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THE ANNALS

AND

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INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—Linnæus.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—Bruckner, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. Taylor, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FOURTH SERIES.]

"................ per litora spargite museum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 109. JANUARY 1877.

I.—*On* Stauronema, *a new Genus of Fossil Hexactinellid Sponges, with a Description of its two Species,* S. Carteri *and* S. lobata. By W. J. Sollas, B.A., F.G.S., &c.

[Plates I.–V.]

Oscar Schmidt's remark, "Die Behandlung der fossilen Schwämme durch die Geognosten und Paläontologen ist eine grausliche," has the merit of being strictly true, though in fairness it ought to be added that the geologists and palæontologists are not wholly to blame for this treatment, since most of their work was done before Schmidt's books had been written, before the Hexactinellidæ and Lithistidæ (which would have thrown light on their labours) had been discovered, and at a time, one may add, when the sponges in general were the outcasts of the animal kingdom.

To understand aright the fossil sponges, one must obtain a thorough knowledge first of the minute structure of these bodies themselves, and next of the structure and classification of existing forms. The older observers were without the means of acquiring either of these essentials; they consequently, in their attempts at a classification of fossil sponges, were compelled to fall back upon external characters alone, with the addition of what internal features might chance to be revealed by a happy fracture; and since, as we now know, different genera of sponges may assume the same form, and diverse forms may belong to the same genus or even to the same species, it is easy to see how "dreadful" (grausliche) the treatment must inevitably be which proceeds upon such a basis.

At the present day, however, things are far otherwise with the palæontologists; the microscope and the lapidary's lathe will give us most of the details we require to know concerning the structure of the fossil forms; and as regards the recent ones, we are here still better off since the researches of Carter and O. Schmidt have given us a scientific knowledge of the organization of a vast number of species, and a good working classification of these into orders, families, and genera. The key to the fossil sponges has thus been placed in the hands of the palæontologist; and if he does not henceforth make good use of it, he will fully deserve the censure which Schmidt has passed so severely upon his predecessors.

In consequence of the assistance and advice which I have received from my friend Mr. Carter, I have been encouraged for some time past to work out the alliances of some of the commoner fossil sponges; and, as a result, I am now able to state that *Siphonia pyriformis* and *costata* possess the structure of a Lithistid sponge, and are closely related to the existing species *Discodermia polydiscus* (Bocage) (*Dactylocalyx*, Bowerbank), that *Stromatopora concentrica* and some other species of this genus show no affinities to the Foraminifera, but are Vitreohexactinellid sponges closely resembling *Dactylocalyx pumiceus* (Stutchbury), and that *Manon macropora* and a sponge called *Chenendopora* in the Cambridge Museum belong to the Holorhaphidota (Carter), or sponges whose skeleton consists of acerate spicula closely bound together into a fibrous network. These results, which have been fully confirmed by Mr. Carter*, I hope to publish in full in the course of a few months; while in this paper I shall confine myself to an account of a new genus of the Vitreohexactinellidæ occurring in the fossil state in the Gault of Folkestone.

In examining a collection of various fossils brought by Mr. Jukes-Browne from Folkestone, to illustrate his paper on the Cambridge Upper Greensand, I was much struck with some curious forms, which were said to be *Ventriculitæ* split into halves down the middle; the regularity of the edges, however (which in such a case should have been broken ones), seemed to preclude such an idea, and rather suggested that the forms in question were in a complete state. I wrote therefore to the Folkestone collector, Mr. John Griffiths, re-

* Except with regard to *S. concentrica*; Mr. Carter has shown that some *Stromatoporæ* are allied to *Hydractinia*.

questing him to make me a collection of these fossils; and from his successful search I am now in possession of some forty or fifty specimens, of which some five or six are in a perfect state of preservation, while all exhibit the halfcup-shape form which I had noticed previously.

Outward Form (Pl. I. figs. 1–8).—The sponge is vertically and simply fan-shaped, compressed, single, sessile, and adherent. In size it varies from 3 inches to $\frac{7}{8}$ of an inch in height, from 2 inches to $\frac{6}{8}$ of an inch in breadth, and from 1 inch to $\frac{3}{8}$ of an inch in thickness. The object on which the sponge grew is generally a small fragment of coprolite (Pl. I. fig. 6, *b*), which in good specimens still remains adherent at or near the point from which the sides of the fan diverge. This point indicates, then, the "base" of our sponge; and it follows that the diverging sides of the fan are the "lateral" edges, and the curved side which joins them, subtending the angle at the point below, is the "distal" or upper margin. The sponge is curved from side to side, the lateral margins being slightly approximated, so as to make the fan concave from side to side like a half-cup or hollow half-cone. The concave is the "anterior" or "interior," and the convex the "outer" or "posterior" surface.

General Structure.—The sponge is composed of two obvious parts—a thin plate in front (Pl. I. fig. 1, *o*), and a thick protuberant mass behind (ibid. *p*); a distinct seam (*s*), which may be merely a line produced by the approximation of the skeletons of the two, or which may be deepened into a shallow groove, defines these two parts from one another along the lateral edges: on the posterior surface the distinction is manifest by the free projection of the anterior plate beyond and above the posterior protuberance (Pl. I. fig. 2, *o*); and in fractured specimens the distinction is seen to be continued within (Pl. II. figs. 1, 2), the two structures, however closely apposed, seldom if ever merging into one another.

Anterior Plate.—The surface of this is even and smooth, its thickness from back to front tolerably uniform, but slightly increasing as it grows upwards from the base; in a specimen $2\frac{1}{2}$ inches high by 2 inches broad and $\frac{5}{8}$ inch thick it measures $\frac{1}{4}$ of an inch at the summit, and at the base a little less than half this amount. The ratio of the thickness of the plate to the other dimensions of the fossil varies widely with different specimens.

The plate projects freely above the posterior protuberance, and terminates in a broken distal edge. This is the case with all my specimens. The anterior plate has been broken off, either down to the level of the posterior mass or at a short distance above it, the maximum distance I have measured being $\frac{1}{4}$ inch.

As, then, the normal distal margin has not been seen in a single specimen, one is unable to say how much further it originally extended: it may have terminated close to its present level, though, from the abrupt way in which it is fractured, it more probably reached some distance above; or it may have been continued into a large flabelliform expansion, thinning away above and many times larger in area than the portion now remaining—in which case this plate would be the really essential sponge, and our fossil merely its base overgrown with the posterior mass; and the probability of this view derives support from the fact that I have in my possession a thin plate of fossil sponge (Pl. I. fig. 9), 5 inches long by 4 broad, and from $\frac{1}{8}$ to $\frac{1}{10}$ inch thick, curved from side to side, and exhibiting, as we shall see presently, every structural peculiarity to be found in the anterior plate of our fossil. Whether this is really a continuation of the anterior plate can only be demonstrated by finding a specimen in which the latter actually passes into such a flabelliform expansion; and for such a one I have directed Mr. Griffiths, of Folkestone, to make a search.

The front face of the anterior plate is a plain surface as far as the level of the posterior protuberance; but beyond this, where it begins to project freely, it is marked by a number of round, or more usually oval, oscular pits arranged quincuncially (Pl. I. fig. 1), and on the whole constant in size and distance from one another in the same specimen, but differing in both these respects in different specimens (Pl. I. figs. 1 & 3). The variations in size may all be comprised between the extremes of $\frac{1}{10}$ and $\frac{1}{30}$ inch for the length of the major axis of the ellipse.

The posterior face is of course covered below by the posterior mass; but above, where it is exposed, it generally exhibits a number of oval spaces arranged quincuncially and closely resembling the oscular pits in front (Pl. I. figs. 2 & 8), a little less regularity in arrangement and a thickening of the intervening structure into irregular ridges in the case of the posterior markings constituting the only difference, and that not a constant one, between the two. Sometimes the free posterior face is smooth, like the lower part of the anterior face.

When the anterior plate is broken across, one may see the oscules of its anterior face prolonged into cylindrical tubes, which pass inwards normal to the surface, and, receiving irregular lateral canals in their course, terminate in the oval spaces which mark, as we have seen, the posterior face, and which probably served as the special pore-areas of the sponge. This arrangement accords with the general rule, that in all cup-shaped and curved fan-shaped sponges the oscules are placed on the interior surface of the cup or on the concave surface of the fan, while the pore-areas occupy the outer or convex surface in each case.

The restriction of the oscules to the free part of the anterior plate is only to be seen in tolerably perfect specimens; in those which are at all worn or much weathered the oscules are exposed all over the anterior surface, and by no means confined to its freely projecting part. The absence in this case of the smooth face below, and the appearance of oscular markings in its stead, is evidently the result of attrition, and suggests that beneath the smooth surface of unworn specimens the oscules may still exist, but concealed by a superficial coating: a slight examination will set this beyond doubt. In some instances a small patch of the outer coating has been completely worn away, while the rest of it has simply been much diminished in thickness; we then see the oscules freely exposed over the denuded area, and dimly to be discerned through the thin coating which remains: in perfect specimens the smooth surface may be removed by dissolving the calcareous matrix of the fossil with acid, and brushing away the superficial network which remains behind; the oscules are then clearly revealed; while, finally, if a section be made across the plate, the tubes which lead directly away from the oscules will be seen traversing it at right angles to the exterior coating (Pl. I. fig. 2, *e'*, and Pl. II. fig. 1, *o*, fig. 2, *o*).

The anterior plate thus possesses the same essential structure throughout; it is a thin plate perforated completely by a number of parallel cylindrical tubes or excurrent canals, which traverse it at right angles and terminate in front in oscular pits, and behind in pore-areas. Its projection past the posterior protuberance shows that it is the first formed of the two structures; and it would appear that as it extended itself vertically and laterally the posterior mass followed after it for some distance as an aftergrowth, while at the same time a superficial covering coated it correspondingly in front, concealing the oscules beneath, perhaps converting them into pore-areas, and leaving patent those only on the projecting part above.

Posterior Mass.—The posterior part forms a compact mass (Pl. I. figs. 2, 4, 6, 7, 8, Pl. II. figs. 1 & 2), which, unlike the oscular plate, rapidly increases in thickness from below upwards and from its edges to the middle of its face; so that in a specimen $1\frac{1}{4}$ inch high, with an oscular plate uniformly $\frac{1}{8}$ inch in thickness throughout, it has increased from a mere trifle at the base and the edges to $\frac{5}{8}$ inch at the top and through the middle of its face. In contrast also with the uniform character of the oscular plate is the irregularity of growth manifest in this portion: in one class of forms it increases in a series of bulgings, which form gently rounded swellings concentric with the distal margin, or rounded ridges so regular as to give the hinder surface a corded appearance; sometimes the gentle swellings are not continuous but sink laterally into faint dimples; while the ridges are not always semicircular, but occasionally change their course abruptly so as to be V-shaped at one side.

Above, the upper surface of the posterior mass may be gently rounded against the oscular plate, or it may form a flat table and join the plate at right angles.

Underlying the variations in this class of forms there is, however, a certain degree of regularity; in all the posterior mass extends laterally as far as the oscular plate, and the two are conterminous along the lateral edges, whilst above, whether it joins the oscular plate gradually or abruptly, it always follows the general curve of the latter in a simple or nearly simple line. But in another class of forms, which, I think, constitute a separate species, the irregularities are much greater than the foregoing; in them the posterior mass is seldom ridged concentrically, but soon after leaving the base it becomes lobed vertically into two or more diverging processes, differing in size and shape, and exposing the oscular plate in the angle between them: in these forms the posterior mass reaches the lateral margins of the sponge near the base only, and soon ceasing to do so as it ascends, allows the anterior plate to extend freely beyond it in a lateral as well as in a vertical direction.

Externally the porous mass presents a plain surface, never excavated by oval pits or specialized pore-areas. In section it exhibits a number of canals, which, passing from the interior in a more or less wandering course, and without any regular arrangement, terminate at length against the attached face of the oscular plate, into the excurrent canals of which they in some cases directly open; but whether they do so always seems to me doubtful.

Minute Structure.—To investigate this the fossil may be prepared in two ways: it may either be treated with some acid (I prefer nitric) by which the matrix of calcite is readily dissolved, while a siliceous network is, in well preserved specimens, left in relief; or slices may be cut from it and ground down till thin enough to be transparent; this is the method to which I have chiefly trusted, only using the former when the latter has not been available. The sections I have had made have been taken along the following planes :—(1) longitudinal and at right angles to the surface, both through the centre and nearer the sides—longitudinal sections (Pl. II. fig. 2) ; (2) transverse and at right angles to the surface—transverse sections (Pl. II. fig. 1) ; (3) parallel to the surface, one through the oscular plate and another through the posterior mass—parallel sections (Pl. II. fig. 1, *b*, *c*, fig. 3).

The appearances of these sections under the microscope I shall now describe, and in so doing shall confine myself first to an account of the skeletal structure which they demonstrate, referring most of the facts which bear on the mineral characters to a subsequent paragraph.

Each of the sections we have defined shows a regular network of fibres arranged in the following manner. Selecting a single node in the net we observe four fibres, usually siliceous, radiating from it at right angles to one another in the form of a cross (figs. 1, 2, 3) ; each is perfectly continuous

Fig 1.

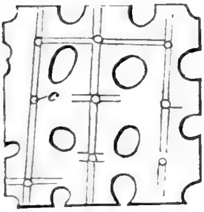


Fig. 2.

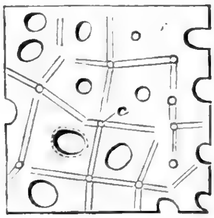
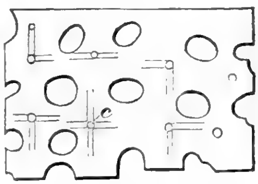


Fig. 3.



Sections taken through the oscular plate of *Stauronema Carteri*, from the specimen represented in transverse section on Plate II. fig. 1 ; all magnified 30 diameters. Fig. 1. Longitudinal section (*a*, Pl. II. fig. 1). Fig. 2. Transverse section (Pl. II. fig. 1). Fig. 3. Parallel section (*c*, Pl. II. fig. 1).

with similar fibre from an adjacent node, and has at its greatest distance from the two nodes it connects (*i. e.* at a point midway between the two) a diameter of $\frac{1}{120}$ to $\frac{1}{180}$ of an inch ; but on approaching the node it thickens considerably so as to fill up the angles of the cross and round them off : in this way the meshes of the net, which, from the disposition of the nodes, would otherwise be rectangular, are always round or oval ; and these rounded spaces, which are bounded by the outer margins of the fibres, are so sharply defined as to enable us to state with certainty that the fibres themselves are perfectly smooth and not in any way spined.

In the centre of the node is a small and very definite circle, $\frac{1}{350}$ to $\frac{1}{300}$ inch in diameter (figs. 1, 2, 3, *c*), which is produced by the section crossing at right angles a cylindrical tube, originally hollow, but now generally filled with carbonate of lime; and from this radiate four similar cylindrical canals, one in the axis of each arm of the cross; these, of course, are seen sideways and not end on, and ordinarily they are continuous from one node to another, like the fibre in which they are excavated. As these appearances are to be seen equally in each of three sections taken at right angles to each other (figs. 1, 2, 3), it is clear that our quadrilateral cross of fibre is really a sexradiate one (fig. 4), with its arms arranged about three

Fig. 4.

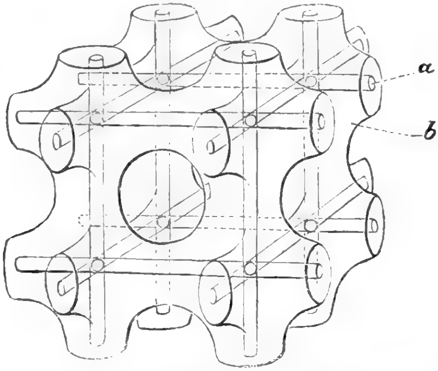


Diagram of the network of *Stauronema*. Scale 60 : 1. *a*, sexradiate canal; *b*, sexradiate fibre.

axes at right angles to each other, and that corresponding with the axes interiorly is a similar sexradiate hollow canal.

Now this structure is exactly that which characterizes the rete of the Vitreohexactinellidæ, and may be seen to perfection, with differences merely as to detail, in deciduous skeletons of *Farrea* and *Aphrocallistes*. In these genera, as in the Vitreohexactinellidæ generally, the skeleton is produced by a growth of siliceous matter over sexradiate spicules; and in *Farrea occa* each node of the resulting network is a rectangular sexradiate cross of fibre, which has formed about a sexradiate spicule, which thus comes to occupy the centre of the fibre. In many vitreous hexactinellids the fundamental spicule is preserved imbedded in the siliceous fibre, which is thus originally solid; and which, as it is composed of the same material all through, without any difference of refractive index, cannot be distinguished into spicule and fibre, but appears homogeneous throughout. But in deciduous specimens of *Aphrocallistes* and *Farrea* the original spicule undergoes a process of absorption and disappears, leaving in its place a hollow sexradiate cavity readily observable in the interior of the fibre. Our sexradiate fibre has, then, in the fossil condition a structure essentially identical with that of the recent skeleton of *Farrea* when in a deciduous state. The siliceous fibre of our fossil corresponds with the siliceous fibre of *Farrea*; and the sexradiate canals in its interior correspond with the hollow casts of the spicules in the latter: the only difference is that the canals in our fossil are continuous from one node to another, while in recent Hexactinellidæ they terminate blindly, as casts of spicules naturally would, their blind terminations generally overlapping one another *. But even this difference vanishes with a close examination of the fossil fibre, as I shall show when we come to speak of the various modes of its fossilization.

The characters of the sponge already described are sufficient to define the genus, which I now propose to call "*Stauronema*," from the cross-like disposition of the thick skeletal fibres about the nodes of the network, a feature readily visible under a common hand-lens. In the oscular plate the nodes of the network are usually arranged symmetrically at equal distances from each other, so as to form meshes which would be cubical but for the thickening of the fibre towards the node, which converts the cubes into spheres or ellipsoids. By reason of the symmetrical grouping of the nodes, the skeletal fibres fall into three series:—one longitudinal, ascending from the base; a second horizontal, radiating from the imaginary axis on which the half-cone of the sponge may be supposed to be described; and a third horizontal and concentric with the curve of the fan.

The longitudinal fibres (Pl. II. fig. 4, *l*) deviate from a parallel course by diverging, as they rise from the base, towards the anterior and posterior faces of the plate; and to maintain the uniform size of the meshes, fresh sexradiate elements are interposed in the same way as I have described in *Eubrochus* and the Ventriculites †. The radiating fibres, since the curve of the fan is gentle and the oscular plate thin, lie in almost parallel lines; but both they and the concentric

* [As the absorption goes on, the form of the spicules becomes lost, and that which remains is a simple cylindrical cavity, which led Bowerbank to say that the fibre of *Farrea* was channelled like that of the Ceratina, ex. gr. *Luffaria*.—*Note by* Mr. CARTER.]

† Quart. Journ. Geol. Soc., Feb. 1873, p. 66, fig. 4; Geol. Mag., Sept. 1876.

fibres are not, strictly speaking, confined to horizontal planes; for they curve upwards in gentle arcs so as to suggest that they once bounded and corresponded with the rounded edge which in all probability terminated the distal margin of the plate, in the same way as a similar edge now limits its lateral margins.

The oscules and excurrent canals are arranged so regularly in the plate that they do not disturb the regularity of the foregoing arrangement to any great extent, though in their immediate neighbourhood the sexradiate nodes become grouped round the excurrent canal, so as to be subordinate to it rather than to the general structure; thus some of the nodal crosses are turned round 45° out of their normal position, so as, in joining with the others, to surround the circular canal with continuous concentric fibres; and, at the same time, the fibres actually forming the walls of the canal are both bent and thickened in order to bring about their complete adaptation to its circumference. These facts may be seen in sections, but better perhaps by etching the oscular surface with acid, when, on the solution of the matrix, the oscular network stands freely out in relief, and with its slightly expanded termination resembles in miniature the mouth of a waste-paper basket; one can then see, by looking down into it, by reflected light, the adaptation in the arrangement of the nodes and the bending and thickening of the fibre, from which results a circular network with circular fibres forming the walls. One will also discover that the oscular fibres are beset with rather short conical spines (Pl. III. fig. 1), which sometimes are simply spinous outgrowths, but frequently also the sixth arm of a nodal radiation, which, instead of passing into the network as usual, points freely into the excurrent canal, just as happens in the canals of *Aphrocallistes*. In direction they usually incline outwards and towards the centre of the excurrent canal, but not always; in exceptional cases they are turned inwards, and then seem to be related to the fine canals which open in the meshes of the oscular network, since they spring from the sides of the fibre about such a space, and point into the excurrent canal. With this modification the rule here, then, as in *Aphrocallistes*, seems to be that the spines always point in the same direction as the outflowing current which at one time passed by them. It is possible that this arrangement indicates a defensive function for these spines; but, as an explanation of their position, one may recur to the fact that Carter has traced the development of the spicule from its mother cell*, and

* Ann. & Mag. Nat. Hist. 1874, vol. xiv. p. 97, pl. x.; 1875, vol. xvi. p. 11.

shows that the sexradiate forms are in all probability produced by a radiate growth from the first of the six arms from a common centre: this being so, one can readily see that if the growth of a free radius took place in the course of the excurrent canal, it would be subject to a pressure in two directions at right angles to each other—one due to its growth onwards, normal to the surface from which it springs, and the other parallel to the axis in the direction of the current; and its ultimate position would be the resultant of these two, and would be in just such a position as the spines, in fact, assume.

The growth of the spicule from a mother cell also explains in part many other matters which would otherwise be enigmatical. Thus the wonderful regularity of the network we have previously described may be looked upon as having resulted from a mother cell which originally gave off buds, one at the end of each of its spicular rays—*i. e.* in the direction of most active growth; the cells so budded off would become in turn mothers, and repeat the process, till, by reason of the limitations imposed by the limits of the organism, they would be unable to produce more than one bud each, and that vertically—except that when the distance between two cells became much greater laterally than twice the length of a spicular ray, a fresh cell would thus appear at the side of one of them, and the vacant place be filled up.

Detached Oscular Plate.—The thin plate of sponge-structure mentioned on p. 4 is bounded on all sides but one by a broken edge; the edge which is not broken is one of the lateral margins, neatly rounded off in the same way as are the sides of the oscular plate in *Stauronema* (Pl. I. fig. 9, *n n n*). Anteriorly the plate is marked by oscular pits (fig. 9, *a*) quincuncially arranged, and of the same shape, size, and distance from one another as in *Stauronema.* These pits are the mouths of cylindrical excurrent canals, which perforate the plate and open posteriorly in rounded pore-areas. The structure intervening between the pore-areas is frequently raised into ridges and prominent monticules, more marked than those which occur on the posterior surface of *Stauronema*, but otherwise similar; the skeletal networks of both fossils have also the same structure and arrangement; and their meshes and fibre are of the same dimensions. These facts, and the absence of the true distal margin of the oscular plate in the other specimens, leave little doubt in my own mind as to the relation which this fossil bears to the latter. I cannot but regard it as a part of a distal expansion of the oscular plate of *Stauronema.*

Posterior Mass.—Between the canals of the posterior mass is distributed a skeletal network similar to that of the oscular plate. The central sexradiate canal, which is the fundamental part of the skeleton, is of the same size and regularity in both; and in one specimen the sexradiate nodes are disposed with a regularity so great as to bring about a general arrangement of the fibres into more or less longitudinal, concentric, and radiating series. But this arrangement, owing to the want of regularity in the course of the canals, is more frequently disturbed by adaptation; the sexradiate spicules are often turned at various angles from what would be their normal position; and of course the fibre follows them, with the result that the arrangement of which we spoke is often nothing more than a tendency to an arrangement; while in most specimens even this amount of regularity would be hard to trace, the sexradiate character of the network almost vanishing or only to be detected in the infallible sexradiate canals.

Superficial Reticulation.—On examining the front face of the anterior plate, there may be seen, in favourable sections, a layer of finer but less regular network proceeding from the outermost meshes of the general skeleton, which lie immediately beneath; and, again, outside this *secondary* rete, as we may term the finer network, a very thin layer of structure may be sometimes observed, so minute and confused that in section nothing intelligible can be made of it, and for its successful examination one must have recourse to the method of etching with acid.

When the face of the attached oscular plate is examined by reflected light in its natural state, it presents a plain surface, the smoothness of which is only disturbed by a faint tubercular appearance; but on dissolving away its calcitic matrix with nitric acid, a beautiful siliceous network is exposed, which may be best examined under a power of about 100 or 150 diameters, and by reflected light. One may see then, in places where the network has wholly broken down, the coarse skeleton-fibres with their nodes forming a layer immediately beneath, and in this position very commonly furnished with short, erect, conical spines (Pl. III. fig. 3); above this follows a layer of similar network, but much smaller in mesh, a little less regular, also spined but more abundantly (Pl. III. fig. 3, Pl. IV. figs. 1, 3): four arms of the sexradiate nodes of this network, which we have observed in section as the secondary rete, lie parallel to the surface in square meshes; of the other two, one passes inwards and joins the general skeleton, and the other projects outwards, normal to the surface, like the "fir-cones" in *Farrea occa*. These free projecting arms all end at about the same level in cylindrical rounded spinose terminations (Pl. III. fig. 2); but now and then these terminations are wanting, and the quadrilateral meshes from which they spring lie level or nearly level with the surface. From the spinose ends, or from the quadrilateral meshes, an exceedingly fine network of delicate, glassy, pullulating fibrelets is given off, which fills up the interstices of the secondary rete (Pl. III. fig. 4, Pl. IV. figs. 4, 5, 6, 7, Pl. V. fig. 4); frequently it is wholly irregular, but in numerous instances exhibits the true sexradiate arrangement. Its meshes and fibrelets vary in size, the average measurement from node to node being $\frac{1}{700}$ to $\frac{1}{1000}$ inch, and the diameter of the fibres $\frac{1}{1500}$ to $\frac{1}{3000}$. Thus the latter are, as a rule, not appreciably thicker than the spines of the secondary rete: and this suggests that some of these spines may be, after all, nothing but the attached parts of fibrelets, which have been broken off or dissolved away; and often a series of gradational forms can be traced, proving that some are of this nature; but many, from their smooth sides, regular conical form, and abundance in places free from fibrelets, must, as we have already considered, be true spines.

From the minuteness and proximity of the sexradiates one would conclude that they have been coated merely with a thin film of siliceous material, or are only soldered together at their ends; and the same characters would also lead us to infer that they do not afterwards come to form a part of the interior skeleton, but remain as a surface-coating, which must be regarded as an aftergrowth creeping over the oscules of the anterior plate, as this becomes overgrown by the posterior mass behind.

Though this network is in general collected only about the ends of the radii from the secondary rete, beneath or between the meshes of this rete, it yet also happens occasionally, especially near the base, that it accumulates in patches to a much greater extent, burying up the network below, so as to completely conceal it from sight (Pl. IV. fig. 4), and forming a low but distinct mound above the general surface, and even, in one case, producing a series of rounded ridges (Pl. I. fig. 2, Pl. II. fig. 2, *r*) which pass straight across the anterior face of the oscular plate, horizontally from one side to the other.

The superficial network, where it covers up the oscules, descends some distance into the excurrent canals, as may be well seen by breaking a specimen across the oscular plate, etching the fractured surface, and then examining it by reflected light. The skeleton-fibres, with their projecting spines, are then exposed; the superficial network is seen covering over the oscular opening, and giving off one or two pendent processes into the excurrent canal; and, moreover, the skeletal fibres which surround the canal are also produced into outgrowths of delicate reticulation and irregular fibres which straggle across the canal from side to side (Pl. III. fig. 2); and the tendency of the fibre to pass into secondary growths thus manifested is carried so far that, even in the normal smooth network not immediately surrounding the canal, an occasional spine puts in an unexpected appearance.

The superficial network does not frequently occur over the posterior mass; and its rarity in this position appears, in some cases, to result from the wear and tear to which a convex surface like that of the posterior mass is especially exposed; in other cases it is due to a less favourable state of fossilization than obtains in the anterior plate; while in others still it would appear to be absent because the posterior surface has never been furnished with it, which last, indeed, is only what one would expect on the view that the posterior mass is an aftergrowth which increases behind while the aftergrowth of fine network is extending itself in front. It is only when the posterior mass has, like the attached anterior plate, ceased to grow, or, at all events, when its growth has for a time been arrested, that one would expect to find a final overgrowth of fine network on its surface. Such a layer I have met with in one case only, though whether it is, in this particular instance, exceptionally produced or exceptionally preserved, is of course impossible to say. This network, under a magnifying-power of 50 or 60 diameters, appeared to be without a sexradiate arrangement, its meshes not having any very regular form, and each of its fibres seemed to be pitted or perforated with a number of minute holes (Pl. V. fig. 1); but when a power of from 100 to 140 diameters was applied, it was found that these minute holes were the intermeshes of a delicate net, and that each fibre was itself a complex reticulation of exceedingly delicate fibrelets (Pl. V. fig. 2), which, where most perfectly preserved, showed a regular sexradiate disposition, with nodes distant $\frac{1}{1250}$ to $\frac{1}{2000}$ inch from each other, and fibre $\frac{1}{1500}$ to $\frac{1}{5000}$ inch in diameter. Where a sexradiate arrangement could not be detected, the defect appeared to be owing to the disappearance of some of the fibrelets necessary to the arrangement, by solution or otherwise. The cylinders of network exhibit sometimes a central axis of solid fibre from which the finer rete is given off all round; and sometimes they pass into a solid fibre ornamented with projecting fibrelets—a transformation apparently due to the fusion of the compound network-fibre into a solid one by the further deposition of siliceous matter. Between the open meshes of this most exquisite net (which, in the delicate and complex tracery of its transparent fibres, surpasses almost every thing I have seen amongst the Hexactinellidæ) one observes either an intermesh perfectly open and leading to the interior of the skeleton, or else a multitude of minute glistening fibrelets, which pass from fibre to fibre of the secondary rete below, and weave across its meshes a transparent vitreous web (Pl. V. fig. 3). The secondary rete passes in its turn into the skeletal network below, which, at first beautifully spined, soon becomes, as it leaves the surface, perfectly smooth.

The foregoing facts could be observed by examining the surface of the etched fossil by reflected light; but by splitting off a few fine chips with a scalpel, treating them with acid in a watchglass, washing with distilled water, and finally drying, the network could be obtained in a state fit for mounting in Canada balsam and other media, and for observation with transmitted light.

Traces of the network with complex fibres may be detected along the lateral edges of the oscular plate in the specimen where it occurs; but further on, over the anterior face, it quite vanishes, and only the ordinary superficial reticulation prevails (Pl. V. fig. 4).

Flesh-spicules.—The perfect manner in which the superficial network is preserved led me to think that some rosettes or other flesh-spicules might perhaps be seen in the sponge; and the most likely places to look for them appeared to be, first, in the residue set free in suspension on treating the fossil with acid, and, next, in the open meshes of the skeleton. A careful examination of the former proved altogether unsuccessful, while in the latter iron pyrites was observed under a variety of forms. In this there was hope, since I have slides showing minute coccoliths and delicate radiolarians perfectly preserved in this material: therefore I made a long search in the expectation of finding some form of iron pyrites which should display evident traces of the rosette form; but, with a few very unsatisfactory exceptions, my search was quite in vain. The flesh-spicules of the Hexactinellidæ have yet to be found in the fossil state.

Other Spicules.—I have, however, met with two spicules other than sexradiates in this fossil. One is a completely erectly spined cylindrical form (Pl. V. fig. 5) with one part hidden in the network, from which the other portion projects freely, making an acute angle with the oscular surface as it points upwards from the base. This spicule bears a close resemblance to that figured by Bowerbank * from *Aphrocallistes* (*Iphiteon*, Bk.) *beatrix*.

The other spicule occurs in a parallel section of the oscular plate, as a cast, partly hollow, partly filled with iron pyrites; it is simple, not spined, terminates so obscurely that its ends cannot be made out, and is imbedded in skeletal fibre in company with the ordinary sexradiate spicules (Pl. V. fig. 5).

Modes of Fossilization.—The fossilizing material is usually crystalline transparent carbonate of lime, or calcite, which fills up the meshes of the network, and occupies the sexradiate canals of the siliceous fibre; where it occurs in large quantity, as in the meshes and excurrent canals, it is traversed by numerous cleavage-planes; and it is usually impure from the presence of a little aluminous matter. The fibre thus enclosed consists of silica, and in a few cases is almost as homogeneous and purely siliceous as when it existed in the living state; but even in this, its most perfect condition it generally exhibits the marks of decay, not only by the absorption of its interior spicule, but in the presence of numerous hemispherical pits excavated from its exterior to various depths, like those described by Carter as affecting recent spicules †; from this condition it soon passes through a series of changes, the final result of which is to leave it wholly converted into carbonate of lime. The first step in the process is a granulation of the fibre about the internal canal, which soon extends itself, chiefly by eating its way from within outwards, till at length it reaches the outer boundary of the fibre; and this, which during the process of change has retained its definite outline, often its transparency as well, yields at last, and the fibre becomes granular all through. The granulation, however, also frequently appears at the outside and the inside of the fibre at once, and proceeds from each direction till it meets in the interior. While the granulation is thus progressing, a process of absorption is set up about the interior canal, accompanied by a replacement of the fibre in carbonate of lime; this change takes place from within outwards, and continues till at length a mere shell of rounded granulations of silica separates the calcite without from that within the fibre; finally this shell itself disappears, and the exterior and the interior calcite become one. But even then, with this extreme mineralogical change, the original structure is not obliterated: the calcite which fills the internal canal and the interspaces of the meshes is transparent and usually colourless, or with a faint yellowish

* Proc. Zool. Soc. 1869, pl. xxii. fig. 9.

† Ann. & Mag. Nat. Hist. ser. 4, vol. xii. p. 457.

tinge; while that which replaces the siliceous fibre is, by reflected light, of a milky blue colour, and by transmitted light brownish, less transparent, and granular with dark spots. And thus while the fundamental spicule has become absorbed, and its hollow cast filled with crystalline calcite, and the same material has replaced the siliceous fibre and the sarcode between the meshes—while, in fact, the whole of the metamorphosed net consists of one material, carbonate of lime, the structure is yet left as definitely recorded as in a sponge with its natural composition only just dead; and from this striking fact is forced upon us the conclusion that in determining the characters and affinities of fossil sponges, the mineral composition is an argument of but fifth-rate value, and the form and structure here, as in most other anatomical questions, is the one thing important.

It frequently happens that while the sponge towards the exterior is preserved in calcite, it is fossilized with silica in the interior; and between these two conditions one can often trace a series of transitional changes. Thus in one specimen the sharp outline of the siliceous fibre soon disappears as it proceeds inwards, and is replaced by a botryoidal surface of hemispherical bosses (p. 18. fig. 6, *a*; p. 19. fig. 7, *a*), each with a corresponding cavity on the inside; from the botryoidal exterior a fibrous crystallization of silica radiates towards the middle of each intermesh *, filling it up; the interior of the fibre, on the other hand, is occupied with clear transparent calcite exhibiting cleavage-planes, and the sexradiate canal is filled with silica, crypto-crystalline, and exhibiting patches of colour when polarized light is passed through it. Thus the original siliceous spicule is, after a cycle of changes, restored again to the siliceous state. And here one may notice the very important fact that these pseudomorphic spicules are not continuous with each other, but remain perfectly distinct, with their rays overlapping, precisely as they do in *Farrea* and *Aphrocallistes* (fig. 5, *a*). In one or two instances (fig. 5, *b*) four spines equally distant from each other have been noticed surrounding the proximal end of each ray, and pointing towards the centre of the spicule—thus indicating that in these cases a hollow process, now converted into a spine, once proceeded from the central canal and entered the thickening of fibre which fills up the angles at the nodes of the network. If, as might easily happen, these canals underwent an extension so far into the thickening as to meet one another, and become continuous, we should have a structure singularly homoplastic with that of

* "Intermesh," the space included between a mesh.

the Ventriculite lantern. I notice, however, in addition to the four spines just mentioned, others (fig. 5, *c*) which appear to radiate from the centre of the spicule, one between each angle of the rays; so that altogether the structure is a very puzzling one, and difficult to work out, because I find no other clear example of it.

Fig. 5.

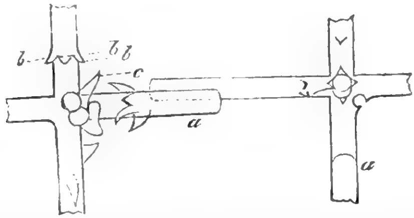


Fig. 5. Siliceous casts of sexradiate canals of *Stauronema*: *a*, overlapping rays; *b*, three accessory spines; a fourth is concealed on the opposite side of the ray; *c*, spine projecting from the centre of the cast.

As the skeletal network is traced further inwards, the calcite inside the fibre becomes replaced by silica (fig. 7), and the silica which represents the original spicule by iron pyrites (fig. 7, *b*).

Fig. 6.

Fig. 6. *a*, botryoidal surface of fibre replaced by calcite; *b*, siliceous cast of spicule; *c*, radiately crystalline silica of intermesh.

The original fibre then vanishes altogether; the botryoidal surfaces no longer define it, but, growing far away from their original position and nearer to one another, diminish the intermeshes into a narrow fibre-like reticulation, and widen the fibres into broad mesh-like spaces; and we can only distinguish the site of each by the fact that the botryoidal surface always presents its bosses towards the meshes and away from the interior of the fibre; to which distinction may be added another, which consists in the fact that the silica deposited *viâ* the fibre is never fibrous like that deposited outside, but gives merely a mottled appearance of colour with polarized light. By this we know that the sexradiate spicules of iron pyrites are truly inside the fibre, as we should expect, and not outside, as they appear to be. Here, again, we find a want of continuity between the rays of neighbouring sexradiate spicules, which come to an end abruptly and overlap without passing into one another.

Fig. 7.

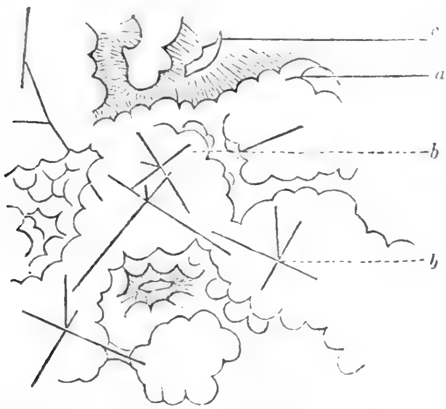


Fig. 7. *a*, botryoidal surface of silicified fibre; *b*, casts of spicules in iron-pyrites; *c*, radiately crystalline silica of intermesh.

Iron Pyrites.—This, as we have seen, fills the central canals when the fibre is replaced by crystalline silica; but it does so as well when the fibre retains its original state and when it is converted into carbonate of lime. It is always granular—so much so, that fine spicular rays are sometimes composed of nothing but its spherical concretions set in a linear series. The pyrites is not confined to the canals, however, but forms bacilli, spherules, and granules in the fibre itself, both when the latter retains its original siliceous state and when it is wholly changed into calcite. It is, moreover, found in the intermeshes, taking frequently the form of globular concretions, which are covered on the surface with crystalline facets, like the iron-pyrites concretions of the chalk seen in miniature; in size these globules are about $\frac{1}{700}$ inch in diameter, and may perhaps have formed about the rosettes which surely once existed in the sponge.

Change in Refractive Index of the Silica of the Fibre.—When fragments of the siliceous network are freed from calcite by means of acid, washed, dried, and mounted in Canada balsam, the fibre is found to be characterized by a remarkable transparency, often so great as to render it almost invisible; and this is perhaps partly to be explained by attributing to it great porosity, by which the balsam would be able to penetrate it everywhere, and great transparency would result; and this view is supported by the fact that the fibre in the dry state, and mounted in air, appears of a pure snowy white by reflected light. But I scarcely think this is the whole explanation, since when such prepared fibre is mounted in glycerine jelly, its transparency is much diminished, and consequently it can be seen with greater distinctness. Now glycerine jelly has a much lower refractive index than Canada balsam; and hence these different appearances can be readily explained by supposing that the silica of the fibre has a refractive index nearly equal to that of the balsam, but higher than that of the glycerine jelly. This change in transparency I have found also well exhibited in some beautifully preserved spicules from the Upper Chalk which I hope soon to describe; these can scarcely be discerned when viewed in balsam, but are seen very clearly in the less-refractive medium. The different appearance of spicules in these different media suggested to me that a corresponding advantage might be gained by mounting recent spicules in glycerine jelly; but on following out this idea I found my recent spicules were quite, or at all events nearly, invisible in this material, from which one draws the conclusion that the recent spicules have a refractive index corresponding closely with the lower one of glycerine jelly instead of with the higher one of Canada balsam, and hence, first, that recent spicules are not themselves seen in Canada balsam, but only their negative images or optical casts, and, next, that in process of time the refractive index of spicular silica undergoes an elevation approximately equal to that of passing from the refractive index of glycerine jelly to that of Canada balsam.

Change from the Colloid to the Crystalline State.—The alteration in the refractive index would naturally accompany a change of the original silica of the fibre from a colloid to a crystalline condition; and that such a change has certainly taken place can readily be proved by examining the network as previously prepared, or in an ordinary transparent section, by polarized light. When this is done, a change in the plane of polarization is distinctly produced by the fibre, since it shines out with faint bluish and yellow glimmerings on the dark ground produced by crossed prisms. If now some recent spicules, or some compound Vitreohexactinellid fibre, be substituted for the fossil silica, no effect will be produced on the light: the dark ground will remain wholly dark; and if the polarizer be turned round 90°, the light admitted will undergo no change of colour in passing through the object.

One may diverge for a moment here to speak of some additions to the modes of examining recent sponges which arise out of these observations. First, the fact that the recent spicule is almost invisible in glycerine jelly, while the horny fibre of sponges is more than usually well defined in it, allows us to optically *despiculize* the fibres of the Chalinida and Echinonemata (Carter) by immersing them in this substance, and thus to observe the kerataceous material independently; and, next, the fact that the calcareous spicules of the Calcispongiæ do produce a marked effect on polarized light, exhibiting brilliant colours, which siliceous spicules and fibre do not, provides us with a speedy method of distinguishing between these two kinds of spicules, and one which may be employed in cases where the use of acid is not available*.

I cannot attempt to explain all the various mineral changes and replacements which we have now described; they are as obscure as most of the pseudomorphic alterations which occur in fossilization; but two most important facts stand out from all the rest in my mind:—first, that siliceous fibre may be completely replaced by carbonate of lime without obliterating its structure; and, next, that spicular silica may with lapse of time pass from the colloidal to the crystalline state.

Alliances.—In looking for the existing relations of *Stauronema* one will not find any near ones. The absence of a "lantern" about the nodes excludes the Ventriculites; *Euplectella* is characterized by ladder-formed fibre, and is in most respects widely divergent. With *Aphrocallistes* the oscular plate presents some analogy, as pointed out to me by Mr. Carter, the walls of the tube-net of *Aphrocallistes* being perforated completely by horizontal excurrent canals quincuncially arranged, just as we found in the plate-net of *Stauronema*; and even, as in the latter the oscules become covered up with a layer of fine network, so a network, but not correspondingly fine, extends itself over the oscules of *Aphrocallistes*, as may

* Mr. Carter points out to me that this latter observation has been previously made by O. Schmidt.

be clearly seen in a specimen which Mr. Carter kindly sent me to illustrate this point. The skeletons of the two, however, are in one respect widely different. In *Aphrocallistes* the imbedded sexradiates are subject to great variations in the disposition of their rays, five, or even all six, radii being sometimes brought into one plane, while two or more of these rays may be and often are enveloped in one and the same fibre; so that the nodes of the resulting network are as often as not sexrotulate in the same plane, and the intermeshes consequently triangular. In *Stauronema*, on the contrary, the spicule maintains a rigid stereometry, never departing from a rectangular triaxial type, and the rete is usually quadrangular; and though it may vary in this respect, yet when it does so the change is never due to the departure of any radius of the original spicules from strict rectangularity, but results from a different disposition of the entire spicules with regard to one another. This difference is seen in the following diagrams:—

Fig. 8.

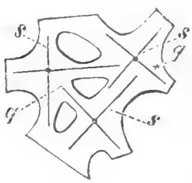


Fig. 9.

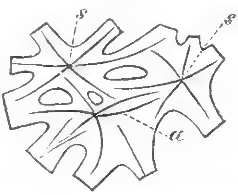


Fig. 8 shows quinqueradiate nodes (q) of *Stauronema*, due to the relative disposition of the spicules (s).
Fig. 9 shows the quinque- and sexradiate nodes of *Aphrocallistes*, and the sexradiate spicules (s) with rays making various angles with each other. At a two rays of a spicule are seen lying approximately parallel and imbedded in the same fibre.

In this character *Stauronema* agrees with *Farrea occa*, where also we find the same persistency in the form of the skeleton-spicule; and to this example may be added the external net of *Eubrochus* (Sollas) and the Ventriculitidæ generally. But, as we have said, the Ventriculites are excluded by the presence of the lantern about the nodes; and *Farrea* is so of course by the fact that its skeleton consists of but a single layer of lattice-work; *Eubrochus* exhibits a more delicate and less regular internal skeleton, and is altogether a very different sponge.

The place of *Stauronema* amongst its relations may perhaps be best illustrated by the following Table, which is a classification of the Vitreohexactinellidæ according to the characters of their skeletal network.

I. Sexradiate skeleton-spicule always rectangular. STAURONEMATA.

(*a*) Skeletal network with simple nodes
(1) one layer in thickness .... *Farrea.*
(2) several layers thick .... *Stauronema.*
(*b*) Skeletal network having the nodes complicated by the presence of an octahedral lantern about each one .... *Ventriculitidæ*, including *Myliusia Grayi.*

II. Sexradiate skeleton-spicule with rays making any angle with each other. APHROCALLISTIDÆ.

Aphrocallistes, *Dactylocalyx**, *Iphiteon**, *Stromatopora* (*Callodictyon*, Sollas, n. g.) *concentrica.*

III. Skeleton-spicules cemented into ladder-like fibre. EUPLECTELLIDÆ.

Euplectella, *Sympagella.*

Vitreohexactinellidæ.

Genus STAURONEMA (mihi).

Form half-conical or half-cup-like, fan-shaped, vertical, sessile, attached.

Structure a thin oscular plate, overgrown at its base by a thick posterior mass. *Oscules* oval or round, quincuncially arranged, patent where the oscular plate is free, concealed beneath a superficial reticulation where attached. *Excurrent canals* cylindrical where they perforate the oscular plate.

Skeleton: spicule triaxial, axes at right angles to each other; fibre robust, nodes sexradiate, meshes quadrilateral.

Formation. Gault and Upper Greensand†.

Locality. Folkestone and the Isle of Wight.

Species:—

1. *Stauronema Carteri* (mihi), type.

Form. Posterior mass more or less rugose horizontally, extending as far as the lateral edges of the plate to which it is attached (see p. 6).

Remark. This species I dedicate with great pleasure to my friend and instructor Mr. H. J. Carter, who was the first to explain aright the structure of the vitreohexactinellid skeleton.

* The imbedded spicules of these two genera have not yet been observed; but the character of the network agrees with that of *Aphrocallistes.*

† I possess a specimen from the Upper Greensand of the Isle of Wight, which evidently belongs to this genus; but it is not well enough preserved for specific determination.

2. *Stauronema lobata* (mihi).

Form. Posterior mass not extending laterally as far as the lateral edges of the attached oscular plate, seldom or never ridged horizontally, usually lobed vertically into two or more diverging processes.

Oscules smaller than in *S. Carteri.*

Remark. This species is characterized by a more variable and less regular form than *S. Carteri.*

EXPLANATION OF THE PLATES.

Plate I.

[All the figures of this plate represent the objects of their natural size.]

Figs. 1 to 4. *Stauronema Carteri.*

Fig. 1. An average-sized specimen, anterior aspect: *o*, oscular plate; *p*, posterior mass; *s*, seam or line of division between the two.

Fig. 2. Same specimen as fig. 1, posterior view: *b*, base; *o*, posterior face of projecting oscular plate; *e'*, excurrent canal crossing oscular plate, shown on a fractured surface; *s' s'*, line of termination of posterior mass against the oscular plate.

Fig. 3. A smaller specimen, anterior view.

Fig. 4. Same specimen, posterior view: *b*, base.

Figs. 5 to 8. *Stauronema lobata.*

Fig. 5. Anterior view of a medium-sized specimen: *p'*, a lobe projecting from the posterior mass.

Fig. 6. Posterior view of preceding specimen: *b*, a fragment of attached "coprolite."

Fig. 7. Posterior view of a specimen showing the diverging lobes of the posterior mass, with the oscular plate visible between them.

Fig. 8. A very gently curved, almost flat specimen, showing the free surface of the oscular plate with its pore-areas.

Fig. 9. Free sponge-plate: *l–n*, simple outline of its surface; *n n n*, original margin (the remaining edge is a broken one); *a*, detailed representation of the oscular markings which cover the whole surface of the plate.

Plate II.

Fig. 1. Transverse section through *Stauronema Carteri*: *o*, oscular plate; *p*, posterior mass; *a*, *b*, & *c*, directions along which other sections were made through the same specimen—*a*, longitudinal, *b* & *c*, parallel sections; *e* & *e'*, excurrent canals. Nat. size.

Fig. 2. Longitudinal section through the centre of another specimen of *S. Carteri*: *o*, *p*, *e*, & *e'*, as in fig. 1; *d*, distal edge of oscular plate; *r*, outline in section of ridges formed by an accumulation of the superficial network. Nat. size.

Fig. 3. Parallel section through the oscular plate along the line *c* in fig. 1. Nat. size.

Fig. 4. Skeletal network of oscular plate, magnified from fig. 2: *a*, margin of fibre, transparent as far as *b*, where it becomes granular;

s, cast of sexradiate spicule filled more or less completely with iron pyrites; *l*, diverging longitudinal, and *t*, curved radiating fibres. ×30.

PLATE III.

Fig. 1. Fibre surrounding an oscule, from a specimen which has been etched with acid, seen by reflected light: *s*, one of the projecting spines. ×30.

Fig. 2. Section along an excurrent canal of the oscular plate, after etching with acid, seen by reflected light: *r*, fine superficial network roofing over the oscule; *p*, fibre produced from it, depending into the canal; *q*, small irregular fibres growing out from the skeletal network. The arrow indicates the original course of the outflowing current. ×30.

Fig. 3. Surface of oscular plate near one of the concealed oscules: *s*, coarse skeletal fibres, smaller than in the interior of the plate, spined, and passing under *r*, the secondary rete. ×60.

Fig. 4. A mesh of the outer skeleton-fibre, giving off at its margins some of the fine superficial network. ×140.

Fig. 5. A part of the oscular plate represented in Pl. II. fig. 3, magnified to show:—*a*, an accrate spicule imbedded in the network; and *b*, part of an abnormally fine skeletal network, a band of which traverses the whole of this specimen of the oscular plate. ×30.

PLATE IV.

Fig. 1. Secondary rete, seen by reflected light: *f*, fibres parallel with the surface; *s*, free spinose ends of fibres normal to the surface. ×104.

Fig. 2. Projecting spinose fibres (*s* of fig. 1), resembling the fir-cones of *Farrea occa*. ×104.

Fig. 3. Similar to fig. 1, but showing a finer meshwork. ×104.

Fig. 4. Fine superficial network, seen near the base of the oscular plate by reflected light, where it conceals the spinose fibres of fig. 2. ×104.

Fig. 5. Similar network, but occurring between the spines of fig. 2. The sexradiate arrangement of the fibres is well seen in this instance. ×104.

Figs. 6 & 7. Minute sexradiate reticulation proceeding from the spinose ends of fig. 2. ×104.

PLATE V.

Fig. 1. Superficial network from the surface of the posterior mass: *m*, intermesh; *f*, fibres; *n*, secondary intermesh. ×60.

Fig. 2. A part of fig. 1, more highly magnified, showing the compound nature of the fibre. ×190.

Fig. 3. Network beneath fig. 1, consisting of *f*, large fibres, the meshes between which are webbed with the fine fibrelets, *g*. ×140.

Fig. 4. Fragment of superficial network from anterior face of same specimen, showing clearly a sexradiate arrangement. ×140.

Fig. 5. Entirely spined cylindrical spicule, projecting from the face of the oscular plate. ×140.

II.—*On some new Genera and Species of Araneidea.*

By the Rev. O. P. Cambridge, M.A., C.M.Z.S., &c.

[Plates VI. & VII.]

Six out of the eleven spiders here described are from Australia, two from South America, two from Madagascar, and one from Ceylon. Those from Madagascar are of very great interest; one (*Phoroncidia aurata*) is a peculiarly brilliant species of Prof. Westwood's curious genus; the other (*Augusta papilionacea*) is the type of a new genus, forming a link between the Gasteracanthides and the remarkable spiders of the genus *Arcys* (*Arkys*, Walck.). The general appearance of this spider is very striking, and reminds one of a small butterfly.

My thanks are due to the authorities at the British Museum for kindly permitting me to describe and figure those of the above spiders belonging to the family Theraphosides, the types of which are in the national collection. The remainder are described and figured from examples in my own possession.

Order Araneidea.

Fam. Theraphosides.

Gen. nov. Atrax.

Generic characters.

Cephalothorax much longer than broad, lateral constriction at caput slight; fore part truncate, and rather narrower than the hinder part; caput not much elevated above the thorax, though rather roundly convex.

Falces large, massive, and very prominent, but with no teeth at the fore extremity of the upperside.

Eyes small and not greatly unequal in size; their position is very nearly that of *Nemesia*, the four exterior ones (being the laterals of each row) forming a transverse oblong figure whose fore side is rather shorter than the hinder one; and within this oblong is another shorter one, formed by the fore and hind central pairs of eyes, and whose fore side is considerably shorter than the hinder one.

Legs moderately long, strong; terminal claws three; no scopula at the extremities. Relative length 4, 1, 2, 3.

Maxillæ long, cylindrical, but prominent in an obtusely pointed form at the inner side of the fore extremity.

Labium short, of a round-oval form, rather truncated at the apex.

Atrax robustus, sp. n. (Pl. VI. fig. 1.)

Adult female, length 13 lines, to end of falces 16 lines.

The whole of the fore part of this spider is of a deep rich red-brown colour; the *cephalothorax* smooth, shining, and destitute of hairs; the colour, however, of the falces is rather darker, and the fang is long and strong.

