a wide circular orifice, the mouth in the very extremity.

It proved impossible to follow the history of these minute creatures, perhaps not equalling the thirtieth part of a line. Nor can I pretend to affirm that they were not of the *Animalcula infusoria* group, fig. 4.

One specimen survived eighteen months, when it perished accidentally.

PLATE XVIII.

- FIG. 1. *Lumbricus cirratus*.
2. Section of a cirrus.
3. Ova.
4. Animalcula.

§ b.—LUMBRICUS MARINUS—ARENICOLA PISCATORUM—*Lug Worm*— Plate XIX.

The inhabitants of the sea-coast, or those who frequent the wet and shallow shores of Scotland, cannot avoid remarking certain places almost occupied by pyramids or rolls of mud and sand cast up, as the tide concealing them recedes. In some quarters these are extremely numerous, of unequal size and quantity, in others they are proportionally rare ; but in all it is evident that considerable humidity favours their production.

All these heaps proceed from an animal lurking at a considerable

depth below, which few of the better informed have had an opportunity of beholding, or of withdrawing from its dark abodes ; circumstances which render me the more desirous of presenting the lively image of one of the most curious of Nature's works to those who wish to become acquainted with its appearance.

1. This animal, the fisherman's worm, extends ten inches in length by nearly half an inch in thickness, the body being cylindrical, and subdivided into very numerous segments. It diminishes slightly towards each extremity.—Plate XIX., fig. 1. The animal occasionally displays the formation of the head or anterior extremity, as shewn in fig 2, of a globular shape, with a hollow centre, which Müller considers a proboscis. It generally protrudes this when the animal is very weak.

A double row of about eighteen pencils commences near the anterior, composed of bristles issuing from the sides of the animal, occupying the greater part of the whole length, and terminates where the body is suddenly reduced in size, and assumes for the remainder quite a different aspect, as if of more uniform nature, with a shagreen surface.

Thirteen pair of beautiful vermilion branchiæ rise from the back, commencing about a third of the length from the anterior extremity, fig. 1, *a, b*. These organs are of inconceivable beauty and interest, of which the art of the limner can produce but a very imperfect representation, difficult enough otherwise to be obtained, both from the incessant contraction and dilatation, and the motion of the animal. By the microscope the resemblance of each to vegetable forms is discovered in stem, boughs, and branches, all in lively action, fig. 3.

The quantity of bristles in a pencil, and the size of the branchiæ, are indefinite and irregular, the smallest being next the head.

The diversity of colour in this species is very great ; nor do I know that it is dependent on either age or dimensions. Of a number collected together some will be found of a carmine colour, or of deeper red, some brownish, and others blackish-green ; besides, there are specimens which exhibit various blending shades in the same individual.

Dwelling constantly in the dark, not only deep in the sand, but

covered by the sea, this creature is extremely impatient of light ; and in confinement it continually attempts to penetrate downwards, even when there is no sand in its vessel. But if amply provided with this material, it soon screens itself from view, and in burrowing, the head, enlarged, as shewn by fig. 2, seems to be employed in effecting its descent.

These animals form a thin coating of sand, which is of some tenacity, investing the body just like a piece of thin linen wrapped around it. When a specimen is removed from its residence, it seems to attempt divesting itself of this covering, and to experience difficulty in doing so.

The distinctive character of the species consists in the branchiæ, occupying only an intermediate portion of the body ; the posterior, therefore, bearing none, is of different formation.

2. Another species of the *Lumbricus marinus*, which I have not hitherto observed to be described, though it is unlikely to have been overlooked, inhabits our seas.

This is somewhat smaller than the former, the body consisting of numerous setiferous and branchiferous annulations.

The branchiæ commence, as in the other, at some distance from the anterior extremity, but they continue, without interruption, down to the posterior extremity, or its immediate vicinity, being about thirty-eight pair in all. They occupy every segment from their commencement, except the last. The lower extremity terminates in a knob. The branchiæ are dichotomous, originating from a root, and successively subdividing into several members. They are somewhat incurved, and some of them have a faint reddish appearance towards the root, but of this portion it is not easy to obtain a view. Their action much resembles that of the branchiæ of the *Terebella*.

The setiferous papillæ are prominent, running down from the anterior to the extremity. There are about fifteen pair of pencils between the anterior and the commencement of the branchiæ. The pencils are composed of several bristles.

Colour of the whole animal very dark green.—Plate XIX., fig. 4 ; head when globular, fig. 5 ; branchiæ, fig. 6 ; substances like ova, fig. 7.

The best specimens I have had were from Zetland.

Though the *Lumbricus marinus* appears a strong and hardy animal, it is of difficult preservation in confinement. The vessels receiving it should be deep, and contain a quantity of sand, always in a humid state, because they immediately shelter themselves, and absorbing it profusely, the pyramidal rolls are formed on the surface as it is discharged.

This animal is vernacularly called the *lug* or *lung* worm ; and it is very extensively used as bait, but, where accessible, mussels are preferred. These animals are dispersed in countless myriads on the various coasts of Scotland.

PLATE XIX.

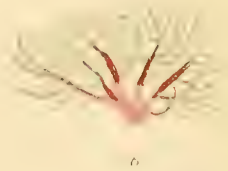
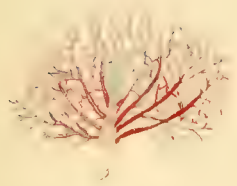
FIG. 1. *Lumbricus marinus*, *Arenicola piscatorum*, common species ; *a*, *b*,
branchiæ.

2. Globular anterior.
3. Branchia, enlarged.
4. *Lumbricus marinus*, another species, or a variety of the former.
5. Globular anterior.
6. Branchiæ, enlarged.
7. Substances conjectured ova.

Many of the Lumbrici are so much more indistinctly characterised than the preceding that I hesitate attempting to describe them, from my conviction of being unable to do so otherwise than in a very imperfect manner. But considering it possible that some one feature, which others have not had an opportunity of observing, may occur in my specimens, I am induced to say a few words on the subject, trusting to better occasions whereby it shall be amplified.

§ *c*.—LUMBRICUS CAPITATUS.—Plate XVII., figs. 8, 9.

Length, two or three inches ; thickness, half a line ; body round ; anterior extremity conical, pointed ; posterior extremity obtuse. The body is composed of numerous segments, each armed with three minute pencils of bristles, one on each side, the third on the middle of the back.



Lumbricus Marinus
Funiculus Piscatorum

A white proboscis issues from the anterior extremity. When the animal is contracted it much resembles a small earth-worm. Colour dull red above, reddish-orange below. No eyes could be discovered.

In crawling, the segments enlarged at the place of their union ; and it is a peculiar feature, that a kind of intumescence appeared at intervals as the body advanced, the portion thus enlarged being vivid red, while the vicinity became pale, and this intumescence was transmitted along the body.

A silky sheath is formed of sandy particles by the animal.

It lurks constantly on the sand of the shore at about half tide, whence the head is protruded, waving to and fro. In confinement it becomes more restless after mid-day, occasionally quitting its retreat to crawl about the vessel.

Its habits bear some resemblance to those of the Nereis.

PLATE XVII.

FIG. 8. *Lumbricus capitatus*.

9. Anterior extremity, enlarged.

§ d.—LUMBRICUS LITTORALIS.—Plate XVII., figs. 17, 18.

Length, fourteen lines ; thickness, the third of a line. Body round, tapering to the extremities ; annulated, each annulation composed of several circles. Short indistinct bristles protrude at the union of the segments. Colour, a fine red, perhaps derived from an internal vessel traversing the body.

The animal forms itself a tubular covering of sand, investing the whole body. It is of a lively nature, and when numbers are present, they entwine themselves together.

Littoral. Found under stones at Rothesay, Eyemouth, and elsewhere.

PLATE XVII.

FIGS. 17. *Lumbricus littoralis*.

18. Enlarged.

§ *e.*—LUMBRICUS TERES.—Plate XVII., Figs. 10, 11, 12.

Length, eighteen lines ; thickness, nearly half a line ; body round, tapering towards each extremity, faintly indented by numerous annulations, with a row of bristles at intervals down each side.—Plate XVII. fig. 10 ; an outline of the head enlarged is seen fig. 11. The mouth seems below, and the termination of the intestinal canal in the centre of the posterior extremity. Under the microscope a red vessel is discovered running down the middle of the body ; and the interanea, which are of peculiar formation, are finely variegated when full. Colour various brownish shades ; the extremities light. This animal swims by contortions in the water. One committed to a watch-glass proved so restless as to render observation inconvenient ; but another being introduced, both were perfectly quiet.

It forms a tube of muddy particles, which is permanently occupied.

The *Lumbricus teres* inhabits a small pond in the city of Edinburgh, in Heriot Row gardens.

PLATE XVII.

FIG. 10. *Lumbricus teres.*

11. Outline of the head, enlarged.

12. Section of the body shewing the formation of the interanea, enlarged.

§ *f.*—LUMBRICUS HIRSUTUS.—Plate XVII., Figs. 13, 14, 15, 16.

Length about fifteen lines ; thickness, half a line or less ; body cylindrical, composed of a number of segments, with lateral rows of bristles, a pencil being situate on each side of each segment, all of which are very conspicuous on the upper segments. The whole body is covered, besides, with short hairs, rather thinly set. Colour of the anterior portion whitish, of the remainder dull red or umber.

A specimen occurred in February, among some collections, on the coast of Fife. It was lost accidentally immediately after delineation.

PLATE XVII.

FIG. 13. *Lumbricus hirsutus*.

14. Anterior part, enlarged.

15. Middle, enlarged.

16. Posterior part, enlarged.

Many other Vermes and Lumbrici of Scotland merit examination, description, and representation. The genera comprehend numerous species, which have been hitherto overlooked, in as far as I know, by all observers. Some of those preceding require further investigation than circumstances would permit me to bestow on them. Their introduction here may be considered temporary or provisional, rather than assigning to the whole a positive position which may be altered. The two genera will certainly admit several subdivisions, which doubtless must be influenced by the appearance presented by the interanea of the more transparent species.

There are various animals participating of the nature of the Lumbricus, which may be considered intermediate stages to the genera. But I shall meantime reserve them for a miscellaneous chapter in another place.

CHAPTER V.

NEREIS, SPIO, AND CONGENERA.

COULD the *Systema Naturæ* be perfected, it is not improbable that, excepting by interruption from tribes now extinct, the transition to successive genera would be very gradually accomplished ; if not by insensible degrees, one might venture to predict that the last of one genus, and the first of another, would appear not far asunder ; that the distinctions presented would be but inconsiderable, farther than in the features peculiar to each denoting their separation.

I know that some distinguished philosophers have expressed a different opinion, thinking each genus so distinct and independent of itself, as to be void of every bond of connection ; that it has been so since the origin of things, and will so remain.

Whether there be actually a connecting chain or not, it belongs to each observer diligently to record what he has seen, leaving it to some scientific systematist to arrange and combine all the knowledge which may be derived from the labour of others besides his own.

In this way the precise state of information would be obtained, so that the purposes of creation might be conjectured, and whether certain genera were allied or estranged.

There is no single territory, even the most extensive on the surface of the globe, from which more than a partial view, commonly one most limited, of some branch or other of animated nature, can be derived,

therefore the observer must find himself continually opposed by many chasms, leaving a disjointed fabric in his hands. He is thus compelled to select some object new to him for commentary, without being able to constitute its immediate connection with those which are old and familiar.

If the effort to establish the alliance or estrangement of genera be important, not less so is the mode of discovering the character of animals. It would be most desirable that this were done, if practicable, by external features, in order to preserve the object from destruction ; for it cannot escape the cautious naturalist, that his lacerating the substances, or extinguishing the life of an object, must deprive him of all opportunity of pursuing its habits.

The ornithologist finds sufficient characters in the formation of the bill and the feet of birds, their plumage, their nests and eggs, to enrol them with the proper genera. He does not kill them, dissect them, and stuff their skins, to discover their position in the *Systema*.

The entomologist can arrange his beetles, bees, and butterflies, by their elytra, antennæ, wings, and other parts of external conformation, without mincing them down to find their internal structure.

But a very different method is recommended, and partially adopted, with certain animals of the extensive orders, classes, and genera of the lower tribes. The external appearance seems to be held of lesser account, and we are directed to lay open the interior of our specimens, in order to assign them their proper positions.

It must be obvious to all the world, that however excellent this plan, the difficulties of its fulfilment are almost insurmountable. First, it requires a skill in anatomy of which few can boast ; and, secondly, equal expertness in dissection. But the gravest objection arises from the destruction of the life of the subject. Could any other expedient be substituted of equal benefit, it would be invaluable.

The simplest mode of reaching any ultimate purpose, provided it is conducted with the same certainty as those which are more complex and difficult, is always to be preferred.

Without presuming to deny the benefit of dissection as a useful and

beneficial guide, it appears to me that in many cases, if not in most, the truly skilful naturalist will obtain sufficient data for the position of the inferior animals, while still preserving them unhurt.

In treating very briefly of the *Nereis* and its kindred, I propose to take only a general view of the subject, without entering into the various specialties which have occupied some learned naturalists ; for, so long as they may be dispensed with, they should be rather considered superfluous.

The *Nereis* proper is a marine animal of vermicular form ; the body somewhat flattened and subdivided into numerous segments. The head provided with two or more antennular appendages, together with two or four eyes ; the lower extremity terminating in a fork.

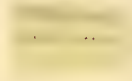
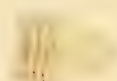
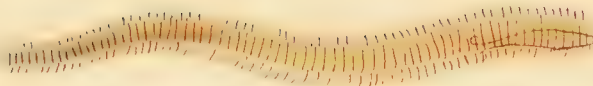
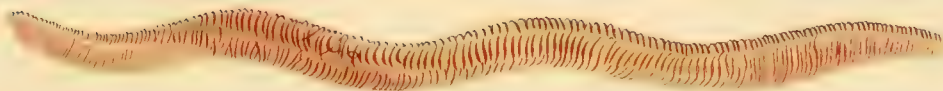
But in reaching this form, which may be exemplified by the *Nereis remex* or *Phyllodoce laminosa* of authors, Plate XXI., and the *Nereis iridescens* or *margaritacea*, Plate XXII. fig. 6. It may be expedient in approaching these, which seem the more perfect of their tribe, merely to give a brief notice of some others, apparently belonging to the genus in a comprehensive sense, avoiding the minutiae of detail.

I. NEREIS.

§ 1. NEREIS TERES.—Plate XX. Figs. 1, 2.

Length two inches and a half ; thickness a line and a half in the middle, whence the body tapers regularly to each extremity ; the anterior pointed, the posterior forked. A long proboscis is frequently darted out from the anterior, issuing in front of the point, or rather under it. The body is very faintly marked by numerous annulations ; with a row of about eighty pencils on each side of such a specimen. These issue from every second segment, there being one interannulation vacant. The pencil, consisting of a few bristles, issues from a low fleshy sheath, with two or three marginal papillæ. Colour universally white, or different shades of red. No eyes or antenna visible.

The animal lies generally coiled up, or it swims with contortions.



Its motions denote violence. It seems to construct a very slight covering of small particles and a glutinous secretion, under which it reposes.

A specimen spawned very profusely on July 23, when a multitude of ova, the merest specks, were observed whitening the water. It was previously round and turgid, but flattened and thin afterwards.

Perhaps this is the *Nereis alba* of Müller, represented *Zool. Dan.*, v. ii. p. 29, Plate LXII. figs. 6, 7: "Caput absque oculis, palpis aut tentaculis."

Marine. Shore.

PLATE XX.

FIG. 1. *Nereis teres*.

1. A. Another specimen.

1. B. Section of 1. A.

2. Proboscis of fig. 1.

§ 2. NEREIS (NEPHTYS), HIRSUTA.—Plate XXI. Figs. 1, 2, 3.

The nature of the species of *Nereis*, now referable to the genus *Nephtys*, is somewhat more explicitly illustrated in the next article.

The present *Nereis hirsuta* extends three inches, including a spine, by which the posterior extremity terminates. The shape of the body is somewhat quadrangular, divided into numerous segments, four of which are enlarged.—Plate XXI. fig. 2. In place of the usual pencil of bristles there is an appendage, whereon is a long prominence, bordered by a superficial row of short bristles above.

Neither tentacula nor eyes were visible in a single specimen which came from Zetland, and was never vigorous.

PLATE XXI.

FIG. 1. *Nereis hirsuta*.

2. Section of the body, enlarged.

3. Appendage on the segment, enlarged.

§ 3. NEREIS (NEPHTYS) LINEATA, NEPHTYS MARGARITACEA.—Plate XXI.

Figs. 4, 5, 6, 7, 8, 9, 10.

Length ten inches, form round ; the body divided into numerous segments, bounded by a row of pencils on each side.* Two short stumps are on the head ; and a proboscis of extraordinary dimensions is occasionally darted forth. Sometimes a black speck is seen in front, but it is neither constant, nor are eyes visible. The figure of the proboscis varies considerably according to the specimen. That of a large Nereis, being somewhat barrel-shaped, extending three-quarters of an inch, by half an inch wide in the middle, beset by several rows of spinous short papillæ towards the extremity, which is terminated by a circle of them. The largest row is composed of at least thirty. The proboscis, as if a hard substance, which it is not, reflects the light. It is protruded in the extreme weakness of the animal, which it at length seems incapable of withdrawing.

This species swims by a serpentine motion, in a horizontal direction, with great violence and rapidity. When at rest it lies among sand, close to the bottom of its vessel, with partial protrusion of the head. It is extremely timid, and if above, retreats downwards on the slightest alarm. If its site be about to become dry, the body twists, as if preparing to leap. Colour white, with a line down the middle.

This animal dwells among the sands of the sea-shore, somewhat lower than at half-tide.

PLATE XXI.

FIG. 4. *Nereis (nephtys) lineata*, adult.

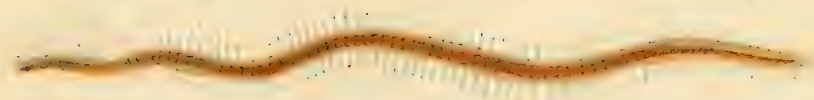
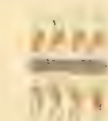
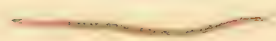
5. Small specimen, taken at Blackness Castle in 1809, coiled

5. A. } The same, extended.
5. B. }

6. Anterior extremity of fig. 4, enlarged.

7. Anterior extremity of a smaller specimen (fig. 5), enlarged,

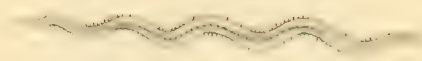
* Dr Johnson enumerates 143 segments in two specimens.—*Ann. and Mag. of Nat. Hist.* v. viii. p. 341.



12



5A

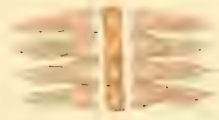


5B

C. L.

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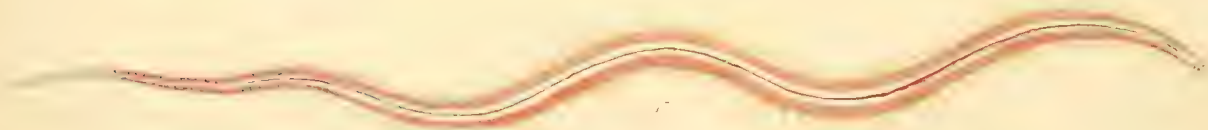
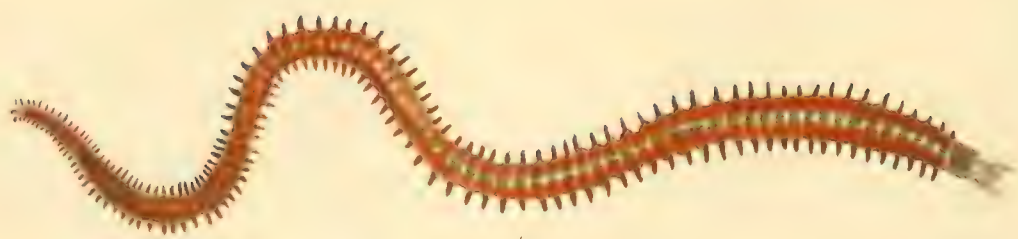
1. II



II

III

IV



Nereis

PLATE XXI.

FIG. 8. Section of fig. 4, enlarged.

9. Proboscis of a middle sized specimen.

10. Proboscis of a large specimen.

§ 4. NEREIS BULLATA—*The Knob Nereis*.—Plate XXII. Figs. 1, 2, 3, 4, 5.

Length above two inches ; body flattened, composed of numerous principal segments, with two interannulations between each ; a row of pencils down each side, the pencil consisting of some short hairs, issuing from under the knob. A small forked projection terminates the anterior extremity ; the posterior ends in two knobs. Towards the anterior extremity are two crescents, each consisting of two or three specks, the horns of the crescent turning outwards. Colour universally yellow.

When exposed to the light, this animal wraps itself up as a crescent.

Marine. Rare.

PLATE XXII.

FIG. 1. *Nereis bullata*.

2. Specimen, enlarged.

3. Anterior portion, more enlarged.

4. Posterior extremity, enlarged.

5. Middle section, enlarged.

§ 5. NEREIS PARVA.—Plate XX. Figs. 23, 24, 25.

I speak of this animal provisionally, being ignorant whether it is adult.

Five or six specimens appeared in a vessel of sea-water in September.

Length five lines ; body slender. Antennæ two, long and flexible. Head rather triangular, somewhat prolonged in front, on each side of which is a black eye like a crescent. The body seems almost quite smooth, perhaps from the faintness of annulations. I could not observe hairs or bristles, but it terminates in two leaves.

The whole creature is white to the eye, unless a small portion about the head.

It is restless and active, so as to render microscopical observations extremely difficult, and hence the crescent-shaped eye may consist of specks.

One seemed to have grown somewhat large in two or three months.

PLATE XX.

FIG. 23. *Nereis parva*.

24. Head, enlarged.

25. Posterior extremity, enlarged.

§ 6. NEREIS ARIES.—*Ram's Horn Nereis*.—Plate XX. Figs. 3, 4, 5, 6.

Length between two and three inches. Body composed of numerous segments, with a row of pencils on each side. Anterior extremity terminating in a stout projection, forked; posterior extremity terminating in eight or nine stout prongs surrounding the vent. Two fleshy, recurving, flexible antennæ almost constantly preserve a position resembling ram's horns. The general aspect of the animal is reddish; a red vessel internally traversing the body.

It swims through the water by contortions, and its motions are sometimes so violent as to rend the body asunder. Also, it involves itself in a knot, and forms a rude covering of sand.

PLATE XXII.

FIG. 3. *Nereis aries*, enlarged, from a specimen eighteen lines long.

4. Anterior portion, upper surface, enlarged.

5. Anterior under surface, enlarged.

6. Posterior extremity, enlarged.

§ 7. NEREIS REMEX, PHYLLODOCIA LAMINOSA.—Plate XXIII. Figs. 1, 2, 3, 4, 5, 6, 7.

This animal is one of the few which it seems impossible to recognize under the various nomenclature which has embroiled the genus *Nereis*.

It is the largest of the whole tribe, in as far as I am aware, inhabiting the Scottish seas. Likewise its characters are so distinct, that it cannot be readily mistaken.

Length two feet ; breadth half an inch. Body composed of above 400 segments, always multiplying with age. Between the segments are three or four interannulations, on the prolongation of which the extension of the specimen seems to depend. Each segment consists of a transverse central portion, with a broad flattened organ, equally large, on each side, from the lower part of which a pencil on the body issues. The head is provided with eight definite antennular organs, and some of inferior dimensions, terminate the anterior extremity. The posterior extremity is terminated by a fork. Two dark blue or black eyes are situate on the front of the head ; if there be others, they are very indistinct. A stout, yellowish proboscis is projected from before.

The natural colour of this animal is a fine green ; bluish-green on the centre of the back, iridescent, reflecting a bright blue, as is also seen on the belly. The paddles, as they may be justly denominated, always green. Young specimens, likewise, are wholly green, the bluish colour and iridescence belonging only to the older.

I have not been able to ascertain that any sheath or external covering is constructed by this Nereis ; but a remarkable profusion of clear glutinous matter is secreted from the whole body, so great, that it may be nearly equal in weight to the specimen itself.

Probably the natural habitation of all the Nereids is among sand, or in the crevices of rocks, where sand is present.

During the day this species lurks in concealment, especially under any large flat shell, where it reposes and unfolds from its many convolutions at night, apparently in quest of prey. Perhaps it feeds on the smaller living animals, for which the size and action of the proboscis seem peculiarly adapted. Sometimes, but very seldom, portions of mussel have been absorbed ; and once it seemed to me that a large specimen had devoured a smaller, which occupied the same vessel, as its disappearance could not be otherwise accounted for. But all kinds of sustenance

are almost invariably refused ; and the animals become lank and emaciated from protracted abstinence.

The mechanism of this creature, its parts, and their powers, are to be ranked among the more conspicuous and admirable works of the creation ; nor can they be contemplated without wonder. Issuing forth from its retreat, it swims by an undulating serpentine motion in the water. Its unwieldy body, gradually withdrawn from its retreat, has its multiplied organs unfolded in regular order and arrangement ; so that, whether intertwined or free, neither are disturbed by intricacy or confusion ; each performs its own proper functions, and the general effect by the united exercise of the whole. When inactive, the lateral parts of the segments generally close over the back ; in activity, they open widely, as if so many oars to aid the animal's course, by their successive impulse on the water.

In confinement, these Nereids can be seldom preserved long entire, if of large dimensions. The body, unmanageable without ample scope, from its length, and the particular structure of so many subordinate parts, expose them to frequent entanglement, without time for evolution leisurely, whence inevitable rupture ensues. An overgrown specimen, whether in the natural or artificial state, is therefore comparatively rare.

A specimen, about twenty-two inches long, was mutilated of part of the lower extremity when procured in October. Regeneration followed in eleven days ; the last articulations exhibiting a diminutive fork at the natural extremity. But on January 22, the body ruptured asunder near the middle. Within three weeks the wound at its extremity healed ; and against the first days of April, above fifty segments with their paddles had regenerated, the whole new portion being of a pale green colour. But the breadth of this new portion did not exceed a third of that part of the body still remaining entire. I speak of the upper half of the Nereis as doing so. In regard to the under half, it had lost a small fragment above, leaving the place ragged, which I endeavoured to correct by separating a portion with sharp scissors, in hopes of preservation. Accordingly the wound healed in eleven days, but in fifty nothing indicated regeneration of the defective head, and about a month later, both

parts perished from accidental vitiation of the water, while the head was yet wanting.

If this important part of the animal's organization is reproduced, as may be possible, the process advances tardily. On the 8th of April, I procured a large specimen, which had ruptured into three portions. Only one of them survived, which extended about two inches ; together with another, which might have been originally about ten inches above the posterior extremity. This latter portion continued very impatient of the light, which abated in a fortnight, but no indications of a regenerated head appeared. The wounds in such cases generally heal, and the portions exhibit much motion, although they do not survive long enough for reproduction, if this can actually take place.

It is otherwise with the lower part, for there seems no doubt that the mutilated extremity is extended by regeneration, as appears from the example lately given, of fifty segments having been reproduced.

A beautiful small and active Nereis, about three inches long, of a fine green colour, is not uncommon among the crevices of rocks, within flow of the tide. To the eye, it seems distinguished by three regular rows of specks down the back, which is illusive, for a lens shews them to be merely the centre of the segment, and the paddle on each side, all exactly resembling the parts of the preceding animals. I have been thence induced to identify it as the young ; if otherwise, it bears a very near analogy. A slight tubular covering, hardly to be called a sheath, is formed by it of silk and sand.

A month subsequent to the capture of several specimens of these animals, the largest being nearly three inches long, a green globular mass, above five lines in diameter, appeared floating in their vessels. It was attached slightly to a very thin silken tube, formed on the side of the vessel near the surface of the water, having probably issued from one of the animals, which kept always in the vicinity. This globular mass consisted of hundreds of green specks amidst a transparent jelly. Next day, May 25, when delineated, its figure had been somewhat impaired, as happens frequently with clusters of the spawn of animals. Under the microscope, the ova in the mass proved nearly spherical, and quite green ; and on

that following, the whole was much attenuated, and numerous green globules were escaping from it to swim at large. When magnified considerably, these appeared nearly spherical, solid, opaque, and environed by cilia. Their motion was rapid, continuing for several days, but I could not obtain any definite result.

Possibly this Nereis may be a variety, but there is another small Nereis commonly found in the clefts of rocks within flow of the tide, simply green throughout, without any longitudinal rows of specks, which I can scarcely hesitate to denominate the young of the Paddle Nereis. It feeds readily, and a number of specimens together, will at once protrude a long green proboscis on fragments of mussel, which are greedily devoured.

PLATE XXIII.

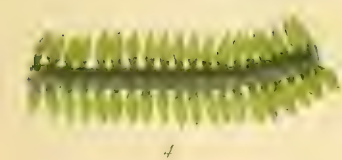
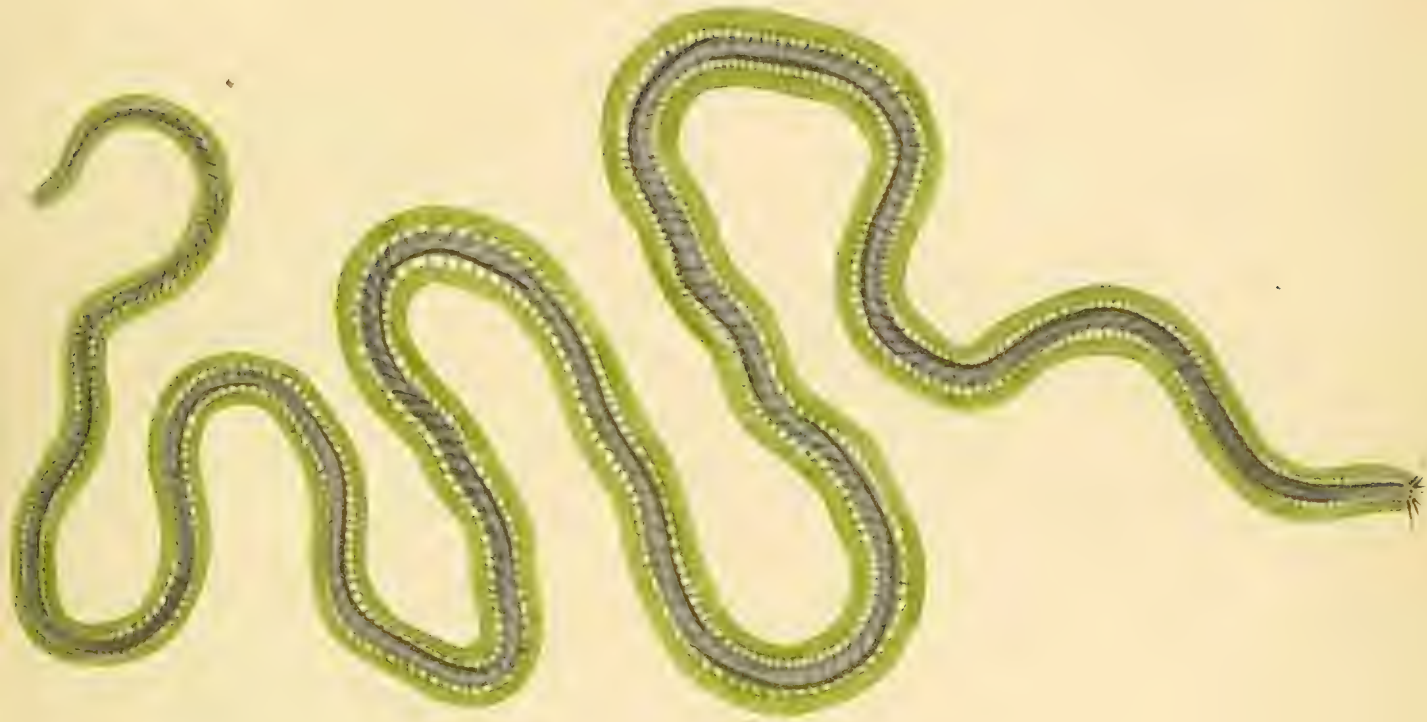
FIG. 1. *Nereis remex*—The Paddle Nereis—*Phyllodocia laminosa*.

2. Head, enlarged.
3. Segment, enlarged.
4. Section of the body, giving an oblique view of the paddles.
5. Mutilation, being part of a specimen expected to regenerate the organ defective.
6. Spawn.
7. Portion of same, enlarged.

§ 8. NEREIS ELLIPSIS.—Plate XX. Figs. 7, 8, 9, 10.

Length two inches and half; breadth half a line. About eleven tentacular organs are in front; four at its extremity, with a fifth somewhat behind them; next, other two larger on the sides, and farther back, other two pair, much larger than any of the rest. Two black eyes, between which the fifth frontal tentaculum originates. Body divided into numerous segments. A row of elliptical organs runs down each side of the body, by two of which, but much larger, the extremity terminates.

Colour greenish to the eye. The microscope discovers two double



Nereis Pomez

dark belts crossing the back, on a greenish-yellow broader predominant line.

This is a beautiful animal, somewhat akin to the preceding. Rare.

PLATE XX.

FIG. 7. *Nereis ellipsis*.

8. Anterior extremity, enlarged.

9. Section of the body, enlarged.

10. Posterior extremity, shewing the terminating organs, enlarged.

§ 9. NEREIS FULGENS—*Iridescent Nereis*.—NEREIS *des Beaucondray*,
Andouin, et Edwards?—Plate XXII. Figs. 6, 7, 8.

Length above seven inches ; breadth, at the head, above four lines. Figure of the body roundish, consisting of above 100 segments. Anterior and posterior extremity, terminate each in a fork, the latter being two slender bristles. The portion comprehending the head, is a smooth cylinder beyond the first segment of the body, with eight antennular organs, some of them apparently of two and three faint articulations, and two at the extremity ; besides which, are two stout conical organs, widely apart, tipped by a smaller soft spongy-looking substance. Eyes four, blue, set in a quadrangle. Colour of the body universally orpiment orange-reddish ; a darker longitudinal line, composed of so many short lines, one on each segment down the back. Belly lighter. The whole surface is finely iridescent, reflecting the prismatic colours, whence it may be conjectured that this is the *Nereis versicolor* of nomenclators. I have never seen any specimens, of many taken in Scotland, with a tinge of green.

Two black incurving jaws are seen within the orifice of the proboscis, the extremity projecting just beyond it.

The whole body is bordered by a row of papillæ, with a white summit, generally three on each segment, from whence pencils or bristles issue.

The intestine of a young specimen, shorter than an inch, appeared corrugated by the microscope.

Few specimens, especially those of larger dimensions, are found entire, for rupture of the body is common ; and even when entire, the due proportions are seldom seen, owing to the progress of regeneration, which readily ensues. But perfection may be always ascertained by the forked extremity, which is more conspicuous in this species than in any of the preceding. It is not improbable that the fork is obliterated by the generation of new parts in its vicinity, as the natural dimensions of the animal are augmented. However, this is a subject of difficult explanation.

This creature constructs a very thin transparent silky tube, from a matter exuding apparently from the whole body. Here it rests, exposing the head, which commonly waves from side to side. The tube is strengthened by the incorporation of sand where accessible. When otherwise it remains quite transparent, and it is framed of sufficient width to admit of the animal's reversing itself within. Sometimes the quantity of the secreted matter employed in the covering is copious.

This is a littoral Nereis ; it retreats from the light, lurking under stones, or in the clefts of the rocks. A very fine specimen was found on raising a large shelving portion of rock, near low-water, where always moist.

I cannot speak definitely of the propagation of the species. Early in February a mutilated specimen discharged thousands of minute ova ; and early in March, I found a quantity of spawn in a vessel containing a specimen, but not solitary. This spawn consisted of thousands of minute yellowish ova, amidst a thin, faint brown, albuminous matter, of too little tenacity to retain them in connection when the vessel was moved ; no development followed.

It is not rare.

PLATE XXII.

FIG. 6. *Nereis versicolor* [*fulgens*].

7. Head, enlarged.

8. Posterior extremity, enlarged.

§ 10. NEREIS FOLIATA—*The Leaf Nereis*.—Plate XX. Figs. 11,
12, 13, 14, 15, 16, 17, 18.

I have found great difficulty in identifying many species of the Nereids with those described by preceding authors. Perhaps certain points may not have struck me as sufficiently prominent, or I may have been unable, in a different course of investigation, from seizing the characters specified by them.

I acknowledge that when external characters seem sufficiently distinct either for classification or recognition, it has not occurred to me as essential that the position of any animal, or its alliances, should be sought from internal organization. There seems no consistent reason why a horse should be killed and dissected to prove it a horse, or a dog to prove it a dog. Besides, destruction is the most fatal error wherein the zoologist can plunge himself, for it is irredeemable.

If I have committed mistakes in ignorance of previous observations, they can be easily corrected. All new names which I have employed are provisional, nor are any derived from obscure and equivocal etymology.

I do not affirm that this is the most philosophical, but it is the most convenient mode of imparting our knowledge to others.

Length of the Leaf Nereis at least five inches; breadth four lines. Head prolonged as a bare snout; tentacula two, long and cartilaginous. Body slightly flattened, composed of many segments, with a row of pencils down each side; likewise a row of thin flattened organs, like a blade or leaf, is reflected from each side on the back. This is their most perfect form. On the higher portion of the edge of the blade being uppermost and at the root of each, a prominent papilla with a pencil is displayed; but in descending towards the posterior extremity, these blades degenerate into filaments.

A small specimen or variety, extending an inch and a half, was obviously regenerating the posterior extremity. The tentacula were carried free before it when in motion, fig. 15; but at rest, they lay over the

back, under the reflected leaves, enlarged, fig. 16. Four black eyes, disposed in two pair, stood in a line across the head, fig. 17.

About ten segments, gradually diminishing in breadth, first constituted the renovating part, terminating by an enlarging trumpet as a prominent thick margin, fig. 18. In three months the renovating segments had multiplied considerably.

Probably fig. 11 had been mutilated.

Colour of the animal reddish ; the upper edge of the blade vivid, under edge yellowish.

These animals swim by violent contortions. They form a slight tube of earthy and fine sandy particles, wherein they repose long, and always below. Marine.

PLATE XX.

- FIG. 11. *Nereis foliata*, Leaf or Blade Nereis.
 12. Head, upper surface, slightly enlarged.
 13. Head, under surface.
 14. Blade or leaf, enlarged.
 15. Smaller specimen or variety.
 16. The same enlarged.
 17. Head, enlarged.
 18. Posterior extremity, enlarged.

§ 11. NEREIS CONTORTA—*The Spiral Nereis*.—Plate XX. Figs. 19, 20.

Length half an inch. Body round, slender, composed of numerous segments. Two large and long cartilaginous-looking antennæ on the head. A pencil of bristles issues from a papilla on each side of the segments, together with a spine of some length towards the back.

No eyes could be discovered.

This animal generally lies in so close a coil, that it is very difficult to ascertain its true figure, especially that of the posterior part, which has a short funnel-shaped margin.

The extremity of some specimens had been regenerated.

PLATE XX.

FIG. 19. *Nereis contorta*, enlarged.

20. Section of the body, shewing the segments, pencils, and spine, more enlarged.

§ 12. NEREIS MONOCEROS.—*The Unicorn Nereis*.—Plate XXII.

Figs. 9, 10, 11, 12, 13.

Length eight lines or more ; breadth the third of a line. Body nearly linear, subdivided into about seventy segments. A long antennular organ, somewhat of a moniliform appearance, issues from the centre of the anterior extremity, and the posterior extremity terminates in a long fork of two similar moniliform organs. Four red eyes, set in a quadrangle, occupy the upper surface of the head, from amidst which the single antennular organ distinctly originates. The site of a large proboscis is denoted by a white part near the anterior extremity. Three kinds of appendages belong to each segment ; a longer pencil, consisting of a larger pencil of several very transparent, delicate, bristly hairs ; also a shorter pencil, together with a fleshy spinous prolongation.

This animal constructs a slight tube on the side of its vessel.

It is rare.

Perhaps it may prove allied to the genus *Syllis*, or be incorporated with that race.

PLATE XXII.

FIG. 9. *Nereis Monoceros*, enlarged.

10. Head, more enlarged.

11. Posterior extremity, enlarged.

12. Section of the body, enlarged.

13. Segments, enlarged.

§ 13. NEREIS PUNCTATA (VILLOSA).—Plate XXI. Figs. 11, 12, 13.

Length about an inch and a quarter. Body flattened, composed of numerous segments, each bordered with a pencil issuing from a sheath of remarkable length, together with a very long flexible cirrus rising from within the sheath. Two stout tentacular organs are in front of the head, and two more slender beside them. Several other organs, apparently tentacular, are also present on each side, or in their vicinity. The posterior extremity terminates in two long hairs. All the villous or hairy organs are transparent, rather cartilaginous, very flexible, and somewhat moniliform. They are numerous and peculiar. The longer are towards the upper portion of the body, where they are seen stretching, contracting, curving, and turning about in every direction, apparently engaged in tentacular offices. They shorten proportionally as they occur farther down the body, and therefore their action is less conspicuous. Four eyes are set in a quadrangle on the surface of the head. A red blood-vessel is visible throughout much of the length. Colour of the finest specimens scarlet; some are yellowish; but the colour is much dependent on the food. It feeds voraciously on mussel, darting out its proboscis, and absorbing a great quantity. The colour changes with the quality of the food.

This animal swims by horizontal undulations. It forms a slight silken sheath, and lurks much in concealment. But some individuals never indicate any disposition to construct an artificial dwelling.

PLATE XXI.

FIG. 11. *Nereis punctata*.

12. The same, enlarged.

13. Head, more enlarged.

II. SPIO.

It has been very judiciously observed, that this is a genus but imperfectly known ; and certainly its characters are very imperfectly specified. Nor is this surprising, for, of two species to be found in Scotland, one is extremely rare, and the other so minute as most readily to escape observation. These may be inserted in the genus, with a few observations, which I offer diffidently.

§ 1. SPIO SETICORNIS.—Plate XX. Fig. 22.

Length nine lines. Body somewhat angular, composed of segments tapering downwards, and terminating in three processes, somewhat elliptical. Head bearing two large, strong, active, extensile, and flexible long tentacula. Two black specks, or clusters of specks, like eyes, in front. Colour universally pale dingy yellow.

This creature constructs a long irregular tube of shelly fragments, or other indurated substances, lined with a tough silky matter. The particles that may be selected for the edifices are seized and passed along the tentaculum, and apparently carried to the mouth. Then they are applied in such a manner as to contract the orifice of the tube, as if to obstruct access. The tube itself is expeditiously constructed.

The animal lies constantly within its dwelling, its long tentacula, equalling half the extent of the body, sweeping around.

Having had only a single specimen, which occurred many years ago at Queensferry, I am induced to suppress various other observations, although the animal survived nine months, as no subsequent opportunity presented itself admitting their corroboration.

This creature seems to be identified with that of Baster, *Opuscula Subseciva*, tom. ii. Pl. XII. fig. 2. Likewise the *Polydore*, found by Bosc on the coast of Carolina, as shewn in his *Hist. Nat. des Vers.*, t. i. Pl. V. fig. 7, is nearly allied to it.

PLATE XX.

FIG. 22. *Spio seticornis*.

§ 2. SPIO CELATA—Plate XX. Fig. 21.

Two very minute, long, slender, flexible tentacula, waving and searching about on the surface of shells, are to be sometimes observed issuing from the low orifice of a short dark tube. Nothing besides can be discovered. But, on dislodging the diminutive tenant of this fragile edifice, it proves an animal, whose body, consisting of eight or ten segments of a flattened form, with a bristle on each side, does not exceed a line in extent. Two cartilaginous active tentacula, surpassing the length of the body, are seated on the head, and on its upper surface, four jet black eyes, set as in the corners of a quadrangle. Colour of the animal reddish-brown.

The formation of the posterior extremity could not be positively ascertained.

PLATE XX.

FIG. 21. *Spio celata*.

The Nereis forms a numerous tribe of fierce, apparently rapacious, active, and restless animals, all of singular and interesting conformation. Their external characters have been minutely detailed by MM. Andouin and Milne Edwards ; in recent publications by Signor Delle Chiaje, and more early by M. de Bosc, after a Treatise by Savigny, which I have not had the fortune to see. But almost all the illustrations which I have been able to examine relate to the detail of the external conformation of the various parts, with the view of settling the precise position of various genera in the Systema.

The principles thus employed appear rather intricate and difficult to be practised, therefore, however meritorious the plan, it might be perhaps very desirable that some simple, yet explicit, method should be

devised. Science would be thence greatly benefited. Travellers shun the path beset with asperities.

I doubt not that merely viewing the precise configuration of the two extremities, would very much lead to a suitable distribution of this curious tribe, to which should be added the more conspicuous appendages. At least the characters found in all these, would preserve the practical naturalist from resorting to the destruction of a living creature for the sake of satisfying his curiosity in searching for hidden organs.

In the pursuit of knowledge, the cause of humanity should never be forgot.

But the arrangement of the genus in detail is embarrassing, and particularly from the ignorance of the observer, as to whether his subject is entire. Next is the great variety of species, and the scarcity of some, which prevents the naturalist from corroborating previous observations.

From these causes, naturalists are compelled to limit their scope of a subject otherwise sufficiently comprehensive.

In general these animals prefer a sandy site ; they dwell in concealment ; nor do they court the light, or voluntarily expose themselves to view. All have the faculty of protecting themselves, either by a copious glutinous secretion from the body lubricating its parts, constructing a simple sheath of silky matter, or by a covering compounded of such matter with earthy particles or sand. There they lurk in safety, commonly below, but some establish themselves on the sides of vessels at some distance from the bottom. The natural secretions are extraordinarily copious in some. The artificial covering leaves the head exposed, which is seen waving continually from side to side.

Among the members of this numerous tribe, are found the finest illustrations of the luminous properties recognised among the lower animals, in the *Nereis noctiluca*, a diminutive species, not exceeding the length of half an inch. When transferred amidst a quantity of marine collections to a glass jar, it commonly ascends to the very edge of the water, and there secures itself just under the surface, in a silken sheath applied to the side of the vessel, reposing almost continually in the spot

without shifting. On sudden agitation the whole body seems in a blaze, while still stationary in its own element and preserving the same position. But beautiful flashes are emitted, when the vessel, having been emptied, is replenished with *fresh-water*; and should different parts of the sides be occupied by several specimens, as is always the case when collections are recently introduced, so many brilliant corruscations will escape from all the parts of the vessel where they are established. This interesting, though rude experiment, may be repeated several times with the same subjects. However, if these are to be preserved, the vessel must be speedily drained, as few marine animals can survive even a short humec-tation or immersion in fresh water.

Several species of the Nereis swim by horizontal, serpentine undulations, the body assuming the figure of what is vernacularly called a flaming sword, which, in an animated being, appears very singular to the beholder.

I have purposely abstained from specifying the number of segments as a leading feature.

It appears to me in as far as hitherto determined, that a frequent, if not a continual evolution of new articulations is advancing, so as to preclude calculation of any precise number as belonging to a species. There is also considerable difficulty in estimating the exact complement of the antennular organs.

CHAPTER VI.

APHRODITA.

THE animals described in the preceding chapter are distinguished by the length of the body compared with its breadth, its division into numerous articulations, prominent warts, or protruding hairs and pencils on the segments, discharging the external functions, partly of fins, and partly of feet, and by evident exertion concomitant on their exercise. The most part of them, if not the whole, establish themselves in natural or artificial dwellings, resulting from exudations of the body simply, or combined with indurated substances. All inhabit the sea ; they retreat from the light, and they prefer concealment.

The subjects of the present chapter are members of the same family. They bear a general resemblance to certain parts of their structure, and correspond in many of their habits. But the body is shorter and broader in proportion, and, with one exception, is totally covered with scales. Neither am I aware that it is protected by any abundant natural secretion, nor is any artificial abode constructed for its safety.

Though seemingly very 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.

But farther than mere description, and accurate representation, I can offer little novelty in observation on the race, and this shall be restricted to remarks on a very few species, as several, generally accounted the more interesting, have fallen under the notice of other naturalists.

§ 1. APHRODITA CIRROSA.—Plate XXIV. Figs. 1, 2.

Length three inches ; breadth half an inch. Form linear, nearly of equal breadth, throughout flattened, covered by thirteen pair of scales, arranged in two rows, nearly parallel, and spreading over the sides, as well as over the head. The whole upper surface presents a gelatinous appearance, especially when under water. Two stout setaceous antennæ issue from the head, besides which, there are six bristles with an enlargement towards the extremity. At the root of each of the two antennæ are seated two black eyes. The sides of the body are bordered by forty-four or forty-five pencils issuing from nipples, with an external red spot at the roots, and denoting division into as many segments. The head is red ; the colour of the upper surface faint purple, the under surface of fine pearly, somewhat iridescent aspect, traversed by a vivid red line. The true colour of the animal is perhaps reddish. The late accomplished artist, Mr Peter Syme, acquainted me, that in executing drawings from the living specimen represented here, he found some difficulty in fixing the precise hue.

When the scales are detached, each irregularly circular, is about three-eighths of an inch in diameter, with an aperture rather of a spherical triangular form towards one side. They seem vascular or susceptible of distension, and when detached, each resembles a flat drop of pale grey or purplish jelly. It is from the peculiar nature of the whole that the upper surface seems gelatinous.

The motion of the animal is very swift, half running, half swimming. But it likewise swims rapidly through the water, and with much more facility than any other of its tribe.

Probably the *Aphrodita cirrosa* preys on living animals, nor does it spare even its own species. Of two specimens procured at the same time, the one was large and fine, two inches and a half in length ; the other not quite half as long, but proportionally broader. After living peaceably together during two or three days, I was surprised to find the former attempting to devour its companion. One-half was absorbed into its

strong and capacious proboscis, while the victim struggled desperately to be free. The assailant, after retaining the prey for some time, was reluctantly compelled to disgorge it. But the suffering animal's back was broke, and some of the scales ruffled off by the rude assault. Next morning only half of the whole remained, the other portion having been devoured, and the victor now darted out the proboscis repeatedly to finish its meal on the rest as it lay in a corner, this organ, like a hard substance, striking the glass.

This species, like others of the genus, is liable to lose the scales. But individuals are tenacious of life. First, the scales separate, and the body ruptures asunder, yet both portions survive for some time.

In the middle of July, a large specimen produced an immense number, not fewer than 10,000 ova, or perhaps more. This great profusion, accumulated on the bottom of a glass vessel, was of reddish hue. The individual ovum was minute, white, and globular to the naked eye; but exposing a darker nucleus under the microscope, within its transparent integument.

I know not whether the eyes of this, or of any other species of the Aphrodita, are confluent. A large specimen, not shorter than three inches and a half, having reached me from Shetland in June, totally divested of the scales, besides suffering other injuries, I could discover only two eyes, of a rude oval form. By eyes, I mean a dark formation on the usual place of eyes. I concluded this to be a specimen of the *Cirroso*. It had forty-four or forty-five pencils.

This Aphrodita is the largest, at least the longest, of what I consider the genuine race inhabiting the Scottish seas. Like the rest, its favourite retreat is under the surface of shells, where it adheres in a reversed position. It is extremely timid, roaming abroad at night, and like the rest, apparently watching for prey. It is rare.

PLATE XXIV.

FIG. 1. *Aphrodita cirrosa*, back.

2. Belly.

§ 2. APHRODITA SQUAMATA.—Plate XXIV. Figs. 3, 4.

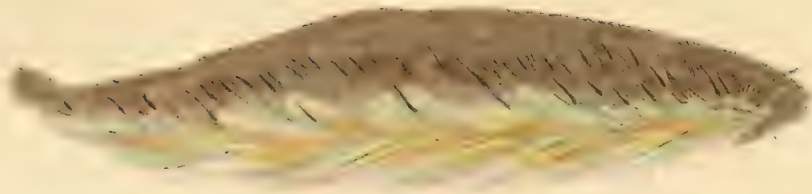
Length of the largest specimen about two inches and half ; breadth nearly one. Figure, a long oval, the body covered with a double row of scales, slightly overlapping each other. The head is small, bearing two antennæ. The posterior extremity terminates in two bristles, which want the enlargement of the aciculæ. At least it is commonly less evident. Between the antennæ are two smaller aciculæ, thus both extremities are as if forked. I do not know that the number of these secondary organs are uniformly regular. There are four black eyes. A strong proboscis with a serrated margin, and containing four incurvated fangs, darts from the anterior part of the body. It is generally protruded when the animal is dead or dying.

This animal presents a perplexing variety both in appearance and in parts, but without enabling the observer to establish different species. Also it is frequently mutilated.

In its most ordinary form it is seen as a fine specimen, which came from Shetland, with about thirteen pair of scales, which is the ordinary complement. I suspect, however, that this number may be augmented with age, as was conjectured to take place among the *Nereids*.

As far as I can observe, the scales consist of from twelve to sixteen pair. A specimen, extending twenty lines, or nearly an inch and three quarters, had sixteen pair. The largest specimen I have seen, had fifteen pairs remaining. The same specimen, extending about an inch and three quarters, had about forty pencils on each side, besides aciculæ or long bristles. Colour of the head red, the body commonly dingy brown, belly pearly, and occasionally iridescent. That of a large specimen, with at least eighteen pair of scales, was totally of a fine dark azure blue ; but the belly of another was not thus distinguished.

This animal is usually dull and languid, but it runs with considerable speed. It swims with difficulty. Its natural abode is near the shore, and especially under stones in shallow water. It always retreats from



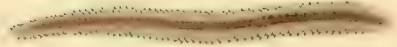
3



1



11



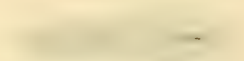
14



12



2



13



5



7



4



6



9



1



8



11



10

the light, chiefly quitting its haunts cautiously and timidly at night, as if dreading enemies, or in quest of prey.

However, it is scarcely ever observed to feed ; nor, amidst great variety of substances offered, is almost any thing found acceptable. A vessel containing a specimen, eight weeks in my possession, being replenished with sea-water, a portion of mussel was dropped before the *Aphrodita* next morning. Darting out the proboscis it sucked up the mussel. Eight or ten days afterwards the like occurred, the proboscis having been quickly withdrawn on both occasions.

The same specimen survived some time longer, and then perished from impurity of the water. This is the most common of the genus.

PLATE XXIV.

FIG. 3. *Aphrodita squamata*, large specimen, one pair of scales, and the terminal caudal bristles defective.

4. Perfect specimen from Shetland, with twelve pair of scales.
5. Head of a perfect specimen, with two pair of scales adjoining, slightly enlarged,
6. Anterior extremity of fig. 4, upper surface, enlarged.
7. Posterior extremity of the same, under surface, enlarged.
8. Ordinary specimen, wanting one or two pair of scales.
9. Ova, enlarged.
10. Proboscis, enlarged.

§ 3. APHRODITA VARIANS.—Plate XXIV. Figs. 10, 11.

The variable aspect of this animal is extremely embarrassing to the general observer. It is sufficient to excite his doubts whether he sees before him a distinct species, or whether only successive varieties. I have been hitherto unable to detect such uniform and permanent features as to pronounce all the specimens, not few in number, as identified by formation with each other. Externally they are certainly very unlike, but it may be only in accidental characters.

The length of specimens apparently full-grown, including antennæ and bristles, is eighteen lines, breadth three. Form nearly linear. From fourteen to perhaps eighteen pair of scales, always composed of two colours, cover the body ; each scale having the second colour as a broader or narrower partial marginal border on the interior side, which margins meeting, produce a narrower red, brown, or black stripe, of various intensity, down the back of the animal.

The colour of different specimens, therefore, is not only very different, but alternations ensue in the same specimens.

The scales of the specimen, fig. 10, were wood-brown, with a crescent of the inner edge blackish-brown. They were so thin as to expose the animal's head of a reddish colour, which seems common to most of the Aphrodita. It had lost almost all the scales a week after being taken, when the body appeared of the faintest purple, the head more livid, exposing its four black eyes. About forty pencils bordered the sides, and a red line traversed the pearly belly.

In five days longer only five of the original scales remained.

Before this time, however, as the loss of the scales was gradual, small distinct circular marks appeared on the upper surface at the root of the pencils, indicating incipient regeneration. Their advances became sensible on the 15th of October, but the middle of the back remained bare, the scales being yet too small to cover it. In six days, however, the edges of each row met, when the margin was there coloured between crimson and purple, though for sometime remaining pale. On the 1st of November, scarcely any difference could be discovered between the original scales and those regenerated. Their progress had advanced ; deep purple stained the margin of the whole on the 12th. Already the dark stripe appeared down the back, which had become still more conspicuous on the 21st, by the edges overlapping each other.

The animal survived a month longer, and never displayed the usual timidity or ready retreat from the light common to its kind.

The margin of the proboscis is surrounded by about eighteen stout, triangular, flattened, fleshy papillary organs, and the anterior of the pro-

boscis is armed with four black fangs. These parts were exposed on the death of a small specimen, not above eight lines long, with a black stripe down the middle of dingy scales.

This species devours other Aphroditæ.

PLATE XXIV.

FIG. 11. *Aphrodita varians*, extending sixteen lines, with brown and blackish scales.

12. Specimen with red and yellow scales.

§ 4. APHRODITA VELOX.—Plate XXIV. Fig. 13.

At first sight I was so much impressed by the great difference between the aspect of this minute animal from all the other Aphroditæ occurring to me, that I felt disposed to name it provisionally *Aphrodita velox*.

Nevertheless it may be possibly only an early stage of the *A. squamata*, *cirrosa*, or some one sufficiently known. I am very far, therefore, from pronouncing it a distinct species.

Much of the appearance and habits of this section of the Aphrodita, perhaps, depend on age. The activity of the small specimen under review, scarcely half an inch long, was extraordinary, and from the transparency, its whole structure was well exposed by the microscope. It swam swiftly and frequently through the water, whence I was disposed to consider it the young of the *Aphrodita cirrosa*. If so, it affords a favourable illustration of the evolution of additional parts.

Length four or five lines ; breadth a line. Four distinct black eyes. About twenty pencils issue from each side, together with eight or ten aciculæ, extending much beyond them, from each side also. At first I believed the animal totally divested of scales, and that it was a mere skeleton, but I afterwards observed a double row of about ten vascular scales in each, covering the back, the sheaths and their pencils being almost invisible from extreme transparency, while the more solid organs seemed predominant from shining through them. There seemed to be an aperture in each scale.

I conjectured that the last segment, along with a pair of scales, might be originally deficient. Whether it was truly so, two minute projections were observed advancing at the posterior extremity in a fortnight.

PLATE XXIV.

FIG. 13. *Aphrodita velox*, enlarged.

§ 5. APHRODITA ARCTA.—Plate XXIV. Fig. 14.

Length nine lines ; breadth the seventh or eighth part of the length. Form cylindrical, or nearly so. Head small, reddish, with [four] eyes indistinctly exposed. Antennæ two. Styles terminating the body two. One which had been mutilated and nearly renewed. The body consists of numerous segments. It is covered by about sixty pair of scales, in two distinct rows, separated by a narrow interval down the back of the animal, and there exposing a small portion of the segments to view. Colour universally dingy white ; a darker internal portion towards the anterior, denoting the position of the proboscis.

This is a sluggish creature, reposing constantly on a leaf of green fucus.

It was taken in Shetland, and survived above a month.

PLATE XXIV.

FIG. 14. *Aphrodita arcta*—Narrow Aphrodita—enlarged.

§ 6. APHRODITA ACULEATA—*The Sea Mouse*.—Plate XXIV. Figs. 15, 16.

Though this subject is incorporated in the genus *Aphrodita* by naturalists, and commonly presented as the type of the race, no animal bears less external resemblance to the preceding forms, which are all sufficiently defined to shew that they are kindred.

The aspect of this species, however, is so peculiar, that it cannot be mistaken. It is the most brilliant of all the lower animals dwelling in the

Scottish seas, and in every place, it has invariably attracted the notice of many who have not otherwise much curiosity regarding the works of creation.

The body of the largest extends eight inches, commonly it does not exceed five, of a long oval figure, with extremities proportionably acute. The back is somewhat convex, the belly flat. Short, thick, brown fur covers the middle part of the former, surrounded, especially towards the sides, with long, bright, green and yellow iridescent hair, very beautiful to behold. Intermixed with this are transverse irregular rows of long, stiff, thorny, brown bristles. Two cartilaginous-looking flexible antennæ, about half an inch long, issue from the head, besides some other organs. Possibly only two real antennæ belong to the Aphrodita. Belly smooth, soft, dark, full of transverse ridges. A row of peduncles with bristles, borders each side of the body, serving to aid the motion of the animal ; but its sluggishness is excessive. It scarcely ever moves, it is always languid, remaining nearly in the same position, with the posterior extremity of the body recurved, and discharging a stream of water from an orifice there.

Baster remarks, that this Aphrodita shewed a certain turgidity, by which it was enlarged a third more at one time than at another. Probably its aspect is modified by absorption. The stream is discharged so forcibly, as to form a slight vortex at the neighbouring surface of the water.

Naturalists have bestowed considerable attention in explaining the structure of the *Aphrodita aculeata*, particularly MM. Andouin and Milne Edwards, as may be seen in their works. It is explained that the body consists of thirty-nine segments ; that the elytræ or scales, concealed by the covering of the back from external view, amount to about thirty, or fifteen pair, thin, smooth, and almost circular, the larger being in the middle, and the others decreasing towards each extremity. There is an aperture in the surface of the head in connection with the respiratory functions, from the position of the branchiæ under the surface of the back.

None, of many specimens living several months in my possession, have fed on any substance offered to them.

The beautiful green and golden hair loses its brilliance a day or two after separation.

This animal is not rare.

PLATE XXIV.

FIG. 15. *Aphrodita aculeata*, back.

16. Belly.

The subjects of the two preceding chapters seem to have proved particularly embarrassing to naturalists, whose modes of treating them are extremely different. Some have been content with description brief and simple, others have offered representations of the external form, and a few have occupied themselves with minute and laborious dissections. However meritorious the last may be, and though perhaps the most serviceable to the cause and permanence of natural history, as a science founded on internal organization, it is plain that such a system is quite incompatible with the views and practice of those observers desiring to ascertain the nature of living animals, by gaining acquaintance with their habits. Neither can dissection ever prove as popular a method of arrangement, as one derived from external configuration and habits combined.

If it be extremely difficult to ascertain the proper name, or the precise functions of some of the external organs, much more so must it be to declare the office of many of those which are internal. But structural characters are beautiful as a profound study, which merits all encouragement from the contributions to our knowledge which it has furnished.

But whatever may have been the individual views of the respective authors adopting these different modes of research, all seem eager to quit the pursuit, as if deterred by the extreme and unsatisfactory embarrassments attending its protracted prosecution.

I do not feel quite assured, that in the various figures given in this volume of the animals ranked as Annelides, that they are not identified

by name with those of more scientific claims. I doubt not that in my oversight of certain features whereon the observations of others have specially rested, I may have mistaken the names previously bestowed on them, and that in my desire for abbreviation, I may not have entered on sufficient detail, errors which may be subsequently rectified on opportunity.

PLATE XXIV. APHRODITA.

- FIG. 1. *Aphrodita cirrosa*, back.
2. The same, belly.
3. *Aphrodita squamata*, large specimen.
4. *Aphrodita squamata*, ordinary specimen from Shetland.
5. Anterior portion of an ordinary specimen, slightly enlarged.
6. Anterior portion of fig. 4, upper surface, shewing the tentacula, eyes pencils, &c., enlarged.
7. Posterior extremity of the same, under surface, enlarged.
8. Ordinary specimen, wanting one or two pair of scales.
9. Ova.
10. Proboscis, enlarged.
11. *Aphrodita varians*.
12. Another specimen.
13. *Aphrodita velox*, enlarged.
14. *Aphrodita arcta*.
15. *Aphrodita aculeata*, back.
16. The same, belly.

CHAPTER VII.

SABELLA AND CONGENERA.

NATURALISTS divide the Annulosa or *Annelides*, as they are commonly denominated, into *erratic* and *sedentary*. The former, as may be easily concluded, are in the more natural state, having no permanent abode; the latter occupy a fixed habitation, sometimes of very durable materials and solid construction. They are themselves its constructors, and real architects of a very ingenious kind.

I doubt not that some grounds might be found for systematic distinctions in the quality of the dwelling, as an accessory to the distribution of the lower animals, did not so much uncertainty prevail regarding the temporary or permanent occupation of the dwelling, for it is still obscure, whether many which seem erratic, have not such a place of refuge, or whether many of tender frame, do not want it entirely. The delicacy of an animal is no infallible presumption that Nature provides some artificial means for its protection.

Among the comprehensive tribe of *Annelides*, are incorporated several creatures, apparently considered by the thoughtless and inexperienced so utterly insignificant, as to merit no particular notice. Yet such are equally the works of Nature with the largest and highest valued of the animal world, as coming from the hands of Supreme Intelligence. They are endowed often with refined faculties of perception and execution, and, above all, with the consciousness whether a certain service or operation required has been effected. Such instinctive displays cannot be undeserving of human investigation.



Different species or varieties of the Sabella are found on the shores and in the seas of Scotland. The most superficial observers must have remarked agglomerated clusters of sandy tubes, with numerous circular orifices, rudely resembling honeycomb; or they may have seen flattened tubes, composed more solidly of particles of sand agglutinated to the surface of shells, in lines or curvatures over them. Or, it may be, they have been struck with some single, perfect, conical tube of larger dimensions, neatly constructed entirely of such particles, with or without a slight silky lining, but altogether so fragile, as to be qualified to offer very little resistance against violence.

All these, whether weak or strong, solitary or conglomerated, confined or capacious, are the work of their respective tenants, and occupied by animals admitting of some comparison with the Nereis and Spio, but of closer resemblances among themselves.

The Sabella is occupied long and sedulously in fabricating its dwelling, which, from the first, is never quitted, for it does not seem capable of constructing a new one.

§ 1. SABELLA ALVEOLARIA—*The Honeycomb Sabella*.—Plate XXV.
Figs. 1, 2, 3.

The length of this diminutive architect is nine lines; thickness above one. Body round, composed of numerous segments, with bristles from the side of some. A slender caudal appendage, generally folded up on the body, terminates its extremity. The anterior extremity of the animal is cleft longitudinally, with two stout obtuse halves, each bordered by about forty tentacular organs, being eighty in all, on a specimen. These organs are extremely flexible, and apparently cartilaginous, under the microscope. One surface has a groove in the centre, its remainder comes out like a file, which peculiar conformation is more conspicuous on the edges. But when completely extended, these organs are *pectinate* on both sides, exactly in miniature like the weapon of the saw-fish, except in colour, as may be discovered by microscopical observation.

The caudal appendage is long in some specimens, commonly extending a line and a half. It consists of eight or ten enlargements, susceptible of some alteration of form.

Numerous ova are produced at different times of the year, in June, August, and in October. They are generally purple, consisting of a darker nucleus, within a gelatinous sphere. A specimen having been injured in the third week of October, by separating a congeries of tubes, a vast quantity of purple ova issued from about the root of the cleft. The parent itself was coloured by the presence of the ovarium, for by this organ are these creatures greatly affected during the season of propagation. They become brownish or dingy white, from a fine ruddy colour, when the spawning season is over.

On removal to a watch-glass, the same specimen continued discharging thousands of ova, all of a beautiful purple colour, and regular ovoidal form. But neither they nor others have afforded any progeny.

This is a timid, lively, active creature, whose most prominent property is constructing itself an artificial dwelling of the grains of comminuted sand, intermingled with shelly fragments, or other indurated substances. But there seems a great difference in the solidity of the dwelling according to the position of the tube, or perhaps the variety of the architects, which has never been the subject of sufficient observation. Thus we find the fabric, when a cylindrical segment, running over some flattened surface, firm, durable, and capable of great resistance. It is not easily crushed. On the other hand, when cylindrical or alveolar, it appears to be always more brittle. Most of the dwellings of the Sabella are lined with a fine silky substance, formed of an exudation escaping from the body, which, consisting of indurated gelatinous matter, is very conspicuous on breaking up the alveolar mass of some old congeries.

The animals testify a decided preference on choosing the materials of their habitations. While always preferring sand and comminuted shell, pounded glass is sparingly and reluctantly employed, and unless for a few fragments, it is soon entirely rejected.

But there is a striking difference in the character of the tubes. One is short and confined, extending little beyond mere accommodation for

the body ; another is considerably prolonged, so as to afford a safe retreat in times of danger. The architect of a third seems to persist in advancing the fabric as long as it can procure materials. It never wearies of working, thus sharing the nature of the *Terebella*, of which more hereafter.

Night is the chief season of architectural labour, though perfect idleness never leaves the day unoccupied.

By means of the tentacular organs, and the cleft in the anterior part, grains of sand are selected and adapted to the precise spot, where glutinous matter secures them to the tube for sheltering its otherwise defenceless tenant.

Among the most interesting instincts displayed in animal life, are those whereby weak and unresisting creatures shew their gift from Nature in rearing the means of self-protection.

I know not that an individual animal, if adult, is capable of founding a tube, but rapid advances extend that which is already in progress, and in repairing the breaches of those which are injured.

This may be readily witnessed by the inquisitive observer.

On one occasion the dwellings of a colony of Sabella had been accidentally impaired, so as to leave them only about half an inch in height ; but on a supply of sand, it became soon evident that a member of the community, more active than the rest, had constructed a tube not less than two inches and a half in length. In endeavouring to ascertain their preference for particular substances, I supplied this specimen, among others, with brick dust and pounded glass. Only a few particles of each being used in a week, shewed them to be unsuitable, therefore I removed the architects to a bed of sand. The active Sabella did not now relax in its industry. Sometime afterwards it was accidentally buried during weeks among mud, which it survived with impunity ; and it next employed itself in extending its cylinder still more and more with sand and shelly fragments.

As the habits of such creatures may be rendered subservient to the curiosity of the observer, who desires a distinct view of their operations while unrestrained in their own dwellings, he must watch the time when

the advancing tube reaches the side of a glass cylinder. They then continue alike industrious, but frequently, as if to economise labour, the growing edifice is reduced to the segment of a cylinder, the transparent glass supplying the defective portion. Whatever passes within is thus sufficiently exposed.

A Sabella previously carrying on its operations in a watch-glass, will sometimes avail itself of the transparent side of a jar on coming in contact with it.

Some outstrip their neighbours. One working from below carries its perfect cylinder to the surface of the sand, where it appears surrounded by a groove, occasioned by removal of the materials to raise the edge of the dwelling. Should several tubes be covered during some time by sand, a perfect labyrinth will be found on washing it out, from the labour of the architects.

The greatest activity is displayed during the warmest weather.

These animals quit their tubes when the water becomes vitiated. They survive a long time though divested of them, which they seem to do spontaneously on other occasions.

Their food is unknown.

Specimens have lived thirteen months in confinement, therefore they may be readily preserved.

PLATE XXV.

FIG. 1. *Sabella alveolaria*.

2. Tentacular organs, enlarged.

3. Ova, enlarged.

4. Ova, more enlarged.

§ 2. SABELLA BELGICA—AMPHITRITE AURICOMA.—Plate XXV. Figs. 5, 6.

Lamarck proposes to institute a genus named *Pectinaria*, comprehending certain species of marine animals, such as the preceding, with others of its kind, and the subject of the present paragraph.

I do not obviously see, however, that the former can be properly included, from wanting such peculiar characters as belong very prominently

to the latter, and whereon the institution of such a genus would be specially founded.

Taking a great and comprehensive view of the general features of the animated universe, many analogies in structure and habits will be found in animals which now stand far apart, or are totally detached by artificial systems. In fact, our attention is to be here directed to individual properties, leaving the strict associations of species in genera to future labourers.

The *Sabella belgica* or *Amphitrite auricoma* extends to four inches and a half in length, by about three quarters of an inch at the shoulder; and the tube in which such a specimen dwelt was a hollow conic frustrum, five inches long, tapering regularly downwards.

Never having possessed a specimen in its highest vigour, I can only say, that in general structure and in habits, it admits of comparison to the *Terebella arenaria* in many points.

The anterior portion is distinguished by a flattened face, wherein the mouth is situated; two pair of flattened gills or branchiæ appear on each side of the head, with numerous tentacular organs, not extending far. Two gilded fans, somewhat like a comb, rise from the head, consisting of eleven or twelve short teeth. The head is presented as a spherical segment at the orifice of the tube. It issues from a frill of four segments, more distinct than any others, with pencils or bristles from their sides. Other fourteen, also with pencils, compose the rest of the body, which terminates by a large scoop, exhibiting rudimental segments indenting the back. The general hue of the animal is reddish, the branchiæ bright vermilion, and a vivid red vessel traverses the body.

This creature constructs a very delicate tube, as thin as paper, exclusively of the grains of sand agglutinated together in an extraordinary manner. The thickness of the side does not exceed a single grain, each lies in its own proper place, and the whole is lined with the slightest silken coating. The sand being collected at the orifice of the tube, its tenant, chiefly by means of the tentacular organs, selects those which are appropriate, and applies them to use. This is done only through the night, all the additions being made at the orifice, and as the animal grows,

the shape and dimensions of the tube, being an inverted conic frustrum, result from the successive growth of the body.

The animal is very timid. It dwells in deep water, lying apparently in a horizontal position on the bottom of the sea. When taken, the body is generally plump and fleshy; but I have not found it easily preserved, from not being vigorous at first.

The tubes of all the specimens occurring to me were regular cones, except in one instance, where it was slightly curved, like the tusk of an elephant.

Found among the Shetland Islands, and in various parts of the Scottish seas.

On the whole this animal has more correspondence with the nature of the *Terebella* than with any other.

PLATE XXV. SABELLA.

FIG. 5. *Sabella belgica*.

6. Posterior extremity, with the scoop.

7. Tube of fig. 9.

8. Portion of the tube, shewing the arrangement of the grains of sand, enlarged.

9. *Sabella belgica*, another specimen.

CHAPTER VIII.

TEREBELLA.

The preceding subjects, the *Sabella alveolaria* and *Sabella belgica*, conduct us naturally to the *Terebella*. Their habits in so far agree most intimately, that the organs which all possess in a modified form, are applied to the construction of an artificial dwelling, for the shelter and safety of their unprotected bodies.

All are architects, nor of contemptible skill, as we shall find on contemplating their mechanical labours.

The instinct of animals being most conspicuously evinced in the pursuit of prey, the care of their young, and the construction of an artificial dwelling, those apparently the readiest to suffer external injury should enjoy this latter faculty in the highest perfection.

Yet, according to human observation, many of the weakest are neither the best protected, nor have they the greatest facilities for securing themselves from danger.

The collection, preparation, arrangement, and combination of various materials in framing a safe and permanent habitation unite in a peculiar property, sparingly conferred by Nature on her creatures. If any, seemingly more defenceless than the favoured few, be left exposed, by denial of this great prerogative in our eyes, it is for some inscrutable purpose, which we cannot discover, or which, if discovered, we could not appreciate. We may not arraign the Omnipotent decree invisibly governing the animated world. All that may be reiterated concentrates in the

conservation of the species being obviously of deeper interest than the safety of the individuals composing it.

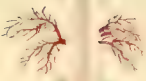
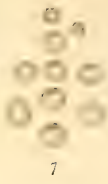
Such synonymes as would signify *mason* or *potter*, might be aptly applied in explaining the character and habits of the Terebella. Nothing could be more appropriate, for this animal, as some others most interesting to naturalists, is alike distinguished by address and perseverance in producing works of art. It is even more admirable than many, for its energies seem always ready to be roused, and its faculties prepared for exercise.*

From the facility of obtaining materials, this creature's labours are incessant, and from its being subject to a certain kind of controul, they may be rendered a fund of great entertainment to observers.

The genus Terebella has been rendered singularly confused even by accomplished naturalists, partly, however, from overlooking the simplicity of its characters as applied to it in the Linnæan *Systema Naturæ*, in as far as they go ; partly from being misled by indistinct and erroneous description. Practical naturalists, those who look at animals as they truly are, who do not embarrass themselves in searching after distinctions so trivial that our skilful precursors never thought them worth their while, cannot but acquit Gmelin of the reiterated charges of inaccuracy as embroiling genera. This was more the fault of his authorities than his own. It originated especially from the want of figures, or from the employment of those which, as in some of the present day, were unintelligible. Yet in recent improvement, let us be merciful to our neighbours, recollecting the innumerable obstacles to perspicuity in these most difficult pur-

* It might prove a great convenience, if those who deal in nomenclature would explain what is to be understood by the names which they confer on genera or species. To receive as *rock piercer*, a character ascribed to the *Terebella*, by that interpretation of its name, would be most absurd, at least in any that I have seen or heard of, for nothing seems more adverse to their nature. All are capable of constructing elevations, but none of the Terebellæ proper can form a cavity in an indurated substance. The Terebellæ are masons or builders in the strictest sense. *Lamarck* comprehends them among the *sedentary* Annelides, certainly meaning to indicate habits (if he ever contemplated habits) opposite to those of *erratic* Annelides, which latter character he does not resort to as a distinction.

11



13



Tarabellus

suits, where an hour's interval may produce an absolute deformity of what has been beheld as beautiful and symmetrical. Description is a very unsatisfactory substitute for representation, as all who study nature in her own garb will agree. Nor can any *system* be useful, abounding in conviction throughout, intelligible and agreeable, unless accompanied by figures of the subjects as beheld in their ordinary form.

The two genera more commonly confounded are the *Terebella* and *Amphitrite*, though corresponding somewhat in general character, are radically distinct in themselves. It would be difficult to point out the grossest errors of recent authors or editors in this respect, themselves utterly to blame, while attempting to blame their more correct fellows.

§ 1. TEREBELLA LITTORALIS, SEU ARENARIA—*The Sand Mason*.—Plate XXVI.
Figs. 1, 2, 3, 4, 5, 6, 7.

Between half-tide and low-water mark numerous cylindrical tubes may be observed projecting from among the rocks and stones of the shore, especially amidst sandy patches. Some terminate in a tuft, like the oozing end of a hempen cord, and on a search being made in the neighbourhood, another of corresponding appearance, or the orifice of a plane, hollow, sandy cylinder, will be frequently found within a short distance.

Here is the dwelling of the *Terebella*, an edifice constructed by itself. If the finder endeavours to pull forth the tube with its tenant, it ruptures in his hand, and the animal retreats below, but on tracing its direction, as it winds a foot or more among the sand, or descending under one of the firmest stones in the vicinity, he may discover the orifice rising on the opposite side.

Now it may be removed along with the architect, which meantime has contracted within the smallest possible space. The naturalist must never forget the importance of obtaining every subject entire and unmutated, which will cost him much time and patience on many occasions. But the first consequence of this oversight would probably be the vitiation of the water, from the decomposition of the injured parts or portions, and the death of the remainder.

The littoral *Terebella*, expelled from its tube, is of a vermicular form ; the body seven or eight inches long, and a quarter of an inch thick towards the head, and consists of numerous segments tapering towards the posterior extremity, which terminates in several points.—Plate XXVI. fig. 1. Sixteen retractile pencils, each of fifteen or twenty bristles, border the sides of the upper segments, which farther down degenerate to stumps. The anterior part of the body consists of a thin frill, divided into three portions, surrounding the roots of sixty, seventy, or a hundred tentacula, according to the age or dimensions of the specimen, with the mouth like a scoop in the midst of them. Immediately behind this frill, three pair of the most beautiful scarlet branchiæ rise half an inch high. The animal is universally of peach-blossom colour, variable in a redder or browner tinge, with a broad, taper, smooth, velvet, bright carmine stripe, descending along the belly between a transverse row of ellipses.—Plate XXVI. fig. 1, *Terebella*, reduced ; fig. 2, section of the body.

An easier guide than following the preceding description, consists in simply observing the formation of the branchiæ, to identify the different species of the *Terebella*. These organs are extremely diversified, sometimes in number, always in structure. It is somewhat singular to remark, that naturalists give one set of branchiæ as that of the *Terebella conchilega*, though actually not belonging to the species, for an illustration of all the rest. But we must allow that the observer's most attentive inspection is indispensable. This organ becomes a microscopical object, about which no one can readily satisfy himself ; its expansion and contraction are incessant, thence nothing is of more difficult delineation.