The *legs* do not differ greatly in length; and their armature consists of hairs, slender bristles, and a few spines.

The *labium*, which is convex in front, is studded with small tooth-like spines, a large portion at the base of the maxillæ being also similarly furnished.

The *abdomen* (in the only specimen examined, a dried one) was much shrunken; it is hairy, and its colour is a dark reddish brown. The spinners, four in number (?), were broken off.

A single example of this spider, from New Holland, is in the British-Museum collection.

Gen. nov. Idiophthalma.

Generic characters.

Cephalothorax oblong-oval; fore part and hinder part about equal in width; rather flattened, but the occipital portion somewhat roundly convex.

Eyes in three transverse rows, very similar to *Idiops* &c., but differing in the greater length of the front row and the contiguity of the outer eye, at each end of the hinder row, to the one next to it, forming two pairs considerably removed from each other. The hinder row is the longest, consisting thus of four eyes, and the middle row the shortest.

Falces strong and bristly, furnished with a group of strong spines on the upperside of their fore extremity.

Legs moderate in length, strong, furnished with hairs and bristles only, the metatarsi and tarsi with a compact scopula. The legs of the fourth pair were wanting; the relative length of the rest is 1, 2, 3.

Maxillæ long, cylindrical, and slightly curved.

Labium oblong, slightly broader at the apex (which is truncated) than at the base.

Idiophthalma suspecta, sp. n. (Pl. VI. fig. 2.)

Adult female, length 6½ lines, including falces 8¼.

The colour of the cephalothorax, legs, and palpi is dark reddish brown, the falces being of a deeper brown than the cephalothorax; abdomen brown.

A single example of this spider, from Granada, South America, is in the British-Museum collection. Although allied to *Idiops*, Perty, it appears to me to be generically distinct from that as well as from other allied genera, *Idiosoma*, Auss., *Idioctis*, L. Koch, and *Idiommata*, Auss.

Gen. nov. AGANIPPE.

Generic characters.

Cephalothorax longer than broad, and its fore extremity rather narrower than the hinder part; caput tolerably and roundly elevated.

Falces massive, furnished with a group of strong tooth-like spines at the fore extremity.

Legs short and strong, relatively 4, 3, 2, 1 (?); terminal claws three, with scopula beneath the tarsi and metatarsi of the first and second pairs, as well as under the digital joints of the palpi.

Eyes minute, but occupying a large area, and disposed in three transverse rows, 2, 2, 4, and somewhat like those of *Idiops*, but more widely separated, and the front row very much longer in comparison to the rest.

Maxillæ moderately long, cylindrical, and slightly curved.

Labium oblong, its sides nearly parallel, and its apex truncate.

This genus appears to be intermediate between *Idiops* and others of that group and *Eriodon*.

Aganippe subtristis, sp. n. (Pl. VI. fig. 3.)

Adult female, length $10\frac{3}{4}$ lines, including falces rather over $12\frac{1}{2}$.

The colour of the cephalothorax, falces, legs, and palpi is yellow-brown; the *eyes* form a broad transverse oblong figure, whose fore side is shorter, but not very greatly so, than the hinder one; the middle row is much the shortest; and the hinder row (consisting of four eyes) is slightly curved, the convexity of the curve directed forwards; the two central eyes of this row are more than double the distance from each other that each is from the lateral eye on its side of the same row.

The *legs* (of which the third and fourth pairs are the strongest) are furnished with hairs and bristles, the genual, tibial, and metatarsal joints of those of the third pair being armed with numerous short and strong spines on their outer sides.

The *abdomen* (much shrunken, but probably of the form given in the figure) is brown and hairy.

A single example of this species is in the British-Museum collection. *Hab.* Adelaide.

Aganippe latior, sp. n. (Pl. VI fig. 4.)

Adult female, length nearly 11 lines.

This spider is evidently of the same genus as the last, though readily distinguishable by some strong differential characters. It is smaller, the cephalothorax is shorter and proportionally broader, and the falces are more powerful; the eyes also are smaller, and the figure formed by them has its fore side shorter and its longitudinal less in proportion to its transverse diameter.

The whole of the fore part of this spider is of a dark, shining, reddish yellow-brown colour. The *cephalothorax* is short, broad, and massive, the caput well and roundly elevated.

The *falces* are very strong, furnished in front with hairs and bristles disposed in longitudinal stripes, and armed with a group of strong spines on the upperside of their fore extremity.

The *eyes* are very minute but not very different in size; they form an area whose transverse diameter (at the hinder side) exceeds its longitudinal diameter taken in the middle, disposed in three transverse lines, 2, 2, 4, the foremost line being equal in length to that formed by the two middle eyes of the third (or hinder) row; while in *A. subtristis* the foremost line exceeds in length that formed by the two hind central eyes.

The *legs* are short and strong, those of the third and fourth pairs being the strongest; their relative length is 1, 2, 3, 4, though the difference between those of the first and second pairs is very slight; and in their armature, as well as in that of the palpi, they are similar to *A. subtristis*, though the spines on the third pair are perhaps not quite so numerous.

The *abdomen* is hairy and of a warm reddish brown colour; but it was too shrunken to give any exact idea of its form.

A single example is contained in the British-Museum collection. *Hab.* West Australia.

Genus Eriodon, Latr.

Eriodon insignis, sp. n. (Pl. VI. fig. 5.)

Adult male, length 5 lines, to extremity of falces 6½ lines.

The *cephalothorax* of this spider is almost circular, the fore part being slightly truncated; the curve of that part is flattened. The colour of the caput and falces is a bright but rather brickish orange-red, that of the thorax being brownish black and covered with slightly tuberculous granulosities.

The *legs* and *palpi* are of a dark shining brown colour, tinged very slightly with metallic purplish; the former are short and strong, but not very different in length, those of the third pair being rather the shortest; they are furnished with hairs, bristles, and some short spines on the inner side of the genua of the first pair, and on the outer side of those of the third pair, with some longer and stronger ones beneath the tibiæ and metatarsi of the first pair; the tarsi terminate with three toothed claws.

The palpi are long, the radial joint about double the length of the cubital, and considerably tumid beneath the hinder half; the digital joint is small; and the palpal organs consist of a roundish basal bulb prolonged into a long, curved, tapering but not very sharp-pointed corneous process.

The *falces* are of great size and very prominent; their surface is granulose; and they have a cluster of tooth-like spines on the inner side of the fore extremity.

The *abdomen*, which was very much shrunken, projects well over the base of the cephalothorax; it is hairy and of a sooty black colour.

A single example of this very striking species is in the British-Museum collection. *Hab.* Swan River, Australia *.

Eriodon incertus, sp. n.

Adult male, length (without the falces) $6\frac{1}{2}$ lines.

This spider is very closely allied to the preceding (*Eriodon insignis*); after close examination, however, I am inclined to think it is of a distinct species, differing not only in its larger size (which is, perhaps, inconstant), but in its longer palpi, in the more strongly constricted bulb of the palpal organs, in the outer eyes of the front row, which are larger, and in some other respects.

The colour of the *cephalothorax* is pitchy black with a slight bottle-greenish hue, and is more roughly granulose than that of *Eriodon insignis*; the falces also are more granulose, and their colour is black on the basal half, the fore half being of a pinkish orange-red.

* Since the above was in press Prof. Ausserer's "Zweiter Beitrag zur Kenntniss der Territelaria," Verh. z.-b. Ges. Wien, 1875, vol. xxv., has come to hand: in this work an *Eriodon* (*E. rubrocapitatus*), very nearly allied to, if not the same species as, *E. insignis*, is described and figured (p. 140, pl. v. figs. 1, 3, 4). As, however, the identity of the two does not at present appear to me quite certain, I have not recorded the British-Museum example as synonymous with Prof. Ausserer's spider.

The *legs* and *palpi* are of a bright shining metallic purple-brown colour; the inner sides of the genua of the first and second pairs (chiefly of the *first* pair) are thickly furnished with spines, as also are the outer sides of the same joints of the third and fourth pairs.

The *abdomen* is small, hairy, and of a sooty brown colour, projecting strongly over the base of the cephalothorax.

This example is also from the Swan River, and in the British-Museum collection, where there is likewise a third specimen from the same locality; this last is (an adult ♂) of the same species as that now described, but differs from it in the entire falces being of a pinkish orange-red colour and the caput slightly tinged with the same hue; its size is also smaller, being the same as that of *E. insignis.*

Fam. **Phoroncidides.**

Genus Phoroncidia, Westw.

Phoroncidia aurata, sp. n. (Pl. VII. fig. 9).

Adult female, length $2\frac{1}{3}$ lines, breadth of abdomen nearly 2 lines.

The *cephalothorax* is round-oval and tolerably convex above, the caput elevated and produced in a somewhat bent form, the occipital portion being rather gibbous; consequently the clypeus is high, deeply impressed in the middle, and prominent at its lower margin. The colour of the cephalothorax, as well as of the rest of the fore part, is a bright orange-red-brown; the greater part, however, of the legs of the fourth pair is strongly suffused with black.

The *eyes* are placed in a tolerably compact group of four pairs at the extremity of the caput; the fore and hind central pairs form nearly a square, whose longitudinal is rather greater than its transverse diameter; those of each lateral pair are placed in almost a straight line with the fore central eye on its side; the laterals and fore centrals thus form a semicircular line; the latter are the largest of the eight, and the laterals the smallest.

The *legs* are short but rather strong, their relative length being 1, 4, 2, 3; and the genual joints are rather abruptly bent downwards near their hinder extremity; their armature consists of a few hairs only; and the tarsi terminate with three claws.

The *palpi* are short and slender, furnished with hairs only, and destitute of a terminal claw.

The *falces* are short and not particularly powerful; they are armed with two small blackish teeth close together, at the fore extremity on the inner side.

The *maxillæ*, *labium*, and *sternum* are normal in their form, the maxillæ being also furnished with a strong tuft of long black bristles on their inner surface.

The *abdomen* is large, nearly round when looked at from above, and of a short pear-shape when seen laterally, the spinners forming the stem, these organs being placed at the extremity of a truncated cone of a coriaceous nature. The whole of the abdomen is of a corneous nature; the upper part and sides are of a bright golden hue and metallic lustre; four tolerably long, strong, divergent, and sharp-pointed, tapering, black spines occupy the upper corners, and form very nearly a square; between the two hinder ones, but a little way within their straight line, is a fifth spine of the same character though not quite so long nor so strong as the rest. Each of these spines consists of a truncated conical basal portion, prolonged by a sharp terminal spine; and their surface is furnished with a few minute tubercles or granulosities, which may originally have had hairs springing from them; but if so, these had been accidentally rubbed off. The whole of the abdomen is more or less covered with reddish and dark red-brown spots of various sizes, some of these being ocellated and the larger ones forming the pattern shown in the figures (Pl. VII.). The surface around the bases of the spines, as well as the whole of the underside and a large patch on the hinder part of the abdomen, are strongly suffused with orange-red.

Two examples of this beautiful and brilliant species were received from Madagascar in 1875, through the kindness of Mr. R. H. Meade, of Bradford, Yorkshire. It is a very distinct species from any yet described, and the most striking, perhaps, among the few known spiders of this remarkable genus.

Fam. **Gasteracanthides.**

Gen. Paraplectana, Capello (1866).

Eurysoma, Koch & Blackw. ad part.
Peniza, Thorell (1868).

Paraplectana maritata, sp. n. (Pl. VII. fig. 7.)

Adult female, length 2 lines, breadth of abdomen nearly 2 lines.

This very pretty and distinct spider has the broad, massive cephalothorax of a uniform pale luteous yellow colour, shining, and furnished with a few fine hairs; the caput is large, much elevated above the height of the thorax, and rather roundly sloping from the occiput to the eyes; the occipital slope is abrupt and rather hollow.

The *eyes* are in three widely separated groups, close to the fore margin of the caput, leaving a clypeus of very small height; the central group of four eyes, seated on a black patch, forms very nearly a square, whose hinder side is the longest, the two eyes forming this side being the largest of the eight; the eyes of the lateral pairs are the smallest, and those of each pair are seated contiguously on a small tubercle quite at the fore corner of the caput.

The *legs* are short, tolerably strong, and not very greatly different in length; they are of a dark blackish brown hue, the basal joints, as well as a portion of the tibiæ and metatarsi of the third and fourth pairs, being brownish yellow; they are furnished with hairs, bristles, and a few spines, the latter chiefly on those of the first and second pairs.

The *palpi* are moderately long and slender, similar in colour to the legs, and furnished with hairs and strongish bristles.

The *falces* are long and powerful, their direction being nearly vertical. At their base their colour is like that of the cephalothorax, deepening, however, to a dark brown at the extremity.

The *maxillæ*, *labium*, and *sternum* are of normal character, and their colour is deep brown-black.

The *abdomen* is large, as nearly as possible round, moderately convex above, and projects over the cephalothorax to the highest part of the caput; the upper surface is of a corneous nature, though the usual boss-like markings are some of them obsolete and the rest very indistinct; its colour is a cream-white, marked with some large and generally well-defined black patches and spots; the nature of these will be best understood by reference to the figure (Pl. VII.): there is some little variation in the extent of these black markings; but they are always easily traced, and generally very conspicuous on the clear white ground-colour. The underside is black-brown; and the sides are longitudinally wrinkled. The spinners are short, compactly grouped, and of a dark brown colour.

The *male* is smaller than the female, being $1\frac{1}{2}$ line in length; the legs of the first and second pairs are longer; and all the legs are of a brownish yellow colour, the femoral and genual joints more or less suffused with dark brown.

The *palpi* are short, the digital joints large, and, together with the palpal organs, form a mass of, comparatively, an enormous size. These organs consist of a congeries of bold corneous spines and processes; the radial joint is short but wide, and is divided into several prominent apophyses.

The *abdomen* is more of an oval form than that of the female, its length being a little greater than its breadth; the upper surface is thickly covered with somewhat shining and apparently slightly depressed pale amber-coloured spots; the black pattern so conspicuous in the female is but just traceable in the male, being ill-defined and mostly of a dull yellowish brown colour on a cream-yellow ground, the ground-colour in this sex, however, being of small extent, and assuming the nature of large ill-defined spots. In all the males examined the dark patch at the hinder extremity of the upperside of the abdomen is of a deep blackish brown.

Adults of both sexes of this very striking little spider were received from Mr. J. H. K. Thwaites, by whom they were found in the Royal Botanic Gardens in Ceylon.

Paraplectana decora, sp. n. (Pl. VII. fig. 8.)

Adult female, length $2\frac{1}{2}$ lines (nearly); length of abdomen nearly 2 lines.

The *cephalothorax* and *falces* are of a rich dark red-brown colour; the caput is broad, massive, well rounded above; and the height of the clypeus exceeds the length of the figure formed by the four central eyes.

The *eyes* are small, disposed in three widely separated groups; those of the central group form a small square, whose longitudinal is rather greater than its transverse diameter, and its fore side rather shorter than its hinder one; those of each lateral pair are seated contiguously on a small tubercle, very near the margin, at one of the fore corners of the caput, and are the smallest of the eight, the hinder ones of the central group being the largest.

The *legs* are short, moderately strong, of a yellow-brownish colour, and furnished with hairs and bristles; they differ but little in length, those of the third pair being the shortest.

The *palpi* are moderate in length, slender, of a pale dull yellowish colour, and clothed with hairs and bristles, a few of the latter having a spine-like character.

The *falces* are tolerably long, powerful, and nearly vertical in their direction.

The *maxillæ*, *labium*, and *sternum* are of the normal type; and their colour is a dark reddish brown, the sternum being nearly black.

The *abdomen* is nearly round, being very slightly less rounded behind than at its fore extremity. Its upper surface is moderately convex and of a corneous nature, the usual ocellated marks or bosses being faintly marked, and this principally round the margins of the hinder half; its colour is a dark rich brownish black tinged with maroon, and marked with twelve distinctly defined yellow spots of different sizes and shapes, three forming a triangle near the centre, and the rest equally disposed round the outer margins, the one on each side of the middle of the fore extremity being the largest. The sides and underside are wrinkled and of a deep blackish brown colour.

A single example of this very pretty spider was contained in a collection made for me on the Rio Grande (South America) by Mr. Henry Rogers, of Freshwater, in the Isle of Wight.

Paraplectana Kochii, sp. n. (Pl. VII. fig. 10.)

Adult female, length $3\frac{1}{4}$ lines (nearly); longitudinal diameter of the abdomen $2\frac{3}{4}$ lines, transverse diameter $3\frac{2}{3}$.

The whole of the fore part of this spider is of a deep red-brown colour, the tarsi (and metatarsi of the first three pairs) of the legs annulated with yellow.

The *cephalothorax* is of the ordinary massive form, the caput elevated into a high, transverse, rounded ridge, and constricted laterally near its fore margin; its surface is roughened and clothed with fine grey hairs.

The *eyes* are in three widely separated groups, near the fore margin of the caput; they are small, and do not differ much in size; the central group of four forms a square whose hinder side is longer than the rest; the posterior pair of these eyes are the largest of the eight; those of each lateral pair are seated very near together (but not contiguously) close to the lower fore corner of the caput; the height of the clypeus (in the middle) is rather less than half that of the facial space.

The *legs* are short and strong, furnished with hairs only, of which some are greyish white.

The *palpi* are short and rather slender; their colour is deep red-brown; and they are furnished with hairs, like the legs.

The *falces* are moderate in length but very powerful; their form is conical, their direction vertical, and the basal half in front is rugulose.

The *maxillæ* and *labium* are of normal form, red-brown with pale extremities, and the *sternum* rugulose, like the base of the falces.

The *abdomen* is large and oval, its transverse diameter considerably exceeding its longitudinal; its upperside is pretty convex, its surface corneous, minutely punctured, and marked with a marginal row of large round and oval boss-like spots of different sizes, and impressed in the usual way in their centres; four other similar markings describe nearly a square in the middle, with a much smaller one on each side of its fore part. The six middle anterior marginal markings, as well as the fore halves of the two anterior central ones, are of a bright orange colour on a paler ground; the rest of the upper surface of the abdomen is of a dull sooty hue, the boss-like markings being of a deep blackish red-brown colour. The underside of the abdomen is of a dull yellowish brown hue, wrinkled and covered thickly with minute dark red-brown tubercles, each of which is surmounted by a short bristle.

A single example of this spider was received from Cape York, and is (so far as I know) the first recorded species of the genus yet known on the Australian continent. It is with great pleasure that I connect with it the name of Dr. Ludwig Koch, the able author of 'Die Arachniden Australiens.'

Fam. **Arcydes.**

Gen. nov. Augusta.

Generic characters.

Cephalothorax broad and rather flattened, truncated before, and rounded behind; caput very distinctly divided from the thorax, which it also exceeds in breadth; it has a deep notch or incision on each side near the fore extremity; and its lateral upper margins are sharp-edged.

Eyes eight, in three widely separated groups; a central one of four, forming nearly a square in the centre, is situated close to the fore margin of the clypeus, and two others on each fore corner, seated on the portion divided from the rest of the caput by the incision before noticed.

Legs short and tolerably strong; relative length 4, 1, 2, 3.

Maxillæ short, broad at their extremity, and bent strongly downwards towards the sternum.

Labium broad and short, of a somewhat semicircular form, pointed at the apex.

Abdomen covered with a large and nearly flat scutum, of a subtriangular form, the base of the triangle being in front; its upper and under sides are completely occupied with shining patches, varying in size, but nearly all of a pentagonal form, the dividing portions or ribs being almost all of a uniform width, and furnished with very minute, corneous, shining and bristle-bearing tubercles, the longitudinal central rib also marked with a few impressed spots or pock-like punctures; the entire margin is studded thickly with small shining tubercles of a similar kind, each furnished with a short bristle; and the two fore corners are armed with a strong but not very sharp-pointed spine.

Augusta papilionacea, sp. n. (Pl. VII. fig. 6.)

Adult female, length 4 lines; breadth of the widest part of the abdomen 6 lines.

The whole of this very interesting and curious-looking spider is of a yellow-brown colour, the abdomen being of a paler and duller hue than the cephalothorax—the tarsi, metatarsi, tibiæ, and genua of the legs being strongly suffused with red-brown. The caput is large, of a somewhat quadrate form, very slightly convex above; the lateral edges of the upperside behind the lateral eyes, as well as the fore margin, are rather sharp and studded with small tubercles, each of which is furnished with a short bristly hair; the upper surface of the caput is marked with small yellow-brown spots, of a deeper hue than the rest of the surface, mixed with a few very minute red-brown tubercles; and there is a large shallow roundish depression on either side towards the occiput, and a well-marked longitudinal groove from between the hind central eyes to the thorax.

The *eyes* are of a pale amber-colour, and not very greatly different in size; the four central ones form a square whose hinder side is rather the longest; this group is placed close to the fore margin of the caput, so that the clypeus is almost obsolete; each of the lateral pairs of eyes is seated close below the outer edge of the fore corner of the caput, on a quasi-tubercular area formed by a deep notch or indentation in its lateral margin; the eyes of these lateral pairs respectively are not contiguous to each other, being separated by at least, if not more than, the diameter of one of them.

The *legs* are short and tapering in form, and do not differ greatly in length; those of the first and second pairs are much stronger than the rest, and though there seems to be a little difference between them in the actual lengths of some of the joints, the total length appears to be as nearly as possible equal; those of the fourth pair are the longest, and the third pair are the shortest; all are furnished with hairs and bristles (of which latter a few have a spine-like character) and terminate with three claws, the two superior ones curved and pectinated, and the inferior one, after its sharp bend at the base, almost straight.

The *palpi* are short and tolerably strong; their colour is similar to that of the legs, and they are also furnished with hairs and numerous spine-like bristles, the terminal claw being slightly curved and finely pectinated.

The *falces* are strong, rather prominent near their base in front, where they are also thickly marked with somewhat quadrate dull yellow-brown blotches; and thence to their extremities on the inner surface there are numerous strong bristles, some of which are of a spinous character.

The *sternum* is of a short oval form, truncate before and produced into a point behind, at the extremity of which as well as opposite the insertion of each of the first three pairs of legs is a small tubercle.

The *abdomen* is quite flat and of a subtriangular form, the apex forming the hinder extremity, which is bifid or broadly notched. Each of the numerous pentagonal shining compartments into which its surface (both above and below) is mapped out has a large central oval depression, made more conspicuous by a brown spot; the fore margin is slightly scalloped, hollow in the middle, enlarging and rounding on either side to the fore corner, which is armed with a strong, deep, blackish red-brown, slightly curved, but not very sharp-pointed spine; between this spine and the central hollow part of the fore margin there are, on each side, at the salient points of the scalloped border, four small, brown, blunt-pointed tuberculiform spines; the whole of the margins of the abdomen, both above and below, are thickly studded with minute round, brown and shining tubercles, each of which bears a small bristle; these bristles are not prominent, but sessile, and are thus scarcely visible, except under a magnifying-glass; the ribs which divide the shining pentagonal plates or bosses are also studded with, for the most part a single row of, very minute, brown, shining, bristle-bearing tubercles.

This remarkable spider, which in its general appearance bears some resemblance to a small butterfly, shows a strong affinity both to the Gasteracanthides and to *Arcys*, and is evidently a transitional form; but as it appears to me to be more nearly allied to the latter than to any of the groups of Gasteracanthides, not only by its general form, but by the peculiar structure of the cephalothorax, I have placed it along with *Arcys* in the family Arcydes; it differs, however, remarkably from *Arcys* in the general character and lengths of the legs, as also in the details of the abdominal scutum; for which and other reasons it has been necessary to constitute a new genus for its reception.

A single example was contained in a small collection of spiders from Madagascar, purchased of a London dealer in 1876.

List of Species.

Fam. Theraphosides.

Atrax robustus ♀, New Holland, p. 27, Pl. VI. fig. 1.
Idiophthalma suspecta ♀, Granada, South America, p. 27, Pl. VI. fig. 2.
Aganippe subtristis ♀, Adelaide, Australia, p. 28, Pl. VI. fig. 3.
—— *latior* ♀, West Australia, p. 29, Pl. VI. fig. 4.
Eriodon insignis ♂, Swan River, Australia, p. 29, Pl. VI. fig. 5.
—— *incertus* ♂, Swan River, p. 30.

Fam. Phoroncidides.

Phoroncidia aurata ♀, Madagascar, p. 31, Pl. VII. fig. 9.

Fam. Gasteracanthides.

Paraplectana maritata ♂ and ♀, Ceylon, p. 32, Pl. VII. fig. 7.
—— *decora* ♀, Rio Grande, South America, p. 34, Pl. VII. fig. 8.
—— *Kochii* ♀, Cape York, Australia, p. 35, Pl. VII. fig. 10.

Fam. Arcydes.

Augusta papilionacea ♀, Madagascar, p. 37, Pl. VII. fig. 6.

EXPLANATION OF THE PLATES.

Plate VI.

Fig. 1. *Atrax robustus* ♀: *a*, spider of natural size; *b*, cephalothorax and falces, in profile; *c*, eyes, from above and behind; *d*, maxillæ, labium, and sternum.

Fig. 2. *Idiophthalma suspecta* ♀: *a*, spider, enlarged; *b*, cephalothorax and falces, in profile; *c*, eyes, from above and behind; *d*, maxillæ and labium; *e*, natural length to the extremity of the falces.

Fig. 3. *Aganippe subtristis* ♀: *a*, spider, enlarged; *b*, cephalothorax and falces, in profile; *c*, eyes, from above and behind; *d*, maxillæ, labium, and sternum; *e*, natural length to the extremity of the falces.

Fig. 4. *Aganippe latior* ♀: *a*, spider, slightly enlarged; *b*, cephalothorax and falces, in profile; *c*, eyes, from above and behind; *d*, natural length to the extremity of the falces.

Fig. 5. *Eriodon insignis* ♂: *a*, spider, slightly enlarged; *b*, cephalothorax and falces, in profile; *c*, eyes, from above and behind; *d*, maxillæ, labium, and sternum; *e*, right palpus, from outer side; *f*, extremity of tarsus of leg of first pair; *g*, natural length to the extremity of the falces.

Plate VII.

Fig. 6. *Augusta papilionacea* ♀: *a*, spider, enlarged; *b*, caput and eyes, from in front; *c*, maxillæ, labium, and sternum; *d*, spider, of natural size.

Fig. 7. *Paraplectana maritata* ♂ and ♀: *a*, spider (♀), enlarged; *b*, ditto, in profile; *d*, ditto, natural size; *c*, spider (♂), enlarged; *e*, natural length of ditto.

Fig. 8. *Paraplectana decora* ♀: *a*, spider, enlarged; *b*, ditto, natural size; *c*, ditto, in profile.

Fig. 9. *Phoroncidia aurata* ♀: *a*, spider, enlarged; *b*, ditto, in profile; *c*, view of abdomen, from behind; *d*, profile of caput; *e*, spider, of natural size.

Fig. 10. *Paraplectana Kochii* ♀: *a*, spider, enlarged; *b*, ditto, in profile; *c*, ditto, natural size.

III.—*Notes on Foraminifera.* By E. PERCEVAL WRIGHT, M.D., F.L.S., Professor of Botany in the University of Dublin, Secretary of the Royal Irish Academy.

WHILE at the Seychelles, in 1867, I made several collections of the Foraminifera met with while dredging. These were, for the most part, preserved in spirits of wine, and unfortunately were lost. One dredging, made in about eight fathoms of water, off the entrance of the harbour of Port Victoria, between the island of St. Anne and Long Island, however, was preserved in a dry state; the bottom consisted for the most part of a coarse white sand, mixed with fragments of shells, spicules of Alcyonarians, and fragments of coral, and evidently contained numbers of Foraminifera. A little bottle of dredged stuff from Mahé harbour turned up subsequently; and the mud and sand washed from the corals and echinoderms which were brought home helped to make up a more or less representative batch of material. The whole was forwarded to my friend Henry B. Brady, F.R.S., of Newcastle-on-Tyne, for examination; and I am indebted to him for the following list of the species found and the accompanying notes upon them.

Seychelles Foraminifera.

1. *Cornuspira foliacea*, Philippi, sp. (1844, *Orbis foliaceus*, Enum. Moll. Sicil. vol. ii. p. 147, pl. 24. fig. 26). Medium-sized specimens, rare.
2. *Biloculina elongata*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii. p. 298. no. 1). Rare.
3. *Biloculina contraria*, D'Orbigny (1846, For. Foss. Vienne, p. 266, pl. 16. figs. 4–6). Very rare.
4. *Triloculina trigonula*, Lamarck, sp. (1804, *Miliolites trigonula*, Ann. Mus. vol. v. p. 351. no. 3). Rare.
5. *Triloculina oblonga*, Montagu, sp. (1803, *Vermiculum oblongum*, Test. Brit. p. 522, pl. 14. fig. 9). Rare.
6. *Triloculina Brongniartiana*, D'Orbigny (1840, Foram. Cuba, p. 156, pl. 10. figs. 6–8). Somewhat rare.
7. *Quinqueloculina seminulum*, Linné, sp. (1767, *Serpula seminulum*, Syst. Nat. 12th ed. p. 1264. no. 791). Rather common. Also several specimens of a concave variety, with thick margin, not answering very well to any figured species.
8. *Quinqueloculina secans*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii. p. 303. no. 43—Modèle no. 96). Rare.
9. *Quinqueloculina subrotunda*, Montagu, sp. (1803, *Vermiculum subrotundum*, Test. Brit. p. 521). Rare.
10. *Quinqueloculina Ferussacii*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii. p. 301. no. 18—Modèle no. 32).
11. *Quinqueloculina antillarum*, D'Orbigny (1840, Foram. Cuba, p. 167, pl. 12. figs. 4–7). Rare.

12. *Quinqueloculina agglutinans*, D'Orbigny (1840, Foram. Cuba, p. 168, pl. 12. figs. 11–13). Very common.
13. *Quinqueloculina reticulata*, D'Orbigny, sp. (1826, *Triloculina reticulata*, Ann. Sci. Nat. vol. vii. p. 299. no. 9.—Soldani, Testaceographia, vol. i. part 3, p. 233, pl. 159. figs. *bb*, *cc*). Rare.
14. *Quinqueloculina*, sp. A beautiful variety, with the crenulate edges and surface of the *Q. ornatissima* of Karrer, but more compactly built and without longitudinal striation; undescribed, I think. Not uncommon.
15. *Spiroloculina limbata*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii. p. 299. no. 12.—Soldani, Testaceographia, vol. ii. p. 54, pl. 19. fig. *m*). Rare.
16. *Spiroloculina canaliculata*, D'Orbigny (1846, For. Foss. Vienne, p. 269, pl. 16. figs. 10–12). Small, very rare.
17. *Hauerina compressa*, D'Orbigny (1846, For. Foss. Vienne, p. 119, pl. 5. figs. 25–27). Small, very rare.
18. *Nubecularia lucifuga*, Defrance (1825, Dict. des Sci. Nat. vol. xxv. p. 210; Atlas Zooph. pl. 44. fig. 3.—Blainville, Actinologie, pl. 66. fig. 3 *a–d*). Rare.
19. *Alveolina sabulosa*, Montfort, sp. (1808, *Miliolites sabulosus*, Conch. Syst. vol. i. p. 174). Small, rather rare.
20. *Peneroplis pertusus*, Forskål, sp. (1775, *Nautilus pertusus*, Descr. Anim. p. 125. no. 65). Rare.
21. *Orbitolites complanata*, Lamarck (1801, Anim. sans Vert. p. 376). Very common.
22. *Placopsilina cenomana*, D'Orbigny (1850, Prodr. Paléont. vol. ii. p. 185. no. 758). Very rare.
23. *Lagena squamosa*, Montagu, sp. (1803, *Vermiculum squamosum*, Test. Brit. p. 526, pl. 14. fig. 2). Small, very rare.
24. *Lagena marginata*, Walker & Jacob (1784, *Serpula* [*Lagena*] *marginata*, Test. Min. p. 3, pl. 1. fig. 7). Small, very rare.
25. *Globigerina bulloides*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii. p. 277. no. 1—Modèles nos. 17 & 76). Medium, rather rare.
26. *Textularia agglutinans*, D'Orbigny (1840, Foram. Cuba, p. 136, pl. 1. figs. 17, 18, 32–34). Medium-sized specimens, common.
27. *Textularia sagittula*, Defrance (1824, Dict. des Sci. Nat. vol. xxxii. p. 177, liii. p. 344; Atlas Conch. pl. 13. fig. 5.—Blainville, Malacologie, p. 370, pl. 5. fig. 5). Common. Also some allied forms too obscure for determination.
28. *Bolivina punctata*, D'Orbigny (1839, Voy. Amér. Mérid. p. 63, pl. 8. figs. 10–12). Small, rare.
29. *Verneuilina spinulosa*, Reuss (1849, Denkschr. Akad. Wissensch. Wien, vol. i. p. 374, pl. 47. fig. 12). Medium, rare.
30. *Pavonina flabelliformis*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii. p. 260. no. 1, pl. 10. figs. 10–12). A single specimen was found of this very interesting form, originally figured by D'Orbigny, *loc. cit.*, with Madagascar as its only locality, and not since recorded by any observer that I know of. It has a conspicuously perforate hyaline test; so that the suggested affinity to *Peneroplis* (Parker & Jones, Ann. & Mag. Nat. Hist. ser. 3, vol. xii.

p. 440. no. 16) is not confirmed. It is difficult from a single specimen to give the species a position; but that it belongs either to the family *Lagenida* or *Globigerinida* there can be little doubt. The original generic name *Pavonia* was changed to *Pavonina* in the "Vienna Basin" monograph, the former term having been employed by botanists for a genus of plants.

31. *Discorbina globularis*, D'Orbigny, sp. (1826, *Rosalina globularis*, Ann. Sci. Nat. vol. vii. p. 271. n. 1, pl. 13. figs. 1–4). Medium, rare.
32. *Planorbulina farcta*, Fichtel & Moll, sp. (1803, *Nautilus farctus*, Test. Micr. p. 64, pl. 9. figs. *g–i*). Medium, rare.
33. *Planorbulina larvata*, Parker & Jones (1865, Phil. Trans. p. 380, pl. 19. fig. 3, *a*, *b*). Rare.
34. *Planorbulina*, sp. An acervuline specimen not unlike *Tinoporus lucidus*, Brady.
35. *Pulvinulina repanda*, Fichtel & Moll, sp. (1803, *Nautilus repandus*, Test. Micr. p. 35, pl. 3. figs. *a–d*). Rare.
36. *Pulvinulina canariensis*, D'Orbigny, sp. (*Rotalina canariensis*, d'Orb., 1839, Foram. Canaries, p. 130, pl. 1. figs. 34–36). Very rare.
37. *Rotalia Beccarii*, Linné, sp. (1767, *Nautilus Beccarii*, Syst. Nat. 12th ed. p. 1162. no. 276). Small, rare.
38. *Rotalia orbicularis*, D'Orbigny, sp. (1826, *Gyroidina orbicularis*, Ann. Sci. Nat. vol. vii. p. 278. no. 1 — Modèle no. 13). Small, very rare.
39. *Cymbalopora Poeyi*, D'Orbigny, sp. (*Rosalina Poeyi*, D'Orb. 1840, Foram. Cuba, p. 100, pl. 3. figs. 18–20). Large, very common.
40. *Tinoporus lævis*, Parker & Jones (1860, *Orbitolina lævis*, Ann. & Mag. Nat. Hist. 3rd ser. vol. vi. p. 33. no. 7). Large, rare.
41. *Tinoporus vesicularis*, Parker & Jones (1860, *Orbitolina vesicularis*, Ann. & Mag. Nat. Hist. 3rd ser. vol. vi. p. 33. no. 5). Very rare.
42. *Polytrema miniaceum*, Linné, sp. (1788, Syst. Naturæ, ed. Gmelin, vol. vi. p. 3784.—Esper, 1797, Zooph. vol. i. pl. 17). Rare.
43. *Patellina*, sp., a minute discoidal form, resembling a septate *Spirillina*, not corresponding with any figured species I can refer to. Very rare.
44. *Polystomella crispa*, Linné, sp. (1767, *Nautilus crispus*, Syst. Nat. 12th ed. p. 1162). Small, rare.
45. *Polystomella striatopunctata*, Fichtel & Moll, sp. (1803, *Nautilus striatopunctatus*, Test. Micr. p. 61, pl. 9. figs. *a–c*). Small, very rare.
46. *Nonionina asterizans*, Fichtel & Moll, sp. (1803, *Nautilus asterizans*, Test. Micr. p. 37, pl. 3. figs. *e–h*). Small, very rare.
47. *Nonionina scapha*, Fichtel & Moll, sp. (1803, *Nautilus scapha*, Test. Micr. p. 105, pl. 19. figs. *d–f*). Medium, very rare.
48. *Amphistegina vulgaris*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii. p. 305. no. 8—Modèle no. 40). Small, common.
49. *Heterostegina depressa*, D'Orbigny (1826, Ann. Sci. Nat. vol. vii.

p. 303, pl. 17. figs. 5–7). Large, very common. Also a small thick variety with angular margin, not outspread as in the typical form: this possibly may only be an immature stage of *H. depressa*; but it is very common.

50. *Operculina complanata*, Defrance, sp. (1822, *Lenticulites complanata*, Dict. Sci. Nat. vol. xxv. p. 453). Medium size, rare.

This thick *Operculina*, common in the Red Sea, Indian Ocean, and Australia, is not the typical *O. complanata*, but rather an intermediate form, showing the close relationship to *Nummulina planulata*.

51. *Operculina granulosa*, Leymerie (1846, Mém. Soc. Géol. France, sér. 2, vol. i. Mém. no. 8, p. 359, pl. 13. fig. 12, *a–c*). Not uncommon.

52. *Nummulina planulata*, Lamarck, sp. (*Lenticulites planulata*, Lamarck, 1804; Ann. Mus. p. 187. no. 1). Medium, rare.

When at Cagliari in 1871, I obtained a small quantity of the foraminiferous sand found in the neighbourhood of the port from the Director of the Museum. This I also forwarded to Mr. Brady, who quite recently sent me the following list.

Cagliari Foraminifera.

Biloculina ringens, Lamarck. Rare.
Triloculina trigonula, Lamarck. Rare.
—— *oblonga*, Montagu. Somewhat rare.
—— *Brongniartiana*, D'Orbigny. Rare.
Quinqueloculina seminulum, Linné. Common. Also some of the subvarietal forms, such as *T. triangularis*, D'Orb., and the like.
—— *secans*, D'Orbigny. Common, specimens very large.
—— *subrotunda*, Montagu. Rare.
Spiroloculina limbata, D'Orbigny. Somewhat rare.
—— *excavata*, D'Orbigny. Somewhat rare.
Nubecularia lucifuga, Defrance. Very common.
Peneroplis pertusus, Forskål. Common.
—— *arietinus*, Batsch. Rare.
Orbitolites complanata, Lamarck. Common, specimens small.
Vaginulina legumen, Linné. Rare.
Cristellaria crepidula, Fichtel & Moll. Rare.
Polymorphina gibba, D'Orbigny. Rare.
—— *compressa*, D'Orbigny. Rare.
—— *communis*, D'Orbigny. Rare.
Textularia sagittula, Defrance. Common.
—— *agglutinans*, D'Orbigny. Less common.
Discorbina globularis, D'Orbigny. Somewhat common, specimens fine.
—— *rosacea*, D'Orbigny. Rare.
Planorbulina mediterranensis, D'Orbigny. Very common.
Truncatulina lobatula, Walker & Jacob. Common.

Truncatulina refulgens, Montfort. Rare.
—— *tuberosa*, Fichtel & Moll. Common—the form named by D'Orbigny *Tr. variabilis*, of which Soldani gives no less than 284 figures in the 'Testaceographia,' the better to illustrate its wonderful range of variation.
Pulvinulina concentrica, Parker & Jones. Rare.
—— *vermiculata*, D'Orbigny. Very common.
Rotalia Beccarii, Linné. Common, specimens large.
Tinoporus lævis, Parker & Jones. Rare.
Polytrema miniaceum, Linné. Common, some of the specimens growing on *Nubeculariæ*.
Nonionina asterizans, Fichtel & Moll. Rare.
—— *depressula*, Walker & Jacob. Rare.
Polystomella crispa, Linné. Common.

IV.—*On the close Relationship of* Hydractinia, Parkeria, *and* Stromatopora; *with Descriptions of new Species of the former, both Recent and Fossil*. By H. J. Carter, F.R.S. &c.

[Plate VIII.]

In limine, it may be observed that an intimate knowledge of the structure of the skeleton of *Hydractinia* is absolutely necessary to trace the chain of resemblances that exists between it and *Stromatopora* through *Parkeria*, not less a perusal of the facts as they are consecutively given in this contribution, and, if possible, the presence of the objects themselves.

Having had to study carefully the horny chitinous skeleton, which is the most imperishable part of the Hydractiniidæ, in order to write and illustrate a paper on several recent species (Ann. & Mag. Nat. Hist. 1873, vol. xi. p. 1, pl. i.), I am not the less able to see the resemblance that exists between them and those of bygone ages whose skeletons alone are handed down to us in a lapidified state; and hence it was announced that *Parkeria* had been inferred to be one of these (Ann. & Mag. Nat. Hist. 1876, vol. xviii. p. 187). I was not aware then that species of *Stromatopora*, even as far back as the Devonian and Silurian systems respectively, would have to fall into the same category; so what I have to state of these will appear in the sequel.

All who have studied *Parkeria* must be aware that it has been well described and illustrated by Dr. Carpenter (Phil. Trans. 1870, vol. 159. pt. 2, p. 721, pls. 72–76); next to which follows *Loftusia*, equally well described and illustrated by Mr. H. B. Brady (*ibid.* pls. 77–80).

Influenced, however, by the presence of the "primordial chamber-cone" figured by Dr. Carpenter in pl. 72, *c*1–*c*4, and pl. 73, fig. 2, *ll*, I was induced to observe, in the short "Note on *Parkeria*," added to my paper on the *Polytremata* (Ann. & Mag. Nat. Hist. 1876, vol. xvii. p. 208), that it could be hardly doubted that *Parkeria* was a species of Foraminifera, but that "one of the chief characters of the Foraminifera," viz. the "foraminated areæ of which the so-called 'nummuline tubulation' is an example," had not been demonstrated. The chief object, however, of this "Note" was to state that the fibre of which *Parkeria* was composed was *not* "arenaceous," and that the structure of *Parkeria* was not identical with the "labyrinthic structure" of the foraminiferal test *Lituola nautiloidea*, Lam., var. *canariensis*, D'Orb.

Up to this time I was under the impression that *Parkeria* had been a species of Foraminifera; for I had only one specimen myself, in which I could see all that had been described by Dr. Carpenter excepting the "primordial chamber-cone." Subsequently, however, I began to doubt the Foraminiferal nature of *Parkeria*; and, the nucleus of my specimen in shape presenting exteriorly the pointed end of a Belemnite, which extended from one side of the sphere to the other, I began to think that it had been a sponge which had grown round the end of a Belemnite. But what sponge? was the next question. *Luffaria* seemed to be the only genus that in fibro-reticulated horny structure, when fossilized, would come near to that of *Parkeria*; and so for some time I, from the presence of this great foreign nucleus, abandoned the Foraminiferal for the Spongial view, still not heartily, till June last, when, my friend Mr. W. J. Sollas having given me some more specimens of *Parkeria* obtained from the Upper Greensand of Cambridge, amongst which was an entirely *un*infiltrated central portion about $\frac{5}{12}$ inch in diameter that, on fracturing the circumferential or hard infiltrated part when the specimen was entire, had fallen like a nut out of its shell, I abandoned both these views; as will be seen hereafter. This nuclear portion also had been so broken as to expose the centre, *on one side of which* is a small circular or ellipsoidal cavity that appears to have originally contained the object on which the organism had commenced its growth (Pl. VIII. fig. 13, *c*).

Seeing, then, that *Parkeria* grew upon a foreign body which was on *one side* of the centre, I also felt satisfied that no Foraminiferous test, either recent or fossil, with which I was acquainted, presented either the fibro-reticulated structure of *Parkeria* or possessed a *foreign body* for a *point d'appui* to grow upon. This decided, I returned to the sponge theory, which again was not satisfactory, as the fibre of *Luffaria*, which of all other spongeous ones comes nearest in structure to that of *Parkeria*, is hollow, and not solid as in the recent Hydractiniidæ that I had described in the 'Annals' of 1873 (*l. c.*); and recognizing the identity in form between the fossilized fibre of *Parkeria* and the recent fibre of the Hydractiniidæ, especially of *Chitina ericopsis*, in which some of the stems are an inch in diameter, and the whole bush-like skeleton, branches, hydrothecæ, and every thing else elaborated out of a mass of uniformly anastomosing, reticulated, chitinous fibre without core or cortex, I immediately inferred that *Parkeria* had been closely allied to, if not a species of *Hydractinia*.

Still to further confirm the inference, I examined the specimens of *Parkeria* and *Loftusia* at the British Museum, and those of *Parkeria* and *Hydractinia pliocena* (Allman) at the Museum of the Royal School of Mines, through the kind aid respectively of Messrs. H. Woodward and E. T. Newton; after which I obtained an excellent specimen of *Hydractinia pliocena* from Mr. Ed. Charlesworth, of the Strand, to which I must now add specimens of a recent *calcareous Hydractinia* from Cape Palmas, on the Guinea coast of Africa, that were sent to me some time ago by my friend Mr. T. Higgin, of Liverpool.

Thus prepared for tracing the resemblance of the recent Hydractiniidæ through the fossil species *H. pliocena* to *Parkeria*, and thence to the *Stromatopora*—it is desirable that I should premise a description of the development of the chitinous-fibred skeleton of *H. echinata*, as well as that of the skeleton or polypidom of the calcareous species from Cape Palmas, in order that I may be the better able to illustrate the fossilized from the recent structure. But as the development of the former has already been represented in the 'Annals' (*l. c.*), I must refer the reader to the figures there given for this part of my communication.

Beginning with *Hydractinia echinata*, and taking for examination a portion of the earliest or first-formed layer (which will be henceforth termed "lamina") of the skeleton as it exists on the inner side of a *Buccinum* bearing this Hydrozoon, where it is almost immeasurably thin, but may be obtained by dissolving away the shell with acid and floating the lamina on to the surface of a slide, for placing it under the microscope—it may be observed, when viewed with an inch compound power, to consist of a branched, anastomosing, cœnosarcal stolon-tubulation, forming a network in which the interstices are filled up with structureless sarcode to complete the membrane. After this, chitinous points (the "horn-cells," see 'Annals,' *l. c.*) make their appearance irrespectively throughout the membrane so constituted; and these sending out processes more or less sexradiately, which unite with each other, thus form, with additionally superimposed laminæ, the chitinous reticulation of which the skeleton of *Hydractinia echinata* is finally composed (Ann. & Mag. Nat. Hist. *l. c.* pl. i. fig. 6). When the reticulation has been thus commenced on the first or basal lamina (Pl. VIII. fig. 1, *a*), the upper arms of the sexradiate points or "horn-cells" respectively, which are now free, grow into short conical serrated spines (fig. 1, *e*, *e*); and thus the surface of the *Hydractinia* presents an area of such spines, with minute but variable intervals between them, interrupted only here and there by much larger ones of a similar form (fig. 1, *g*).

The same process takes place during the evolution of a second or superimposed lamina (fig. 1, *c*); but here for the most part the descending arms of the "horn-cells" respectively unite with the conical serrated or ascending ones of the first lamina; while the opposite or free arms respectively again assume the short conical form, to remain free, or unite in like manner with the descending arms of a third lamina (fig. 1, *f*).

We have now three laminæ (fig. 1, *a*, *c*, *f*), and therefore two intervals or interlaminal spaces (fig. 1, *b*, *d*), beyond which the chitinous skeleton of *Hydractinia echinata* seldom extends. In both instances the two intervals are converted into pillared cavities respectively by the union of the ascending and descending arms of the horn-cells respectively; but the upper interval is much wider than the lower one, and therefore the reticular spaces thus formed much larger.

On examining the surface of each lamina separately, it may be further observed that many of the short conical serrated spines of the first lamina are not met by corresponding *descending* points of the second one, and therefore remain *free* (fig. 1, *e*, *e*) in the lower interval. This does not appear so often in the upper interval, while, of course, on the surface of the third or last lamina, which is that of the surface of the skeleton of the *Hydractinia* itself, they are *all free* (fig. 1, *f*). Although differing slightly in height, they average about $\frac{1}{750}$ inch, which is twenty times less than that of the large spines (fig. 1, *g*), to which I have above alluded; but while they consist, for the most part, of solid points respectively, the structure of the large spines is more or less reticular, as will now be particularly explained.

In outward form the large spines, which average $\frac{1}{18}$ inch in height, resemble the small ones in being serrate, with the points of the teeth directed upwards (fig. 1, *g*); but in a vertical section of the whole skeleton they will be found to be based upon a number of the smaller spines of the first or basal lamina, which, like the rest, become lost in the general reticulation of the skeleton before the latter rises upwards into the large conical spine mentioned. This spine consists of a series of serrulated longitudinal ridges corresponding with the horizontal radial terminations of its internal network (fig. 2), and, diminishing in number from several ridges at the base as they slope inwards and upwards, are finally reduced to three or four at the summit, which, by the union of the remaining ridges there, thus becomes closed (fig. 2, *a*); so that the whole somewhat resembles a pinnacle of open gothic architecture which is in direct communication with the skeleton below, where, as before stated, it thus becomes based on pillars which were once the small spines of the first or basal lamina.

Hence, if a horizontal section be made near the summit, it will represent a stellate form in which the rays or ridges appear to radiate from a *solid* axis (fig. 2, *a*); while, a little further down, a similar section will present a *hollow* axis in communication with the reticulate structure of the spine, which also finally terminates in the ridges on its surface (fig. 1, *g*, and fig. 2). Thus the *point* of the larger spine is solid and the *body* hollow-reticulate.

In short, if projected on a plane surface, the greater number of ridges at the circumference reduced to three or four at the summit would represent the septa of an asteroid polyp-cell in a stony coral, whose intervals, in like manner, flowing from two or three gutters at the summit, and branching out towards the circumference, would also be stelliform—a circumstance which it might be well to remember, as it seems to be repeated under another form in *Stromatopora*, where the summits appear sometimes to be solid and sometimes hollow, according to the position of the section, but always with an asteroid or stellate appearance.

The large spines are thickly scattered over the surface among the small ones at short but irregular distances, and are only found fully developed or largest on those parts of the *Buccinum* which are not exposed to friction by the *Pagurus* (by which the shell is on such occasions almost invariably tenanted) dragging it over hard objects at the bottom of the sea.

Lastly, on the surface of the skeleton may frequently be observed a branched reticulation formed of cœnosarcal tubular stolons, about $\frac{1}{500}$ inch in diameter (fig. 3), which here and there produces corresponding grooves in the chitinous structure; while in some parts it is almost free, and at others covered with chitinous points (fig. 3, *c*), which are in continuation with the surface structure of the skeleton. This cœnosarcal tubulation also here and there presents short branches which, from their *annulation* (fig. 3, *a*), appear to have been the pedicels of polypites—a ringed feature which is remarkably common on the stems and pedicels of the Hydroid zoophytes, and one to which it is desirable here to direct attention in a *sectional* point of view, viz.:—

As the "annulation" consists of circular constrictions of the stem following each other in a moniliform manner, so, when a horizontal section is made of this part through the interval between the constrictions, the latter presents the appearance of a circular diaphragm or line with a circular hole in its centre (fig. 3, *b*); and if the section be oblique, then there is a succession of fragmentary circular lines ending in an entire circle, completed by the addition of the cut line at the inner end of the section of the stem to the semicircle of the diaphragm, thus altogether somewhat resembling the spiral line of a "thread-cell" (fig. 23).

Further, it is desirable, for our present purpose, that all the skeleton-structure of *Hydractinia echinata* should be borne in mind, while we discard the sarcodic parts, as they may be assumed to be destroyed long before fossilization.

Hence we should remember that the small spines remain free on the surface of the laminæ respectively, and thus retain the conical serrated form as they appear on the surface of the entire skeleton, while other spines are joined to, incorporated with, and thus support the following lamina; also, that the large spines are hollow in the body and solid or closed at the summit, while the structure is more or less radiated throughout.

Nor should the structure of the laminæ be misconceived, inasmuch as, although in a vertical section they give the appearance of a continuous layer, still this chiefly arises from the union of the horizontal arms of the horn-cell, when viewed in the *vertical* section; while if viewed *horizontally*, they present the reticulation seen on the surface of the skeleton, which is that of each lamina in succession.

To facilitate an understanding of the way in which the skeleton of *Hydractinia echinata* is developed, I have taken the most regularly formed portion, which, as will be seen by my illustration in the 'Annals' (*l. c.* pl. i. fig. 6), has very much the appearance of that of a hexactinellid sponge; but after this it should be remembered that this regularity is by no means persistent throughout the skeleton, but, on the contrary, subject to great latitude in point of modification and irregularity. When, therefore, the *regularity* may be found almost persistently in the structure of some species of *Stromatopora*, it is no indication that they were hexactinellid sponges, but, on the contrary, that they were something else; for I have never seen the hexactinellid structure in sponges so persistently regular as in these species of *Stromatopora*.

Calcareous Hydractiniidæ.

Let us now direct our attention to the structure of the skeleton in the calcareous species from Cape Palmas, which, hitherto having been undescribed, will be given under the designation of "*calcarea*."

Hydractinia calcarea, n. sp. (Pl. VIII. figs. 4–6.)

Skeleton laminiform, incrusting, spreading, cancellous, massive, not reticular, stony coral-like. Composition calcareous. Colour greyish white. Surface rough, spiniferous: spines at the growing margin commencing in minute points of calcareous matter scattered through a sarcodic lamina of almost immeasurable thinness, arranged more or less linearly so as to resemble a furrowed area, afterwards becoming thicker and rising into conical points, which, uniting more or less together, form serrulated lines that are rendered irregular in height by some points being higher than others (fig. 4, *a*, *d*); finally developing another lamina (fig. 4, *c*), which is supported on some of the small spines of the first, and which, in its turn, also throws up similar spines on its surface (fig. 4, *e*). Upper lamina much thicker than the lower one, having an irregular interval between them (fig. 4, *d*) about 1-180th inch high, which in the vertical section presents a number of arched cavities formed by the small spines of the first or basal lamina uniting, in the form of pillars of support, with the under-surface of the second or surface lamina, leaving some of the spinulæ still free on the floor of the arched cavities. Skeleton (fig. 4) seldom if ever formed of more than two laminæ. Surface of the upper lamina ridged reticulately; ridges compressed, serrulated irregularly with small spines, interrupted at irregular distances by large ones (fig. 5, *a a a*, *b b b*, small spines omitted in the illustration for perspicuity); interstices pit-like and without spines (fig. 5, *d d d*). Large spines about 1-60th inch high (fig. 4, *f*, and fig. 5, *a a a*), variable in shape, round or compressed, hollow in the interior (fig. 4, *f*, and fig. 6, *a*), communicating at the base with the interval between the two laminæ, closed at the summit (fig. 4, *f*); massive, but radiate in structure, the ends of the radii corresponding to serrulated ridges on the surface of the spine (fig. 6), which ridges diminish in number upwards until by union they form the summit of the cone (fig. 6, *b*). Small circular apertures, about 1-600th inch in diameter, plentifully scattered among the serrulated points of the rugged ridges and bases of the large spines (fig. 5, *c c c*), which are the openings of short tubular cavities, that respectively end in diaphragms with a small circular hole where they open into the interval between the two laminæ (fig. 4, *g g*). Diaphragms about 5-1800ths inch in diameter, apparently continuous with the chitinous membrane lining the internal cavities, and, for the most part, visible through the apertures on the surface.

Hab. Marine, incrusting small univalve shells.

Loc. Cape Palmas, Guinea coast, Africa.

Obs. There are two specimens of this species, viz. one on a small *Murex* about eight twelfths of an inch long, bearing two spines equally covered by the *Hydractinia*, and the other on a broken shell of the same size and kind. Each shell contains a hermit crab (*Pagurus*). They were sent to me in a dry state; and failing to obtain, by soaking in warm water, any return of form in the soft parts beyond that of thread-cells, I am unable to describe more than the skeleton. With the exception of the skeleton being massive and not reticular and chitinous, it is otherwise so like that of *Hydractinia echinata*, that, on a superficial view, it would, but for the colour, be said to be the same species.

Fossil Hydractiniidæ.

We now come to the fossil species of Hydractiniidæ, viz. *H. Michelini* and *H. cretacea*, Fischer—the former from the Upper Miocene and Older Pliocene respectively, and the latter from the Upper Greensand (Bull. de la Soc. Géol. de Fr. t. xxiv. p. 689, 1857); also *H. pliocena*, Allman, from the Older Pliocene or Coralline crag of Suffolk; to which I can add another species from the Upper Greensand of Haldon Hill, near Exeter, lent to me by my kind friend Mr. W. Vicary, of Exeter, after whom I shall call it *H. Vicaryi*.

Deferring M. Fischer's species for the present, we shall commence with *H. pliocena*; and as Dr. Allman has not entered into a sufficiently detailed description of this species for our present purpose, I shall describe it from the specimen to which I have before alluded, which has grown over the outside of a shell like a *Buccinum*, and of which I have made a longitudinal section through the columella, leaving what was the mouth of the shell, now marginally covered by the fossil, entire.

Hydractinia pliocena, Allman (Geol. Mag. No. 98, August 1872, p. 337). (Pl. VIII. figs. 7–10.)

Skeleton laminated, thick, incrusting. Composition calcareous. Colour white. Surface rough, uniformly granulated with small conical spines (fig. 9, *a*, *e*), interrupted by larger conical ones (fig. 8, *a*), generally separate, but in the depending parts aggregated into tubercular eminences, *over all of which the same granulated surface extends*. Granules or small spines obtusely conical and themselves minutely granulated, about 1-200th inch high. Large spines (fig. 8, *a*) also obtusely conical, numerous, thickly scattered over the surface at unequal distances, about 1-30th inch high, and the same in diameter at the base. Minute circular apertures, varying in size, but averaging 1-360th inch in diameter, thickly and generally scattered over the surface between the granules (fig. 8, *c*); granulated surface traversed by deep grooves branching reticulately among the large spines (fig. 8, *b b*), the broadest about 1-225th inch in diameter. Presenting in the vertical section a confused, laminated, and chambered structure traversed vertically by narrow tubes (fig. 7, *b b*). Laminæ not distinctly continuous; chambers compressed, irregular in size and position, arched, and often presenting on their floor free conical granules, or small spines, such as are seen on the surface (fig. 9, *d d d*). Vertical tubes of various lengths (fig. 9, *c*), about the same diameter as the apertures on the surface, with which in the surface lamina they may be observed to be continuous (fig. 9, *b*), irregularly constricted in their course, so as often to present a submoniliform appearance (fig. 10); constrictions, when viewed *in* the entire tube, presenting a diaphragmatic appearance with central circular hole (fig. 10, *a*); tubes terminating inwardly in apertures of the roof of the chambers (fig. 9, *d d d*), and outwardly on the floor of the same respectively, as on the surface (fig. 9, *c*). Small spine or granule solid; large spine closed at the summit, hollow in the interior, cavity presenting a stellate form in the horizontal section. Size, horizontally, that of the *Buccinum* (fig. 7, *a a*) or shell over which it has grown, viz. in this instance about 2 inches long by 1 inch broad; thickest part of incrustation (fig. 7, *b*) 5–12ths inch.

Hab. Marine, incrusting.

Loc. Coralline Crag, Suffolk.

Obs. By comparing the description of the skeleton of *Hydractinia echinata* with that of *H. pliocena*, it will at once be seen that I must differ from Dr. Allman where he states (*l. c.*) that "it is impossible to find any character which can separate it [*H. pliocena*] from the living *Hydractinia echinata*." Here Dr. Allman assumes that the original composition of *H. pliocena* was chitinous, and that this has been "entirely replaced by carbonate of lime." But now that the living Cape-Palmas specimen shows that the skeleton of *Hydractinia* may be calcareous as well as chitinous, it seems to me much more probable, as the skeleton of the calcareous species is solid and shows no signs of fibre, that *H. pliocena*, which also shows no signs of fibre, was also calcareous.

Of the identity of the large and small spines of *H. pliocena* with those of the living species there can be no doubt. Nor can we doubt that the apertures on the surface leading down to the chambers (which, although present in *H. echinata*, are not so plainly marked as in *H. calcarea*) are equally identical with those on the surface of *H. pliocena*. Of the identity of the grooved reticulation on the surface of *H. echinata*, where the cœnosarcal branched stolon-tubulation which produces it is also present, with the branched grooved reticulation on the surface of *H. pliocena* (fig. 8, *b b*) there can also be no doubt; while the annular constriction in the descending tubes of the latter is equally identical with the annulation of the pedicels on the cœnosarcal tubulation of *H. echinata*, together with the diaphragmatic rings which are seen at the bottom of the tubes, more especially in *H. calcarea*.

The presence of some of the small spines on the floors of the chambers (fig. 9, *c d*) is the same, and the hollow radial form of the internal cavity of the large spine closed at the summit the same as that of the large spine also especially seen in *H. calcarea* (fig. 6, *a, b*).

So that altogether, part for part, we have just the same formation in *H. pliocena* as in the living species, while the structure of the fossil is more like that of *H. calcarea*.

Lastly the large spines in *H. pliocena* are for the most part broken off by accident, and thus present a hollow interior; but where perfect the summit will be found to be closed or imperforate.

Hydractinia Vicaryi, n. sp. (Pl. VIII. fig. 11.)

Skeleton thick, incrusting. Composition siliceous. Colour greyish white. Surface rough, uniformly granulated with small obtuse spines interrupted by larger ones, over which the granulation also extends. Small spines solid. Large spines round and conical or compressed, elongated and wedge-shaped, about 1-25th inch in diameter at the base, more or less regularly distant from each other (fig. 11, *a*). Minute circular apertures variable in size, but averaging 1-257th inch in diameter, thickly but not generally scattered over the surface, being chiefly confined to the base of the large spines respectively (fig. 11, *b*), often connected by a small groove. Vertical sections presenting traces of vertical tubes and chambers, of which the former often contains an annulated core (fig. 12, *b*), but no distinct lamination. Size of specimen horizontally about $1\frac{1}{2}$ inch in diameter; vertical thickness about 4-12ths inch.

Hab. Marine, incrusting.

Loc. Upper Greensand, Haldon Hill, near Exeter.

Obs. This differs from the foregoing, viz. *H. pliocena*, in the larger size and more compressed form of the large spines, which are also arranged more regularly than those of *H. pliocena*; also in the distribution of the apertures on the surface, which instead of being generally spread over it, are chiefly confined to the bases of the large spines respectively, where, when the spine is broken off low down, they may be seen to lead into tubes somewhat radiating round the base of the spine; also in the absence of the grooved branched reticulation so evident on the surface of *H. pliocena*, while the apertures may often be observed to be connected by a small groove which seems to indicate the position of a cœnosarcal tube that once connected them, like that seen in some species of *Stromatopora* (fig. 21).

The situation of the apertures round the bases of the large spines respectively resembles that seen in the living calcareous species (*H. calcarea*), where they do not appear in the pit-like "interstices;" also the compressed, wedge-shaped form of many of the large spines; while the irregular moniliform cast or core of the vertical tubes coincides remarkably with the same kind of *mould* presented by the vertical tubes in *H. pliocena*.

On what this specimen was based it is impossible to say now, as its only form is that of a broad cone covering a shapeless piece of solid, opaque flint of a whitish grey colour, which was probably the form of the object on which it grew; but that it was laminated its thickness shows, although now there is no trace of this lamination remaining, save in the presence here and there of one of the chambers of the intervals with a few of the small spines just projecting above its floor, as seen in *H. pliocena*.

Since M. Fischer has given no detailed description of his *H. cretacea*, it is impossible to say if this be the same species.

Parkeria, Carpenter. (Pl. VIII. figs. 13–17.)

We now come to *Parkeria*, whose skeleton was formed not of solid material, like that of *Hydractinia calcarea* and the two fossil species last mentioned, but *entirely* of reticulated tissue like that of *Chitina ericopsis* (Ann. & Mag. Nat. Hist. *l. c.*), out of which the whole structure, architecture as it may be termed, was elaborated without, as before stated, "core or cortex"—in short, somewhat like a mass of "crochet knitting" or the woody fibre of a washed-out gourd (*Luffa*), to make the similes more familiar (fig. 14)—of course supplied with sarcode when living, which completed the cavities indicated by the architectural arrangement. Such, then, having been the tissue, as it may be termed, and the structure of *Parkeria* while living, it may be now added that the fibre of which the tissue is composed was probably homogeneous and solid, also like that of *Chitina ericopsis* and the recent chitinous species of *Hydractinia*, but that during fossilization it became transformed into homogeneous, colourless, transparent calcspar (fig. 14, *a*), coated with a layer of granular yellowish calcite (fig. 14, *b*), so as (again using a familiar allusion) to resemble strings of sugar-candy, in which the string or thread would represent the fibre, and the sugar-candy the granular incrustation of calcite around it; at least this is what is presented by a transverse section of the calcified fossilized fibre, but not so in the silicified state, as the mounted section of a siliceous *Parkeria* at the Museum of the Royal School of Mines shows, where the fibre has no coating whatever. Subsequently the tissues thus fossilized became infiltrated with homogeneous translucent calcspar, as if they had been soaked in so much wax; and thus the whole structure also became entirely or partially solidified, so as to assume the spherical form originally possessed by *Parkeria*, but in a lapidified state. Owing, however, to the infiltration being frequently partial, the central portion often remains *un*infiltrated, so that here the structure is composed of the coated fossilized tissue-fibre *only* (fig. 13, *d*). Such is the case with one of the specimens I possess, in which, as before stated, this portion (fig. 13, *d*) about 5-12ths inch in diameter, is broken across so as to expose the centre, and was originally contained in a shell or infiltrated zone about 5-24ths inch in thickness (fig. 13, *a*, *b*), so that, when entire, the diameter of the whole specimen amounted to about

10-12ths inch (fig. 13). From this uninfiltrated portion, then, the structure of *Parkeria* will be chiefly described.

It is desirable to premise that the fossilized tissue-fibre averages about 1-900th inch in diameter, one third of which belongs to the core or central portion, and the rest to the incrustation (fig. 14, *a*, *b*). In the stems of *Chitina ericopsis*, where the fibre is largest, it measures, *when round*, about 1-900th inch in diameter; but, of course, this varies slightly in each instance with position; also it must be premised that the structure of *Parkeria*, which is concentric, will be divided into laminæ, intervals and vertical tubes, and that the two latter increase in size outwards, so that, while the first interval and tube are respectively 1-300th and 1-200th inch, the same, five rows from the centre, are respectively 1-200th and 1-60th inch in transverse diameter.

Commencing immediately round about the centre, whose structure itself will be more advantageously considered hereafter, the first lamina may be observed, under the microscope, in the vertical section, to be composed of two layers of reticulated tissue presenting between them a line of openings, and to be about 1-300th inch in thickness; after this, on progressing outwards, the thickness is increased a little, rather by the addition of more tissue-fibre than by the enlargement of the openings. These are the openings of "passages running at right angles to the plane of section," which Dr. Carpenter (to whose faithful descriptions and illustrations in the 'Philosophical Transactions,' *l. c.*, I shall often have to refer) likens to "communications between the contiguous series of chamberlets in *Alveolina*" (*op.* et *l. c.* p. 730); but they are more analogous to, if not homologous with, the openings observed in the horizontal lamina of *Tubipora musica*, as will be better understood hereafter. But to return to the thickening of the lamina: in progressing outwards, this may be observed, as before stated, to be chiefly owing to an increase in the amount of tissue-fibre, that, rising into pillar-like forms on the outer surface of the basal lamina, may be seen, in the vertical section, to grow out in the same way, on *both* sides of the succeeding laminæ, so that, where meeting their *vis-à-vis*, they form pillars of support to, and where not meeting remain with free ends in, the interval.

In the first three or four intervals, this outgrowth of tissue-fibre from the laminæ is almost entirely limited to cylindrical pillars scattered irregularly through the intervals, which, when broken, may be observed to be hollow and to extend simply from one lamina to the other (figs. 13, *d* and 17, *b*). These are the "radial tubes" of Dr. Carpenter. They increase in number and slightly in size outwards; so that while they average transversely about 1-300th inch in diameter near the centre, their cavity is about 1-125th inch in transverse diameter at the circumference of a specimen of *Parkeria* $1\frac{1}{2}$ inch in thickness. On progressing outwards, these cylindrical pillars, for the most part, lose their individuality from the increase in quantity of the tissue-fibre, which involves those in its course as the latter assumes a columnar disposition, increasing in size outwards. The columns so produced thus radiate from the centre to the circumference, and, arching towards each other in all directions as they arrive at each lamina, appear to divide the "interval," in the vertical section, into a number of chambers. These are the "chamberlets" of Dr. Carpenter.

So long as the vertical tubes retain their individuality—that is, in the first three or four intervals, where they are not obscured by the additional growth of the tissue-fibre (fig. 17, *b*)—they, with the laminæ of *Parkeria*, closely resemble the laminæ, intervals, and tubes respectively of *Tubipora musica*, especially as the whole structure of the latter is elaborated out of a similar tissue; but besides being almost incomparably larger (that is, while the laminæ, intervals, and tubes in *Parkeria* are at the part mentioned respectively 1-900th, 1-200th, and 1-900th inch across, those of *T. musica* are 1-24th, 1-4th, and 1-10th inch across, the cross diameter of the interval indicating the length of the tube in each instance), the tissue of *T. musica* is *not reticulated* but *sieve-like* and *laminiform*, all the holes being on the same plane and of all kinds of sizes, precisely like the structure of the calcareous tissues in the Echinodermata. The radiating tubes of *T. musica*, too, are for the most part opposite each other, so as to appear vertically continuous for a long distance, although internally their cavity is frequently interrupted by a diaphragm of the same sieve-like tissue, which is for the most part just below the lamina; and it is worth noticing that while the openings in a vertical section of the lamina of *T. musica* resemble those in the lamina of *Parkeria*, they are also present in a ring-like form inside the tube of *T. musica* opposite the lamina—that is, just above the diaphragm; so that the radial tubes, as in *Parkeria*, were in communication with the passages in the centre of the lamina, and not so continuously hollow as at first sight they would appear to be.

Having now described *Parkeria* from the vertical section, let us turn our attention to the surfaces of the lamina (that is, the outer and inner surfaces), *concentrically*—an examination which the same *un*infiltrated specimen renders comparatively easy, as the outer surface of this (fig. 13, *c*) represents the outer surface of the lamina and the inner surface of the cover or shell (from which the *un*infiltrated portion came) the inner surface of the lamina—the fracture or separation having taken place through the centre of the *interval* concentrically.

Taking the outer surface first (fig. 15), we may observe that the *floor* of the interval, which is the *outer* surface of the lamina, meanders almost continuously (that is, without interruption) round the ends of the broken radiating columns of tissue-fibre, with which it contrasts strongly for this reason, viz. that while the floor presents a continuous even surface of unbroken reticulated tissue-fibre, that of the broken columns enclosing the radial tubes is rough and jagged from fracture (fig. 15, *a*). As for the ends of the radial tubes, they appear indiscriminately scattered all over the concentric surface, sometimes broken through, as in the broken columns especially, at others ending on the surface of the floor naturally, thus appearing to be entirely independent, in position, of the columns (fig. 15, *b*).

On the other hand, if we turn our attention to the *roof* of the interval, which is the *inner* surface of the lamina, we see the same thing repeated, except that the roof is more angular; and this, with the comparative flatness of the floor, accounts for the arched appearance of the interspaces between the radiating columns observed in the vertical section.

Returning now to the proper nucleus or centre, all that I can state of this is, that when the *Parkeria* commences growth on a *foreign body* it does so just as *Hydractinia*—that is, beginning with a simple lamina, which, so long as the concentric layers continue to be not large enough to surround the foreign body, forms an incomplete circle, resembling a horse-shoe; but when the span or diameter of the concentric layer is sufficiently large to embrace the foreign body, then the growth goes on in continuous lines, viz. commencing elliptically and becoming circular outwardly (figs. 13, *d*, and 17, *b*). I now allude to a foreign body such as that in fig. 13, viz. about 1-24th inch in diameter. What the *natural* nucleus of *Parkeria* may be I am not prepared to state, as it is difficult to be certain, when the foreign body is very minute, whether there is one present or not, or one through which the section may not have passed. But in cases where there has apparently not been any foreign body, there the nucleus has presented itself under the form of minute reticulated tissue-fibre, more condensed in some than in other parts.

On this point, however, depends an important argument as to the real nature of *Parkeria*, viz. whether the "primordial chamber-cone" of Dr. Carpenter is, or is not, a foreign body and not the natural nucleus of *Parkeria*. It is a foreign body. Out of the sections of *Parkeria* that I have examined, one of which is in my own poseession, by far the greater number present a fragment of a concamerated test like that of a minute Nautilus or Ammonite, in which more or less septa are distinctly visible. Moreover the interior of the chambers of the fragment is filled with transparent calcspar, the lamina of white shell-substance surrounding it being still present and contrasting strongly with the grey tissue-fibre of the *Parkeria*, which only begins to make its appearance *outside* the concamerated test, as the homogeneity of the calcspar filling the interior evidently demonstrates. The instance in my own possession presents itself in a spherical specimen of *Parkeria* $\frac{3}{4}$ inch in diameter (fig. 17), where the foreign body consists of a fragment of a nautiloid shell whose transverse section represents a hyperbola with its apex in the centre of the *Parkeria*, on which the structure of the latter has evidently commenced growth (fig. 17, *c*). This hyperbola is 5-48ths inch high and 4-48ths inch in diameter at the base, while the *concavity* of the septum, of which only one is visible, is a little more than 4-48ths inch from the apex. The chamber thus formed between the septum and the apex of the hyperbola is filled with calcspar; and immediately *outside* the septum the reticulated tissue-fibre of *Parkeria* (fig. 17, *b*) is as distinctly visible as its absence is distinct *within* the septum.

After this, it may be stated that *Parkeria* is seldom without some foreign body either about its centre or in some part of its structure between this and the circumference, sometimes singly, at others in plurality; while sometimes it appears to have grown round the extremity of a cylindrical body $\frac{1}{5}$ inch or more in diameter, and sometimes round a cylindrical body of this kind which has traversed or transfixed it. But in most of these instances the foreign bodies are made up of minute Foraminifera, sponge-spicules, and fine material which looks like part of a sea-bottom. How this is to be explained I am ignorant. But the tissue-fibre itself is often filled up with such material, which appears to have become incorporated with it during growth.

Lastly, we come to the natural surface of the full-grown *Parkeria*, or to that of a specimen $1\frac{1}{2}$ inch in diameter; and this may be observed to be formed by the ends of the radiating columns of tissue-fibre, which, at the circumference, rise above the rest of the structure into little circular convex eminences, varying in diameter under 1-24th inch (fig. 16, *a*), and possessing an irregular radiated structure, in the midst of which, as well as in the intervals between them, may be seen the openings of one, two, or three radial tubes (here 14-1800ths inch in diameter), in accordance with the size of the eminence (fig. 16, *b*). The difference in diameter or size of the eminences arises from the columns, as they progress outwardly, having to supply offsets or branches, here and there, to fill up the increased space caused by their radiation; while the interval between the eminences is supplied by the surface of the last-formed lamina. I regret that the illustrations are so small; but the object has been to keep them of the natural size as much as possible, for comparison, leaving the reader to magnify them into diagrams if he should feel so disposed.

Obs. To say that the tissue-fibre of *Parkeria* in its present condition was identical with chitine in the living state would be absurd; but to say that calcareous fibre under this form does not occur in any recent organism of this kind, and that chitinous does, as in *Hydractinia* and especially in *Chitina ericopsis*, is indisputable. Again, the uninterrupted homogeneity of the tissue-fibre of *Parkeria* is incompatible with the more or less *cored* tissue-fibre of sponges. Moreover, that a thick *laminated chitinous* species of *Hydractinia* of considerable thickness does occur, is proved by the recent species figured under the name of *H. lævispina* in the 'Annals' (*l. c.*).

Having thus identified the tissue-fibre of *Parkeria*, we come to its structural or architectural developments; and here again we have undoubtedly the "tubes" foreshadowed in our description of *Hydractinia*, and identified in those of the fossil species (viz. *H. pliocena*), indicative of a cœnosarcal stolon-tubulation united throughout the interior, and finally opening on the surface. As to the "annulation" seen in the latter, that could hardly be expected, from the irregularity of the reticulated tissue-fibre; at the same time, if every individual were exactly alike, there would be no occasion for specific distinction.

The possibility of *Parkeria* being a species of Foraminifera rested chiefly on the presence of a "primordial chamber-cone" and the tissue-fibre being arenaceous like the composition of *Lituola*, &c., which have both been shown to be untenable; while the absence of a primary or embryonic chamber in the centre and the presence of reticulated tissue-fibre in its stead, together with the neighbouring structure that I have mentioned, the elaboration of the whole of the architectural structure of the test out of reticulated tissue-fibre, and the presence of one or more comparatively *large* foreign bodies in the midst of it are all facts, so far as my experience extends, singly or all together, unparalleled in the structure of recent or fossilized Foraminifera.

Lastly, the general homogeneity of the tissue-fibre in *Parkeria* is incompatible with the general or partially cored fibre of sponges, to say nothing of its *uniformity in size*, as before mentioned. It may be a question, by-and-by, when we come to *Stromatopora*, how far the radial tubes of *Parkeria* extended continuously in a vertical direction—that is, whether they went beyond *two* successive laminæ. If they were like those of *Tubipora musica*, they did not do so; for although those of *T. musica* appear to be continuous through a great many successive laminæ, they will, if examined interiorly, be found, as before stated, to possess a diaphragm close to *each* lamina, which thus divides them into a great number of partitions. Again, in the fossil species *Hydractinia pliocena* the radial tubes seem, from their length in the vertical section, (fig. 7) to pass through several successive laminæ; but on reference to the illustration (fig. 9) it is evident that this may be explained by their openings respectively in the floor and roof of the interval or chamber (fig. 9, *d*, *d*) being frequently *opposite* each other. So in *Stromatopora*, the vertical continuation of the tubes is no indication of their having been continuously hollow, any more than in *Tubipora musica*. However, in the hydroid polyp *Tubularia indivisa* the tubes are not only continuously hollow for 6 to 12 inches, but separate, and equal in diameter to those of *Tubipora musica*, viz. 1-16th of an inch (Hinck's Brit. Hydr. Zoophytes, p. 115, pl. xx.).

Species of Parkeria.

Besides the spherical form of *Parkeria*, which, for distinction sake, may be named *P. sphærica*, there is a bossed form, in which the surface projects into a number of large, circular, convex eminences, which might be designated *P. nodosa*. In structure, the latter appears to differ from the former in the wavy disposition of its laminæ (which, of course, follow that of the surface) from the very centre, showing that this form is concurrent with the commencement of its growth. There is also another form in the Cambridge Greensand, of which my friend Mr. W. J. Sollas gave me specimens; and this is circular compressed—that is, biconvex or lenticular. It might be designated *P. compressa*. Possibly there are other varieties, which may hereafter be recognized.

Loftusia (fig. 18).

As regards *Loftusia* (*L. persica*, Brady), which appears to have been so nearly allied to *Parkeria* that, if one can be shown to have been allied to *Hydractinia*, the other must follow, there can be no doubt that the general structure of *Loftusia* is spiral and not concentric; but then, as Mr. Brady states, and as I have verified by my own observation in the transverse and longitudinal sections of this fossil respectively, there is no "primordial" cell or embryonic chamber in the centre (*l. c.* p. 744), but, in its place, a minute "network" (p. 745). This, as I have also just stated, has not in my experience any parallel in recent or fossilized Foraminifera. The latter always begin from an embryonic cell or chamber. As regards the "imperforate nature" of the lamina ("spiral"), which is synonymous with "primary wall," as stated in paragraph 37, p. 746, this appears to me to be contraindicated at the commencement of par. 42, p. 747, wherein we may read, that "the layer immediately within the primary wall adds greatly to its strength, not only from the additional thickness it imparts, but also from the connexion its septal [? tubular] prolongations establish *between the successive whorls*" (the italics are mine). That the tubulation, or "radial tubes," did respectively communicate with the outer or "parallel tubular columns" of the accessory structures of the preceding and following whorls, especially towards the "end of the central axis" in the long section, is made evident by figs. 1 and 3, pl. 79 (*l. c.*); for Mr. Brady's descriptions and illustrations of *Loftusia*, like those of Dr. Carpenter of *Parkeria*, are equally faithful; and hence I cannot help thinking that, if Mr. Brady had had the advantage of an *un*infiltrated specimen of *Loftusia*, wherein he might have *looked down* upon the surface of the spiral lamina instead of *against* a vertical section of it only, the two layers of which the lamina is composed, and between which are situated the "openings" as in *Parkeria*, would have been found to be equally *perforated*, although, as I have before stated, in *Hydractinia* they appear respectively, in the vertical section, to be the edges of a continuous membrane or layer (see p. 49).

Indeed I have now (thanks to the kindness of Mr. Brady in sending me a specimen) been able to demonstrate this satisfactorily, by having ground down and polished the round external surface of a *Loftusia* in such a way as to cause the convexity to present the fine cribriform structure of the spiral lamina, while the latter is surrounded on all sides by the coarser one below or, rather, within it, just, in fact, what Mr. Brady himself has represented in his pl. 71. fig. 1, *c*. The existence of this cribriform structure is further confirmed by the weathered surface of the specimen of *Loftusia* in the Museum of the Geological Society of London (which, through the kind help of my friend Mr. Dallas, I have been permitted to examine), whose granulated surface, close to the edge of the section, where it can be identified with the spiral lamina to which it belongs, when viewed with the microscope, aided by the addition of a little water covered by a thin glass disk for a temporary varnish, presents the same reticulated structure with (what were) the circular apertures, now filled with transparent calcspar, varying from 1- to 4-1800ths inch in diameter. This, in comparison with the diameter of the apertures of the radial tubes (viz. 14-1800ths inch) on the natural surface of a *Parkeria* 1½ inch in thickness, seems very small; but then it should be remembered that towards the centre of the *Parkeria* this aperture is not more than 6-1800ths inch in diameter, while in *Hydractinia calcarea* the apertures do not exceed 3½-1800ths inch, and in *H. echinata* the cœnosarcal stoloniferous creeping tubulation is only 5-1800ths inch in diameter, &c. So that, after all, these apertures on the surface of *Loftusia* were not relatively small.

Comparing the radial tubes in *Loftusia* with the single one that unites the successively enclosing chambers of the ovoid Foraminifera termed "*Ellipsoidina*," as Mr. Brady has done (p. 748), would lead one to infer that they finally opened on the surface of *Loftusia* as in *Parkeria*, which is just what might be expected, although not actually stated by Mr. Brady. Undoubtedly there is a great resemblance between the spiral growth of *Loftusia* and that of the Foraminifera generally, especially *Alveolina*; but here the resemblance ends; while a "spiral growth" is by no means peculiar to the Foraminifera. The general form also of *Loftusia* is elliptical, as in *Alveolina*; but instead of the sigmoid longitudinal lines dividing the surface of *Alveolina* into segments like those of an orange, with transverse parallel lines between them, we have in *Loftusia* a minutely granulated surface, irregularly bossed, and sprinkled with papilliform eminences about 1-50th inch in diameter (fig. 18, *a*, *b*). At least this is what may be observed in the large specimen of the Geological Society's Museum.

And here it should be remembered that, in studying the fossil structure, the white parts or lines represent the substance of the test, and the dark ones the intervals which were occupied by the sarcode; at the same time, that a white line may be merely the cylindrical wall of a dark interior, as seen in the radial tubes of *Parkeria* under section.

That *Loftusia* was irregularly bossed during growth may also be seen *in the section*, which in this respect serves to confirm what, on the surface, might be doubted, from the quantity of matrix left about the specimens, consisting almost entirely of minute Foraminifera and rounded objects which might be confounded with the proper surface-elevations. But while the sections show that the surface was an irregularly undulating one, it also seems to show that the bosses for the most part originated from the accidental incorporation of a larger foreign body than the animal was accustomed to enclose.

With reference to the resemblance of *Alveolina meandrina* to *Loftusia*, as stated in my paper in the 'Annals' (1876, vol. xvii. p. 192), that can only be taken now for what it is worth. The former is undoubtedly a species of Foraminifera, the latter not.

As in *Parkeria*, there are many foreign bodies to be observed in the test of *Loftusia*, probably arising from its unfixed habit in the bottom of the sea, where it would be constantly rolling about in contact with small objects which it might thus incorporate during growth, after the manner of Sponges under similar circumstances. Indeed, as many specimens of *Parkeria* present foreign nucleiform portions which are filled with sea-bottom *only*, so does *Loftusia*; and not only this, but in some instances, both in *Parkeria* and *Loftusia*, there are parts of the tissue-fibre structure which are almost obscured by the quantity of foreign material (sand, &c.) incorporated with it during growth.

While, then, there can be little doubt that *Loftusia* was no more a species of Foraminifera than *Parkeria*, there may be doubt as to the nature of the substance of which the test was formed, since I see no means at present of determining whether this was calcareous or chitinous, from the metamorphosis which the original structure has undergone by crystalline infiltration.

Finally, although it has been stated that *Loftusia* cannot be considered a species of Foraminifera, it should be remembered that its spiral structure is so much like one that it seems to indicate a close relationship between the Rhizopoda and the Hydrozoa, *ex. gr. Amœba* and *Hydra*.

? *Bradya tergestina*, Stache, MS.

We now come to a fossil (from the Lower White Chalk of Dover) which forms an important link in our series, since it not only presents the cœnosarcal stolon-tubulation of *Hydractinia echinata* on its surface, but the tissue-fibre of *Parkeria* throughout, and the vein-like stellates which are so characteristic of the *Stromatopora*. It belongs to the British Museum; and through Mr. H. Woodward's kind help, I am enabled to give the following description of it.

General form irregularly subglobular, bossed with four or more monticular eminences of unequal size and height, which meet each other at their circumferences respectively. Composition calcareous. Colour whitish grey. Surface granulated from the weathering of minute reticulation formed by the anastomosing of delicate tissue-fibre; tissue-fibre like a mass of crochet-knitting, the thread of which is about 3-1800ths inch in diameter, and the interstices a little more, viz. about 5-1800ths inch in diameter; opaque, whitish on the surface, transparent in the interior, but not coated with granular calcspar as in *Parkeria*; presenting circular apertures about 12-1800ths inch in diameter (now filled up with calcareous material), densely scattered at variable distances from each other on the surface throughout the tissue-fibre; also a stellate arrangement of branched grooves which, radiating from the summit of each boss or eminence, finally mingle in their ultimate divisions with those of the surrounding eminences; but with no appearance of aperture on the summit; crossed by a creeping, branched, tortuous, dendriform fibre in prominent relief, which appears to be independent of the grooves, although in intimate relation with tha tissue-fibre, which it penetrates or issues from here and there, sometimes dipping under a portion to appear again after a short distance, and sending off laterally minor branches throughout the whole of its course; largest branches about 10-1800ths inch in diameter, cylindrical, and composed of a thin opaque layer externally, filled with transparent calcspar interiorly. Internal structure consisting throughout of the same kind of delicate, anastomosing, tortuous tissue-fibre seen on the surface, traversed by straight circular tubes from 5- to 12-1800ths inch in diameter and at variable distances from each other of 5- to 20-1800ths inch, which assume a radiating direction as they increase in number with their distance from the centre to the circumference, where the last open on the surface by the apertures above mentioned, or did so before they were fossilized and filled with calcspar. Each tube now composed of a white opaque cylinder filled with transparent calcspar, the centre of which is also opaque and clouded. Size of specimen ¾ inch in its greatest diameter; width of widest grooves, that is, at the summit of the boss, 1-24th inch in diameter.

Hab. Marine. Lower White Chalk.

Loc. Dover.

Obs. I am informed by Mr. H. Brady, who had previously sent me for examination a thin slice of a fossil similar to that above mentioned, that Dr. Stache, of Vienna, has described and named it, as above stated, "provisionally." He obtained his specimens from a limestone deposit on the eastern shore of the Adriatic, near Trieste, which deposit he has called "Liburnische Stufe," and considers intermediate between the Upper Cretaceous and Lower Eocene strata. Possessing this thin slice only, I, of course, am not able to say if it be the same species as that from the Lower Chalk of Dover, although the contour of the section, its size, colour, composition, and structure, so far as the tissue-fibre goes, appear to be identical; but the "thin slice" presents no trace of radiating tubes, although the tissue-fibre is more neatly defined, and there are evident, although indistinct, lines of concentricity which do not appear in the British-Museum specimen. Then Mr. Brady also states that his example cannot claim to be a type specimen; and therefore, for the present, the question must thus remain undecided.

However, this does not interfere with the facts which the English fossil supplies; and the first is the presence of the "branched, tortuous, dendriform fibre in prominent relief" on the surface, which is precisely like that which the cœnosarcal stolon-tubulation on the surface of a specimen of *Hydractinia echinata*, picked up on the beach here (Pl. VIII. fig. 3), would represent if fossilized, even to the annulation, which, although ill-defined, also appears to be present in one portion of the structure; next to this, the reticulated anatomosing tissue-fibre, without incrustation, of which the fossil is composed, which, with the radiating tubes, at once establishes a close resemblance between *Bradya tergestina*, *Parkeria*, and *Stromatopora*; lastly, the stelliform branched systems of grooves respectively (which were probably tubular in the recent organism), on the summit of the eminences, are identical with those seen on the surface and summits of the bosses in *Stromatopora*.

I had hoped to find the latter on the summits of the bosses respectively in *Parkeria nodosa*; but Mr. E. T. Newton, who kindly undertook to examine the specimen at the Museum of the Royal School of Mines, as well as the still better one at the British Museum, states in his letter of the 2nd of October last, "I cannot see any trace" of them; while he gives a rough sketch from memory of a specimen in the Cambridge Museum with much larger bosses, indeed not altogether unlike in shape, but much larger than those of *Bradya tergestina*, stating, at the same time, that he had seen a specimen in the British Museum on which "there are certain irregular prominences; and from these vein-like markings are seen spreading out somewhat as in *Stromatopora*." This was the specimen above described, which Mr. H. Woodward, having since had it sliced and polished, has kindly submitted for my examination.

Whether the tissue-fibre of this fossil was calcareous or not, I am unable to decide, further than that, if right in identifying the "branched, tortuous, dendriform fibre" on the surface of the fossil with the cœnosarcal stolon-tubulation of *Hydractinia echinata*, the former also may have undergone the same change—that is, from chitine to carbonate of lime.

I have stated that there are boss-like projections irregularly scattered over the surface of *Loftusia persica*, corresponding with a wavy condition of the spiral lamina opposite them in the section, and that they also bear branched lines running over their summits respectively, which look like traces of the stellate systems seen in *Bradya* and *Stromatopora* (fig. 18, *c*); but I have also added that most of these appear to be accidental. How far the reason I have assigned for this may be accepted, remains for future observation to determine.

It might be said that *Bradya tergestina* is a *Stromatopora*; but if so, *Stromatopora* is handed down to us in *Parkeria*; for the tissue-fibre and radiating tubes in *Parkeria* are, in a tangential section, identical with those both of *Bradya* and *Stromatopora*.

I regret that the fossil reached me after my plate of illustrations to this paper had been filled up; but a diagram of the tissue-fibre would only be a repetition of that which is given of *Parkeria* in fig. 14, minus the incrustation; and an almost facsimile of the stellates may be seen in fig. 19, making allowance for the larger size and lesser number of bosses in *Bradya tergestina*; while the branched fibre in prominent relief on the surface is represented in the cœnosarcal tubulation of *Hydractinia echinata* (fig. 3).

D'Orbigny gives a figure, viz. *Stellispongia variabilis*, very much in appearance like the above fossil, which is stated to extend from the Trias (Saliférien) to the Eocene (Suessonien) strata inclusively (Cours élément. de Paléont. et d. Géologie, t. i. p. 214, fig. 338).

Stromatopora.

My friend Mr. W. J. Sollas, who has for some time past been directing his attention to the different species of *Stromatopora* within his reach, and who has generously presented me with some specimens, and brought to my notice others, had, from the regular hexactinellid structure of one in particular (to which I shall return hereafter), been, like myself, inclined to the idea that it was originally a Sponge. But when I learned from Prof. King, of Galway, and Mr. Sollas, too, that some of these specimens at least presented a reticulated structure, it struck me that they might be allied to *Parkeria*.

Under this impression, I paid a visit to my friend Mr. Vicary, of Exeter, in whose beautiful collection (the more beautiful, too, because it has been made subservient to researches in geology and palæontology) I knew there were several specimens of *Stromatopora* from the Devonian Limestone, especially a large conical one, about 6 inches by 4 in its greatest diameters, in dark, almost black, limestone, with a bossed surface not unlike the bossed form of *Parkeria* to which I have before alluded.

Having found my friend, as usual, only too anxious to place every thing in this way at my disposal, I examined this specimen, as well as another of the same kind, which, although imperfect, had retained a portion of the bossed surface from which a polished section had been made *inwards vertically*, so as to show the structure of the *Stromatopora* in this direction,—when I became impressed with the resemblance of the wavy character of the concentric lines to that of *Parkeria nodosa*, and, on turning to the surface itself, found this granulated also like that of *Parkeria*, arising from the weathering out of the interstitial matter of the same kind of tissue-fibre. Moreover, on the summit of each of the bosses just mentioned is a stelliform lineation, whose arms descending in a branched, radiating, subdendritic form, meet in their ultimate divisions those of the neighbouring stellates; while over the whole surface, bosses and all indiscriminately, are irregularly scattered small papilliform elevations about 1-96th inch in diameter, but of variable sizes and at variable distances from each other (fig. 19, *a a*, *b b*). The stellate lines, together with a similar papilliform eminence in the centre, about 1-48th inch in diameter, and the papilliform eminences throughout, are chiefly made up of transparent calcspar, which contrasts strongly from its homogeneity with the surrounding tissue-fibre, indicating that originally all these parts were *hollow*; besides this, the more superficial lines of the stellate are rendered more evident by being slightly raised above the general surface; so that they are not *grooves* like the stellate lines of *Bradya tergestina*. The stelliform systems, which are a well-known feature of *Stromatopora*, have already been foreshadowed in the description of *Bradya tergestina*, and perhaps, as has before been stated, in a rudimentary form in *Loftusia persica*, if not also in the subradiating lines on the eminences of the surface of *Parkeria sphærica* and, through the plane projection, of the large spine of *Hydractinia echinata*, as before mentioned (p. 48).

But be this as it may, it appears here, as well as in *Bradya* *tergestina*, under a form so like the vents on several kinds of Sponges, where they are outlets of so many systems of superficial radiating, branched, excretory canals (which, albeit in their natural state they are grooves or gutters in the dermal structure of the sponge converted into canals by the dermal sarcode and rising more or less into monticular eminences respectively, more or less regularly arranged, become mere gutters, as in *Bradya tergestina*, when all the soft or sarcodic parts are abstracted, but, if filled with mineral material, might present in relief the same form as in the *Stromatopora* to which I have just alluded), that, as stated respecting the near proximity of the Hydrozoa and the Rhizopoda (*Amœba* and *Hydra*), in regard to the spiral structure of *Loftusia* we might also add here:—there is a near proximity between the Hydrozoa and the Spongida, whereby the stellates of *Stromatopora* might have been excretory canal-systems in each instance, although the rest of the structure pertains more to the Hydrozoa.

When we consider that all animal forms are evolved out of simple, apparently structureless sarcode, whether passing or permanent, it is not more surprising that such sarcode should possess the power of movement than that it should be able to assume a definite and beautiful form by movement, *ex. gr.* the *Spongozoon*, which, at one moment is a flagellated infusorium and at another a polymorphic piece of sarcode like an *Amœba*, or the test of Foraminifera, which is produced by an animal apparently differing very little from a polymorphic *Amœba*, and it is not strange that the Hydrozoa, which are so near the latter in the scale of organization, should evolve similar forms.

The next object to which Mr. Vicary directed my attention is part of a large specimen of a *Stromatopora* that is *subinfiltrated* on the surface, and presents in a most striking manner the vertical tubes and transverse laminæ coated with granular calcspar, very like that of the tissue-fibre of *Parkeria*. With the advantage of thus knowing the exact position relatively of the tubes and laminæ, it was not difficult to grind down a fragment of this vertically to the tubes and to the laminæ respectively. Thus was obtained a direct view of the ends of the tubes on one side (fig. 20), and a longitudinal section of them on the other (fig. 21, *a*). In the former the tubes were observed to be intimately connected by direct intertubular communication of a smaller kind (fig. 21, *b*), like that uniting the apertures on the surface of *H. Vicaryi*, and to be scattered throughout the mass of reticulated tissue-fibre indiscriminately—that is, in the midst of the stellates (which are also present here and there; for, of course, on every layer they are formed, although covered in by the following one, and thus in horizontal or tangential sections must appear throughout the fossil), as well as between the stellates; while the lateral section of the tubes showed that they were continuous through several laminæ, and possessed of the diaphragms (fig. 21, *a*) seen in *H. pliocena* (fig. 10, *a*), and identified here with the annulation of the cœnosarcal stolon-tubulation of *Hydractinia echinata* (fig. 3). Although, however, the tubes themselves appear continuous, their interior may be, and evidently is, *divided by diaphragms* of some kind, as before noticed in comparing the radial tubes of *Parkeria* with those of *Tubipora musica*. The "intertubular communication" is a feature of *Syringopora*.

Here it should be remembered that there is a marked difference presented by the structure of *Stromatopora* in the vertical and horizontal sections; that is, while the former represents a series of vertical lines cut at right angles by horizontal ones, the latter represents nothing of the kind, but a mass of minutely reticulated tissue instead, sprinkled over with the truncated ends of the radiating tubes and more or less fragmentary remains of the stellates. It would therefore be impossible to learn the vertical structure from the horizontal one, and *vice versâ*, here, any more than in *Parkeria* and *Loftusia*.

In the section of another specimen (fig. 22), called by Mr. Sollas *Syringopora*, the apertures of the truncated radiating tubes, now filled with calcspar (fig. 22, *b*), are larger and confined to the area between the stellates (fig. 22, *a*); while the latter, structurally, are often closed in the centre, indicative of their central tubulation not having been continued throughout, as we have seen in the larger species of *Hydractinia echinata*, &c., together with those of *H. pliocena* and *H. Vicaryi*. Again, on account of this section having been made a little obliquely to the horizontal plane, the lines of the "annulation" have been brought into view most convincingly, so much so that, from the large size of the tubes, they present the spiral appearance of annulated gonothecæ in the Hydrozoa cut slantingly (fig. 23). Why the parietes of the tube do not show a corresponding annulation I cannot explain; but in *H. Vicaryi* this is also the case, although the casts of these tubes within them are distinctly constricted (fig. 12, *b*). In *H. pliocena*, however, where there is no cast and nothing but a hollow cylinder, the constrictions are equally evident (fig. 10).

The largest specimen of *Stromatopora* seen by Mr. Vicary in the quarries of the Devonian Limestone in Devonshire, he thinks must have had a hemispherical radius of 2 feet.

Stromatopora striatella (figs. 24 & 25).

Subsequently Mr. Sollas brought me a specimen of *Stroma-*

topora striatella obtained from the Silurian formation at Wenlock. It is composed of yellowish-grey compact limestone, cylindrical in form, obtusely conical at the free end, and truncated at the fixed one, which is fractured, about 3 inches long and 1½ inch in diameter; granulated on the surface and covered more or less with papilliform eminences, each of which (about 1-20th inch in diameter) appears to have had an opening in the summit, about 8-1800ths inch in diameter, now filled up with calcspar (fig. 24, *b*), in the midst of which are stellates (fig. 24, *a*) with centres respectively about $\frac{1}{6}$ of an inch apart, and composed of radiating branched grooves *in* the surface, whose ultimate divisions meet those of the neighbouring stellates; each stellate also appears to have had a papilliform eminence in the centre, about 24-1800ths inch, with the appearance of an aperture in its summit about 8-1800ths inch in diameter, now also filled with calcspar; while the *fond* or granulated surface is produced, as before stated, by the weathering out of the interstices of a reticulated tissue-fibre like that of *Parkeria*, &c. Internally, on the other hand, the structure is laminated and concentric, irregularly undulating in accordance with the irregularities on the surface during the successive periods of growth. It is not difficult to see that the tubular spaces, which communicate with each other in the midst of the reticulated tissue-fibre, finally terminated on the surface; and on examining the *centre* of the fossil, Mr. Sollas and myself observed a foreign body bearing very much the appearance of a fragment of an *Orthoceras* (fig. 25, *a*), which is at least $\frac{1}{3}$ of an inch long and $\frac{1}{8}$ of an inch in diameter, filled with transparent calcspar, whose homogeneity contrasts strongly with the tortuous tissue-fibre of the *Stromatopora* generally, and presenting *three* distinct septa towards the largest end, with a fourth, which probably, from its appearance, terminates this part; while the shell-substance on the sides presents under the microscope an obliquely laminated structure throughout, indicative of its having been formed of the consecutive concave layers of the septa generally.

Obs. Now here we have a very similar structure to *Parkeria*, with a concamerated shell for a foreign body in the centre, while the surface is somewhat like that of *Loftusia*, with the stellates more evidently developed as in *Stromatopora*, all in a fossil so far back as the Upper Silurian System.

After this, Mr. Sollas showed me a fragment of a specimen of a calcareous *Stromatopora* from the Devonian Limestone, of which a polished section had been made vertically to the lamination, and therefore longitudinally with the tubulation. Here the base or tissue, if it may be so called, is not fibrous like that of *Parkeria*, &c., but massive, white, and opaque like that of *Hydractina pliocena*, in the midst of which the tubes, together with traces of the stelliform systems, show themselves in dark lines filled with transparent calcspar, which, with those of the undulating lamination indicated by broken lines of circular holes and oblong spaces, are altogether so like that of *H. pliocena*, that the two, *mutatis mutandis*, are almost identical; that is, the tubes are a little less in diameter transversely, and there are traces of the stellate systems, which do not exist in *H. pliocena*. There are also lines of opaque white matter across the transparent calcspar of the tubes, which indicate here and there in their parietes the presence of diaphragms and apertures, the latter indicating the union of the tubes by intertubular channels like that represented in fig. 21, to which I have before alluded as a feature of *Syringopora*.

I have said "traces of stellates;" but if the section had been made horizontally or tangentially to the lamination, the stellates would have been complete. This shows that to fairly describe species of *Stromatopora* it will be necessary to get their natural surface as well as their interior, if possible, and to cut the specimens vertically and parallel to the planes of growth respectively, thus obtaining two surfaces, which will then satisfactorily show the form, size, and relative position of the elementary parts of the structure; after which oblique sections may be made for further elucidation. All this I must leave to my friend Mr. Sollas, who has paid much more attention to the subject than I have, and whose intention now is to publish an exhaustive account of the *Stromatoporæ* as soon as time permits; hence the brevity of my remarks.

Meanwhile, to return to the calcareous specimen from the Devonian Limestone, which Mr. Sollas presented to me as an instance of hexactinellid structure closely resembling that of the hexactinellid sponges, and which at the time I myself could conceive to be nothing else,—I now find by actual comparison that in structure it is almost too persistently regular for that of any solid hexactinellid sponge with which I am acquainted. In this specimen or species the vertical, which are the largest white lines or fibres seen in the vertical section, are almost continuous for a *long* distance, which is not the case in the hexactinellid sponge-structure, and only has its direct type in the structure of *Tubipora musica*, where the interior of the vertical tubes, as I have before stated, is interrupted by diaphragms, and therefore not continuous, as might appear from mere external examination; while the horizontal fibres, which are smaller, are equally continuous and hollow. Again, turning to the horizontal section (that is, parallel with the lamination), the ends of the vertical fibres appear to be most frequently arranged hexagonally, with one in the centre, thus presenting respectively six horizontal arms, which, together with the ascending and descending one, would make eight.

We have also to assume, in case of its having been a hexactinellid sponge, the transformation of siliceous into calcareous material,—not a usual occurrence; for there are no calcareous sponges with a hexactinellid structure; indeed they are all *fibreless*, that is, they consist respectively of a mass of sarcode densely charged with calcareous spicules, like a bag of pins—only, of course, with a definite arrangement. But, as I have just stated, the structure of this species, like that of all the rest of the *Stromatoporæ*, requires to be studied in all its bearings before a correct opinion can be obtained of its original nature.

Thus, in recapitulation, we have seen the identity that exists between the recent species of *Hydractinia* and the fossil species of the Suffolk Crag and Upper Greensand of Haldon Hill, near Exeter, respectively; then the striking resemblance between the chitinous tissue-fibre of the chitinous Hydractiniidæ, especially that of *Chitina ericopsis*, and the tissue-fibre of *Parkeria*, together with that of the radial tubes of the latter to the radiating or vertical tubes of *Hydractinia pliocena*; afterwards the resemblance of *Parkeria* to *Loftusia*. Then the resemblance of the Lower White Chalk fossil (? *Bradya tergestina*) to *Parkeria* on the one, and the *Stromatoporæ* on the other side; lastly, the presence in *Stromatopora striatella*, of the Upper Silurian System, of a concamerated test in the centre, just as foreign to its structure as the concamerated test in *Parkeria*, which *Stromatopora* otherwise so intimately resembles.

All this chain of evidence seems to lead to the conclusion that the whole of these organisms, both recent and fossil, were species of Hydrozoa, and neither Foraminifera nor Sponges.

But foregone conclusions with so-called scientific men, are too often unfortunately like fashion in their governing power, since, although facts may be demonstrated, they are frequently negatived by individuals who, if they reflected, would, from their want of actual experience in this matter, be modest where they are violent in party denunciation. At the same time, as I have long since stated, "in proportion to the general acquaintance with the lower animals will be the correctness of the views respecting them, both recent and fossilized."

EXPLANATION OF PLATE VIII.

N.B. Figs. 1-6, 10, 12, 21, and 23 are on the scale of 1-48th to 1-1800th inch, fig. 9 on the scale of 1-96th to 1-1800th, and fig. 14 on the scale of 1-96th to 1-2700th inch; all the rest are of the natural size. It should be remembered that the ground-work of figs. 8, 11, 15, 16, 18, and 19 is granulated, but too small to be represented in a drawing of the natural size; hence the white ground must be considered as such; the granulation being produced by the weathering out of the interstitial matter of the tortuous anastomosing tissue-fibre of which the organisms respectively were composed. In figs. 20, 22, and 24, this granulation, of course, is not present, as they are taken from *fresh sections.*

Fig. 1. *Hydractinia echinata.* Vertical section of skeleton, magnified; composed of chitinous tissue-fibre. *a*, primary lamina; *b*, primary interval; *c*, secondary lamina; *d*, secondary interval; *e e*, small spines, free and connected with the secondary lamina respectively; *f*, surface of third lamina and that of the *Hydractinia*; *g*, large spine.

Fig. 2. The same. Horizontal section of base of large spine: *a*, closed summit of same.

Fig. 3. The same. Fragment of cœnosarcal stolon-like tubulation creeping over the surface, forming corresponding grooves in the latter and connected with the interior. *a*, annulation; *b*, the same, truncated to show the diaphragmatic form of the constrictions; *c*, points of chitine ("horn cells") on the part sinking into the interior.

Fig. 4. *Hydractinia calcarea*, n. sp. Vertical section of skeleton, magnified; composition calcareous. *a*, primary lamina; *b*, primary interval; *c*, secondary or surface-lamina; *d*, small spines, free, and connected respectively with secondary lamina; *e*, spines on secondary or surface lamina; *f*, large spine; *g g*, chitinous diaphragms leading from the apertures on the surface (fig. 5, *c c c*) to the primary interval.

Fig. 5. The same. Diagram of portion of surface to show:—*a a a*, large spines; *b b b*, area of small spines, not delineated for perspicuity; *c c c*, apertures leading down through short tubes respectively into primary interval; *d d d*, interstitial fossæ, smooth, not spined; *e e*, hole of the diaphagm as seen through the aperture.

Fig. 6. The same. Horizontal section of base of large spine. *a*, form of columnar cavity; *b*, closed summit of large spine.

Fig. 7. *Hydractinia pliocena*, Allman, (fossil), natural size; vertical section. *a a*, *Buccinum*; *b b*, *Hydractinia*, showing the "intervals" in the form of chambers, arranged in horizontal lines, cut vertically by radiating tubes.