The branchiæ of every species of *Terebella*, I say, are different. Here they are so complex and luxuriant, they abound in such numerous points, extremities, and curvature ; their shades and intensity of colour, and the alternation of shape are so variable, that no object is more beautiful and interesting to behold, or more difficult to be rendered intelligible by description. To attempt it would be vain. The mind alone must conceive it. During life, the motion, the enlargement, reduction, and spiral twisting of the branchiæ, singly or collectively, is perpetual,

but instant cessation, followed by speedy disfiguration and decay, are concomitant on death, rendering every attempt to ascertain their structure fruitless.

This may be well understood from the presence of a serpentine internal vessel appearing blue, which, winding through most of the body, seems to discharge much of its contents during vigorous life into the branchiæ.

The first or highest pair of these organs is the largest, and all of an arborescent form. Each, as viewed individually, consists of a main trunk, with boughs and branches, shortening as they rise towards the summit of their principal parts respectively. The boughs, in alternate arrangement, diverge from the trunk; the branches, single, in pairs, or in triplets, are arrayed around the boughs. Most of the subordinate parts originate from the convexities of those sustaining them.—Plate XXVI. fig. 3, enlarged. A section of one of the extremities exhibited thirteen prominent cups under the microscope, fig. 4.; none could be discovered on another. The beautiful red of the branches fades, and is converted into a green, as the animal weakens; and then, as when in a dying state, the whole body tends to the same colour.

Under the microscope, a convoluted intestinal organ was exposed in a young specimen, not half an inch long; likewise were discovered by the same means, numerous round, black specks, like so many ocelli, under the margin of the frill.

It is not improbable that certain organization, resembling tubercles or prominences, evidently distinct from the neighbouring parts, may be of a glandular nature. We cannot ascertain the various secretions from the body of the lower animals, nor the precise organs instrumental in producing them.

But the use of some of the rest of the external organs of this animal is easily seen, for example, the tentacula, and it proves most amusing to the observer.

If a specimen be dislodged from its tube, it swims by violent contortions in the water, after the fashion of the Nereis, and some other worms

or Annelides. The tentacula and the branchiæ are compressed and contracted about the head like a brush, and as the animal becomes very soon exhausted by such unnatural exertions, it soon sinks to the bottom. Should a quantity of sand be now scattered from above, the tentacula, relaxing speedily, extend to sweep the vessel clean, so that in the briefest interval, not a particle remains within their reach. The whole have been collected for employment in the construction of a new artificial dwelling for sheltering the naked body of the architect. Permanent exposure to the light, or to the air, is pernicious.

The artifice, the selection of materials, and the expedition demonstrated by this creature, are truly admirable ; nor is it a small gratification to the curious, that all its qualities may be displayed before them.

Should a tube be already constructed on the side of a glass vessel wherein a specimen has had a permanent abode, the inhabitant is found lurking within in the earlier part of the day ; only the extremities of the tentacula protrude beyond the orifice ; and so they remain till towards noon. But scarcely has the sun passed the meridian, when the animal begins to be restless. Between four and five the animal has risen upwards, the tentacula extending with the approach of evening, and after sunset, they are in the greatest activity. They are now let down from the orifice like so many slender cords, each seizes on one or more grains of sand, and drags up its burden to the top, there to be employed at the summit of the tube according to whatever service is requisite. Should any of the lading slip its hold, the same organs search eagerly after it at the bottom, to be seized and raised to the top anew.

Such operations are protracted during several hours, though without any visible additions to the tube. Nevertheless, on resuming inspection next morning, a surprising prolongation will be discovered ; or, instead of an accession of the same description, the orifice is sometimes surrounded by forking threads of sandy particles agglutinated together.

The architect has now retired to repose ; but, as evening comes, its activity is renewed, and against sunrise, a further prolongation has augmented its dwelling.

All these are nocturnal labours. Such, indeed, are the habits com-

mon to the tenants of the deep, whose faculties are most energetic, and their industry most active, while the upper world are buried in sleep.

Comparing the effects of this persevering artificer with manual powers, even when these are aided by the high prerogative of reason, it will be understood how the operations of sixty, eighty, or a hundred prehensile organs, all directed towards the same purpose, can produce definite and considerable consequences.

At first sight the numerous tentacula seem only so many long, slender, cylindrical, fleshy threads, of infinite flexibility. Looking to them more attentively, we see that in exercising any special function, the portion which is applied to the surface of objects, flattens into twice or thrice its ordinary diameter; and while conveying the sandy materials to the tube, these are seized and retained by what appears a slit in each. Thus the tentaculum becomes a flat narrow ribband, folding longitudinally in different places to hold the particles securely.

Although those organs collecting as a brush be scarcely double the thickness of the body, they extend four inches singly, or half the length of the animal, thus sweeping the area of a circle eight inches in diameter.

A thin silken internal coating, perhaps derived from a glutinous exudation of the body, lines the whole tube, while serving as a real cement to unite and strengthen its innumerable parts.

Notwithstanding the unrivalled expertness, and the expedition of this diminutive architect in advancing its work, it has never been observed to resume possession of its tube when once forsaken. To obtain the shelter of a new dwelling in place of the old, its labours are recommenced from the foundation.

Both extremities of the tube are open, which, let it be recollected, is a positive character of the genus, distinctive from all analogies offered by the Sabella, an Amphitrite, or any other architect of its habitation, not undergoing metamorphosis, with which I am acquainted. I cannot speak of the *Pectinaria* (*Sabella belgica*), no entire tube having come into my possession. The length of that of the *Terebella* is indefinite, but the diameter no greater than allowing the tenant's reversal within

by doubling the body. After the tentacula turn the head follows, and the body folding on itself, the anterior extremity is liberated where the tentacula begin to protrude.

The worker can invest part of the body, even the whole, with sand by adhesion, but not as a tube, for this edifice requires a peculiar kind of construction.

A subsisting tube is prolonged one or two inches in the course of a night, though not with equal solidity under all circumstances, whether from scanty materials, defective secretions, or the disposition of the architect. In the natural state, the tube seems to be always directed horizontally. No parts, perhaps, unless the orifices, are vertical. In confinement the *Terebella* inclines to build upwards, at least such a tendency is then more evident. But it may result from the limited sphere of operation.

The fashion of the architect is subject to capricious modifications, sometimes it formed a vertical cylinder unsupported, though composed of very slight materials; also it appeared from a long and tortuous tube ascending the side of a glass jar, that, 1. It was cylindrical for a considerable distance from the foundation; that, 2. The animal then began to economise its labour, by appropriating the glass as one side of the rising edifice; that 3. On being conducted in this form to the highest edge of the vessel, which was immersed in one more capacious, the cylindrical form was resumed, because the substituted support by the side of the glass was lost; that, 4. When the continued extension of the tube at length reached the side of the larger vessel, the animal, to spare its labour, again availed itself of the side of the glass, and now directed the formation of the edifice downwards.

Though the creature commonly prosecutes its advantage as far as possible for saving labour, when the structure reaches a solid wall, this advantage is often abandoned as useless where a perfect cylinder might be constructed in actual contact with that wall, or within a hair's breadth of it. Likewise, after the cylinder has been advanced indefinitely, a new orifice is broken through the side, and a branch from it prolonged in different directions from that of the original edifice, where, in process of

time, a confused assemblage of tubular projections and orifices are connected with the main structure.

A tube, constructed with considerable regularity on the side of a spacious vessel, where the animal has partly saved its labour, is represented on Plate XXVI. fig. 5.

Sometimes while the anterior part of the *Terebella* occupies its tube, the posterior extremity is suddenly reversed, to discharge a quantity of sand from the same orifice, and as suddenly withdrawn. This is accomplished by the body folding within the tube, and the purpose of reversal may be to discharge the materials within reach of the tentacula. Thus there must be an internal reservoir. This part, however, very seldom comes under observation. I believe the whole animals of the genus can reverse themselves in the tube, so as to carry on the operations from either end.

In the natural state, a singular kind of tuft terminates, on indeed both extremities of the tube, proving an excellent guide to the animal's retreat. But such tufts are rarely formed in confinement. If they do appear, it is generally in May or June. The tuft consists of thirty or forty threads of sand, nearly nine lines long, fashioned by agglutination of many grains of sand, laterally or longitudinally together. In the course of a night a young specimen fabricated two threads, each being a single row of about thirty grains, at the opposite sides of the orifice. If the tube rises amidst the heterogeneous mass of matter on the shore, the threads issue from the edge of the orifice, many of them forking about the middle into two or more lines of sand. The use of these tufts is uncertain, whether as a defence against enemies, as a nidus to receive the spawn, which I have never had the fortune to see, or to entangle prey, which is less probable. Frequently both tufts are forsaken in their original position by the subsequent prolongation of the edifice beyond them.

The *Terebella* is a very lively, active animal, but of great timidity. Its energies seem to be aroused chiefly by the state of its dwelling, towards the enlargement of which incessant labour is devoted. By sundering a long tube below, while the architect is above, the observer will

discover how it proceeds to rectify so serious a disaster. The light of day seems obnoxious to all the race.

On removal of an intermediate portion of its tube, the tenant in repairing the breach prolonged the lower part upwards, so as to preserve the regular course of communication, uniting the new work with the older fabric above.

A series of experiments might tend to ascertain the precise extent of the instinctive faculties among the architectural tribes, and whether there is any approximation to that kind of retrospective reasoning generated by experience ; also how their labours are exercised, if according to circumstances.

Nothing has supported any conjectures relative to the food of this genus. All have rejected animal substances. The whole vermicular race not known to subsist on prey, seem to derive most part of their sustenance from sandy or earthy matter. The timidity of the *Terebella* effectually precludes it from attempting the capture of living prey. It is always readier to retreat than to advance. The smallest and most defenceless creature might, apparently, repell its attacks.

Everything, indeed, is secured by the tentacula, animal or vegetable fragments, particles of shell, and the like, not for food, but to be incorporated with the wall of the dwelling. Something of earthy consistence occupies the intestinal organs. Thus it may resemble the other vermicular species, swallowing earth as the source of aliment, or sand, to be repositied in a special reservoir.

Frequent renovation of its native element is essential for the salubrity of the *Terebella*, as well as for the vigorous exercise of its functions. With moderate precaution specimens have survived six months in confinement.

The healthy aspect, and the strength and plumpness of the body, argue copious subsistence in the natural state.

Mutilation of the body is often concomitant on the violent contortions of the *Terebella*, when dislodged from its tube. Large portions of the posterior part seem easily ruptured ; the tentacula, also separating by force or accident, continue a long time demonstrating vitality. Yet



Polychaeta

the animal is so little affected, that its labours are not only commenced, but continued under such privations.

Slight injuries often prove fatal, especially in hot weather. Whenever the body acquires a greenish tinge, the conservation of a specimen is a vain attempt. The vivid red of the branchiæ and the other parts exhibits the same conversion of colour. Some contract or disappear in death, insomuch, that the creature once so active and industrious can scarcely be recognised.

Like the Amphitrite, the Terebella in dying quits its tube.

This species, the *Terebella littoralis* or *arenaria*, is thus named from the place of its abode, and the materials of its architecture. It must not be confounded with the *Terebella conchilega* or shell binder, which dwells in deep water, and from which it may readily be distinguished, first, externally by the materials of its tube; next, the different configuration of the branchiæ and general appearance.

PLATE XXVI.

FIG. 1. *Terebella littoralis*—The Sand Mason—Tentacula *a*; branchiæ *b*.

2. Section of the body.

3. Section of one of the branchiæ, enlarged.

4. Section of a part, magnified.

5. Terebella in its tube, partly on the side of a glass.

6. Tuft terminating the tube.

7. Substances of uncertain nature discharged by the Terebella.

§ 2. TEREBELLA FIGULUS—*The Potter*.—Plate XXVII. Figs. 1, 2.

As the history of genera can be composed only by viewing species, wherein must be comprehended both aspect and habits, naturalists would do well to avoid the oversight of either.

We are wont to consider the strongest demonstrations of instinct as a wonderful prerogative, inherited from Nature by those diminutive beings incorporated with the great, numerous, and extensive class of insects. But it must be admitted that they are rivalled by the subjects

now under discussion, which are far removed from them by modern systematic arrangements.

The figure and the habits of the *Terebella figulus*, which may be most appropriately explained the *potter*, from its operations, as its chosen materials resemble the preceding species under a few modifications. Like the *Sand Mason* it is an architect, equally industrious, though less skilful. Where circumstances allow, it selects soft mud or clay exclusively for the materials of its dwelling, which also is fashioned of a tubular form, heavy, thick, and clumsy, instead of the comparatively light, thin, and fragile sandy edifice above described. It is smaller, and of more irregular shape.

The dimensions of this animal are generally much inferior to those of the former, but the product of its labours, if estimated by quantity, much surpasses the proportion, and is more speedily executed.

Were such delicate and defenceless beings liable to protracted exposure, they would be quickly sacrificed by numberless rapacious enemies ever in quest of prey, thence do they seem to know instinctively how they should be guarded from danger, or how to secure the readiest retreat.

For the most part the individuals of this species establish themselves in empty shells in deep water. But the finest specimen of all, I obtained casually on breaking up the shelving floor of a recess left in a shallow pool by the tide, wherein it seemed to have a permanent dwelling of the neighbouring softer substances.—Plate XXVII.

Length of the body about three inches and a half; thickness of the anterior part about three lines. Twenty-four pencils, each consisting of several bristles, issue from each side of the body, which afterwards become serrated down to the lower extremity. But many smaller specimens have only twelve pencils on each side, perhaps indicating another species or variety, for distinctions are not so readily seized by the observer, as in animals of definite parts in number and dimensions. Twelve elliptical prominences, with the rudiments of one or two cross the belly; a deep groove from the lowest runs farther down. The skin of the first segment of the body advances in a kind of scoop, with the broader edge

outwards, and from behind it, originate about fifty long, flexible, contractile tentacula, much stronger than those of the preceding *Terebella*. Three pair of branchiæ, together forming a beautiful crest, four or five lines high, rise from the second and third segment, the former supporting the first pair, and from their root the internal vessel extends visibly nine lines downwards. Each of these branchiæ may be compared to a minute, luxuriant, florid specimen of coral, with spiral branches.—Plate XXVII. fig. 1. ; fig. 2, the same, enlarged.—Plate XXVIII. fig. 1, more highly magnified.

But much embarrassment is experienced in determining the true configuration of so many living parts, and under such an arrangement in continual motion, expanding, contracting, and changing their form. According to the conventional comparison hitherto adopted, the members composing them seem to be four,—stem, bough, branch, and twig.

Each bough originates by a short stalk from the common stem, and forks into two branches, while each branch forks into two twigs, or the whole extremities form screws and spirals. These extremities, probably amounting to 150 in all, exhibit a pleasing variety of line and figure by their incessant contraction and expansion. The branchiæ are remarkably tenacious of life. A detached section exhibited precisely the same action during eight days as when entire. This fact renders the source of their mechanical functions somewhat more perplexing than we should otherwise account it.

Perhaps this species enjoys, to a certain extent, the reproductive faculties belonging to many of the vermicular tribes. A small fragment, preserving the whole series of tentacula, once occurred. Likewise a small specimen, which had been mutilated of all but a dozen, exhibited a fringe of the renovating organs under two lines long in a fortnight, and in five or six weeks they had become complete.

Some naturalists have taken extreme trouble in endeavours to settle the number of parts, whereof the different regions, if I may call them so, of their bodies are composed. They have attempted to enumerate the number of rings, papillæ, bristles, pencils, hairs, with other minutæ,

many of which lead to fallacies. I do not deny, by any means, that there may be some fixed members, and some fixed forms. But in examples innumerable, so many, that in fact I fear to refer to them, many such details are absolutely equivocal. Some things, such as dimensions and proportions, which we reasonably deem very essential, are unfortunately no less so. I am far from disparaging the labours of such learned naturalists as have followed the preceding course, but I cannot suppress my opinion, that if persons so skilful devoted their care to perfect living specimens, instead of to those chiefly dead or disfigured, they would have found far more prominent, more permanent and satisfactory features, whereon to found their systematic arrangements.

Undoubtedly the number of the tentacula in the *Terebella figulus* is dependent on age, or it may denote differences not yet sufficiently recognised. None, except the fine specimen represented, have had above twenty-five. But in this individual that number was doubled. Those of this specimen seem to be all different dimensions ; observing, however, that the aspect of such variable organs is wonderfully modified. They are stouter than those of the preceding species, and when extended completely they reach nine inches, that is above twice the length of the body of the animal, being thus capable of sweeping a spacious area. Their natural colour is uniformly brown, or tending to carmine, often shewing dark tips. When stretching far, they resemble a strong whitish horse hair.

In fabricating its dwelling, this creature gives an evident preference to mud, as the most suitable of materials. Should a quantity of this substance, of sand, and of comminuted shells be alike accessible, the first is always preferred, and the last always rejected, or reluctantly used. The *Terebella* is continually in quest of materials. The contents of a watch-glass introduced within its reach at night, have generally disappeared against morning.

If the animal be dislodged from its tube, the body becomes closely coiled up, but the tentacula speedily search around, sweeping up every thing within their reach ; and if the materials are abundant, a covering is speedily formed. It contracts greatly while the earlier part of the edifice

is advancing, either from the impression of the light, perhaps, or from the apprehension of danger.

The sufficiency of the tube for accommodation by no means satisfies the tenant, though ample. Like the former, after the temporary repose of the morning, its restlessness is displayed through much of the day, and augmented as evening approaches. At this period an active search for materials commences. Some tentacula secure muddy ladening, others are withdrawing grains of sand, and several seize on shelly fragments. Much industry is manifested, and meantime the various collections approximate merely by contraction of the respective organs retaining them. Amidst this, an undulatory action, apparently unconnected with mere vital functions, like repeated inflation of the upper part of the body, is repeated fifteen or twenty times in a minute, and in an upward direction, as towards the orifice of the tube. Next are small masses of ten or twelve particles discharged within the orifice, perhaps from the mouth, after having undergone some previous preparation there. The under lip seems occupied in smoothing that part up and down, or possibly cementing it with glutinous matter. Undoubtedly the materials are swallowed.

During several experiments to obtain a variegated tube, I supplied the large specimen with a quantity of its red native rock, whereon it had been found, now pounded. Next day its body appeared quite red, as if from the quality of the contents. Also, its dwelling had been augmented. At least two organs or under lips are engaged in preparing the materials, for it is improbable that merely in a crude state they can be adapted for use. During all this the branchiæ, however quiescent at other times, are in great activity; yet without discharging any evident external functions.

Nothing is more surprising than the attention of so humble an artist, being directed towards such a variety of operations at the same moment. Many tentacula are searching after the materials—many in collection—many bearing them to the edifice—some quitting their hold—others recovering the load—while the architect itself seems occupied in

kneading masses in its mouth, disgorging them successively, or in polishing the rude workmanship resulting from its labours.

A perfect tube is half an inch in external diameter, the sides being at least an eighth of an inch thick. It is wider within than the size of body, to admit of reversal, like the former. From the dimensions it appears massive and clumsy, yet in fact so fragile as to be incapable of sustaining its own weight. From the fragility of their tubes, the *Terebellæ* in general seek adhesion to solid substances for support, often conducting them horizontally. Likewise, both extremities of the artificial dwellings of the *Terebella* are open, a characteristic whereby they are distinguished from those of the genus *Amphitrite*. The same peculiarities of fabrication, in a cylindrical form, of rising vertically, or assuming a horizontal direction where the space is free, or of restriction to an imperfect cylinder when ascending a vessel's side, are demonstrated by this as by the preceding species.

The circuit being free, a complete uninterrupted revolution is performed by the architect while constructing its tube. The cylindrical form results from the revolution, not from the shape of the body, among those animals framing artificial dwellings.

An imperfect cylinder is constructed much more speedily on the side of a vessel, than a perfect cylinder in the centre. The artist does not perform a full revolution, though capable of doing so, while fabricating the segment of a cylinder. That would be superfluous. Having discharged its compound to the left, it continues towards the right, instead of passing around by the vacant side of the glass. Thus it pursues a retrograde movement, instead of describing a complete circle. Its operations are conducted from left to right, and from right to left alternately, without covering the internal surface of the glass, whereby there is a saving of labour, as well as of material.

Shall this be accounted the demonstration of a higher degree of instinct, warning the creature against superfluous work? Or does it result simply from the configuration of its body? The latter is not evident, for the cylindrical form may be resumed apparently at will. But the influ-



Terebella Tuberculata

ence of instinct is extremely obscure in an animal exhibiting such an insatiable propensity for exhausting its materials. It would rather seem to be influenced by some kind of necessity ; nevertheless its procedure is an act certainly consequent on some comparison of circumstances, to which its labour is modified or adapted.

The sense of feeling seems to regulate the discriminative faculties of this and other Terebellæ, whence the sand, the mud, or the comminuted shell is selected in preference. The presence of the other senses is less evident, and that of vision the most obscure of all. Nevertheless, during the day, a simple wave of the hand will sometimes induce the tenant to retreat within its dwelling, which can be scarcely ascribed to any thing but interception of the light.

This species can resume possession of the tube several hours after having forsaken it.

The *Terebella figulus* is not common. Although the food be unknown, specimens live for a considerable time in confinement. That represented, Plate XXVI., which afforded the most satisfactory results, survived four months. Yet so little is derived from individuals preserved with all possible care, that the preceding brief details are the accumulation of many years.

PLATE XXVII.

FIG. 1. *Terebella figulus*, mouth, *a* ; branchiæ, *b* ; tentacula *c*. The upper part of the belly is in front, and the branchiæ behind.

2. One of the branchiæ enlarged.

PLATE XXVIII.

FIG. 1. Branchiæ, magnified,

2. *Terebella figulus*, smaller specimen, back.

§ 3. TEREBELLA TUBERCULATA.—Plate XXVII. Figs. 1, 2. ; Plate XXVI. Fig. 8.

This is one of the larger and most beautiful of the Scottish Terebellæ, and if rarity has any value, it has herein a recommendation. But, as elsewhere adverted to, that is rather an imaginary than a real quality, being often accidental.

The body extends about five inches ; and it is provided with about seventy long and strong tentacula, stretching nine inches, which are capable of sweeping an area eighteen in diameter around the head, while the body remains stationary.

Six branchiæ are disposed in three pairs, the highest pair the longest, the other two successively decreasing. These are fine and florid organs, of peculiar formation, appearing somewhat mottled like birch bark under the microscope. These parts are alike numerous as those of the others, but they do not abound in similar curvatures, their extremities terminate in forks like thorns. Their action is incessant, whence, together with the slightest movement of the animal withdrawing them every instant from the field of the microscope, excessive difficulty obstructs the delineation of even a small portion magnified, Plate XXVI. fig. 8. Thirteen transverse furrows indent the upper portion of the body, which is subdivided into numerous annulations, and tapering down towards the lower extremity.

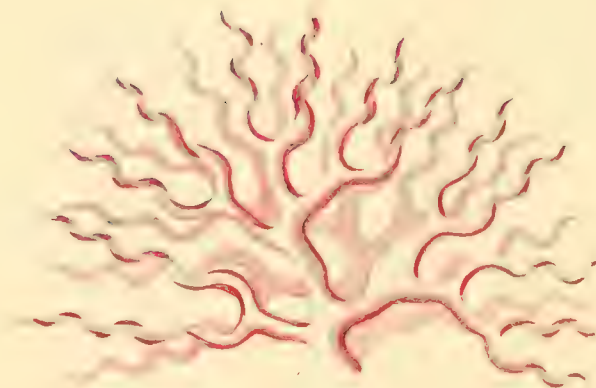
As the animal extends its body, the annulations of the upper portion are quite obliterated.

The whole is of a fine reddish-brown colour, the surface universally speckled with low white tubercles, rendering it altogether a very beautiful object.

This Terebella constructs a wide loose case of fine sand, so large that it can reverse itself within, and sometimes the tentacula are seen protruding from both orifices. At first, from its general resemblance to the *figulus*, I thought it might construct a tube of mud or clay. But it testified no disposition to work in either, though employing some fragments of comminuted shell along with the sand. Night is the season of its greatest activity.

When dislodged from the tube for the purpose of inspection or delineation, and then supplied with sand, the higher portion of the body is that which is first protected by the rudiments of a new edifice.

The specimen represented Plate XXIX. fig. 1, having been committed to a wide vessel with a quantity of sand, it continued lurking within at its work. Desirous of observing its future operations, I then



C. ...

transferred the specimen to a tall narrow jar, wherein the tube now constructed was carried up the side as a semi-cylinder, thus exposing every thing satisfactorily to view. Sometimes, on attaining to a certain height, the tube quitting the glass becomes a perfect cylinder, and is continued in this shape, with the orifice directed towards the centre of the vessel.

Two specimens of large size reached me from Shetland on June 29. Both were mutilated at the posterior extremity, which prevented the determination of its true form. But such as it was is truly represented.

The smaller of the specimens died in a week. The largest survived, remaining vigorous, and displaying great activity.

Regeneration of the defective extremity soon followed. In ten weeks it consisted evidently of ten or twelve segments. Their number and dimensions augmented, and in five months from the date of acquisition, the portion reproduced appeared as in Plate XXIX. fig. 2. It then remained grey as from an early stage, but gradually darkening, and becoming finely speckled throughout, an original characteristic of the species was satisfactorily exhibited.

The specimen survived at least ten months, having become somewhat darker with time.

PLATE XXIX.

FIG. 1. *Terebella tuberculata*.

2. Regenerated extremity.

PLATE XXVI.

FIG. 8. Portion of one of the branchiæ, enlarged.

§ 4. TEREBELLA CONCHILEGA—*The Shell-binder*.—Plate XXVIII.

Figs. 3, 4, 5, 6, 7, 8.

Of the whole *Terebellæ* inhabiting our seas, this species seems to have misled naturalists the most. Transient inspection, and that of a very insufficient and unsatisfactory kind, has been probably the means of confounding it with the species first described. But although the distinc-

tion between them, both in habits and configuration, be obvious, few have attempted to correct the error.

The largest specimens of the Shell-binder extend above five inches. Pencils of several bristles and fleshy stumps down the sides, long flexible tentacula, a mouth with active lips, resemble those of the others. The posterior extremity is slightly trumpet-shaped.—Plate XXVIII. fig. 4.

The branchiæ consists of two bunches of ten or twelve beautiful florid fleshy filaments in each, which resemble expanding ringlets, spirals, or screws. Their incessant motion by contraction and dilatation, together with the involution of the parts, renders it impracticable to discover during life, whether these bunches are collectively sustained each on a short stem, both on one stem, or whether they originate from the skin. They are confused, decayed, and disfigured in death. A very vivid crimson spot marks the extremities, fig. 5. The body of the animal is also of a fine red, probably speckled, because specks are exposed by fading of the deeper hue, especially towards the lower extremity. About twenty-five tentacula, infinitely stronger, and considerably longer than those of the *Terebella litteralis*, form the complement belonging to the present species; they are at least five times their diameter. They are nearly the length of the body, and capable of laborious efforts. Flattening like a ribband, they fold longitudinally in seizing an object.

The fashion of the operation of the tentacula is according to the service required. The portion applied to the smooth surfaces is flattened; or the longitudinal fold, naturally preserved by the whole tentaculum, opens to seize and convey solid substances to whatever point is required, fig. 6. Each portion of the tentaculum is endowed with a prehensile faculty independently of every other portion, so that, if the middle applies to any surface, or seizes any object, the remainder, both behind and before, can fulfil similar functions at the same moment. A number thus affixed by intermediate points in their length, resemble so much extended cordages. A row of round red spots runs down the middle of each, fig. 7.

A strong musky odour exhales from some specimens of the *Terebella conchilega* recovered from the deep sea.

This creature constructs a dwelling of comminuted shell exclusively, in preference to all other materials, and is enabled, by the strength of the tentacula, to avail itself of large fragments. In the natural state, it generally takes shelter within some capacious empty shell, such as a valve of the *Venus islandica*, there to establish its edifice ; and it likewise often winds the tube over the surface. But many other situations are taken, sometimes those very inaccessible, such as amidst groups of the *Tubularia indivisa*, whence its artificial casement is inextricable. On all occasions this tube is formed of irregular and unequal fragments, and lined with the silky matter from an exudation of the animal.

The Terebella may be induced to exercise its architectural faculties by diminishing the light during day, as if night were approaching. If supplied with different coloured fragments of shell, a variegated tube in bands, or otherwise constructed, may be obtained. A beautiful edifice is constructed of the shivered pearly interior strata of oyster shells. Thin fragments are preferred to thick, but there is no evident discrimination of suitable dimensions, as in the course of the work portions very large are united to those very small. If the Terebella be restricted to the more transparent fragments, a better view of itself within is afforded.

A specimen having been dislodged from its tube, and committed to a vessel containing a few shelly fragments, some sand, and a number of small Venetian beads, it employed the whole indiscriminately in fabricating a new dwelling. But another, supplied with a quantity of sand, together with a number of the same kind of beads, rejected the latter, confining itself to the sand alone in constructing its edifice. It was not a vigorous specimen.

In default of comminuted shell, the *Terebella conchilega* will build a tube exclusively of sand.

By eliciting the propensities of this animal, the observer may have much agreeable and interesting entertainment.

If dislodged from its dwelling in a vessel of pure water, the Terebella profits by the earliest provision of fresh materials to construct another. While this is conducted up the side of a vessel, the tentacula, those essential mechanical auxiliaries, are busily employed. A silky ten-

taculum seizes a fragment to be elevated to the orifice, instead of being abandoned if too ponderous and unwieldy, two or three others unite their efforts in raising the load to its intended position. An empty mussel shell, above half an inch long, was thus elevated and secured in its place to augment an edifice in progress.

Great expedition is exhibited in fabricating a tube solely of sand, under total deficiency of more favourite materials. Then are heavy loads dragged towards its naked body, with which the mouth is speedily occupied. But shell, as best adapted for the labours of the architect, receives a decided preference.

Some particles of this substance are certainly swallowed, but from the dimensions of others incorporated with the edifice, they must be combined with adhesive matter for fixture. When recovered from the sea, the whole structure consists of a very tough silk covering with the fragments of shell.

Perhaps this animal enjoys distinguished reproductive properties. Sundered portions survive a long time, and the lower part of mutilated specimens is completely regenerated, as we have seen in the case of the *Terebella tuberculata*.

An immense quantity of spawn was produced by a specimen of the *Terebella conchilega* early in December. It covered the bottom of a narrow jar, and on gross computation consisted of at least 8000 ova or capsules, perhaps imbedded in albuminous matter, invisible from transparency or tenuity. The ovum is very minute, spherical, and reddish, of various intensity, according to the parent. Under the microscope, an internal substance has been discovered within the diaphanous integument, which might be the embryo.—Plate XXVIII. fig. 7, ova.

Thousands of minute carnation ova, discharged by another specimen, perished accidentally in September.

On one occasion a number of specimens having reached me near the end of December, were found much weakened by the impurity of the water. Some having been extracted from their tubes as they protruded far, one or two produced a multitude of eggs.

During the earlier days of November, numerous spherules appeared

within an internal organ of a different specimen from any of the preceding, but not accumulated in an ovarium. On the contrary, they were loose, rising and falling within the cavity like small shot dropped amidst a very dense and resisting medium. This continued several weeks without any definite consequence.

It might have been some architectural materials for the tube.

Were many alike prolific as the most fertile above quoted, the race should be common. But in districts where the other *Terebellæ* abound, this species is on the contrary rare. Thus I have either never found the place of its nativity, or, surrounded by enemies, the most of the progeny perish at an early stage. Observers are prone to conclude that the reproductive faculties are lavished in superfluity on the lower animals; that the embryonic members are excessive, so that the world would be incapable of sustaining the whole did they reach maturity, or even on advancing a short way in progress towards it. Shall we, therefore, deem it essential to the harmony of the universe, that exposure to danger shall admit destruction of the young, while only a few adults are preserved to fulfil the general laws of Nature?

Specimens have survived nine months in confinement.

PLATE XXVIII.

FIG. 3. *Terebella conchilega*.

4. Extremity enlarged.
5. Branchiæ, natural size.
6. Tentaculum conveying a portion of shell, *a*, enlarged.
7. Tentaculum, shewing the spots on the back, enlarged.
8. Ova.
9. Ova, enlarged.

§ 5. TEREBELLA MACULATA—*The Spotted Terebella*.—Plate XXVII.

Figs. 10, 11, 12, 13.

Compared with any of the preceding species, the subject of this paragraph is one of the smaller *Terebellæ*. Its length is disproportionately

greater than the thickness, but in all other respects it corresponds generally as well in configuration, as in propensities, with the others.

The Spotted *Terebella* extends about an inch and half by less than a line in the largest diameter of the body; and it is provided with twenty or twenty-two tentacula, stretching about an inch. The lower extremity terminates in points.—Plate XXVIII. fig. 10, enlarged.

The definite branchiæ consist of a single pair, and are composed of six or eight subordinate forking ramifications. But we do not find either the number or arrangement of the forks corresponding exactly in different specimens. Indeed, I cannot affirm confidently, that in the species of *Terebellæ* with three pair of branchiæ, the formation of all the three strictly correspond. I rather think otherwise, though the extreme difficulty obstructing observations prevents both description and delineation. In the finest specimens of the *Terebella maculata* the colour of the branchiæ tends to scarlet, sometimes to tile-red, the central line of various intensity. Behind them stand a pair of short, obtuse, pellucid stumps, which are not distinguished by obvious peculiarities. The figure of the branchiæ, however, is quite distinctive, fig. 11, enlarged.

The back of the tentacula is spotted brown; their general appearance and functions may be compared to those already described; but here a row of short obtuse teeth, somewhat apart, border each side of each tentaculum, such as have not been remarked in any of the others. These are best exposed, under favourable circumstances, on the organ being flattened.

This is the most beautiful of the genus, mottled, patched, or speckled with variegated colours, wherein brown, green, and yellow predominate. A longitudinal light line traverses the speckled olive back; the root of the pencils is bounded by a dark line, and a stripe within two darker lines runs down the belly. Faint-green stains the tentacula, their row of oblong or oval spots down the middle contracting or dilating along with their action.

The Spotted *Terebella* constructs a very compact, small, cylindrical tube of minute grains of sand, which is prolonged by irregular curvatures. In the natural state, it is attached to corallines, or similar marine pro-

ducts, with their slender filaments alternately interwoven in its sides. The tube follows no regular course wherever constructed.

Sand is collected profusely near the orifice, and quantities of it swallowed. But I know not whether the heaps appearing, both in the immediate vicinity of this and of other *Terebella*, are the product of tentacular collections, or whether they may not be accumulated from the regurgitation of what has been swallowed.

Momentary protrusion of the lower extremity is witnessed here, as with the *Terebella littoralis*.

Sometimes supervening putrescence of its native element compels this creature to forsake its dwelling. If not, should the observer desire inspection, the tube must be shortened as much as possible, and the tenant to become a little enfeebled by remaining in the vitiated water. Then, when applying the mouth to one end, while the other remains immersed, it may be forcibly blown out. No other expedient can obtain the *Terebella* entire.

When this experiment has succeeded, the naked animal coils itself up spirally like a screw, forming six or eight volutions, which absolutely preclude a view of its configuration; and, amidst its contortions, the posterior part, remarkably long and slender, is readily ruptured. But a little sand scattered in the vicinity will prevent all inconvenience, by inducing the *Terebella* to unfold for the purpose of constructing a new habitation. The anterior portion of the body is covered first, and the remainder gradually protected by the advancing edifice.

Numerous minute white globular capsules are frequently found in vessels containing these *Terebellæ*. Where a specimen had been dislodged from its dwelling, they evidently issued from the very extremity, which had not been entire. Nothing has shewn their definite nature. If they are not animal substances, does any kind of internal formation contribute to modify their form?—Fig. 13.

This species is common. Individuals may be preserved many months.

An animal, rather indistinctly described and represented by Müller as the *Amphitrite cristata*, seems to have only a single pair of branchiæ.

But I cannot identify it with that of this paragraph.—*Zoologia Danica*, vol. ii. p. 40, tab. lxx.

PLATE XXVIII.

- FIG. 10. *Terebella maculata*, enlarged.
 11. One of the branchiæ, enlarged.
 12. Tentaculum, back, enlarged.
 13. Front of the same, enlarged.
 14. Globular corpuscula.
 19. Ova.

§ 6. MISCELLANEOUS.

The general nature and the history of the preceding five species of the *Terebella* are sufficiently explicit. But several others, apparently nearer or more remote kindred species, must be treated with much diffidence, some from presenting certain anomalies, and others from the rarity of their occurrence preventing them from being clearly understood.

1. TEREBELLA TETRIX—*The Weaver*.—Plate XXVIII. Figs. 15, 16, 17, 18.

So few specimens of this animal, presuming it a distinct species, have occurred during a long series of years, that I feel considerable embarrassment regarding it. At the same time, it was so long before my attention was directed towards it, more may have been in my possession. I doubt whether or not I can speak of the adult.

Length of one specimen six lines, of another nine, of a third twelve. The first had twenty-five tentacula, extending an inch, and a pair of ramified red branchiæ on each side, with a stump behind each.—Plate XXVIII. fig. 15, enlarged. The third species had forty tentacula, but these organs totally intercepted the view of the branchiæ.

This species constructs a semicylindrical sheath of sandy or muddy particles, which is always of insufficient dimensions to cover the body, or

to receive the head. None of any other form has been seen. This sheath is frequently abandoned and as often resumed ; neither does the animal restrict itself to the construction of one sheath only.

A peculiar feature in its history is producing a real cobweb, as distinct as that of the spider, with which it covers itself, and which also frequently, if not always, serves to support its spawn. The texture is very thin, rather irregular, and composed of the finest threads, these almost invisible, from their slenderness and extreme transparence. Neither the mode of formation or extension, nor the expedients for securing their extremities are obvious.

Such a web, from the specimen nine lines long, covered an area fifteen lines square. This is plainly a work of some exertion, as the threads, sometimes amounting to fifty, are fixed to the side of the vessel, as high above the bottom as equals the length of the weaver, or more, and they also extend below, there to be secured. Thus it is evidently an artificial work, and it receives successive accessions. The specimen continued its work about three weeks in May, but although surviving a month longer, it wove no more.

Such a web has been formed by four different specimens, and always in May. These alone came under special observation.

During the first week of this month a cluster, consisting of thirty-seven white elliptical ova, as I concluded then, was removed in successive portions by a small specimen contained in the same vessel, which had meantime spread an irregular cobweb. These were not its own ova, but the product of some other animal, nor were they sustained by a web.

The spawn of this species is of a different character. Seven years after the preceding incident, just about the same season, a specimen, quite an inch long, produced above 1000 spherical carmine ova in the course of two days ; and perishing accidentally a fortnight later, many more escaped on rupture of the body. At the same time another specimen proved very prolific.

The spawn consists of irregular albuminous matter, of various quan-

tity, several being produced by the same parent. One albuminous mass, tending to a globular form, whereon eighty or more ova were imbedded, was lodged by a specimen amidst its web. Other masses, produced by the same animal, and by a different specimen, were lodged both amidst the web and elsewhere, fig. 17.

None of the spawn proved fertile. Further observation must determine the precise form of the branchiæ, and other peculiarities of conformation; also whether the species ever constructs an entire tube; and further, whether there is any connection between the production of the web, and the perpetuation of the race.

PLATE XXVIII.

FIG. 15. *Terebella textrix*—The Weaver—enlarged.

16. Mass of spawn lodged amidst a web.

17. The same spawn, enlarged.

18. Portion of spawn, magnified.

2. TEREBELLA PECTEN.—Plate XXVI. Fig. 9.

Length four lines, with long black bristles, forming pencils down the sides. A wide thin lip in front. Tentacula about twenty. Branchiæ peculiar. A stout fleshy stem sustains the whole, which consists of four members, two larger, two smaller, each composed of a rib, with prolonged cylindrical and somewhat extensile subordinate organs from one side, on the whole resembling four combs, with long flexible teeth. These branchiæ testify considerable action. Colour of the animal reddish.

Only one specimen occurred, which had quitted its dwelling. Nor did it construct a new one when supplied with sand and earthy matters.

PLATE XXVI.

FIG. 9. *Terebella pecten*, enlarged; branchiæ *a*.

3. TEREBELLA OSTREÆ.—Plate XXVI. Fig. 10.

From what has been said above it may be inferred, as it is also explained in detail, that if the generic name, *Terebella*, is truly meant to signify a creature endowed with the faculty of penetrating rocks, the quality is not enjoyed by those described, therefore such a characteristic name is misapplied.

Nevertheless there is one exception, a very small animal, bearing some remote kindred to the *Terebella*, which seems capable of forming an enlarged cavity for its own lodgement in so hard a substance as shell.

If here denominated it is provisionally, first, to shun the multiplication of genera ; next, for the purpose of recognition.

While inspecting the exterior of old oyster shells, the observer may sometimes see several slender brownish tentacular organs playing around a fixed point, and occasionally withdrawing from view. On separation of the laminae, and breaking down the shell, an animal, from which they proceeded, is discovered lurking in a cavity amidst its solid substance.

In some respects this animal bears considerable analogy to the *Terebella*. It is of vermicular form, the body extending about nine lines, composed of numerous segments, and with obtuse extremities, tapering from the middle to each side, and is bordered *throughout* by a row of pencils, composed of three or four bristles ; fewest are next the head. The mouth is a cavity in the anterior extremity, somewhat behind which are eight round flexible tentacular organs, situated on the neck. They are susceptible of being flattened and folded longitudinally, like those of the *Terebella*. Eight seem the peculiar complement, and they are possibly developed in succession. Specimens, extending only two lines, had a single pair. A red internal, flexuous, contracting and dilating vessel, is near the surface, towards the upper part of the body, and is most conspicuous in young specimens. The colour of adults is very dark umber, almost black, the posterior extremity and tentacula dull yellow. The young animal is yellowish.

The organization of this creature is certainly modified by age.

The special habitation of this creature is a cavity adapted for its body, often in the thickest part of the shell. I have not seen it in any other substance. The cavity is lined with silk, and corresponds with the dimensions of the body ; it may be enlarged by some solvent. There the tenant lurks, protruding its tentacula by a circular aperture, which are always searching around the vicinity, like those of the *Terebellæ* proper.

Although not dwelling in society, several specimens are occasionally found within narrow limits. At least twelve have been seen displaying their tentacula from the surface of a single shell ; besides which, there were probably some of small dimensions, obscured by adventitious matter.

PLATE XXVI.

FIG. 10. *Terebella ostrea*.

Besides the peculiarities of the *Terebella* proper, such as are definitely shewn by the *littoralis*, *figulus*, *tuberculata*, and *conchilega*, above explained, a brilliant phosphorescence belongs to some of the genus, and particularly to the *figulus*. But it is rarely displayed.

As in the *Nereis noctiluca*, this apparently results from constraint or suffering. Flashes were emitted by a small specimen having left its tube on transference to a different vessel. On replenishing the latter with water, the most copious bright blue refulgence, intermingled with a reddish flame, streamed from the tentacula and other organs. Apparently the phosphorescent property is diffused over the body, and here the coruscations evidently attended violence.

Several facts merit particular investigation, such as, whether all branchiæ, or the hairs of them, are identically of the same character ; and whether their full complement is original or successively developed. Also, whether the habits of the animal are not affected by age, and from the season of propagation.

In as far as I have observed, the generic character may be found in a vermicular annulate body, with pencils issuing from a number (perhaps sixteen) of the upper segments ; numerous extensile, flexible tentacula ; external ramified branchiæ on the back of the neck ; the construction of a tube, open at both extremities, so wide as to admit reversal of the animal within. Specific distinction may be found in the configuration of the branchiæ, and in the quality of the materials for binding the tube.

CHAPTER IX.

AMPHITRITE AND CONGENERA.

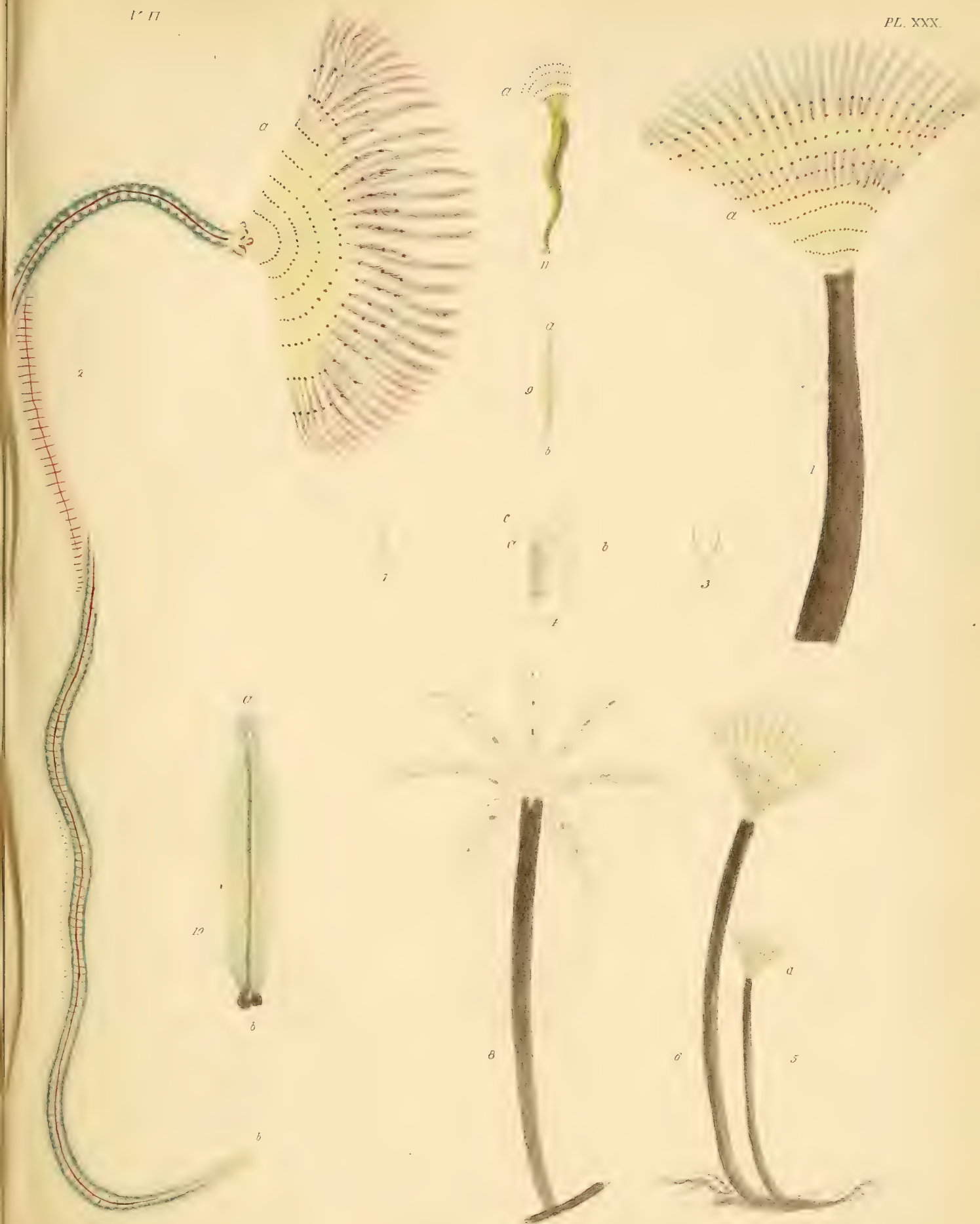
WE have already had some examples of the different edifices which the instincts of Nature prompt the humbler animals to construct for their protection. We have seen the various materials, and the artifice employed in the work. It is coarser or finer, more or less durable, larger or smaller, but always directed to the same specific purpose.

In further illustrating the subject, let a few examples be given of those curious and interesting facts, wherein the energies of the humblest creatures are aroused, and wherein, at the same time, are disclosed some very singular facts in physiology.

§ 1. AMPHITRITE VENTILABRUM—*The Fan Amphitrite*.—Plate XXX.

Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11.

At the depth of sixty or seventy feet from the surface of the sea, a black leather-like tube, about two feet long, is affixed by the lower extremity to some solid foundation. Its position is erect, gradually enlarging upwards from a very contracted basis, to nearly the size of the little finger, or five lines diameter at the orifice. It frequently resembles a reed or vegetable stem of stunted growth, as if furrowed by age, with portions of the bark injured below by decay, but fresher and smoother above, where visibly more recent and entire.



Amphiprion *Quoyi* *Labrum*

Y
Y

When originally withdrawn from the sea, the orifice of the higher extremity is closed by compression of the sides, and if the lower part be not ruptured, it tapers down to the point of adhesion. All the intermediate space is quite smooth, when free of corrugations, very elastic to the touch, with the peculiar softness of moistened leather. And, on the whole, when clear and perfect, this submarine product bears the narrowest resemblance to a tube of caoutchouc, manufactured by human art.

We now behold it in its simplest state ; but, on plunging this dark, artificial-looking tube amidst a quantity of recent sea-water, the compression above relaxes, and a few air-bubbles escape ; the tip of a variegated pencil is gradually protruding, which suddenly unfolds as a splendid plume, composed of many feathers. Thus it remains stationary and motionless, or perhaps it commences a slow, regular horizontal revolution, as if of the spokes of an unbound wheel with their vertical axle only. An admirable spectacle is offered to the view. We see a living creature, of infinite beauty, in motion for some purpose, or discharging some function unintelligible. Let the slightest shock be communicated, and the whole instantaneously collapses and disappears within the tube, almost before its image has faded from the eye.

On dislodging the tenant of the tube from its dwelling, the body, hitherto concealed below, proves to be of vermicular form, twelve to fifteen inches long, composed of about 350 segments, and crowned by a head of eighty or ninety feathers, resembling a shuttlecock. The lower extremity terminates in a double gland, fig. 2.

This head, or anterior portion of the animal, which I shall, for brevity, denominate the plume, though truly the branchiæ, is disposed in two vertical fans, in such a position and arrangement as to form a perfect funnel, which will be seen on simple inspection. In larger specimens it exceeds thirty lines in depth when the plume is displayed, and forty lines in diameter, variegated in brown, red, green, and yellow colour, figs. 1, 2.

Two triangular pointed brown and green antennulæ rise about three lines high from the bottom of the funnel, fig. 3 ; and towards one side, also below, are two external fleshy lobes or trowels, with an organ like a

tongue or scoop between them, forming altogether a remarkable apparatus, fig. 4.

The margin of the first segment enlarges as a frill, fig. 2 *a*. A superficial, longitudinal groove traverses the body throughout, and short pencils, with a smaller brush at the root, issue in a row from each side of the segments.

But a minute detail of the external and internal organic structure would exercise the faculties of a skilful anatomist. Nor is it an easy task to explain the nature of parts imperfectly exposed, whose use may be equivocal during life, and which are utterly disfigured or obliterated by death.

In this animal the branchiæ most intimately resemble fleshy feathers. The feather consists of a rib, clothed on each side by numerous active cilia ; and on its back are several prominences, their number depending on its length. The branchiæ or feathers, I say, are disposed as *two fans*, from the flattened, fleshy roots, of which both originate. A groove or channel is so adapted in this fleshy portion, as to receive any foreign matter falling on the rib, and passing downwards, whereby it is transmitted to the organ between the two trowels, fig. 4.

In regard to this particular organ, which originates much higher than the trowels, inclining downwards, so as to share in their operations, it is somewhat of the nature of a long triangular tongue, very thick and broad at the root, but susceptible of dilatation as a scoop, or the sides fold together longitudinally.

The observer may be very long disappointed of obtaining a view of these organs in the living subject. His search for them in others would be hopeless.

The *Amphitrite ventilabrum* is decked with various colours, all of different shade and intensity, distributed in proportion ; according to the specimen, red, green, and purple predominate. The expanded funnel seems environed by so many vivid circles, from the bright spots with which the branchiæ are studded. One side of the body is greenish and brown, with a brighter ellipse on each segment. The opposite side is greenish-

grey or lead colour. Sometimes the colours are very vivid. Green is always exhibited ; the fluid wherein a specimen dies is tinged with green. The same peculiarity follows the decay of another species, wherein green appears, while the subject remains entire.

The organic structure of the Amphitrite is dependent entirely on its dimensions. Additional parts unfold incessantly with its advancing age ; nor can I conjecture where their multiplication ceases. Thus the number of segments assigned to the body of not only this animal, but, in as far as I know, to all its kindred Annelides, must be qualified by taking the age, that is the dimensions of the specimen, into account.

A month after a small specimen had been obtained, it did not exceed three lines in length ; and, in another month, the plume consisted of seven branchial feathers. A second specimen, somewhat larger, had fourteen ; a third, twenty-one ; a fourth, thirty-three ; a fifth, fifty, and so on, up to ninety-two, the greatest profusion enumerated in this splendid organic ornament—one utterly inimitable by art.

As the ribs of the branchiæ extend, the cilia multiply proportionally ; and while these new evolutions are advancing above, additional segments are forming below. Thus the energy of Nature seems never to repose, provided animation admits its demonstration by augmenting accessions.

In a previous publication on the Zoophytes, I had an opportunity of claiming the notice of the contemplative to the formation and incredible multitude of parts belonging to the *Pennatula mirabilis* or *Virgularia*, over which that singular creature would apparently exercise a certain controul ; yet, in as far as simple observation could appreciate, its power was not directed to the execution of any definite external functions. Here it is otherwise. We have before us a being still more admirable, inasmuch as availing itself of its formation, it can discharge real mechanical operations, by the aid of the various organs with which it is provided, while several different offices have to be fulfilled.

We are enabled to witness both the means and the end.

It is known that all the parts of the human frame susceptible of voluntary direction to a specific purpose, are limited within hundreds. In this humble tenant of the deep, they amount to many thousands. Its organs,

and their action, are tenfold in proportion. Without taking into account obscure and indefinite parts, which nevertheless do certainly exist, the organs of progressive annulations, and pencils or stumps alone regulating its position in the tube, surpasses thousands. If the plume of an adult displays eighty branchiæ, with 500 cilia on each, here are no less than 40,000 organs endowed with voluntary, distinct, and independent action. So many other parts are alike privileged in their own peculiar motion, without the participation of the rest, that it is no exaggeration to affirm, that the will of this timid, lowly, defenceless creature, is fulfilled through the controul of 50,000 living parts.

But how do they receive their impulse ; how is the principle communicating volition conveyed to proximate, remote, distinct, computed, or unconnected parts of the organic structure ? Can we refuse the creature something which is comparable to a rational faculty, that it knows what is required, and puts these portions of its organs in action which are necessary to effect its object ? That this definite purpose is committed to one, to ten, or an hundred of its infinite parts, while all the rest shall remain inactive ? What is the precise spirit which actuates them ? How are they preserved from interference, kept to their office, and made to operate by one consent ? Simple reflection on the source and the fulfilment of the design is enough to perplex the most sagacious, and render human learning shallow.

We can speak of what is external and patent to view, omitting all conjecture and computation of the numberless hidden parts, their combination and action, as too inaccessible, minute, or complicated for such observation as could be applied to them.

Yet the physiological features characterizing this creature, and the mechanical art whereby it renders its wonderful organic frame subservient to important definite purposes, are alike interesting as the beauty and symmetry by which it is distinguished.

Lodged in a strong tubular casement, wherein rivetted from its origin to the same spot, it must live and die, the tenant enjoys the faculty of enlarging that dwelling which has to be adapted to its necessities, proportioned to its increment, and to shelter its imbecility.

Let a tall and ample crystal jar, containing an Amphitrite, be emptied of its contents, and speedily replenished with sea-water, the animal, if in view, has retreated during the short interval ; the orifice of the tube is closed, all is at rest. But soon after replenishment, it rises to display its branchial plume still more vigorously than before, and remains stationary, as if enjoying the freshness of the renovated element, always so grateful,—the harbinger of health and strength to those whose dwelling is there. The passing spectator would conclude that he now beholds only a beautiful flower, completely expanded, inclining towards the light, like some of those ornaments of nature decorating our gardens. He pauses in admiration. But if a drop of liquid mud falls amidst the element from above, disturbing its purity, then, while the plume unfolds to its utmost capacity, does the animal commence a slow revolution, the body also passing around within the tube. Now are the thousands of cilia fringing the ribs of the branchiæ discovered to be in vigorous activity, and their office to be wondrous. A loose muddy mass is soon afterwards visibly accumulating in the bottom of the funnel ; meantime the neck or first segment of the body, rising unusually high above the orifice of the tube, exhibits two trowels, fig. 4, beating down the thin edge as they fold and clasp over the margin, like our fingers pressing a flattened cake against the palm of the hand. During these operations, the muddy collections are seen descending between the roots of the fans towards the trowels, while another organ, perhaps the mouth, is also occupied, it may be, in compounding the preparation with adhesive matter. Still does the partial or complete revolution of the plume above, and of the body within the tube continue ; the bulk of the muddy mass diminishes, activity abates ; it is succeeded by repose, when the tube is found to have received evident prolongation.

The whole presents a scene of uncommon interest, one of many well adapted to elevate the philosophic mind in contemplating the harmonies of the universe, and the wonderful mode pursued for the fulfilment of ultimate designs. Mankind discourse of symmetry and beauty as grateful when offered to the eye ; they boldly condemn that which in their judgment is defective or superfluous organization ; they arrogantly

condemn the humble, the unresisting creature, as worthless, only fit to be trodden under foot—for it cannot make a blank in their eyes. Audacious ignorance! How can they presume to judge of Nature's works, having never seen their progress? Or, when they are revealed, are lost in the incapacity of comprehending the means whereby the Divine energy has stimulated the exercise of those faculties appropriated to relieve temporary necessities, or to provide for permanent conservation.

Nothing is more admirable than the separate operation of so many distinct organs to effect a single purpose. The plume forms a capacious funnel, wherein thousands of cilia collect invisible muddy atoms, which, passing down the ribs of the branchiæ, as so many channels, to a common conduit as their base, they there accumulate in loose pellets below. The primitive simplicity of the muddy matter is not enough; its consistence and tenacity must be augmented by the incorporation of an adhesive substance in transition from the scoop or tongue to the trowels, whereby, concocted as paste, it may be employed in raising the edge of the tube. On reaching its destination there, it is moulded into proper shape, by the tongue or trowels merely applying it on the margin; but curving as far over the exterior circumference as they can stretch, they actually polish the clay by moving them while clasping it by their pressure. How does the artificer perfect its work,—when the orifice appears as circular, clear, and even, as the mouth of the cylinder finished by the tool of an expert turner?

I know not whether any naturalist has witnessed the commencement of the edifice, or can tell how the architect lays its foundation. But certain it is, that the artificial structure results from the instinct implanted by Nature in the living being. All that I can attempt to describe must be confined to the process for advancing it, for I have never been fortunate enough to see its origin. It is otherwise with the *Terebellæ*, for these animals, at whatever age, when expelled from their habitation, can rapidly re-establish themselves by fabricating a new one. This the Amphitrite cannot do. If once dislodged, it must remain exposed and unprotected for ever.—Perfect tube, Plate XXX. figs. 5, 6.

Eight minute specimens occupied the slender branches of the *Sertu-*

laria dichotoma, one of the most delicate among the Scottish corallines. Three weeks after I procured them, none spread above half a line across the funnel. Yet all were even then industriously employed in enlarging their dwellings.

At that early period the feathered branchiæ are very few, not exceeding six or eight in number; nor are the cilia clothing them more than twelve on each side, being proportionally scanty, compared with future accessions. But now was an admirable spectacle presented by the microscope, for the field of which so small an object was most suitable. The whole external organs of those minute artificers were in active operation. A current of thin muddy matter, supplied by many other currents *passing along the cilia*, was transmitted down the rib of each branchial feather, here receiving them as in a common channel. Thence the whole descended for preparation below, and application to its definite purpose.

I have compared each of the branchiæ to a feather, consisting of a rib bordered by its cilia, but whether these be clothed with similar organs, invisibly feeding them with sundry particles, merits investigation. I feel much disposed to credit their existence; in which event, those we have discoursed so freely about would become secondary, instead of discharging a primary office. Should there be no such invisible primary organs, the cilia bordering the branchial rib have themselves the faculty of promoting the descent of the muddy matter down to the centre.

In general these young animals had six branchial feathers; that represented fig. 8, had seven. The longest plume among them expanded about a line and a half, the tube rising about four lines; the trowels, while clasping over the edge of the orifice, were white and fleshy.

A waving depression seemed to run up the centre of the rib. No semblance of circulation was perceptible.

These nascent animals survived several months, during which the dimensions of their tubes were considerably augmented.—Plate XXX. fig. 7, 8.

On investigating the nature of their dark soft leathern-like tube, its composition proves to be an earthy coating, which invests a thick adhe-

sive internal lining of gluten, much resembling the same that is used in the arts, and capable of resisting rude external impressions. Its obvious origin is an animal secretion, combined with mud or earthy matter. After several months preservation in a dry state, a portion of the tube cuts like very soft horn ; and the glutinous lining, half a line thick, yields in combustion the odour of burning horn, accompanied by slight foetor.

It is evident that the edifice can advance only when the entire plume with the mechanical organization rises free above the orifice. The bottom of the funnel requires to be about twice the diameter of the tube above its edge, whence the tongue or scoop is always elevated for performing its functions. Perhaps this organ and the trowels may be found integral parts of the same apparatus.

The office of the antennular prismatic spines in the centre of the funnel is obscure. Rising erect, and apparently for some peculiar function during fabrication of the tube, particles of matter seem ascending in contact with them, and sometimes pouring like a stream from their points.

The tenant seems totally dependent on the presence of mud for enlarging its habitation, and it is surprising how speedily a quantity accumulates in the centre of the funnel previous to commencing its revolution, demitting the preparation between the trowels, and pasting it around the orifice.

Surely the presence of the suspended muddy matter is very grateful and inviting. It seems to arouse the dormant faculties of the humble artists, and to excite their energy while lurking for a season within their tubes in languid quiescence. No sooner is the water rendered turbid, than they issue forth and begin their architectural preparations.

Perhaps some secret necessity urges constant prolongation of the dwelling, whether for security, or for advancing increment. Should the animal be alarmed during its preliminary collections, it vanishes in a moment ; the muddy aggregate discharged by collapse of the branchiæ fall useless among the surrounding element. But if a feather, now dipped in mud, be first plunged among the water of another vessel, to separate the grosser parts, and afterwards in that which contains the Amphitrite,

then, as the turbid matter descends gently from above, the creature will forsake its concealment, display its plume, and renew its labours.

More than mere instinct must be ascribed to all this, for the architect can certainly testify a certain discrimination, both of what is essential to be done, and in the mode of doing it, whether in simple prolongation of its dwelling, or in repairing attainable breaches. Thus its revolution is either partial, complete, or repeated ; it advances and returns, plastering the same portion once and again ; nor is it satisfied with a single application of its trowels in moulding the work ; their office is varied and appropriately resumed.

To obtain satisfactory exhibition of the process above detailed, a tall vessel, little exceeding three inches in diameter, should be employed, which will bring the whole within the focus of an ordinary lens ; or a smaller vessel may suffice, according to the specimens. The water should rise considerably above the object, that the muddy drops may descend in gentle dispersion.

The softest earthy particles are the most congenial to the delicate structure of the ciliated funnel. Nevertheless grains of sand enter the lower part of large tubes, in the natural state, while the higher consists of the wonted materials. Short tubes, those under six inches, have consisted exclusively of mud and gluten. Long tubes, those of twenty or twenty-four inches, have consisted, first, of the finest sandy particles, for a third upwards, of agglutinated or silky matter ; next, of mud and gluten as usual, for the remainder. Their foundation was never obtained, and although some, extending two feet, seemed of this latter compound exclusively, they were also ruptured below. They appear to enlarge gradually from a line in diameter near the foundation, to about three lines at the orifice. The substance of the tube is no doubt dependent on its situation. Possibly where originating near a quantity of sand, a portion of that ingredient becomes affixed externally with the glutinous secretion from the animal, while there is nothing but mud above to be purposely employed in the fabric. It is from the forcible means adopted for recovering the tubes that they are ruptured in the

weaker part. Less injury is received from nets or lines than when obtained by dredging.

Tubes of an inch or two are often found on corallines. Here, as in others, the inhabitant is short in proportion, not occupying above a third of the whole. Those of smaller size, that is, rising from one inch to six, are readily procured entire with their contents. But the tenants of larger tubes are frequently mutilated, especially of the head.

It is extremely difficult to dislodge them uninjured from the largest; the usual expedient of vitiating the water seldom avails, as it requires to be so long protracted as to prove pernicious. Besides all, constraint or pressure is vain. Slitting up the tube might be supposed, of all expedients, the most effectual. Yet, from its extraordinary elasticity, as the sides are divided by the points of sharp scissors, to the great peril of its inmate, the edges singularly overlap each other more and more as the slit advances, thereby squeezing the animal harder and harder. Thus the tube twists in a spiral, or rolls up in such a manner as to obstruct observation entirely.

The largest tubes are often profusely invested with irregular masses of the white *Lobularia*, an inch thick in some places, and, in others, as thin as paper. The former are to be cut through with sharp-pointed scissors, insinuated so as not to graze the surface of the tube, carefully avoiding contact with the *Amphitrite*, to which the smallest wound in many parts is fatal. The thinnest parts of the investing *Lobularia* may be rent asunder, and thereby the tenant liberated.

Preserving large tubes entire is extremely inconvenient. Nor could the *Amphitrite* be kept alive without much difficulty did it remain uninjured, as the edifice, detached from its foundation, whence it rose erect, now falls flat in the vessel. A very simple expedient, however, rectifies the evil. By removing a small portion of the lower extremity of the tube, and allowing it to remain undisturbed in a vessel of sea-water, either lying flat on the side, or sustained by a thread from above, while the lower part touches the bottom, it will be found affixed there a few days afterwards. It then gradually rises erect from whatever may be the position, and the animal resumes its functions.

In the course of such an experiment, while the tube at first lies flat, the upper orifice is closed ; next the lower extremity of the Amphitrite is seen protruding at night, that great season of activity, and searching about by a short radius, as in quest of a proper spot for fixture. A small triangular silken sheath is soon after discovered attached to the glass, serving both as a new foundation, and to cover the naked part. In twenty-four hours the end of the tube is adhering, and in two days it begins to rise, but very slowly, and in a curvature, to which all have an ultimate tendency. Although the natural direction be upwards it is not vertical, perhaps from disturbing causes. Some even assume a compound curvature, as in the letter S, which is less inconvenient than might be supposed, from the shortness of the body compared with the edifice. The specific gravity of both being much greater than that of the surrounding element, nor is there is any channel for the admission of air were it present, the mode of elevating from the extremity is not evident. Perhaps this, as well as closing the extremity, may result from air actually occupying the longitudinal sinus of the animal's body.

The welfare of the animal is dependent on fixture, otherwise it is totally helpless ; neither, until the extremity be secured, does the Amphitrite usually venture to shew itself. Sometimes the renovated part of the sheath extended an inch or more at the bottom of the vessel, which being attained, all subsequent care seemed to be devoted to the opposite extremity about the orifice.

An amusing resemblance to a bed of animated flowers may be readily obtained by the preceding expedient. Let a number of tubes be mutilated at the lower extremity, and then tossed into a capacious vessel of sea-water ; in a few days, all will be found adhering by the lower extremity. When rising upwards, the tenants issuing forth to display their beautiful plumes, are beheld as enjoying their native element, or performing their mechanical operations.

In prosecuting a course of observations, it is frequently necessary to shorten tubes for accommodation in such vessels as may be at command. Separating a portion of the extremity while the animal is known to be

above, may be always done with indemnity. If pressure below be employed, it must be very gentle.

This artificial dwelling, or tube, seems designed both for permanent shelter, and as a place for immediate retreat from danger, because the animal always courts the light, and displays its plume when confident of safety.

Both the original aspect of the Amphitrite itself, and the mode whereby its dwelling originates, are exceedingly obscure. Accessions to the latter must depend for facilities in the presence of materials, when its progress is certainly much quicker than the organic increment of the occupant. A tube, sixteen inches long, sheltered an animal not above seven, though, perhaps, of considerable age. Here a broad coral ring, whereon several of the vermicular tribes had established their habitation, encompassed some of the lower parts of the edifice, while the white *Lobularia* loaded another portion; and, chief of all, a grove of beautiful *Sertulariæ*, investing the higher parts in great profusion. Specimens among them rose three inches high. Nothing but constant renovation of the native element, by submarine currents or otherwise, could have averted the consequences of the repeated decay concomitant on such a variety of animal matter. Naturalists, let it be repeated, probably misled by transient observation, are disposed to restrict the duration of the lower tribes to a term within the truth. Perhaps the *Amphitrite ventilabrum* is not one of the shorter-lived creatures.

However expert in its natural state, the architect, if deprived of the tube, seems incapable of replacing it by any means. Yet it does not evidently suffer; the plume is unfolded as usual; and smaller specimens have survived during weeks uninjured.

The great timidity of this creature indicates the exposure to many enemies roaming through the wide expanse of the deep. Circumstances also tend to shew the hostility of one more invidious, the *Gordius maximus*, which might gain readier access but from closure of the orifice of the tube. Nevertheless, it probably does enter the dwelling to devour its tenant.

From the preceding detail, it may be collected how much the welfare of the Amphitrite depends exclusively on the preservation of the branchiæ ; and that the vital and mechanical functions cannot be otherwise discharged without imminent peril or exposure.

But Nature has here conferred one of her most valuable prerogatives, as on some other of the humbler tribes, as may be illustrated by impressive examples.

In the end of April 1825, several specimens having been recovered from the sea, all were found to be mutilated and wanting the head. One of the largest was cleansed of parasite matter, and lodged in a tall glass jar, three inches and a half wide, the largest then at command, after shortening the higher and lower extremities of the tube for adapting it to the dimensions of the vessel. The animal not only occupied all the residue, now exceeding a foot, but the lower extremity stretched an inch beyond the orifice, from which, however, it withdrew in two or three days, when secured by the peculiar adhesion previously explained.

Cramped for room in its tubular mansion, the Amphitrite repeatedly protruded its mutilated stump from above, when the trowels appeared in feeble, and necessarily inefficient operation. In eight days, what during the interval seemed a cluster of low irregular prominences, became better defined as appurtenances of the mouth ; and ten of the shortest filaments behind then denoted the rudiments of the two fans. The original plume, composed of numerous branchiæ, had been found among the heterogeneous matter always accompanying the recovery of such creatures, and on cutting it asunder, the antennular organs were recognised in their proper place.

After several days concealment, momentary exhibition of the stump shewed rapid reproduction, which, in its progress, might raise the renovating plume too high for the vessel. The tube was therefore curtailed of two inches of the upper part as its tenant retreated below.

In another week about twenty-five regenerating branchiæ were discovered in each fan, the longest of them extending towards four lines, and also rising in regular proportion from the side next the trowels, being there scarcely perceptible. Many were simple ribs like hairs ; the

sides of others partially ciliated ; and a large vacuity in front admitted inspection of the four lobes, which had made corresponding advances, together with the parts near the mouth. Whether these had been actually lost, or only injured, could not be ascertained. They are always present amidst the perfect organs, and very difficult to be observed at any time, or under any circumstances. Thus it is necessary to be reserved regarding either form or number. But the best exposure of the living parts is during regeneration from such extraordinary mutilations as I am now endeavouring to describe, especially as they are neither lethal, nor sufficient to restrain the animal from attempting, on the first opportunity, to repair its dwelling.

At this time the largest of the ciliated branchiæ were adorned by four beautiful orange spots, those shorter had fewer ; the shortest were not of such dimensions as to allow of any. The regenerating antennulæ seemed to be nearly an eighth of an inch in length.

Three weeks subsequent to mutilation, the renovated branchiæ formed a regular funnel an inch wide ; but the side next the trowels was lower than the rest. Their number and size had augmented ; cilia clothed more of the ribs, for the evolution of those subordinate organs advances upwards, the lowest cilia originating first.

In another week the branchiæ amounted to sixty or more ; the cilia approached within a line and a half of the tips of the largest ribs, and six orange spots were on the latter. Let us remember that the number of such spots is multiplied by the prolongation of the branchial feather.

Thirty-four days after mutilation, the animal had become bold and vigorous ; the progress of reproduction apparently enabled it to resume its natural functions so long interrupted. Now the funnel, composed of about seventy branchiæ, expanded about an inch and a half ; the longest of the branchiæ, extending above ten lines, were of fine green colour, with seven spots on the ribs, and the antennulæ rose nearly three lines.

At this time also, the revolution of the renovated plume commenced on the water being rendered turbid, and the speedy accumulation of small muddy collections within it, proved the restoration of its organic faculties.

Soon afterwards, however, the regularity of the funnel became impaired. The animal projected considerably from the tube ; some bristles of the pencils were lost, when it began to consume at the segments, and after six or seven inches of the body hung from the orifice, it was kept no longer.

This mutilated specimen survived six weeks under observation, the reproductive process meantime advancing incessantly. The tube had received some accessions, but the orifice was much contracted. As the cut shortening the tube had been oblique, this inequality may have occasioned aberration of the parts.

Among a number of specimens obtained in April 1828, several tubes, as well as their tenants, were injured. One of the latter had lost the entire plume, that of another being ragged, I cut half an inch off it to preserve the remainder, and shortened the tube. In five days the lower extremity adhered, and the orifice above was brought to a proper direction by means of a silken loop passing over it. Renovating ribs prolonged the mutilated parts in nine days ; and on the water being rendered turbid, the animal rose to fabricate an addition to its dwelling. Five weeks after mutilation, when the ribs were almost completely fringed, it displayed the plume during the day, and also at night. Though seemingly tranquil and inactive, muddy accumulations in the funnel, besides their preparations in paste, shewed its industry. Nature makes infinite use, both physical and mechanical, of the cilia, whose motion now resembles the successive inflexion of the teeth of a comb, while the finger passes over them. On the 11th of July, the ribs were fringed throughout, and the animal, uncommonly bold and vigorous, afforded the most satisfactory view of the organs engaged on its tube.—Plate XXX. fig. 4, representing the plume in an early stage.

The economy of Nature, in the precise order of all her provisions, is too remarkable to escape observation. Here the regeneration of the rib precedes the evolution of the cilia. Advancing more rapidly than they do, it is preparing for the gradual accession of a complete fringe, whose mechanical functions are of such importance to the living being. Viviani, an Italian naturalist, conjectures that the rib is tubular, a fact to

which my attention was not specially directed while prosecuting the *history* of the Amphitrite.*

But it has proved embarrassing to understand the contraction, and sudden reception, of many ciliated hydræ within such narrow dwellings as they occupy, and their subsequent enlargement, unless by presuming their tubular conformation. At the same time, it is not to be readily comprehended how and where the liquid contents are discharged.

Other partial mutilations are consequent on disease, or on violence. The tube of a specimen with a plume of fifty branchiæ, expanding above fifteen lines, was shortened on the 3d of November. The occupant, now fixed anew at a point distant six diameters of the tube from the lower end, becoming very bold, even sustaining shocks without retreat. But in three weeks it lurked chiefly within, and the branchiæ appeared to be diseased when shewing itself. Towards the close of November, a quantity of mucilaginous matter was discharged from the orifice, and in some days the animal, rising from below, exhibited the bare ribs of the branchiæ only. Thus the cilia, consumed by disease, had been probably cast forth with other matter, or as mucilage. Now shutting itself up in pertinacious retreat, I found two-thirds of the cilia regenerated on the 13th of December, and the vigour of the plume seemed completely restored. Contrary to the original boldness distinguishing this specimen, it continued always reluctant to display itself during five months of subsequent observation.

The practical naturalist cannot but be embarrassed at missing certain characteristics assigned to this genus in the *Systema Naturæ*. The reason is explained by the preceding facts.

As already said, the number of branchiæ is constantly augmenting with the age of the specimen; recollecting that those composing the

* Viviani, *Phosphorentia Maris*, p. 14, 17, tab. iv., v.: *Genus*, 1805, in 4to. The observations of this author on the anatomical structure of the *Amphitrite ventilabrum* merit notice. He seems disposed to render his specimen the type of a new genus, "Spinographis, id est penicillus in spinam depictus." But he cannot have remarked that the spinal arrangement of the external parts is only accidental, resulting from disease.

plume have been seen from six to ninety-two. Their accession may be observed with greater convenience from their first appearance as flexible hairs, on the edge of the fans next the trowels, where several are generally discovered in progress. After advancing considerably, these, the ribs, still remain bare, the cilia being generated last. Among the numerous figures embellishing Müller's celebrated work on *Danish Zoology*, is the "*Amphitrite penicillus*" [*ventilabrum*], which he distinguishes by "*tentaculis binis setaceis*;"* and other authors assign *no feathered approximate feelers* to the genus. As entering its definition in the *Systema Naturæ*, I am unwilling to affirm that Müller, to whom science owes such deep obligations, is wrong; but most probably two branchial ribs with regenerating cilia, were mistaken for tentacula. None of the numerous specimens occurring to me during a long course of years, exhibited tentacular organs in the same position, therefore the real antennular or tentacular organs should be substituted in the definition as *two bare, triangular, approximate spines*. In the largest specimens these extend little above three lines. Their real use is uncertain. The muddy collections seem to be carried up behind, then to fall in front from the extremity; yet no ciliated apparatus has been detected as a conductor on their surface. The two exterior or longest branchiæ of one plume bore some resemblance to antennæ, from being of a dark brown colour, while all the rest were greenish; whence transient inspection might have deluded any observer. Another specimen of larger size, was distinguished by the correspondence of the dark ruddy brown of the [two] branchiæ with the preceding, while all the rest were white. But the spinous antennulæ of both were in their proper place.

On March 28. 1850, I procured, among others, a full-grown specimen, which quitted its tube. It had a fine plume, rather of light colour. But two of the branchiæ together, which were quite as large as the largest of the rest, were very dark brown. They had much the appearance of antennæ. But no difference from the structure of the other branchiæ could be recognised.

* Müller, *Zoologia Danica*, tom. iii. p. 13, Plate LXXXIX.

Thus naturalists in general have, perhaps, overlooked the real antennulæ, while distinguishing as such, either those exterior branchiæ which had lost their fringe, or which were different from the rest.

Perhaps the violence employed to displace the tube from its original foundation at the bottom of the sea, may induce the occupant's precipitate retreat within ; and when returning to the orifice after divulsion, its head is so much entangled with extraneous matter that separation ensues.

But it may be subject also to natural mutilation. The fans of a specimen that had been two months under observation, were overlapping in the end of January ; and, next morning, the whole plume, detached, was found inanimate in the vessel. For some days the vacant stump protruded occasionally ; but afterwards the orifice remained close, or sometimes only a small aperture opened. In three weeks, exposure to the sunshine induced the animal to rise, shewing the progress of reproduction, which advanced so rapidly in other twenty days, that the various organs were employed in augmenting its dwelling. In another week the funnel, composed of about thirty-six branchiæ, was complete, both sides of the rib being fringed. It was afterwards constantly displayed with the natural recurvature, and in six weeks from the date of mutilation, it had acquired half its natural length, originally about an inch. A subsequent rent in the tube probably surpassed the creature's ability to repair ; it languished and died in April.

Naturalists should beware of hastily abandoning specimens because they are mutilated.

The posterior extremity of the Amphitrite is much more tenacious of life than the anterior. Its motion continues long after that of the rest has ceased, and the whole animal may be literally said to die downwards.

The unequal distribution of vitality throughout the different parts of the organic system merits greater attention than it has received.

A powerful reproductive principle resides in this animal, whereby the functions essential to life may be carried on by new evolutions ; nor is it evidently confined to any part of the body. The plume of a small speci-

men, which had been found without its tube, consisted of fifteen or sixteen branchiæ. Yet the whole body extended but the eighth of an inch. Here there were both original and regenerated segments, but in natural proportion, it should have been five or six times as long if unmutilated. Thus the upper portion with the plume was older than the rest. This specimen survived two months.

A clean tube, half a yard long, was curtailed to ten inches, and transferred to a suitable vessel, on June 19. Its fixture ensued in a fortnight, and its tenant then rose freely to display a plume of the finest colours. Half an inch of the lower extremity separated however on the same day after transference, from an incidental wound. The anterior part of this fragment appeared to be healed in twenty-three days. A prominent papilla was recognised there in other five, when, testifying some impatience on exposure to the light, the fragment was deposited along with a little mud in the dark.