Fig. 8. The same. Portion of natural surface, natural size, showing:—*a*, large spines; *b b*, grooves formed by cœnosarcal tubulation (fig. 3); *c*, circular area, to which the apertures of the surface are added, all the rest having been omitted for perspicuity.

Fig. 9. The same. Vertical section of fragment of surface of last-formed "lamina and intervals," magnified, showing how the vertical tubes on each side of the interval or chamber, being opposite, might appear in the general section to be continuous. *a*, small spines of natural surface; *b*, apertures in natural surface; *c*, annulated tubes leading down from apertures to intervals; *d d d*, chambers or intervals; *e*, spines remaining free in intervals.

Fig. 10. The same. Longitudinal section of a tube magnified, showing the "annulation;" *a*, tranverse section to show the diaphragmatic form of the constriction, with hole in the centre.

Fig. 11. *Hydractinia Vicaryi*, n. sp. (fossil), nat. size. Portion of natural surface, showing:—*a*, large spines; *b*, circular area, to which the apertures of the surface are added; all the rest having been omitted for perspicuity.

Fig. 12. The same. Cast of tube, showing annulations. *a*, cylindrical form of the cavity in which the cast (*b*) is found.

Fig. 13. *Parkeria sphærica.* Vertical section, natural size. *a*, infiltrated or consolidated zone or shell; *b*, semi-infiltrated zone; *c*, *un*infiltrated portion, or kernel; *d*, the first six laminæ of *c*, delineated to show intervals traversed vertically by the radiating tubes; the innermost elliptical, at one end of which the dark portion represents a cavity in which probably there was some kind of foreign body.

Fig. 14. The same. Diagram of tissue-fibre, magnified to show its reticulated, anastomosing, contorted arrangement and its composition. *a*, fibre, composed of colourless transparent calcspar; *b*, coating or incrustation, composed of granular, crystalline, yellowish calcite.

Fig. 15. The same. Diagram of portion of surface of kernel (fig. 13, *c*), showing:—*a*, ends of radiating pillars of tissue-fibre; *b*, circular area, to which the ends of the radiating tubes are added. Natural size.

Fig. 16. The same. Diagram of portion of natural surface of a specimen $1\frac{1}{3}$ inch in diameter, showing:—*a*, ends of radiating pillars of tissue-fibre; *b*, circular area, to which the ends of the radiating tubes are added. Natural size.

Fig. 17. The same. Vertical section, natural size. *a*, circle indicating size of specimen; *b*, the first six laminæ, delineated to show intervals traversed vertically by the radiating tubes; *c*, foreign nucleus, consisting of a fragment of a Nautiloid test.

Fig. 18. *Loftusia persica*, Brady. Portion of natural surface, natural size. *a*, papilliform apertural eminences of radial tubes; *b*, boss-like eminence, presenting, *c*, a trace of branched lines across (? radiating) from the summit.

Fig. 19. *Stromatopora* with bossed surface, in black-grey Devonian limestone. In the possession of Mr. Vicary. Portion of natural surface, natural size. *a a a*, bosses presenting the "stellate system of canals" respectively on the summit; *b*, papillary apertures of radial tubes.

Fig. 20. *Stromatopora* in grey Devonian limestone, subinfiltrated. In the possession of Mr. Vicary. Diagram of horizontal section, natural size. *a*, stellate systems of canals; *b*, ends of radiating tubes.

Fig. 21. The same. Horizontal section of ends of radiating tubes, magnified, to show intertubular communication like that of *Syringopora*: *a*, longitudinal section of tube, to show diaphragmatic lines and appearance of annulation; *b*, intertubular communications.

Fig. 22. *Stromatopora* (*Syringopora*), in grey Devonian limestone. In the possession of Mr. Vicary. Nearly horizontal section, natural size. *a*, stellate system of canals; *b*, ends of the radiating tubes, much larger than in the foregoing instance.

Fig. 23. The same. Section of radiating tube, magnified, to show the diaphragmatic lines of annulation cut obliquely.

Fig. 24. *Stromatopora striatella*, in yellowish compact limestone, from Upper Silurian system. Portion of natural surface, natural size. *a*, stellate systems of canals; *b*, papillary apertures of radial tubes.

Fig. 25. The same. Horizontal section, natural size, showing:—*a*, foreign nucleus, consisting of a fragment of a concamerated test like *Orthoceras*.

V.—*Descriptions of twenty-five new Species of* Hesperidæ. By W. C. Hewitson.

When ten years ago I described 176 new species of *Hesperidæ*, I stated that I would apologize for doing so (knowing the worthlessness of descriptions unaccompanied by illustrations) if I did not hope to figure the whole in the 'Exotic Butterflies.' I am happy to say that nearly the whole have been figured; and, though I cannot now make the same promise, since that work has come to its hundredth and final part, I still hope to figure the *Hesperidæ* which I am now describing in the 'Illustrations of Diurnal Lepidoptera,' in which the *Lycænidæ* now make their appearance. I may repeat now what I stated then, that, although numbers of *Hesperidæ* differ little on the upperside, some characteristic traits exist on the underside of the posterior wing; and upon these I have chiefly relied to enable me to discriminate one from another.

Hesperia Gonessa.

Alis utrinque fuscis: anticis punctis octo hyalinis: his infra angulo anali albo fasciaque submarginali pallida: posticis infra fasciis duabus macularum pallidarum: abdomine albo.

Upperside dark brown. Anterior wing with eight small transparent white spots—two in the cell, three in a longitudinal band below these, and three near the apex: the fringe of the posterior wing and the abdomen white.

Underside as above, except that the anal angle of the anterior wing is broadly white, and that there is a submarginal series of indistinct pale spots, and that the posterior wing has two submarginal series of similar spots.

Exp. $1\frac{1}{2}$ inch.

Hab. Angola (*Rogers*).

In the collection of W. C. Hewitson.

Hesperia Fiscella.

Alis utrinque fuscis: anticis punctis sex hyalinis: posticis fascia ochracea: his infra fascia flava.

Upperside dark brown. Anterior wing with six transparent spots—one in the cell, one just below it, one (minute) between it and the inner margin, and three (at a distance from each other) between it and the apex. Posterior wing crossed transversely by an indistinct ochreous band.

Underside as above, except that the band of the posterior wing is more distinct and pale yellow.

Exp. $1\frac{4}{10}$ inch.

Hab. Para.

In the collection of W. C. Hewitson.

Hesperia Zema.

Alis utrinque rufo-fuscis: anticis punctis sex hyalinis: posticis macula ochracea: his infra fascia alba.

Upperside dark rufous-brown. Anterior wing with six transparent white spots—one in the cell, two divided by a branch of the median nervure, and three near the apex: a black linear spot (which denotes the male) from the inner margin. Posterior wing with an indistinct central ochreous spot: the fringe white.

Underside as above, except that it is rufous, that the anterior wing has the costal margin and a subapical band ochraceous, and that the posterior wing is crossed from the costal margin to the submedian nervure by a band of pale yellow.

Exp. $1\frac{3}{10}$ inch.

Hab. Darjeeling and Sarawak.

In the collection of W. C. Hewitson.

Hesperia Zimra.

Alis supra fuscis: anticis fascia longitudinali media punctisque duobus subapicalibus bifidis hyalinis: posticis fascia angulari ochracea: his infra viridi-fuscis, macula basali fasciaque lata flavo-albis.

Upperside dark rufous-brown. Anterioı wing crossed longitudinally at the middle by a quadrifid band, and near the apex by two bifid spots, all transparent. Posterior wing crossed transversely near the middle by an angular ochreous band: the fringe pale yellow.

Underside as above, except that it is tinted with green, that both wings have a submarginal band of ochreous spots, and that the posterior wing has a pale yellow spot at the base and a central broad angular band of pale yellow from the costal margin to the submedian nervure.

Exp. $1\frac{5}{20}$ inch.

Hab. Brazil.

In the collection of W. C. Hewitson.

Hesperia Oropa.

Alis supra fuscis: anticis puncto fasciaque flavis: posticis puncto fasciaque angulari lata fulvis: alis infra viridi-fuscis, fasciis albis.

Upperside dark brown. Anterior wing crossed from the costal margin near the apex to the middle of the inner margin by a continuous orange-yellow band. Posterior wing with a spot near the base and a broad central angular band from the costal margin to beyond the middle, both orange.

Underside as above, except that the bands are nearly white, that the anterior wing has the apical half green and a spot of yellow in the cell, and that the posterior wing is green and has the band extended to nearer the anal angle.

Exp. $1\frac{3}{20}$ inch.

Hab. Brazil.

In the collection of Dr. Staudinger.

Very near to *H. Zimra*, but differs from it in the continuous band on the upperside of the anterior wing, in having a small spot in the cell on the underside of the same wing, and in having the spot which in *H. Zimra* is at the base of the underside of the posterior wing lower down.

Hesperia Goza.

Alis utrinque rufo-fuscis: anticis fascia maculari longitudinali flava: posticis macula ochracea: his infra fascia lata recta alba.

Upperside dark rufous-brown. Anterior wing crossed longitudinally by a band of three pale yellow spots. Posterior wing with a central indistinct ochreous spot.

Underside as above, except that it is paler and that the posterior wing is crossed at the middle by a broad, straight, very equal band of pale yellow and has a triangular spot of the same colour on the inner margin: the fringe and a pale spot near it rufous. The palpi, breast, and abdomen orange.

Exp. $1\frac{3}{20}$ inch.

Hab. Venezuela.

In the collections of W. C. Hewitson and Dr. Staudinger.

Hesperia Meza.

Alis utrinque fuscis: anticis punctis novem hyalinis: posticis puncto hyalino punctisque duobus ochraceis: his infra fasciis duabus cineraceis.

Upperside dark brown. Anterior wing with nine transparent spots—two in the cell, four in a central longitudinal band, and three (touching) near the apex. Posterior wing with a transparent spot before the middle and two ochreous spots below it.

Underside as above, except that the anterior wing has a spot of grey near the inner margin and one at the apex, and that the posterior wing has a pale yellow line bounding the abdominal fold, and is crossed at the middle and near the outer margin by bands of grey.

Exp. $1\frac{2}{10}$ inch.

Hab. Angola (*Rogers*).

In the collection of W. C. Hewitson.

Hesperia Galesa.

Alis utrinque fuscis: anticis punctis octo hyalinis: posticis punctis quatuor, quorum duo solum sunt hyalina.

Both sides dark brown. Anterior wing with eight transparent white spots—two in the cell, four in a longitudinal band, and two near the apex. Posterior wing with a transverse series of three or four spots, two of which only are distinct and transparent. Anus white.

Exp. $1\frac{1}{2}$ inch.

Hab. West Africa.

In the collection of W. C. Hewitson.

A very robust species and much like the last, probably its male.

Hesperia Fibrena.

Alis utrinque fuscis: anticis punctis undecim hyalinis: posticis angulo anali albo: his infra albis, maculis fasciaque rufo-fuscis.

Upperside dark brown. Anterior wing with eleven transparent spots—one on the costal margin and two in the cell, one below these in the form of an l, three between this and the apex, one above these, and three as usual near the apex. Posterior wing with a tuft of rufous hair at the base: the anal angle broadly white, divided by a band of brown.

Underside. Anterior wing as above, but paler. Posterior wing white, with the costal margin, two spots below it near the base, a spot below these, and a transverse irregular band, and a spot at the anal angle, all rufous-brown.

Exp. $1\frac{4}{10}$ inch.

Hab. Amazon, Tonantins (*Bates*).

In the collection of W. C. Hewitson.

Unlike any other species.

Hesperia Maheta.

Alis supra fuscis: anticis punctis septem hyalinis punctoque fulvo: posticis fascia fulva: his infra rufis, maculis quatuor argenteis.

Upperside dark brown. Anterior wing with seven transparent spots—one in the cell, three below forming a longitudinal band, and three at the apex; a spot of yellow on the inner margin. Posterior wing crossed transversely by a band of orange.

Underside pale rufous-grey, except the lower half of the anterior wing and the inner margin and anal angle of the posterior wing, which are dark brown. Posterior wing marked by four silvery white spots—two before the middle and two below these, one of which is minute—and by a less distinct white spot and several small brown spots.

Exp. $1\frac{3}{10}$ inch.

Hab. Queensland.

In the collection of W. C. Hewitson.

A very distinct and beautiful species.

Hesperia Luda.

Alis utrinque fuscis: anticis basi cæruleo tincta, punctis quatuor hyalinis: posticis infra macula media fasciaque marginali lata albis.

Upperside dark brown, tinted with blue at the base. Anterior wing with four transparent spots—one in the cell sinuated on its outer border, and three below this forming a longitudinal band, the middle spot large and triangular. Posterior wing projecting at the lobe.

Underside as above, except that it is rufous-brown, that the small spot near the inner margin of the anterior wing is large and undefined, and that the posterior wing has a small central spot and a broad band of grey intersected by black nervures at the middle of the outer margin.

Exp. 2 inches.

Hab. Chiriqui (*Ribbe*).

In the collection of Dr. Staudinger.

Hesperia Mytheca.

Alis utrinque fuscis: anticis maculis tribus hyalinis: posticis infra fascia lata argenteo-alba.

Upperside dark brown. Anterior wing with three transparent white spots—one in the cell and two below it between the branches of the median nervures.

Underside as above, except that there is a broad central silvery white band from the costal margin to the abdominal fold of the posterior wing.

Exp. $1\frac{9}{10}$ inch.

Hab. Malacca.

In the collection of Dr. Staudinger.

Hesperia Fidicula.

Alis utrinque fuscis: anticis punctis tribus hyalinis: posticis macula quadrata alba.

Both sides dark brown. Anterior wing with three transparent spots—two between the branches of the median nervure, and one near the apex. Posterior wing with a large quadrate white spot near the middle of the outer margin.

Exp. $1\frac{9}{20}$ inch.

Hab. Costa Rica.

In the collection of Dr. Staudinger.

Hesperia Fufidia.

Alis utrinque fuscis: anticis punctis sex hyalinis: posticis infra fascia alba.

Upperside dark brown. Anterior wing with six transparent spots—one in the cell, three below this forming a longitudinal band, the middle spot sagittate, and two very minute near the apex.

Underside as above, except that it is rufous-brown and that the posterior wing is crossed below the middle from the costal margin to the abdominal fold by a band commencing at the costal margin by a separate spot.

Exp. $1\frac{9}{10}$ inch.

In the collection of Dr. Staudinger.

Hesperia Lota.

Alis supra fuscis: anticis punctis quatuor hyalinis: posticis infra rufescentibus punctis quinque nigris.

Upperside dark brown. Anterior wing with four transparent spots—one in the cell and three below it forming a longitudinal band.

Underside pale rufous-brown, except at the base of the anterior wing, which is dark brown. Anterior wing with two minute black spots near the apex where the white spots usually are. Posterior wing with five black spots—three forming a longitudinal band near the middle, and two smaller spots, one on each side of these.

Exp. $1\frac{11}{20}$ inch.

In the collection of Dr. Staudinger.

Hesperia Meda.

Alis supra rufo-fuscis: anticis infra apice, posticis omnino cineraceis, venis nigris.

Upperside dark rufous-brown.

Underside. Anterior wing with the basal half dark brown, the apical half and the whole of the posterior wing grey: the nervures black.

Exp. $1\frac{13}{20}$ inch.

Hab. Brazil.

In the collection of Dr. Staudinger.

Hesperia Uza.

Alis utrinque rufo-fuscis: anticis infra margine postico, posticis dimidio postico cineraceis.

Upperside dark rufous-brown.

Underside as above, except that the outer margin of the anterior wing and more than the outer half of the posterior wing are lilac-white.

Exp. $1\frac{13}{20}$ inch.

In the collection of Dr. Staudinger.

Hesperia Egla.

Alis utrinque fuscis: anticis punctis octo hyalinis: posticis fascia tripartita hyalina.

Both sides dark brown. Anterior wing with eight transparent white spots—two in the cell obliquely placed, three below these forming a longitudinal band, the middle spot large and triangular, and three at the apex. Posterior wing with a transverse trifid transparent band.

Exp. $1\frac{1}{2}$ inch.

Hab. Chiriqui (*Ribbe*).

In the collection of Dr. Staudinger.

Near to *H. opigena.*

Hesperia Kora.

Alis utrinque atris: anticis punctis tribus hyalinis: posticis macula bipartita hyalina: alis infra fascia submarginali lilacina, anticis macula subapicali, posticis fascia lilacinis.

Upperside black. Anterior wing with three transparent white spots—two between the branches of the median nervure, and one (minute) near the apex; a small white spot on the fringe at the anal angle. Posterior wing with a central bifid white transparent spot: the fringe white at the apex and anal angle.

Underside as above, except that both wings have the nervures and a subapical band lilac, that there is a lilac spot near the apex of the anterior wing, and a lilac band near the base of the posterior wing.

Exp. $1\frac{6}{20}$ inch.

Hab. Brazil.

In the collection of Dr. Staudinger.

In general appearance like *H. Calvina.*

Hesperia Midia.

Alis utrinque rufo-fuscis: anticis punctis quinque hyalinis punctisque duobus albis: posticis infra puncto albo.

Upperside rufous-brown. Anterior wing with five transparent white spots—two large and triangular between the branches of the median nervure, and three separate near the apex, and below them a minute dull white spot; a similar spot near the inner margin. Posterior wing with one dull white spot below the middle: the fringe rufous-white.

Underside as above, except that it is paler, especially on the outer half, and that there is a second minute pale spot on the underside of the posterior wing.

Exp. $1\frac{15}{20}$ inch.

Hab. Chiriqui (*Ribbe*).

In the collection of Dr. Staudinger.

Hesperia Abima.

Alis supra fuscis, anticis punctis quatuor hyalinis: anticis infra apice ochraceo: posticis omnino ochraceis, punctis quinque fuscis.

Upperside dark brown. Anterior wing with four transparent spots—one, deeply sinuated, in the cell, two between the branches of the median nervure, and one near the apex; the costal and inner margin from the base to the middle clothed with ochreous hair. Posterior wing clothed with ochreous hair from the base to the middle.

Underside. Anterior wing as above, except that the costal margin and apical half are ochreous. Posterior wing ochreous, with five undefined brown spots—two before the middle and three after.

Exp. $1\frac{1}{2}$ inch.

Hab. Macassar (*Wallace*).

In the collection of W. C. Hewitson.

Hesperia Hazarma.

Alis supra rufo-fuscis: anticis infra fuscis, fascia margineque postico rufis: posticis ochraceo-rufescentibus, macula nigra media.

Upperside rufous-brown.

Underside. Anterior wing dark brown, with the costal and outer margins rufous, a curved band of paler colour commencing near the apex and ending at the middle of the wing in two separate spots. Posterior wing pale ochreous brown, marked at the middle by a distinct black spot and near it two minute brown spots; crossed near the outer margin by two bands of pale yellow.

Exp. $1\frac{3}{10}$ inch.

In the collection of Dr. Staudinger.

Hesperia Neba.

Alis supra fuscis: anticis margine costali ochraceo, punctis octo hyalinis: posticis fascia flava quinquepartita: his infra pallide rufescentibus macula anali triangulari fusca.

Upperside dark brown, the fringe broad and white. Anterior wing with the costal margin ochreous: eight transparent white spots—two in the cell and one below them, three near the apex and two below them: a triangular pale yellow spot near the inner margin. Posterior wing with a transverse band a little below the middle, of five pale yellow spots divided by the nervures.

Underside. Anterior wing as above, except that the apical half is grey. Posterior wing grey, with the abdominal fold dark brown.

Exp. $1\frac{1}{10}$ inch.

Hab. Natal.

In the collection of W. C. Hewitson.

A pretty and very distinct species.

Hesperia Optata.

Alis utrinque rufo-fuscis: anticis infra plaga atra plagisque duabus flavis: posticis plaga flava.

Upperside rufous-brown, paler at the middle of the anterior wing, the fringe rufous-yellow, the head and thorax tinted with lilac-blue.

Underside rufous. Anterior wing with a band of dark brown from the base to beyond the middle, bordered below with pale yellow. Posterior wing with the base rufous-brown, tinted with purple and bordered below with pale yellow.

Exp. $1\frac{9}{20}$ inch.

Hab. Brazil.

In the collection of Dr. Staudinger.

Unlike any other species in the strange colouring of the underside.

Hesperia Onasima.

Alis utrinque rufo-fuscis: anticis punctis quatuor (duobus sub apicem minutissimis) hyalinis: posticis punctis duobus hyalinis: anticis infra plaga flava.

Upperside dark brown. Anterior wing with four transparent white spots—two between the branches of the median nervure and two (very minute) near the apex. Posterior wing with two central transparent spots.

Underside as above, except that it is red-brown, that the anterior wing has a small pale yellow spot in the cell, and a large yellow spot bordered with dark brown near the inner margin.

Exp. $1\frac{4}{10}$ inch.

Hab. Brazil.

In the collection of Dr. Staudinger.

VI.—*Remarks on Observations by Captain Hutton, Director of the Otago Museum, on* Peripatus novæ-zealandiæ*, *with Notes on the Structure of the Species.* By H. N. MOSELEY, Fellow of Exeter College, Oxford, Naturalist to the 'Challenger' Expedition.

THE above-cited paper by Captain Hutton, which appeared in the November number of this Journal, contains so many

* Ann. & Mag. Nat. Hist., Nov. 1876.

statements concerning the structure of *Peripatus* which are at variance with my own observations, and, indeed, with zoological probability, that it cannot be allowed to pass without comment.

I described various points in the structure of *Peripatus capensis*, in a paper in the Phil. Trans. Roy. Soc. vol. clxiv. 1874, p. 757, confining my remarks to those particulars which seemed to have been missed or erroneously described by former observers; and I further described the development of the species.

The points of chief interest which I determined, and which were new to science, were :—

1. That *Peripatus* was a tracheate.
2. That the tracheal openings were diffused over the body-surface, not confined to certain restricted regions only, as in all other tracheates.
3. That the animal was not hermaphrodite, but that the sexes were separate.
4. That the supposed testis of Grube was a slime-secreting gland, the mode of use of which was explained.
5. That *Peripatus* was viviparous, and that its horny jaws were foot-jaws, homologous with those of Arthropods and not with those of Annelids.

Captain Hutton, who unfortunately had access to the abstract of my paper only, as will be seen by reference to his paper, confirms some of my points by his investigations of *P. novæ-zealandiæ*, but comes to the extraordinary results that this closely related species is not unisexual but hermaphrodite, and that the horny jaws are not foot-jaws, but homologous with those of Annelids.

When H.M.S. 'Challenger' was at Wellington, Mr. W. T. L. Travers, who has done so much for science in New Zealand, and who first drew Captain Hutton's attention to the existence of *P. novæ-zealandiæ*, brought me off some specimens of the animal to the ship, and gave me such information about its whereabouts that collectors sent from the ship were able to procure me about fifty living specimens. I was unable to refer to special publications at the time; and I thought the *Peripatus* was certainly already named; but I examined some of the specimens at once, and made notes, which I should have published long ago had not press of work prevented me.

P. novæ-zealandiæ is not hermaphrodite, but has well-developed males, which, however, as is the case with the Cape species, are less numerous than the females. Captain Hutton has been unlucky, as was Grube; and his twenty specimens have all been females. The males have their generative organs in essential structure exactly similar to those of *P. capensis*; but the organs differ in that the prostates are considerably larger in proportion to the testes in *P. novæ-zealandiæ*. The testes are placed one above the other in the body-cavity in both species.

The common termination of the male ducts is very muscular, and evidently acts as an intromittent organ. It is more developed in *P. novæ-zealandiæ* for this purpose than in *P. capensis*. It twists under the nerve-cord to reach the external generative aperture on the right side, as in most cases in *P. capensis*.

This enlarged terminal duct or penis was found in *P. novæ-zealandiæ* to be provided with a mass of unicellular accessory glands imbedded in its wall, in an enlargement near its outward termination. It contained in some cases a long spermatophore, forming a stiff rod distending the whole length of the enlarged duct, and composed of felted spermatozoa. The connexion of the vasa deferentia with the penis was not properly made out, nor the junction of the left duct with the right. The arrangement is possibly different from the peculiar one existing in *P. capensis*.

Captain Hutton has evidently mistaken portions of spermatophores present in the upper part of the oviduct for the testes. Large masses of spermatozoa penetrate the oviduct and pass right into the ovary in a similar manner in *P. capensis* (see my paper, pl. lxxiv. fig. 1 *a*). Captain Hutton must have been entirely deceived in imagining he saw *vasa deferentia*. Had he established his position, *P. novæ-zealandiæ* would have been not only an hermaphrodite, but one of the most extraordinary in existence, considering its affinities. The testes are, according to him, mere appendages of the oviduct, with very short ducts opening into the oviducts close to the ovary; and he avers that the ova are fertilized in the oviduct immediately on their leaving the ovary, on their reaching these openings of the male ducts. These are his words (*l. c.* p. 367) :—“ On passing the vesiculæ seminales it (the ovum) becomes fecundated, and total segmentation ensues.” *P. novæ-zealandiæ* would thus be a self-impregnating hermaphrodite according to our author, in which cross-fertilization would never occur.

With regard to the development of the jaws, Captain Hutton's description runs (*l. c.* p. 367), “ Two large oval or pyriform swellings arise from the lower surface of the cephalic lobes, just in front of the opening of the gullet; a longitudinal depression is formed in each of these by invagination; and in these depressions the teeth are subsequently formed." The whole of Captain Hutton's figures are most crude and imperfect. I believe that he has missed the turning-in of the first pair of limbs, of the claws of which the jaws are the homologues, and that in (*l. c.* pl. xvii.) fig. 13 the pair of appendages marked *a* correspond with those marked *f* in fig. 15 (*i. e.* with the jaws), and not with those marked *a* in that figure (which become the oral papillæ).

I have no doubt at all that he has been here misled by imperfect observation, as in the case of the generative organs. I examined the embryos of *P. novæ-zealandiæ*, and observed some nearly 7 millims. in length, in which the first pair of appendages was not yet turned inwards. Hence I saw the same condition to exist as that which occurs in the Cape species.

In some minor points I think Captain Hutton must be further misled. He fails to see the dorsal heart in *Peripatus*, and describes as the blood-vascular system the two well-known linear lateral bodies which are of doubtful function and homology, and which have before been supposed to be possibly connected with the vascular system (Claus, 'Zoologie,' p. 387), but which I considered to be mere fat-bodies.

He further describes salivary glands. I have not seen such structures in *Peripatus capensis*, and do not see how I could have missed them in the other species, since I dissected *P. novæ-zealandiæ* with considerable care. In regard to Captain Hutton's general remarks, it may be noted that he does not seem to see the importance of the determination of foot-jaws as existing in *Peripatus*, though it is the presence of these structures which forms the real distinction between Arthropods and Annelids. The real points of interest which Captain Hutton has determined appear to me to be:—

1st. The observation of the offensive use of the viscid fluid of *Peripatus* for catching prey and obtaining food. Were the ducts otherwise placed as to their opening, we might here almost find a step towards the development of the spider's web; for the ejected slime forms a web (Phil. Trans. *l. c.* p. 760); and I believe *Peripatus* to be ancestral to spiders together with other tracheates.

2nd. The probable shedding of the skin by *Peripatus*. What points most certainly to this is the presence of the reserve horny jaws and claws within the active ones. I observed, however, in the case of both jaws and claws in both *P. capensis* and *P. novæ-zealandiæ*, three sets one within the other; and Captain Hutton's figure (*l. c.* fig. 2) seems to indicate such a condition, although he mentions only two.

3rd. That the animal breeds all the year round. I was astonished to find it breeding in mid-winter (July).

4th. The observation of the mode of birth.

Captain Hutton's reference to the geographical distribution of *Peripatus* is extremely apposite. He might have added Australia to the list of regions in which *Peripatus* occurs. Its occurrence in Australia, the West Indies, Chili, New Zealand, and the Cape is additional evidence to its structure of its great antiquity. I am not without hope that its horny jaws may some day turn up in the fossil condition in strata older than the Carboniferous; for of such age must *Peripatus* be if it be a representative of the Protracheata.

The fact that two pairs of jaws are formed from the modification of one ambulatory member, being simply the slightly specialized pairs of foot-claws, would seem to point to the possibility that in Myriopoda and other tracheates the two pairs of maxillæ may possibly be derivable from one segment only.

My friend Prof. E. Ray Lankester has drawn my attention to a late paper by Mr. J. F. Bullar *, of Trinity College, Cambridge, in which the conclusion is arrived at that five species of parasitic Isopoda are hermaphrodite and probably self-impregnating. And Mr. Lankester suggested to me that possibly an error in observation has here occurred similar to that fallen into by Captain Hutton in the case of *Peripatus*, viz. that spermatophores or portions of them have been mistaken for testes. A result so remarkable and apparently improbable as the determination of the existence of hermaphroditism amongst the Arthropoda should certainly not be admitted without the very strongest evidence. No description whatever of the finer structure of the supposed testes in the Isopoda examined by Mr. Bullar is given in the paper in question; and the figures do not give evidence of any testicular tissue. Apparently only spermatozoa have been observed in the supposed testes and what seem to be spermatophores (pl. iv. fig. 6). Of testis-cells and vesicles of evolution no mention at all is made; yet if such had been observed it is very unfortunate that in a case of such importance they should not have been described, since it is they and not spermatozoa which constitute a testis. For evidence that large masses of spermatozoa may occur in a female Arthropod in the closest relation with the ovary, I would refer to my figure of the ovary of *Peripatus capensis* (Phil. Trans. *l. c.* pl. lxxiv. fig. 1). It is possible that an external opening to the oviduct may exist in earlier stages

* "The Generative Organs of Parasitic Isopoda," Journal of Anat. and Physiol. vol. xi. part 1, Oct. 1876, p. 118.

than that described by Mr. Bullar as the third, but be difficult of detection. It is difficult to see why what appear to be spermatophores, or portions of such, should be formed in a self-impregnating animal; and the immobility of the spermatozoa observed is a fact quite as much in favour of these having been introduced for some time and tired out, as freshly developed and functionally active. Surely it is quite possible that in such a case as that of *Cymothoa œstroides*, which Mr. Bullar cites as unable to swim, active males may exist, which have not yet been detected. The rudiments of both external and internal male organs may well exist in a female Isopod; and it is significant that the double penis is present only in the earlier stage in development of the Isopod in question. It is quite possible that Mr. Bullar has observed testis-cells and the actual development of spermatozoa in his Isopods, but has not described their occurrence. If so, it is to be hoped that he will not omit to do so in some further account of his most interesting researches, and thus set all doubt as to his conclusions at rest.

With regard to my own observations on *P. novæ-zealandiæ*, I may mention some further facts. *P. novæ-zealandiæ* differs from *P. capensis* in that it has 15 pairs of ambulatory members and no anal papillæ. There is further in the New-Zealand species a distinctly prolonged but short conical tail, with a slight knob-like enlargement at its extremity, which does not exist in *P. capensis*; further, the anus being terminal, the vulva is separated from it, and situate at a considerable interval further forward and between the last pair of members. The two orifices are close together in the Cape species. In *P. novæ-zealandiæ*, and probably also in *P. capensis*, there is present, in addition to the jaws, a single mesially placed row of very small simply conical chitinous teeth on the roof of the mouth, running from before backwards. The antennæ are in *P. novæ-zealandiæ* provided at the tips with tactile hairs. The place of commencement of the rectum appears better-defined in *P. novæ-zealandiæ* than in *P. capensis*; and the viscus is longitudinally plicated.

The ovarian ova of *P. novæ-zealandiæ*, apparently ripe, were ovoid in form, 1 millim. in length, filled with oily particles, and with a germinal vesicle and spot. When pressure was made on the covering-glass the egg-membrane was seen to be tough and elastic, and only gave way after the egg had been distorted into various forms. When the contents finally escaped by rupture, the germinal vesicle made its way out, becoming elongated and altering its form in order to pass the aperture in the membrane; but it resumed its shape again when free, giving evidence of its toughness and definite walling. It contained a single germinal spot.

The New-Zealand *Peripatus* is much smaller than the Cape species; and yet the embryos are much larger. In all the specimens examined by me the embryos were far fewer in number than ordinarily in *P. capensis*; yet Captain Hutton in one instance found 26 embryos in one female. The embryos, as observed by Captain Hutton, occur in successive stages of development in the oviduct, and are not all nearly equally mature as in *P. capensis*. The embryos have the contents of the developing intestine coloured red in *P. capensis*; in *P. novæ-zealandiæ* the contents are white. The embryos appear in the New-Zealand species not to go through the preliminary worm-like stage, with the body spirally coiled (Phil. Trans. *l. c.* pl. lxxv. fig. 1), which is present in *P. capensis*; they seem to have lost this earlier stage, and to skip at once to the further stage of *P. capensis* (Phil. Trans. *l. c.* pl. lxxv. fig. 4), the first indication of form being the appearance of a hilum near one pole of the ovoid egg, which hilum marks the spot where the tail and head meet in the doubled-up condition of the embryo.

VII.—*On* Rhopalocera *from Japan and Shanghai, with Descriptions of new Species.* By Arthur G. Butler, F.L.S. &c.

Mr. Montague Fenton (of Tosengi, Takanawa, Tokei, Japan) has recently forwarded to the British Museum a small box of Diurnal Lepidoptera, comprising the following species.

Cœnonympha annulifer, n. sp.

Nearly allied to *C. geticus*, but larger, longer in the wing, much darker; on the underside with the plumbagineous streak, which bounds the ocelli of secondaries internally, straight on its inner edge instead of undulated. Expanse of wings ♂ 1 inch 7 lines, ♀ 1 inch 10 lines.

About 370 miles from Tokei (Yedo).

This species is probably the same as that noted by the Rev. R. P. Murray as *Cœnonympha œdipus*, Fabricius.

Neope Fentoni, n. sp.

Lasiommata epimenides ♀, Ménétriés, Reisen und Forschungen im Amur-Lande, ii. 1, Lepid. tab. iii. fig. 9 (1859).

In the heart of the mountains, about 370 miles from Tokei.

There can be no question that, whereas the male described and figured by Ménétriés is a *Pararge* allied to *P. deidamia* and *P. dejanira*, the female is a *Neope* not very widely separated from *N. Gaschkevitschii*; it is far more nearly allied to the succeeding species than to the male associated with it.

Neope callipteris, n. sp.

♂. Bronzy olive-brown; external area smoky brown; outer border paler, lunated: primaries with a discal series of ochraceous spots, forking above the third median branch; the veins upon the central region densely clothed with dark brown scales, especially the submedian vein and the three median branches; two dusky streaks across the apical half of the cell: secondaries with six ochraceous spots, the first, second, fourth, and fifth oval and enclosing large, ovate, black spots, the last small, transverse, enclosing two small black spots: body bronzy brown; thorax reddish in front, greenish in the centre. Wings below altogether paler, sandy yellowish; external area dusky: primaries with two brown bars across the apical half of the cell, a lunated angulated transverse discal band of the same colour; three pale subapical spots, the uppermost trifid, the second ocelliform; a lunulated submarginal stripe: secondaries with the basal area slightly dusky, three pale-edged dusky lines from the costal nervure across the cell; a lunated and angulated, diffused, brown, discal line bounding the ocelli internally; six ocelli, the first and fifth large, the third extremely minute, the sixth small and geminate; all black, with white pupils and yellow irides; area immediately beyond the ocelli beautifully pinky opaline; a brown-edged series of compressed angulated spots of the same colour close to the margin; edge of margin black; fringe white-varied: body below sordid whitish; legs ochreous. Expanse of wings 2 inches 7 lines.

From the same locality as the preceding species, to which it is allied.

Neptis ludmilla, Herrich-Schäffer.

This species, which was taken at the same locality with the preceding species, is new to Japan.

Vanessa hamigera, n. sp.

Allied to *V. agni* and *V. comma*.

Wings above bright orange tawny; basal area bronzy brown; outer border golden brown, flecked with black; fringe varied with white; a submarginal series of semiconnected reddish chocolate-coloured spots, immediately inside which the ground-colour becomes yellower in tint: primaries with a large bifid black spot cross the middle of the cell; a second similar spot divided by the base of the first median branch; a broad patch (widest upon the costa) across the discocellulars; two small, quadrate, discal black spots, placed obliquely upon the median interspaces; a broad, tapering, subapical patch, dentated externally, its base resting upon the costal margin; a large, subquadrate chocolate patch, confluent with the submarginal series (so as to enclose a lunule of the ground-colour) at external angle, and two linear, subapical, angulated markings of the same colour, but feebly indicated: secondaries with a rounded subcostal spot, an elongated, oblique, discocellular spot, and a spot at the base of each median interspace black; a broad discal macular band of chocolate, only separated from the submarginal spots of the same colour by a series of five golden-orange lunate spots: body brown; crest, collar, and thorax densely clothed with bright olive-green hairs having bright bronze reflections; palpi grey, fringed on their upper edge with white, their inferior surface white, edged externally with black. Wings below brown, varied with grey, and covered with irregular black striæ; two extremely irregular transverse black lines, indicating a central band; the disk of primaries and a broad, subapical, costal patch on the secondaries, white, clouded with grey and striated with grey and black; a discal series of more or less rounded spots, and a submarginal series of lunated spots, golden green: secondaries with a central, silvery white, semicircular marking; pectus purplish grey; tibiæ and tarsi yellow; venter grey, yellowish towards the anus. Expanse of wings 2 inches 2 lines.

About 370 miles from Tokei (Yedo).

V. hamigera is probably the species erroneously referred to *C. album* by Mr. Murray; it is utterly distinct.

Argynnis nerippe, Felder.

A very fine example, differing from the typical form in having the submarginal spots of secondaries tawny, and the ocelli below as large as the black spots above.

About 370 miles from Tokei.

Argynnis rabdia, n. sp.

Argynnis daphne, Butler (*nec* Denis), Journ. Linn. Soc. ix. 1866; Murray, Ent. Mo. Mag. xiii. p. 33, 1876.

This species is certainly distinct from its European congener, being larger, paler, less heavily spotted above and much more so below, much duller and more sickly-coloured on the underside, with the transverse lines of secondaries chocolate-brown; the lilacine streaks replaced by slaty grey. Expanse of wings 2 inches 3 lines.

About 370 miles from Tokei.

A. rabdia differs from *A. daphne* in structure as follows:—Palpi longer; primaries more produced, their outer margin not convex (more inclined to be concave), scarcely undulated. An example from Hakodadi, in the Museum, more nearly resembles *A. daphne*, but still differs too evidently from it to admit of their being associated together.

Colias palæno, Linnæus.

Of this species Mr. Fenton says:—"I had great trouble in capturing two couples on the side of a barren volcanic mountain covered with scanty grass, low herbs, and wind-dwarfed pines, at an elevation of about 7000 feet above sea-level (registered by a pocket aneroid)."

Thecla japonica, Murray.

About 370 miles from Tokei.

Mr. Murray need not be in the slightest degree alarmed for his species; it is perfectly distinct from *T. smaragdina*. We have the latter from Hakodadi.

Before passing on to Chinese species, I should wish to make a few remarks upon Mr. Murray's paper, "List of Japanese Butterflies," because if it be, as its author states, merely preliminary, it will be well for him to have an opportunity of weighing my opinions against his own, and, at any rate, he will have the advantage of any little facts which I am able to give him (or any other who may wish to study Japanese butterflies).

Lethe diana is not only not identical with *S. marginalis*, Motsch., but is probably not congeneric with it; the latter is, in all probability, a *Mycalesis*. *L. Whitelyi* is perfectly distinct from *Lasiommata Maakii*, being quite different in form, colour, and marking.

Pronophila Schrenki is not a *Satyrus*, but a *Lethe*.

Argynnis ella is = *A. anadyomene*; the *A. daphnis* of Motschoulsky is probably *A. nerippe*; *A. adippe* is not Japanese.

It is extremely doubtful whether *Araschnia burejana* is *A. strigosa*, although I have regarded them as possibly identical.

Neptis aceris (var. *eurynome*). Under this name Mr. Murray has confounded two very distinct species, neither of which is identical with Westwood's species.

As regards the white and yellow butterflies I will say nothing, or I might overstep the bounds of courtesy, which (especially to a friend) I would rather avoid.

The following butterflies from Shanghai have been liberally presented to the collection by Mr. W. B. Pryer.

Neope segonax, Hewitson.

This appears to differ sufficiently from *N. Muirheadii* to be kept separate.

Lethe syrcis ♂, Hewitson.

We previously only possessed the female of this species.

Lethe lanaris, n. sp.

♂. Wings smoky brown, the disk of primaries rather paler; the basal area of all the wings densely clothed with woolly hair: primaries with a dusky submarginal line: secondaries with five indistinct ocelli, the first four dusky, with scarcely traceable irides, the fifth larger, dull black, with white pupil and diffused sordid testaceous iris; a whitish submarginal stripe, intersected by a blackish line. Primaries below with the basal two thirds uniformly smoky brown, apical third and internal area greyish; five discal ocelli in an almost straight line (the first and last slightly smaller), black, with white pupils, yellow irides, and dusky zones surrounded with lilacine; a whitish submarginal stripe intersected by a blackish line: secondaries smoky brown, crossed by two dusky central lines, the outer one concave to third median branch, and then angulated to back of apical ocellus; six discal ocelli, the first and fifth four times as large as the others (which are of the size of those in the primaries), similar in character to those of primaries; outer border whitish, with a submarginal black line; margin black. Expanse of wings 2 inches 10 lines.

Near to *Lasiommata Maaki* of Bremer and *Pronophila Schrenki* of Ménétriés.

Pararge deidamia, Eversmann.

This is the male of *P. Ménétriésii*.

Mycalesis sangaica, n. sp.

Allied to *M. janardana*. Wings above smoky brown; outer border narrowly whity brown, with marginal and submarginal black lines; primaries with a large ocellus on first median interspace, black, with white pupil and narrow yellow iris. Wings below sandy brown, mottled with grey, crossed by a central narrow externally diffused lilacine streak; outer border narrowly whity brown, with submarginal and marginal dark brown lines: primaries with four ocelli, the second and third extremely small and sometimes obsolete, the first also small but well-defined, the fourth much larger, black with white pupils and yellow irides; secondaries with seven ocelli of similar character, but surrounded by pale zones, the second, third, and seventh very small, the fifth largest. Expanse of wings 1 inch 11 lines.

This species is also in the Museum from Mongolia.

Synchloë sordida, n. sp.

♂. Wings above white, base blackish: primaries with the basal half of costa grey; an oblong costal patch at apex, its inner margin dentated, its externo-inferior angle confluent with the first of three subapical marginal conical spots, all greyish brown: secondaries with a costal and four decreasing squamose marginal spots blackish. Primaries below with the basal three fifths of discoidal cell and the basal half of costa densely irrorated with dark grey; apical area sandy yellow, sparsely irrorated with grey; two discal blackish spots as in *S. rapæ*: secondaries pale yellow, densely irrorated with dark grey, excepting the veins and internervular folds; base of costa golden orange. Expanse of wings 2 inches 4 lines.

Allied to, but very distinct from, *S. rapæ*.

Synchloë claripennis, n. sp.

♂. Wings above white, with black markings nearly as in *S. gliciria*, but the base less suffused with grey, and the large discal black spots of primaries absent on the upper surface: primaries below with the discal spots well marked and large, the basal two fifths of the cell grey; secondaries with the lower half of the cell and the median interspaces greyish, base of costa broadly orange. Expanse of wings 2 inches 8 lines.

Mr. Pryer has several examples of this species.

Pyrgus sinicus, n. sp.

Allied to *P. maculatus*; primaries the same; secondaries above with the central transverse interrupted streak composed of only three well-separated white spots, the outer or discal series of five spots, all small: secondaries below very different from *P. maculatus*, sordid white; a rather broad olive-brown band, shorter than the darker band of *P. maculatus*, and crossed by white veins, indistinctly bordered with white internally, and broadly white-bordered externally; the internomedian, first median, and discoidal interspaces irrorated with the same brown (beyond the white border); external area broadly brown, its inner half blackish; no trace of the angulated submarginal white streak common to *P. maculatus*; fringe white, spotted with brown. Expanse of wings 1 inch 3 lines.

I have seen several examples of this species.

VIII.—*On Polyzoa from Iceland and Labrador.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plates X. & XI.]

THE species noticed in the present paper were obtained by Dr. Wallich off the coasts of Iceland and Labrador. For the opportunity of examining them I am indebted to Mr. Busk. Some new forms occur amongst them; and they have besides their special interest as illustrating local variation and geographical distribution.

The material which I have dealt with in this paper has been for a very long time in my hands, but after partial examination was laid aside under the pressure of other engagements.

ICELANDIC SPECIES.

Order INFUNDIBULATA.

Suborder **Cheilostomata**.

Genus HIPPOTHOA, Lamx.

1. *Hippothoa expansa*, Norman.

A single specimen of this form occurs on shell. Off Reikiavik, in 100 fathoms, amongst icebergs.* All the Icelandic species were taken in this locality.

[Arctic seas, not uncommon (*Norman*, 'Valorous' dredgings); Shetland (*id.*).]

Genus Scrupocellaria, Van Beneden.

2. *Scrupocellaria scabra*, Van Ben.

Not uncommon.

It has a place in the Greenland fauna of Fabricius, and was obtained by the German Polar Expedition at Sabine Island.

[Godhavn Harbour, Disco, 5–20 fathoms (*Norman*, 'Valorous' dredgings); Spitzbergen, 6 fathoms, and more frequently 80 and 150 fathoms (Swedish Expedition, teste *Smitt*).]

Genus Caberea, Lamx.

3. *Caberea Ellisii*, Fleming.

A single specimen.

[Hebrides; Shetland (*Norman*); North Sea, from North Britain to Finmark, in deep water (50–80 fathoms), not uncommon (*Smitt*); Labrador and Maine (*Packard*); Scotch Glacial deposits (*Geikie*).]

Genus Menipea, Lamx.

4. *Menipea ternata*, Ellis and Solander.

Not uncommon.

[Arctic Seas (*Smitt*); Britain; Labrador.]

5. *Menipea arctica*, Busk.

Only a fragment occurred in the small gathering which came under my observation; but the species seems to be a common arctic form.

[West Greenland (*Sutherland*); Arctic Seas, in deep water, to 200 fathoms (*Smitt*); Nordshannon (German Polar Expedition); entrance of Baffin's Bay, 175 fathoms ('Valorous' dredgings).]

Genus Bugula, Oken.

6. *Bugula Murrayana*, Johnston.

The form which occurs in the Reikiavik dredging is the var. *fruticosa* of Packard, which seems to predominate in the Arctic seas.

[Spitzbergen; Finmark, 100 fathoms (*Smitt*); Labrador (*Packard*); Holsteinborg Harbour, both typical form and var.; entrance of Baffin's Bay, var. *fruticosa* (*Norman*, 'Valorous' dredgings).]

Genus Membranipora, De Blainville.

7. *Membranipora lineata*, Linn.

A single specimen, with oviecells, characteristic, on *Scrupocellaria scabra*.

[South Labrador (*Packard*); coasts of Scandinavia, in shallower water, common (*Smitt*); Finmark (*Lovén*); Spitzbergen, a single specimen (teste *Smitt*); Britain.]

8. *Membranipora craticula*, Alder.

On shell.

[Spitzbergen, not rare (*Smitt*); Britain; Scotch Glacial deposits (*Geikie*).]

9. *Membranipora Sophiæ*, Busk.

On shell. An arctic form first discovered by Dr. Sutherland in Assistance Bay; Spitzbergen, common in 30–50 fathoms (*Smitt*).

10. *Membranipora cymbæformis*, n. sp.

Membranipora spinifera, Smitt, Krit. Förteckn. öfver Skandinaviens Hafs-Bryozoer, pt. iii. pl. xx. fig. 32.

Zooœcia oval, short, massive, of considerable depth, irregularly disposed; the margin with about eight to ten tall and erect spines, two of which are placed at the top of the cell; *avicularia* pedicellate, borne on a very long stem, very slender, springing from the side of the cell, near the oral extremity; mandible acute, pointing upwards. *Ooœcium* unknown.

This form has been figured by Smitt under the name of *M. spinifera*; but it is very distinct from Johnston's species, which it seems to replace in the Arctic seas.

The chief points in which it differs from our British form are the much smaller size, the somewhat boat-like shape, and the more massive character of the cells, and their irregular arrangement, and the small number of its spines, which are much taller and stouter and more erect than those of *M. spinifera*.

In the latter the cells are elongate-oval, disposed in lines with much regularity, and armed with sixteen or eighteen spines, which, for the most part, bend inward over the membranous area; they are shallow and not calcified *below*, the flooring of the cell being simply membranous. But the cell of *M. cymbæformis* is deep, inclosed by comparatively high walls, which are well seen in the marginal zooœcia, and is furnished with a calcareous lamina beneath. There are usually no more than two or three spines on each side, which are very tall and stout, cylindrical and suberect. There are also differences in the avicularium, though in both cases it is of the pedicellate type. That of *M. cymbæformis* is borne on a very long pedicel, to the top of which the avicularian cell seems to be articulated; and it is altogether more slender that that of its ally.

Several specimens occur forming small patches on weed. Smitt states that it is not uncommon in the Arctic seas, as far as the north of Spitzbergen, in 10–60 fathoms. The *M. lineata* of the German Polar Expedition, obtained at Sabine Island, should probably be referred to this species.

Genus Lepralia, Johnston.

I retain for the present the genus *Lepralia* as Johnston defined it, though well aware that the somewhat heterogeneous assemblage of forms which it includes must be broken up and redistributed.

11. *Lepralia trispinosa*, Johnston, var. (Pl. XI. fig. 1.)

Escharella Jacotini, forma *lamellosa*, Smitt, Krit. Förteckn. öfver Skandinaviens Hafs-Bryozoer, pt. iv. (1867) pl. xxiv. fig. 56.

On shell, common.

[Davis Strait, 100 fathoms (*Norman*, 'Valorous' dredgings).]

In the variety of this well-known species, which alone occurs amongst the Icelandic dredgings, the surface of the polyzoary is very flat and uniform in appearance and of a dull whitish colour. The zoœcia are smooth or very minutely granular, areolated round the margin, and bordered by prominent lines; the aperture is suborbicular, well arched above, the lower lip rising in the centre into a small denticle; the margin is not at all elevated. The large pointed avicularia are present as in the more usual form; and there is also frequently a small oval avicularium with rounded mandible on one side of the mouth. Similar avicularia sometimes occur on other parts of the cell, as represented in the figure (Pl. XI. fig. 1). The oœcium is of the usual form, with the characteristic group of perforations on the front.

In the preliminary report on the "Biology of the 'Valorous' Cruise," printed in the Proceedings of the Royal Society for June 15, 1876, p. 208, Mr. Norman records this form as amongst the Greenland dredgings, and regards it as a new species, which he proposes to name *L. Jeffreysii*.

The chief characters which he seems to rely upon as distinctive are the ovoid avicularia and the absence of the spout-like sinus on the lower margin of the aperture. But the oval avicularia are commonly present *on the normal L. trispinosa*, though, curiously enough, they have hitherto escaped observation, and are not figured or referred to by any writer on the Polyzoa. They are, of course, frequently wanting, as are also the large pointed avicularia; but in some part or other of the colony they may generally be detected. In some cases they are present in great numbers, two or three on a cell, and are very irregularly placed. I have specimens, probably from deep water, which in some respects resemble the Icelandic variety, in which there is an extraordinary development of them. As to the form of the mouth, it is very variable in *L. trispinosa*. The spout-like projection is much more markedly developed in some cases than in others; at times it is scarcely perceptible. Near the edge of the colony cells may commonly be met with which bear the closest resemblance to those of the arctic variety, especially in the character of the mouth, *being altogether destitute of the elevated peristome.*

There is therefore no valid ground, in my judgment, for erecting the present form into a species. It exhibits a very slight divergence from the normal *L. trispinosa*, the absence of the raised peristome marking, as stated above, an early stage of growth in this species. The presence of the *oval avicularia* is really one more proof of their identity.

Smitt has given a good representation of the different states which this species assumes, though he seems not te have noticed the small avicularia.

12. *Lepralia tubulosa*, Norman. (Pl. XI. fig. 8.)

Two or three specimens of this interesting species occur on fragments of shell. In their perfect condition the cells are armed with three or four spines. They are less thickly perforated than in the only British example which I have had the opportunity of examining. On one of the specimens the oœcia, which have not hitherto been described, are present; they are arcuate in form, shallow, depressed, and set very far back behind the tubular neck of the cell. The surface is smooth and silvery, with a few perforations.

This remarkable species will stand as the type of a new genus, for which I propose the name of *Cylindroporella*.

[Shetland (*Norman*); Wick (*Peach*).]

13. *Lepralia hyalina*, Linnæus.

On shells and on other Polyzoa, abundant.

14. *Lepralia* (*Discopora*) *sincera*, Smitt. (Pl. XI. fig. 2.)

One or two specimens of this well-marked form occur. Smitt reports the species as common in the Arctic Sea as far as Spitzbergen, in 19–60 fathoms.

Lovén has taken it in Finmark. Off Hare Island, Waigat Strait, entrance of Baffin's Bay, 175 fathoms (*Norman*).

15. *Lepralia porifera*, Smitt. (Pl. X. figs. 1 & 2.)

Not uncommon.

[Spitzbergen, not rare, in 20–80 fathoms (Swedish Expedition, teste *Smitt*); Hammerfest (*Lovén*); South Devon (*T. H.*).]

Several forms occur which seem to be related to this species or to the true *L.* (*Eschara*) *Landsborovii*. I can most fully adopt Smitt's naïve declaration respecting the last-named:—"This species, in all its varieties of calcification, has given me much trouble." It is, indeed, a matter of extreme difficulty to interpret satisfactorily the group of forms which bear a more or less near relationship to the *L. Landsborovii* of Johnston. In the first place I believe we may accept Smitt's *L. porifera* as a good species, taking as the type his pl. xxiv. fig. 30 ('Kritisk Förteckn.').

The "forma *minuscula*" and "forma *majuscula*" ranked under it, he has himself, as a result of further examination, transferred to his *Escharella Landsborovii* ('Floridan Bryozoa,' part ii. p. 60).