However improbable the evolution of these organs we are wont to assign as the head, might seem from a fragment so far asunder as the opposite extremity, short slender hairs now denoted the rudiments of branchiæ. Forty days after separation, the whole reproduction exceeded a line; both fans were quite distinct, and eight or ten bare ribs seemed to be subsequently fringed. All these closed together like half-shut hands, for they were in two portions. The whole was exposed by the microscope, shewing also one or two brown spots on the ribs, regenerating parts about the tongue and bristles on the shoulder indicating incipient pencils. Omitting the reproduction, the entire fragment at this time extended nine lines.—Plate XXX. fig. 9; enlarged, fig. 10.

All the parts had augmented on the 1st of August. The fringes were clearly distinguished by an ordinary lens on the 4th, and next day the length of the plume was computed at a quarter of that of the body. But this body itself was more meagre than previously, the natural consequence of deficient aliment, from the privation of organs. On the 9th, the plume extended three lines; it was fresh and vivid, consisting of the branchiæ beautifully decorated with three complete circles of red spots on

the ribs, while some among them had four. The trowels likewise stretched in a curvature from the neck, as if preparing for their proper functions.

Above fifty days having now intervened from the period of mutilation, the body, somewhat reduced of its original dimensions, consisted of thirty or forty segments. Advancing reproduction, enlargement of the parts, their action on the accession of spots on the branchiæ, shewed that nothing for the salubrity of the animal was wanting unless a proper position. In sixty-four days it appeared to be endowed with the essential requisites, for both organic and mechanical faculties, had it occupied a tube.—Plate XXX. fig. 11, slightly enlarged. It survived its separation from the original Amphitrite eighty-three days.

It is truly remarkable that a fragment from the posterior extremity of such a creature as the Amphitrite, should generate a multitude of organs belonging to the anterior portion, capable of such complex operations.

It is alike singular, and, at the same time unaccountable, that Nature should have denied this animal that alone whereby it may avail itself of this prerogative, the power of constructing any but its original tube. Even when entire, if once dislodged, it is apparently incapable of constructing the smallest portion of another dwelling, or that protection wherein its gifts can be turned to any use. When losing its earliest habitation it survives a considerable time, but always prostrate. Should it remain in the tube, it is secure notwithstanding privation of the plume, and if mutilated, it will regain another to be employed as the first. The regeneration of a plume by a fragment separating below, while confined in the tube, would be nugatory, as, while thus imprisoned, there is no scope for the exercise of its functions. A similar fragment free acquires a plume, but although so far privileged as to become entire, it remains naked and defenceless, equally incapable of sheltering itself by the exercise of its natural functions. Of what use, therefore, is this wonderful prerogative? I am induced to conclude that there is here something undiscovered, some conditions whereby the peril may be averted. The

functions of the branchiæ, physical and mechanical, may be combined in some manner unknown, notwithstanding the apparent design of Nature be frustrated in regard to the latter.

It would be a problem of infinite curiosity and interest, investigating the precise extent of the evolution of such a complication of organs as may subsist throughout the body. What are the spots,—where are the intervals by which they will be afforded? Do their elements reside in each of the segments, or are they dispersed among a certain number of segments? Can we obtain the materials allowing conjecture that many germs are ready to unfold similar generations when opportunity offers?

If the important privilege of reproducing what the animal employs for its own preservation subsists in many parts below, should we not infer that there may be some unknown means whereby a new tube can be constructed, in order that the regeneration shall serve its original purpose?

After divulsion from the original site, the Amphitrite commonly fixes the extremity speedily again. But a fortnight elapsed before adhesion of that of the preceding specimen, mutilated of the fragment, possibly because the secretory organs had been lost along with it. In five weeks a slight sheath extended from the end of the tube along the glass. Its source may be probably sought in two terminal organs, doubtless glandular below, besides which there must be much secretion from the rest of the body.—Figs. 10, 11, *b*.

During reproduction of an adult Amphitrite preserving its natural place, the disproportion between the renovating parts and the body is always diminishing; that is, the dimensions of the body and the plume are approaching their mutual relation. But if there be no fallacy the reverse succeeds with a fragment. Here the disproportion is continually augmenting inversely. The body pines as the plume enlarges. The just proportion of a fine adult specimen *in situ* may be rated at the fourth of the length of the body, three inches, for example, if the latter be twelve. If half its length, the plume would be thought monstrous. But a new plume, generated from a fragment of the extremity, may become double the length of the body. The one pines as the other grows. Perhaps evolution of the lower parts of the animal depends chiefly on the func-

tions of an active plume, hence it is restrained when the plume is defective ; and the body declining while simple increment of the branchiæ advances, an unmeasurable disparity between them may follow.

In the natural state, mere survivance seems productive of new parts towards either extremity, and all in their proper order. But such a regeneration as above described is then precluded, for two plumes cannot subsist in a single tube ; nor can the same body have more than one. If the animal be sundered, each portion regains the defective parts. The two terminal glandular papillæ were recognised very distinctly as reproduced by the larger portion losing the fragment. The tube being curtailed below, a second time exposed them on the 6th of October, then, however, adhesion scarcely followed, and the tenant forsaking it entirely, perished within a week.

A disordered plume always indicates disease ; protrusion from the orifice is unfavourable ; and the Amphitrite seems to abandon its dwelling to die.

No creatures are more dependent on the quality of their proper element. When denied frequent renewal they retreat far from view, and remain in pertinacious concealment, becoming altogether enfeebled, while the symmetrical arrangement of the plume is impaired. Yet after a month's interval, so great is the benefit from a recent supply, that in half an hour they endeavour to resume their wonted functions.

I have never obtained the progeny of the Amphitrite directly from the parent, which precludes me from treating of the fertility of the one, or of the earliest aspect of the other. Very small tubes are usually solitary. Once, however, a group exceeding twenty, occurred within limits not greater than the circumference of a shilling, which indicated a quantity of spawn or ova as having issued from one individual. The tubes, from an inch and a half to three inches high, were connected by extraneous matter. We have already described the appearance and operations of some very minute specimens on the *Campanularia (Sertularia) dichotoma*.

Specimens have survived above a year in confinement. One, very small, seated on a Sertularia, was preserved in the purest water, the Sertularia having been the principal object of observation. Nevertheless

the Amphitrite had doubled the length of its tube, which, in twelve months, extended just nine lines. Doubtless these dimensions would have been more ample, and more rapid, with a copious supply of suitable materials ; but the precautions which had been taken to avoid them, in connection with the success, shewed the art of the animal in collecting ingredients for its work, where their presence appeared insensible to our observation.

The following are among the conclusions to be deduced from the preceding detail :—

I. The *Amphitrite ventilabrum*, one of the Annelides or segmentine animals, extends fifteen inches. It is composed of two distinct parts, a vermicular body, consisting of above 350 segments, crowned by ninety-two ciliated branchiæ, arranged in two separate fans, together forming a funnel, the extremity terminating below in two glandular organs. In the centre of the funnel are two stout, short, antennulæ.

II. The number of the segments, and of the branchiæ, are dependent on the size and age of the specimen.

III. A powerful reproductive energy is distributed throughout the body, whereby lost parts are speedily regenerated.

IV. The *Amphitrite ventilabrum* dwells in a tube of its own fabrication, composed of earthy matter, collected by its branchial apparatus, prepared as a paste, incorporated with animal gluten, and adapted by peculiar organs to the orifice of its habitation.

V. The exercise of the mechanical parts depends wholly on the specimen being preserved in its original dwelling, for it cannot construct a new one.

VI. Reproduction of lost parts advances, though the Amphitrite be deprived of its tube.

PLATE XXX.

FIG. 1. *Amphitrite ventilabrum*, adult, issuing from its tube. The lower extremity of this specimen extended farther than the bottom of the Plate, therefore it is omitted. Funnel or branchiæ, *a*.

2. Adult specimen without the tube, funnel, *a*.

PLATE XXX.

FIG. 3. Antennulæ, natural size.

4. Regenerating plume from a stump within the tube. Trowels, *a*, *b*, clasping the edge of the orifice. Scoop or tongue between them, *c*.
5. Young specimen in a perfect tube. Branchiæ or funnel, *a*.
6. Another.
7. Young specimen with seven branchiæ.
8. The same, enlarged.
9. Fragment, which separated from the posterior extremity of an adult, regenerating a branchial plume, *a*; secretory glands, *b*.
10. The same enlarged.
11. The same, with the plume regenerated slightly, enlarged.

§ 2. AMPHITRITE BOMBYX.—Plate XXXI. Figs. 1, 2, 3, 4, 5.

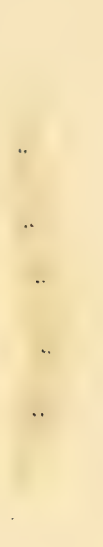
The general structure of this animal resembles that of the preceding subject, in a luxuriant plume of branchiæ crowning a vermicular body, and in dwelling in a sheath.

Its name is derived from the materials whereof the sheath is formed, being an animal gluten like silk, without earthy particles incorporated during its fabrication.

The total length of the Amphitrite is about three inches, or little more, whereof the plume, composed of towards sixty branchiæ, constitutes a third, and the body, equalling two-thirds, consisting of sixty or seventy segments, is terminated by two white papillæ.

The shoulder enlarges as a marginal white frill, from which the plume originates; and each side of the body is bordered by a row of short bristly pencils, with a black speck near the roots. A groove commences at some distance from the frill towards the belly; and within the frill the neck of the plume, which is white, is encircled by a row of very dark lines.—Plate XXXI. figs. 1, 2.

The branchiæ of the plume are disposed in lunate arrangement, like those of the *Cristatella*. They bear a narrow resemblance to feathers, each consisting of ribs bordered by a double row of active cilia, alike numerous, and longer in proportion than those of the preceding species,



Ampelura Bonyer

figs. 3, 4, 5. Besides corresponding coloured spots, several pair of peculiar shaped, flattened, transparent organs, endowed with some extension and contraction, and apparently of the same consistence as the cilia, project from the back of the rib.—Fig. 6, *a, b, c*, stem enlarged. Two stout pointed antennular spines are situate in the centre of the bottom of the plume or funnel, where the converging branchiæ meet below. These organs are susceptible of prolongation, and have the faculty of transmitting particles up the back.—Fig. 7, enlarged.

The plume is proportionally larger and more luxuriant than that of the *Amphitrite ventilabrum*. It is finely variegated with different shades of brown and yellow. Orpiment orange is the colour which predominates on the body.

This animal dwells in a tube surpassing its own length, which is not of mechanical construction, but is formed by a spontaneous exudation from its whole body, comprehending the extremities, or from any part of it. When originally produced, it is clear as crystal, completely exposing the tenant's external organization, of corresponding figure. If deprived of the surrounding element, its aspect is somewhat gelatinous, but it seems truly of silken fabric, and becomes quite opaque with age. The upper part is corrugated, darker, thicker, and stronger than the rest, evidently for protection of the plume, which is the most delicate part of the creature. The lower extremity is close and obtuse.—Plate XXXII., fig. 1.

The secretion whence the tube is derived, must be accounted very copious, as several tubes can be formed in succession. Whether any share of it is afforded by the plume seems uncertain, farther than as a glutinous matter, overspreading the vicinity, as a preservation of the animal parts from abrasion.

Contrary to the direction of the tube essential for discharging the mechanical functions of the *Amphitrite ventilabrum*, naturally vertical, that of the *Amphitrite bombyx* is usually horizontal. Herein the plume is stationary, it has no such functions to discharge; nor, although the tube be occasionally vertical, and the plume remains free, is there any revolution, as by the former species. It affixes readily to all substances.

One occurred vertically inverted, being reversed with the orifice downwards. A specimen of this animal had established itself in the cavity of an old shell, occupied by the *Ascidia intestinalis*, covering an inch of the tube. The shell was sawn asunder to liberate the Amphitrite, and the tube, thick and dark, slit up to dislodge it entire. This being accomplished, the animal produced a new and transparent sheath, in twenty-four hours, corrugated and strengthened near the orifice. As specimens seem largest where best protected, this subject was old.

Gentle pressure upwards always induces the *Amphitrite bombyx* to quit its tube.

It is a very timid creature and impatient of light. On the slightest shock, or on interception of the light, the plume collapses, which is accompanied by instant retreat and closing the orifice of the sheath. The rise of the tenant is slow, with a partial revolution during ascent, perhaps to avoid deranging the order of the plume. But, instead of uniformly disappearing on alarm, it frequently endeavours to quit its dwelling; and, when the water becomes stale, the body protrudes very far, as if the animal would depart. The facility of forming a new sheath, renders the loss of the old one the less inconvenient. When entirely dislodged, the plume expands much more than when the sheath is occupied, the branchiæ remaining some time displayed like the radii of a circle.—Plate XXXI., fig. 2.

The branchial apparatus is united to the body by a very thin skin. A specimen, while merely crawling in a vessel, lost the plume entire, the lower part of which, or neck, resembled a complete opening.

As in the *Amphitrite ventilabrum*, the branchiæ of this species augment in number with age.

Perpetuation.—Of two specimens obtained in the middle of August, one was very turgid. Both formed transparent sheaths, and in three days, a vast profusion of many thousand white specks strewed the bottom of the vessel, amidst the thinnest gelatinous matter. Where most abundant, they were of the faintest carnation. Under the microscope, these specks proved to be spherical. They were solid, consisting of a dark and irregular central nucleus, invested by transparent albumen. In one the

nucleus seemed to be composed of several smaller globules ; those of others were somewhat elongated : rudely angular in a few ; in many they were not referable to any given form. But, whether such variety was a symptom of advance or decay is doubtful.—Plate XXXII., fig. 2.

Spawning continues during most of summer. Two specimens spawned first in May, in considerable quantity, and afterwards copiously in June. The whole broke up in six or seven days, without any definite result.

On another occasion, two of sixteen specimens, procured on June 5, were turgid with spawn. They, accordingly, produced a great quantity on the 15th. Here, also, the ova were spherical, with a dark central nucleus, which, in some, appeared elongating within two days. But the whole decomposed immediately afterwards. Thus, in spite of every precaution, I have been always disappointed of the progeny of the *Amphitrite bombyx*.

It would be most desirable to ascertain the earliest aspect of such animals. Nevertheless, the accession of parts, both in respect to the segments of the body and the organs composing the branchial apparatus, evidently augments. Being always fewer in the young than in the old, we may question whether any are sensibly different, as the foetus is liberated from the ovum.

Reproduction.—When disappointed of enquiries into one interesting subject, it is gratifying to find satisfactory illustrations of another.

The present species, in common with the preceding, enjoys the most powerful reproductive energies from the gifts of nature. Those organs, whereof it may be bereaved by violence, or which may be consumed by disease, are completely restored, so that each mutilated animal again becomes perfect. The plume is subject to gradual deperdition of its peculiar parts, the body is liable to privation of the plume, yet the whole are reproduced as if nothing had been deficient.

A specimen which had been recently obtained, lost the plume completely on the 5th of April. This separated portion, expanding an inch, lay at the bottom of the vessel. The branchiæ were partly in circular, partly in lunate order, with the central antennular organs rising erect

amidst them, the frill remaining with the mutilated trunk, shewed its correspondence to the lunate portions. In twenty-six hours, the trunk, now extending two inches, was invested by a fine slim silken sheath. In fifteen days the rudiments of a regenerating plume rose, as several shoots, an eighth of an inch long ; and in other three, specks on the back of the ribs were discernible. Incipient fringes began to clothe the latter, and in twenty-three days from the date of mutilation, the branchiæ had attained a third of the dimensions of those they were replacing. The plume, also, with the regenerated antennulæ, was half its proper diameter. Accidental contamination of the water, at this time, occasioned separation of the new plume, as entire as that which it had succeeded. The Amphitrite, however, weakened and died,—tinging the surrounding element green by its decay.

A notable instance of reproduction succeeded, with a fragment half an inch long, separating from the extremity of a specimen, recovered from the sea on October 25. In three days a prominence was perceptible on the anterior part, which, in other three, exhibited very short but distinct originating branchiæ. This fragment invested itself with a sheath, and continued always to repeat it when dislodged for observation. In two months, the new parts proved a fine reproduction : the organs behind the rib, at first mere prominences, were now acquiring their peculiar figure, and the whole plume was about equal to the length of the body when the animal was at rest. However, the extremities of the ribs were still bare, and remained so five or six weeks from their origin.—Plate XXXI., fig. 8 ; Plate XXXIII., the same, enlarged.

The secretions of this specimen were very copious. Sometimes the new sheath was invisible to the eye after it was formed. But the creature was apparently weakened by too frequent expulsion for the purpose of observation, because new exudation necessarily followed privation of its former dwelling. It survived seven months. Nothing could be more satisfactory than the various illustrations afforded of the wonderful prerogative of repairing lost parts, and the faculty of contributing to its own security.

In prosecuting this subject, about five lines, or a fourth of the body,

separated below, on November 18, during an attempt to dislodge a specimen from the sheath. Both wounds healed speedily. But nothing had been generated from the fragment in fifteen or sixteen days, though it formed itself a sheath with an orifice.—Plate XXXII., fig. 3. Ninety-two days after mutilation, a renovating plume, of greenish colour, consisted of a short compressed assemblage of ribs, becoming very distinct in another week. Several were now acquiring a fringe, and the whole reproduction extended about two lines. In 116 days after mutilation, the plume almost equalling half the length of the body, unfolded in nearly the natural figure. All the parts, old and new, were vivid. Besides some ribs advancing, eight branchiæ were fringed, but the cilia had not reached the summit of the rib.—Plate XXXI. fig. 4, regenerated branchia ; fig. 5, enlarged.

While the sundered fragment gained a plume, that of the original entire animal still subsisted ; therefore, as exemplified in the *Amphitrite ventilabrum*, here were two cotemporary plumes, two complete systems of the branchial apparatus, in vigorous existence at once, on two portions which had constituted an integral animal.

Farther illustration of the subject might be considered superfluous, were it not from the interest attending the discovery of similar results by artificial mutilation.

In natural mutilation, succeeded by perfect reproduction, some may conclude that there are definite limits, comprehending the elements of all the defective parts, whose evolution follows. The same cannot be conjectured of artificial mutilation, for there are no external indications of such limits, if they do exist, nor of the elements of such parts, to be developed subsequently.

The specimen, Plate XXXII., fig. 7, was mutilated of half an inch of the posterior extremity.—Plate XXXII., fig. 5.

A specimen having been preserved during six weeks or two months, was then dislodged, and half an inch sundered from the lower extremity ; next day, the anterior portion had ascended the side of the vessel, displaying its plume as if unhurt. In four days it had formed itself a slight sheath, and the wound appeared healed. Some very short

hairs were generated from the anterior part of the sundered portions in sixteen or seventeen days ; and in twenty-four days, a regular plume, composed of sixteen or seventeen unequal branchiæ, with very short cilia, was reproduced. This became of nearly corresponding proportion to the subject in thirty-three days, and to what is witnessed in the entire animal, being about a fourth of the whole.—Fig. 5. In forty-two days it was perfect, having five rows of spots on the ribs, forming a circle in display. But the same disproportion, as described in the former species, subsisted between the plume and the body, and was very conspicuous, for, as the one advanced the other declined. In sixty-three days it was almost half the length of the body. Meantime, the original mutilated animal still survived, bearing its own original plume, while that of the fragment subsisted in vigour, as in the former observation.—Figs. 6, 7.

In another experiment, the body of an entire and vigorous animal, extending an inch, was mutilated of a portion equalling two lines, from the posterior extremity : then of a portion above it equalling four lines. Thus, there were three parts, first, the original, comprehending the plume and antennulæ, *a*. Secondly, the middle portion, *b*. Thirdly, the posterior extremity, *c*. All were set apart.

In three weeks, the original anterior, *a*, with the plume and antennulæ, remained sufficiently vigorous.—Plate XXXII. fig. 8. The middle section, *b*, had generated a new plume, rising an eighth of an inch.—Fig. 9. But no sensible reproduction issued from the upper part of *c*, the posterior extremity.—Fig. 10. The wound having healed, however, without decay or injury, still encouraged expectation of the defective organs.

Accordingly, in ten days longer, a plume, composed of greenish ribs alone, could be discerned through the sheath, arising from the fragment. This advanced regularly and rapidly : and, in fifty-five days after the section, it consisted of eight perfect branchiæ, extending nearly two lines, besides two large and conspicuous antennulæ.—Fig. 11. ; the same enlarged, fig. 12.

Thus, it is proved that the elements of the branchial plume reside in different parts of the body of the *Amphitrite bombyx*. It is also proved,

that the secretion of the substance forming the sheath is not confined to a single part of the animal.

The theory of such reproductions involves the naturalist in extraordinary embarrassment. It is not surprising, indeed, that accidental wounds or lacerations should heal ;—that the energies of animated nature should restore the integrity of mutilated organs, essential for the preservation of the injured individual. But, to behold the evolution of the most complex organization, where none, to the senses, previously existed, nor could exist, in accordance with the integrity and safety of the animated being, or that its development should be dependent on an act of violence, for the purpose of replacing that whereof it had been deprived, is enough to perplex the mind.

Some imperceptible constituent atom, or its residue, may escape destruction, when we attempt to eradicate an organ, and survive to enlarge in its place, and expand in similar form. But the same argument is not of obvious application to the evolution of similar parts from another site, one where there is no rational probability of the regular course of nature having provided for their existence. Here we seem to reach a postulate, demanding the indefinite—the universal diffusion of germs, ready for development wherever the obstacles to it cease : or of some creative power, effecting a secretion of such matter as may produce new organs, in form and substance. If, assuming that instead of the *universal* diffusion of elementary atoms, or the *universal* subsistence of creative energies, both may be *partial*, there ought to be certain limited points from which such complex organization originates, as the branchial plume is produced by artificial sections. On the other hand, by assuming the universality of such points, we are led to conceptions of tenuity which baffle language to express.

The preceding deductions have been afforded by at least sixty living specimens, the finest of which were natives of the Shetland and Orkney Islands.

Note.—A specimen of the *Amphitrite bombyx* once occurred, which was lodged in a black tube, three inches long, adhering inside of an old

oyster shell. This animal protruded a snow-white plume, sparingly stained with some dark specks. It consisted of about twenty-eight feathered branchiæ, but was never unfolded, nor shewing more than about half an inch. The Amphitrite was always extremely strong. I preserved it, in hopes of farther disclosure ; but it disappeared in three months, without any visible change, having probably wasted away.— Plate XXXII., fig. 13.

PLATE XXXI.

- FIG. 1. *Amphitrite bombyx*.
 2. Another specimen.
 3. Branchiæ, enlarged.
 4. Another reproduced, enlarged.
 5. Another one of fig. 4, Plate XXXII., reproduced, enlarged.
 6. Organs on the back of one of the branchiæ, *a*, *b*, *c*, enlarged.
 7. Antennulæ, enlarged.

PLATE XXXII.

- FIG. 1. *Amphitrite bombyx*, sheath.
 2. Spawn, enlarged.
 3. Fragment about five lines long, separated from the extremity of a specimen, delineated 27th November 1830.
 4. The same, having generated a plume in 116 days, delineated 14th March 1831.
 5. Sundered fragment, extending about an inch, as appearing when delineated, 28th March 1831.
 6. The same, with a regenerated plume, 25th April 1831.
 7. Original trunk and plume from which fig. 5 was sundered.
 8. The first of three sections of a specimen, with its original plume appearing three weeks after mutilation of the rest.
 9. The second or middle section of the same specimen, delineated at the same time as fig. 8.
 10. The third section, or extremity of the specimen, still without any symptom of reproduction, delineated at the same time as figs. 8, 9.
 11. The same, fig. 10, having generated a perfect plume of eight branchiæ, fifty-five days after mutilation.
 12. The same, fig. 11, enlarged.
 13. Specimen with a snow-white plume.



Capitulum P. h. h.
1



Asplenium adnigrum

PLATE XXXIII.

Fragment of an *Amphitrite bombyx*, being the same as Plate XXXII. fig. 8, with the plume regenerated and enlarged.

§ 3. AMPHITRITE FLOSCULA.—Plate XXXI. Fig. 9.

Animals which are modelled after the same general type by nature, are sometimes distinguished by strange peculiarities, of which the subject of this paragraph is an example. Yet, its rarity has precluded me from investigating its history with sufficient precision. The more obscure and equivocal any genus or species of living creatures may appear to the naturalist, the greater the number of specimens are required to satisfy him.

Though smaller than either of the preceding, which are both of great interest, the *Amphitrite floscula* surpasses them in beauty ; nor is it inferior to them in certain singularities, and all of which merit much farther notice than it has been in my power to bestow on them.

In general formation this creature resembles the *ventilabrum* and *bombyx*, consisting of a vermicular body, crowned by a branchial plume. It extends two inches in whole, of which the latter is equivalent to about a fourth part, and consists of thirty-two branchiæ, disposed in two vertical compartments, forming together a circular funnel as before. The branchiæ are composed of a rib, bare towards the summit, and fringed on each side with cilia of unusual length, inclining inwards. The tip of the rib itself is incurved. A transparent elastic web connects the branchiæ with each other below ; and the whole form a perfect funnel, with an incurvature of the tip. I have been unable to detect antennulæ in the centre, such as are borne by the others. If present, they are minute or colourless. The body consists of a number of segments with interannulations. Thus, a narrower ring is interposed between two which are broader and of greater diameter.

I have been also unable to discover whether there is a row of anything resembling pencils on the sides, but I sometimes thought a row of

warts or prominences occupied their place, though I cannot speak confidently of the fact.

From the long luxuriant fringes and incurvature of the branchiæ, the expanded plume resembles the double corolla of a fine flower.

A transparent, tubular, thick gelatinous mass constitutes the dwelling of this animal, of very different appearance from the receptacles of the two preceding species. It has none of the regular form belonging to either. The side is not under an eighth of an inch in thickness, or once and a half the diameter of the body, and sometimes more ; it also exceeds the length of the body considerably. It is originally quite diaphanous and invisible, free of all adventitious matter, and seems entirely the product of an animal secretion. Sometimes it has been seen of a slight silky aspect, but it may almost always be compared to a gelatinous mass, which is affixed to an extraneous substance.

The tenants of two such tubular habitations, each with a wide orifice, having been dislodged, they speedily generated a quantity of the most transparent jelly. But their plumes becoming mutually entangled from want of room, one of the specimens was transferred to a short glass tube, suspended in a different vessel. Here, it formed itself a copious covering in a week or less, apparently filling the cavity ; and, in time, the jelly projected beyond the mouth of the tube. At length, when the animal rose upwards, the jelly rose along with it, as much as nine lines above the edge of the orifice of the glass tube. Along with the expansion of the plume, the centre of the gelatinous matter expanded also ; on the other hand, as the plume contracted the diameter of the jelly contracted ; and if the animal sunk, the tubular orifice was depressed along with it and closed. All this gelatinous substance could not be under ten or twelve times the weight of the tenant ; yet, from excessive transparence, it then proved impossible to determine the precise outline of the jelly, nor until slightly darkened beyond the glass tube, when it appeared conical.

If this tube, withdrawn from the water, be inverted, the jelly adhering within it hangs down from the orifice like a compact tenacious mass.

The animal sometimes reverses itself in its gelatinous dwelling, then remaining a short time with the head downwards ; and sometimes it forms an additional orifice above—therein shewing an analogy to the genus *Terebella*.

It is surprising how such a diminutive creature can exhibit secretion so abundant in a definite form. Perhaps the exudation is from the whole body ; and it seems invariably concomitant on renewal of the surrounding element.

Buoyancy is promoted by many air bubbles, which are especially about the orifice. If the tenant be vigorous, it is constantly there displaying its plume ; if weak and languishing, it hangs far out of the tube, like the preceding species.

This is a timid animal ; it retreats suddenly for safety. Then, as well as during its return, it performs a partial revolution, the branchiæ, meanwhile, being closed as a spiral, whereby the entire plume resembles a screw of multiplied threads. Some weight may be thence allowed to Viviani's characteristic *Spirographus*, as distinguishing the genus *Amphitrite*.

This, the *Floweret* *Amphitrite*, seems rare in the Scottish Seas. Only about six specimens have occurred to me, the last at the interval of seventeen years from those preceding it. None survived above four months.

PLATE XXXI.

FIG. 9. *Amphitrite floscula*.

§ 4. MISCELLANEOUS.

Besides the preceding species, whose features are sufficiently defined, there are some other annulose animals which may be placed provisionally in the vicinity of the *Amphitrite*. Farther observation will point out their precise position in the *Systema* if they ought to remain here.

1. FABRICIA.—Plate XXXI. Figs. 10, 11.

A minute animal, dwelling on shores, bears so much resemblance to one denominated *Fabricia* by Müller, in honour of a distinguished naturalist, that I shall not venture to assign it any other name. Fabricius, indeed, ascribes twelve segments to the body of his specimen, and Dr Johnston thirteen. Mine have had only six, whence, from that and other things, I cannot positively identify it with theirs; and, before being aware of its having been observed by them, I had proposed to call it the *Amphitrite palmata*.

This animal consists of a body composed of about six segments, crowned by a plume. Its total length about a line, and the expansion of the plume is as much. The latter consists of six compartments, each being a rib bordered by long tentacula, and each tentaculum fringed by cilia. Two black specks are on the neck. A bristle is on each side of the segments of the body.

This animal dwells in a tube of its own fabrication, four lines long, and narrow. When the water is rendered turbid, the plume or branchia may be observed protruding as a pencil from the tube, and particles are transmitted down the centre of the ribs, as the animal revolves like the Amphitrite. I have been unable, however, to discover tentacula within the plume, or trowels without it.

Fabricius says that it cannot resume its place in the tube after having been dislodged.

Specimens have survived four or five months in confinement, during which time the tube received sensible accessions.

This animal dwells in pools near low water. As it is said that a later naturalist has named a different product *Fabricia*, Dr Johnston proposes that it shall be now denominated *Othonia*, thus still retaining the Christian name of Fabricius.

PLATE XXXII.

FIG. 10. *Fabricia*.

11. Another specimen.

2. AMPHITRITE LUNA.—Plate XXXI. Figs. 12, 13.

The larger animals are generally distinguished by prominent features ; those of many of the smaller are frequently equivocal. They involve us in perplexity ; yet I acknowledge that I have perhaps exposed myself to greater embarrassment than some others, from my reluctance to institute new genera if the older could receive new species.

The subject of this paragraph, like that of the former, is placed here provisionally, until the genus to which it really belongs is ascertained. I feel doubtful whether it is an Amphitrite, though dwelling in the sea, or allied to a *Cristatella*.

The higher extremity consists of forty-four or forty-six tentacula, crowning the body, which projects from an indurated sandy surface, covering old shells for about four lines. The tentacula are disposed in lunate or horse-shoe arrangement, resembling the higher portion of *Cristatella*, fourteen or sixteen occupying the interlines. A web, rising about a fifth up the tentacula, unites the roots of the whole. Diameter of the head or tentacular plume a line and a half.

Neither cilia nor antennulæ are visible. The animal rises erect from the indurated sand, projecting the head, or hanging over the surface. The termination of the intestinal canal is under the middle of the interior row of tentacula, as in the *Cristatella*.

A current or circulation is carried on through the body to the very tips of the tentacula, which are thus discovered to be hollow or undivided. Dark particles are carried up the body in a vessel on one side of the stomach, introduced and conveyed to the extremities of the tentacula, from whence they are returned and carried down a vessel on the other side of the stomach.

These currents run with extraordinary force and rapidity. They are accelerated, retarded, or suspended by short interruptions, but otherwise their course is incessant. The dark particles conveyed by the fluid are unequal in quantity, dimensions, and proximity. They are

quite visible, both during transmission into the tentacula and as they return. But I have not been able to ascertain whether the ascent there and the return are by different channels.

PLATE XXXI.

FIGS. 12. 13. *Amphitrite luna*.

3. FILIPORA FILOGRANA.—Plate XXXIV. Figs. 1, 2, 3, 4, 5, 6.

Some authors propose to incorporate this product with the Zoophytes; but its proper position seems between the Amphitrite and the Serpula, for it consists of a tube, originating from one of the Annelides by which it is occupied.

The *Filipora filograna* is a marine product, generally recovered from deep waters. It constitutes irregular masses, composed of a vast congeries of shelly tubes, alike irregular in dimensions and arrangement, formed from a minute animal, closely allied to the Amphitrite.

There is no uniformity either of size, shape, or appearance, among the different masses: no two are alike. Their formation can be scarcely said to be regulated by any common laws, which may be partly ascribed to every tube originating from a different animal, whose numbers do not seem under any known modification.

This animal extends in whole about three lines. It consists of a vermicular body, crowned by a plume of eight pinnate organs, each composed of a rib as before, bordered by about fourteen cilia, rather thick and obtuse. The body is composed of about twenty-four segments, each with a pencil of several bristles on both sides. It originates, as in the Amphitrite, in a kind of frill, and terminates with two small tubercles.

The plume forms a funnel, equalling a third of the length of the body. No antennular organs within it could be detected by the microscope. But, interception of the neighbouring parts precluded a distinct view of the centre.



Filipora filigrana

It is difficult to offer any intelligible description of this product, farther than in saying it consists of a congeries of innumerable slender filaments, united in irregular bundles, or fasciculi, forming altogether something like filigree work. The mass is penetrated by numerous deep cavities, of indeterminate size and form. The fasciculi are so disposed that the orifices of all the tubes are directed outwards, and many clusters of them advance beyond the circumference or outline of the product.

A specimen resembled a quantity of the most luxuriant moss, which might have been covered by a hollow spherical segment, above three inches in diameter and two and a half in depth. Another specimen was infinitely larger, in general form an ellipsoid, above seven inches long, six broad, and four thick. The whole bounded by curves : there were no angles. Cavities of all different dimensions penetrated this substance. The surface, especially the circumference, universally in obtuse prominences, so that the specimen resembled a piece of rich carving. Here the myriads of tubes exceeded calculation.

The specimen represented Plate XXXIV. fig. 1. was nearly four inches high, above three broad, and two inches thick. It seemed to have been formed from the smaller portion or root upwards, and it was of the same irregularity as any of the others.

The tubes are always very slender and intricately interwoven : none have exceeded seven lines in length at most, and some are as slender as a coarse horse hair.

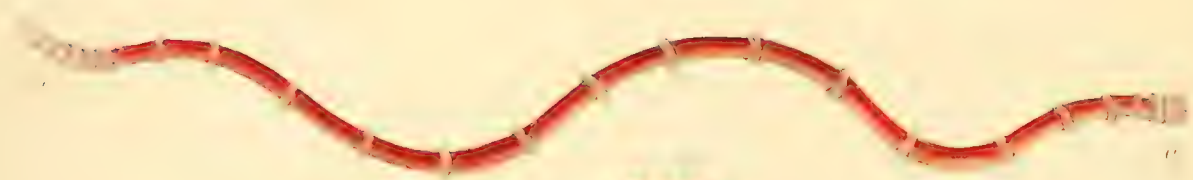
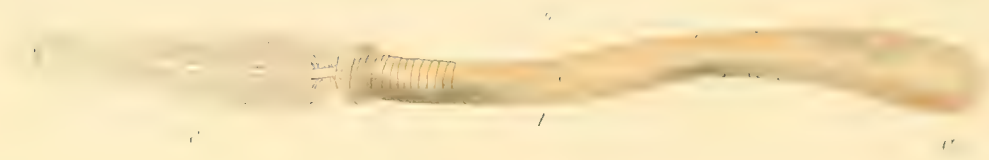
The animals display themselves in great numbers from the orifices of the tubes ; but they seem delicate, as many fall from their site like the animals of certain Ascidian Zoophytes. Then they are seen to be of unequal size, the body of some being quite as slender as a horse hair, to which the smaller tubes have been already compared.

None have survived above fifteen days. The whole product is dingy white ; the animal grey. It is less symmetrical than the Amphitrite.

This substance occurs in deep water.

PLATE XXXIV.

- FIG. 1. *Filipora filograna*, specimen.
2. Cluster of tubes with the Amphitrite, enlarged.
3. Amphitrite protruding from a tube.
4. Plume of eight branchiæ viewed in front.
5. Amphitrite having fallen from its tube.
6. Another, exposing some internal organization.
All the preceding figures, except the first, enlarged.



Chrysothrix *Hyphomycetes*

CHAPTER X.

MISCELLANEOUS.

BEFORE advancing farther, let me devote some general observations to a few detached animals, whose structure and habits have proved of equal obscurity.

It is not always the rarity of the subject that involves the naturalist in difficulties, for some of the following are of frequent occurrence. Others, again, are rare, scarcely to be obtained, and several seem to be distinguished by peculiarities, which I have been unsuccessful in endeavouring to understand. None, along with many more which could be specified, seem to have received any attention in this country, though to appearance not unworthy of notice.

It is of some importance to science, that every natural product should occupy an obvious and definite position. It greatly facilitates our mechanical knowledge, and it is a ready relief to our fellow students. But instead of at once multiplying genera to an inconvenient extent, merely for the purpose of comprehending a single subject, it is infinitely preferable to search after a place for its reception among those already constituted. Perhaps it is only our ignorance that leads us to remove some animals from places which they might suitably occupy.

1. PRIAPULUS CAUDATUS.—Plate XXXV. Figs. 1, 2.

Authors differ much on the position of this animal in the *Systema*. Some have considered it a species of Holothuria, which assuredly it is

not, and others approximate it to the Sipunculus with as little reason. This matter might be elucidated perhaps by dissection.

The figure can be explained better by the representation than by any description. Length seven or eight inches ; thickness in the middle about half an inch. The anterior extremity nearly three quarters in its longest diameter. The body may be described as consisting of three parts ;—the anterior, *a.* called the gland, swelling and longitudinally sulcated or striated ; the middle, *b.* annulated ; and the tail, *c.* composed of a series of moveable filaments, and tapering to the extremity. The mouth is in the centre of the anterior extremity, and the vent, *d.* at that part of the body where there are some tuberculated rings at the origin of the filamentous tail. Some animals are pure white, others faint dingy yellow.

This animal dwells in various parts of the Scottish seas : the finest having come from Shetland, where it lives in a foul muddy bottom. I found one, however, towards three inches long, considerably above low water, under the stones of the shore, not far from Granton Pier, in the estuary of the Forth. But specimens are said to be everywhere of rare occurrence.

I have provided specimens with a quantity of fine sand in their vessels, which they never penetrated.

The animal is always full of a blackish matter ; and portions of a soft or thready faecal substance have been discharged. A specimen like Plate XXXV. fig. 2. discharged a vermicular substance extending three inches, which, at the time, I conjectured to be some worm that it had swallowed. The state of such substances prevents their nature from being clearly recognised.

PLATE XXXV.

FIG. 1. *Priapulus caudatus.* Anterior extremity, *a* ; middle, *b* ; posterior, *c* ; vent, *d.*

2. Another specimen.

2. CLYMENE BOREALIS.—Plate XXXV. Fig. 5.

Naturalists have instituted a genus *Clymene*, which, to me, seems not very remote from the *Terebella*, or which might be perhaps introduced between the *Lumbricus* and the *Terebella*. It wants several features of the *Nereis*, and exhibits some which do not belong to the *Lumbricus*, therefore standing apart from both.

Savigny is reputed the founder of a genus to comprehend this animal, observed first by him in Egypt, but I have not been so fortunate as to obtain his account of it.

I am not aware that either its description, or its history, have entered the British *Fauna*. Only one species is known to me as inhabiting Scotland, which occurred many years ago.

It extends three inches in length, by about a line in thickness. The body consists of about twenty-four segments of irregular dimensions, some being twice the length of others, with a pencil of several bristles issuing from both sides of each.

The extremity of the first segment dilates into a dental thin rim of from sixteen to twenty-four teeth, according to the specimen. These are somewhat extensile. The extremity of the last segment is obtuse as an ovoid.

The anterior extremity forms a very shallow funnel, with the mouth in the centre. And there is a longitudinal groove or depression down some of the segments.

This animal dwells in a compact, hard, irregular tube, constructed of sandy particles, united by an exudation apparently from the whole body, and fashioned chiefly during the night. The teeth of the funnel are probably instrumental in the work.

It is extremely difficult, almost impracticable, to free the tenant of its tube without rupture of the body, or some great injury.

It is not rare, dwelling in rocky clefts on the shore towards low-water; but specimens as large as the dimensions instanced are uncommon. They survive readily for a considerable time.

PLATE XXXV.

FIG. 3. *Clymene borealis* in its tube.