In *L. porifera* the zooœcia are short, ovate, or rhombic, flattish, very thickly punctured over the entire surface, and of a dull white colour; the mouth is suborbicular, slightly contracted below, where two small denticles mark the position of the hinge of the opercular valve and form a shallow sinus on the lower margin; the peristome is very slightly elevated, and there is no central denticle: the *avicularium* projects immediately below the inferior margin; it is larger than in *L. Landsborovii*, and of a more elongate form; the ooœcium is rounded, closely adnate, not hooded, somewhat depressed in front, and perforated; spatulate avicularia none.

In the typical *L. Landsborovii* the zooœcia are oblong, much lengthened out, somewhat flat, vitreous and glistening when fresh, covered over the whole surface with rather large pores or merely punctured round the margin; the mouth suborbicular, with a prominent tooth on the lower lip in addition to the two lateral denticles; peristome thin, very much raised, with a deep narrow cleft in front, within which the avicularium is placed; avicularium small, round; ooœcium rounded, large, prominent, glassy, hooded, thickly punctured, frequently with a large spatulate avicularium on one or both sides of it, placed transversely. I have not met with this form amongst the Reikiavik dredgings.

16. *Lepralia propinqua*, Smitt. (Pl. X. figs. 5–7.)

Eschara propinqua, Smitt, *l. c.* pp. 22 & 146, pl. xxvi. figs. 126–128.

Zooœcia short, convex, rising towards the very prominent avicularium; surface warty, sometimes indistinctly areolated round the margin, which is bordered by a raised line; mouth ample, arched above, with a broad, very shallow sinus below; peristome slightly thickened, not elevated, except in the fertile cells; no central tooth; avicularia round, standing out boldly below the inferior margin, so as to have the appearance of a prominent beak. *Ooœcium* large, rounded, adnate or subimmersed, sometimes adorned with radiating lines, punctured, the pores often forming a semicircular series round the outer edge of the ovicell, and a small circular group in the centre; in the fertile cells the peristome is much elevated at the sides, sometimes rising into large flap-like expansions, but falls away towards the front, where there is a wide opening in which the avicularium is placed. There are frequently spatulate avicularia on each side of the ooœcium; but they differ in shape from those of *L. Landsborovii* (normal) and are inferior in size (Pl. X. figs. 7 & 8).

This form seems entitled to specific rank. It exhibits a different type of cell from that of *L. Landsborovii* (*short, ovate or rhombic, and very convex*); and it also diverges from that species in the character of the ooœcium and of the peristome, as well as of the large avicularia. It agrees with *L. porifera* in the absence of the marginal denticle, but wants its porous surface.

It must be left for further investigation to show whether these forms are so closely connected with each other and with *L. Landsborovii*, by intermediate varieties, as to constitute truly but one specific group. With our present knowledge they are properly accounted distinct.

Smitt refers *L. propinqua* to his *L.* (*Eschara*) *verrucosa* group; but its closest affinity is clearly with *E. Landsborovii*.

[Spitzbergen, 60 fathoms (*Malmgren*); Greenland (*Torell*); Finmark (*Lovén*).]

17. *Lepralia reticulato-punctata*, n. sp. (Pl. X. figs. 3 & 4.)

Escharella porifera, forma *edentata*, Smitt, Förteckn. part iv. p. 9, pl. xxiv. fig. 39.

[Spitzbergen (Swedish Expedition).]

Zoœcia ovate, moderately convex, strongly reticulato-punctate; orifice suborbicular, somewhat compressed, with a broad well-marked sinus on the inferior margin; peristome not raised; no central tooth; avicularium large, elongate-oval, sometimes half immersed, sometimes prominent, placed in the centre immediately below the mouth, occasionally at a short distance beneath it or turned transversely. *Ooœcium* rounded, closely adnate above, thickly punctured; peristome in the fertile cells not raised.

This is another form belonging to the same group as the two preceding. It is figured by Smitt, and described by him as *Escharella porifera*, forma *edentata*. It is distinguished from that species by its reticulate and coarsely punctured surface, by the form of the mouth, which is much less arched above (compressed) and with a more marked sinus below, and by the large elongate-oval avicularium, which is somewhat variable in position, whereas that of *L. porifera* is constantly attached to the inferior margin. The two also differ much in general aspect.

The preceding three forms occur amongst Reikiavik dredgings only in an incrusting state; and there is nothing to show whether they ever assume the Escharine mode of growth.

18. *Lepralia radiatula*, n. sp. (Pl. X. figs. 9–14.)

? *Cellepora plicata*, var., Smitt, Förteckn. iv. pl. xxviii. fig. 193.

Zooœcia ovate, disposed in linear series, whitish, minutely roughened, traversed by rib-like lines, which run from the margin towards the centre; mouth suborbicular, surrounded by a thin, much-raised, frill-like peristome, which is cleft in front into a deep loop-like sinus; within it on one side a small avicularium, the mandible directed upwards; a minute pointed denticle immediately within the lower margin. *Ooœcium* semicircular, punctured, set far back. The peristome frequently rises at the sides into prominent expansions, which are curiously cut and crenated at the top, and present a very fantastic appearance.

On shell, zoophytes, &c., common.

I have met with no description of this remarkable form; but it seems to be represented in Smitt's figure 193 (Förteckn. part iv.). He refers it to his *Cellepora plicata*, with which, I confess, I cannot see that it has any close affinity whatever. It varies much in different states of growth, and especially in the degree in which the peristome is developed: at times it forms a plain border round the mouth (Pl. X. fig. 10); at others it takes on such shapes as are represented in Plate X. figs. 11–14.

[Arctic Sea (*Smitt*).]

Genus Cellepora, Fabricius.

(*Celleporaria*, Smitt.)

19. *Cellepora incrassata*, Lamk.

This fine species, judging from the fragments which abounded in the dredging, must be common off the coast of Iceland, as it is, according to Smitt, in the seas about Spitzbergen and Greenland. In Finmark it seems to be less abundant East Greenland, plentiful (German Polar Exped.).

20. *Cellepora ovata*, Smitt. (Pl. XI. fig. 5.)

Two fragments occur.

[Spitzbergen, in 10–60 fathoms; less common than *C. scabra* and *C. plicata* (*Smitt*); Sabine Island (German Polar Expedition).]

In this species the mouth is orbicular, instead of triangular as in the allied *C. plicata*, Smitt, and the avicularium *much* shorter than in that species. The mucro is set completely at one side of the mouth. The surface of the cells, which are very convex and regularly ovate, is coarsely punctured, the spaces between the punctures rising at times into ridges. The peristome is thin and not at all elevated.

Smitt, as Kirchenpauer has already noticed, ranks this form with his *Cellepora scabra* in such a way that it is difficult to determine whether he regards the two as specifically distinct or not. From his description of the figures (p. 226) I should infer that he looks upon these two forms and *C. plicata* as merely varieties of one and the same specific type. Judging, however, from those figures, as well as the Icelandic and Labrador specimens, I have little hesitation in considering *C. ovata* an independent species with well-marked features.

Smitt, indeed (p. 188), refers to certain intermediate forms by which, he thinks, the distinction between *C. ovata* and *C. plicata* is reduced to a very small matter—forms in which the general appearance of *C. ovata* is combined with an ovicell resembling that of *C. plicata*, though wanting its punctured surface, and a mouth which often suggests the three-cornered shape* so characteristic of the aperture in the last-named species; but as he does not figure these forms it is difficult

* I am afraid this is a very free translation of the Swedish, "och dervid ser djurhusmynningarne äfven har fã en antydan till trekantform;" but I hope it does not misrepresent its real force.

to estimate their precise significance. The mouth in *C. ovata*, as I have seen it, is orbicular, slightly compressed or flattened below; in *C. plicata* it is decidedly subtriangular, and the lower margin runs to a point. This is an important structural distinction, the specific value of which we are certainly not justified in rejecting without much fuller evidence respecting transitional forms than we now possess. It is of course eminently undesirable that species should be multiplied on trifling pretexts; it is equally undesirable that well-differentiated and tolerably stable forms should be confounded.

21. *Cellepora plicata*, Smitt. (Pl. XI. figs. 3 & 4.)

Iceland, 100 fathoms.

[Spitzbergen, 2–60 fathoms, very common (*Smitt*); Greenland (German Polar Expedition); Godhavn Harbour, Disco, 5–20 fathoms (*Norman*, 'Valorous' dredgings).]

In this species the cells are ovate, somewhat depressed; surface smooth and glistening, sometimes traversed by ribs radiating from the circumference; mouth subtriangular, slightly arched above, the sides running to a point in front, so as to form an acute angle; peristome thin and slightly raised at the sides; on one side a prominent mucro, bearing a large elongate-oval avicularium, with rounded mandible, looking obliquely sideways. *Ooœcium* semicircular, smooth, punctured in front. Allied to the preceding, but, I think, distinct. A very salient character is the great length of the oval avicularian opening.

Genus Eschara, Ray.

22. *Eschara pavonella*, Alder.

A single specimen was met with.

[Spitzbergen, in 20–60 fathoms, not rare (*Torell* and Swedish Expedition); Finmark, in 20 fathoms (*Goës* and *Malmgren*). Not yet found in Southern Scandinavia (*Smitt*). England, north-eastern coast.]

Genus Myriozoum, Donati.

(*Leieschara*, Sars.)

23. *Myriozoum coarctatum*, Sars.

Iceland, 100 fathoms.

[Spitzbergen, in 19–80 fathoms (Swedish Expedition); Norway (*Ström*, *Sars*, &c.).]

24. *Myriozoum subgracile*, D'Orbigny.

Iceland, 100 fathoms.

[Spitzbergen, 19–80 fathoms, common (Swedish Expedition); Greenland (*Möller* and *Torell*); Holsteinborg Harbour, 7–35 fathoms; entrance of Baffin's Bay, 175 fathoms ('Valorous' dredgings); Anticosti and Mingan Islands; South Labrador (*Packard*).]

In this very distinct species, the small oval avicularia are sometimes placed on each side of the mouth at the top, or sometimes on one side only: occasionally they occur about the middle of the aperture; they are also distributed irregularly over the zoarium. In many cases they are wanting altogether in connexion with the mouth of the cell.

Genus Retepora, Imperato.

25. *Retepora Wallichiana*, n. sp., Busk (MS.). (Pl. XI. figs. 9–13.)

Retepora cellulosa (Linn.), forma *notopachys* (Busk), var. *elongata*, Smitt, *l. c.* pt. iv. pp. 36 & 204, pl. xxviii. figs. 226–232.

Zoarium irregular, sometimes giving off long free branches; *fenestræ* elongate, narrow, lozenge-shaped. *Zoœcia* immersed, elongate, somewhat rectangular, bordered by lines, the mouth suborbicular; peristome thin, raised, the inferior margin projecting and with a very minute central sinus; immediately below it in many of the cells a prominent rostrum placed obliquely, bearing on its summit a large avicularium with strongly incurved beak and a long triangular mandible pointing downwards. *Oœcium* small, rounded, smooth; placed very far back behind the mouth and separated from it, in the centre of the arch of the opening, a small denticle (Plate XI. fig. 12).

This form has been very accurately described by Smitt; but he regards it as a variety of the Crag species *R. notopachys*, Busk. Some years since Mr. Busk, who had met with it amongst Dr. Wallich's dredgings, gave it the MS. name which I have retained in this paper, and which fittingly commemorates one of the earliest and ablest pioneers in the work of deep-sea exploration. I agree with Mr. Busk that it is specifically distinct, though in some respects it seems to approach the fossil form. The chief points of difference between it and *R. notopachys* are to be found in the mouth, which in the latter, according to Busk's figure, is furnished with a rather deeply incised sinus on the lower margin, whereas in *R. Wallichiana* the sinus is very minute and shallow*—and in the ovicell, which in the last-named is small, with a very moderate orifice and a conspicuous denticle in the centre of the oral arch, while that of the Crag form is described as large and open in front.

The *position* of the ovicell in the present species is also

* The contour of the oral aperture is very different in the two species.

peculiar; it is developed at some distance above the mouth, and is apparently quite separated from it at first, though at a later stage united to it by an extension of the peristome, as Smitt has remarked. Judging from Busk's figure, I should also suppose that the avicularia differed in character in the two, though this portion of the structure is badly preserved in the fossil.

In *R. Wallichiana* there is none of the remarkable thickening of the branches behind, nor is there any trace of the "crescentic laminæ" which are ascribed to the other species. Its dorsal surface is flattened, traversed by raised lines, which for the most part run longitudinally, while that of *R. notopachys* is marked by deep, usually transverse sutures. The fenestræ also seem to be much smaller in the latter form.

In the present species the zoœcia are sometimes very indistinct, at others they are well defined by conspicuous raised lines. On the dorsal surface, at the base of each fenestra there is an immersed avicularium, placed transversely.

Iceland, 100 fathoms, apparently common.

[Spitzbergen, 20–80 fathoms, common; Finmark (*Smitt*); Godhaab, 150 fathoms (*Busk*).]

Suborder **Cyclostomata**.

Genus Crisia, Lamx.

26. *Crisia denticulata*, Lamk.

Iceland, 100 fathoms; several small fragments occur.

[Norway (*Sars*); Spitzbergen; Bahusia (teste *Smitt*); Great Britain &c., Scotch Glacial deposits (*Geikie*).]

Genus Idmonea, Lamx.

27. *Idmonea atlantica*, E. Forbes.

Iceland, 100 fathoms; abundant.

[Scandinavia, from Bahusia to Finmark, common (*Sars, Lovén, Smitt*); Shetland (*Barlee*); entrance of Baffin's Bay, 175 fathoms (*Norman*).]

Genus Tubulipora, Lamk.

28. *Tubulipora ventricosa*, Busk.

Iceland; on *Sertularella tricuspidata*, Alder.

[West Greenland, on *Fucus* (*Sutherland*).]

29. *Tubulipora flabellaris*, Johnst.

In the form which I refer to this species, the zoarium is flat, depressed, opaque, minutely specked, and somewhat rugose transversely; the tubes are placed horizontally, somewhat radiately disposed, of comparatively large bore, free only for a short distance at the extremity, the free portion not turning upwards, but taking the horizontal direction. It is more or less regularly flabellate in its mode of growth. It is well represented by Johnston's figure and in Busk's 'Cyclostomata,' plate xxiv. fig. 2. It is distinct, in my judgment, from the true *T. phalangea*.

Genus Diastopora, Johnston.

30. *Diastopora*, sp.?

A small patch of a *Diastopora* occurs on a specimen of *Cellepora incrassata*, but in so imperfect a condition that I cannot determine the species with certainty. I believe it to be referable to *D. obelia*, Johnston, which is not uncommon in the Arctic seas.

Genus Discoporella, Gray.

31. *Discoporella verrucaria*, Fabricius.

Iceland; abundant on *Sertularella*, &c.

[Bahusia (*Lovén*); Spitzbergen (Swed. Exped., teste *Smitt*); Greenland, Assistance Bay (*Sutherland*); Anticosti and Mingan Islands; Bay of Fundy (*Packard*); Orkney and Arran (*Busk*).]

Mr. Busk has rightly challenged Smitt's identification of this form with the *Discoporella flosculus* (mihi). The latter is the *Melobesia radiata* of Audouin, with whose figure I was unacquainted at the time (1862) of the publication of this species.

Suborder **Ctenostomata**.

Genus Buskia, Alder.

32. *Buskia nitens*, Alder.

Iceland; very fine, creeping over Hydroids.

[Great Britain.]

This seems to be the only Icelandic form not hitherto recorded from the Arctic seas.

Of the 32 species contained in this list, 18 are British; of the latter, *Hippothoa expansa* and *Idmonea atlantica* have only occurred in the Shetland waters; *Caberea Ellisii* is common to Shetland and the Hebrides, and *Lepralia tubulosa* to Shetland and the north-eastern part of Scotland (Wick). The following may be regarded as forming a distinctively Arctic group:—*Menipea arctica*, *M. Sophiæ*, *Lepralia sincera*, *Cellepora incrassata*, and perhaps *Myriozoum coarctatum*. Twelve of the Icelandic species have been found on the North-American coast.

It should be mentioned that the dredging which supplied the material for the above list was contained in a single bottle of very moderate size.

Labrador Species.

The forms recorded in this list were taken in Hamilton's Inlet, at a depth of 15 fathoms, by Dr. Wallich.

INFUNDIBULATA.

Cheilostomata.

1. *Menipea ternata*, Ellis & Sol.
2. *Cellularia Peachii*, Busk.
3. *Gemellaria loricata*, Linn.
4. *Lepralia annulata*, Fabricius.
5. *Lepralia propinqua*, Smitt.
6. *Lepralia hyalina*, Linn. The prevalent form.
7. *Lepralia pertusa*, Esper.
8. *Lepralia radiatula*, Hincks.
9. *Membranipora lineata*, Linn.
10. *Membranipora cymbæformis*, Hincks.
11. *Cellepora scabra*, Smitt.

This belongs to the same group as *C. plicata* and *C. ovata* of Smitt, the three being ranked as varieties of one and the same species by this writer.

In the present form the zoœcia are very short, convex, crowded, and suberect; the mouth orbicular, slightly compressed in front; immediately below the inferior margin rises a somewhat massive mucro, as broad as the mouth and stretching back for some distance over the wall of the cell; it bears on one side an avicularium with rounded mandible, directed upwards. The surface of the cell is smooth, but often traversed by ribs which radiate from the margin and are carried up as prominent keel-like lines to the apex of the rostrum. The ovicell is semicircular, and, in an early stage at least, without punctures. Within the inferior margin there is a small denticle.

The cells have a very crowded appearance, and are more erect than those of either *C. plicata* or *C. ovata*. The mucro is central (that is, the apex corresponds with the centre of the inferior margin, and the base spreads out equally on each side), while in the two last-named species it is placed completely on one side of the cell.

12. *Cellepora bilaminata*, n. sp. (Pl. XI. figs. 6, 7.)

Amongst the Labrador dredgings there is another form referable to the same group as the above, but presenting some marked and distinctive peculiarities. It occurs in two very different conditions. In one (*a*) the cells are rather crowded, ovate, suberect, the surface smooth; mouth orbicular, the peristome rising on each side into a mucronate process, one of the two (and occasionally both) bearing on its side an avicularium with rounded mandible; between the two processes there is a rather wide cleft, and immediately within it a small denticle (Pl. XI. fig. 6). Occasionally there are traces of the formation of a second calcareous lamina over the primitive cell-wall. Cells occur in which the second envelope has only partially overspread the original wall, and the edge of the later growth can be distinctly traced.

In the other condition in which the species appears (*b*) almost every cell exhibits the double lamina, the later process of calcification being only partially effected (Pl. XI. fig. 7). In this state there are no avicularia. The processes on the inferior margin are both simple extensions of the primitive lamina, somewhat rounded at the top and separated by a broad cleft. With the growth of the second lamina they would assume their perfect mucronate condition; and the development of the avicularium (or avicularia) would probably follow. The ovicells are developed plentifully on this form; they are semicircular, almost truncate in front, partially concealed by the ascending marginal processes, smooth, with a few rather large punctures on the front. I have not noticed this doubling of the cell-wall in any of the kindred species, while the character of the mouth is very distinctive. I have therefore thought it best to give this form a separate name.

13. *Cellepora ovata*, Smitt.

The specimens of this form from Labrador and Iceland are identical in character.

Cyclostomata.

14. *Crisia eburnea*, Linn.

[Mediterranean; Madeira; Australia.]

15. *Tubulipora flabellaris*, Johnst.

16. *Discoporella verrucaria*, Fabr.

Of the foregoing species eight, or half the number, are not included in Packard's list of the Polyzoa of South Labrador. Fourteen are common to the American coast and the Arctic seas. Ten are British. Two are Mediterranean forms, both of them having a very wide range.

EXPLANATION OF THE PLATES.

Plate X.

Fig. 1. *Lepralia porifera*, Smitt.
Fig. 2. The same, showing the ovicell.
Fig. 3. *Lepralia reticulato-punctata*, Hincks.
Fig. 4. The same, more highly magnified.
Fig. 5. *Lepralia propinqua*, Smitt.
Fig. 6. The same, more highly magnified.
Fig. 7. Large avicularium of *Lepralia propinqua*.
Fig. 8. Ditto of *Eschara Landsborovii*, Johnston.
Figs. 9–14. *Lepralia radiatula*, Hincks.

Plate XI.

Fig. 1. *Lepralia trispinosa*, Johnston, var.
Fig. 2. *Lepralia (Discopora) sincera*, Smitt.
Fig. 3. *Cellepora plicata*, Smitt.
Fig. 4. The same.
Fig. 5. *Cellepora ovata*, Smitt.
Fig. 6. *Cellepora bilaminata*, *a*, Hincks.
Fig. 7. The same, *b*.
Fig. 8. *Lepralia tubulosa*, Norman.
Fig. 9. *Retepora Wallichiana*, Busk, MS.
Fig. 10. The same; a portion of the dorsal surface.
Fig. 11. The same, a fragment of about the natural size, showing the shape of the fenestræ.
Fig. 12. The same, a single cell and ovicell.
Fig. 13. The same, avicularium in profile, showing the strongly developed beak.

MISCELLANEOUS.

Christian Gottfried Ehrenberg *.

Among the men whose names will ever be associated with the history of science, Ehrenberg occupies a very prominent place. Fifty years ago he boldly penetrated into Africa as far as Abyssinia in the face of difficulties of which we can now scarcely form any idea, collecting zoological and botanical materials, whilst the fanaticism of the inhabitants followed the Christian wherever he went, and more than once placed him in peril of his life. The results of these travels led him to the department of science the investigation of which constituted the principal labour of his life, and especially contributed to his scientific fame, namely the study of the lower forms of animal life, and especially the world of microscopic organisms, whose richness and variety were previously unsuspected. And it was not only to the living forms that Ehrenberg devoted his attention; he also demonstrated their wide diffusion in the rocks of former periods of the earth's history, and became the founder of microscopic palæontology, which has been of essential aid to the geology of the sedimentary rocks. With the greatest care the objects of numerous observations were united by him into a collection which is unique in its kind, and which will remain at once as an important aid to study and as a monument of the indefatigable industry of a German savant.

Ehrenberg was born on the 19th April, 1795, at Delitzsch in the province of Saxony. Up to his fourteenth year he attended the school of his native place; in 1810 he obtained a free scholarship in the Pforta Academy, where he had several men of note (as, for example, Leopold von Ranke) among his associates; and he left this institution in 1815 to study theology at Leipzig, in accordance with his father's wish. But even in the midst of his classical studies at the Academy, he had already devoted his hours of leisure to investigations in natural history; and this bent of his mind led him when he had been a year at the University, to exchange the study of theology for that of medicine. He completed his academic studies in Berlin, where he attained his degree of Doctor of Medicine on the 5th November, 1818, his inaugural dissertation bearing the title "Sylvæ mycologicæ Berolinenses."

In the two following years we find the young doctor engaged with his friend Hemprich in sketching plans for a great journey of investigation to some distant part of the earth; and the wishes of both of them were fulfilled in the year 1820, when General von Minutoli, who was on the point of starting on an antiquarian journey into Egypt, requested the Berlin Academy of Sciences to recommend him two young naturalists as companions. The Academy selected Ehrenberg and Hemprich. Their journey in common extended into the Libyan desert as far as the oasis of Jupiter Ammon (Siwah); but after their

* [For the original of this notice we are indebted to the kindness of Prof. C. Rammelsberg.—Eds.]

return to Alexandria, the two naturalists quitted the General's expedition in order to carry on natural-history investigations on their own account. They traced the Nile upwards as far as Embukohl in Dongola, made an excursion into the Fayoom, returned to Cairo in 1823, and then examined the northern coasts of the Red Sea and especially the Sinaitic mountains. While Hemprich conveyed the collections they had made to Alexandria, and remained in that city awaiting remittances, Ehrenberg remained for six months in Tor, occupying himself principally with the corals of the Red Sea.

The two naturalists afterwards undertook a third journey, into Syria and Cœlosyria; they penetrated as far as Baalbec, and reached the snowy summits of Lebanon. Their further journey was commenced in 1825; it carried them through Arabia to Loheia and across to Massowa on the Abyssinian coast. Here Hemprich fell a victim to fever; and his friend committed him to the grave on the small island of Toalut. Ehrenberg then made an excursion to the hot springs of Eilet, and returned by Kosseir and Alexandria to Europe in 1826. During the six years of his absence he lost nine of his European companions by death. In the Memoirs of the Berlin Academy for the year 1826, Alexander von Humboldt gave a preliminary report upon these great travels and the important collections which had reached Berlin through Ehrenberg and Hemprich.

In the year 1827 Ehrenberg was made an Extraordinary Professor in the University of Berlin, and on the application of Alexander von Humboldt obtained, through the minister Von Altenstein, the means of making known the scientific results of his travels. In consequence of this, two volumes of 'Symbolæ physicæ,' with copperplates representing mammals, birds, insects, &c., appeared in the years 1828–1834. Unfortunately circumstances were unfavourable to a continuation of the work.

A short historical sketch of the first part of his travels appeared in 1828 under the title "Naturgeschichtliche Reisen durch Nord-afrika und Westasien in den Jahren 1820–26, von Hemprich und Ehrenberg." In 1827, Ehrenberg had already published a description of the deserts in the Memoirs of the Academy. He also published some of his observations upon various subjects in different periodicals, *e. g.* on the Manna of the Tamarisks, on the Scorpions and their geographical distribution, on the Monkeys of Sennaar and Kordofan, on the peculiar noise heard on Djebel Nakuss among the mountains of Sinai, and on the Corals and Acalephæ of the Red Sea.

The journey to the Ural and the Altai and to the Chinese frontier, undertaken in 1829 by Alexander von Humboldt at the desire of the Emperor Nicholas, principally for the purpose of bringing to light the mineral riches of the Russian empire, has been well described by Gustav Rose, who, with Ehrenberg, accompanied Humboldt.

On his return, Ehrenberg devoted himself exclusively to microscopical researches; and in 1830 he published a memoir on the organization, classification, and geographical distribution of the Infusoria, of which Cuvier speaks as follows in the 'Analyse des travaux de l'Académie Royale de Paris:'—"This discovery entirely changes our ideas, and especially upsets many systems; it is one of those which constitute epochs in the sciences." This memoir was followed by contributions which were continued until the year 1835. In 1838 appeared the great work 'Die Infusionsthierchen als vollendete Organismen,' with 64 plates, for which and for his geological researches the Geological Society conferred upon Ehrenberg the Wollaston medal as a special distinction. As early as 1836, Ehrenberg had discovered that the polishing-powder known as tripoli abounded in fossil organisms, and that the polishing-slate of Bilin, near Teplitz, contained innumerable siliceous shells of similar creatures. The same result was obtained by the microscopic examination of the so-called "edible earths" from various localities. This occurrence of fossil organisms was soon afterwards demonstrated by Ehrenberg in older formations, as is evidenced by his memoirs 'Die Bildung des europäischen, libyschen und uralischen Kreidefelsens und Kreidemergels aus mikroskopischen Organismen' (1839), and 'Ueber noch jetzt zahlreich lebenden Thierarten der Kreidebildung und den Organismus der Polythalamien.' In the year 1841 he demonstrated the presence of organisms in the peat-beds in various parts of Berlin (Museum, Friedrichsstrasse, and Karlsstrasse), and gave an impulse to the technical employment of these, and of the Infusorial earth of Ebstorf in the Lüneburger Haide, as, according to the reports of old writers, an earth serving for polishing-purposes could be used for the manufacture of light building-stones, capable of floating upon the water, and the dome of the mosque of Saint Sophia, the celebrated structure of the Emperor Justinian, is composed of such stones. With the hearty cooperation of the then director of the Royal Porcelain Factory, the Mining Privy Councillor Frick, Ehrenberg had stones manufactured from the Berlin material, which proved from their porous nature to be very useful, and were employed by the architect Hoffmann in the construction of the cupola of the museum.

In 1845, at the request of the Mining Department, Ehrenberg made investigations on the diffusion of the infusorial tuffs in the Eifel; in 1847 he published his "Beobachtungen über Passatstaub und Blutregen," in the Memoirs of the Academy of Berlin; and this was followed by a long series of papers in the 'Monatsberichte.' In 1840 he had prepared his 'Microgeologie,' which appeared in 1854, with 41 copperplates. The first part of a continuation of this work, relating specially to America, appeared in 1856.

A new field is opened by his works on the Greensand and the illustrations of its organic life (1855), and his communications on the gradually advancing knowledge of immense quantities of microscopic organic forms in the lowest Silurian deposits near Saint Petersburg (1852–62). His attention also was vividly excited by the recent investigations of the sea-bottom; so that, by the receipt of samples of soundings from the most different regions, he was enabled to investigate thoroughly the microscopic organisms of the depths of the sea. In 1872 he published a revision of these, illustrated with 12 plates, which was followed in 1875 by a work on "die fossilen Erd- und

Felsproben des Meeres und Süsswassers aller Länder, und die Polycistinen-Mergels von Barbados" (with 30 plates). Thus, nearly to the close of his long life, which took place on the 27th June in the year just closed, he showed no relaxation in his activity.

From the year 1839 Ehrenberg was an Ordinary Professor in the Faculty of Medicine. From 1842 he was Secretary of the Physico-mathematical Class of the Academy of Sciences, of which he had been a member since 1827. In 1839 king Friedrich Wilhelm III. conferred upon him the great gold medal for Art and Science; and at the same time the Crown Prince gave him a gold medal relating specially to Ehrenberg's discoveries; the Civil Class of the order "Pour le mérite" counted him as one of its members from the time of its establishment by king Friedrich Wilhelm IV.; and foreign honours were not wanting in recognition of his scientific merits.

Quite in the evening of his life he was gratified by the receipt of the large gold medal founded by the Dutch Academy of Sciences at Amsterdam in honour of Leeuwenhoek, the discoverer of the Infusoria, and conferred for the first time unanimously upon Ehrenberg.

Corals in the Hunterian Museum figured by Ellis and Solander.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen.—In rearranging the corals in the Hunterian Museum I recognized the nineteen specimens mentioned in the following list as figured in Ellis and Solander's work. Doubtless more of the Hunterian specimens are figured in that work; but I have only given those which have some characteristic feature admitting of certain identification. Moreover Ellis selected for illustration parts only of some of the bulkier specimens. The list, however, as it stands, will not be without interest to those who desire that the location of type specimens should be known.

I am, Gentlemen,
Yours obediently,
John Young, M.D.

Glasgow University, Nov. 1876.

List of Specimens in Hunterian Museum figured in Ellis and Solander's 'Natural History of Zoophytes.'

1. Pl. 29. *Madrepora anthophyllites.*
2. Pl. 32. fig. 1. ?
3. Pl. 35. *M. carduus.*
4. Pl. 34. *M. angulosa.*
5. Pl. 38. *M. ramea.*
6. Pl. 39. *M. aspera.*
7. Pl. 40. *M. undata.*
8. Pl. 41. figs. 1, 2. *M. ampliata.*
9. Pl. 43. *M. cinerascens.*
10. Pl. 45. *M. pileus.*
11. Pl. 46. fig. 1. *Madrepora dædalea.*
12, 13. Pl. 47. figs. 4, 5. *M. areolata.* Pl. 48. fig. 2. *M. phrygia.*
14. Pl. 50. fig. 2. *M. abdita.*
15. Pl. 52. *M. foliosa.*
16. Pl. 53. fig. 1. *M. annulosa.* figs. 5, 6. *M. foveolata.*
17. Pl. 55. *M. rotulosa.*
18. Pl. 56. *M. interstincta.*
19. Pl. 57. *M. muricata.*

Descriptions of new Species of Blattidæ *belonging to the Genus* Panesthia. By JAMES WOOD-MASON.

Panesthia monstruosa, n. sp.

Ingens, aptera, aterrima, nitida. Corpore crassissimo. Tegumento valde indurato. Pronoto in maribus valdissime, in feminis modice, inæquali et impresso; bituberculato; incisura profunda, lata, medio recta et linea elevata marginata, lateribus cornigera, cornibus in mare magnis, in femina modicis, reflexis, apice plicatis. Abdominis segmentis basalibus infra supraque sparsim minute punctatis, ultimo laminaque supraanali punctis crebrioribus necnon majoribus conspersis: hac postice 5-dentata. Pedibus validis, spinis tibialibus fortibus armatis; femoribus anticis trispinosis. Long. corporis maris 58 millim.; pronoti $14\frac{1}{3}$, pronoti lat. $19\frac{1}{3}$, incisuræ lat. 6; mesonoti long. 9, mesonoti lat. $21\frac{2}{3}$; metanoti long. 8, metanoti lat. 23; abdom. long. 30, abd. lat. (ad medium) 23. Long. corp. fem. 52.

Hab. A male and a female from Southern India (*R. C. Beddome*). This fine insect offers a curious resemblance to the *Gromphadorhina portentosa*, Schaum, from Madagascar.

Panesthia Wallacei, n. sp.

Aterrima, nitidissima. Pronoto ut in *P. morione* sed nitidiore et distinctius crebriusque punctato. Abdomine sparsim punctulato, punctis apicem versus sensim frequentioribus ac paullo majoribus; segmento ultimo marginibus integro angulisque posticis vix producto; lamina supraanali disco parce fulvo-pilosa, postice rotundata, tota integra, dentibus lateralibus nullis; lamina subgenitali confertim grosse punctata. Cercis tumidis, fulvo pilosis. Tegminibus alisque pæne ut in *P. morione*, abdominis apicem longe superantibus; venarum omnium parte apicali perspicua, utrinque pallida, subhyalina; illorum vena anali recta impressa hyalina. Femoribus anticis basin versus bidentatis. Long. corporis maris $36\frac{1}{2}$ millim.; pronoti $9\frac{2}{3}$, pronoti lat. 14; long. tegminum 40, alarum 35; abdom. 18, abd. lat. (ad medium) 16.

Hab. A single male from Sinkep Island, near Singapore.

Panesthia flavipennis, n. sp.

Aterrima, nitidissima, pulcherrima. Pronoto antice granulato, postice medio sparsim, ad latera confertissime punctato; aliter ut in *P. javanica*. Oculis maculisque ocelliformibus flavidis. Tegminibus lætissime flavis, singulis maculis duabus nigris, una parva ad basin, alteraque magna orbiculari pone medium posita, notatis; vena anali elevata potius quam impressa, fortiter arcuata; abdominis segmenti ultimi apicem vix attingentibus. Alis apice flavo marginatis. Antennis apicem versus flavido annulatis. Abdominis segmentis dorsalibus punctatissimis; ultimo laminaque supraanali punctis grossissimis: hac margine postico 5-dentato, angulis lateralibus latis; illo angulis posticis acutissime producto;

segmentis ventralibus lateraliter punctatis, medio vix punctatis; lamina subgenitali conspicua, lævi, politissima, convexa. Femoribus anticis muticis. Larvis totis aterrimis. Long. corporis ♂ 37–45, ♀ 43 millim.; pronoti ♂ 10–13, ♀ $10\frac{1}{3}$; pronoti lat. ♂ $14\frac{1}{2}$–$17\frac{2}{3}$, ♀ $16\frac{1}{3}$; long. tegminum ♂ 29–53, ♀ $29\frac{1}{2}$.

Hab. Numerous adult and immature specimens of both sexes from the Nágá hills (*J. Butler* and *Godwin-Austen*), Brahmaputra valley (*A. W. Chennell*), and Dikrang valley (*Godwin-Austen*).

Panesthia Saussurii, n. sp.

♀. *P. mandarinea*, Saussure, Mélanges Orthopt. p. 100, pl. 3. fig. 23, non p. 40, pl. 1. fig. 25.

I have recently received from Johore in the Malay peninsula a fine series of specimens of *P. mandarinea*, none of which exhibit the least approach to the remarkable structure of the abdomen seen in the insect described and figured by De Saussure as the supposed female of it. The larvæ of *P. mandarinea*, moreover, are jet-black throughout, while those of *P. Saussurii* are deep black-brown symmetrically variegated with pale testaceous on every part of the body, including the legs, which are ringed, the antennæ, which are tipped, and the head, which is triply banded, with the same colour. A further reason for refusing to accept the insect figured by De Saussure on pl. 3 (*op. supra cit.*) as the female of the one represented on pl. 1 is that the latter is itself also a female, the sides of the pronotum in the true males of which are produced into huge curved horns, each separated from the broad semioval median lobe covering the head by a deep rounded emargination.

Hab. A single specimen of the male from Sikkim (*L. Mandelli*). This insect having been captured just prior to the last moult, the organs of flight are still in rudiment, and the pronotum is still non-emarginate.—*Journ. Asiatic Soc. Beng.* vol. xlv. part 2, 1876.

On some Facts relating to the Nutrition of the Embryo in the Egg of the Fowl. By M. C. Dareste.

My investigations in experimental teratogeny have enabled me to ascertain some facts with regard to the nutrition of the embryo in the egg.

If in the first days of incubation we remove the blastoderm with the portion of the vitelline membrane that covers it, and the layer of albumen lining this section of the vitelline membrane, and then, after separating the blastoderm from the vitelline membrane, coagulate the albumen by means of alcohol or hot water, we find that the albumen has completely disappeared above the embryo. There is here a vacant space in the form of a hollow cylinder, or rather a portion of a cone with a circular base. This perforation of the albumen is the more considerable in proportion to the distance from the commencement of incubation, and consequently to the space occupied by the embryo in the blastoderm.

This fact was observed by Agassiz; but I have been able to go further than that illustrious naturalist. In fact I have ascertained that this disappearance of the albumen is connected solely with the development of the embryo and of the vascular lamella, which, in its origin, is not distinguished from the embryo itself. The albumen disappears only above the circle formed by the vascular area; and its disappearance increases like this circle. If by chance, as I have observed in my experiments, the vascular area presents an elliptical form, the empty space produced by the disappearance of the albumen presents the form of an elliptical cylinder, or, more correctly, of a portion of a cone with an elliptical base. Thus during the early part of the development the formation of the vascular area is connected with the gradual disappearance of the layer of albumen corresponding to it on the other side of the vitelline membrane. On the contrary, nothing of the kind takes place in all that portion of the blastoderm which is beyond the vascular lamella and surrounds it.

This led me to think that the albumen necessary for the nutrition of the embryo does not assist in the nutrition of the blastoderm itself. I have verified this prevision by the examination of blastoderms which had developed without producing any embryo, and which nevertheless had covered almost the whole surface of the yelk. This fact I have several times observed in the course of my teratogenical studies. Under these circumstances the albumen forms a perfectly continuous layer above the blastoderm. We must therefore assume that the blastoderm derives its elements from the yelk, whilst at the commencement of incubation, and, at least, up to the period of the complete closure of the amnios, the embryo is developed at the expense of the albumen.

I may add that the ascertainment of the disappearance of the albumen is the process that I adopt in my investigations whenever I wish to know whether an embryo is being developed in an egg, a fact which the death and disorganization of the blastoderm do not always allow to be ascertained directly. There are, in fact, many circumstances under which the embryo perishes very early, quite at the commencement of the development; and if the egg is not opened until after the lapse of some days, it is often very difficult to find any appreciable traces of its existence. The disappearance or the preservation of the albumen furnishes a sure means of deciding as to the former existence of an embryo, and to decide whether the blastoderm has produced an embryo or whether it is one of those blastoderms without an embryo, the occurrence of which in my experiments I have just mentioned.—*Comptes Rendus*, Oct. 30, 1876, p. 836.

On the Structure and Organization of the Polyphemidæ. By Dr. C. Claus.

The structure of the body and limbs of the Polyphemidæ (*Bythotrephes*, *Polyphemus*, *Podon*, *Evadne*) may be referred in detail to the well-known structure of the Daphnidæ, and their peculiarities thus completely explained morphologically. The principal difference which leads physiologically to new conditions of embryonic nourishment, and is also of importance with regard to the external form of the body, consists in the transformation of the brood-chamber, bounded by the skin of the back and the inferior lamella of the shell, into a uterus-like sac, the cellular wall of which (*hypodermis*) becomes a nutrient organ of the ova and embryos, either throughout its whole extent (*Podon*, *Evadne*), or only in the ventral lamella, which is in contact with the intestine.

The nervous system could be traced in its whole course in all four genera. The brain is followed by a subœsophageal ganglion, which is united to it by short broad œsophageal commissures, and by the ventral ganglionic chain, the four inflations of which, united by transverse commissures, emit nerves for the limbs. The last and smallest pair of ganglia also sends forth nerves to the abdomen and to the tactile setæ of the postabdomen.

The crystalline cones of the large movable eye consist throughout of five segments; the nervous rods belonging to them show lamellar structure.

The shell-gland was traced in all the genera in its whole length to its orifice. In its course it presents characteristic peculiarities in each genus and species, but consists throughout of the ampulliform sac, the inner and outer looped canal, the terminal duct, and the short narrow efferent tube. The dilated terminal duct, extended after the fashion of a reservoir, contains large shining urinary concretions in *Podon* and *Evadne.*

The adherent organ of *Evadne* and *Podon* is not a sucking-cup with radiating muscles, but an excretory organ composed of large glandular cells with streaky protoplasm. In *Evadne* nine or ten cells are usually employed in its formation; their conically decreased secreting ends are applied to the well-known cuticular disk.

The ova, as in the Daphnidæ, are produced in four-celled chambers of the ovary, but are extraordinarily small when they pass into the brood-chamber, where an abundant supply of nourishment is furnished to the developing embryo by secretion from the walls. In *Evadne* the embryo becomes pregnant while still in the body of the mother, and is usually born with four ova in process of segmentation in the uterus.

The formation of the winter egg in *Evadne* takes place by absorption-processes of the neighbouring egg-chamber.—*Kais. Akad. der Wiss. in Wien*, Oct. 26, 1876.

On the Colydiidæ *of New Zealand.* By D. Sharp.

In the 'Annals,' July 1876, p. 22, I established a new genus of Colydiidæ, with the name *Epistrophus.* I find this word has already been used by Kirsch for a genus of Curculionidæ; and I propose therefore for the genus of Colydiidæ above alluded to the name of *Epistranus* in place of *Epistrophus.*

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IX.—*On two Vitreohexactinellid Sponges.* By H. J. Carter, F.R.S. &c.

[Plate IX.]

The following descriptions of *Eurete farreopsis*, n. sp., and *Myliusia Grayi*, Bk., respectively have been made more especially for two purposes, viz. the former to show the mode of growth in *Farrea occa*, which has not yet been described from a *living* specimen, and the latter to illustrate the only known *living* species possessing the structure of the Ventriculidæ that has come to notice.

I am indebted to my friend Dr. J. Millar for the specimen of *Eurete farreopsis*, which has been whitened at the expense of the soft parts—for sale, not for the purposes of natural history,—and, from being very delicate in the last-formed portions, has been much broken. Nevertheless sufficient remains for description and for the accompanying illustration of the the general form, which has been taken from a photograph; while the elementary parts more particularly have been obtained from minute shreds of dried sarcode still left about the skeleton, in which are wrapt up the rosettes and smaller spicules of the species.

The specimen of *Myliusia Grayi*, Bk., belongs to the British Museum; and through the obligingness of Dr. Günther I am enabled to give an illustration of this, also delineated from a photograph. It was taken alive, as the presence of the sarcode in many parts indicates; but, appearing very insignificant from its smallness, it has not received that treatment which its importance as the only *living* representative of the Ventriculidæ in structure deserves; nevertheless with what remains of this also there is, as will be seen, abundance left for description and illustration. It has already been described and named by Dr. Bowerbank (Proc. Zool. Soc. May 13, 1869, p. 335, pl. xxv. fig. 1), who has given a most faithful illustration of its general structure, to which I would refer the reader; but as neither the general form of the specimen itself, including its elementary composition, has been illustrated, nor the resemblance of the latter to that of the Ventriculidæ pointed out, it seems to me that a more detailed record of this precious little sponge is desirable; and this I have endeavoured to supply.

Eurete farreopsis, n. sp. (Pl. IX. figs. 1–7.)

Vitreohexactinellid. Skeleton. General form bush-like, fixed, sessile, composed of many tubo-branches anastomosing clathrously. Colourless, translucent, becoming white from increasing density of structure towards the base. Branches short, thick, cylindrical, hollow, formed of a delicate thin reticulated wall thickening from the growing margin towards the base or oldest part, widely separate, dichotomous, anastomosing as before stated. Orifices of branches respectively circular at first (fig. 2, *a*), then expanded (fig. 2, *b*), afterwards funnel-shaped (fig. 2, *c*), becoming elliptical and contracted in the centre (fig. 2, *d*), where, by the union of the approximated parts of the margin, two circular orifices are formed which grow into two short, round, tubular branches in opposite directions (fig. *e*), to divide again after the same manner, and so on—or to anastomose with other neighbouring branches, when each branch still gives off two others, so that at the point of junction there are four branches instead of two. Where union takes place, either by the approximation of the two opposite parts of the margin or by direct anastomosis, a raphe is formed. General structure of the wall reticular, the longitudinal lines of fibre, which are the largest, remaining parallel while the tube is round (fig. 2, *a*), but radiating upon the same plane successively where the orifice becomes expanded (fig. 2, *c*, *d*). External surface rough, from the projection of the arms of sexradiate spicules which have not become enveloped by the vitreous fibre; internal surface still rougher from the same cause; mid structure or wall composed of sexradiate spicules woven into a reticulated tissue by the vitreous fibre, of which the meshes are subquadrangular, and, as before stated, the longitudinal fibres largest; varying in thickness from an extremely thin layer of minute sexradiate spicules in the *growing* margin of the orifices at the circumference to a lamina 1-24th inch thick in the fixed or oldest portions at the *base*. Spicules of three kinds, viz. skeleton-, subskeleton-, and flesh-spicules. Skeleton-spicule sexradiate; arms spined throughout, pointed in the smallest, inflated at the extremities in the largest specimens, 5- to 40-6000ths inch long with proportionate thickness (fig. 4). Subskeleton-spicules of two forms, viz.:—1, accrate, straight, fusiform, attenuately pointed, spined throughout, spines all inclined one way and more or less closely applied to the shaft, 200- by 2-6000ths inch in its greatest diameters (fig. 5): 2, scopuline spicule, consisting of a shaft and head (fig. 6 and fig. 3, *e*); shaft cylindrical, abruptly pointed at the free end, quadrangularly inflated at the other, microspined throughout, most evidently towards the free end, 68- by 1-6000th inch in its greatest diameters (fig. 6, *a*); head consisting of four arms respectively supported by the four angular projections at the end of the shaft, at first running parallel or slightly curved towards each other and then expanded; arm much thinner than the shaft, inflated globularly at the extremity, microspined throughout, especially towards the inflation, where the spines are long and inclined backwards, leaving the convexity of the inflation smooth or bald, 11-6000ths inch long (fig. 6, *b*, *c*). Flesh-spicule a hexactinellid rosette, each arm bearing four capitate rays expanded *en fleur-de-lis*, 7-6000ths inch in diameter (fig. 7 and fig. 3, *f*), or without extended arms, the latter being reduced to a central point, from which the rays radiate in all directions so as to present a globular form, 15-6000ths inch in diameter (fig. 3, *g*). Skeleton-spicules free and minute at the growing margin, afterwards becoming larger and enveloped in the vitreous fibre, or distributed throughout the whole structure, from the youngest to the oldest developed part, in a minute form, where one arm is frequently attached vertically to the smooth fibre (fig. 3, *d d*). Accrate subskeleton-spicule sparsely distributed. Scopuline spicule very numerous. Flesh-spicules also numerous. Vitreous fibre *smooth* between the knots (fig. 3, *a a a*), which are globular and spino-tuberculated all over, except where interrupted by their union with the fibre (fig. 3, *b b b*), or by the projection of one or more arms of the sexradiate spicule in the form of large spines, thickened or elongated, pointed or inflated at the extremity, and spinulated throughout (fig. 3, *c c c*); thickest smooth fibre 15- to 19-6000ths inch in diameter. Size of specimen $3 \times 4 \times 2$ inches. 3 inches high. Last-formed tubo-branch (viz. at the summit) 4-12ths inch in diameter: first-formed branch (viz. at the base) 2-12ths inch in diameter.

Hab. Marine, fixed on hard objects.

Loc. Philippine Islands.

Obs. The patulous ends of the tubular branches, accompanied by the plumose or radiating structure of the *lamina* out of which they are formed at this part, and the dichotomous manner of the branching itself, closely ally this species to *Farrea occa*, whose structure and mode of growth is also thus explained. In a specimen, too, of the latter growing upon a branch of *Lophohelia prolifera* dredged up on board H.M.S. 'Porcupine,' the fixed end (which, unlike the *single* layer forming the tube above, is composed of *massive* reticular tissue) presents a number of minute hexactinellids, each of which has one arm attached to the fibre, as in *Eurete farreopsis*. This is also the case in *Farrea infundibularis* (Ann. & Mag. Nat. Hist. 1873, vol. xii. p. 448, pl. xvii. fig. 1), whose structure, in many respects, is so very like that of *Eurete farreopsis* that one can only be considered a variety of the other; but I do not observe this remarkable feature in either of the *Aphrocallistes* or in *Aulodictyon Woodwardii*, Kent.

On account of the absence of the sarcode in the specimen above described, I am unable to state the position which the subskeleton- and flesh-spicules respectively and relatively presented. Nor am I able to say any thing of the dermal or growing layer of sexradiate spicules, which in these specimens is generally washed off with the rest of the sarcode to give them a more attractive appearance in the market, thus leaving nothing but the bare skeleton with a few fragments of dried sarcode here and there, in which, however, some of the minute spicules are almost sure to be retained.

Possessing a broom-like or scopuline spicule, I am able to place this species among those characterized by a "scopuline shaft" (Ann. & Mag. Nat. Hist. 1873, vol. xii. p. 559), and with *Farrea occa*, as characterized by the tubular branches being patulous at their orifices (ib. p. 360).

Like as the general form of this specimen is to that given by Marshall of Semper's *Eurete simplicissima* (Zeitschrift f. wissensch. Zoologie, xxv. Bd. 2nd Supp. Taf. xii. *c*), there is no part of the detail of the structure given by Marshall in Taf. xiv., except the attachment of the sexradiate to the vitreous fibre (fig. 32, *a*), which can be identified with it (*E. farreopsis*). What value may be due to the absence of the scopuline shaft and rosette in *E. simplicissima* (p. 185), I am unable to say, seeing that the reappearance of the spicules in the centre of the vitreous fibre in Marshall's illustrations (Taf. xiv.) indicates that the specimen had perished long before it was picked up for preservation, and therefore might have lost, with its sarcode, most, if not all, of these spicules. But where it is stated, a little further on, that neither *Sclerothamnus* nor *Aphrocallistes* possesses a rosette, it would have been more to the purpose if Mr. Marshall had said that he had not found any in *his* specimens, since a knowledge of this kind of sponges points out that the scopuline shaft has hitherto never been found present without a rosette or its representative. Indeed I have stated, from actual observation, that *Aphrocallistes Bocagei has a rosette* (Ann. & Mag. Nat. Hist. 1873, vol. xii. p. 360, pl. xiii. figs. 9 and 10); and *Sclerothamnus Clausii*, which I now find to be my *Farrea densa* (*op. et loc. cit.* p. 51, pl. xvii. figs. 5 and 6), appears in *my mounted specimen* with its rosettes attached to it, as well as the head and part of the shaft of one of the scopuline spicules. At the time of figuring the fragment of *F. densa*, I could only be certain of the characteristic spine, as I was not sure that the rosettes and scopuline shafts belonged to it; but now that I have seen an entire branch, &c., I see also that they *do* belong to it, and that *Farrea densa* (=*Sclerothamnus Clausii*) *does* possess a rosette. When the description and illustrations of the whole specimen, "nearly three feet high," have been published this identity will be more evident.

The peculiarities of *Eurete farreopsis* are the globular tuberculated knots of vitreous fibre (fig. 3, *b b b*), which, with the centrally developed spine, looks like a bossed omphalic shield, and the globular inflations respectively at the ends of the scopuline arms very much like a "bald head" (fig. 6, *c*), while the form of the rosette flesh-spicule is that which generally accompanies the scopuline shaft (Ann. & Mag. Nat. Hist. 1873, vol. xii. pl. xiii. fig. 9), occasionally varied, as in the present instance, where the arms are reduced to a mere point and the diameter of the rosette much larger (fig. 3, *g*). The acerate spicule (fig. 5), too, with closely applied spines all directed the same way, is still more common among the Hexactinellida. To the presence of the minute sexradiate, one arm of which is attached to the vitreous fibre (fig. 3, *d d*) by an extension from the surface of the latter, I have already alluded as a remarkable feature in this kind of sponge-skeleton.

Mr. Marshall's criticisms generally of my papers on the Hexactinellida and Lithistida, and on my "Notes introductory to the Study and Classification of the Spongida," respectively (*op. et loc. cit.*), I have neither time nor inclination to reply to, especially as the author's amount of knowledge of the subject does not appear to me to be equal to my own; so I must leave them for a future generation.

Since the above was written, I have received from Mr. T. Higgins a microscopic specimen of a Hexactinellid sponge purchased by the Liverpool Free Museum from Mr. Gerard, and said to have been collected by Dr. Meyer in the Philippine Islands. It is *Eurete farreopsis*, and is fellow to Dr. Millar's specimen above described, as I have now ascertained by an examination of the entire specimen.

Myliusia Grayi, Bk. Proc. Zool. Soc. 1869, p. 335. (Pl. IX. figs. 8–17.)