4. Anterior portion, enlarged.

5. Entire specimen, enlarged; anterior *a*; posterior extremity, *b*.

3. SIPHONOSTOMA.—Plate XVIII. Figs. 10, 11, 12.

As the subject of this paragraph bears some resemblance to what might prove a species of the Siphonostoma of Otto,* taken by him in the bay of Naples, I shall meantime abstain from disturbing nomenclature by proposing the alteration of either.

Before being aware of that naturalist's description, I had named it provisionally *Nereis gelatinosa*. It occurred to me many years ago.

As the preceding animal may present some elements of the Terebella, so does this shew some analogies to the habits of the Nereis.

In general appearance this creature is green, and quite gelatinous. It extends three inches in length, by less than three lines in thickness, and swims by contortions like the Nereis, continuing its activity at night for a considerable time without interruption. Thus the smaller extremity is always in advance, while what may be considered the anterior is behind.

The body is of a quadrangular figure, with about forty pencils, composed of two long bristles, and a row of specks down the back. The head or anterior extremity, consists of two thin leaves, capable of folding together over the neighbouring parts, together with two yellow contractile tentacular organs. There are several setaceous organs, disposed in two bunches, nearly twenty each, issuing from between the leaves, and between the roots of those bunches is a single, round, black speck, resembling an eye.

The whole body is traversed by a reddish intestine. Other interanea are also visible through the translucent integument, and the gra-

* Vide *Otto*, apud *Acta Physico-Medica Academiæ Cæsareæ Leopoldinæ Carolinæ Naturæ Curiosorum*, tom. x. p. 628-633. Tab. LI.

dual formation at certain seasons of what seems an ovarium. A quantity of green spawn once appeared in a vessel containing a specimen in the beginning of June.

This animal lurks in shells, or under them, protruding the head, which, like that of the Nereis, is waved from side to side. Probably it dwells in mud, by which it is generally much disfigured, but which leaves it clean and translucent when washed away. I could never discover any tube or shelter of its fabrication. It is impatient of light.

This animal is neither rare, nor difficult to be preserved.

Its gelatinous consistency is best seen on pouring off the water, when it appears smooth and shining.

PLATE XVIII.

FIG. 10. *Siphonostoma gelatinosa*.

11. Section of the body, enlarged.

12. Head, enlarged.

4. PHERUSA MULLERI.—Plate XVIII. Figs. 5, 6, 7, 8, 9.

A distinguished naturalist, Otho Frederic Müller, has named the subject of this brief notice *Amphitrite plumosa*. M. de Blainville considers it as bordering on the Spio; but Oken institutes a genus *Pherusa* for its reception.

Certainly the subject in question has none either of the principal or subordinate features of the Amphitrite, and it is still more unlike the Spio. In the reference which I have seen to Oken, a clay tube is ascribed to it for a dwelling; but among a number of specimens taken from different situations, nothing of the kind has ever occurred to me; neither has the animal testified a disposition to occupy any tube, though such might be inferred from its organization.

The body of this creature is of vermicular form, crowned by a head or anterior extremity of complex structure. The whole extends three inches and a half, by above three lines in thickness. It is quite round,

and tapers slightly downwards, divided into about 80 to 110 very distinct segments, the last the extremity, which is obtuse. Six or seven flexible contractile tentacular organs, two of them long and more active than the rest, together with six or eight, sometimes more, long, slender bristles, all issue from the anterior extremity. The whole of the apparatus is retractile within the body, like the arborescent tentacula of the *Holothuria*.

The segments are more cylindrical, and more deeply divided from each other than in most of the *Annelides*.

The surface of the skin is wholly granulated, covered with tubercles, and like shagreen. A row of pencils, composed of several bristles, belong to the segments; besides which, there are some curving spines. This animal is sufficiently active at night, crawling over the bottom of its vessel. During the day it lurks between shells among mud, or under them, where it may remain a long time without shifting. The two longer tentacula, which much resemble those of the preceding animal, protruding far, and searching around with lively action. It shuns the light. The body is of a brownish or earthy appearance, the two longer tentacula pale or yellowish, the others green.

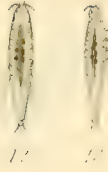
If the animal constructs a tube, it is of the slightest and most indefinite description. I have never seen it, either in its natural abode, which is both littoral and in deeper water. Specimens have survived many months.

An ovarium, with deep grass-green ova, protruded from the body, with spherical ova, fig. 9.

PLATE XVIII.

FIG. 5. *Pherusa Mülleri*.

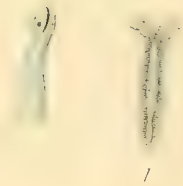
6. Transverse section, enlarged.
7. Section shewing the spines of the body, more enlarged.
8. Bristles of the anterior, enlarged.
9. Ova, enlarged.



12 13



16



1



14



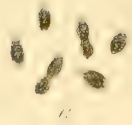
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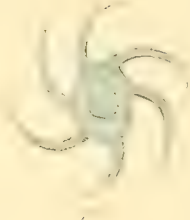
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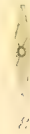
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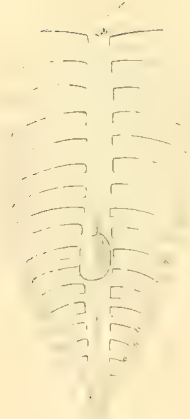
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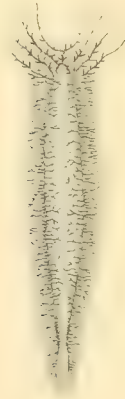
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15



Miscellaneous.

5. NEREIS HIRSUTA.—Plate XXXVI. Fig. 10.

Length the sixteenth of an inch. Body roundish, about a fifth of the length in thickness, consisting of seventeen or eighteen segments, terminating by two knobs. Head with two articulated flexible antennæ, and two black eyes.

The body totally villous.

Swims swiftly with the antennæ recurved.

Three of these animals occurred in a vessel full of sea-water in the beginning of May.

PLATE XXXVI.

FIG. 10. *Nereis hirsuta*.

6. NEREIS PECTINATA—*The Feathered Nereis*.—Plate XXXVI.

Figs. 12, 13, 14, 15.

This animal is probably allied to the *Nereis*, and may perhaps prove an intermediate link to *Amphitrite*. This is only a conjecture, however, for it may be found something quite different, and only the larvæ of some more perfect creature. Therefore I introduce it here with great diffidence.

Length towards two lines ; breadth under half a line. An indentation seems to distinguish the head from the rest, but the segments of the body are imperceptible, and the tail terminates in a fork. Tentacula two, fringed with bristles. Four stumps appear towards the anterior, from which issue bristles half the length of the body.

Colour to the eye white.

This creature occurred among miscellaneous collections from the sea in May, and survived about a month.

PLATE XXXVI.

FIG. 12. *Nereis pectinata*, the back, enlarged.

13. Profile.

14. Anterior extremity, enlarged.

15. Posterior extremity, enlarged.

7. NEREIS PHASMA—*The Spectre Nereis*.—Plate XXXVI. Figs. 16, 17, 11.

Nothing perplexes the observer more, than inability to obtain a distinct view of all the parts of his living subject ; and, perhaps, this may be one reason why naturalists have testified such a decided preference for studying those poor creatures which they have deprived of life.

If it be difficult to distinguish the parts of a subject, this must always aggravate the embarrassment of determining its systematic position.

Other observers may have experienced greater facility than has fallen to my lot, or, without it, they may have followed the modern fashion of those who, disappointed of analogies, institute a new genus as the readiest method of solving the problem.

One evening, early in January, while inspecting a vessel of sea-water, my attention was attracted to an indistinct vortex amidst it, without presenting any definite object to the view. This motion was connected, however, with an air-bubble, certainly shifting it to different parts of the vessel. I could account for neither. Nothing else was perceptible, and it seemed still more singular, that I should afterwards witness the same by day. But on altering the position of the vessel, so as to throw different shades of light upon it and its contents, I discovered with much surprise that the agent was a very active animal, by no means so diminutive as to escape detection, but of such excessive transparence as to disguise its form. Nor is this any exaggeration of the fact ; for having sent the vessel to an accomplished artist, already named, Mr Peter Syme, for the purpose of obtaining a delineation, I found, on reaching him, that he had been unable to discover the object. However, by resorting to similar expedients as practised by myself, he could now represent the most conspicuous parts of the animal.

Nearly three years afterwards I obtained another specimen in November. Both occurred in a capacious jar of sea-water taken from about the same place, Newhaven Pier. But with ample opportunities none have been again found there.

Twenty years later, six specimens were obtained on the Isle of May, not less than thirty miles distant, and from the whole I have been able to gain some slight acquaintance with this singular animal,—singular, because human vision can scarcely discover what is of sufficient size to expose every feature. Hence it is that there must be always slight discrepancies between the drawings of different artists.

This animal is towards an inch in length. It might be inscribed in a triangle. The head is forked or cleft, furnished with two long antennæ issuing from the sides, between the roots of which, or somewhat behind them, are two black eyes, rather oval, and probably compound. If the body is divided into segments, they are invisible from transparence. If so, the segments consist of a central portion, as the central part of the Nereis, and a long arm, an integral part towards each side, gradually shortening from the middle to the lower extremity, which is pointed. Towards this extremity they degenerate into mere stumps, which seem to be successively developed as arms. Sixteen or seventeen of these arms were conspicuous in fig. 17, and fourteen or fifteen in fig. 16. In some others were four or five or seven pair of limbs or arms. The extremity of the limb is cleft, and terminates in two portions like hollow walnut shells, fig. 11. To some of the artists the termination seemed a pencil. An intestinal organ traverses the whole length of the body.

This animal is absolutely colourless ; it can be distinguished from the water only when in particular positions, and under a particular incidence of the light.

It swims horizontally, and then partly by faint undulations. In this position the greater convexity of the back, and slighter convexity of the belly, are sensible. It always seeks the higher part of the water, near the surface, like the Medusæ, keeping the antennæ recurved.

I sometimes believed that segments were indicated on the under surface ; that the whole was crossed by wrinkles which were effaced on extension ; and one of the cleft extremities of the limb also seemed to move as if by a joint ; and the hollows of some contained a minute yellow body like an ovum.

The animal is rather of a gelatinous appearance. It can be preser-

ved with difficulty, from being liable to entangle itself in every foreign substance, and is easily mutilated in its struggles for liberation.

None have survived longer than twenty-four days. They generally live only a week.

The only specimen shewing an air-bubble was fig. 17 ; and in this specimen I am induced to think the pencils at the extremity of the limbs should be shewn as cleft.

An animal called the *Briarean scolopendra*, represented in the Plates of the voyage of MM. Quoy and Gaymard, bears much resemblance to the preceding, only the posterior extremity is greatly prolonged. It was found in the Straits of Gibraltar.

I have not observed any other representation of it.

PLATE XXXVI.

FIG. 17. *Nereis phasma*—The Spectre Nereis—as delineated by Mr Peter Syme, enlarged.

16. Another specimen.

11. Enlarged limb of fig. 16, shewing the cleft.

The study of transparent animals is commonly attended with great embarrassment. We are frequently uncertain whether we actually behold them or not—whether they are entire or mutilated.

S. OCTODACTYLUS INHLERENS.—Plate XXXV. Figs. 1, 2.

Among the decrees of Nature, the least comprehensible is that which ordains the preservation of one animal by the destruction of another : her ostensible cares are directed to the safety of her creatures ; therefore there seems a strange inconsistency that life shall be sustained only at the expense of life.

But there are, besides, innumerable examples, where living animals are infested by multitudes of parasites, to their torment, if not to their destruction. They are consumed as the prey of generation after genera-

tion ; and the existence of the parasite is apparently dependent on the existence of the life of the other. If the one dies, so shall the parasite be destroyed.

The subject of this paragraph infests the gills of the ling, to which it adheres with considerable tenacity.

It is of a thin and flattened form, extending nine lines in extreme length, by about two in the broadest part. One extremity dilates into two portions, to the right and left, each composed of four tentacular-looking organs, a line in length. The remainder of the body tapers downwards, much like that of the common *Planariæ*. A longitudinal internal cavity seems to consist of a larger and a smaller compartment ; besides which, numerous pinnate organs also occupy the substance of the body. The colour of the whole is bluish-grey.

The body being remarkably thin, soft, and flexible, it applies closely to its site, with some adhesion ; and the two anterior portions clasp the rib of the gills in their fold.

They have little other motion than slightly extending and contracting.

Probably the tentacula are hollow.

The site of the mouth could not be discovered ; but a ventral pore was visible after death. Can this be the orifice of a proboscis ?

In a short time these animals lose the anterior portion by decay.

On one occasion, twenty-nine specimens, of various dimensions, were removed from a portion of the gills of a ling ; and several were found on other occasions.

It is doubtful whether their survivance is not very short, on removal.

PLATE XXXVI.

FIG. 1. *Octodactylus inhærens*.

2. The same, enlarged.

9. SPHÆRULA.—Plate XXXVI. Figs. 3, 4.

The nature of this animal is very perplexing. If those I have seen be adults, there seems no place in any genus incorporated in the *Systema Naturæ* for its reception. But it must be remembered, that the young and the adult of many among the lower animals are so unlike each other, as to delude the most experienced naturalist, who may not have had an opportunity for the protracted study of the same individuals.

Form of the animal spherical or ovoidal, the largest of the latter extending a line. There is an aperture at one end, from which between sixty and seventy fine transparent silky threads are extended, twice or thrice the length of the animal, to affix it to some neighbouring surface. These (which are with difficulty visible) stretch in all directions, sometimes forming a fan, broadening upwards from the aperture; sometimes circularly, but in general irregularly. In the sun, the integument of the animal is quite smooth and shining, like a shell.

The motion of the Sphærule is extremely slow, imperceptible to the eye, and only to be discovered by having shifted its place, wherein it frequently remains very long. None are seen in progress.

This animal has occurred on the corallines of different kinds. Once above twenty were found on a lump of scorix from the shore.

It is easily preserved.

For a long time I supposed it the young of the Echinus; but my conjecture has not been verified.—Plate XXXVI. Figs. 3, 4.

10. ANIMALCULA.—Plate XXXVI. Figs. 18, 19, 20.

An immense number and great variety of minute living creatures pass by the general name of Animalcula, whereof the *Animalcula infusoria*, so distinguished by a name almost alike general, form by far the greater proportion.

It is not improbable, however, that with the advance of science and

observation, some will be removed from their present position and annexed to the species constituting genera of larger animals.

The minuteness of many of the Animalcula is a great obstruction to observation, while rendering them utterly unmanageable for experiment.

11. MELICERTA RINGENS.—Plate XXXVI. Fig. 5.

This minute animal, which dwells in an artificial tube, will perhaps prove one of the Annelides allied to the Amphitrite.

It consists of a vermicular body, indistinctly appearing annulated when protruding from its tube, crowned by a curious apparatus, consisting of four fans, with a curving ciliated edge. A stump protrudes from one side of the neck or upper part of the body. I could not find any other. About the centre of the second segment, there is a kind of pulsatory action within the animal.

The tube, affixed by the lower extremity, tapers upwards, and becomes at length twice the diameter of the animal. It is composed entirely of minute spherules, which are perhaps of artificial formation; and the work may be, possibly, executed after the fashion of the *Amphitrite ventilabrum*. The lower part is dark brown, the higher and newer part lighter brown or yellowish.

The animal rises from its retreat within, expanding its broad fans, with their fringes of active cilia, as it issues forth. All the fans incline in the same direction.

Diameter of the fans above a line, length of the tube two or more.

Found in fresh-water lakes, affixed to slender vegetable products.

PLATE XXXVI.

FIG. 7. *Melicerta ringens*, enlarged.

12. CARBASARIA FIMBRIATA.—Plate XXXVI. Figs. 6, 7.

This animal has much resemblance to a Planaria. It is about an eighth of a line in length, and of plump appearance. The anterior extremity fringed with fourteen or fifteen cilia, which are not long, opens

widely, the orifice being directed somewhat downwards ; the posterior extremity is obtuse.

This is a beautiful animal, of colour finely variegated, mottled brown and yellow, at first vivid, but fading as the water becomes stale.

It seems one of the *Animalcula infusoria* origination, with the decomposition of the corpusculæ of the *Flustra carbacea*. I have seen it under no other circumstances. But they have then occurred, though not very numerous, in successive years.

From contraction of the body they probably multiply by transverse division.

PLATE XXXVI.

FIG. 6. *Carbasaria fimbriata*, group enlarged.

7. Specimen magnified.

13. ANIMALCULUM CRUCIATUM.—Plate XXXVI. Fig. 8.

A very minute shuttle-shaped Animalculum has been seen among the ova of the *Lumbricus cirratus*, besides one with a ciliated margin, previously described when treating of the Lumbricus itself.

Here there are no external organs, unless the indistinct appearance of a St Andrew's cross on the back. Colour pale dingy yellow. Motion very slow.

PLATE XXXVI.

FIG. 8. *Animalculum cruciatum*, magnified.

14. CERCARIA.—Plate XXXVI. Fig. 9.

This is a minute Animalculum, somewhat resembling a Planaria, with an annulated tapering tail. The mouth is an orifice in the centre of the anterior extremity. The body is of mutable form, the tail very extensile, when the rings are almost obliterated.

Colonies of these animals, like white specks, dwell in fresh-water.

PLATE XXXVI.

FIG. 9. *Cercaria*, magnified.

CHAPTER XI.

GASTEROPODES.

THE literal interpretation of what constitutes the subject of this chapter, signifies those soft-bodied or molluscous animals which crawl on the belly. This, it will be observed, however, is a restricted view, for there are many which do so that belong to very different branches of the System of Nature.

A considerable number of such animals having occurred to me in the course of years, I purposed devoting some chapters to them in detail, but circumstances have induced me to confine myself to a few abstract observations. Probably the recent works of accomplished naturalists will more than supply the deficiency.

It is somewhat doubtful, unless by conventional arrangement, whether a character sufficiently exclusive is taken for the extensive genera and species to be comprehended under Gasteropodes. But that is of less importance here, as I shall speak of only some of the animals formerly constituting the extensive genus *Doris*, after a sentence or two on the *Aplysia*, as a suitable introduction.

All the subjects of this chapter are very nearly akin to the *Limacine* tribe, of which one peculiar characteristic is, crawling on the under surface of the body, and, in this respect, the name is perhaps more appropriate than either *Trachelipodes* or *Cephalapodes*, the one applying to those inhabitants of shells whose flesh fills the spiral, and those whose

position, reversed, with the head downwards, are sustained on the suckers clothing their tentacular arms.

Another distinctive denomination is also found among the Gasteropodes, into *tecto-branchiate* or *covered branchiæ*, and *nudi-branchiate* or *naked branchiæ*. The *Aplysia* belongs to the former, the *Doris* to the latter.

APLYSIA DEPILANS—*The Sea Hare*.—Plate XXXVII. Figs. 1, 2, 3.

At certain seasons of the year, especially about the middle of summer, an animal may be found under the larger stones on the sea-shore, bearing much resemblance, in form and habits, to the common naked *Limax*, only exceeding it somewhat when of full size.

The body is of long triangular shape, extending four inches or more, with a distinct head, furnished with four horns, two upright on the neck, which may be called *cornicula*, two terminating the angles of the head, *tentacula*,—a convenient characteristic of each. Nearly between the roots of the former are two small black eyes, set in white. A deep cavity in the middle of the back, containing the branchiæ, is surrounded by an elevated membrane, with a purple margin closing over it. The sole is long and narrow. In certain positions, the head of the animal bears some similitude to that of a *Doris*, particularly from a fold in the higher part of the tentacula, not unlike the palpi of that organ.

The narrowness of the sole indicates that the animal avoids situations exposed to the wash of the waves, and that it may frequent the region of the more slender zoophytes or algæ.

I took a middle-sized specimen in the beginning of February, but it was cramped and contracted by the cold. No race of creatures is more readily affected by even a slight degree of refrigeration than all the *Limacine* tribe. By heating a glass vessel to receive it, and after replenishment, by repeatedly dipping it in warm water, the *Aplysia* was gradually restored.

It proved a beautiful, fine, and fleshy specimen, of transparent chestnut hue, universally strewed with darker specks above, and of dingy



Fig. 1

hue below. While crawling up the side of the vessel, its form was well displayed: the tentacula, with a fold or hollow in the upper part, much resembling a horse's ear: the cornicula, rising erect from the neck, with the black eye near the base, and the cavity of the back open or closed, or surrounded by its protecting membrane. This animal extended just two inches. It afforded satisfactory delineations, from which its form and appearance are rendered very explicit.

In another fine and healthy specimen, of about equal dimensions, or rather larger, the black eye was surrounded by a white line.

This animal was quite vigorous, and fed copiously on the common green fucus. But I know not that such food was the most congenial, for it did not undergo much alteration by digestion. The creature's body was very transparent.

This specimen always testified a disposition to rise to the surface of the water, where it swam supine; or it would adhere by the tip of the tail to some solid substance, or to the glass, suspending itself in the water. It is a distinguishing habit of the *Aplysia* to suspend itself in this manner.

A third specimen, towards the same size as the others, was very beautiful: the skin sparingly strewed with white specks, the animal plump and vigorous. I rate these animals as nearly equal, for they extended twenty-four, twenty-five, and twenty-six lines respectively.

White specks were also on the body of a smaller specimen, which fed copiously on some of the Floridæ, and increased rapidly in size. Indeed, the colour of the species seems to indicate that the natural food is to be sought among algæ of that description. This animal survived ten months; it died suddenly, tinging the water purple. Sometimes a great quantity of water is so tinged by a single living specimen.

None are easily preserved permanently.

PLATE XXXVII.

FIG. 1. *Aplysia depilans*, profile.

2. Upper surface.

3. Under surface. Tentacula, *a*. Cornicula, *b*. Branchial cavity surrounded by its protecting membrane, with a smooth purple margin, *c*.

THE DORIS.—Plate XXXVIII.

The comparative simplicity of the preceding subject, whose nature corresponds so intimately with that of the animals of this section, forms a very suitable introduction to it.

The great section established as the Doris by earlier naturalists, has been partitioned by later observers into several distinct groups. But there is no race of animals more difficult to subdivide satisfactorily, to arrange, and to connect, than the Doris. Perhaps we have yet too few intermediate links to unite the chain. Whence it is very questionable whether the present divisions will retain their permanence.

Without attempting any refined classification, however, a few general observations on some of the animals comprehended within the sections *Tritonia*, *Eolis*, and *Doris*, as proposed by authors, may prove useful to those devoting themselves to the subject. I have constantly found varied novelties result from the enquiries of different naturalists, though relating to the same subject.

The basis of arrangement may rest on many different principles.—Such as,—

- I. The general configuration of the animal.
- II. The special form of some of its principal parts, such as the head or the sole.
- III. The number and formation of the tentacular organs.
- IV. The presence or absence of cloak or mantle, a total or partial covering of the upper surface.
- V. The position and form of the branchiæ.
- VI. The peculiar form and arrangement of the spawn.

Of the features common to the whole tribe, are a number of external organs: an extensive sole, whereon the individual crawls; and horns in two pair, one projecting from the head, to be denominated tentacula, generally of simple structure; a pair called cornicula, projecting above



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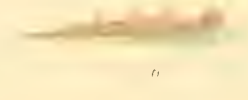
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Salmo trutta

the neck, of more complex structure ; besides, in certain species, long prolongations of the shoulder, apparently exercising a tentacular faculty : and a number of branchiæ, variously disposed in external arrangement. All individuals are distinguished by extraordinary fertility. Much diversity, according to genera and species, distinguishes the spawn ; and the young of all apparently undergo a remarkable metamorphosis, in their progress to maturity.

On minute investigation, I believe, a correspondence may be found between the form of the head, the structure and arrangement of the branchiæ, and the mode wherein the spawn is deposited.

SECTION I. TRITONIA.—Body solid, invested by a cloak. Tentacula two, retractile, within sockets. Branchiæ marginal, erect, palmate.

1. TRITONIA HOMBERGII—*Homberg's Doris*.—Plate XXXVIII.

This is the giant of the race, insomuch that the naturalist, familiar with the puny specimens of ordinary occurrence, can hardly persuade himself, on seeing them together, that they belong to the same genus. He deems its association, even with the best of the larger kind, as somewhat incongruous, the mass is so unwieldy.

But the vast disproportion between the parts of kindred animated beings, while the vital functions are alike effective in both, is well adapted to prove the excellence of the model whereon they are framed.

The rarity of adults having attained their full dimensions in the Scottish seas, my ignorance of the quality of their food, the difficulty of preservation, and the injuries of atmospheric influence, for a long time embarrassed my exertions to ascertain any definite points in the history of this remarkable species. Nor, in this country, will it be easy for any one to counteract these obstacles, or to find a remedy.

But we have, further, to conjoin the sluggish disposition of all the tribe, doubtless extending to their native haunts ; and the exhaustion, almost to the death, inseparable from the waste, concomitant on spawn-

ing so profusely, as pertains to the tribe. Besides, an universal collapse of the parts is often incident to transference to an artificial abode: the finest specimen sinks into absolute quiescence, from which it cannot be aroused to display its structure. Sometimes the animal, remaining a shapeless mass, as recovered from the deep, declines and dies, without any symptoms of evolution, leaving all conjectures regarding its real aspect, its symmetry or deformity, unsolved.

From so great a series of difficulties, there is no animal, perhaps, which has been so imperfectly represented as after nature. The most distinguished naturalists, Cuvier, Delle Chiaje, De Blainville, and others, have been actually unable to illustrate their own commentaries, from the inability of their artists to shew the truth.

Assuredly these facts are sufficient to stamp some value on the true representation of such animals in the vigour of life.

This is not to be obtained, however, at all seasons; for the naturalist is alike dependent on the quality of the specimen and on a favourable opportunity, for which he may be compelled to wait beyond the endurance of his patience; or it may be actually unattainable.

Full grown specimens of Homberg's *Doris* extend eight inches in length, by two in breadth and one in thickness. It is a compact, solid, fleshy animal; head a thin flap, two inches broad, with a dentate margin; cornicula of singular formation, eight lines high, consisting below of a socket, with a deeply indented margin, from the centre of which rises a smooth pillar, crowned by several foliaceous organs, environing a prolonged central lip. A tuberculated cloak covers the whole upper surface, with a border on each side of the back, of palmate branchiæ, seven or eight lines high, and spreading as much.

The under surface shews the mouth, situate between two corrugated fleshy portions, forming the face; the belly or sole tending to a long triangular shape, with a rounded shoulder; the whole quite smooth.

A transverse section of this animal would be irregularly quadrangular, slightly convex above, and flattened below.

No eyes have been discovered.

The main ducts terminate in the thickness of the side, at a considerable distance from the head.

A very great difference prevails both in the colour and in the general aspect of the specimens of this animal. Leaden grey, or a ferruginous hue, in general predominates ; and such, in as far as I have had an opportunity of observing, are always specimens of the largest size. One, extending about three inches, of transcendent beauty, was universally pure white, unless the central tuft of the corniculum, tending to the olive. It was taken near the Bass Rock. Another, extending towards four inches, was of a beautiful transparent primrose-yellow. The branchiæ were very transparent ; the colour of all the rest uniform, rather more vivid than primrose-yellow ; and the aspect of the animal so beautiful and peculiar, that it seemed to me, at first sight, as if a new animal.

Hombert's *Doris* is rarely white ; but specimens an inch long occur sometimes several at the same time. No peculiarity is concomitant on the colour. The sole is always dingy white. Some adults are brown as copper, whereas smaller specimens are commonly grey, or almost white.

Cuvier says he has assured himself of the presence of eyes. If so, they are probably deep seated, as he speaks from the result of dissection. Omission to specify the eyes of many of the minor animals, is not the denial of their existence, whether in the *Doris* or in others. The nature of the parts may oppose their detection. Colour may conceal them in one specimen, contrast may expose them in another. The powers of vision, in a different medium from air, cannot be satisfactorily estimated, without knowing much more of the organs.

The whole body is susceptible of great alterations. The cornicula may be completely retracted ; and all its three portions are endowed with independent action. The branchiæ are susceptible of alternate contraction and dilatation ; and the entire animal enlarges greatly, when crawling, above its dimensions in repose. In full vigour, and during genial weather, the specimen represented in Plate XXXVIII. figs. 1, 2, extended eight inches, whilst in motion. It seemed too heavy to attempt swimming supine, as done by smaller subjects. It is only under salubrious

conditions that their size may be conjectured. A fine specimen, extending six inches in health, afterwards contracted a third, and died. When transferred to spirit of wine, it shrunk in a solid mass, like a double wedge, two inches and a half long by an inch thick in the middle, declining towards the extremities. The tentacula had disappeared, and the branchiæ had become a regular narrow border, environing the body.

Naturalists, in general, have been too sparing of their observations on healthy living animals. M. Cuvier's dissections were of preserved specimens, which, he says, had been taken in the Mediterranean.

Investigation of the nature of living animals can never be alike satisfactory, as when their food is before us. But herein I have been often greatly perplexed, and particularly in regard to that of the animal we are now considering. No doubt this may have been much aggravated by its sluggish disposition, and extreme susceptibility of cold. Many of the lower orders feed only at a certain temperature of the atmosphere, and may scarcely feed at all during the season of propagation.

It does not appear that the substances whereon the *Doris* is found always serves it as sustenance. It is very rarely that anything the naturalist can offer is acceptable. Accident, however, sometimes unexpectedly favours him.

The *Tritonia Hombergii* feeds on the *Aleyonum digitatum*, the *Lobularia* of modern authors, whereof a succinct account is given in the second volume of the *Rare and Remarkable Animals of Scotland*. I had observed smaller specimens, indeed, frequently lurking in the recesses of that product, whether white or orange. But the real subsistence of no animal proved more difficult to ascertain, nor wherein I had been so often disappointed as this species. It might be partly owing to my own prejudices; for I credited its preference of vegetable substances.

After the preceding large specimen had been six weeks in my possession, it continued very vigorous; the sole spread broadly, and adhered firmly to the vessel. It then fed on a small portion of the orange *Lobularia*; farther, it continued to feed upon both the white and the orange species, as denoted by the secretions.

Propagation.—Many distinctions characterise the different modes ap-

pointed by Nature for introducing the young of animals to existence, affording a noble field of observation to the speculative philosopher.

A singular variety prevails among the different species of the tribe wherewith we are now engaged—one of the most prolific inhabiting the waters of the deep.

Probably the *Tritonia Hombergii* begins to breed at an early age, and continues fertile very long. The presence of an ovarium and its gradual advances, may be detected in many specimens through the transparent skin of the under surface.

Having attained maturity, the spawn is discharged as a rope from the oviduct on the right side of the body. The parent affixes the end of the rope to the solid substance whereon it rests, and gradually withdraws during its further discharge. But its course being around the point of fixture, the rope escaping forms a regular logarithmic curve, which, from a peculiarity, is waved throughout the whole length.

The spawn of smaller specimens is commonly of beautiful regularity, consisting of four or six waving coils or volutes.

But mark the provisions of Nature. In delivering itself of its progeny, the parent must quit the original spot of fixture. If it did not retreat a mass of spawn would remain, but to preserve the whole entire and undisturbed by its body, the second coil is apart from the first, and the third from the second, hence an elegant figure from this mute mathematician.

Such is the result when the specimen is quite free and open; and sometimes a perfect form is produced. But such an extensive surface as a larger specimen would require being generally interrupted or irregular, corresponding irregularities disfigure the arrangement of the spawn.—Plate XXXIX. fig. 1.

Thus the arrangement of the spawn from smaller specimens is more definite. From whatever specimen it issues, however, the arrangement peculiar to the species may be discovered. Nor does this belong exclusively to Homberg's *Doris*, for, as we shall see, it extends to others.

The ovarium of the present species is very ample. Its progress is exposed through the skin of the under surface, and from fainter indica-

tions it gradually becomes yellow. The dimensions of one, not of the largest size when far advanced, I found equalling a pullet's head. The formation of the ovarium in the specimen, figs. 1, 2, was visible in the end of December. It became yellow, and the contents more conspicuous in January, and, on the 6th of February, a great quantity of spawn was deposited on the side of its vessel. This constituted a rope fifteen or eighteen inches long, and above an eighth of an inch thick, containing innumerable ova. Had the vessel been more spacious, less irregularity would have impaired the figure of the rope. The parent could have withdrawn without impediment. It was somewhat disturbed, besides, by partial replenishment of the vessel with sea-water before the spawn was observed. Sometimes it is very regular, as that from another or smaller specimen.—Plate XXXIX. fig. 2.

The parent remained five days in absolute quiescence beside the spawn.

In three weeks from the preceding date another great spawning followed, under similar arrangement, forming a waving logarithmic curve. Here the rope would have extended two feet in a straight line, but it did not exceed half the thickness of the former one. Somewhat later, the remaining contents of the ovarium seemed still advancing to maturity.

In both cases the spawn was covered with a whitish integument of the finest texture, which did not seem albuminous. But the ova themselves, which occupy no definite arrangement in the rope, are certainly lodged amidst albuminous matter.

In regard to this prolific animal, its size declined considerably after the first spawning; but it fed copiously on the orange *Lobularia*, and recovered nearly its pristine vigour, for it extended seven inches. Likewise it fed after the second spawning, but died unexpectedly, having survived fifteen weeks. Now it shrunk to little more than above three inches.

Though preserved with sufficient care, none of all the spawn was productive.

Nevertheless ample illustration of the mode of propagation, as far as it could be carried with this gigantic race, have been obtained from various other specimens.

The period does not seem to be confined to any particular season of the year.

When most regular the spawn consists of about six volutes of small diameter, as appeared in that from a specimen fifteen lines, produced on February 7. Yet there is no positive rule. This latter spawn came to maturity in eighteen days. An example corresponding in all circumstances occurred seven years afterwards, when the ova came also to maturity in eighteen days from November 11. Two or three days usually elapse between the escape of the first and last of the young from their prison.

The spawn of the whole tribe of the Doris exhibits a multitude of white spherical ova, as they appear amidst the rope, if it be a belt issuing from the parent.—Plate XXXIX. fig. 1, enlarged. Each ovum contains the elements of a single embryo, whose evolution in the same form as the parent would be expected by the observer. But as the ovum advances onwards, the motion of an animal apparently different in shape and aspect of the parent is discovered within, as shewn on inspection of a portion of the spawn.—Plate XXXIX. fig. 2, enlarged.

This creature having gained that state of maturity enabling it to quit its position, presents an extraordinary view, for it shews an intimate resemblance to some of the Vorticellæ while lodged in the shell. Two cylinders, apparently hollow, and crowned by a fringe, rise from the shoulder of what must be compared to that of other animals, and the body itself seems to contain several viscera.—Plate XXXVIII. fig. 13, nascent animals from the spawn ; fig. 14, enlarged ; fig. 15, another more enlarged.

As the spawn continues dissolving, multitudes of these creatures, like the most minute specks, swim through the water.

They remain visible and active a considerable time, at length their course relaxes ; their sources of motion are impaired ; they become contracted and totally disappear, leaving only a small shell at the bottom of the vessel containing them.

Having never heard of anything of the kind, I own that on originally seeing these creatures amidst the ova of the Doris, and afterwards

at large, I felt more inclined to class them with the *Animalcula infusoria*, than to believe them to be the offspring of such a parent. In the progeny we are disposed to believe there should be some resemblance inherited. We are surprised or disappointed if there is none. Even the conviction, without the demonstration of metamorphosis, is unsatisfactory.

It seemed very extraordinary also, that the same product should come from the spawn of every different species of *Doris* which I had an opportunity of examining, though the parents bore little reciprocal resemblance.

After an active but brief existence, all these animalcula perished under their primitive form, leaving only a vacant shell.

This, which is perhaps the most minute shell hitherto observed, bears some resemblance to that of the *Nautilus*, I have named the *Nautiline*, for the purpose of recognition. It is white, and consists of a single volute, with a wide surface. Nor could I discover the smallest difference in the multiplicity of thousands. Nevertheless, on viewing the product while animated, there is the utmost difficulty in determining precisely of what it consists. Thus we must not be too confident of specifying its form and its parts correctly.

By lodging specimens of the various species of the *Doris* in fine transparent glass vessels, the observer may casually obtain excellent opportunities of investigating the nature of the spawn if deposited in a favourable position. I have had many such in the course of years; yet I have gained less from them than might have been expected.

The spawn above referred to as deposited on November 11, having almost entirely dissolved on December 1, a number of *Nautilines*, like absolute specks in the water, were in great activity. The spawn had been pure white, and the same purity distinguished the *Nautilines*. Under the higher powers of the microscope, a general correspondence pervaded the appearance of all,—a sac containing several smaller distinct viscera, varying somewhat in aspect, according to the view they presented. Among them, or in their vicinity, I thought the pulsation of a transparent vessel might be discovered. There were altogether two cylinders, crowned by long flexible cilia. Behind the roots of the cylinders were

two circular spots, very perceptible, possibly the site of originating cornicula; also a spine or other organ projecting in front of the Nautiline.—Plate XXXVIII. fig. 15. All these animals at length disappeared after the wonted contraction, leaving their numerous shells below.

It is singular we should never behold any similitude to the parent in any of the animals quitting the spawn. Some have very freely called them the larvæ, that is, they are presumed to be the larvæ, or an embryonic form, which shall undergo certain metamorphosis in its growth, until in maturity it shall resemble the parent. But I have not understood that any observer has hitherto witnessed its progress. In another work I have shewn the like obstacles in opposing our discovery of the advances of young animals which pass through similar changes.

There is little doubt, if we may reason from analogy, that in the Nautiline we behold only the prelude to metamorphosis.

The Doris and the Limax are closely allied, therefore I may be perhaps allowed to compare the species now under discussion, the largest of the tribe, with the largest of the Scottish testaceous univalves, the *Murex antiquus*, which is occupied by a Limax.

This animal spawns profusely in the month of April and later. The spawn is of very peculiar formation, consisting of a number of capsules in adhesion, sometimes forming a mass larger than the whole animal. Each capsule is nearly a spherical segment, containing from ten to twenty embryos; but these are not individually contained in integuments investing them singly, which would retain the embryo in its place.—Plate XXXIX. fig. 3. The embryo within the capsule, which is yellow, becomes gradually more conspicuous, as with the Doris, each grows more distinct. When hatched, it consists of a shell of a single volute, with a wide orifice, fig. 4, containing an animal, whose margin is prolonged as if in a double scoop, which is bordered by active cilia. Their rapid motion produces a vortex, attracting minute buoyant particles in the water. A distinct view of all the internal structure is observed by the opacity of the parts. But behind this organization a little farther down, the pulsation of a vessel, perfectly transparent, is perceptible.—Plate XXXIX. figs. 5, 6. The whole subject does not exceed half a line

in length ; the animal has a very solid aspect, and vivid yellow colour, which is chiefly derived from minute ovoidal pellets occupying the stomach, which are profusely discharged.

The correspondence of the nascent *Murex* with the *Nautiline*, is such as to sanction the conclusion that the latter is actually the progeny of the *Doris*, though we find preservation throughout its metamorphosis impossible.

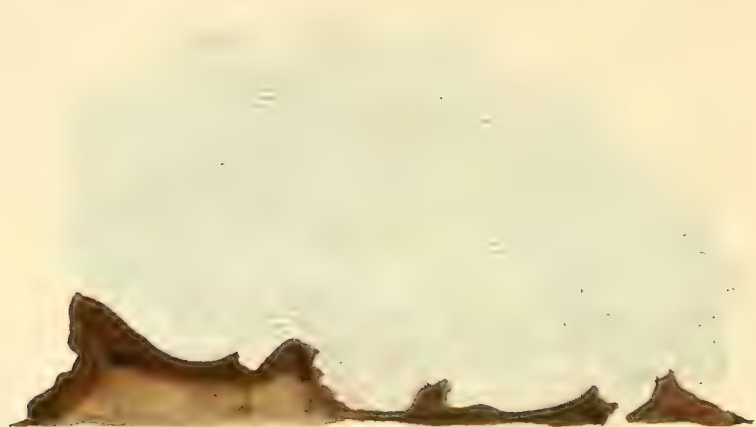
But certain evident changes are seen in the ova of the *Tritonia*, although the earliest may not have been observed, because the animal cannot be then procured or preserved. With scanty organization a gradual accession of parts and new segments ensue, as with many creatures of the lower orders. In a young specimen, not above two lines long, the originating branchiæ were denoted by a few tubercular prominences, and the formation of the head was almost alike indefinite.—Plate XXXVIII. fig. 9 ; fig. 10, the same, enlarged.

In specimens of inferior dimensions the branchiæ are few, and of greater simplicity than in adults. At that time, or rather on an increase of their number by the animal advancing, they seem to be arranged in a double row on each side of the cloak, one being within the line of the other ; and the whole border composed of them consisting of those alternately larger and smaller. Thus, supposing the first of the branchiæ, next the corniculum, to be larger, and in the outer line, the next of the inner line is smaller. If the first of the outer line be small, the next of the inner is large. In later stages their structure is more pinnate ; they are light and feathery, whereas in the earlier stages, they are somewhat foliaceous or palmate.

All these characters are stronger or weaker according to the specimens ; and very often according to their degree of development from prevalent temperature or other cause.

Specimens are very impatient of heat ; they require copious and frequent renewal of their element.

A great quantity of mucus is secreted from the skin, possibly designed by Nature only for temporary purposes. Brushing it off with a feather seems beneficial. The secretions are very ample from the tribe



in general. When adhering to the surface of the vessels whereon specimens repose, it should be removed. The Abbé Dicquemare remarks, that an organ beneath the posterior extremity is the source of this mucous matter.

Some of the race of the *Doris* are more languid than others, but all are extremely sluggish. The smaller swim supine, but they can be seldom incited to motion.

From the great diversity of size and colour, from the scantiness of the branchiæ, their dimensions and appearance, also from the indentations of the flap, sometimes seeming an entire piece, sometimes cleft almost in two down the middle, I was long induced to contemplate the subdivision of the *Tritonia Hombergii* into distinct species. But after seeing many of all different dimensions, colours, and proportion, extending between four lines and eight inches, I am not prepared to deny the identity of the whole as belonging to a single species. Progressive evolution produces an incredible change.

PLATE XXXVIII.

- FIG. 1. *Tritonia* [*Doris*] *Hombergii*, adult, back.
 2. Belly.
 3. Corniculum of an adult.
 4. Branchiæ.
 5. Younger specimen with few branchiæ, back.
 6. The same, profile.
 7. Corniculum of the same, enlarged.
 8. One of the branchiæ of the same, enlarged.
 9. Minute specimen.
 10. The same, enlarged.
 11. Spawn of fig. 5.
 12. Portion of spawn, enlarged.
 13. Another deposit of spawn.
 14. Nautiline from the spawn, magnified.
 15. Nautiline from the spawn, magnified.
 16. Nautiline from the spawn, magnified.
 17. Nautiline from the spawn, magnified.
 18. Empty shells of the Nautiline, enlarged.

PLATE XXXIX.

- FIG. 1. *Tritonia Hombergii*, spawn.
 2. Spawn, enlarged.
 3. *Murex antiquus*, spawn.
 4. Young of the same, from the spawn.
 5. One of the young magnified, shewing some correspondence with the Nautiline.
 6. Another.
 7. Pellets discharged by the young, enlarged.

2. TRITONIA CERVINA.—Plate XL. Figs. 1–13.

The aspect of this animal is very singular, because its form is of the most remarkable kind. Naturalists have bestowed different names on it; some of them, and apparently those the most appropriate, from the striking resemblance of the more conspicuous members to a stag's horns. Nevertheless, in the copious and learned work of Messrs Alder and Hancock, it is proposed to restore a name said to be originally given by Müller—*Dendronotus*. With great submission, I would prefer that which is most explicit.

It is impracticable to describe or to explain the appearance of this creature without figures—indeed, scarcely with them. Artists, besides, have particular modes of representing objects, according as they hope to render them most intelligible.

The branchiæ rise upright from the cloak; but, by being so represented, they interfere with the view of each, and produce nothing but confusion.

Instead of representing them here as upright and in profile, they are seen in the figures as viewed from above, and as if diverging in plane, whereby all the parts are exposed quite distinctly.

Length of specimens from an inch to an inch and a half. Body narrow in proportion, fleshy. Head rounded, extremity tapering. Mouth situate amidst the corrugated face of the under surface. The cornicula, *a*, rising from the neck, consist of two distinct members; first, a pillar, with a socket above, cleft into five or six irregular leaves, serving as a



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Cornu h.

receptacle for the tentacular or sensitive portion, which resembles a fir cone. Five or six pair, or more, of palmate branchiæ rise from the margin of the back, *b*, the number and dimensions depending on the age and size of the specimen. Towards the posterior extremity, these gradually shorten and simplify in structure, and at length degenerate into mere prominences. Several organic prolongations, besides, of different character, likewise issue from the anterior part. The orifice of the oviduct opens under the right of the branchia of the first pair.

The whole upper surface of the animal presents a tuberculated aspect, which is certainly heightened by the variegation and interspersion of colours, sometimes exhibiting delusive appearances.

Plain or mottled brown predominates in the colour of the Stag-horn Doris; sometimes with white extremities. Small sized live specimens, of dingy white, have occurred. One, perfectly white, an inch and a half long, but scarcely surviving, seemed of the same species. In such light-coloured specimens, especially if young, ocular specks may be occasionally recognized behind the roots of the cornicula. Besides more obscure examples, a white patch with a black speck appeared at the exterior basis of each corniculum, in a small specimen. But observations on this subject have not been satisfactory.—The pulsation of the heart, in favourable specimens, is very distinct, the great dilatation being backwards, as a circular segment, below the first pair of branchiæ. On favourable occasions, also, two marginal channels, running along the back, may be discovered, penetrating the roots of the branchiæ, from whence they are distributed towards the extremities.

The union of these animals has been witnessed in October. It was once followed in two days by spawn. On the same day, another union ensued, both animals being much reduced in size, as is always concomitant on breeding.

The spawn consisted of two portions, each a waving rope in a logarithmic curve. The larger, composed of three coils or volutions, was the sixth of an inch in diameter, the ova pure white.—Plate XL. figs. 8, 9, enlarged.

The young having come to maturity in twelve days, escaped in the

same form as the *Nautilines* of the *Tritonia Hombergii*, above described, as mere specks : they likewise traversed the water rapidly. The shell seemed to be rather longer than that of the other, less incurved, and with scarcely more than a notch for an orifice. It is of extreme transparence, without any visible connection with the body of the animal it contains. The internal organs of the included animal, the two spots about the same site as of the tentacula of the adult, and the activity of the cilia, are all conspicuous.

For eight days the animals were quite entire and transparent, having undergone no alteration, but afterwards they contracted and disappeared, leaving their shells at the bottom of the vessel as before.

Perhaps this species feeds on the *Sertularia abietina*.

This animal is not common.

PLATE XL.

- FIG. 1. *Tritonia cervina*, adult, upper surface. Cornicula, *a*, natural size.
 2. Another specimen, under surface, slightly enlarged.
 3. Corniculum, enlarged.
 4. Branchiæ, enlarged.
 5. Younger specimen, enlarged. Back. Cornicula, *a*. Branchiæ, *b*.
 6. Another specimen, outline enlarged, upper surface.
 7. Under surface of the anterior part of fig. 6.
 8. Spawn.
 9. The same, enlarged.
 10. Nautiline.
 11. The same, contracted in the shell.
 12, 13. Empty shells.



Tribonia Pennatipeda

SECTION II. TRITONIA.—Body fleshy, solid, lanceolate. Head hammer-shaped. Tentacula two, simple, retractile, in long trumpet sockets. Branchiæ marginal, erect, tufted, or composed of successive stages.

1. TRITONIA PINNATIFIDA—*The Crested Doris*—*The Crested Tritonia*.—
Plate XLI. Figs. 1, 2, 3, 4, 5.

The transitions of form of the different parts of these animals render it difficult to comprehend more than very few under the same paragraph. Both the species of the preceding section are distinguished by the peculiar form and arrangement of the tentacula, branchiæ, and coils of the spawn. But the head is scarcely to be called of any definite form as such.

Here the head is more definite, being somewhat in the form of an ordinary hammer. As we advance in considering the species of the tribe, we shall find successive changes in this part of the animal, such as may lead to the foundation of new divisions.

Length of the *Tritonia pinnatifida* an inch, breadth two lines. Body lanceolate, shoulder rounded. Head hammer-shaped, having a projection on each side. Tentacula two, rising upright from sockets, susceptible of considerable prolongation. A row of marginal branchial tufts on each side of the back, which is bare and the skin smooth. Colour white, dingy brown, yellowish, or greenish.*

The figure of the head and tentacula are constant features: the number of branchial tufts, their dimensions, and the colour of specimens, are variable.

One specimen had nine pair of branchiæ, another eight, which latter number, if I mistake not, Dr Johnston ascribes to the animal, in his valuable contributions to the Scottish Fauna, observing, at the same time, that various authors, whom he quotes, derive their descriptions from Montagu. I had a third specimen with seven pair, some with still fewer.

* Montagu, in Linnæan Transactions, vol. vii. p. 78, Plate VII. fig. 2. Although this figure is not satisfactory, it certainly indicates the species mentioned here.

The paucity of these parts, however, only shew the earlier stage of the specimen, as the branchiæ are of successive evolution with age and dimensions, while they attain greater perfection of form. Those of the second or third pair are the longest, the rest diminish gradually towards the extremity of the animal.

At first sight the branchial tuft bears considerable resemblance to a fir cone. It consists of a series of prolonged prominences, arranged in circumferential stages. About twelve such stages constituted the largest tuft.—Fig. 4. The colours of the branchiæ commonly correspond with that of the body, but darker. The first specimen above referred to was white, smooth, the surface much like sheep-skin leather; the branchiæ pale purple. Many specimens are white, which is perhaps converted to brown, as the tips of the branchiæ have been observed darkening.

No eyes have been discovered, though the white or fair colour of subjects might favour their detection.

The orifice of the oviduct is under the root of the right tuft of the first pair of branchiæ. Specimens appear quite turgid with spawn, at various seasons, produced alike in July and in January, or at other seasons. It is deposited in the form of a waving ribband, containing numerous milk-white spherical ova, imbedded in albuminous matter.—Fig. 5.

From the quantities of spawn found on the *Sertularia (nemertesia)*, *antennina*, perhaps the animal feeds on that zoophyte.

This species is very subject to mutilation of the branchiæ. Two specimens, the one with eight pair, the other with six or seven, had lost thirteen tufts between them, in the course of their second night of confinement; and, in two more nights, the former had only three tufts of the whole remaining. These organs are regenerated. A smooth white papilla denotes incipient reproduction. Thence some specimens appear deformed, from the disproportionate size and position between the old and the renovating parts; though all will prove complete and symmetrical ultimately.

No regularity appears to govern the loss of the branchiæ, either in

size, place, or approximation. They are detached, either when together or asunder.

PLATE XLI.

- FIG. 1. *Tritonia pinnatifida*, adult, profile.
 2. Back.
 3. Belly.
 4. Branchial tuft, enlarged.
 5. Spawn.

The distinctions among these animals are so slight, as to impair our confidence when desirous of constituting different species, for which it is easy to mistake mere varieties. Such should be named rather indefinitely or provisionally, so that they may fall out of the list, without leaving any hiatus of consequence.

2. TRITONIA PUNCTATA.—*The Speckled Tritonia*.—Plate XLI. Figs. 6, 7, 8.

This species presents some striking analogies with the preceding.

Length seven lines ; branchial tufts, five, six, or seven pair, according to the age and dimensions of the specimen. In one about three lines long, with five pair, the longest tufts consisted of three circumferential stages. These successive stages are not quite so definite as in the preceding. The tentacula resemble the former : the sockets are very dilatible ; and the animal shews great power over their form. A black speck is situate at the root of each. The colour of specimens is white, speckled with red ; and sometimes so very profusely, that the back seems almost uniformly stained by it.

A quantity of spawn, of much the same general character as the preceding, but less regular, was deposited by a specimen, about half an inch long, with six pair of tufts, on 14th April, which had hatched in eleven days.

This is a beautiful animal, whenever the variety of speckling of

different specimens is very great, and the contrasting colours very ornamental. It is neither rare, nor of difficult preservation.

PLATE XLI.

FIG. 6. *Tritonia punctata*, enlarged: back.

7. Another specimen: belly, enlarged.

8. Spawn, enlarged.

The valuable work of Messrs Alder and Hancock contains a magnified view, and some account, of an animal bearing considerable resemblance to this species, under the name of *Doto coronata*, Family 3, Plate 6. But I scarcely think the two are to be identified as the same.

3. TRITONIA DIVARICATA.—Plate XLI. Figs. 9, 10, 11.

Length four lines, breadth under one; two black specks between the sockets of the tentacula. Two pair of branchiæ rise from the back, each consisting of two or three stages of short obtuse cylinders, spreading around a central one, which is considerably larger. Colour very pale watery blue, with short irregular brown streaks. The tentacula extend far from the socket.

The adhesion of the animal is tenacious.

Only a single specimen has occurred.

This, when taken in October, was mutilated of two of the tufts. Regeneration appeared in a week; and it had advanced far in some weeks, during which the animal survived.

PLATE XLI.

FIG. 9. *Tritonia divaricata*, enlarged: back.

10. Belly.

11. Tuft, enlarged.

4. TRITONIA CONIFERA—*The Pine Tritonia*.—Plate XLI. Figs. 12, 13.

I have sometimes conjectured that the subject of this paragraph might be a *lusus naturæ*; but not being entitled, without better evidence, to presume that it is so, a place is reserved for it here.

Length five lines; general form and aspect resembling the *Tritonia pinnatifida*; tentacula two, long, retractile, within dilatable sockets; a dark speck is obscurely seen, behind the root of each, by the microscope.

Six pair of branchiæ: two, being a pair of stumps, rise from the back. The first pair is very low, the second disproportionately large, the third pair not half their length or thickness, the fourth and fifth diminishing, and the stumps denoting incipient organization. Besides all these, a large central branchial tuft or cluster is situate on the back, between the two branchiæ of the third pair. The structure of the tufts bears some resemblance to a pine-apple, the prominences somewhat higher comparatively. Colour of the animal dingy white, the tufts darkly speckled.

The motion of this animal, when crawling, appeared unsteady, from the disproportion between the size of the tufts and of the body. Under the microscope the latter resembled ovoidal prominences; the central one, at the summit, larger than the rest. Five series, or stages, compose the tuft.

Only one specimen of this animal occurred, which survived nine weeks.

PLATE XLI.

FIG. 12. *Tritonia conifera*.

13. A tuft, magnified.

Note.—A species, somewhat analogous in the formation of the branchiæ, is referred to in the *Melibœa fragilis*.—*Forbes' Malacologia Monensis*, p. 41, Plate I, figs. 4, 5.

SECTION II. DORIS.—Formerly the whole tribe of animals, whereof this group is now only an inconsiderable part, was distinguished as the Doris ; and, under that name, comprehended a great number and variety of species. In dismembering the Linnæan genus, a separate section was reserved for the name ; though it might have been more consistent to have retained it, as generally indicating the entire race.

Body totally or partially invested by a cloak. Tentacula two, retractile, within sockets. Branchiæ concentrated, in circular arrangement towards the posterior part of the back, and collectively retractile.

1. DORIS VERRUCOSA—*The Warty Doris*.—Plate XLII. Figs. 1, 2, 3.

Length twenty lines, breadth eight lines, thickness six lines ; figure, in repose, the longitudinal section of an ellipsoid ; head a broad thick flap, with a curved margin, somewhat narrower than the shoulder, or anterior part of the sole ; mouth in the under surface of the head, which becomes very conspicuous after death. Two tentacula, with indented sides, issue from two very low sockets, almost level with the skin, wherein they are retractile. The branchial apparatus, composed of eleven or twelve foliaceous or pinnate organs, with the vent in the centre, is situated towards the lower extremity of the back, into which it is totally retractile within the body, the orifice closing over it.

The colour of this species is extremely variable, such as would indicate varieties, were it not for other constant features. It is pure white, dark grey, mottled brown, and all intermediate shades, frequently so disposed as to exhibit no imperfect resemblance of a moth.

The warty Doris is both pelagic and littoral, and it is the most common of its tribe. Thirteen occurred at once between the valves of an old empty shell ; and fifteen, at another time, among a moderate quantity of miscellaneous collections.

It is extremely sluggish, and seems to exist almost in constant torpor ; never feeding, and very seldom crawling, in confinement.



1



17



5



18



7



15



13



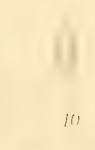
9



3



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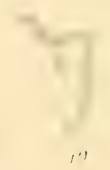
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12



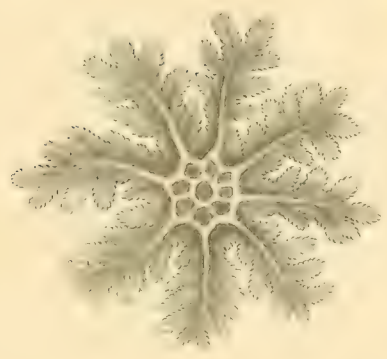
14



16



15



2

C. pus. C. pus.

The spawn of this animal is produced in the form of tape or ribband, about an inch broad, and above a line thick. The length depends on the dimensions and the age of the parent. One of middle size (for few attain the dimensions as above assigned) produced what must have contained at least 20,000 ova, in the course of ten days, ending with the first week of February.

The orifice of the oviduct is on the right side. The end of the spawn first produced is affixed to a solid substance, and the remainder is delivered as a broad waving frill, apparently in one continuous web, where in a convenient position. But probably, from some inconvenience, that which is just referred to was discharged in interrupted portions, not above an inch long, and about three lines broad; resembling a thin white silk ribband. Here the ova were pure white, spherical, not the twentieth of a line in diameter, lodged amidst an albuminous mass. More than one is the thickness of the ribband. Under the microscope the ovum consists of a white central speck, within its own peculiar albumen.—Plate XLIII. fig. 5.

Perhaps the spawn sometimes appears a belt or web, in spiral arrangement, such as Plate XLIII. fig. 1.

But here I must be allowed to express some embarrassment, especially regarding the parentage of certain extraordinary quantities of spawn, sometimes occurring in the course of observation. The *Doris*, it is true, is a remarkably prolific creature, like some of the other molluscous animals; and it does baffle conjecture to account for the fate of a vast proportion of its young. The contents of a single mass of spawn, certainly the produce of a single parent, seems to exceed computation. Two examples may be quoted.

A mass occurred in February, which had been deposited on the outside of the lower valve of an old oyster-shell, to which the upper valve was still united. This consisted of a waving belt or ribband, from seven to nine lines broad, a line thick, and which could not be under two feet in length, if extended. It was affixed by the edge, in such a position as to be erect, and resembled fine white frills.—Plate XLIII. fig. 2.

Herein were contained ova in millions.

The other specimen, also consisting of a surprising quantity, and of much the same character, was deposited on the exterior of an old oyster-shell. It was little inferior in extent, and consisted of many convolutions, in more picturesque form, and formed a beautiful aggregate of frills.—Plate XLIII. fig. 3. But I could not ascertain whether the parent was the *Doris argo* or the *Doris verrucosa*, though some inclined to ascribe it to the latter. This beautiful specimen occurred likewise in the month of February.

The margin of all this kind of spawn is thick, transparent, and distinct; nothing is lodged in it. The ova are contained amidst the albuminous matter, lower in the ribband.

In some parts of the former, the young were far advanced, when it resembled the texture of the finest lace.—Plate XLIII. fig. 4.

More than one ovum had a place in the thickness of the spawn; all were arranged in lines and curvatures, but without any regularity there or in their dimensions.

The contents of the ribband are sometimes very distinct.—Plate XLIII. figs. 5, 6. Also, where the young are seen in the ovum, it sometimes appears to contain two. Yet this may be a deception, if a single embryo naturally belongs to the animal, as is probable; for the separation of the two integuments may be imperceptible.

In the second deposit above mentioned (fig. 3.), as it advanced gradually to maturity, the Nautilines became more and more distinct. They were better seen than in any preceding spawn; and here was an instance of two in some, and three in others, occupying single ova.

A portion of this being cut off with scissors, it was subjected to the microscope. A singular scene was disclosed. The most mature part consisted of perfectly transparent capsules, quite spherical, all apparently connected, because deposited amidst albuminous matter. The whole appeared merely white specks to the naked eye.

A spherical integument evidently formed each capsule, including two or three Nautilines, which were in the greatest activity; a few had only one, and a solitary capsule contained four. Their form was clearly defined; their activity very great within, equally as after liberation.

They came into mutual contact, as they were seen tumbling over each other. The integument of the capsule must be inconceivably thin, from its transparency. It is doubtful whether, of these four Nautilines contained in a capsule referred to, each is confined in its own peculiar integument.—Plate XLIII. fig. 7.

This great deposit, obtained on the 12th of February, was chiefly dissolved and broke up on the 1st of March; and numbers of the Nautilines were observed floating at the surface of the water.

All this was of no avail, however, in determining whether the spawn had been produced by the *argo* or *verrucosa*; though the subjects afford good illustrations of the general nature of the Doris.

It is not easy to obtain a satisfactory microscopical view of the composition of the prolific ribband, and it would be vain to attempt computing the multitude of the offspring from a single individual.

The propagation of this animal is not confined to any particular season, though more common in the earlier part of the year. Vast numbers of young have been matured from spawn produced in March. Multitudes of the Nautiline formed a whitish scum on the surface of the water of a vessel, which, exposed to the microscope, proved partly those creatures, partly their empty shells. It should be understood, that the shells are simple cavities; they contain neither chambers nor partitions. When occupied, the animal appears wholly grey, with several internal sacs or solid organs; also a transparent vessel, of considerable size, containing a colourless fluid, wherein dark globules are suspended and carried about, as if around the interior circumference. All Nautilines exhibit two external circular spots, apart, on the middle of the front, which certainly denotes two organs in the earliest stage.

Although this be the most common of the tribe, often dwelling little within low water-mark, and occurring of very small dimensions, I have never met with it, or with any other so minute, or of such form, as would indicate transition from the Nautiline. Perhaps it feeds on the algæ and the fuci. It is of the most sluggish nature, and actually becomes agglutinated at last to the surface whereon it reposes.

This species is prone to quit the water.

PLATE XLII.

- FIG. 1. *Doris verrucosa* : back.
 2. Belly.
 3. Branchial teeth.

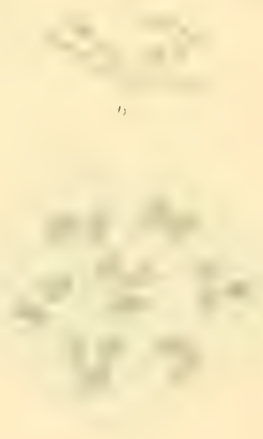
PLATE XLIII.

- FIG. 1. Spawn of the *Doris verrucosa*, or *Doris argo*, in a spiral form.
 2. Another deposit, in great quantity.
 3. A deposit still more ample.
 4. Spawn refining, in its progress to maturity.
 5. The ova, or capsules, in a portion of spawn, enlarged.
 6. Capsules containing more than one Nautiline.
 7. Portions of Fig. 2, shewing the Nautilines within capsules, enlarged near maturity.

2. DORIS ARGO.—Plate XLII. Figs. 4, 5, 6, 7.

Formerly, when a more limited view was taken of the lower animals, authors were disposed to assume this species as the type of the genus *Doris*; and they may have been induced to do so, either from the facility of obtaining it, or from its dimensions, that of the Scottish seas being of size inferior only to the *Doris* or *Tritonia Hombergii*.—Plate XXXVIII. figs. 1, 2.

Length towards five inches; breadth towards two inches. Figure of the animal in quiescence oval. A verrucose or warty cloak forms the upper surface, and covers the whole body, which is quite smooth. The head and sole are distinctly separated; the former small, not exceeding nine lines in breadth, fleshy, with the mouth in the centre of the face; and each corner a very short obtuse cone. Two horns rise from the anterior of the upper surface, conical and obliquely indented like a cross cut file, issuing from low sockets, with a tuberculated margin. The branchial apparatus is situate on the back near the posterior extremity. It generally consists of seven or eight foliaceous organs, finely fringed, resembling feathers, originating from a short pillar, with the vent in the centre. A prominent smooth rib, with five or six subordinate ribs, also smooth,



diverging from it to the margin, runs down the middle of each leaf. The whole apparatus is retractile within the body, where the lips of a wide gaping cavity close over it.

This animal is vernacularly called the Sea Lemon. From simple lemon-yellow it appears greatly diversified with purple patches. Of five specimens taken 6th March, four were of pure lemon-yellow, and the fifth of faint purple, variegating a dingy yellow ground. Of other five taken on March 9. of a different year, some were either of plain lemon-yellow, or variegated with small purple patches. The principal difference among many appearing in nothing but the dimensions, and in the greater or less profusion of purple, for yellow always predominates. The finest are saffron-yellow. All the preceding were above middle size, or extending more than two inches and a half. But the full size of this animal is to be very seldom seen. Its torpid inactivity is surprising ; it scarcely ever moves, and commonly dies very soon in the first vessel to which it has been committed. I have never been able to preserve a specimen any considerable time ; and the artists have seldom procured a sufficient view for satisfactory representation. This seems from their real nature, but it may be also from the force required to detach so large a surface as the sole from rocks or stones. It does not appear that our specimens are smaller than those of foreign countries, as the Abbé Dicquemare computes the length of specimens on the coast of Havre at five inches.

The reader will remember what is said of the propagation of the *Doris verrucosa* in the preceding paragraph, as I have not been so fortunate as to discover the real and undoubted distinction.

PLATE XLII.

- FIG. 4. *Doris argo*, back.
5. Belly.
6. Another larger specimen, back.
7. Branchial apparatus.

3. DORIS (GONIODORIS) NODOSA.—Plate XLII. Figs. 8, 9, 10, 11, 12, 13, 14.

The two preceding animals, the *Doris verrucosa* and the *Doris argo*, are distinguished, 1. By a cloak covering the whole body, unless a small portion of the posterior extremity. 2. By two tentacula rising from the surface towards the anterior extremity. 3. By the site of the branchial apparatus on the back, wherein it is completely retractile.

The present subject corresponds in this last feature only.

All the parts are of different formation, some of them not far removed.

Length an inch ; breadth half an inch ; body thick and fleshy. Sole somewhat lanceolate ; shoulder round ; extremity slightly obtuse. Head broad, the corners forming two tentacular processes by duplication of the skin. Two cornicula rise from the anterior surface of the cloak. The branchiæ, usually eleven in number, are flattened organs, rise from the back, and are susceptible of being withdrawn into the body. The margin of the cloak is like a flounce, in projecting somewhat over the body and its curvatures. The whole animal is of a soft fleshy aspect, and fine carnation colour ; the surface smooth, with some white speckling, also reaching the sides, and apparently from the lowest tubercles.

This animal seems to feed on the *Ascidia papilla*, from which is certainly derived the reddish colour, rendering it a fine and delicate object. This is more obvious when viewed from below.

Two large and beautiful specimens having occurred on the 1st of July, they were committed to the same vessel. Their union took place on the 2d and 4th of that month, the head of one being diverted upwards, and that of the other downwards, so that both were reversed, as in the *Tritonia verrucosa*. Spawning ensued on the 4th and on the 18th of the same month. In both instances an irregular circular ring of spawn, about seven lines in diameter, and forming a rope above a line thick, was deposited on the side of the vessel, just below the surface of the water. On a third occasion, a rope was produced on the 3d of March, near the neck of a bottle, which would have extended three inches if in

a straight line ; the middle was irregularly circular, as if for casting a knot, and each end prolonged. The rope is always solid and clumsy, and above a line in thickness. The motion of Nautilines within the former spawn of July 4th, was visible on the 18th under the microscope.

This spawn is always of the purest white ; and the multitude of ova such as to make it appear almost solid. It comes to maturity, and the Nautilines are liberated in fifteen days.

This animal is not common.

PLATE XLII.

FIG. 8. *Doris (Goniodoris) nodosa*, back.

9. Belly.

10. Tentaculum.

11. Branchiæ.

12. Spawn.

13. Spawn.

14. Portion of spawn, enlarged.

4. DORIS (ANCULA) CRISTATA.—Plate XLII. Figs. 15, 16, 17, 18, 19, 20.

An animal is described by Messrs Alder and Hancock under the name of *Ancula cristata*, as given by a foreign naturalist, with which I apprehend the following may be nearly identified. But I acknowledge that there is such an enormous difference in the size of the magnified figures in the work containing them and any specimens I have had, that I feel some perplexity. A musquito magnified to the size of a partridge ceases to resemble the original.

Length seven lines ; breadth a line. Body thick, lanceolate. Head somewhat hammer-shaped, front obtuse, with an obtuse prolongation towards each side. Tentacula two, each originating from between two slender flexible processes about half the length of the tentaculum. Under half of the tentaculum smooth ; each side of the upper half deeply indented on each side by about ten short leaves. The tentacula somewhat clavate, with the tip cylindrical, and they are slightly recurved during progression. Two minute black eyes are behind their roots.

The branchial apparatus is situate in the middle of the back. It seems to consist of three quadripartite organs, surrounded by fourteen clavate organs, of which latter the number is variable in different specimens.

The predominant colour of the animal is bluish-white; the whole parts, tips and stems, enlivened by vivid yellow belts and stains.

The specimen represented spawned, on May 31, an irregular albuminous rope, extending nearly an inch, with pure white ova. Next day another portion, considerably smaller, was produced.

This is a beautiful animal, from the finely contrasted colours. It is not common.

PLATE XLII.

- FIG. 15. *Doris (Ancula) cristata*, back.
 16. Belly, delineated after the specimen spawned.
 17. Tentaculum, enlarged.
 18. Pinnate portion of the branchial apparatus, enlarged.
 19. Rope of spawn.
 20. Portion of spawn, enlarged.

5. DORIS CLAVIGERA—*The Club Doris*.—Plate XLII. Fig. 21.

Length six lines; breadth between two and three. General figure tends to a long ellipse. The body is wholly covered by tubercles and long papillary processes; the latter somewhat clavate, rough, and retractile. The form of the head is elliptical, as crossing the direction of the body, with a cylindrical white string from each side. A kind of flap, probably the margin of a thin cloak, investing the body, projects over it. The branchiæ, consisting of three pinnate organs, rise from near the middle of the back. About twelve elongating papillary processes rise erect, near the edge of the upper surface. The pinnate organs are all directed upwards, none of them downwards to the lower extremity.

This is a very beautiful animal. The ground colour seems white; the whole prominences and elongations tipped with vivid orange or yellow. It is rare.

PLATE XLII.

- FIG. 21. *Doris clavigera*.

SECTION III. EOLIS.—In the dismemberment of the genus *Doris* by recent naturalists, they have left a place for a very large section, under the name of *Eolis*.

But, so many novelties, varieties, and difficulties, continually occur to the practical naturalist attempting a systematic arrangement of such a numerous tribe as the *Doris*, as taken in its original signification and more comprehensive sense, that he will even find himself compelled to modify his general plans on a retrospect. He cannot discover such specific, exclusive, and permanent characteristics, as enable him to assume with confidence the exact principles laid down for his guidance, and, in general, he will find that instead of including the great field of Nature, they embrace but the narrowest portions of it.

Thus, we cannot yet admit the detail proposed by some systematic authors to be irrevocably settled. It is still open to alteration.

Though having had a multitude of specimens of the different families in my possession, as many, perhaps, as would have induced more skilful observers to frame several genera from them, I can never take a retrospect of the subject without distrust, so much had to be seen amidst the little that was disclosed. Therefore, instead of classing certain members in determinate series, I shall do no more than give a general description, and suggest how they may be united, from some of their most prominent features. The accompanying figures may contribute assistance.

The preceding sections comprehend such animals as may be generally discriminated with tolerable facility. Perhaps the whole to be included here are not alike definite.

EOLIS.—Tentacula two, prolonged from the head. Cornicula two, rising from the neck, without sockets. Back partly bare. Branchiæ commonly formed as elongated papillæ, tapering or enlarging from their origin on the upper surface, single or disposed in groups or clusters.

1. *EOLIS PLUMATA*—*The Feathered Eolis*.—Plate XLIV. Figs. 1, 2.

This animal extends about half an inch when crawling. The body slender, covered by a remarkable profusion of branchiæ, disposed in eleven or twelve rows, leaving only a portion of the back bare, behind the head. These are long and slender, and extend considerably over the posterior extremity. Representation of the whole is precluded, from their number. They bear no indifferent resemblance to a feathered cloak in the arc. The shoulder is somewhat enlarged. Colour universally greyish; tips of the branchiæ clear. Only a single specimen has occurred.

PLATE XLIV.

FIG. 1. *Eolis plumata*, back.

2. Belly.

2. *EOLIS RACEMOSA*—*Cluster Eolis*.—Plate XLIV. Figs. 3, 4, 5.

Length four lines; breadth under one. Head roundish, with a tentacular organ from each side. Body slender; shoulder enlarged. A black speck or eye at the base of each of the cornicula. Three or four pair of clustered branchiæ border the back, leaving the remainder bare. The first is composed of ten enlarging elongated papillæ, of various dimensions, as are those of all the others.

Colour whitish, with dark brown specks scantily distributed. A brown belt encircles the middle of each corniculum.

This is a lively animal; its adhesion is slight, and it is very rare, only one specimen having occurred.

PLATE XLIV.

FIG. 3. *Eolis racemosa*, back.

4. Belly.

5. Cluster branchiæ, more enlarged.



Colis - Plumata

3. *EOLIS MINOR*.—Plate XLIV. Figs. 6, 7.

Length seven lines ; breadth a line and a half. Head rounded in front, with two obtuse tentacula, shorter than the cornicula. At the external base of each of the latter, a black eye, very distinct. Back bare, bordered by several bunches of branchiæ ; about four being on the shoulder bunches : lower down the branchiæ are single, cylindrical, and obtuse, with a dark circle near the summit. They curve over the back. Colour universally mottled grey or dingy white ; on the skin are scanty white specks.

Only a single specimen occurred, near the Isle of May ; probably young. It seemed full of ova, but died in a day or two.

PLATE XLIV.

FIG. 6. *Eolis minor*.

7. Anterior portion of the same, enlarged.

4. *EOLIS DEAURATA*—*The Gilded Doris*.—Plate XLIV. Figs. 8, 9, 10.

Length above six lines ; breadth above one. Body lanceolate, slender ; front of it semicircular : shoulders broadening into two processes, somewhat obtuse. Tentacula and cornicula curving outwards. Two very black specks on the neck. Nine rows of ellipsoidal branchial papillæ cross the back, which is otherwise bare ; they decrease in length and in number as approaching the posterior extremity, so that only a stump is next to it.

The body is green, the papillæ purple, tipped with golden yellow.

This is a beautiful animal, abounding in vivid colours, agreeably contrasted.

Specimens have spawned in October and November. The spawn green, and consisting of two elliptical volutes, of confused form, is composed of pale green ova, amidst albuminous matter.

PLATE XLIV.

FIG. 8. *Eolis deaurata*—*The Gilded Eolis*—back, enlarged.

9. Belly, enlarged.

10. Spawn, enlarged.

5. *EOLIS VIRIDIS*.—Plate XLIV. Figs. 11, 12.

Length six lines; breadth under two. Tentacula and cornicula nearly of equal length, rather cylindrical and obtuse. A black speck at the base of each corniculum. Back bare; bordered by ten pair of branchial clusters of elongated papillæ, three, four, or five papillæ being in each cluster. The central papillæ of each cluster are the longest, the exterior the shortest. They are always of a dark green colour; the body green, of various intensity.

PLATE XLIV.

FIG. 11. *Eolis viridis*, back, enlarged.

12. Belly.

6. *EOLIS SANGUIFER*.—Plate XLV. Figs. 7, 8.

Length eight lines. Shoulder rounded; lower extremity acute. Head rounded in front, with two tentacula behind; while, at some distance, are two smooth, long, and slender cornicula. These are so closely approximated at the base, that they seem to fork from some lower organization. A black speck or eye behind each. Back bare, bordered by two pair of branchial enlarging papillæ. The branchiæ do not evidently form more than two clusters on each side in young examples. The whole papillæ of a large specimen amounted to forty-eight, being twenty-four of a side. On one, half the size, the same number occurred, the four lowest overtopping the extremity. No subdivision of these two clusters were obvious, therefore the sides appeared to be clothed by only one. They may, however, be rated at four in adults. Colour universally milk-white or watery blue. The cornicula have a reddish tinge; the branchiæ brighter than tile-red, their extremities white. The red is duller in some specimens; and it has faded with time in others. The young are more beautiful than adults.

This animal feeds on the *Tubularia indivisa* and on the *Tubularia polyceps*, infesting those Zoophytes in numerous colonies. In the history

of the latter species, given in the Rare and Remarkable Animals of Scotland, there is an instance of no fewer than sixty-eight of the Eolides being dislodged from a single group. The specimen, first observed on a stalk, afterwards descended among the less accessible parts, from whence it reappeared in two months, considerably grown, and the parts multiplied, the inseparable concomitant of greater age and dimensions.

The spawn is produced as an irregular ovoidal albuminous mass, containing 300 or 400 ova. It appears at various seasons, summer or winter, June or December; but the chief breeding seasons are perhaps March and April. The same specimen spawns repeatedly in masses like a minute sausage, larger or smaller, some measuring three lines in length, some much less. It appeared to me that on one occasion red spawn was deposited by a specimen, fig. 12; the same enlarged, fig. 13.

The ova of all the other spawn were white. Prolific animals are often turgid with spawn, which is visible. When deposited it is commonly attached to the stalks of the Tubularia, or it is at the surface of the water. Various specimens floating there, spawn in this manner.

Under favourable circumstances, the ova are seen to be in singular arrangement, as if in long compartments across the mass. Each ovum also is contained in an external ovoidal substance. Thus, the inner or central substance is probably the embryo.

A portion of spawn being subjected to the microscope, on June 18, numerous objects of those composing it were evidently in motion. This motion, on attentive inspection, certainly originated from the opaque part of the ovum, which, in turning within, presented prominences to the spectator. Many living beings were changing their position without removing, which indicated their confinement by some invisible medium, as they seemed exerting themselves for liberation. A portion of the mass separating soon afterwards, the moving bodies proved to be Nautilines, each within its peculiar ovum or capsule.—Fig. 14. Thus, the Nautiline constitutes the nucleus or white speck. It is the embryo; and as it advances, the intestinal organs display themselves, as the irregularities of shape which strike the observer's eye.

On raising and transferring one of the larger masses of spawn, a

week subsequent to the preceding remarks, it broke up when depositing, thus giving exit to a multitude of Nautilines, which swam with great activity; various individuals pursuing their course singly through the water, or several clustering together, were seen in horizontal revolution in the same place. Sometimes two in contact performed a common revolution, while many solitary animals did the same. It was a most peculiar, amusing, and interesting spectacle.—Fig. 15. But nothing more than what has been already recorded distinguished these diminutive beings. Sometimes, indeed, as may be readily imagined, a better view of species or of individuals may be obtained than usual. But we can scarcely allow that it is ever satisfactory: it may be often illusive; and, while instructing others, we may be unwittingly misled by imperfect observation. It seems to have been no part of the design of the Creator that the Nautiline should meet the eye of mankind. In fact, although we strive to render it plain, it is always seen imperfectly. Mere enlargement on a flat surface is not all that is required.

The parts of so minute an animal, passing through metamorphoses, are obscurely visible perhaps; but their functions may be the subject of conjecture. Observations, however, are generally intercepted, first by the water, however pure, secondly by the shell, however transparent. Thus they can never be entirely exposed, or always under the same aspect, to say nothing of the fallacies generally concomitant on microscopical observation.

Like its fellows, the Nautiline of the *Eolis* occupies a shell, serving as a receptacle whither it can retreat completely. It can return to display itself at pleasure, protruding partially beyond the orifice. There is the appearance of two cylinders, with marginal cilia in rapid motion, precisely as exhibited by the revolution of a wheel. When thus relaxed, the motion became so slow, that each of the cilia seemed to be distinguished distinctly. The two black points, previously alluded to, remained always apart, below the cylinders.—Fig. 16.

Some features inexplicable were presented by these minute creatures. At certain times preceding the protrusion of the body from the shell, a lid seemed to fold back, as if by a hinge. My artist, occupied in delineat-



Sela

tion, considered it a real lid. I cannot presume to assent to this, as it might be some disproportionate part of the organization protruding, to be subsequently modified.—Fig. 17. When it was withdrawn, or the lid closed, and the Nautiline quiescent, the figures resembled the object in fig. 18.