Vitreohexactinellid. General form hemispheric; general appearance enteromorphous or cerebriform; sessile; consisting of tortuous anastomosing tubular canals or passages separated by equally tortuous labyrinthic intervals. Tubular canals or passages now terminating on the surface in round patulous or long tortuous gutter-like openings. Colour white, translucent, slightly yellowed by the presence of dried sarcode. Surface of tubular passages, both externally and internally, covered with a dermal layer of small sexradiate spicules, whose horizontal arms overlapping each other form a continuous quadrilateral meshwork. Margin of the openings of the passages on the surface fringed with the spined arms of long, thin, sexradiate spicules mixed with still larger (?accerates), whose shafts are uneven but not spined, unless it be microscopically in some parts. Pores and vents not discernible, from the mutilated state of the surface. Internal or body structure of the wall of the tubular passages composed of lozenge-shaped or lantern-like knots of vitreous fibre applied end to end, three or more layers deep, thus forming a laminate mass of trapezoids united to each other at their angles in successive rows (fig. 10), with cylindrical intervals between them crossing each other more or less rectangularly (fig. 10, *h h*); traversed by the branches of the excretory canal-system, and when fresh probably more or less divided into cavities by soft porous expansions of the sarcode (now dried) bearing the ampullaceous sacs or groups of spongozoa. Spicules of two kinds, viz. skeleton- and flesh-spicules. Skeleton-spicules of three forms, viz.:—1, small, sexradiate, arms not inflated at their junction, attenuately pointed and thickly spined throughout, about 15-1800ths inch long by ½-1800th inch thick at the base (fig. 13); 2, much larger, sexradiate, the same, but with the arms slightly inflated at the extremity and 30- to 100-1800ths inch long (fig. 16); 3, still much larger (?acerate fusiform, attenuately pointed), unspined, but uneven on the surface and here and there microspined; length unknown; largest fragment 170- by $\frac{3}{4}$-1800th inch in its greatest diameters (fig. 17). Flesh-spicules of two forms, viz.:—1, rosette, globular, consisting of six short arms (the third axis, which is vertical to the other two, is omitted in the illustration for perspicuity), each of which is surmounted by five long capitate rays expanded in a vasiform manner, $4\frac{1}{2}$-1800ths inch in diameter (fig. 14 and fig. 10, *f*); 2, bundles of minute, hair-like, undulating acerates like the tricurvate or bow spicule, about 4-1800ths inch long (fig. 15 and fig. 10, *g*).

The *small* sexradiates become the centres respectively of the trapezoids (fig. 9, *c*), which are thus formed by the extension of a thread of vitreous sarcode from one end of each of the arms of the sexradiate spicule to the other (fig. 9, *a*), strengthened at each attachment by subsidiary threads, which form an irregular reticulation between the main thread and the arm at each end of the latter (fig. 9, *b*); finally increasing in thickness throughout till the trapezoid is fully formed and presents four sides (fig. 10, *a*), with eight lantern-like holes in them, one in each triangular face (fig. 10, *i*), through which the sexradiate form of the original spicule may be seen in the centre *intact* (fig. 10, *c*). Trapezoid about 14-1800ths inch in diameter. Spicules nos. 2 and 3 form the fringe round the apertures which interknits with the body-structure of the lamina internally, the latter, or the supposed acerate form, extending beyond the former, both distally and proximally; while the flesh-spicules are scattered throughout the structure unequally—that is, much more numerously towards the surface. Size $\frac{1}{2}$ inch high by $\frac{7}{8}$ inch in horizontal diameter.

Hab. Marine.

Loc. Island of St. Vincent, West Indies.

Obs. In the Proc. Zool. Soc. Lond. 1859, p. 439, pl. xvi. Radiata, the late Dr. J. E. Gray described and illustrated a vitreohexactinellid sponge, to which he gave the name of "*Myliusia callocyathes*," after Christopher Mylius of 1753. There are two specimens of this sponge in the British Museum, viz. the original one (figured *l. c.*), about $3\frac{3}{4}$ inches in diameter, and the other about $1\frac{1}{2}$ inch wide, numbered "43.2.13.67." Both are stated by Dr. Gray, in his "Notes on the Arrangement of Sponges" (*op. cit.* 1867, p. 506), to have come from the West Indies. To which a third specimen has been added from the "Island of St. Vincent in the West Indies, collected by the Rev. L. Guilding," with the name "Scriviner" (? dealer) on the board bearing the specimen, numbered "40.10.23.11."

In the same 'Proceedings,' but of 1869 (p. 335, pl. xxv.

fig. 1), Dr. Bowerbank figures faithfully a fragment of the latter, which he finds not to be *Myliusia callocyathes*, but, although very like in outward appearance to it, totally different in structure; hence he calls it "*Myliusia Grayi.*"

Having subsequently had to examine this sponge for the late Dr. Gray, I saw that its minute structure (fig. 10) was like that of the fossil species figured by Schmidt (Atlantisch. Spongienf. Taf. ii. fig. 16) under the general appellation of fossil spicules from "*Scyphia* and *Ventriculites*" (Ann. & Mag. Nat. Hist. 1873, vol. xii. p. 365). Next I identified the lantern-like knot of *Myliusia Grayi* with Mr. W. J. Sollas's figures of the structure of the Ventriculites (Proc. Geol. Soc. Lond. 1872, p. 65, fig. 2); lastly, with the late Mr. J. Toulmin Smith's representations of the structure of the "Ventriculidæ of the Chalk" (Ann. & Mag. Nat. Hist. 1847, vol. xx. pl. vii. figs. 8–14.

I next observed the lantern-like knot among the "Cretaceous Microzoa of the North of Ireland," figured by Mr. J. Wright (Report of Belfast Naturalists' Field-Club, 1873–74, Append. iii., published 1875, pl. iii. fig. 7). After this I found it myself among fossil sponge-spicules from the Mid Eocene of Brussels, kindly sent me by M. Ernest Vanden Broeck. And it again appears under another form in the beautiful illustrations of the structure of *Cœloptychium agaricoides* by Prof. Karl Zittel of Munich ('Ueber Cœloptychium,' München, 1876, Taf. iii. figs. 7–12). Finally in 1876 I obtained a slice of a Ventriculite from Mr. Ed. Charlesworth, of the Strand, London, and identified it therein myself.

It was then that I saw the desirability of illustrating the only known living specimen of the kind, viz. *Myliusia Grayi* in the British Museum; and having obtained permission of Dr. Günther for this purpose, I have done my best to publish it; for the specimen is very small, and, from its insignificant appearance and dirty colour, would be very likely to be lost sight of altogether, since it does not present the attractive bright glassy aspect and sarcodeless character usually possessed by the vitreous sponges after they have passed through the the hands of the dealer.

Although *Myliusia Grayi* presents the convoluted *cerebriform* appearance of *M. callocyathes*, yet its minute structure is totally different, inasmuch as the knots or junctions of the fibre in the latter are solid and round, not hollow and lantern-shaped as in *M. Grayi*. Again, the general structure of *M. Grayi*, although convoluted, is massive and labyrinthic throughout, not cup-shaped or hollow in the axis as that of the Ventriculites; while *Cœloptychium* consists of radiating tubes more or less branched round a hollow axis or stem, which in the horizontal section resembles *Ventriculites.*

In the evolution of the lantern-like joint it may be observed that this commences on a sexradiate spicule (fig. 9, *c*), the centre of which becomes the centre of the lantern, while the structureless sarcode, which here very much resembles that of the Rhizopoda, creeps crookedly and fungus-like from one point of the sexradiate direct to the other, thus marking out the lines of a trapezium (fig. 9, *b*). After this, subsidiary pseudopodal prolongations are continued from the fixed ends of the threads respectively to the arms of the sexradiate, which in a reticulated form thus further unite the two and act as additional stays to the main ones. After this the silicifying sarcode still goes on adding layer after layer to the original structure, until the whole becomes greatly thickened and the interstices of the reticulation reduced to eight spaces as before mentioned, so as almost to obscure the cross of the original sexradiate in the centre, which, although also thickened by the silicifying sarcode, still remains intact. Thus, in short, the sexradiate becomes as much imbedded in the vitreous sarcode as if it were in radiate fibre.

The fringe of spicules which is or, rather, was (for it now lies in loose pieces about the specimen) attached to the growing margins of the circular and gutter-like openings, is also composed of sexradiates, but much larger than those upon which the lanterns are formed; and while five of their arms interknit proximally with the body-structure of the wall of the tubular tortuous channel, the sixth is free and very long comparatively; while the fringe thus formed is still further lengthened by the presence of many (?acerates) much thicker and longer than any of the rays of the sexradiate, and which, by their uneven surface, seem to represent that form of acerate, so common among the Hexactinellida generally, in which the spines are long and *all inclined one way*—that is, inwardly *in situ* (fig. 5). Still this is of course conjecture; for I have never been able to find more than a fragment of the shaft of these, but never connected with any cross piece so as to indicate that they belonged to a sexradiate spicule. However, the surface is so mutilated that the fragments of this fringe are, as just stated, all loose upon the specimen, and only by their pencil-like form here and there, in which the spicules are held together in their natural position by the dried sarcode, show the manner in which they were arranged when attached to the margin of the circular and gutter-like openings of the tubular channels or passages.

The rosettes are large (especially when compared with those of the last species, as the illustrations figs. 7 and 14 respectively, which are drawn to the same scale, indicate) and numerous, particularly towards the surface; and the little bundles of minute undulating, fine, hair-like acerates (fig. 10, *g*), which I have so often figured in the Esperiadæ and other sponges of the Holorhaphidota, are also very plentiful, and very frequently present a distinct, tricurvate or bow-like form (fig. 15).

I need not allude further to the differences between this and the foregoing species, viz. *Eurete farreopsis*, as these may be gathered from the descriptions and illustrations respectively.

In the formation of the lanterns from the sarcodic substance one cannot help being struck with the fact that, while this part of the sponge appears to be Radiolarian, the addition of the Spongozoa makes *the sponge*. This "radiolarian" sarcode is the "intercellular substance, which forms the bond of union between the cells" in sponges, that I described and delineated in *Spongilla* in 1849 (Ann. & Mag. Nat. Hist. vol. iv. pp. 87 and 91, pl. iv. fig. 2) as possessing the polymorphic power and contracting vesicles of an *Amœba*.

EXPLANATION OF PLATE IX.

Fig. 1. *Eurete farreopsis*, n. sp., natural size; from a photograph.

Fig. 2. The same. Five diagrams, to show the mode of growth, commencing with *a*, simple cylinder with circular orifice; *b*, the same, with orifice expanded; *c*, the same, with orifice become funnel-shaped; *d*, with orifice elliptical and contracted in the centre, like the figure 8; *e*, approximated sides united so as to form a simple cylinder on each side, with circular orifice, *f f*, like that of *a*.

Fig. 3. The same, minute structure of the wall, magnified. *a a a a*, fibre; *b b b b*, knots or points of junction of the fibre; *c c c*, occasional spines on the same; *d d*, minute hexactinellid spicules which the fibre has attached to itself; *e*, scopuline spicule; *f*, small rosette, common form; *g*, large rosette, occasional form. Scale 1-24th to 1-1800th inch.

Fig. 4. The same, form of staple sexradiate spicule.

Fig. 5. The same, spined acerate.

Fig. 6. The same, scopuline spicule. *a*, shaft; *b*, arm; *c*, head of arm, more magnified, to show the form and arrangement of the spines.

Fig. 7. The same, usual form of the rosette. (The third axis, which would be vertical to the others, has been omitted for perspicuity.)

N.B. Figs. 4 to 7 inclusively are on the scale of 1-24th to 1-6000th of an inch.

Fig. 8. *Myliusia Grayi*, Bk., natural size; from a photograph.

Fig. 9. The same: four knots or trapezoids, magnified, to show their earliest appearance. *a*, trapezoid; *b*, reticulated threads of silicifying sarcode extending from point to point of the sexradiate spicule, *c*. (The vertical axis of the latter omitted here also for perspicuity.)

Fig. 10. The same: four knots or trapezoids, magnified, to show their form under full development. *a*, trapezoid with reticulated threads of silicifying sarcode all run together into solid fibre, thus enveloping the sexradiate spicule, *c*, in the centre, which is otherwise hollow; *d*, spine or arm of sexradiate increased in size by the silicifying sarcode, but not enveloped in the fibre; *e*, end of vertical arm of sexradiate truncated; *f*, rosette; *g*, bundle of minute hair-like undulating accerates, frequently tricurvate or bow-shaped; *h h*, cylindrical intervals or channels between the trapezoids; *i*, lantern-like hole, reduced to eight in each trapezoid.

N.B. Although both these figures, viz. 9 and 10, are drawn upon the same scale (viz. 1-24th to 1-1800th inch), it must not be assumed that the trapezoids are as regularly formed throughout the mass; hence they must, to a certain extent, be viewed more or less as diagrammatic.

Fig. 11. The same: oblique view of the trapezoid of fig. 9, showing all the arms of the sexradiate spicule *within* the reticulated threads of silicifying sarcode.

Fig. 12. The same: diagram of trapezoid to show the sexradiate cross as it exists in the trapezoid of fig. 10.

Fig. 13. The same: staple form of dermal sexradiate, scale 1-24th to 1-1800th inch.

Fig. 14. The same: rosette, more magnified.

Fig. 15. The same: tricurvates, more magnified.

Fig. 16. The same: large sexradiate spicule of the fringe.

Fig. 17. The same: fragment of large uneven spicule in the fringe.

X.—*List of the Species of Crustacea collected by the Rev. A. E. Eaton at Spitzbergen in the Summer of* 1873, *with their Localities and Notes.* By Edward J. Miers, F.L.S., F.Z.S., Assistant in the Zoological Department, British Museum.

A small collection of Crustacea, made by the Rev. A. E. Eaton during a voyage with B. Leigh Smith, Esq., to Spitzbergen, in 1873, was presented to the Trustees of the British Museum in the following year. The species are most of them well-known Arctic forms; but the specimens generally are of a large size and in an excellent state of preservation. The value of the collection is further enhanced by the exact locality of nearly every specimen being recorded.

The crustacean fauna of the Scandinavian and adjacent arctic seas appears to have been investigated more thoroughly than that of any other great region of the globe, if we may judge from the amount of literature relating to it; for in the Introduction to his 'Skandinaviske og Arktiske Amphipoder' (Christiania, 4to, 1872), A. Boeck enumerates no less than 273 publications in which animals of this order alone are referred to in connexion with this area.

In 1863 A. v. Goës published a list of the Decapoda inhabiting the region mentioned, with remarks on the geographical distribution of each of the species (in Œfvers. Kongl. Vetensk. Akad. Förhandl. p. 161); in addition to all which are mentioned below, he records many others from Spitzbergen.

The long-known and widely distributed Isopod *Ægа psora*, Pennant (*Æga emarginata*, Leach), has not, to my knowledge, been obtained in these seas before.

In 1865 the Spitzbergen Amphipoda were dealt with by A. v. Goës (in Œfvers. af K. Vet. Akad. Förh. 1865, pp. 517–536, pls. 6). *Anonyx bidenticulatus*, S. Bate, is the only one in the present collection that is unnoticed by him. Mr. Spence Bate, in the Catalogue of Amphipodous Crustacea in the collection of the British Museum (1862), referred to this species as synonymous with *A. nugax*, Phipps; but a careful comparison of the two forms leads me to differ from him in opinion, and to consider them to be quite distinct from one another *.

The cirriped *Balanus porcatus*, Da Costa, is another addition to our knowledge of the Spitzbergen fauna; and so is one of the two species of Pycnogonida collected, *Nymphon gracile*, Leach.

DECAPODA.

Hyas, Leach.

Hyas araneus.

Cancer araneus, Linn. Syst. Nat. (ed. xii.) p. 1044 (1766); Pennant, Brit. Zool. iv. p. 6, pl. ix. fig. 16 (1777).
Cancer bufo, Herbst, Naturg. Krabben u. Krebse, i. p. 242, pl. xvii. fig. 95 (1790).
Hyas araneus, Leach, Ed. Encycl. vii. p. 431 (1814); Mal. Pod. Brit. pl. xxi. A. figs. 1–5; Bell, Brit. Crust. p. 31 (1853); Goës, Œfv. Kongl. Vet. Akad. Förh. p. 161 (1863).
Hyas aranea, M.-Edw. Hist. Nat. Crust. i. p. 312 (1834).

Hab. Green Harbour (Ice Fiord), in 30 fathoms (*Walker*).
A single example (an adult male) is in the collection.

Eupagurus, Brandt.

Eupagurus pubescens.

Pagurus pubescens, Kröyer, Kongl. Danske Vidensk. Selsk. 7 Deel, p. 314 (1838); Nat. Tidsskr. förse R. ii. p. 251 (1838–9); Voy. en Scand.

* Among the shells collected were some miscellanea not seen by me, which were sent to the Rev. A. M. Norman for examination. Fragments of *Vertumnus serratus*, Fab., and of *Byblis Gaimardi*, Kröyer, were detected by him. Accepting his determinations, I include them in the list and give their synonymy. Their localities were not stated in the letter.

pl. ii. fig. 1; Brandt, Middend. Sibirische Reise, Zool. pt. i. p. 111 (1851); Goës, Œfv. Kongl. Vet. Akad. Förhandl. p. 166 (1863).
Eupagurus pubescens, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 237 (1858).

Hab. Green Harbour.

A fine series of specimens, young and adult, is in the collection.

The crustacea and fish from Green Harbour and Magdalena Bay were mostly obtained with a trawl by Captain Walker of Hull, Master of Mr. Leigh Smith's yacht the 'Sampson,' acting as tender to the 'Diana.'

Sabinea, Ross.

Sabinea septemcarinata.

Crangon septemcarinatus, Sabine, Capt. Parry's 1st Voy. Appen. no. x. p. 58, pl. ii. figs. 11–13 (1821); M.-Edw. Hist. Nat. Crust. ii. p. 343 (1837); Goës, Kongl. Vet. Akad. Förh. p. 173 (1863).
Sabinea septemcarinata, Owen, Append. Ross's 2nd Voy. Zool. Crust. p. lxxxii (1835).
Sabinea (Crangon) septemcarinata, Kröyer, Nat. Tidsskr. iv. p. 244, pl. iv. figs. 34–40, pl. v. figs. 41–44 (1842–43).

Hab. Green Harbour.

A single specimen is in the collection. Length 3 inches.

Cheraphilus, Kinahan.

Cheraphilus boreas.

Cancer boreas, Phipps, Voy. North Pole, p. 190, pl. xii. fig. 1 (1774).
Cancer homaroïdes, O. Fabr. Fauna Grœnlandica, p. 241 (1780); Mohr, Isl. Naturhist. Nr. 245, pl. v. (1786).
Crangon boreas, Fabr. Ent. Syst. Suppl. p. 410 (1798); M.-Edw. Hist. Nat. Crust. ii. p. 342 (1837); Kröyer, Nat. Tidsskr. iv. p. 218, pl. iv. figs. 1–14 (1842–43); Goës, Œfv. Kongl. Vet. Akad. Förh. p. 173 (1863); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 271 (1874).
Cheraphilus boreas, Kinahan, Proc. Royal Irish Acad. viii. p. 68 (1864).

Hab. Green Harbour; Lomme Bay, in 15 fathoms.

A large series of specimens of various ages is in the collection. There is a median longitudinal series of four spines on the carapace, of which the second and third are placed near to one another and are sometimes united. In the adult specimens the lateral ridges are less strongly defined, and the spines upon the carapace and first and second abdominal segments are more obtuse or even obsolete. The largest specimen (a female with ova) has a length, from tip of rostrum to extremity of telson, of nearly 4 inches.

Hippolyte, Leach.

Hippolyte polaris.

Alpheus polaris, Sabine, in Parry's 1st Voy. Append. no. x. p. 60, pl. ii. figs. 5–8 (1821).
Hippolyte polaris, Owen, Append. Ross's 2nd Voy. Zool. Crust. p. lxxxv

(1835); M.-Edw. Hist. Nat. Crust. ii. p. 376 (1837); Kröyer, Monogr. Fremst. Slægt. Hippolyte's nord. Art. p. 116, pl. iii. figs. 78–81, pl. iv. fig. 82 (1842); Goës, Œfv. Kongl. Vet. Akad. Förh. p. 169 (1863).

Hab. Carl Island and Cape Torell, in 12–18 fathoms.

Hippolyte Gaimardii.

Hippolyte Gaimardii, M.-Edw. Hist. Nat. Crust. ii. p. 378 (1837); Kröyer, Monogr. Fremst. Slægt. Hippolyte's nord. Art. p. 74, pl. i. figs. 21–29 (1842).
Hippolyte Gaimardi, Goës, Œfv. Kongl. Vetensk. Akad. Förh. p. 168 (1863).

Hab. Green Harbour.

Hippolyte borealis.

Hippolyte borealis, Owen, Append. Ross's 2nd Voy. Zool. Crust. p. lxxxiv, pl. B. fig. 3 (1835); M.-Edw. Hist. Nat. Crust. ii. p. 372 (1837); Kröyer, Monogr. Fremst. Slægt. Hippolyte's nord. Art. p. 122, pl. iii. figs. 74–77 (1842); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 276 (1874).

Hab. Carl Island and Cape Torell, in 12–18 fathoms.

In nearly all the specimens that I refer to this species the three or four teeth on the inferior margin of the rostrum are very obscurely defined. In one specimen they are entirely obsolete. The upper margin of the rostrum in this species is always smooth, entire, and unarmed.

ISOPODA.

Æga, Leach.

Æga psora.

Oniscus psora, Pennant, Brit. Zool. iv. pl. xviii. fig. 1 (1777).
Æga emarginata, Leach, Trans. Linn. Soc. xi. p. 370 (1815); M.-Edw. Hist. Nat. Crust. iii. p. 240 (1840); Cuvier, Règne Animal (ed. Crochard), pl. lxxvii. fig. 1.
Æga psora, Spence Bate and Westwood, Brit. Sessile-Eyed Crust. ii. p. 283 (1868).

Hab. Green Harbour.

Two specimens in the collection. Length $1\frac{5}{6}$ inch.

AMPHIPODA.

Stegocephalus, Kröyer.

Stegocephalus ampulla.

Cancer ampulla, Phipps, Voy. North Pole, Append. p. 191, pl. xii. fig. 3 (1774).
Lysianassa? ampulla, M.-Edw. Hist. Nat. Crust. iii. p. 22 (1840).

Stegocephalus ampulla, Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 63, pl. x. fig. 2 (1862); Goës, Œfv. Kongl. Vet. Akad. Förh. p. 521, pl. xxxviii. fig. 9 (1865); Boeck (part), Forhandl. Vidensk. Selsk. p. 128 (1870).

Hab. Near Carl Island and Cape Torell, in 12–18 fathoms.

In the single specimen of this species in the collection the rostrum is obtusely pointed and reaches beyond the peduncle of the short superior antennæ. The coxæ of the second pair of pereiopoda have the anterior margin straight, and are produced posteriorly to a distance equalling twice the width of the coxa at its upper margin. The bases of the fifth pair of pereiopoda have the postero-lateral margins rounded. The third segment of the pleon has the posterior margin regularly concave excavate. The colour is dark olive-green, with a small faintly marked white spot on each side of every segment of the body.

Stegocephalus inflatus.

Stegocephalus inflatus, Kröyer, Nat. Tidsskr. 1 R. iv. p. 150 (1842–43); 2 R. i. p. 522 (1844–45); Voy. en Scand. pl. xx. fig. 6.
Stegocephalus ampulla, Goës, Œfv. Kongl. Vet. Ak. Förhandl. p. 521, pl. xxxviii. fig. 8 (1865); Boeck (part), Forhandl. Vidensk. Selsk. p. 128 (1870).

Hab. Carl Island and Cape Torell, in 12–18 fathoms.

Several specimens are in the collection. They all have the rostrum acute and shorter than the peduncle of the superior antennæ. Coxæ of the second pair of pereiopoda hatchet-shaped; the anterior margin slightly concave, the postero-lateral lobe acute and produced to a distance not exceeding the width of the coxa at its upper margin. Bases of fifth pair of pereiopoda with the postero-lateral angle acute. Third segment of the pleon with the posterior margin angularly excavate. Colour yellowish white, with transverse series of brown patches on each segment and coxæ.

VERTUMNUS, Boeck.

Vertumnus serratus.

Oniscus serratus, O. Fabr. Fauna Grœnl. p. 262 (1780).
Amphithoë serra, Kröyer, Danske Vidensk. Selsk. Afh. vii. p. 266, pl. ii. fig. 8 (1838); M.-Edw. Hist. Nat. Crust. iii. p. 25 (1840).
Acanthonotus serratus, Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 127 (1862).
Vertumnus serratus, Goës, Œfv. Kongl. Vet. Akad. Förhandl. p. 523 (1865); Boeck, Vidensk. Selsk. Forhandl. p. 180 (1870).

Hab. Spitzbergen.

ANONYX, Kröyer.

Anonyx nugax.

Cancer nugax, Phipps, Voy. North Pole, Appendix, p. 192, pl. xii. fig. 2 (1774).
Lysianassa (Anonyx) lagena, Kröyer, Danske Vid. Selsk. Nat. Afh. vii.

p. 237, pl. i. fig. 1, ♀ (1838); M.-Edw. Hist. Nat. Crust. iii. p. 21 (1840); Goës, Œfv. Vet. Ak. Förh. p. 518 (1865).

Lysianassa (Anonyx) appendiculosa, Kröyer, *l. c.* p. 240, pl. 1. fig. 2, ♂ (1838).

Anonyx ampulla, Kröyer, Nat. Tidsskr. 2 R. i. p. 578 (1844); Voy. en Scand. pl. xiii. fig. 2.

Anonyx (Lysianassa) lagena, Boeck, Skandin. og Arktiske Amphip. p. 152 (1872).

Hab. Green Harbour; Carl Island, Cape Torell, in 12–18 fathoms.

Phipps's figure of this common Arctic species is quite recognizable; and his name must therefore be adopted for it.

Anonyx bidenticulatus.

Lysianassa bidenticulata, Spence Bate, Ann. & Mag. Nat. Hist. ser. 3, i. p. 362 (1858).

Lysianassa nugax, Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 65, pl. x. fig. 3 (1862), nec auctorum.

Hab. Fair Haven, in 4–5 fathoms; Lomme Bay, 15 fathoms.

The specimens which I refer to this species are distinguished by the form of the third segment of the pleon, which has a second tooth on its posterior margin above that of the postero-lateral angle. Boeck, in his 'Skandinaviske og Arktiske Amphipoder,' refers Mr. Spence Bate's figure of *L. nugax* to *Socarnes Vahlii*, Kröyer—wrongly, I think; for in that species the inferior angle of the third segment of the pleon is "valde rotundatus" (see also Kröyer's figure of *S. Vahlii* in the 'Voy. en Scandinavie,' pl. xiv. fig. 1).

Atylus, Leach.

Atylus carinatus.

Gammarus carinatus, Fabr. Ent. Syst. ii. p. 515 (1793).

Atylus carinatus, Leach, Zool. Miscell. iii. p. 22, pl. lxix. (1815); M.-Edw. Hist. Nat. Crust. iii. p. 68 (1840); Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 134, pl. xxv. figs. 1–3 (1862); Boeck, Forhandl. Vidensk. Selsk. p. 190 (1870); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 357, pl. x. (1874).

Amphithoë carinata, Kröyer, Kongl. Danske Vid. Selsk. 7 Deel p. 256, pl. ii. fig. 6 (1838); Voy. en Scand. pl. xi. fig. 1; M.-Edw. Hist. Nat. Crust. iii. p. 41 (1840).

Paramphithoë carinata, Goës, Œfv. Kongl. Vet. Akad. Förh. p. 523 (1865).

Hab. Lomme Bay, in 15 fathoms.

Acanthozone, Boeck.

Acanthozone hystrix.

Acanthosoma hystrix, Owen, Append. Ross's 2nd Voy. Zool. Crust. p. 91, pl. B. fig. 4 (1835).

Amphithoë hystrix, Kröyer, Kongl. Danske Vid. Selsk. Deel 7, pl. ii. figs. 6 & 7 (1838); M.-Edwards, Hist. Nat. Crust. iii. p. 40 (1840).

Paramphithoë hystrix, Bruzelius, Kongl. Vet. Akad. Handl. iii. p. 71

(1859); Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 147, pl. xxviii. fig. 1 (1862); Goës, Œfv. Kong. Vet. Akad. Förh. p. 525 (1865).

Acanthozone hystrix, Boeck, Forhandl. Vidensk. Selsk. p. 184 (1870).

Hab. Carl Island and Cape Torell, in 12–18 fathoms.

This species has been referred by Boeck to the *Oniscus cuspidatus* of Lepechin (Acta Acad. Sci. Petrop. p. 249, pl. viii. fig. 3, 1780); but the species figured by that author differs in having vertically projecting spines upon only the first four segments of the pereion. The species figured by Buchholz (Zweite deutsche Nordpolarf. Zool. Crust. p. 362, pl. xi.) as *Acanthozone hystrix* differs from that figured by Owen in the more numerous and closely placed spines upon the posterior margins of the basa of the pereiopoda, and in the form of the rostrum, and is, I think, distinct.

The name *Acanthozone* has been substituted by Boeck for *Acanthosoma*, the latter name being preoccupied in entomology.

TRITROPIS, Boeck.

Tritropis aculeata.

Oniscus aculeatus, Lepechin, Acta Acad. Sci. Petropolit. p. 247, pl. viii. fig. 1 (1780).

Talitrus Edwardsii, Sabine, Capt. Parry's 1st Voy. Append. no. x. p. 54, pl. ii. figs. 1–4 (1821).

Amphithonotus Edwardsii, Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 151, pl. xxviii. fig. 5 (1862).

Amphithonotus aculeatus, Goës, Œfv. Vet. Akad. Förh. p. 526 (1865); Buchholz, Zweite deutsche Nordpolarf. p. 316, pl. iv. (1874).

Tritropis aculeata, Boeck, Forhandl. Vidensk. Selsk. p. 158 (1870).

Hab. Green Harbour.

BYBLIS, A. Boeck.

Byblis Gaimardi.

Ampelisca Gaimardi, Kröyer, in Gaimard's Voy. en Scand. Crust. pl. xxiii. fig. 1; Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 91, pl. xv. fig. 1 (1862); Goës, Œfv. Kongl. Vet. Akad. Förh. p. 529 (1865).

Tetromatus typicus, Spence Bate, Brit. Assoc. Rep. p. 58 (1855); Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 139 (1857); White, Pop. Hist. Brit. Crust. p. 171, pl. x. fig. 4 (1857).

Byblis Gaimardi, A. Boeck, Vidensk. Selsk. Forhandl. p. 228 (1870).

Hab. Spitzbergen.

EUSIRUS, Kröyer.

Eusirus cuspidatus.

Eusirus cuspidatus, Kröyer, Nat. Tidsskr. 2 R. i. p. 501 (1844–5); Voy. en Scand. pl. xix. fig. 2; Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 154, pl. xxviii. figs. 6, 7 (1862); Goës, Œfv. Vet. Akad.

Förh. p. 529 (1865); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 313, pl. iii. fig. 12 (1874).

Hab. Carl Island and Cape Torell, in 12–18 fathoms.

Amathilla, S. Bate and Westwood.

Amathilla Sabini.

Gammarus Sabini, Leach, Append. Ross's 1st Voy. p. 178 (1819); Sabine, Capt. Parry's 1st Voy. Append. p. 54, pl. i. figs. 8–11 (1821); Kröyer, Kongl. Danske Vid. Selsk. Deel 7, p. 244, pl. i. fig. 3 (1838); Goës, Œfv. Vet. Ak. Förh. p. 531 (1865).
Amathia Sabinii, Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 197, pl. xxxv. fig. 9 (1862).
Amathilla Sabini, Spence Bate & Westwood, Brit. Sessile-Eyed Crust. i. p. 361 (1861); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 346, pl. viii. figs. 1, 2, and pl. ix. fig. 1 (1874).

Hab. Treurenberg Bay, along the shore.

Gammarus, Fabricius.

Gammarus locusta.

Cancer locusta, Linn. Syst. Nat. ed. xii. p. 1055 (1766).
Gammarus locusta, Fabr. Ent. Syst. ii. p. 516 (1793); Leach, Trans. Linn. Soc. xi. p. 359 (1815); M.-Edw. Hist. Nat. Crust. iii. p. 44 (1840); Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 206. pl. xxxvi. fig. 6 (1862); Goës (part), Œfv. Kongl. Vet. Akad. Förh. p. 530 (1865); Boeck, Vidensk. Selsk. Förhandl. p. 204 (1870); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 343 (1874).
Gammarus boreus, Sabine, Capt. Parry's 1st Voy. Append. p. 51 (1821).
Gammarus Duebeni, Lilljeborg, Œfv. Kongl. Vet. Akad. Förhandl. p. 22 (1851).
Gammarus mutatus, Lilljeborg, Kongl. Vet. Akad. Handl. p. 447 (1853).
Gammarus sitchensis, Brandt, in Middendorff's Sibirische Reise (2nd part), i. p. 133 (1851).

Hab. Magdalena Bay.

Themisto, Guérin-Méneville.

Themisto libellula.

Gammarus libellula, Mandt, Observ. Hist. Nat. in itin. grœnland. factæ Diss. p. 22 (1822).
Themisto arctica, Kröyer, Kongl. Danske Vid. Selsk. naturv. Afh. vii. p. 291, pl. iv. fig. 16 (1838); Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 315, pl. 4. fig. 11 (1862).
Themisto crassicornis, Kröyer, *l. c.* p. 295, pl. iv. fig. 17 (1838); Spence Bate, *l. c.* p. 315, pl. 4. fig. 12 (1862).
Themisto libellula, Goës, Œfv. Vet. Akad. Förh. p. 533 (1865); Boeck, Skandin. og Arktiske Amphip. p. 88, pl. i. fig. 5 (1872).

Hab. Spitzbergen, abundant among the floes and along the shore.

Some of the specimens in the collection were found in a Saddleback's stomach killed off the Western Ice in green water.

CAPRELLA, Lamarck.

Caprella septentrionalis.

Squilla lobata, O. Fabr. Fauna Grœnland. p. 248 (1780), *nec* Müller.
Caprella septentrionalis, Kröyer, Nat. Tidsskr. 1 R. iv. p. 590, pl. viii. figs. 10–19 (1843); Voy. en Scand. pl. xxv. fig. 2; Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 355, pl. lvi. fig. 3 (1862); Goës, Œfv. Kongl. Vet. Ak. Förhandl. p. 534 (1865); Boeck, Vidensk. Selsk. Forhandl. p. 276 (1870).
Caprella cercopoïdes, White, in Sutherland's Journ. Crust. p. 207 (1852).

Hab. Fair Haven, in 4–5 fathoms. Abundant on Algæ and Polyzoa. Colour in life reddish brown.

Now and then a moving speck might be seen on the smooth surface of the water from the boat. Sometimes close inspection would enable the cause of the minute disturbance of the sea to be detected in the form of a *Caprella* making strenuous efforts to swim, throwing itself about like a letter S in agonies.

Caprella spinosissima.

Ægina spinosissima, Stimpson, Syn. Invert. Great Manan, p. 44 (1853).
Caprella spinifera, Bell, in Belcher's 'Last of the Arctic Voyages,' ii. p. 407, pl. xxxv. fig. 2 (1855); Goës, Œfv. Vet. Akad. Förhandl. p. 535 (1865); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 338 (1874).
Ægina echinata, Boeck, Forh. Skand. Nat. p. 670 (1860); Vidensk. Selsk. Forhandl. p. 271 (1870).
Caprella spinosissima, Spence Bate, Cat. Amphip. Crust. Brit. Mus. p. 361, pl. lvii. fig. 3 (1862).

Hab. Carl Island and Cape Torell, in 12–18 fathoms; Lomme Bay, in 15 fathoms.

The spines which cover the body of this species are of very variable length, being sometimes long and acute, sometimes quite small.

CIRRIPEDIA.

BALANUS auctorum.

Balanus porcatus.

Balanus porcatus, Da Costa, Hist. Nat. Test. Brit. p. 249 (1778); Darwin, Monogr. Cirripedia, Balanidæ, p. 256, pl. vi. fig. 4 (1854); Buchholz, Zweite deutsche Nordpolarf. Zool. Crust. p. 396 (1874).

Hab. Carl Island, in 18 fathoms; Cape Œtker, in 15 fathoms.

Mr. Leigh Smith in a previous voyage also obtained this species a few miles to the westward of the northern extremity of Prince Charles's Foreland.

PYCNOGONIDA.

Nymphon, Fabricius.

Nymphon gracile.

Nymphum gracile, Leach, Zool. Miscell. i. p. 45, pl. xix. fig. (1814).
Nymphon gracile, Johnston, Mag. Zool. & Bot. i. p. 380, figs. 9, 10 (1837).

Hab. Carl Island and Cape Torell, in 12–15 fathoms.

The colour of the animal is light brown, with very short cinereous hairs, which render it scabrous to the touch; the legs are banded with very fine longitudinal lines of a deeper brown. The joints of the tarsi are subequal; the second joint of the palpi is rather longer than the third. This species is evidently very nearly allied to *N. grossipes*, Fabr., as described by Kröyer (Nat. Tidsskr. n. R. i. p. 108, 1844) and figured (Voy. en Scand. pl. xxxvi. fig. 1); but in that species the third joint of the palpi is much longer than the second, and the animal is described as glabrous.

Leach's specimens of *N. gracile* in the collection of the British Museum are much smaller and slenderer than the specimens from Spitzbergen; but the proportional length of the joints is the same, and it is evident that the animal becomes more robust as it increases in age.

Nymphon hirtum.

Nymphon hirtum, Fabr. Ent. Syst. iv. p. 417 (1794); Kröyer, Nat. Tidsskr. n. R. i. p. 113 (1844–45); Voy. en Scand. Crust. pl. xxxvi. fig. 3.

Hab. Carl Island and Cape Torell, in 12–15 fathoms.

XI.—*Descriptions of new Genera and Species of New-Zealand Coleoptera.*—Part IV. By Francis P. Pascoe, F.L.S. &c.

Gyrinidæ.

Gyrinus Huttoni.

Parnidæ.

Potaminus angusticollis.

Curculionidæ.

Trachyphlœus irritus.
Nicæana, n. g.
—— modesta.
Lyperobius tuberculatus.
Eiratus, n. g.
—— parvulus.
Epitimetes, n. g.
—— lutosus.
Erymneus, n. g.
—— Sharpii.
Erirhinus glottis.
—— limbatus.
Dorytomus trilobus.
Neomycta, n. g.
—— pulicaris.
Eugnomus Wakefieldii.
—— fucosus.
Pachyura metallica.
Acalles impexus.
—— perpusillus.
Acallopais, n. g.
—— rudis.

Pedilidæ.

Macratria exilis.

Gyrinus Huttoni.

G. obovatus, niger, nitidus; prothorace longitudine quam latitudine quadruplo minore; scutello elongato-triangulari; elytris lineatim punctulatis; sutura ænea; pedibus antennisque rufo-testaceis. Long. 2 lin.

Hab. Waikato.

Rather larger than our *G. minutus*, the anterior half broader than the posterior half, and the prothorax very considerably longer (the breadth is above six times the length in *G. minutus*); and its scutellar lobe is very transverse. My specimen has a slight iridescent hue. This and other species from Waikato and Otago have been kindly sent to me by Captain Hutton.

Potaminus angusticollis.

P. angusto-ovatus, sat dense griseo-hirtus; antennis capite fere duplo brevioribus; prothorace latitudine paulo longiore, apicem versus gradatim angustiore, basi bisinuata, lobo scutellari truncato; scutello triangulari; elytris prothorace latioribus, convexis, sat fortiter striato-punctatis; tibiis intermediis rectis, tarsis linearibus; unguibus pallidis. Long. $1\frac{2}{3}$ lin.

Hab. Waikato.

Considerably narrower and more convex than *P. substriatus*. Probably not strictly congeneric.

Trachyphlœus irritus.

T. ovatus, indumento fusco tectus; rostro crasso, capite breviore; scapo valido, setigero; funiculo clavaque nitide rufo-ferrguineis, illius articulo basali ampliato, secundo paulo breviore, cæteris transversis; prothorace fere in medio utrinque subangulato, supra modice convexo, subtuberculato; elytris subcordatis, prothorace paulo latioribus, basi arcuatis, subpunctatis, interstitiis vix elevatis, squamulis paucis pallidis adspersis; pedibus rufo-ferrugineis. Long. $1\frac{1}{3}$ lin.

Hab. Tairua.

Size and shape of *T. porculus* (*ante*, xviii. p. 59), but with a remarkably stout scape, and the prothorax with the side a little before the middle obtusely angled; in *T. porculus* the sides are rounded.

NICÆANA.

Rostrum breve, crassiusculum, capiti continuatum; *scrobes* foveiformes, apice rostri supra sitæ. *Oculi* rotundati. *Antennæ* validæ; *scapus* ad oculum postice attingens; *funiculus* articulis crassiusculis; *clava* distincta. *Prothorax* transversus, lobis ocularibus nullis. *Elytra* obovata, humeris obsoletis. *Pedes* mediocres, intermedii paulo breviores; *tibiæ* anticæ subflexuosæ; *ungues* liberi.

With some hesitation I have come to the conclusion that the nearest ally of this genus is *Prosayleus*, from which, however, it differs, *inter alia*, in its foveiform scrobes, placed on the dorsal surface near the apex of the rostrum. At first sight the species here described reminds one of our *Metallites marginatus*.

Nicæana modesta.

N. oblongo-ovata, dense griseo-squamosa, maculis indistinctis albis (aliquando vitta humerali) notata; antennis pedibusque rufo-testaceis, pilis griseis adspersis; capite supra oculos modice convexo, antice subplanato; prothorace antice posticeque truncato, utrinque rotundato; scutello triangulari, minuto; elytris subcordatis, striato-punctatis; tibiis intus muticis; tarsis articulo secundo dilatato. Long. $1\frac{1}{2}$ lin.

Hab. Otago, Waitaki.

Lyperobius tuberculatus.

L. ovalis, fuscus, griseo-squamulosus; capite antice convexo; rostro modice longiusculo, in medio subcarinulato, basi fovea impressa; prothorace subtransverso, supra inæquali, lateribus subangulatis, apice constricto; elytris ovatis, seriatim punctatis, interstitiis tertio, quinto septimoque paucituberculatis; abdomine leviter punctulato. Long. 7–8 lin.

Hab. Christchurch.

Notwithstanding a great dissimilarity in general appearance, owing to the squamosity and tuberculation, I have no hesitation in placing it with *Lyperobius*. I am indebted for my specimens of this and other Curculionidæ from Christchurch to C. M. Wakefield, Esq., who informs me that it is found on a plant called the "Spaniard," which, in the spring, abounds with Curculionidæ.

EIRATUS.

Rostrum arcuatum, validum, apicem versus gradatim latius; *scrobes* subterminales, obliquæ. *Oculi* ovales, transversi. *Antennæ* breviusculæ; *clava* majuscula. *Prothorax* utrinque rotundatus. *Elytra* subcylindrica, postice callosa. *Prosternum* antice elongatum. *Coxæ* anticæ separatæ. *Processus* interfemoralis late truncatus. *Tibiæ* rectæ, apice uncinatæ; *ungues* simplices. *Abdomen* segmentis duobus basalibus valde ampliatis.

An *Hylobius*-form, as it appears to me, but differing in its longer metasternum; the character of the elytra, however, is that of most of the Hylobiinæ. The spaces between the coxæ are gradually more and more apart. An obvious angle occurs at the point where the rostrum joins the head.

Eiratus parvulus.

E. oblongus, subdepressus, piceo-fuscus; rostro prothorace breviore, parce piloso; funiculo articulo basali modice ampliato, cæteris conjunctim quam clava vix longioribus; prothorace latitudine longitudini æquali, crebre punctato; scutello parvo; elytris fortiter striato-punctatis, apice rotundatis; corpore infra sparse punctato. Long. $1\frac{1}{4}$ lin.

Hab. Tairua.

Epitimetes.

Caput parvum. *Oculi* exigui, rotundati. *Rostrum* breviusculum; *scrobes* subapicales, oculos haud attingentes. *Prothorax* ampliatus, versus apicem multo angustior. *Elytra* elongato-cordata, basi arcuata, lateribus abrupte deflexa. *Femora* antica valida; *tibiæ* anticæ apice flexuosæ; *ungues* approximati. *Coxæ* anticæ contiguæ, intermediæ approximatæ.

The anterior cotyloid cavities are apparently not separated from one another as in *Dysostines*, to which this genus is allied; the elytra also in that genus are not bent down at the sides. The greater part of the scrobes are clothed with scales like the rest of the head. The species described below has the outline and general appearance of the Chilian *Listroderes frigidus*, but scarcely any resemblance to the New-Zealand Rhyparosominæ known to me.

Epitimetes lutosus.

E. oblongus, indumento griseo dense tectus, setulis nigris minutis adspersus; rostro capite plus duplo longiore antice tricarinato; antennis gracilibus, funiculo nitido, articulis duobus basalibus elongatis; prothorace convexo, in medio longitudinaliter excavato; scutello nullo; elytris supra subplanatis, irregularibus, postice utrinque trituberculatis; metasterno abdomineque longitudinaliter excavatis; tibiis posticis intus ad basin dente acuto armatis, versus apicem intus penicillatis. Long. 4 lin.

Hab. Christchurch.

Erymneus.

Caput parvum. *Oculi* exigui, rotundati, grosse granulati. *Rostrum* longiusculum, carinatum; *scrobes* foveiformes, ante medium rostri sitæ. *Antennæ* funiculo articulis duobus basalibus longiusculis æqualibus, primo haud ampliato, tertio ad sextum transversis, septimo longiore; *clava* distincta, ovata. *Prothorax* oblongus. *Elytra* ovalia. *Tarsi* breves, articulo penultimo rotundato, integro, ultimo cæteris conjunctim longiore; *ungues* divergentes.

Allied to the European genera *Styphlus*, *Dichotrachelus*, *Orthochætes*, &c., but at once distinguished by its foveiform scrobes. Contrary to M. Lacordaire's statement, I find in three species of *Dichotrachelus* now before me the penultimate tarsal joint bilobed, not entire. I am indebted to Dr. Sharp for most of the species from Tairua described in this paper.

Erymneus Sharpii.

E. oblongus, aureo-fulvus, squamoso-setosus, supra irregularis; rostro prothorace vix breviore, curvato, versus apicem gradatim crassiore, rugoso-squamoso; mandibulis nigris, bidentatis; prothorace latitudine longiore, basin versus majus tenuato, supra tricarinato, carina media dimidio apicali limitata: scutello nullo; elytris ovalibus, basi arcuatis, humeris elevatis, supra seriatim punctatis, interstitiis paucituberculatis, tuberculis subfasciculatis; pedibus rostroque setulis curvatis vestitis. Long. $2\frac{1}{2}$ lin.

Hab. Tairua.

Erirhinus glottis.

E. pallide flavescens, parce pilosus, vage fusco-plagiatus; capite rostroque infuscatis, illo rotundato, convexo-punctato, hoc gracili, prothorace duplo longiore, leviter punctulato, apicem versus crassiore; antennis in medio rostri insertis, infuscatis; funiculo longiusculo, articulo basali elongato, secundo triplo longiore; prothorace subtransverso, utrinque valde rotundato, sat vage punctulato; scutello infuscato; elytris prothorace multo latioribus, striato-punctatis, interstitiis leviter convexis, apice rotundatis; corpore infra infuscato. Long. $1\frac{2}{3}$ lin.

Hab. Otago.

At first sight this species resembles *E. acalyptoides* (*ante*, xvii. p. 55); but it has a longer and more slender rostrum, much broader at the apex, and only a faint trace of striæ at the base; the prothorax is less transverse; and there is a marked difference in coloration.

Erirhinus limbatus.

E. infuscatus, subnitidus, parce pilosus, marginibus elytrorum testaceis; rostro testaceo, prothorace duplo longiore; antennis in medio rostri insertis; funiculo articulo basali valde ampliato; prothorace transverso, fortiter punctato; scutello parvo, distincto; elytris breviter subovatis, fortiter striato-punctatis, interstitiis planatis; pedibus testaceis; corpore infra infuscato. Long. 1 lin.

Hab. Tairua.

A very distinct species, the elytra unusually broad, especially when compared with the small transverse prothorax.

Dorytomus trilobus.

D. testaceo-fulvus, pube subtilissima parce vestitus, basi elytrorum macula triloba nigra signatus; rostro haud striato, longitudini prothoracis æquali, subtiliter punctulato; oculis rotundatis; funiculo antennarum brevi; prothorace transverso, utrinque rotundato, leviter punctulato; scutello nigro; elytris paulo depressis, fortiter striato-punctatis, interstitiis punctulatis; femoribus infra angulato-dentatis. Long. 2 lin.

Hab. Tairua.

In size and shape this species resembles our *D. maculatus*. The femora are produced into a strong angle beneath, terminating in an almost obsolete tooth.

NEOMYCTA.

Rostrum latum, prothorace brevius; *scrobes* laterales, infra oculos desinentes. *Oculi* prominuli, rotundati. *Antennæ* subterminales, graciles; *funiculus* articulo primo ampliato, reliquis breviusculis. *Prothorax* antice posticeque truncatus. *Elytra* mediocria. *Femora* incrassata; *tibiæ* flexuosæ; *unguiculi* liberi. *Mesosternum* modice elongatum.

Differs from *Erirhinus* in its broad rostrum, with antennæ inserted near the apex.

Neomycta pulicaris.

N. testaceo-rufa, sparse pilosa; capite rostroque vage punctulatis, hoc apice mandibulisque nitide nigris; funiculo articulo primo duobus sequentibus conjunctim longitudine æquali; clava ovato-acuminata; prothorace transverso, utrinque rotundato, confertim punctulato; scutello exiguo; elytris prothorace multo latioribus, breviusculis, subdepressis, fortiter striato-punctatis, dorso plus minusve infuscatis; corpore infra pedibusque testaceis. Long. $1\frac{1}{4}$ lin.

Hab. Tairua.

Eugnomus Wakefieldii.

E. fusco-castaneus, capite rostroque nigris, dorso elytrorum prothoraceque in medio squamulis ochraceis vestitis; antennis castaneis, funiculo articulis duobus basalibus elongatis, clava longiuscula; elytris supra planatis, a medio abrupte declivibus, postice vittis duabus niveis ornatis; corpore infra niveo-piloso. Long. $2\frac{1}{4}$ lin.

Hab. Christchurch.

This pretty little species is at once distinguished by the form of its elytra.

Eugnomus fucosus.

E. fusco-castaneus, supra setulis numerosis instructus, pedibus rufo-testaceis; rostro sat valido, capite sesquilongiore, apice rufo; clava antennarum ampliato-ovata; funiculo articulo basali ampliato, longiusculo, secundo multo breviore; prothorace subtransverso; scutello elongato, albo; elytris striato-punctatis, interstitiis subplanatis, supra fere obsolete albo-maculatis. Long. 1 lin.

Hab. Tairua.

A smaller species than *E. fervidus* (*ante*, vol. xviii. p. 62), with a longer head and proportionally shorter and stouter rostrum. In some specimens there is a reddish spot on each shoulder.

Pachyura metallica.

P. oblonga, aureo- (♂) vel purpureo-cuprea (♀); antennis, tibiis tarsisque brunneo-testaceis, illis basi rostri insertis; capite prothoraceque fortiter punctatis; scutello majusculo; elytris transversim punctatis, interstitiis (transversis) elevatis; corpore infra sparse albo-piloso; metasterno in medio longitudinaliter canaliculato. Long. $2\frac{1}{3}$ lin. ♂, 4 lin. ♀.

Hab. Christchurch.

Except the South-American *Homalocerus*, the Belinæ (to which this genus belongs) are a purely Australian group; this species, however, is not to be approximated to any of its congeners, although a most orthodox *Pachyura*. Perhaps the difference in size and coloration of the two sexes is not always so well marked as in my specimens.

Acalles impexus.

A. ovatus, fuscus, griseo-squamosus, squamulis erectis adspersus; rostro modice elongato; antennis subferrugineis, pone medium rostri insertis; funiculo articulis duobus basalibus longitudine æqualibus; prothorace latitudine longitudini æquali, antice constricto, apice bidentato, in medio bicalloso; scutello inconspicuo; elytris cordatis, convexis, rude punctatis, interstitiis secundo bi-, tertio juxta basin unicalloso, lateribus minus callosis; pedibus rude squamosis. Long. $1\frac{1}{2}$ lin.

Hab. Canterbury.

Size and shape of *A. intutus*, but elytra more cordiform, and with the prothorax very irregular.

Acalles perpusillus.

A. ovatus, fusco-piceus, esquamosus, rostro antennisque pallidioribus, illo lineatim punctulato; prothorace latitudine longitudini æquali, antice constricto, supra vage punctato; elytris breviter ovatis, prothorace latioribus, humeris obsoletis, supra modice convexis, fortiter seriatim punctatis, interstitiis latis, lævigatis; corpore infra vage punctato; abdomine segmentis duobus basalibus valde ampliatis, tribus ultimis pallidis; pedibus validis. Long. 1 lin.

Hab. Tairua.

A very small pitchy-brown species.

Acallopais.

Rostrum validum, apicem versus gradatim incrassatum; *scrobes* laterales. *Antennæ* pone medium rostri insertæ; *scapus* brevis; *funiculus* ad clavam gradatim crassior. *Oculi* majusculi, grosse granulati. *Prothorax* basi latior. *Scutellum* nullum. *Elytra* breviter subcordata. *Rima* pectoralis ampla, apice cavernosa. *Femora* crassa, infra canaliculata; *tibiæ* rectæ, apice uncinatæ; *tarsi* articulo penultimo bilobo; *ungues* divergentes.

The pectoral canal is large, terminated by the raised border of the mesosternum, forming a well-marked cavity, to which, as I have explained, I apply the term "cavernosa," whether the raised portion is erect or bent over the apex of the canal, the passage between the two being too gradual to be of any practical value. It is in that character that it differs principally from *Acalles.*

Acallopais rudis.

A. ellipticus, valde convexus, fuscus, squamosus, squamis erectis numerosis adspersus; rostro nitide fusco, capite vix longiore; antennis piceis; prothorace oblongo, utrinque subrotundato; elytris prothorace paulo latioribus, nigro-variegatis, in medio niveo-subquadrinotatis; abdomine segmentis duobus basalibus amplissimis. Long. $1\frac{1}{4}$ lin.

Hab. Tairua.

Macratria exilis.

M. angusta, fusca, albido-setulosa; capite depresso; collo testaceo; oculis magnis; antennis testaceis, extus infuscatis; prothorace oblongo, apice angustissimo; scutello inviso; elytris seriatim punctatis et setulosis, apice late rotundatis; pedibus testaceis, femoribus posticis dimidio fuscescentibus. Long. $1\frac{3}{4}$ lin.

Hab. Tairua.

Macratria is an almost cosmopolitan genus, but is not found in Europe, nor, so far as I know, in Australia. This is the smallest species that has come under my notice.

XII.—*Contributions to the History of the Hydroida.*

By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plate XII.]

I. NEW BRITISH SPECIES.

Suborder **THECAPHORA**, Hincks.

Family **Plumulariidæ**.

Genus PLUMULARIA, Lamk. (in part).

Plumularia siliquosa, n. sp. (Pl. XII. figs. 2–6.)