But there are so many illusions ready to deceive the observer, in contemplating such difficult and unintelligible objects—also with two different intercepting media from view—that he can never speak too diffidently regarding them.

The true colour of these creatures seems white; their shells are remarkably smooth and shining, which is best seen in a number floating together at the surface of the water, apparently unable to descend.

Among those at the bottom of the watch-glass, were some corpuscles of uncertain nature, like a dark spherical ovum, with a transparent coating.

The *Eolis* dwells in society. I have scarcely ever found it solitary. It is one of the few whose food is known, which renders it a favourable subject for observation; and, as the young grow readily and rather speedily, a progressive evolution of their external organs may be satisfactorily investigated.

PLATE XLV.

FIG. 7. *Eolis sanguifer*. Back.

8. Belly.

9. Spawn.

10. The same, enlarged.

11. The same, more enlarged.

12. Spawn of reddish colour.

13. The same, enlarged.

14. Nautilines in the spawn.

15. Nautilines, free.

16. Nautiline, more enlarged.

17. Another, with the lid.

18. One with the apparent lid closed.

7. *EOLIS CONSPERSA*.—*The Sprinkled Eolis*.—Plate XLIV. Figs. 13, 14.

Length above four lines ; breadth a line. Tentacula and cornicula rather stout, and nearly equally long. A black speck at the base of each corniculum. Back bare, bordered by several branchial clusters of elongated ovoidal papillæ, neither so numerous, nor so definitely clustered, as in other species with similar clusters. Upper surface universally pale yellow. Clusters olive brown, sprinkled with white tips, and roots of the papillæ lighter. Cornicula of one specimen tipped with yellow. This animal is very rare.

PLATE XLIV.

FIG. 13. *Eolis conspersa*. Back, enlarged.

14. Belly.

8. *EOLIS INEQUALIS*.—Plate XLIV. Figs. 15, 16.

The chief characteristic of this species consists in the irregularity of its parts, both in size and distribution.

Length fifteen lines, breadth four. Head somewhat round. Shoulder rounded, body tapering downwards. Mouth wide, amidst thick lips in the face below. The cornicula are longer than the tentacula. They seem to fork from a short pillar rising on the surface of the neck. A dark speck on the neck, at each side of the cornicula. Middle of the back bare. The branchial papillæ, of very unequal dimensions, are scattered irregularly over the rest of it, not obviously in clusters, but more profusely on the shoulders. Colour of the body pale blue and dingy white ; extremities of the papillæ vivid yellow, centre dark.

Two specimens exhibited the same general features. The second was about half the size of the first. A third specimen from the Mar Bank, as I concluded, on 22d March 1850, extended about eight lines ; the branchial papillæ numerous, and rather disposed in tufts : only a few of them were tipped with yellow. The animal, originally weak, survived but a short time.

PLATE XLIV.

FIG. 15. *Eolis inequalis*. Back, enlarged.

16. Belly.

9. EOLIS MONOCEROS.—*Unicorn Eolis*.—Plate XLV. Fig. 1.

I am induced to allude, in this imperfect paragraph, to a specimen of the *Eolis*, with an organ which, from the preceding, may not be a monstrosity.

Length three lines; body lanceolate, slender, with three scanty clusters of long ellipsoidal papillæ on each side of the back. A pillar rises from the middle of the neck, which diverges into two cornicula, with about seven whirls in each. The pillar and corniculum equal each other's length; and their joint length equals that of the tentacula. The pillar is plain. It is situated between two black specks. Colour of the body white; centre of the papillæ dark.

This is a lively little animal, bristling up the papillæ on any annoyance.

Only a single specimen has occurred, and a drawing made of the corniculum. Before the whole subject could be executed, it had crawled out of the water and perished.

PLATE XLV.

FIG. 1. *Eolis monoceros*—Unicorn *Eolis*.—Corniculum, enlarged.

10. EOLIS TENAX—*The Adhering Eolis*.—Plate XLV. Figs. 2, 3.

Length seven lines; body lanceolate, slender; shoulders elongated, in triangular processes. Tentacula and cornicula extending about two lines. A black speck at the base of each of the former. Back rather meagrely clothed with elongated branchial papillæ, not definitely arranged in clusters. Colour light watery blue. A white line traverses the upper surface, also the back of the cornicula and tentacula. Papillæ partly orange. The whole extremities tipped with white.

A specimen occurred among the *Tubularia polyceps*, where it fed on the epidermis of the zoophytes. It was small, and had few papillæ. At first the length of the cornicula and tentacula was equal to about a third of the whole animal, which grew rapidly; but they did not extend in

proportion. Its size doubled in two months, accompanied by a great accession of branchial papillæ ; but the colour had faded.

This animal adheres with remarkable tenacity to the substance sustaining it.

PLATE XLV.

FIG. 2. *Eolis tenax*. Back, enlarged.
3. Belly.

In a small animal, only two lines long, which at first I rather thought a young specimen, the bunches of papillæ were four pair. Those on the shoulders were the shortest, and consisted each of three papillæ. The second consisted of two, and the third of the like number. The fourth pair consisted each of only one, but the longest of all.

This was a good example of the multiplication of these organs. The other specimen, when small, on being first obtained, had six or seven in each bunch on the shoulders.

11. *EOLIS HYSTRIX*—*The Porcupine Eolis*.—*EOLIS DRUMMONDI*?—
Plate XLV. Figs. 4, 5, 6.

This species is distinguished by its peculiar habits. The *Doris* is a sluggish animal ; and less animation is displayed by the whole tribe than is usually seen among the lower animals. Their form, indeed, is diversified, but their habits are nearly the same. It is otherwise, however, with the present subject, which is fierce and active, and clearly demonstrates very decided propensities.

On August 18. 1821, I took six specimens from among a colony under a very large stone, on the southern shore of the Forth, some miles east of Edinburgh, where none were ever seen before or since. Being indistinctly seen, they were at first supposed young *Asteriæ*, but when committed to a suitable vessel of sea-water, they soon shewed their peculiar form.

The largest extended eight or nine lines from the tip of the tenta-

cula to the extremity of the tail. The body rather of a broad lanceolate figure, the shoulders prolonged in slender processes, endowed with tentacular action. Back bare in the middle, clothed with four large bunches of long slender branchial papillæ, crossing each other towards the lower extremity of the animal when quiescent, and bristling up when suffering any annoyance. They are more numerous in proportion to the size of the specimen. The clusters on the shoulders of one consisted of thirteen, and on that of a smaller specimen, it consisted of eight. Head round, with the mouth wide and conspicuous, towards the front of the face below. The cornicula, about half the length of the tentacula, are indented on the upper part by about twelve whirls. At the root of each a very black speck denotes the eye. Colour universally delicate carnation of different shades; the central line of the branchiæ red; the whole extremities of the animal tipped with white.

On September 3, when the thermometer at ten o'clock morning and evening stood at 66° and 70° respectively, the pulsations at the heart were just sixty in a minute. They are very conspicuous in this animal.

The Porcupine Doris shews several peculiarities. It does not shun the light; its six appendages all exercise a kind of tentacular faculty. Its adhesion is slight, though its mucous secretions are abundant; but, above every thing, its voracity, so different from the usual habits of the Doris, is most remarkable. It fed voraciously on mussel, and on the periwinkle, whereof large portions being swallowed entire, the back rose in proportion to the quantity. The quality of the food also was disclosed by the transparency of the skin, which was very evident on one occasion, when a black Planaria was thus devoured.

It cannot have escaped the notice of practical observers, how seldom it is that the food of any of this numerous tribe can be ascertained, and how often all that we can provide is rejected. They are not commonly understood to be carnivorous; but the subjects of this paragraph were eminently so, for they sometimes gorged themselves to such an excess, as to be scarcely capable of moving. Contrary to the nature of most living animals, they seemed ready to devour their own species.

In six or seven weeks after capture, only two of the original six

specimens remained, the one smaller and weaker than the other. The union of this pair seemed to have taken place, and to have been productive. Yet soon afterwards, the larger unexpectedly devoured its mate, all except a portion, then conjectured to belong to the head, from which it endeavoured during hours to extract further nutriment.

A third specimen, previously in the same vessel, likewise smaller and weaker, had disappeared, having been probably devoured by its companions.

The older observers considered the *Doris* a hermaphrodite animal. But this opinion may be safely abandoned, by admitting the usual course of nature. The preceding union was on the 4th of October; spawning followed next morning, though probably not its consequence.

If the parent be vigorous, the spawn is deposited as the most regular undulating logarithmic curve of several volutes. But it appears in small spiral masses if the parent be attenuated.

The transparence of the body exposed the formation of the ovarium in clusters, as if occupying the whole cavity of the abdomen, towards the close of August. Yet the first spawning did not precede the 5th of October. The third on the 8th of October, consisting of seven entire and uninterrupted volutes; and another of five, followed on the 11th. This was succeeded on the 16th by four volutes, more perfect and regular, if possible, than any of the former, fig. 6. Now it was computed that the whole hitherto produced might have extended twelve inches in one uninterrupted line. Spawn appeared at four subsequent intervals until November 6.

The orifice of the oviduct opens under the first branchial cluster on the right side. From hence the spawn issues like a coarse white thread, of albuminous consistence, studded throughout the diameter with ova. The extremity of the line first discharged being affixed, the parent recedes slowly and gradually in circumferential progression as expulsion of the thread continues, until the whole spiral figure is completed. But this is a very slow process, an hour being consumed in producing two volutions.

Here the diameter of the figure of the earlier spawn was six lines,

but the volutes had so diminished, that the later spawn did not exceed a line in diameter, and it resembled an upright spiral spring of eight or ten volutes, the lower affixed, the higher floating like a white thread in the water. Spawn was also produced at the surface, while the parent swam supine.

The young attain maturity in six days, when the spawn dissolves and disappears.

We have already adverted to the reproduction of the branchiæ in other species. A similar prerogative is enjoyed by those creatures with which we are now occupied. They assume many strange attitudes, and exhibit much violent action, more indeed than any other I am acquainted with. While reposing supine just under the surface of the water, the tentacula are recurved like ram's horns, the cornicula naturally directed downwards, and the branchial papillæ crossed on the back. If active, or during progression, any interruption or annoyance is suffered, the branchiæ bristle up in resentment or defiance. During contention for prey all are in action, when the vehemence with which both they and the tentacula seem to strike is surprising. The animals also bite each other. Thus they appear to be very irritable—contentious even in their amours. Under such agitation some of the branchiæ being detached, prove to be long, round, pointed, fleshy organs, very tenacious of life, contracting, extending, and apparently searching around them.

Whether it be in accordance with the necessities resulting from such a disposition, or that the species is merely more subject or more exposed to mutilation, the defective organs are speedily repaired. Soon after capture of the six preceding specimens, one of them had lost a tentaculum by the root, and another was deprived of the right or left corresponding organ, but reproduction operated vigorously. Half of the defective tentaculum was regained in a fortnight. Another specimen, after partial mutilation of a tentaculum, followed by partial regeneration, lost the whole by the root on the 25th of September, and, on the 28th, likewise a corniculum. Thus the animal was wholly mutilated of the right tentaculum and the right corniculum, two important organs, though by what means is unknown. The mutual animosity displayed between itself and com-

panion in the same vessel, from the bristling up of the branchiæ, and biting each other as they met, led to conjecture that it was from violence. On the 1st of October a papilla, rather cylindrical than conical, indicated renovation of the tentaculum ; and a low prominence denoted the originating corniculum. Both the organs had regained half their natural dimensions on the 31st, and were tipped with white.

Some of the other specimens also suffered mutilations of the tentacula, and conical papillæ subsequently arose from the stumps. But the preceding animal suffered most, for, besides complete privation of a tentaculum and corniculum, it lost a fragment of the posterior extremity of the body on the 9th of September, which remained still indented, instead of being pointed, on the 23d. None of the whole specimens survived long enough to admit redintegration of the defective parts.

The exhaustion concomitant on the profuse spawning of the prolific specimen above described enfeebled it so much, that, rejecting sustenance, and losing the adhesive faculty, it died, having shrunk to a third of its original dimensions.

The survivance of no specimen exceeded eleven or twelve weeks.

This animal is rare ; but about fourteen years after the preceding colony was taken, a small specimen, not extending above three lines, occurred, which reposed constantly supine in quiescence under the surface of the water. Its survivance was short.

After the lapse of other fourteen years, one occurred of larger dimensions, being about equal to the size of the largest of the former colony. The general disposition of all these animals was in correspondence.

PLATE XLV.

FIG. 4. *Eolis hystrix*.

5. The same, slightly enlarged.

6. Spawn.

12. EOLIS PURPUREA—*The Purple Eolis*.—Plate XLV. Figs. 19, 20.

Hitherto our attention has, with few exceptions, been directed to those species of the *Eolis* having the anterior of the shoulder or sole

rounded nearly as a circular arc, or extremely obtuse, including other characteristics. But there are some wherein this feature is entirely obliterated, the shoulders being prolonged into a triangular process, which advancing progressively through several species, at length narrowly resembles real tentacula; and they seem to participate somewhat of their nature.

From its conformation, perhaps, this species may be approximated to the *Eolis viridis*.

Length, from the tip of the tentaculá to the extremity of the tail, fifteen lines; breadth a line and a half. Body slender, tapering downwards to a point. Shoulder elongating in a slender recurving process, very flexible. Head small and round; mouth conspicuous below; cornicula somewhat taper; deeply indented, tending to whorls; a black speck behind the root of each. Back bare, each side bordered by five, six, or seven branchial tufts, according to the size of the specimen. The papillæ elongated, flattened, pointed, more prominent as the tuft is higher. In an early stage they are merely stumps. Colour of the body fine delicate purple; all the extremities white. Centre of the papillæ red, amidst a lighter hue. In some specimens the white tip seems surmounted by a black one. But the colour is not invariably purple, being sometimes rather of various red, or tending to faint orange. Yet it is always a beautiful and delicate looking creature, bristling up the papillæ when exposed to any annoyance.

When quitting the side of the vessel to swim supine, the anterior part of the body is folded together longitudinally.

Fine specimens are not common.

PLATE XLV.

- Fig. 19. *Eolis purpurea*. Back.
 20. Belly.
 21. Another specimen: Back.
 22. The same: Belly.

13. EOLIS PAPILLOSA.—Plate XLV. Figs. 23, 24, 25, 26, 27.

This species having been frequently the subject of observation and discussion, since first noticed by Baster in 1759, it is unnecessary for me to speak of it in much detail. But I cannot coincide with that author, in viewing it as one of the deformities of the creation :—“ *Doris hæc animal deforme est, et foedum aspectu ;*” for it has been to me a curious and interesting creature, when contemplating its history. There is one advantage also in its dimensions. From being the third largest of the whole tribe inhabiting Scotland, and the largest of its own particular kind, the *Eolis*, it may be very conveniently assumed as the type ; while the size of all its parts admits a ready field for anatomical investigation.

The finest specimen I ever saw was brought by Robert Wilson. Crawling, it extended completely four inches from the tip of the tentacula to the extremity of the tail, which, for about half an inch, is quite bare beyond the branchiæ, being a continuation of the bare portion of the back. The colour of the skin of this animal is formed from an intermixture of brownish, greyish, and reddish ; the branchiæ very numerous and very fine, of somewhat the same appearance. I never saw a finer animal.

Length two and a half inches from the front of the head to the posterior extremity ; breadth of the sole eight lines ; shoulder elongating in a triangular pointed organization, exhibiting somewhat of a tentacular faculty. Tentacula and cornicula each extending about three lines, the latter cylindrical, obtuse, and so close together as almost to fork from a common root. Head round, presenting, with the divergence of the long pointed tentacula, exactly the semblance of the head of an ox. Dr Johnston remarks, “ Head depressed ; the mouth terminal, sub-inferior, encircled with a dilatable lip, and furnished with a very short proboscis, which contains a pair of rather large, thin, oval, corneous jaws.”—*Magazine of Natural History*, vol. viii. p. 317.

A black speck, deeply seated in the flesh, appears behind each corniculum, which seems compound. Similar specks are seen in others ;

but I cannot affirm that they are ocular. No sense of the presence of external objects is ever shewn unless by feeling. Back bare in the middle, and clothed on the sides by long, flexible, extensile, subulate or awl-shaped branchial papillæ, disposed rather in rows than in bunches, and varying from 300 to 350 in number. These are in frequent motion, curving, waving, and bristling up, when the animal suffers any annoyance. The highest and the lowest on the side are the shortest.

Slight variations are seen in the form and the disposal of the branchiæ. The back is sometimes bare throughout. Of eight specimens, the back was bare down to the extremity in five; but, in the other three, only the upper portion of it was bare, while the lower part was clothed as thickly as the sides, and in rows as definite.

The colour of the body varies from faint purple to leaden-grey, and in some specimens even to brownish. The branchiæ are greyish purple, the texture of their surface resembling ivory. Carnation distinguishes the cornicula, while the back in their vicinity is reddish. A yellowish shade of the under surface denotes the internal site of the ovarium.

This is a very prolific species. Many individuals approach the shore in June, July, August, and even September, when a great profusion of spawn is deposited on the under surface of stones. In captivity, the animals spawn on the sides of their vessels, in the form of spiral ropes; or, swimming supine, the rope, which is always seen of the same form, is produced just under the surface of the water. On turning up the stones near low water, the spawn may be recognized, from its resemblance to numerous grains of rice. When in greatest profusion, it appears in the general arrangement of a logarithmic curve of two or more volutes. The cause of this peculiar form being assumed, has been previously explained. But the perfection of this figure depends on the motion of the parent being unrestrained. But peculiarities are often found, which I cannot pretend to explain.

A fine specimen (Plate XLV. figs. 24, 25) spawned on 6th February, in two complete volutes, resembling a coarse white thread, on the back of an oyster-shell; and, at the interval of a week, produced other two volutes at the surface of the water. Two weeks subsequent to the first

spawning, though considerably exhausted, it produced four volutes at the surface of the water, while swimming supine ; and twelve days later still, two volutes additional. The extenuation concomitant on the breeding of these animals is very remarkable. The specimen (Plate XLV. figs. 25, 26) is evidently much reduced from that cause. If surviving so important an incident, prolific animals probably resort to the depths of the sea.

The diameter of the mass of spawn is commonly from an inch to about an inch and a half. But here there is no uniform rule. A very fine, curious, and interesting example of spawn, is represented in Plate XLV. fig. 27. But the form here is very complex whereas it is usually simple, consisting of a curve nearly plain, or indented throughout. The present spawn occupied a stone on the shore : it consisted of two complete volutes ; but instead of these forming a single gelatinous thread or rope full of ova, here was a gelatinous rope, four lines in diameter, encircled by such a gelatinous thread in 120 circles, occupying the whole two volutes, from the centre to the extremity. I feel much perplexed how to describe this product intelligibly. But we may suppose the whole extended in a straight line, instead of preserving its curve, and in that case forming a cylinder, with a thread wrapped spirally around it. I doubt not that some illusion doubled the number of encircling spirals, as the same thread might appear next the eye, and as another beyond it. But such was the appearance, whatever might be the reality.

The spawn of this *Eolis*, I have said, resembles grains of rice. In the encircling spiral of the specimen before me, were found five or more such grains (fig. 12), somewhat enlarged. Under the microscope the grains consisted of a cluster of broad ovoidal transparent ova, each occupied by four or five Nautilines, the greatest number seen in any of them. At that time I had not previously observed more than a single Nautiline in the ovum. Here it was otherwise ; nor did any illusion mislead the eye, for the Nautilines were very active, continually interchanging places, crushing through their fellows in their respective prisons, as if compressed for want of room. The cilia of what were supposed their cylinders had at that stage become quite conspicuous. On June 16th,

the grains composing the spawn, and of snowy whiteness, had dissolved, when numerous Nautilines swam as pure white specks amidst the water, no larger than those from other species of the tribe.

I have remarked on different occasions, indeed, that Nautilines from the larger kinds were as small as Nautilines from the smaller; and that those of the *E. papillosa* exhibited the cylinders with the cilia almost as if protruding from within, like wheels; and, when withdrawn, that the cylinders closed like conic frusta over them; also, that the intestinal organization consisted of at least seven distinct portions.

On studying the external configuration of the *Eolis papillosa*, the observer must beware of delusion, from the contraction attendant on extenuation from spawning.

PLATE XLV.

- FIG. 23. *Eolis papillosa*: back, before spawning.
 24. Belly.
 25. Another specimen: back, after spawning.
 26. Belly.
 27. Spawn.

Note.—Besides the preceding, which I conclude to be all distinct species, various others have occurred, which, though less definitely characterised, are evidently allied to the same tribe. I shall select one as an example, regretting that any obscurities disguised it.

I. This may be descriptively called the Fan-head *Eolis*, as it certainly approaches more nearly to the race last under discussion than to any other.

Length three lines, breadth half a line. The anterior extremity dilates into two flat leaves, capable of folding together. Towards the side of each, a stout and rather short cylindrical tentacular organ rises upright from the back of the neck; and behind them are two very black

specks or eyes, apart from each other, not deep-seated in the flesh, but quite conspicuous.

The middle of the back is bare. Seven pair of elongated, clavate, truncated, branchial papillæ border the body. The upper four are considerably apart; the other ten more crowded together; and the lowest pair seem as if merely cleft asunder. The body is of a dingy colour, with white specks; the branchiæ, also speckled, shew a dark centre, amidst a lighter exterior.

Only one specimen occurred, which was lively and active, and survived about three weeks.

PLATE XLV.

FIG. 28. *Eolis ventilabrum*—Fan-head Eolis: back, enlarged.

II. Among the fuci in pools, on the southern shore of the Forth, and down as far as Eyemouth, is found an animal black to the eye, which is now ascribed to the Doridean tribes.

Length above a line, back very convex, belly narrower, best seen as it swims supine; front of the head thick, apparently cleft; eyes two, black, far apart, seated amidst a white portion on the upper surface. The body appears enlarging like a barrel over the narrow sole; so that the animal seems carrying a load.

On June 5, specimens, substances which I considered ova, were deposited on a fucus.

This animal dwells at about half tide.

When Dr Johnston first observed it, he proposed that it should be denominated *Limapontia nigra*. Messrs Alder and Hancock, in reclaiming it to the present tribe, propose a new order for its reception. Along with a description they give its anatomy.—*Annals and Magazine of Natural History, Science, &c. Second Series*, vol. i. p. 402.—Plate XIX. figs. 4, 5, 6.

THE NAUTILINE.

Among the most interesting facts pertaining to animal physiology, are the earliest form and condition of living beings. But, in attempting to discover what these may be, we are met by invincible obstacles, such as compel us to be content with assuming some later point of departure than the origin, and pursuing our course downwards.

In ascending very high, we should probably find some invisible germ the source of future evolution ; and that, in all living beings, such evolution is attained through the medium of successive changes. Thus it has not appeared, that the earliest stage of mankind hitherto witnessed presents a human being in miniature, but that the subject then resembles a worm.

Of later years naturalists have been ardently occupied with the study of metamorphoses, whereby many singular facts have been disclosed. But as yet their history is less marked by continuity than by the aspect of objects at considerable intervals, a circumstance not to be wondered at, on duly appreciating the extraordinary difficulty of accompanying or tracing the progress of living nature.

We have just beheld a series, not a succession, of unintelligible facts in the history of the Doris, whereof no rational or satisfactory theory is offered in explanation.

The figure of the parent is sufficiently obvious : it is reciprocally alike, wherever found in the adult state ; likewise there is the most perfect resemblance, in form and habits, between the earlier young at large, and the specimens of amplest size, though the external parts be less numerous. But here we are arrested. On rising towards the embryonic stage, we can find no more diminutive similitudes of the animal than those which we have taken for comparison with the adult.

It is reasonable to conclude, that the roe or spawn, so readily obtained in confinement, contains the elements of the offspring. Yet amidst thousands and tens of thousands of opportunities presented, we cannot trace any immediate connection between the living animal developed from it and the Doris itself.

The spawn is discharged by the parents in some variety, as a line, a rope, a coil, a curve, or a spiral, the finest of pure gelatinous consistence. Perhaps nothing visible is intermingled with the finest ; but on almost all, exposed to observation, are innumerable minute corpuscula. Besides the examples already dispersed throughout this section, I propose to add a few more illustrations, which, although very obscure in themselves, may satisfy some queries of the curious. I could have wished they had been more explicit as well as more numerous.

Originally these corpuscula are the merest specks, hardly to be discovered by the acutest vision. But, armed with the microscope, we find them becoming more distinct with the lapse of time. They evidently advance from an earlier to a later stage, acquire the faculty of motion, and at length, escaping the prison wherein they are confined, reach strength and maturity to swim in the surrounding element.

Thus we behold the connection of the Nautiline with the Doris. It exists in the spawn, but here our knowledge terminates. No resemblance, not the most remote, can be traced between the Nautiline and the parent of the spawn it has quitted. Its form is permanent ; it does not shew the slightest tendency to metamorphosis ; it undergoes no sensible change whatever, and it may be said to die exactly in the same shape wherein it was born.

If, by losing some parts and acquiring others, it approaches to maturity, this change is accomplished while beyond the cognizance of the naturalist. If it could be beheld in the sea, there is no means of following its courses, and, as disappearing, of recognizing it again. Thus there is no possibility of connecting the two.

The extreme minuteness of the Nautiline forms our main obstacle to the prosecution of its history. None of its parts, and scarcely the whole, can be distinguished by the naked eye ; and, under the microscope, those of all different species seem almost identically the same.

But, we can say that there is certainly a body contained in a shell of a particular shape ; that the body seems to consist of a sac, containing subordinate organization below, with two hollow cylinders, on which vibrate marginal cilia. All those parts appear tolerably distinct ; yet we

cannot speak with confidence of their true character. Some are dim or obscure from the interception of vapour, clouds, or films, lessening their distinctness to the eye.

All bear a general resemblance to each other, without betraying the precise action of any single member.

Thus it would be vain for us to reason on what they are, or what may be their use and purpose. The whole body is susceptible of some contraction within the shell, and of some protrusion beyond it. All are endowed with vigorous locomotion,—all contract, decay, and disappear, and leave incredible multitudes of whitened, spiral, wide-mouthed shells behind them.

As regards these general facts there seems to be no illusion ; they are daily verified.

The whole Nautilines contained in any mass of spawn are not produced at once. It is evident that the requisite degree of maturity is progressively attained. The life of all is short, and having escaped from confinement, they speedily perish.

It is extremely probable that, notwithstanding the preceding general conclusions regarding the reciprocal resemblances of these beings, and the form of their shells, many discrepancies and distinctions would be discovered by patient investigation.

Through the medium of the *Doris* we have been rendered familiar with the Nautiline, but it does not appear that this minute being is by any means peculiar to the tribe. There is reason to conjecture that a similar animal is seen in an early stage of many others.

Drawings of the different Nautilines have been very carefully executed, both as complete and of the shells only. But no great difference is to be recognized among them. Artists seldom coincide exactly in their representations of very minute objects.

But it must be owned that these objects are not seen with sufficient plainness and distinctness. Thus, the few remarks to be made on the subject, are intended simply for the purpose of attracting attention.

Let us remember what occurred with the *Murex antiquus*, one of our

largest Testacea. The Nautiline exists among its spawn. Possibly the Nautiline may belong to many of the Limacine species, and the univalve Testacea, as well as to the Doris.

A few facts may be stated without attempting to solve the obscurities.

Spots of spawn are found on marine vegetables, such as the *Laminaria* on the shore, within low-water mark. One, from an unknown parent, appeared in July, of small dimensions, and resembled a thick drop of yellow colour, almost hemispherical, with a depression in the centre. Possibly the true figure might have been a short bent cylinder, with the ends in contact, or nearly so, thus forming a circular ring.—Plate XLVI. fig. 1. Such spots consist of numerous minute white ova. When dissolving, on the 1st of August, a corresponding multitude of minute white specks, proving to be Nautilines, swam actively through the water; while others remained motionless at the bottom.—Fig. 2. The drop little exceeded a line in diameter, and it may have been the spawn of some Doris or of a testaceous animal.

Among the varieties of appearances disclosed by the spawn of the humbler animals of this tribe are the Nautilines, at rest or in motion. The specks, in an ovoidal mass of spawn, somewhat more ample than that from the *Doris sanguifer*, performed a revolution while confined within the capsule, as each was confined by its own integument. The cilia were quite visible while still enclosed there.—Fig. 3. When released from their prison by maturity, it was to display all the peculiarities of the Nautiline.—Fig. 4. They rose in multitudes from below, and formed a scum on the surface of the water, from which they were incapable of descending until precipitated by the vessel being shaken. Did we know the sources of that which we consider spawn to have been derived, our inquiries would be greatly facilitated; we could seek for corroboration, or weigh the causes of disappointment. Researches after marine products are so vague and difficult, and so often unsatisfactory, that all illustrations are most desirable. The two figures, 3 and 4, represent Nautilines from an ovoidal mass of spawn, from an unknown parent. In the former they are still confined, each within its own integument; in the latter they are

free. Another ovoidal mass afforded Nautilines, such as fig. 5, and the empty shells, fig. 6, the parent also being unknown.

In general, only a single Nautiline is confined in a single ovum or capsule; but there are examples, as we have seen, of three, four, or five being together. The integument is often of that extreme tenuity as to be almost invisible, and then the common liberty of the inmates is discovered chiefly by their interchange of places within their prison. While doing so within this limited space, a barrier environing the whole evidently prevents their escape. Perhaps we are yet unprepared for discussing this question, which must necessarily remain in much ambiguity amidst such scanty materials. Very little of the spawn of aquatic animals is known to naturalists, who can determine but little as the pristine produce of different tribes.

Pendulous clusters, of which we do not witness the origin, are frequently found on the Corallines,—the *Sertularia falcata* or *halecina*, for example, composed of spherules under half a line in diameter. They resemble bunches of minute currants, each of which is attached by its peculiar pedicle to a certain part. A cluster of this kind is represented Plate XLVI. fig. 7. A coating of the finest sand sometimes invests the bunches, from which others are entirely free. The sand can be discovered only by the microscope. I have not seen any species of the Doris to which these clusters might be ascribed.

The clusters, it will be observed, are composed of spherical capsules, either invested by sand, or partially or entirely free of it. On June 11, two capsules, partially free, being subjected to the microscope, exposed a number of irregular quiescent corpuscula, reddish in the one, and yellow in the other. Each of other two contained at least twenty-five corpuscula, also quiescent. Although the skin of the capsules was tolerably free of sand, their form was too obscure to be distinctly defined. Three of these four capsules are represented as enlarged, figs. 8, 9, 10. But in other two, entirely divested of the sandy coating, not fewer than twenty were discovered pursuing an active course amidst the liquid contents, and the last among them especially interchanging their places everywhere with the rest, figs. 11, 12.

These creatures seem to be opaque, solid, and heavy, and swimming with some exertion. The skin of the capsule was still too dark to admit exposure of any delicacy of organization, should it have been then unfolded. It only shewed the observer that they might be inscribed in rude spherical triangles, fig. 13. However, the capsular integument attenuating its form for days, the tenants were distinguished by great activity, while their precise form could be ascertained. On the 18th, almost all the capsules were quite freed from the sandy investment, now fallen in grains to the bottom, and then were beheld multitudes of beings swimming as so many specks at large in the water.

The numbers, now liberated, uniformly resembled the Nautilines so often described, only the cylinders seemed wider, and the sac or contents of the shell shorter than in any of the others. Their course was swift through the element, and the action of the cilia rapid. In all respects, allowing for the flexibility of the parts, their whole organization and habits, as far as I could determine, were to be identified with those of the rest, fig. 14. Such was the appearance of this numerous brood of Nautilines, and thus it continued until June 23. But they were very different when in retreat. In two days, only two of the multitude remained active. None survived in two days more. Their contents were speedily dissolved. Their shells, now empty, admitted of the most favourable microscopical inspection. They are white, rather pearly, consisting of a single volute, with a circular orifice, so wide as to exhibit no contraction whatever, fig. 16.

I was induced, by various reasons, to conclude these observations, corroborative of a course made eight years previously, though shorter, and with less perfect instruments. At that time the capsules of a cluster were rated at sixty or seventy, and the Nautilines included apparently larger than the last when free, were computed at thirty or forty in each. There were five capsules from the unknown parent, connected by slender ligaments, fig. 17; enlarged, fig. 18, three Nautilines from them; fig. 19, their empty shells.

The included animals traversed the whole fluid contents, which,

having dissolved in a week, liberated multitudes of their inmates, narrowly resembling all those I had seen before.

These animals were equally restless during confinement as after liberation. Their constant change of place and position rendered all computation of their numbers liable to fallacy, likewise, if appearing larger when confined than free, this may have resulted from some optical illusion, such as the convexity of the fluid contents of the capsules.

It is evident, however, that a single capsule is sometimes occupied as a common prison by a number of Nautilines, all confined in a common integument. Likewise, that the young animal is sometimes contained within its own peculiar ovum, from which it is to be liberated on attaining maturity.

Although I have made very numerous observations on the Nautilines, I regret to say that they appear so vague and indefinite to myself, that I cannot feel they will prove satisfactory to others.

Their presence under such a variety of circumstances infers a peculiarity which ought to receive farther investigation.

Apparently the Nautiline is the progeny of the Doris. Nevertheless I do not presume to identify the two, so long as observation and experiment are wanting to prove the fact.

Many minute specimens of many species of the former have fallen into my possession, yet I never beheld any so minute that a thousand would not be required of the Nautiline to equal its size.

Nothing has hitherto indicated the slightest approach to metamorphosis. No incident whatever has attended the existence of the Nautiline, excepting its death in the shell, proving the transient life of the one, and the permanent substance of the other.

If such a metamorphosis succeeds, as we are induced to believe, there are indispensable conditions necessary in food, in temperature, a marine abode, and the like, for which there is no suitable substitute in confinement.

Without affirming that the tenant of the shell of the Nautiline is allied to *Animalcula infusoria*, it would be gratifying to see the result

of experiment on the different species of such creatures generated amidst albuminous matter.

Meantime the production of the Nautiline, whether a larva or not, from the spawn of the Doris, is alike positive and invariable as of the embryo and the chick from the ovum of a fish or of a bird.

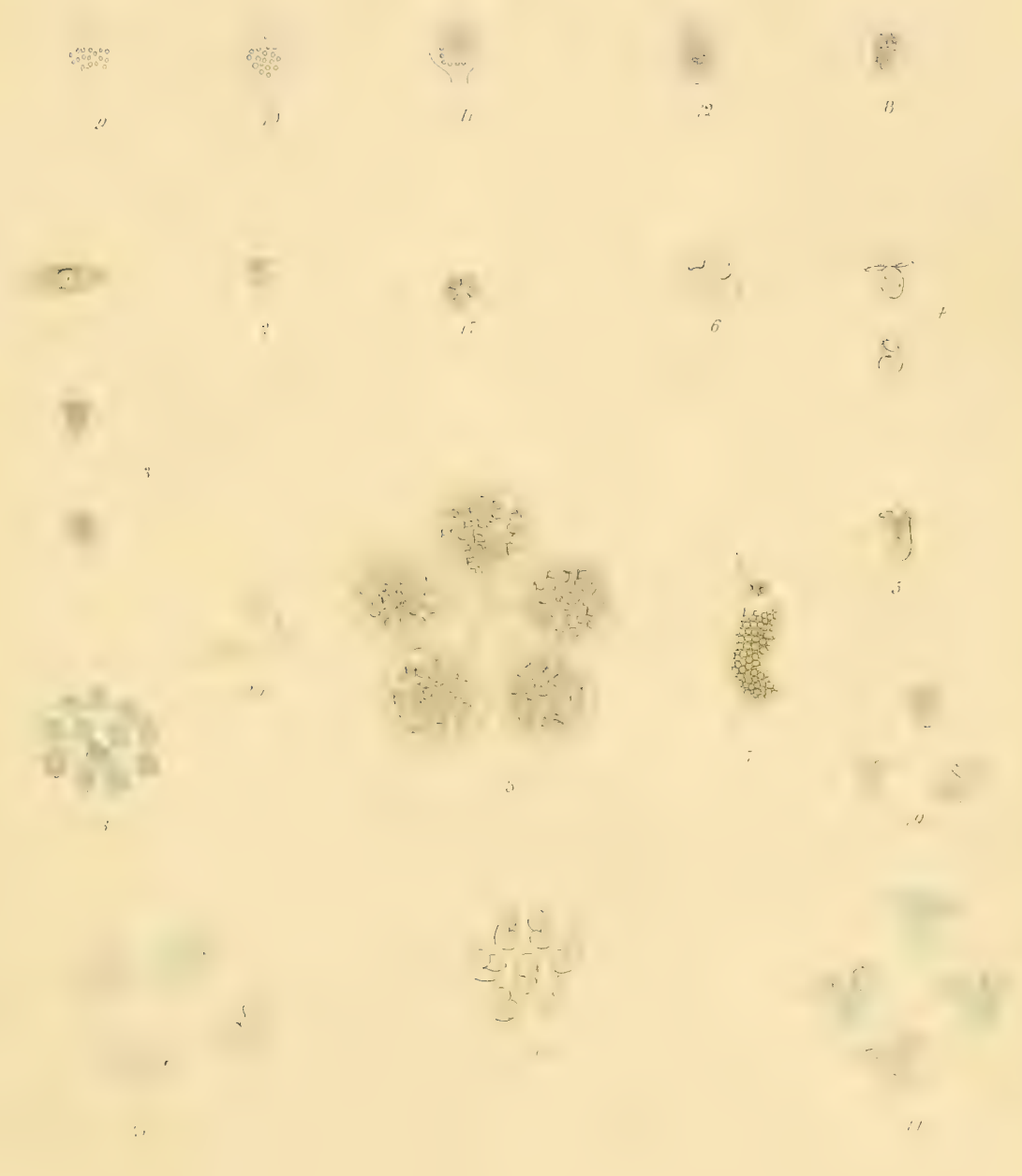
PLATE XLVI.

FIG. 1. Spawn, resembling a thick drop deposited on a marine vegetable.

• Parent unknown.

2. Nautiline produced by the same, enlarged.
3. Two Nautilines, each within its respective integument, still contained in an ovoidal mass of spawn from an unknown parent, enlarged.
4. The same two Nautilines when free, enlarged.
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12. Another.
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14. Nautilines from the same, free, active, enlarged.
15. Nautilines in retreat, enlarged.
16. Empty shells of Nautilines, enlarged.
17. Five capsules of spawn, connected by slender ligaments. Parent unknown.
18. The same five capsules, enlarged.
19. Three active Nautilines from the same, enlarged.
20. Empty shells.

All the figures of this Plate, except 1, 7, 17, are enlarged.



Cuticle

There is one singular fact connected with the history of the *Doris* and some more of the lower animals, wherein there is great distinction shewn between them and the higher orders.

In the whole animated creation the unimpregnated ovum may subsist a long time without any important change, and in the course of its existence, it seems to resemble a portion of brute matter, yet endowed with such a living principle as preserves it from decay.

In all the larger animals it seems that impregnation of the ovum is productive of the evolution of an embryo ; that the embryo requires a considerable time for attaining maturity, in order that it may be separated with safety from the parent, and enjoy an independent existence as a perfect animal.

But it is inanimate and motionless in the beginning, feeble and inactive in its progress, and at the moment of gaining maturity, still incapable, without some fostering aid, to provide for its own necessities.

So there are many beings, and among them man, then ready to perish.

The life, the growth, the changes undergone by the originating of the higher animals, are all carefully veiled from the inquisitive eye of mankind. If betrayed to view, it is generally by some fatal accident, precluding farther observation.

It is absolutely the reverse with some of the lower animals. We nourish the *Doris*, it unloads its vast ovarium before us. Here we see innumerable ova, and in a brief interval as many embryos appear from them animated. But if those objects which we call embryos be truly the offspring of the *Doris*, they are void of all resemblance to the parent.

Unlike the embryo of the larger animals, its activity is great from the beginning, and it gradually augments, insomuch that when discharged as a mere speck from the spawn, wherein all are lodged, it has already attained in the earliest infancy infinitely greater powers than belong to the oldest and most vigorous of adults.

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