Shoots clustered, simple, not plumous, resembling ordinary pinnæ, but rising directly from the creeping stolon and not borne on an erect stem, regularly jointed, the joints oblique: *hydrothecæ* cup-shaped, rather deep, with an even margin, standing out from the shoot, one on each internode immediately above the joint: *sarcothecæ* three on each internode, bithalamic; one of them, immediately below the calycle, of larger size, curved, projecting, one above the calycle, and one at the upper extremity of the internode immediately below the joint; two in connexion with the calycle, one on each side above, pedunculate, emarginate on one side: *gonothecæ* (female) elongate, truncate at the top, and tapering off below; (male) very small (about $\frac{1}{4}$ the size of the female), ovate, curved inwards, somewhat pointed below.

This very distinct species was obtained on the coast of Guernsey by R. S. Cooper, Esq., of Weymouth, lately resident at St. Peter's Port, who has paid much attention to the marine zoology of the island, and whose stores of information and material have always been freely placed at the service of his brother naturalists. He has kindly supplied me with the specimens on which the above description is founded.

P. siliquosa has only occurred so far in the stemless form; but it is probable that in its perfect condition it exhibits the plumous mode of growth which is characteristic of its tribe. *P. Catharina* is also found occasionally in this humble guise; but more commonly it assumes the true Plumularian habit.

The calycle in the present species exhibits no very distinctive feature, if we except the pair of pedunculate sarcothecæ which are associated with it. These differ from the similar structures on *P. Catharina* in being emarginate on one side, a peculiarity which also occurs in one at least of the species described by Meneghini. The calycle is not appressed to the shoot, but stands out from it at an angle.

The female capsules are of very large size, either much elongated and rather slender, or of a broader and shorter type (Pl. XII. fig. 6); but in all cases they present a striking contrast to the males. They are developed in the usual position at the base of the calycles.

The *sarcothecæ* exhibit several varieties of form. The hydrotheeal pair are pedunculate; the one below the calycle is incurvate and projects from the stem like a bracket; the two above the calycle consist of an elongate, stem-like portion, tapering off to a point below, which supports a minute cup; they are directed upwards parallel to the shoot. These organs supply good diagnostic characters.

Suborder **ATHECATA**, Hincks.

Family **Atractylidæ.**

? Genus Perigonimus, Sars.

? *Perigonimus nutans*, n. sp. (Pl. XII. fig. 1.)

Stems erect, simple, smooth, slightly tapering downwards, not dilated above; *polypite* large, clavate, terminating above in a short proboscis, and borne on a neck-like extension of the cœnosarc, which rises considerably above the polypary, white, with a slight tinge of light yellowish colour; tentacles 8, four erect and four depressed; body of the polypite frequently bent downwards, so as to droop on one side: *gonophores* unknown.

In the absence of the reproductive bodies, this very graceful species can only be referred provisionally to the genus *Perigonimus.* So far as the trophosome is concerned, it is a well-marked form. The very delicate transparent polypary only extends to the base of a neck-like prolongation of the cœnosarc, which enlarges gradually into the club-shaped body of the polypite. This neck-like portion is very flexible; and the polypite commonly droops to one side, assuming a graceful pendent posture. It has no power of retracting itself in any degree within the polypary, which exhibits no trace of a cup-like dilatation above. The endoderm is opaque white, with a slight yellowish tinge, and the ectoderm transparent. The arms are roughened as usual, and arranged in two sets of four, one carried erect and the other everted. There is no wrinkling or annulation of the polypary, which forms a very delicate and filmy covering. The striking features of the species are the large elevated polypite and the pendent habit.

II. Podocoryne carnea, Sars, and its appendages. (Pl. XII. figs. 7 & 8.)

I have elsewhere noticed* the occurrence on this species of spiral and filamentary appendages similar to those which are found on *Hydractinia echinata*, Fleming, and which were first described by the late Dr. Strethill Wright. In his work on the Tubularian Hydroids, Prof. Allman has suggested a doubt as to the real nature of these appendages. Neither kind, he tells us, was present in any of the specimens that came under his observation; and he adds, "whatever be the nature of the spiral bodies observed by Hincks, they certainly do not possess the constancy which characterizes the spiral appendages of *Hydractinia*; and it is difficult not to regard both the spiral bodies and the tentacular-like filaments observed by Hincks in *Podocoryne* as merely abnormal alterations of the ordinary hydranths" (polypites)†.

First, then, as to the spirals. There can be no doubt about their occurrence on *Podocoryne carnea*, as I have now in my collection a well-developed specimen on which they are present, forming a line along that portion of the basal crust which edges the mouth of the shell supporting the colony. They are usually curled up in two or three coils; they have a white central core, and are rounded off and slightly clavate at the top, which glitters with thread-cells.

Allman seems to think that they are much more frequently wanting than the similar bodies in *Hydractinia*, and regards the inconstancy of their occurrence as a proof of their abnormality. But, according to my experience, the spiral appendages of *Hydractinia* are by no means constant; on the contrary, they are only present, I believe, on very fully matured colonies; and in numerous instances I have failed to find them. This seems to be the case also with *Podocoryne*.

No doubt all these appendages must be regarded as "alterations of the ordinary hydranths;" but I can see no more reason for considering them "abnormal" in *Podocoryne* than in *Hydractinia*. They present the same general appearance and occupy the same position in both; and in both they seem to be developed only on mature colonies.

Secondly, as to the filamentary or tentaculoid appendages:

* 'History of British Hydroid Zoophytes,' i. p. 32.
† 'Gymnoblastic Hydroids,' part ii. p. 350.

these are as definite zooidal forms as the polypites themselves. They occur on the outskirts of the colony, where *they are thickly distributed*, and seem to be very generally present. I have lately had the opportunity, at Torquay, of reexamining them, and have figured them for this paper (Pl. XII. figs. 7 and 8). They consist of an extensile filamentary body, of a somewhat clavate figure at the free extremity, in which, I believe, a number of thread-cells are immersed, and at the base surrounded, as the polypites are, by a tubular extension of the polypary. They are in pretty constant motion, stretching themselves out hither and thither, and are often so much attenuated as to appear like "long and slender threads of gossamer." They certainly do not strike one as in any respect "abnormal."

We have, then, in *Podocoryne* another instance amongst the Hydroida of that curious polymorphism which recalls so forcibly the complex structure of the Siphonophora.

III. Note on Acharadria larynx, T. S. Wright.

Dr. Strethill Wright has given a very brief and insufficient description of this species, though his figure of it is graceful and characteristic. Allman has studied a young polypite, obtained in Mr. Rotch's aquarium, and has embodied some notes upon it in his 'Gymnoblastic Hydroids.' He conjectures that possibly *Acharadria* may be only "the immature state of some already described form of pennaridan Hydroid." No further account of it has been published.

I have obtained it pretty abundantly between tide-marks in the island of Herm, where it was first found, I believe, by Mr. Rotch. It is a well-marked and extremely beautiful species. The polypites are remarkable for the freedom and activity of their movements. They are able to assume a drooping attitude and to sway the body over to considerable distances, and so to command a wide range of the surrounding water. This power is due to the peculiar constitution of the polypary, the upper portion of which is composed of very delicate and filmy material, and offers no resistance to the motion of the polypite. A very considerable tract of the polypary in the adult is thus attenuated; and the result is a freedom and variety of movement which are unknown amongst other members of the tribe.

Allman has referred to this peculiarity, though it seems not to have been so strongly marked in the young polypite which he examined as it is in the adult. The proboscis and the capitate tentacles were also in active movement, while the aboral tentacles were frequently and energetically clasped together and variously intertwined. The proboscis is opaque white at the top and of a pinkish colour below it.

On a single polypite there were traces of the reproductive bodies; but they were in too rudimentary a condition to allow of any conjecture as to the probable course of development. They were produced at the base of the filiform tentacles, forming a circle within the verticil, and presented much the same appearance as those of *Tubularia* at a similar stage.

IV. Lafoëina tenuis, Sars.

This remarkable Hydroid, which was first noticed by the elder Sars, and afterwards more fully described and figured by his son, is an interesting addition to our fauna. I have obtained it creeping over other zoophytes, which were dredged in Shetland.

I am also inclined to think that it occurs on the Northumberland coast. In a letter from the late Mr. Alder accompanying some specimens of what he believed to be *Cuspidella humilis*, mihi, he writes, "What are the blunt spine-like processes parasitical on the *Cellularia* with *C. humilis*? Have they any connexion with the latter?" I have little doubt that the supposed *Cuspidella* was, in fact, *Lafoëina* (the two bearing the closest resemblance, so far as the calycles are concerned), and that the "spine-like processes" were the curious sarcothecal organs with which the latter is furnished, and which are thickly distributed along its creeping stolon.

I draw attention to the matter in the hope that some of our excellent northern naturalists may be on the look-out for the *Lafoëina*, and may have the opportunity of settling the question as to its geographical range.

EXPLANATION OF PLATE XII.

Fig. 1. *Perigonimus? nutans*, n. sp., Hincks, highly magnified.
Fig. 2. *Plumularia siliquosa*, n. sp., Hincks, natural size.
Fig. 3. The same, portion of a shoot bearing two female capsules, magnified.
Fig. 4. The same, a single calycle and male capsule, magnified.
Fig. 5. The same, a single calycle, more highly magnified.
Fig. 6. The same, a female capsule, magnified.
Fig. 7. Tentaculoid appendages of *Podocoryne carnea*, Sars.
Fig. 8. One of the same, more highly magnified.

XIII.—*New and peculiar Mollusca of the Order* Solenoconchia *procured in the 'Valorous' Expedition.* By J. Gwyn Jeffreys, LL.D., F.R.S.

Solenoconchia.

Genus Dentalium.

*Dentalium candidum**, Jeffr.

Body whitish, with a faint tinge of brown: *mantle* very thin, forming a collar, which encircles the inside of the upper part of the shell: *tentacles* very numerous, with pear-shaped tips, issuing between the mantle and the shell: *foot* when at rest conical, having a semicircular lobe or flap on each side, so as to give it a tricusped appearance; the lobes are fringed or puckered at the edges. The animal from which I took the above description was sluggish and probably half-dead, in consequence of its having been dredged up from a depth of 1100 fathoms.

Shell having the shape of a narrow funnel, tapering, slightly curved, rather thin, opaque, more or less glossy: *sculpture*, about forty fine and regular rounded longitudinal striæ, which disappear towards the front margin; these striæ are crossed by extremely numerous and close-set circular microscopic lines: *colour* glistening-white: *margin* at the anterior or broader end jagged, at the posterior or narrower end abruptly truncated; there is no notch, groove, slit, or channel. L. 1·75. B. 0·3.

Station 5, 410 fms.; 6, 1100 fms.; 8, 1750 fms. 'Porcupine' Expedition, 1869, west coast of Ireland, 664–1476 fms.; Bay of Biscay, 2090–2435 fms.

Allied to *D. grande*, of Deshayes, from Japan. The present species differs from *D. striolatum*, Stimpson (*D. abyssorum*, M. Sars), in being straighter, less cylindrical, and of a thinner and more delicate texture, and in having twice the number of ribs.

Dentalium capillosum †, Jeffr.

Shell tapering to a fine point, slightly curved, rather solid, opaque, and mostly lustreless: *sculpture*, numerous and sharp (not rounded) longitudinal striæ, some of which are intermediate and smaller than the rest; they disappear towards the posterior or narrow end, which is quite smooth and glossy

* Glistening-white.

† Covered with threads or hair-like markings.

for a quarter of an inch: *colour* whitish: *margin* at the posterior end having a short and narrow notch. L. 1·4. B. 0·15.

Station 12, 1450 fms.; 13, 690 fms.; 16, 1785 fms. 'Porcupine' Expedition, 1869, Bay of Biscay, 862 fms.; north of the Hebrides, 542 fms.: 1870, off the coast of Portugal, 220–1095 fms. Off Bahia Honda, Gulf of Mexico, 418 fms. (Pourtales). 'Challenger' Expedition, off the Azores, 450 and 1000 fms.

This appears to attain a size considerably exceeding that given in the above description, as fragments measure nearly $\frac{4}{10}$ inch in breadth.

Dentalium ensiculus *, Jeffr.

SHELL tapering, considerably and regularly curved throughout, compressed or flattened, thin, nearly transparent, and glossy: *sculpture*, a sharp keel on both the dorsal and ventral sides (giving the appearance of a double-edged scimitar), besides occasionally a few slight and irregular longitudinal keels or raised striæ and concentric lines of growth: *colour* clear-white: *slit* of moderate length and very broad, semicylindrical, placed on the upper or dorsal side; the posterior or narrower end of the shell is nearly bisected to form the slit, the upper part being abruptly truncated; when viewed sideways the lower part appears split; the point is rounded and entire. L. 0·9. B. 0·1.

Station 12, 1450 fms.; 16, 1785 fms.: fragments are not uncommon. 'Porcupine' Expedition, 1869, off the west of Ireland, 1366 fms.; Bay of Biscay, 862 fms.: 1870, off the coast of Portugal, 740–1095 fms.

The annual or occasional growth is sometimes shown by the irregular formation of the new or succeeding portion of the shell, which is narrower than the former or preceding portion.

Dentalium subterfissum †, Jeffr.

SHELL slender and finely tapering, more curved towards the point, rather thin, nearly semitransparent, and glossy: *sculpture*, from 12 to 16 delicate and sharp regular longitudinal striæ, which are continued to both ends: *colour* whitish: *margin* at the posterior end bulbous: *slit* long and narrow, placed on the lower or ventral side; its length is double that of the greatest diameter of the shell. L. 0·6. B. 0·075.

* A little sword. † Slit underneath.

Station 12, 1450 fms.; a fragment only, but evidently belonging to this species, which I have described from specimens taken in the 'Porcupine' and 'Challenger' Expeditions. 'Porcupine' Expedition, 1869, off the west coast of Ireland, 1180–1476 fms. 'Challenger' Expedition, lat. 37° 26′ N., long. 45° 14′ W., 1000 fms.

The slit in *D. subterfissum* is on the under or ventral side of the shell, being the same position as in the *D. inversum* of Deshayes, and the reverse of that in his *D. rubescens* and in *D. ensiculus*. The organization of the animal is unknown; but *D. inversum* may be the type of a distinct genus.

A single and dead specimen of another shell, apparently belonging to the genus *Dentalium*, occurred in Station 16, 1785 fathoms. It is narrowly cylindrical, rather solid, glossy, smooth, and a quarter of an inch long. Its peculiarity consists in the posterior termination forming a second and narrower cylinder, which issues out of the larger and longer one, as if from a sheath. This process has an entire and circular point; so that the shell cannot be a species of *Siphodentalium*. I propose to name it *Dentalium vagina*. Perhaps two imperfect specimens of a *Dentalium* from Station 12, 1450 fathoms, may belong to the same species.

Siphonodentalium, M. Sars.

In the 'Journal de Conchyliologie' for 1874, p. 258, the Marquis di Monterosato proposed the abbreviation of this generic name to *Siphodentalium*; and I agree with him that it would be convenient.

Siphodentalium vitreum, M. Sars.

Dentalium vitreum, M. Sars, Nyt Magaz. Naturvid. 1851, Bd. vi. p. 178 (*Siphonodentalium*, 1858).

D. lobatum, G. B. Sowerby, Jun., Thes. Conch. (1866), vol. iii. p. 100, fig. 44.

Body whitish, gelatinous, and nearly transparent: *mantle* rather thick, forming a collar round the foot: *tentacles* thread-like, very slender, and having oblong tips or bulbs; they are not numerous, but extensile and irregular in length, issuing from underneath the edge of the mantle: *foot* cylindrical, extensile, and attaining a length equal to that of the shell; when at rest it is conical; but the point fully stretched out expands into a round and somewhat concave disk with serrated or notched edges: *excretal fold* or tail at the narrowest end of the shell, tubular, and having the front split open and exposed diagonally; edges jagged; externally covered with very fine and close-set cilia: *liver* dark-brown: *ovary* lemon colour.

Station 6, 410 fms.; 9, 1750 fms.; 12, 1450 fms. Finmark, 40–100 fms. (M. and G. O. Sars, M'Andrew, Malmgren). Spitzbergen (Torell, Goodsir). Swedish Arctic Expedition, 1868, 730 fms. 'Lightning' Expedition, 1868, North Atlantic, 550 fms. 'Porcupine' Expedition, 1869, between the Faroes and Orkneys, 560 fms.: 1870, off the coast of Portugal, 740–1095 fms. Gulf of St. Lawrence, 150–200 fms. (Whiteaves). Fossil: Norway, older Glacial deposit, 90 feet above the sea-level (M. Sars and Kjerulf).

The very young resembles *Siphodentalium affine*, M. Sars, but is more conical or less cylindrical.

Siphodentalium affine, M. Sars.

Siphonodentalium affine, M. Sars, Christ. Vid. Selsk. Forh. 1864, p. 299, tab. vi. f. 34, 35.

Station 12, 1450 fms.; a single specimen. Finmark, 100–300 fms. (G. O. Sars). 'Porcupine' Expedition, 1869, West of Ireland, 1215–1380 fms.: 1870, Channel slope, 690 fms.

Siphodentalium lofotense, M. Sars.

Siphonodentalium lofotense, M. Sars, *loc. cit.* p. 297, tab. vi. f. 29–33.

Station 9, 1750 fms. Norway, 30–300 fms. (M. and G. O. Sars, J. G. J.). Hebrides and Shetland, 40–140 fms. (J. G. J.). 'Porcupine' Expedition, 1869, West of Ireland, 90–1630 fms.: 1870, Bay of Biscay, 227–1095 fms.; Vigo Bay, 20 fms.; Mediterranean, 51–1456 fms. Gulf of Gascony, 60–80 fms. (De Folin). Mediterranean, 50–600 fms. (Acton, Spratt, Nares, Monterosato).

Specimens from the Bay of Biscay and the Mediterranean are usually much smaller than those from more northern seas.

*Cadulus tumidosus**, Jeffr.

Shell forming a short spindle, slightly bulging in the middle on the lower or more concave part, and very gibbous on the back or outside, somewhat curved, contracted towards both ends, but much narrower at the base, rather solid, glossy and semitransparent: *sculpture* none, except microscopic and close-set lines: *colour* whitish: *mouth* roundish-oval, obliquely truncated or sloping to the back; the inner margin is furnished with a slight circular rib or thickening like that in many

* High-swelling.

species of *Helix*: *base* notched on each side, as in *C. subfusiformis*. L. 0·2. B. 0·075.

Station 12, 1450 fms.: one specimen is abnormally arched. 'Porcupine' Expedition, 1869, Channel slope, 557 fms.: 1870, Bay of Biscay, 292–1095 fms. 'Josephine' Expedition, 110–550 fms. Fossil at Messina (Seguenza).

This is much larger and more gibbous than *C. subfusiformis*; and, like that species, it varies in shape and size. It has the character on which Monterosato lays stress in generically separating *C. subfusiformis* from *C. ovulum*, viz. in the mouth or anterior opening being more or less thickened inside by a circular rib.

*Cadulus gracilis**, Jeffr.

SHELL more curved and cylindrical than *C. subfusiformis* (to which it is evidently allied), not swollen in the middle, but throughout nearly equal in breadth; the mouth slopes more, and has a slight circular rib or thickening within; base broader; oblique marks of growth are conspicuous. L. 0·2. B. 0·04.

Station 13, 690 fms.; a single specimen.

Cadulus Olivi, Scacchi.

Dentalium Olivi, Sc., Notiz. foss. Gravina (Ann. Civ. 1835), p. 56, tab. 2. fig. 6, *a*, *b*.

Station 12, 1450 fms.; fragments only. 'Porcupine' Expedition, 1869, West of Ireland, 1230 fms.; south of the English Channel, 862 fms.: 1870, Channel slope, 539 fms. Sicilian Tertiaries (Scacchi, Tiberi, and others).

Awl-shaped and variable in size. Probably *Dentalium coarctatum* of Lamarck, and certainly that of Deshayes and Philippi, is *Dischides bifissus*.

C. gadus of Montagu resembles *C. Olivi*; but it is not only very much smaller, but is proportionally shorter and less slender, and the anterior end is more contracted. The locality given by Montagu ("many parts of the British Channel"), with the mariner's name "Hake's-tooth," is at least very doubtful as regards this species; and it is not unlikely that he may have mistaken for the "Hake's-tooth" *Ditrypa arietina* (a testaceous Annelid), which is frequently found adhering to the grease or "arming" of the deep-sea lead in soundings. But his description and figure evidently apply to a species of *Cadulus* from the noted collection of old George Humphreys, the

* Slender.

shell-dealer, of which I possess specimens. This species was dredged by the late Professor Barrett at Jamaica; and it is a fossil of the Sicilian Tertiaries. I received specimens of the latter from the Marquis di Monterosato as "*Cadulus subfusiformis*, Sars," and from Dr. Tiberi as "*Siphonodentalium Olivi*, var. *minor*, Scac."

An undescribed species of *Cadulus*, dredged by Admiral Sir Edward Belcher in the N.W. Pacific (for specimens of which I am indebted to his kindness), is also allied to *C. Olivi*; but the narrower and smaller extremity has four slight notches and corresponding slits. It is therefore possible that the genera *Siphodentalium* and *Cadulus* should be united, and that *Dischides* must "follow suit."

*Cadulus cylindratus**, Jeffr.

Shell forming a narrow cylinder, slightly contracted at each end, gently curved, thin, transparent, and glossy: *sculpture* none, except a few microscopic and faint lines of growth: *mouth* somewhat obliquely truncated, but not thickened: *base* circular, with numerous minute notches, which are not perceptible to the naked eye. L. 0·325. B. 0·075.

Station 12, 1450 fms.; a single specimen. 'Porcupine' Expedition, 1869, off the West of Ireland, 1215–1476 fms.; very rare.

XIV.—*On the Fundamental Error of constituting* Gromia *the Type of Foraminiferal Structure.* By G. C. Wallich, M.D., Surgeon-Major Retired List H.M. Indian Army.

Rather more than forty years have elapsed since the first attempt was made by Dujardin to classify the Rhizopods. During the latter half of this period, the study of these singular organisms has not only been invested with much additional scientific interest, but has received a powerful impetus from its intimate connexion with the geological and biological relations of the deep-sea bed. And yet our knowledge of the Rhizopods as a whole, and especially of the animal portion of their structure, is by no means so complete as it ought to have been, considering the amount of attention that has been bestowed upon it. This, I venture to think, is in a great

* Cylindrical.

measure attributable to the fundamental error which pervades that classification of these organisms which has hitherto been very generally, and in other respects very deservedly, held in high estimation by naturalists.

In an article upon the Systematic Arrangement of the Rhizopoda, by Dr. W. B. Carpenter, published in the 'Natural-History Review' for October 1861, the author thus expresses his views on the subject:—"It is, as it seems to me, in the *structural and physiological conditions of the animal alone* that we should look for the characters on which our primary subdivisions should be constituted; and notwithstanding that the extreme simplicity and apparent vagueness of those conditions appear almost to forbid the attempt to assign to them a differential value, yet a sufficiently careful scrutiny will make it clear that, under their guidance, lines of demarcation may be drawn as precise as in any other great natural group, between three aggregations of forms which assemble themselves round three well-known types, *Amœba*, *Actinophrys*, and *Gromia*,—*the sarcode-bodies of these three types presenting three distinct stages in the differentiation of the protoplasmic substance of which they are composed, and exhibiting, in virtue of that differentiation, three very distinct modes of vital activity*" (*loc. cit.* p. 460).

Regarding the perfect soundness of the principle laid down in the opening sentence of the above extract, it may at once be assumed that no question can arise. But this renders it only the more inexplicable that such a thoroughly illogical application of the principle should have followed as is involved in the separation from each other, and the location in three distinct ordinal divisions, of *Amœba*, *Actinophrys*, and *Gromia*—three forms in each of which are prominently combined the only true *structural* characters of the animal that clearly indicate an advance, in the highest group of Rhizopods, towards the more complex organization of the Infusoria and Gregarinæ.

The structural characters here referred to by me consist in the possession, in common, by *Amœba*, *Actinophrys*, and *Gromia*, of a NUCLEUS and CONTRACTILE VESICLE:—the former being the reproductive organ of the Rhizopod in its most fully developed condition; the latter, a fluid-respiratory organ, to be met with, so far as my experience goes, for the first time in the third or highest order of the Rhizopods*. On these grounds I have done my utmost, for the last twelve years, to prove that the three genera referred to cannot be thus parted

* See Supplementary Note at the end of these observations.

without doing violence to the most natural and important of all affinities, namely those founded on the "structural and physiological conditions of the animal alone."

But, irrespectively of this, were further proof needed of the error committed in the separation of these three genera on the basis of differences supposed to be more or less constantly observable in the characters of their respective *pseudopodia*, and the accompanying degrees of "differentiation" said to exist respectively in the external layer of the body, or "ectosarc," and the general protoplasmic mass within, or "endosarc," I undertake to show, on Dr. Carpenter's own evidence, that the pseudopodial characters are by no means sufficiently uniform or sufficiently constant to be depended upon as ordinal distinctions. In short, I hope to make it clear that the terms "ectosarc" and "endosarc" embody a scientific fiction, and that the sole purpose they serve is to mask our ignorance. The sooner, therefore, they are dispensed with, save as convenient names for the portions of the sarcode-mass that happen for the time being to constitute the external boundary and the internal mass, the sooner may we expect to arrive at an adequate idea of the visible characters which distinguish the organism called a Rhizopod *.

Dr. Carpenter, in defining the characters of the lowest order in his system, namely the *Reticularia*, tells us that "in the cases in which the differentiation into ectosarc and endosarc has proceeded furthest, so that that body of the Rhizopod bears the strongest resemblance to an ordinary 'cell' † (as is the case with *Amœba* and its allies), a *nucleus* may be distinctly traced; in those, on the other hand, in which the original protoplasmic condition is most completely retained (as seems to be the case with *Gromia* and the Foraminifera generally), *no nucleus* can be distinguished. The same," he says, "appears to be true of the peculiar *contractile vesicle*, which may be regarded as a vacuole with a defined wall" ('Introduction to the Study of the Foraminifera,' 1862, p. 14).

Dr. Carpenter afterwards goes on to make the following

* For a detailed account of my observations on the Rhizopods generally, I would refer the reader to a series of six papers on the *Amœban, Actinophryan,* and *Difflugian* Rhizopods, contributed by me to the 'Annals' between April 1863 and March 1864; and a paper "On the *Polycystina,*" embodying a Classification of the Rhizopods as a whole, and this family in particular, which was published in the 'Quart. Journ. Micr. Soc.' for July 1865.

† Biology and physiology are undoubtedly under heavy obligations to the "cell" doctrine. But it is not saying too much to assert that biologists and physiologists have had a great deal of nasty work cut out for them by the perpetual misapplication and misconception of that doctrine.

very specific statement:—"The subdivision of the Rhizopods into orders seems to be most satisfactorily accomplished by taking as a basis those structural characters which are most expressive of physiological differences. Such characters are presented in the form, proportions, and general arrangement of the pseudopodial extensions; for, notwithstanding their apparently unrestricted *polymorphism*, it will be found that the Rhizopods present three *very distinct types of pseudopodian conformation*, to one or other of which they may all be referred, *and that the groups thus formed are eminently natural.* How intimately related these diversities are to those *fundamental potentialities* of each type which find so little structural expression in the lowest form of animal life, appears from the circumstance that *even a particle of protoplasm, detached from the general mass of the body, will put forth the pseudopodian extensions characteristic of its type*,—those of the substance forced out by crushing the 'test' of an *Arcella* having the broad, lobated form of those of the *Amœba*, whilst those of the substance forced out in like manner by crushing the shell of a *Polystomella* have the delicate thread-like character of those of the Foraminifera generally" (*op. cit.* pp. 14 & 15).

Here, then, we have a clear and definite admission on Dr. Carpenter's part that the presence of a *nucleus* and of a *contractile vesicle* is indicative of the highest stage of structural organization of which the Rhizopods are capable. And I take it for granted, therefore, that, conversely, it is meant to be inferred that the absence of both of these organs indicates the lowest stage, the zero, of organization. Yet, extraordinary as it must appear, it is not upon the presence or the absence of one or other or both of these important specialized organs that Dr. Carpenter has based his classification, but "on the characters presented by the form, proportions, and general arrangement of the pseudopodial extensions"—characters which, even if constant and uniform, could not possibly compare with them in point of physiological significance, but which, if shown to be both so inconstant and fluctuating as to present themselves with nearly equal frequency in the highest and in the lowest orders into which the Rhizopods are divisible, and even to vary entirely in the same genera, cannot be regarded as otherwise than illusory, and therefore worthless for the purpose of ordinal subdivision.

I do not mean to assert that the evidence of advance from the lower to the higher grade of organization on which I have invariably laid the greatest stress, namely the appearance of a *nucleus* and a *contractile vesicle*, may not be accompanied by perceptible differences in the general aspect of the sarcode (nor has this ever been my opinion), but only that these differences are neither commensurate in importance, nor at all sufficient in kind, or sufficiently constant, to be admissible as proofs of such advance. And this will be seen from the following short extract from my observations on the Polycystina, taken from the 'Quarterly Journal of Microscopical Science' for July 1865:—"Although not prepared to regard the degrees of differentiation (as described by Dr. Carpenter) as applicable to the demarcation of orders, or as affording perfectly constant characters *under any circumstances*, there cannot be a doubt as to their affording, in the majority of cases, a valuable means of completing *generic* diagnosis. Beyond this their value does not appear to extend."

The only point which might reasonably be deemed open to discussion (though probably not by any one who has witnessed the behaviour of the body-substance of *Actinophrys sol* when being torn to bits and devoured piecemeal by an *Amœba*) is that alluded to when Dr. Carpenter says that "a particle of protoplasm detached from the general mass of the body of a Rhizopod will put forth the pseudopodia characteristic of its type,"—*Arcella* being specified as putting forth the "lobose" pseudopodia of *Amœba*, and *Polystomella* (itself a Foraminifer!) being, curiously enough, singled out as putting forth the "delicate thread-like" pseudopodia of—the Foraminifera *.

As interpreted by me, the appearances here described, although not indicative of sufficiently important or constant "differences" in the constitution of the exterior layer and interior protoplasmic mass to be available as ordinal distinctions, prove in a very decisive manner that there *cannot* be any thing approaching to a definite external layer †; unless we are also prepared to believe, because an oil-globule retains its form whilst suspended in pure water, or, if split up

* Those who have studied the living Foraminifera, and know to their cost how much time and patience is necessary in getting these intensely sensitive beings to project their pseudopodia at all, will, I think, agree with me that there is more conveyed in Dr. Carpenter's statement on this point than could possibly have been intended by him. For two whole years the naturalists on board the 'Challenger' watched constantly and anxiously before their eyes were rewarded with a sight of the projected pseudopodia of the ubiquitous Foraminifera of the open ocean. He must have been an exceptionally fortunate observer, therefore, who saw the crushed "particle" of the complex-shelled *Polystomella* put forth the pseudopodia of its tribe.

† Of course I except what is observable when the final stage of the life-cycle of *Amœba* has arrived, namely its encystment, as having no real bearing on the present question.

into two portions, each of these behaves precisely as another oil-globule does by instantaneously presenting an unbroken outline, that the said oil-globule is differently constituted at its surface and in its interior. The same argument applies, and with redoubled force, to a mass of albumen suspended in water; for here the tendency to assume a spherical form is by no means so pronounced as in an oil-globule; and if we break up the mass into a number of smaller masses, we have presented to us appearances which very closely resemble those observable in the pseudopodium of the *Amœban* Rhizopod. Indeed *so* close is the resemblance, that, barring the element of vitality (which the chemist is still as far off as ever from producing at call), we have before our eyes those very "fundamental *potentialities*" which a highly imaginative rendering of certain appearances has declared to be typical of the living sarcode of the Rhizopod.

Were it not that it befits us to speak with bated breath of the mighty dead, another instructive argument on this subject might be adduced from the history of the rise and fall of the unfortunate "*Bathybius*."

But the fact is, that, divide the sarcode body of a living *Amœban*, or even an *Actinophryan*, Rhizopod as we may, by pressure or other agency, the *divided surface* will forthwith present every character presented by the undivided portion: any peculiarity of outline, if present in the undivided part, will at once reappear in the divided part; any seeming contrast between the external layer and the contained mass within will instantly show itself; and the character of the pseudopodial processes will be the same. This identity of character in the divided and undivided surfaces is absolutely instantaneous, there being nothing like a gradual transition from one condition to another, such as we should undoubtedly be 'able to see taking place were the ruptured surfaces in any respect dissimilar to the rest of the mass. This is the view I have always advocated, its unacceptable point being, I presume, that it is quite unconformable with Dr. Carpenter's published definitions of Rhizopod structure.

As it would be foreign to the immediate purpose of the present paper to enter into all the details of the subject, I must confine myself to stating that the inconstancy of the pseudopodial characters in *Amœba*, which is of course quite incompatible with the assumed presence of an external layer of much more highly developed sarcode than that which it encloses, is conceded (but without the inevitable inference which must be associated with it) in the 'Introduction to the Study of the Foraminifera,' 1862 (p. 23), when Dr. Carpenter says that "sometimes *Amœba* puts forth a few broad lobated expansions; sometimes these are more numerous, slender, and elongated, *assuming a radial direction*; and occasionally they are so greatly multiplied, *radiate with such regularity, and taper so uniformly from base to apex, as strongly to resemble the pseudopodia of* ACTINOPHRYS."

This is undoubtedly true; and I therefore leave Dr. Carpenter to reconcile the fact with his classification and definitions of the orders, of which I now subjoin a summary, taken from his paper in the 'Natural-History Review' to which reference has already been made*.

Dr. Carpenter's Arrangement of the RHIZOPODA.

LOBOSA.	RADIOLARIA.	RETICULARIA.
Amœbina.	*Actinophryina.* *Acanthometrina.* *Polycystina.* *Thalassicollina.*	*Gromida.* *Foraminifera.*
INFUSORIA. GREGARINIDA.	SPONGIADA.	PROTOPHYTA.

After saying that "any small separated portion of the sarcode body of the Rhizopoda will behave itself after the characteristic fashion of its type" (that of *Arcella* behaving like that of *Amœba*, that of *Polystomella*, or *any other* of the Foraminifera, like those of *Gromia*), and adding that "this fact seems to him to afford an additional justification of the employment of the characters furnished by the *pseudopodia* as the *basis* of a systematic arrangement of the class," he informs us that the characters of the three orders into which he proposes to distribute its various forms may be concisely summed up as follows:—

"I. RETICULARIA.—The body composed of homogeneous granular protoplasm, without *any* distinction into ectosarc and endosarc; neither nucleus nor contractile vesicle; pseudopodia composed of the same substance as the body, extending and multiplying themselves by minute ramification, and inosculating completely wherever they come into contact; a con-

* It may be well to bear in mind that the article in the 'Review' appeared in 1861 as an *avant-courier* to the 'Introduction to the Study of the Foraminifera,' which appeared just a year afterwards. The tabular classification of the Rhizopods is taken from page 17 of the latter work.

tinual circulation of granular particles throughout the viscid substance of the body and its extensions. This order consists of the Foraminifera and the *Gromida*.

"II. RADIOLARIA.—Incipient differentiation of the protoplasmic substance into endosarc and ectosarc, the former semifluid and granular, the latter more tenacious and pellucid; a nucleus and contractile vesicle; pseudopodia rod-like, tapering from base to point, composed of the same substance as the ectosarc, exhibiting little disposition either to ramify or coalesce, although a movement of particles adherent to their exterior is often to be distinguished. The type of this order is *Actinophrys*.

"III. LOBOSA.—More complete differentiation of the protoplasmic substance into endosarc and ectosarc, the former being a slightly viscous granular liquid, and the latter approaching the tenacity of a membrane; a nucleus and contractile vesicle; pseudopodia few and large, being in reality lobose extensions of the body which neither ramify nor coalesce, having well-defined margins, and not exhibiting any movement of granules on their surface, the circulation in their interior being entirely dependent on the changes of form which the body undergoes as a whole."

As regards those "*fundamental potentialities of each type*" —which, according to Dr. Carpenter, find a much more accurate physiological expression in the "form, proportions, and general arrangement of the pseudopodial extensions" than in the definite *step-by-step* advance from the simplest condition of the body-substance, observable in the Foraminifera (in which there is only the faintest foreshadowing of any thing akin to reproductive organization*), to the intermediate stage, in which this foreshadowing shows itself in the shape of a centralized but still imperfectly aggregated mass, and, finally, to the highest stage, in which the reproductive gemmules assume the concrete form of a distinct specialized nucleus (the culminating point being marked, at the same time, by the association of the nucleus with a specialized respiratory organ,

* It was shown by me that the "*yellow cellules*" of MM. Claparède and Lachmann, or more or less colourless homologues of these "cellules," occur in the sarcode of all the Rhizopods without exception, that in the lowest order they are formed, as it were, from minute granules uniformly distributed in the sarcode, that in the second and third orders they are formed by the splitting-up of the nucleus (which is in these a specialized reproductive organ), but that in all three orders they constitute the *sarcoblast*, or, in other words, the earliest visible embodiment of the young organism. See Ann. & Mag. Nat. Hist., June 1863 (where these bodies are figured), Dec. 1863, March 1864; and Quart. Journ. Micr. Science, July 1865.

namely the *contractile vesicle*)—I venture to say that however plausible Dr. Carpenter's hypothesis may be, it finds no response in nature. And I maintain that we are furnished with the most complete proof that could be desired of the invalidity of the characters derived from the pseudopodia for purposes of ordinal classification, in the passage from Dr. Carpenter's own writings quoted at p. 164. At all events I confess that it is quite beyond my humble powers to reconcile the admissions there made on Dr. Carpenter's part with his allegation, already quoted, that "the sarcode bodies of his three types *Amœba*, *Actinophrys*, and *Gromia* present three distinct stages in the differentiation of the protoplasmic substance of which they are composed," and that "the lines of demarcation thus drawn are as precise as in any other great natural group, between the three aggregations of forms which assemble themselves round the three well-known types" above named.

But in order to prevent all misconception on this very important question, I must request attention to another extract from Dr. Carpenter's observations on the Systematic Arrangement of the Rhizopods (Nat. Hist. Rev. 1861, p. 461), where he states that "the ordinal designation *Reticularia* is meant to express the reticulose arrangement of the pseudopodial extensions, *which is its distinguishing character*." And again, at page 463, he says that "the radiating pseudopodia of *Acanthometra* correspond *precisely in all their characters* with those of *Actinophrys*, having the same rod-like tapering form, and same regular radiating arrangement, the same mutual isolation, the same slow movement of particles along their surface; some of them are, however, enclosed in *tubular* sheaths*, the differentiation of *Acanthometra* into ectosarc and endosarc having obviously proceeded further than in *Actinophrys*."

But although it is true that in *Acanthometra* the differentiation into ectosarc and endosarc *has* proceeded further than in *Actinophrys*, it is equally true that it has also proceeded further than in *Amœba*. But even stopping short at Dr. Carpenter's point, that it has proceeded *further* than in *Actinophrys*, how can this be reconciled with the statement that "the radiating pseudopodia of *Acanthometra* correspond

* It was pointed out by me years ago that the appearance of *tubularity* in *Acanthometra* is altogether an illusion. There is no such thing as a tubular portion in the structure of these organisms. See a paper "On the Process of Mineral Deposit in the Rhizopods and Sponges," Ann. & Mag. Nat. Hist., Jan. 1864.

precisely in *all* their characters with those of *Actinophrys*"? The fact is that the pseudopodia of no other Rhizopods could possibly present appearances more distinct from each other, both as regards habit and arrangement, than those of these two organisms.

From what has already been brought forward it will be seen, I think, that the question under discussion, namely the error of making *Gromia* the type of foraminiferal structure, is reduced within very narrow limits. In short, it resolves itself into this:—Is the practically imperceptible degree of organization, which Dr. Carpenter ascribes to the lowest or Reticularian order in his system, exemplified, as he pronounces it to be, in the type *Gromia*? Of course, if it be not so exemplified, and if it can be shown, on the one hand, that the so-termed typical pseudopodia of *Gromia* may be identical in all respects with the pseudopodia of the Foraminifera which Dr. Carpenter associates with *Gromia*, and, on the other hand, that *Gromia*, the reputed type of extreme primordial simplicity, besides having pseudopodia identical with certain Actinophryans, possesses both the *nucleus* and a *contractile vesicle* (which Dr. Carpenter allows to be distinctive of the highest degree of physiological development in the Rhizopod), there is, of course, on Dr. Carpenter's own showing, an end to his arrangement of these organisms on the basis upon which it has heretofore rested; and, what is more, there must be an end to every other classification of the Rhizopods which is based, in like manner with his, on characters derived primarily from the pseudopodia. There is no alternative, so far as I can see. And yet, as will presently appear, knowing these facts, Dr. Carpenter is quite unable to brace himself up sufficiently to make the necessary recantation candidly and ungrudgingly.

In my remarks "On the Distinctive Characters of *Amœba*" ('Annals,' Aug. 1863) it was mentioned that I had discovered a well-marked *nucleus* in *Gromia*, but had not, at that time, detected a contractile vesicle. In view, however, of the analogies existing between *Gromia* and the *Amœbæ*, so confident was I that the organ was there, that I expressed my conviction that I should speedily be able to trace the contractile vesicle also, adding that, if traced, the transfer of *Gromia* from the lowest to the highest order would of course be inevitable. Having for many months, both before and afterwards, spent many hours daily in watching the changes taking place in specimens of various genera of Rhizopods kept in tanks, I was fortunate enough in November of the same year to see the long-looked-for contractile vesicle in *Gromia*. This was announced in my "Further Observations on the Distinctive Characters and Reproductive Phenomena of the Amœban Rhizopods," published in the 'Annals' of Dec. 1863. And at a still later period, when I had managed to establish several colonies of healthy *Gromiæ* in my tanks, I had ample opportunities of verifying my earlier observations in a sufficient number of cases to render all further doubts on the subject inadmissible. I may add that my examinations embraced both freshwater and marine forms of *Gromia*, and that no material distinction presented itself between the characters of the two sets of specimens, beyond differences in size and colour, or, I should rather say, in the presence or absence of dirt on the otherwise nearly hyaline tests—the dirt being generally present on the freshwater form, and as generally absent on the saltwater one. After a time there was not the slightest difficulty experienced in finding plenty of sufficiently clean and hyaline tests to admit of the easy detection of the two organs under notice.

In the latest (1875) edition of 'The Microscope and its Revelations,' Dr. Carpenter takes a first cautious step towards a change of front, without, however, pointing out (as he might with a very good grace have done) that his entire classification was sapped to its foundations by the discovery that *Gromia*, whose *pseudopodia* he had declared to be precisely similar to those of the lowest and simplest known form of Rhizopod, possesses the two specialized organs which only make their appearance "in the cases in which the differentiation into ectosarc and endosarc has proceeded furthest." This omission will perhaps explain itself on the publication, side by side, of the two subjoined short extracts:—

1862. "Nothwithstanding the apparently unrestricted polymorphism of the pseudopodial extensions, it will be found that the Rhizopods present three *very distinct types of pseudopodial conformation*, to one or other of which they may all be referred, and that all the groups are *eminently natural*." (Introd. Study Foram. p. 15.)

1875. "To the first of the orders thus marked out, the name *Reticularia* seems appropriate; the second has been distinguished as *Radiolaria*; and the third may be designated *Lobosa*. It must be freely admitted, however, that these groups cannot be distinctly marked out, the *typical* examples which will now be described being connected by *many intermediate forms*. This is not to be wondered at, when the extreme indefiniteness which characterizes the lowest type of animal life is duly borne in mind." (The 'Microscope and its Revelations,' 5th edit. p. 467.)

Again, at p. 470 of Dr. Carpenter's work 'The Microscope,' referring to the *Reticularia*, he continues:—"There is, moreover, a negative character of much importance which is naturally associated with the absence of differentiation, namely the deficiency of the 'nucleus' and of the 'contractile vesicle,' that present themselves alike in the *Radiolaria* and the *Lobosa*. It is by animals belonging to this order that those very remarkable minute shells are formed which are known as *Foraminifera*. In *Gromia*, however, we have an example of a Rhizopod which *very characteristically* exhibits the Reticularian type in the disposition of its pseudopodia, but which Dr. Wallich was the first to point out possesses both a nucleus and contractile vesicle, thus showing a *transition* to the higher orders"! That is to say (at least if there is any meaning in words) that the presence of the very organs in *Gromia*, the absence of which he had in the same page declared to be "a *negative character of much importance, naturally associated with the absence* of differentiation" merely shows that it is a transitional form between the *very lowest* and the *very highest* of the whole series of Rhizopods!

But Dr. Carpenter's extreme reluctance to relinquish his published opinions even when they are demonstrated to be untenable is only on a par with the vehemence with which he is in the habit of enforcing his evidence when he has a theory to support. Referring to M. d'Orbigny (Intr. Study Foram. p. 63), he says:—"By M. d'Orbigny the family *Gromida* was altogether ignored, no member of it having been known when he first applied himself to the study of the Foraminifera, and no mention having been made in his subsequent writings, even of the typical genus *Gromia* described by M. Dujardin in 1835, notwithstanding the clear demonstration given by that admirable observer of its close relationship to *Miliola*." ... "Between the 'test' of *Gromia* and that of *Arcella*, indeed, there is little difference; but *between the animals which form and inhabit these 'tests' respectively, the difference is as wide as any known to exist in the whole Rhizopod series*"!

Lastly, as it is with the *Reticularia* of Dr. Carpenter, so must it be with the *Radiolaria*. Both of these ordinal designations presuppose the existence of characters on which not the slightest reliance can be placed; whilst they serve effectually to mask, if not entirely to supersede, those truly important characters by means of which the gradational advance from the most simple to the most complex type of Rhizopod structure can at a glance be recognized. Indeed, either ordinal name may with equal aptitude be applied to the families which are ranked in the other orders. Thus the name *Radiolarian* is just as appropriately applied to the pseudopodia of some of the "perforate" Foraminifera as to those of the *Polycystina*, which are placed by Dr. Carpenter in his second order, the *Radiolaria*, under the erroneous idea that they and the other families which he associates with them in that order possess both a nucleus and a contractile vesicle. *Actinophrys*, which he makes the type of this order, undoubtedly possesses both organs; but it is the only form in the *Radiolarian* order (as constituted by Dr. Carpenter) which is so gifted. It is consequently quite out of place elsewhere than in the third or highest order, in which every family, without exception, possesses both these organs. The *Polycystina*, on the other hand, do not possess a definite nucleus, their body-substance being almost identical in its degree of "differentiation" with the body-substance, for example, of *Orbulina*. It is quite unnecessary for me to point out that since the nature of the animal of the *Foraminifera* and of the *Polycystina* is to all intents and purposes identical, no valid objection to their association in the lowest of the orders into which the Rhizopods are divisible can with justice be based on the mere difference in the mineral constitution of their shells.

It is well to bear in recollection that Müller based his classification of the Rhizopods on the purely artificial difference between the naked and the shell-covered forms. His designation of "*Radiolariæ*" is certainly not retained therefore out of deference to the meaning which its propounder attached to it. But inasmuch as an attempt is being made to supersede the name of *Polycystina* given by Ehrenberg to these organisms by calling them *Radiolaria*, and, according to every rule of priority* and scientific usage, "*the name originally given by the founder of a group should be permanently retained to the exclusion of all other synonyms*," unless some good cause can be assigned for the change, I must say the procedure appears to be altogether unjustifiable. For if it be urged that the meaning lurking under the name *Polycystina* is misleading, what is to be said of the name of *Foraminifera* as applied to a *Miliola* or a *Lagena*?

The following is the classification of the Rhizopods which was appended to my paper on the Polycystina in 1865. I beg leave to submit it once more to naturalists without comment or modification of any kind, either in the tabular por-

* See "Rules for Zoological Nomenclature," authorized by Section D of the British Association, 1842. Reprinted by requisition of Section D at Newcastle, 1863, p. 9.

RHIZOPODA.

No definite nucleus. *No* contractile vesicle.		Definite nucleus. *No* contractile vesicle.		Definite nucleus. Contractile vesicle.	
1. HERPNEMATA *.		2. PROTODERMATA †.		3. PROTEINA ‡.	
Shell never siliceous.	Skeleton invariably siliceous.	Skeleton solid.	Skeleton tubular.	Pseudopodia monomorphous.	Pseudopodia polymorphous.
FORAMINIFERA.	POLYCYSTINA.	PLAGIACANTHIDÆ.	DICTYOCHIDÆ.	ACTINOPHRYNA.	AMŒBINA.
Lieberkuhnia? (Clap.).		ACANTHOMETRINA.		*Actinophrys.*	*Amœba.*
Pamphagus? (Bailey).		THALASSICOLLINA.		*Gromia.*	*Difflugia.*
				Lagynis.	*Arcella.*
				Euglypha.	*Pseudochlamys.*
				Cadium (Bail.).	
				Protocystis (Wal.).	
				Plagiophrys? (Clap.).	
		SPONGIDÆ.		INFUSORIA.	

* From ἕρπω, to creep and νῆμα, a thread.
† From πρῶτος, first or earliest, and δέρμα, skin.
‡ This name is adopted from the classification of MM. Claparède and Lachmann, inasmuch as the order so designated comprises the two families whose affinities they recognized, although on grounds which appear to me of very minor importance as compared with those now adduced.

tion or the general definitions. Owing to an oversight when the MS. was sent to press in 1865 the words "*monomorphous*" and "*polymorphous*" were omitted under the twice repeated word "Pseudopodia" in the third order Proteina. These have, therefore, been now inserted (see p. 171).

Order I. HERPNEMATA.—The Primary and Secondary characters of this order are as follows:—No definite nucleus. No contractile vesicle. Sarcode without any appreciable differentiation into endosarc and ectosarc, consisting of homogeneous viscid protoplasm, in the substance of which vacuolar cavities occasionally occur. Pseudopodia forming anastomoses, and exhibiting, both along the surface and within their substance, the phenomena of *pseudo-cyclosis**.

Order II. PROTODERMATA.—Definite nucleus present, but no contractile vesicle. Sarcode so far advanced in differentiation that the ectosarc constitutes a nearly hyaline stratum of greater tenacity than the endosarc, which still retains much of the general consistence of that of the Herpnemata. The transition, however, from endosarc to ectosarc is gradual. Here, as in the last-named family, vacuolar cavities occur. The pseudopodia, *when present*, are scattered and attenuated, rarely coalescing, for the most part rigid, but still highly contractile, and exhibiting in their interior and on the surface only such minute granules as find their way into the ectosarc. Pseudo-cyclosis manifest. Sarcoblasts conspicuous†.

Order III. PROTEINA.—A definite nucleus and, with it, a contractile vesicle; sarcode very highly differentiated into endosarc and ectosarc: the former granular, more or less nearly colourless, very viscid, and exhibiting but little contractility; the latter nearly hyaline and very contractile, but never assuming a membranous consistence, except during the period of encystation. Vacuolar cavities numerous and constant, seen principally to occur in the endosarc. Sarcoblasts abundant and frequent, but, owing to their pale colour, less easily detected than those of the oceanic Rhizopods‡.

It only remains for me to add:—that the above classification

* A term applied by me to indicate that there is no such thing in the Rhizopods as a circulatory movement of any kind, apart from the inherent contractile movement of the sarcode. If that ceases for a moment, the movements of the granules cease. See "Further observations on Amœban Rhizopods," Ann. & Mag. Nat. Hist. Nov. 1863.

† See page 165, *antè*, note. Sarcoblast was the name given by me to the "yellow cellules" of MM. Claparède and Lachmann, indicating their reproductive function, which these observers had failed to recognize.

‡ For the complete details of this classification I must refer the reader to the 'Quarterly Journal of Microscopical Science' for July 1865, in which they were first published.

is by no means put forth as perfect in all its parts, but simply as embodying what I conceive to be, for reasons already assigned, as close an approximation to a natural arrangement of the Rhizopods as the present state of our knowledge allows; and that, having done my best during the course of the past twelve years to test it whenever opportunities occurred, I have not been able to detect any serious flaw in it. It must nevertheless be accepted merely as an attempt to reduce the group of organisms in question to something like natural order.

Supplementary Notes.

Contractile vesicle.—It has always been urged by me that there is more reason for regarding the contractile vesicle of the Rhizopod as an organ whereby the effete residue of the watery fluid absorbed by the animal is first collected, and then discharged by an orifice in the vesicle, *extemporized* at the moment of extreme dilatation, than for regarding it as a circulatory organ. I may therefore be allowed to point out that although the nature of this organ was discussed by me in detail in the 'Annals' for December 1863, and it was there shown (both on the independent evidence of my friend Mr. Carter, and as the result of my own observations) that the contractile vesicle in *Amœba*, *Actinophrys*, and certain *Infusoria* discharges its contents at the immediate surface of the animal's body (my description of the process being accompanied by illustrative figures), Dr. Carpenter has not scrupled to say, at p. 472 of his work 'The Microscope' (5th Edit. 1875), that the nature of the process was for the first time "fully established by Dr. Zenker in 1867"—and this in the same page in which he shows that he was acquainted with my series of papers in the 'Annals' upon the Rhizopeds, in which the observations were recorded.

Noctiluca.—In the Report of the 'Challenger' Expedition, published in the Proceedings of the Royal Society, 1876, vol. xxiv. pl. 21, there are three figures which are described as representing "*true Diatoms*," to which the generic name of *Pyrocystis* has been given by the discoverers. I am, indeed, grievously mistaken if these structures bear the slightest affinity to Diatoms, or are any thing else than true oceanic *Noctilucæ.* It would be just as irrational to separate the testaceous from the naked Rhizopods, because the former have hard coverings and the latter have none, as to regard these new forms as distinct from *Noctiluca*, because they present a delicate siliceous wall. The figures of the elongate form, if accurate representations, as they doubtless are, show at a glance that the structure is *not* that of any Diatom.

Dictyocha.—In Dr. Gwyn Jeffreys's Report on the 'Valorous' Expedition (Proc. Roy. Soc., June 1876, p. 228), there is an account of some Diatoms examined by Professor Dickie, it being mentioned incidentally that along with these "were two *Polycystina*, namely *Dictyocha fibula*, Ehr., and *Dictyocha gracilis*, Ehr." With all deference to Prof. Dickie, I beg leave to point out that the *Dictyochidæ* are neither Diatoms, as they have been regarded by some writers, nor *Polycystina* as they would now appear to be regarded by others. They are *Rhizopods*, holding an intermediate place between *Thalassicolla* on the one hand, and the siliceous sponges on the other; and hence (as was long ago shown by me) they constitute the true connecting link between the Rhizopods and the Sponges. The basket-shaped framework of the *living Dictyocha* is never single, but invariably double, the concavities being placed face to face, and the two portions retained in position solely by the sarcode body, which fills and surrounds them. The distinct *nucleus* may always be seen, in recent specimens, suspended as it were in the middle of the sarcode, half within the boundary line of one framework, half within that of the other. The most remarkable feature, however, of *Dictyocha*, and the one which at once establishes its alliance with the siliceous sponges, is that *every* part of the siliceous framework is *tubular*.

BIBLIOGRAPHICAL NOTICES.

The Primæval World of Switzerland. With 560 Illustrations. By Professor HEER. Edited by JAMES HEYWOOD, F.R.S. &c. 2 vols. 8vo. Longmans & Co.: London, 1876.

The Geology of England and Wales. By HORACE B. WOODWARD, F.G.S. &c. With coloured Geological Map and numerous woodcuts. 8vo. Longmans & Co.: London, 1876.

ENGLAND and Wales have been said to exhibit an epitome of geology to the student of successive rock-formations and fossiliferous strata. From the oldest and lowest, or nearly lowest, known series of rock-masses, now much altered, to the latest or uppermost deposits of sea, lake, and river, some representative rock or layer is found in place, indicating period after period of the earth's history, as far as geologists can recognize its terraqueous existence.

Switzerland also presents an epitome of the geological history of the world—except, 1st, that the oldest portion of the record is obscured to a greater extent by the change of strata into crystalline rocks, and, 2ndly, the marine formations of the latest period are wanting in this inland region.

As different books of history, having the same basis of facts, vary in their style and appearance, treating the subject-matter broadly or succinctly—forming a simple plain volume, or appearing with sensational pictures and embossed binding, so the first-mentioned of our natural epitomes of geology has its leaves and chapters plain and unbedecked, carrying on the student quietly from stage to stage, with but few outbursts and disturbances of events; whilst the latter, beginning with the results of great changes and *bouleversements*, has often great events to speak of, fuller series of events to describe, and better-known communities of life to introduce to notice.

The mountains, gorges, valleys, lakes, and rivers of Switzerland astonish or vaguely interest the mere tourist, give studies of lights, shades, and distances to the artist, offer many problems in physics to the exact inquirer, and, while presenting difficulty after difficulty to the geologist, at the same time help him to unravel the intricate and solve the doubtful in their structure, and thus open out the succession of events, not only among these crumpled and riven mountains, but in the gradual formation and changes of strata all over the world.

After the long series of labours carried out by eminent savants, numerous geological sections have been drawn across Switzerland, and excellent maps have been constructed. The more easterly Alpine districts also have been explored and explained by these geologists. Prof. O. Heer, in the work before us *, illustrates the old geography and hydrography of Central Europe, and its old life-groups, during successive periods, from the Carboniferous to the Quaternary, taking the known stratal conditions and collected fossils as the basis of his animated descriptions and of the pictorial illustrations with which his work is ornamented.

The oldest and much-altered rocks are known as crystalline and metamorphic, and, although now schistose, gneissic, and granitic, are referable probably to the Devonian, Silurian, and Cambrian systems, if not to the Laurentian also. They form axial masses, longitudinal and otherwise, in many parts of the Alps, having been not only folded but intensely crumpled strata, low-seated, crushed, chemically altered, and ultimately forced to a higher position by the great lateral pressure to which the whole complicated mountain-mass or *massif* was subsequently subjected. They have been here and there exposed by the destruction of the overriding schists and strata; and then they stand out as peaks and ridges, or even great rounded bosses, according to their relative hardness, and according

* The Editor states that the German and French editions were both placed in the hands of W. S. Dallas, Esq., F.L.S., for translation, and that thanks are especially due to that gentleman for the care he has bestowed on natural-history details.

as their structure is massive or laminated. Of the seas in which these oldest rocks originated, of the life-forms inhabiting the waters and lands of their times, Switzerland gives no evidence. Their hidden story is to the rest of the geological record of the Alps what the mythic period is to any human history. Everyday affairs in the one, and organic and inorganic processes in the other, may have been conducted on the same principles as at present; but the details have been obscured and are irrevocable.

The strata formed in the Carboniferous period have in many places participated in the successive foldings and squeezings of the mountain-masses; and the coal has been changed into anthracite. Much, however, remains sufficiently unaltered, in the Lower Valais and elsewhere, to supply evidence that the crystalline rocks of the Central Alps had been raised above the sea at the Coal-period, that the corals and shells are those of the Mountain-limestone elsewhere, and that the jungles and forests, which were converted into seams of coal, consisted of the great trees of the Clubmoss family (*Lycopodiaceæ*), the gigantic Calamites, and the manifold Ferns, which grew so abundantly at that time in nearly every region of the world. In Chapter I. Prof. Heer discourses with knowledge on the origin of coal, and of analogous formations of peat, paper-coal, and lignite, and on some of the plants and insects found in the shales of the Coal-measures. The succeeding Permian (or Dyas) series is represented by red sandstone, with breccia, in the valley of the Sernft or Sernif. This rock, termed *Sernifite* by M. Heer, contains copper-ores, as usual with rocks of that age.

The Swiss *Saliferous formation* is the subject of Chapter II. Here the origin of rock-salt by the desiccation of shallow seas is briefly discussed, and the Swiss salt-works described. The fossils of the Muschelkalk and especially the fossil plants found in the Keuper (Plates II. & III.) are treated of.

Chapter III. elucidates the history of the Liassic strata (the *Black Jura* of the Germans) occurring at Schembelen in the Canton of Aargau. An analogous recent formation is described as taking place at the Gongulho, Madeira. What kind of creatures the Liassic fossils once were is shown by the study of the shells, crustaceans, fishes, seaweeds, land-plants, and insects. Among the last are Cockroaches, Grasshoppers, Earwigs, Termites, Dragonflies, 114 species of Beetles (comprising such as feed on wood, fungi, leaves, flowers, dung, and carrion, and on insects and other small creatures, showing the contemporary existence of a multitude of terrestrial organisms), also Water-beetles and some other insects. Figures of many fossils determined by M. Heer are given in Pls. IV.–VIII. Some comparisons are offered of the Liassic fauna of Switzerland with that in other countries. The extent of the marine areas of the Lias and their warm climate, the fertility of the Lias and its hydrocarbon products are also noted.

The Middle and Upper Jurassic Formations ("Brown" and "White Jura" of the Germans, "Oolites" of the English, &c.) are treated of in Chapter IV., which is full of interesting information as to Coral Islands, Coralline Limestone, and minute marine organisms of these old strata, with Sea-urchins, Ammonites, and other Shells, Turtles &c., and Seaweed. The Land-plants, Insects, and unique old Bird of the Jurassic period also occupy attention.

Together with a general table of the Swiss "Jura" (pp. 152–4), a more detailed account of the successive stages is given; also a rough chart of the Jurassic Sea in the European area, and some notes on the economic products of the Jurassic rocks.

In sketching the features and history of Central Europe during the Cretaceous Period, in Chapter V., M. Heer shows, with the help of another little map *, the changes which had taken place in the shape of the lands, from the alteration of levels and coasts. With these changes, in the course of ages, the fauna and flora also were greatly modified by variation of species or "transmutation of organic forms." The Cretaceous Cephalopods, carefully tabulated at pp. 183 & 185, are used as terms of comparison in showing the relationship of different Cretaceous areas in Europe. Other fossils are noticed, especially Seaweeds, Diatoms, Foraminifers, Echinoderms, Mollusks, &c. The distribution of Land Plants in the Cretaceous period is described with M. Heer's accurate knowledge of multitudinous specimens found in Europe, Greenland, North America, and Tropical Africa (Chargeh, west of Thebes).

The Eocene formation in Switzerland (Chapter VI.) comprises:—the curious Glaris slate, yielding many fossil Fishes, some Turtles and Birds; the *Flysch*, with its characteristic Fucoid remains and imbedded blocks of granite; the Nummulitic Limestone, containing an extensive marine fauna; and the local pea-iron-ore (Bohnerz), with mammalian bones.

The Miocene or Molasse Period of Switzerland (Chapter VII.) flourished when the land in what is now Central Europe had greatly increased, by the gradual uprising of the Alpine and other districts. Lakes had been formed, the recipients of much vegetable matter; volcanoes burst out here and there; and great accumulations of gravel were formed by mountain-torrents, and of shingle by the sea, during oscillations of land. The Miocene Flora, preserved in the lignites and plant-beds of the period, whether at home or in England, Greenland, Spitzbergen, or North America, has been a favourite study with M. Heer; so also has the Insect-fauna of the same period, at Œningen especially, where well-preserved remains of Mammals, Birds, Reptiles, Amphibia, Fishes, and other creatures also abound. These are vividly described in Chapters VIII.–XI., and comparisons are made with those of other countries. Descriptions of special localities rich in these fossils, and philosophic considerations on the probable climate of the Miocene Period, are also given. The principal results of this investigation are stated

* Like the Jurassic map above mentioned, and others that follow, this is an improved portion of one of the late M. Elie de Beaumont's palæogeographical European sketch maps.

(vol. ii. p. 147) in the following numbers, expressing approximately the temperature of the Miocene districts :—

A. *In the Earlier Miocene Epoch.*

	° Cent.	° Fahr.
1. Upper Italy (at 250 feet above the sea) had a mean annual temperature of ..	22	71·6
2. Switzerland	20·5	69
3. The basin of the Lower Rhine	18	64·4
4. The vicinity of Dantzig..............	17	62·6
5. Spitzbergen (78° N. lat.)	8	46·4

B. *In the Later Miocene Epoch.*

1. Sinigaglia	21	69·8
2. Upper Italy	20	68
3. Switzerland	18·5	65·3
4. Silesia (Schossnitz)	15	59

The Quaternary Period (newer than the Pliocene, which is not represented in Switzerland) has left the lignites of Dürnten and Utznach, formed after the Miocene strata had been tilted up with the flanks of the Alps. Their flora and fauna approximate closely to the groups now living; but the Elephant and Rhinoceros were inhabitants of Europe. Glacial sands, gravels, and blocks lie over the lignites, and lead us direct to such natural-history and physical conditions as now rule in the highest Alps. The chapter on "Glacial History" well describes these phenomena, and connects them with the hypothetical history of the great interval between the Quaternary Period and our own day.

Chapters XIV. and XV. conclude M. Heer's work with (1) a brief view of the succession of periods and their life-groups; (2) of the possible causes of the upheaval and depression of land during perhaps incalculable time; (3) of the results of these movements, as shown by Switzerland, both in the formation of strata and in the conditions of the surface as eroded by water, ice, and weather; (4) of the possible course of nature in "the remoulding of species," with regard to which, the author remarks, we are still in the dark, and which he does not consider the Darwinian theory competent to explain *.

Thus, with great skill and in a pleasant style, has the Rev. Dr. O. Heer epitomized the geological history of Switzerland, and much of Europe at the same time, keeping before us the great features of

* The editor has appended, pp. 295–302, Prof. Rütimeyer's description (with woodcut) of a group of pointed sticks and wattle or basketwork, found in an Interglacial lignite at Wetzikon, and regarded as the handiwork of primæval man. He has also given, p. 303, a comparison of English and Continental measures, weights, and thermometric scales, for the use of the student.

land and sea, faunas and floras, however much they shifted from age to age—as the scenes of a theatre, or the pictures of a magic-lantern, change under the skilful guidance of the manager, to illustrate the various turns of a story or a whole series of historic events.

Woodward's 'Geology of England and Wales' is another good book epitomizing geological history—but in this case by referring mainly to facts relating to inorganic nature, such as the various successive strata in their order, and not as to the extent and conditions of their areas of formation, and referring to fossils only as the distinctive coinage of each period, preserved in the strata, and not as directly suggestive of the animated features of the faunæ and floræ once occupying the long-since wasted regions.

After a lucid Introduction, treating of the meaning, objects, and methods of Geology, the author proceeds to describe each formation in detail, as to its topography, lithological characters, thickness, leading fossils, and economic productions. The Malvern gneiss and some other very old rocks of doubtful age serve as the basis of the Laurentian section; and the other formations follow in order, from the Cambrian (treated in the Sedgwickian sense) to the Quaternary gravels and brick-earths. The Igneous and Metamorphic rocks and Mineral Veins are separately noticed (Chapter XII.). Springs, Swallow-holes, Tufa, Caverns, Landslips, Blown Sands, Submarine Forests, Peat, Soils, and "Grey Wethers" are all briefly considered. Denudation and Scenery, and the Sections exposed by the chief Railways, are also treated of in Chapter XIII., well worthy of study. Chapter XIV., on "Geology in the Field" and other matters, should be read in connexion with the Introduction (p. 1).

Mr. Woodward's work is careful and conscientious; and he shows a healthy desire to refer directly to originators of theories and discoverers of facts; though sometimes a ready reference to the writings of his colleagues in the Memoirs of the Geological Survey has hindered his doing justice to more original notices—for instance, in the case of Swallow-holes in the Chalk, at p. 346, and the "Grey Wethers" at p. 364. Conciseness has been successfully aimed at; and yet the amateur, student, and professor will each for himself find a rich mine of facts and inferences in the short chapters of this compendious and well-conditioned book. A glossary of geological terms, a synopsis of the animal kingdom, having especial reference to fossil forms, bibliographical lists, and an excellent index satisfactorily complete the work.

In conclusion, we heartily recommend these works by Mr. Oswald Heer and Mr. Horace Woodward to geologists wishing to find the position and nature of the strata and the natural history and geography of the times of their formation. There are many points of geological detail, perhaps in every chapter of each book, that are not yet quite settled, or that at least may be further elucidated with advantage; there are omissions too, which the author's line of thought, or the plan of his work, or want of space, did not allow of being filled up; but the general truth of the deductions is none the less for such slight imperfections. If all is not, and cannot be, yet known about transmutation of species, the great changes of climate, the origin and metamorphism of rocks, and the antiquity of man, yet the main outline of geological history has been fairly sketched to the satisfaction of inquiring minds, and is suggestive of some of the grandest ideas of which the mind of man is capable.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 6, 1876.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

Supplemental Note to a Paper "On the Structure, Physiology, and Development of *Antedon* (*Comatula*, Lamk.) *rosaceus*." By William B. Carpenter, M.D., F.R.S.

Since my communication of the above-cited Paper to the Royal Society on the 16th December, 1875, two important contributions to the Anatomy of *Antedon* have appeared—one by Dr. Ludwig, chiefly based on his study of *Antedon Eschrichtii* ("Zur Anatomie der Crinoiden," Zeitschrift für wissenschaftliche Zoologie, Bd. xxvi. 1876, p. 361, continued in Nachrichten von der Königl. Gesellschaft der Wissenschaften und der G. A. Universität zu Göttingen, No. 5, Feb. 23, 1876), and the other by Prof. Greef, of Marburg (Sitzungsberichte der Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg, January 1876), both of which seem to have been prompted by the appearance of Professor Semper's short paper on the subject. These able observers fully concur with me, as to all essential particulars, in the account I have given of the triple canal-system of the arms, which M. Edmund Perrier not only could not himself find, but ventured to predict that no one else would find; in fact, Professor Greef's figure of a transverse section of an arm might have been copied from one of the drawings I have had by me for more than ten years, save for one slight additional feature. The German investigators also accept the correctness of the statements made by me in my First Memoir, that the "nerve" of Müller is really the genital rhachis, and that Müller's "vessel" in the arms is solid, not tubular—though neither is disposed to believe with me that this "axial cord" is a nerve. The character of a nerve, on the other hand, is assigned by Ludwig to a fibrillar band lying beneath the epithelial floor of the ventral furrow of the arms; which band had been independently noticed by my son, Mr. P. H. Carpenter * (who is at present working in the laboratory of Professor Semper at Würzburg), in two of Professor Semper's Philippine species, *Actinometra armata* and *A. nigra*, as also in *Antedon Eschrichtii*, in which it had been previously discovered by Ludwig. It is not nearly so distinct, however, in *A. rosaceus*; but its existence in that species was also independently recognized by Professor Huxley, who, like Ludwig, was led by his general view of the homologies of the Crinoids to regard it as a nerve. My son regards both the ventral band of Ludwig and my "axial cord" as belonging to the nervous system, being led to that conclusion, as regards the former, by its homology with the radial nerves of other Echinoderms, and, as regards the latter, by the very definite branching he has discovered in the axial cord of the arms of *Actinometra armata* and *A. nigra*—two pairs of branches running on each side towards the dorsal surface, and two towards the ventral, where he has distinctly traced their ramifications as far as the leaflets bounding the ventral furrow. Prof. Greef, on the other hand, describes the whole epithelial floor of the ventral furrow as a nerve, on the ground that its histological character resembles that of the nerves of other Echinoderms.

Having recently had an opportunity of examining at Würzburg the very thin sections prepared by my son, I can say with certainty that the fibrillar band is quite distinct from the layer of columnar epithelium which it underlies; but it appeared to me to send off very minute fibrils that pass up between the cells of which that layer is composed.

To myself it appears by no means improbable, looking alike to its position and to its histological characters, that this band is a nerve; but having regard to its immediate proximity to the sensory (ventral) surface, and to its separation from the muscles by the interposition of the triple canal-system, I cannot but think it more likely that it is functionally related rather to the former than to the latter—in other words, that it is an *afferent* rather than a *motor* nerve.

As it seemed to me that important evidence might be obtained on this point from experiments made on the living animal, I took the opportunity afforded by my recent visit to the Zoological Station at Naples to institute such experiments; the results of which I am desirous of appending to my paper, as they seem to me to place the doctrine advocated in it beyond reasonable doubt.

Every one who has had the opportunity of observing the habits of the living *Antedon* well knows the peculiarly rhythmical and symmetrical swimming action which it executes when it spontaneously leaves or is detached from the anchorage afforded by the grasp of its dorsal cirri. Each of its five rays divaricates into two arms, which may be characterized (like the two legs proceeding from the human trunk) as the *right* and the *left* respectively; and the act of swimming consists in the alternate

* "Remarks on the Anatomy of the Arms of the Crinoids," in the Journal of Anatomy and Physiology for April 1876, p. 571.

consentaneous advancement of the *five right* and then of the *five left* arms, each of which is bent forwards in a curve which resembles that of the swan's neck in its graceful arch, and is then straightened backwards. The perfect similarity of the movements of all the five arms that work together, involving the conjoint contraction of several hundred pairs of muscles, seems to me to point almost certainly to coordination through a nervous centre; and it will be seen that experiment has fully confirmed that conclusion.

It will be recollected that the centre of what I regard as the motor nervous system is the quinquelocular organ contained in the centro-dorsal basin, which Müller (who did not recognize its cavitary subdivision) characterized as a heart. Müller's view of its nature is still upheld by Greef (*loc. cit.*), who says that it gives off vessels to the cirri, and regards what I have described as a circular commissure (analogous to the "circle of Willis") as a closed blood-vascular system in connexion with this, although he admits that the axial cords of the arms, which are derived from this ring, are solid. The careful and repeated investigations I have made on this point, however, have fully satisfied me that my previous statement was correct. There is no passage whatever out of the chambers into the axial cords either of the cirri or the rays; and in the pedunculate Crinoids, as in the early Pentacrinoid stage of *Antedon*, there is no ventricular dilatation, the solid radial cords directly arising from the axis.

Experiment 1.—Taking up a large and vigorous specimen of *Antedon*, I turned the entire visceral mass out of the calyx, leaving behind it, therefore, as the *centrum* of the animal, only the calcareous segments of the calyx with their muscles and ligaments, the centro-dorsal basin with its cirri, and the five-chambered organ contained in the cavity of that basin. On replacing the animal in the water, *it executed the usual swimming movement as perfectly as the entire animal had previously done.*

Experiment 2.—I removed from a second specimen, which I took out of the water in the act of swimming, the entire centro-dorsal basin, with its contents and appendages, leaving every other part as it was. On replacing the animal in the water, *all the arms were rigidly straightened out*, apparently by the action of the elastic ligaments, which the muscles were powerless to antagonize.

This second experiment, then, not only confirmed my previous belief that the source of the perfect coordination of the swimming movements lies in a Nervous centre, but seemed to establish beyond doubt that the quinquelocular organ is the instrument of that coordination—the centre of a Nervous system, whose peripheral portion consists of the axial cords of the rays, arms, and pinnules. On the other hand, the first experiment, taken in connexion with the second, clearly shows that nothing contained in the visceral mass is essential to the perfect coordination of the swimming movements. And since it is clearly in the oral ring that we should expect to find the centre of any nervous system lying immediately beneath the tentacular furrow, it seems to me fair to conclude that the supposed "nerve" of Ludwig, if a nerve at all, has no immediate relation to those movements.

Experiment 3.—I divided, in another lively specimen of *Antedon*, the soft parts of one of the arms down to the calcareous segment, thereby cutting through the "nerve" of Ludwig. This ought, on his supposition, to paralyze the arm so treated, or at any rate to destroy the consentaneousness between its movements and those of the other arms. But on replacing the specimen in water, *all the arms worked as usual*, without the slightest disturbance of regularity.

Experiment 4.—I then endeavoured to make a corresponding section of *my* nerve, the "axial cord," by cutting from the dorsal side of the arm, with the blade of a very thin knife, sufficiently deep between the segments to divide that cord without injuring the "nerve" of Ludwig. Having been repeatedly baffled in this endeavour, however, by the throwing-off of the half-divided arm, I had recourse to another method, the application of nitric acid. Carefully drying with a bit of blotting-paper the part to be thus burned away, so as to prevent the spreading of the acid, I applied it with a finely pointed camel-hair pencil, until I had reason to feel sure that it must have reached the axial canal. On replacing the animal in the water, *that arm remained rigidly stretched out, while all the other arms worked as usual.*

Now if these experiments, taken in connexion with the one described in my Paper, which I have again repeated with the same result, are not admitted as valid evidence that the quinquelocular organ with its radiating cords constitute a Nervous system, I am at a loss to understand what is the superior probative force of the evidence which is universally held to justify the assignment of such functions to the Brain, Spinal Cord, and the white solid cords proceeding from these centres in a Vertebrate animal. And I should feel it necessary to enter a strong protest against the refusal of a similar character to what I hold to be the Nervous system of the *Crinoida* (if based on no other objection than that its position does not correspond with that of the accredited Nervous system of other Echinodermata), were it not that an investigation which I commenced seven years ago into the structure of the *Ophiurida* showed that they will probably afford the means of bridging over this difficulty; for the calcareous segments of their arms, instead of being perforated by a central canal, have a deep notch on their ventral margin, which is sometimes almost completed into a canal; so that there is here an easy passage on the one hand towards the *ventral* nerve-cord of the *Asteroida*, on the other towards the *central* nerve-cord of the *Crinoida*. Further, it is to be borne in mind that in the early stage of the development of the Pentacrinoid larva of *Antedon*, as described in the First Part of my Memoir (Phil. Trans. 1855), the "axial cords" lie on the *ventral surface* of the Radials and Brachials, which are then mere flat plates: by an endogenous thickening of the calcareous network of those plates, the axial cords come to lie in *furrows* channelled out in their ventral surfaces; while by a further endogenous growth of that network these ventral furrows are completed into *canals*; and it is by a still further endogenous thickening that these canals finally come to occupy the *centre* of each Radial and Brachial calcareous segment.

At the same time I would repeat that I see no reason for refusing to believe that the subepithelial band of Ludwig is a sensory nerve, the functions of the single trunk of the *Asteroida* being here divided between two, an afferent and a motor, just as, in Man, the double function of an ordinary spinal nerve is divided in the head between the 5th and 7th pairs. And it seems not unlikely that while the "axial cords" (motor nerves) of the arms are derived from the peripheral part of the Crinoidal axis, the "ventral bands" (sensory nerves) are derived from the central part of that axis, which has been shown to be continued, as the "axial prolongation," to the oral ring.

June 15, 1876.—Dr. J. Dalton Hooker, C.B., President, in the Chair.

Preliminary Note on the Structure of the Stylasteridæ, a group of Stony Corals which, like the Milleporidæ, are Hydroids, and not Anthozoans. By H. N. Moseley, Naturalist on board H.M.S. 'Challenger.'

On 14th February, 1876, in lat. 37° 17′ S., long. 53° 52′ W., off the mouth of the Rio de la Plata, the trawl brought up from 600 fathoms a number of specimens of corals of the family Stylasteridæ (Gray *). The specimens included six genera of the family, and seven species. They were all in most excellent preservation, notwithstanding the fact that they had been slowly raised from 600 fathoms; and all had their generative organs in full development. An opportunity which had long been desired was thus afforded for making a detailed examination of the structure of the soft parts of this family, which, in the structure of its coralla, shows so many points of variance from that of Zoantharian coralla. From observations made on a species of *Stylaster* obtained from 500 fathoms off the Meangis Islands, and on a *Cryptohelia*, a short account of which is given in the Royal Society's 'Proceedings,' vol. xxiv. p. 63, I had already been led to suspect that the Stylasteridæ might prove to be Hydroids—although I did not venture to express this opinion, because the evidence was then insufficient. The examination of the series of forms obtained off the Rio de la Plata at once showed that the Stylasteridæ are true Hydroids.

Unfortunately the trawl came up rather late in the day, and hence a very short period of daylight was available for the examination of the animals in the fresh condition; but it sufficed for

* Ann. and Mag. Nat. Hist. vol. xix. (1847).

the sketching of the male gonophores of a new genus of Stylasteridæ (*Polypora*), with the stages of development of the spermatozoa, and of the female gonophores of *Cryptohelia*.

Portions of the corals were preserved by means of chromic acid, osmic acid, absolute alcohol, and glycerine; and they were subsequently examined in the usual manner by means of sections. In cutting the sections, a new method, described by Mihakowics, 'Arch. für mikroskopische Anatomie,' ii. Bd. 3 Hft. p. 386, was adopted, and found to yield most astonishingly successful results. The method seems to supply a want long felt of a means of cutting fine sections of structures the parts of which are very loosely held together, and where it is desirable to maintain the exact relations in position of parts which in the sections often become entirely disconnected from one another. Mihakowics used his method for sections of vertebrate embryos; it is certainly the best possible method for the investigation of decalcified tissues, such as those of Corals or Echinoderms. A strong jelly, composed of equal parts of glycerine and gelatine, is used as an imbedding substance; it permeates the tissues, and takes the place of the hard calcareous supporting structures which have been removed by the acid. The sections are mounted in glycerine, and the imbedding substance, which is left *in situ* in the sections, becomes perfectly transparent, in fact almost invisible in this fluid. I stain the decalcified corals with carmine, then soak them in glycerine, and then transfer them directly to the warm fluid jelly, instead of treating them first with absolute alcohol after staining, as does Mihakowics. A teaspoon heated in hot water is a most convenient instrument for transferring the small masses of tissue, with the fluid jelly, to the cavities in the hardened liver used as an imbedding base. I have dwelt upon this method because it seems to me likely to be one which will prove of the greatest service in all kinds of difficult histological problems, such as Corti's organ, early stages of embryos, retina, &c. It is quite possible by the method to obtain sections of a single hydroid sporosac or planula.

The Stylasteridæ obtained off the Rio de la Plata comprised six genera, viz.:—*Stylaster*; *Cryptohelia*; *Allopora*; *Errina*; a new genus, *Polypora*; and a further new genus allied to *Errina*, which I propose to term *Acanthopora*. There is much confusion as to the determination of even the genera of the Stylasteridæ, and I have found it impossible to determine species in the absence of specimens for comparison. The *Stylaster* appears probably to be *S. erubescens* of Pourtales*. The *Cryptohelia* is the same as that obtained all over the world by the 'Challenger' in deep water, and apparently not specifically distinct from *C. pudica* †. Of the *Allopora* I cannot determine the

* Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College. No. IV. Deep-Sea Corals. By L. F. de Pourtales. Cambridge, Mass. 1871, p. 34.

† Hist. Nat. des Coralliaires, par MM. Milne-Edwards et J. Haime, t. ii. p. 127.

species. There is one coral which appears to belong to the genus *Errina*, Gray *, of which a further diagnosis is given from the type specimens by Saville Kent †, and one of the allied new genus *Acanthopora*. The whole of the classification of the Stylasteridæ will need revision on the more certain basis of the knowledge of the structure of the soft parts. In the older regions of its stem *Lepidopora* appears to assume the character of a *Stylaster*. The coral for the reception of which I form the new genus *Polypora* differs markedly from other members of the family; I at first took it to be a *Millepora* with unusually large zooids.

The genus may be thus characterized, as far as the hard parts are concerned:—

Genus Polypora.

Corallum pure white, composed of a finely reticular but compact cœnenchym. It forms single, stout, vertical stems, usually compressed from before backwards, so as to be oval in transverse section. The stem gives off a limited number of irregularly dichotomous branches, which are flattened like the stem from before backwards, and tend to coalesce by their lateral margins and assume a flabellate form, which is sometimes somewhat curved. The surface of the corallum is perfectly even and smooth, and pierced by deep calicular cavities, simply circular in outline, and of two kinds, large and small. The larger less numerous calicles are disposed at irregular intervals over the surface; they are very deep, reaching nearly to the centre of the axis of the branch or stem, and contain a deep-seated, very long, and slender style with a brush-like tip. The more numerous smaller calicles vary in size; they are thickly disposed between the larger ones; they have no style. Seated beneath the surface between the calicles are numerous ovoid cavities, the ampullæ, which in this genus do not project; at certain stages of development these communicate with the exterior by minute irregularly shaped pores, seated in small shallow pits on the surface of the corallum. The calicles are usually more abundant on one face of the corallum than on the other, especially in its older basal region.

Type of the genus *Polypora dichotoma*.

Dimensions of the specimen:—Height of the corallum from $1\frac{3}{4}$ to 1 inch; breadth of fan 6 inches; diameter of stem from $1\frac{3}{4}$ to 1 inch; diameter of the mouths of the larger calicles $\frac{1}{50}$ of an inch.

A further examination of the species of *Stylaster* obtained off the Meangis Islands was made in connexion with that of the corals referred to above. This *Stylaster* resembles *Cryptohelia* in every particular, excepting that it has not the peculiar lid in front of its calicles. It will have to be separated from the other *Stylasters*, and placed in the genus *Cryptohelia*.

* Proc. Zool. Soc. 1835, p. 35. † Proc. Zool. Soc. 1871, p. 282.

Structure of the soft parts of the Stylasteridæ.

In all the Stylasteridæ examined there is present an abundant cœnosarc, made up, as in the Milleporidæ, of a network of anastomosing canals, composed of an endoderm and ectoderm, and ramifying in corresponding canals in the spongy trabecular calcareous cœnenchym. In *Polypora* the meshes of the network are comparatively close; in all the other genera examined far more widely open. In *Cryptohelia* and the *Stylaster* from off the Meangis Islands, in which the calicles appear as swellings seated upon slender connecting branches, bundles of larger canals traverse the axes of these branches, and connect the zooid groups of the several calicles with one another. A continuous layer of tissue, as far as has yet been seen without cellular structure, but containing thread-cells, covers the external surface of the cœnosarc in all the genera. In all the Stylasteridæ there are two kinds of zooids, as in *Millepora*; the larger and less numerous have mouths and a special layer of digestive cells lining their body-cavity. The more numerous smaller zooids have no mouths and no gastric cells. The alimentary zooids are short and cylindrical; the smaller or tentacular zooids long and tapering. The alimentary zooids in *Stylaster erubescens* have eight tentacles; in *Cryptohelia*, and in the *Stylaster* so closely resembling it, they are devoid of tentacles. In *Allopora* they have twelve, in *Errina* four, in *Acanthopora* six, in *Polypora dichotoma* four. In *Polypora*, in which the tentacles of the alimentary zooid were examined in the fresh condition, the tentacles were seen to be clavate, the heads of the tentacles being somewhat elongate, not spherical as in *Millepora*. I am as yet uncertain whether these tentacles are clavate in the other genera. The point is difficult to determine in the extremely contracted condition of the organs in reagents. The tentacles of these alimentary zooids are very short; they are placed in a single whorl at the base of the broadly conical hypostome. In *Cryptohelia* and in the allied *Stylaster* the tentacleless alimentary zooids are flask-shaped, with a conical projecting hypostome, as seen by Sars *. The rounded bottoms of the zooids are blind and unconnected with the cœnosarcal canals; but a series of canals radiate upwards from the sides of the flask to branch and join the network above. The smaller zooids I have termed tentacular zooids, because, though invariably devoid of tentacles themselves, they have the form of the simple elongate tentacles, and evidently must perform a tentacular function. In *Polypora*, *Errina*, and *Acanthopora* these tentacular zooids are dispersed irregularly amongst the alimentary zooids; in *Cryptohelia*, *Stylaster erubescens*, and *Allopora* they are arranged in a circlet around a centrally placed alimentary zooid in each so-called calicle of the corallum. The bases of these zooids communicate by large vascular offsets with the general network of the cœnosarc. The cavities of the alimentary zooids are four-rayed in transverse section, and in *Polypora* they divide at their base into four large vascular trunks, which

* Forh. Selsk. Christ. 1872, p. 115.

subdivide to join the cœnosarcal meshwork. The cavities of the tentacular zooids are circular in transverse section. Both kinds of zooids are provided with strong circular and longitudinal muscles, which form wide conspicuous bands beneath the ectoderm. The alimentary zooids are situate on the summits of the styles of the corallum, where these are present. In *Polypora*, in the retracted condition of the zooids, the styles traverse the axes of the zooids from below for at least two thirds of their length. In *Polypora*, *Errina*, and *Acanthopora* the zooids of both kinds are retracted within long sacs, the cavities of which communicate with the surrounding network of the cœnosarc by a series of radially disposed canals, which canals in transverse sections of the zooids have at first sight exactly the appearance of a system of mesenteries. In *Cryptohelia* and the *Stylaster* so closely resembling it the alimentary zooids, lying as they do deep in the calicles, are probably never far protruded. The tentacular zooids are partly retracted between the pseudo-septa, partly doubled down within the calicles when the colony is in the retracted condition. In the other *Stylasters* and in *Allopora* the conditions are much the same. Two kinds of thread-cells are present, large and small: the large are of the slightly curved cylindrical form, and emit a thread with an elongate enlargement upon it near the sac, beset with a spiral of spines; these larger cells are mostly gathered together in nematophores, which are disposed irregularly amongst the zooids in *Polypora*, regularly in the intervals between the tentacular zooids at the margins of the calicles in *Cryptohelia* and the *Stylaster* resembling it. The smaller kind of thread-cells are of an ovoid form, slightly flattened on one side; they occur in the tentacles of the alimentary zooids, and form a closely set covering over the entire external surfaces of the tentacular zooids. No three-spined thread-cells, like those occurring in *Millepora*, exist in the Stylasteridæ. Reproduction takes place by means of adelocodonic gonophores, which are produced as buds from the cœnosarcal network without having any other connexion with the other zooids. They occupy in the corallum the ampullæ which in *Polypora* are concealed beneath the even external surface of the corallum, but in the other genera of Stylasteridæ show themselves as rounded prominences on the surface of the coralla, being specially prominent in *Errina* and *Distichopora*. The Stylasteridæ are all diœcious. Females only of *Errina* and *Cryptohelia** have been examined, and males only of the other genera. The generative elements of *Acanthopora* were not observed at all. In the males of *Polypora* the gonophores present the usual structures occurring in Hydroids; they are simple ovoid sacs, with an axially placed spadix, and resembling in all respects those, *e. g.*, figured by Allman from *Laomedea flexuosa*†.

* Off Japan last year a small fragment of what, at the time, I determined to be a male *Cryptohelia* was obtained by the dredge. I unfortunately cannot now refer to the specimen.

† 'A Monograph of the Gymnoblastic or Tubularian Hydroids,' by G. J. Allman, M.D. &c., Ray Soc. part 1, p. 65.

The gonophores are sometimes single in the ampullæ, sometimes in groups of two or three arising from a common base with their contents in various stages of development. The ripe spermatozoa are precisely similar in form to those of *Garveia nutans**. In *Allopora*, *Acanthopora*, and *Stylaster erubescens* the male gonophores have a similar structure. In the *Stylaster* allied to *Cryptohelia* the male elements are developed in a series of sacs, which encircle the calicle, often in a double row. The sacs spring from the cœnosarcal network; they contain numerous smaller globular cysts, attached to a common basal endodermal tissue. These cysts are some of them filled with ripe spermatozoa, others with spermatic cells in various stages. The female gonophores are, in *Errina*, simple, *i. e.* each ampulla contains only a simple ovum or embryo. In *Cryptohelia* large sacs are present at the sides of the calicles, which contain ova and embryos in all stages of development. Only a single sac of the kind is developed in relation with each calicle. In both genera the spadix in its earliest stage is cup-shaped, the cup having fitted into it an ovum with germinal vesicle and spot well marked. The ova early lose the germinal vesicle and spot, and develop into very large planulæ, in the same manner as, *e. g.*, those in *Laomedea flexuosa*†. In *Errina* the planulæ are more ovoid in form than in *Cryptohelia*, in which they are long and worm-like, measuring $\frac{1}{8}$ of an inch in length. They have a thick transparent ectoderm, abundantly supplied with the larger form of thread-cells. The spadix in both genera, as the development of the ovum proceeds, becomes divided at its margin into a series of lobes, which lobes subdivide and encroach over the surface of the ovum until more than half the proximal surface of the ovum is thus embraced by the cup of the spadix. The lobes of the margin of the spadix appear just like developing tentacles; and the spadix of *Cryptohelia* was at first supposed to be a developing actinula. The outer, thin, perforated calcareous walls of the ampullæ in *Errina* appear to get thinner as development of the embryo advances, until they fall away or are absorbed altogether, and give free exit to the planula. In *Cryptohelia* the planulæ probably escape through the mouths of the calicles. The endoderm, spadices, &c. are coloured red by a colouring-matter, soluble in spirit, insoluble in glycerine, in *Polypora*, *Cryptohelia*, and *Errina*. In the *Stylaster* resembling *Cryptohelia* the coloration is dusky green. The green colouring-matter is soluble in spirit, and yields an absorption-band in the spectrum. In *Polypora* the living layer of cœnosarc set free by decalcification is very thick, not merely a thin superficial film as in *Millepora*; indeed all but the most central axial regions of the branches of the corals are in active life. In the other genera the whole of the coral appears to maintain its vitality, there being no dead region represented by a cavity after decalcification.

* 'A Monograph of the Gymnoblastic or Tubularian Hydroids,' by G. J. Allman, M.D. &c., Ray Soc. part 1, pl. xii. fig. 9.

† Allman, *l. c.* p. 86.

Conclusions.

Since the observations of Prof. Sars* on the polyps of *Allopora oculina* it has been to some extent suspected that the Stylasteridæ were not Anthozoa, but possibly allied to the Milleporidæ, although the fact was not in any way demonstrated. Milne-Edwards long ago expressed himself extremely uncertain as to the affinities of *Distichopora*, and suspected that it might be an Alcyonarian†. In consideration of the facts now ascertained, there can be no doubt as to the hydroid affinities of the family. The Stylasteridæ appear to form a very natural family. They all possess two kinds of zooids. The tentacular zooids are closely similar in form in all the genera; and in the variations in the forms of the alimentary zooids all gradations are present. The thread-cells appear to be alike in form in all the genera. In all the gonophores are developed within ampullæ. The corals all bear, as far as has yet been ascertained, fixed sporosacs, as do, according to Allman, all deep-sea Hydroids‡. It is possible, however, that forms such as *Stylaster sanguineus* occurring in shallow water§ may bear planoblasts. There can be no doubt that *Distichopora* will prove closely allied to the other six genera of Stylasteridæ: its well-marked ampullæ and two kinds of pores are decisive in the matter. *Pliobothrus* is said by Pourtales|| to have ‘occasional round cavities in the centre of its branches filled with a yolk-like substance contained in a membrane.” These cavities seem to be ampullæ; and if so, then *Pliobothrus* may prove to belong to the Stylasteridæ, and not to the Milleporidæ. In a specimen of *Pliobothrus* obtained by the ‘Challenger’ I have been able to detect neither ampullæ nor tabulæ. It will evidently be possible easily to form natural genera for the Stylasteridæ characterized by the number of tentacles of the alimentary zooids, grouping of the tentacular zooids around them, &c. This I propose to attempt when I have completed my study of the subject.

The Milleporidæ differ from the Stylasteridæ in having tabulæ, and in possessing neither styles nor ampullæ, as well as in having their mouthless zooids provided with numerous tentacles. The two families have, however, many points of alliance, and they should, provisionally at least, be referred to a special suborder of the Hydroidea, which may be termed the Hydrocorallinæ.

A most remarkable result of the present inquiry is the determination that the calicles of *Stylaster* and *Cryptohelia* are tenanted and formed by colonies of zooids, and not by single polyps, as was most naturally hitherto supposed to be the case. Prof. Verrill, in criticising Prof. Agassiz's relegation of the Rugosa

* Sars, Forh. Selsk. Christ. 1872, p. 115.

† MM. Milne-Edwards and Haime, *l. c.* t. iii., Appendice, p. 451.

‡ Allman, *l. c.* vol. ii. p. 155; also ‘Nature,’ Oct. 28th, 1875, p. 556.

§ Pourtales, *l. c.* p. 83.

|| Pourtales, *l. c.* p. 57.

to the Hydroidea*, dwells on the utter impossibility of Acalephs forming corals with distinct septa; yet in *Cryptohelia* and the *Stylasters* septa are present in the corallum, which in many cases so closely resemble those of Zoantharian corals that these corals were placed by Milne-Edwards in the Oculinidæ, and the septa were never suspected to be pseudo-septa until Sars† observed that in *Allopora oculina* the tentacles (tentacular zooids) were situate between the septa, and not upon them. I should not have detected the compound nature of the calicular groups in *Stylaster* had I not been led up to the fact by the examination of other genera of the family, in which the tentacular zooids are widely separated from the alimentary ones. The determination of the compound nature of the calicular groups at once explains the otherwise very anomalous arrangement of the pseudo-septa in many Stylasteridæ. The condition existing has been described‡ as a "tendency of the septa to unite by their inner edges and enclose in the interseptal chamber thus formed the septa of a higher order." The real explanation of the matter is that the apparent interseptal chambers are the pores or calicles of the tentacular zooids. In those species in which the tentacles are removed from harm's way in the retracted condition of the coral by being bent inwards down into the wide cavity containing the alimentary zooid (calicular cavity), these pores have their walls incomplete on the side nearest to the calicle, and take the form at their mouths of elongate slits, in order to allow of this inward inclination of the contained tentacular zooid when at rest, or when feeding the deeply seated alimentary zooid. The supposed included septa of higher order are the styles of the tentacular zooids. In some forms of the family these styles are brush-like in shape, just like the central styles of the alimentary zooids; they have this form in *Allopora miniacea* §, and less markedly in *Stylaster complanatus*, Pourt.‖ In some Stylasteridæ, as *e. g.* in *Stylaster amphihelioides*, S. Kent ¶, there is no appearance at all of pseudo-septa. The pores of the tentacular zooids are simple circular-mouthed pits, arranged in a circle around the large pore of the alimentary zooid. In *Allopora subviolacea*, S. Kent**, the pores of the tentacular zooids are, in some zooid groups in the same specimen, mere pores; in others slits communicating with the cavity of the pore of the alimentary zooid. The irregularly scattered condition of the zooids existing in *Polypora* is to be regarded as the primitive one in genesis from which that existing in *Stylaster amphihelioides* and that in *Allopora subviolacea* represent transitional stages towards the high specialization of the zooid groups found in *Cryptohelia* and other species at present termed *Stylaster*.

* Prof. A. E. Verrill, 'Ann. & Mag. Nat. Hist.' 1872, 4th ser. vol. ix. p. 358.

† Forh. Selsk. Christ. 1872, p. 115.

‡ Pourtales, *l. c.* p. 33.

§ Pourtales, *l. c.* pl. iii. fig. 15.

‖ Pourtales, *l. c.* pl. ii. fig. 17.

¶ Saville Kent, *l. c.* pl. xxiv. fig. 1 *c*.

** *Ibid.* pl. xxv. fig. 2 *a*.

It has hitherto been a matter of regret that the Hydroidea were of such a structure as to be unsuitable * for preservation in the fossil state, and that thus we were almost, excepting as far as Graptolites are concerned, without direct evidence as to the forms which may have been presented by their remote ancestry. We have now two families excellently adapted for preservation as fossils, viz. the Milleporidæ and the Stylasteridæ. At present no members of these families appear to have been observed in rocks older than the tertiary deposits. A single species only, *Distichopora antiqua*, is known to occur in tertiary beds in France, at Chaumont and Valmondois †; but now that special attention will be directed to these corals, and their structure is better understood, no doubt allied fossil forms will be detected. It seems just possible that amongst Palæozoic corals such forms as *Cyathonaxia* may have been tenanted by a group of hydroid zooids with a large alimentary zooid situate upon the projecting style. *Cystiphyllum vesiculosum* has a crowd of small slit-like pits covering the inner surface of its calicle, which have all the appearance of having been tenanted by hydroid tentacular zooids. I cannot, however, now refer to specimens; indeed I have never seen any. Ampullæ seem to be absent in these corals; but in shallow-water forms, as in *Millepora*, they probably would be so. It is quite possible that the Millepores produce Medusæ.

Although the Milleporidæ take a very large part in the formation of coral reefs, the Stylasteridæ have very little share in the building up of these structures, being for the most part confined to the deep sea. A few species only occur in shallow water, and apparently not in great abundance. In deeper water, however, the Stylasteridæ are most luxuriant. Immense quantities of a large flabellate red *Distichopora*, brought from the Marquesas group, are sold to tourists at Honolulu. The corals are said to come from deep water. The results of the 'Challenger's' dredging off the Rio de la Plata in 600 fathoms showed that at that depth very considerable deposits of calcareous matter must be formed by these various genera of hydroid corals, growing associated as they do in masses and attached to one another. Large dead masses of *Polypora* brought up by the dredge were especially remarkable, weighing more than 1 lb., and forming bases of attachment for sponges and all kinds of other animals.

I am at present engaged in preparing a series of drawings illustrative of the anatomy of the Stylasteridæ, which I hope shortly to lay before the Royal Society, together with a more complete account of the structure of these corals.

South Atlantic,
March 24, 1876.

* Allman, *l. c.* vol. ii. p. 231.
† MM. Milne-Edwards & Haime, *l. c.* t. iii., Appendice, p. 451.

MISCELLANEOUS.

On the Reproductive Apparatus of the Ephemeridæ. By M. Joly.

Male Genital Apparatus.—So far as we know, since Swammerdam, no one has studied the internal structure of the genital apparatus of the Ephemeridæ. Léon Dufour confesses his almost complete ignorance on the subject of this apparatus *. F. J. Pictet says nothing about it, or, at least, he speaks only of the external organs assisting in copulation. The Rev. A. E. Eaton, in his monograph † does not say a single word about the internal genital organs.

We regret that we have been unable to multiply our dissections sufficiently to leave no important gap in our anatomical investigation. We have sought in vain for the male organs in a great number of individuals of that sex belonging to *Palingenia virgo*, which flew about in the evening in the light of the lamps along the quays of the Garonne ‡. It is probable that in them these organs were already shrivelled up immediately after the accomplishment of fecundation.

But in the males of *Baëtis sulphurea*, which we have several times dissected, we have very clearly seen the internal genital apparatus, formed of two testes, or *milts* as Swammerdam calls them §, placed one on each side of the digestive tube.

They present the form of two elongated, clavate sacs, recurved into a hook at their apex, pure white, and with gibbosities on their surface. The membrane forming their outer envelope is of extreme delicacy, and contains large vesicles or *spermatic capsules* (*cellules-mères*, Godard ; *œufs mâles*, C. Robin), which in their turn are filled with rounded *spermogenous cells* (*cellules-filles*, Godard ; *cellules embryonnaires mâles*, C. Robin), in many of which we have distinctly seen the spermatozoids rolled upon themselves just like minute snakes.

The testicular tube or sac is bordered along its inner side by a duct, to which the spermatic capsules appear to be suspended by a short pedicle, like grapes to their stalks ; they thus open to the deferent duct, which in its turn is continued into an ejaculatory duct which penetrates into one of the two corresponding penises, traverses its whole length, and terminates at the exterior orifice to pour out its contents there. I say one of the two penises, because, by an excep-

* "Recherches anatomiques et physiologiques sur les Orthoptères, les Hyménoptères, et les Névroptères," Mém. des Savants étrangers, tome vii. (1841) p. 581.

† "A Monograph of Ephemeridæ," in Trans. Ent. Soc. Lond. 1871, pp. 41–44 and 49–53.

‡ In this species the males have always appeared to us to be much fewer than the females.

§ Swammerdam believed that the ova of the Ephemeræ are fecundated after the manner of those of fishes—that is to say, without previous copulation.

tion which is as rare amongst insects as it is common in the Crustacea, the male Ephemeridæ are provided with two copulatory organs *.

These organs are attached to the penultimate inferior half-segment of the abdomen. They are of horny consistency, of a curved form, hollow within, and pierced at their free extremity with an orifice through which the seminal fluid escapes during fecundation. They are situated at some distance within the two corneous, curved, and quadriarticulate pieces which form the *forceps*, or copulatory armature by which the male holds the female during copulation, and which, from the point of view of philosophical anatomy, is nothing but an abdominal foot converted into an organ of prehension.

The author of the 'Biblia Naturæ' has represented the testes of *Palingenia longicauda* in the form of two elongated tubes with the surface uneven, as if mamillated. He adds that at their posterior part they are furnished with two smaller sacs, which he believes to be seminal vesicles; but he dees not mention either the deferent ducts or the ejaculatory canals. Now these ducts and canals exist, as we have ascertained by dissecting several individuals of *P. longicauda*, obtained direct from Holland, but preserved for some time in alcohol. A maceration of two or three hours in slightly tepid water has enabled us to isolate the testes of this Ephemerid without much difficulty, and thus to make sure that their structure is identical with that of the testes of *Baëtis*.

We have sought in vain for the supposed seminal vesicles described by Swammerdam. Léon Dufour states that he could not find the least trace of them in *Ephemera nigrimana*. We are therefore led to believe that the celebrated Dutch naturalist mistook for seminal vesicles simple adipose sacs like those which we have ourselves observed in *Baëtis sulphurea*, and which, at the first glance, have some little resemblance to seminal vesicles.

However this may be, our dissections, repeated several times, enable us to affirm that no seminal vesicles exist in the Ephemeridæ that we have studied. As to the testes, they have struck us by their comparatively considerable size, and especially by their resemblance in form and their analogy of structure to those of the Libellulinæ, and even to those of the higher Vertebrata in this respect, that, like the latter, they are found in final analysis to consist of a tube containing spermatic capsules (*œufs mâles*, C. Robin) lodging smaller cells (*cellules embryonnaires mâles*, C. Robin), in the interior of which the spermatozoids are developed.

Female Genital Apparatus.—In several thousands of individuals

* In assuming the existence of two penises in the Ephemeræ we shall, perhaps, seem to some entomologists to be committing a serious mistake, and to be taking for penises the pieces (which are often absent) to which Léon Dufour has given the name of "*volselles*," and which, according to him, are constituent parts of the copulatory armature. But besides that these "volselles" are often deficient in insects, we have, to support the correctness of our determination, the indisputable fact of the excretory seminal duct passing through these organs which we regard as two penises.

collected still living among the carcasses of *P. virgo* which strewed the banks of the Garonne, we have not observed a single one the ovaries of which were not almost completely empty. On opening the abdomen after oviposition, we have only found a double sac of considerable capacity, formed by a membrane of extreme delicacy, receiving at its interior part a great number of ovigerous sheaths of three or four chambers containing an equal number of ova in course of formation. Other ova, more advanced in their development, and already furnished with the sort of hood or cap which covers the extremity opposite to that where the head of the embryo will be, are accumulated in greater or less numbers in the great sac into which the ovigerous sheaths open *.

Is there a special oviduct for each of these two sacs? Léon Dufour says that the sac which constitutes the ovary terminates posteriorly by a tubular neck, which unites with its congener to form a very short oviduct. Swammerdam says nothing of any such arrangement; nor have we ever seen any thing of the kind; so that we are more disposed to think that there are two oviducts as there are two penises, and that these two oviducts open separately, in the membrane which unites the seventh abdominal segment to the eighth.—*Comptes Rendus*, October 30, 1876, p. 809.

On the Nervous System and Muscles of the Echinida. By M. L. Fredericq.

1. *Nervous System.*—Notwithstanding the labours of Tiedemann, Van Beneden, Krohn, J. Müller, Valentin, Baudelot, C. K. Hoffmann, and Lovén, the nervous system of the sea-urchins still presents many obscure points. The investigations that I made this summer at Roscoff on the nervous system of *Echinus sphæra* and *Toxopneustes lividus* have furnished the following results.

Anatomy.—The pentagonal nervous ring that surrounds the œsophagus, and the five ambulacral cords that start from it, are continued within a system of canals which has hitherto been unobserved. This anatomical peculiarity is easily verified, even without the aid of sections, on the cords which run along the ambulacral zones in the interior of the test. Here we find two greatly flattened superposed canals: the inner one is the ambulacral canal; the outer one, which is intimately united with the other, contains the ambulacral nerve in the form of a dark-coloured flattened ribbon. The nervous cord floats freely in this sheath, and is only kept in its place by the series of nervous branches which it emits on each side towards the base of the ambulacral vesicles. The envelope of the nervous system is firmly united, but only on the middle line, with

* Swammerdam remarked the extreme smallness of the eggs of the Ephemeræ: he says, "Ovula cæterum stupendæ sunt parvitatis, et vix animadverti queunt." It is, in fact, by this minuteness, that he explains the necessity of the long sojourn (*trienni spatio*) that the larvæ issuing from the eggs have to make in the water before changing into perfect insects (see 'Biblia Naturæ,' tom. ii. p. 255).

the membrane that lines the interior of the test; of this it seems to be only an expansion, and presents the same structure (epithelium without connective tissue).

The nervous ring has no relation with a supposed inferior vascular circle of the lantern. On its upper surface it presents a furrow which divides it incompletely into two concentric bands: the outer of these passes entirely into the ambulacral cords; the inner one takes only an insignificant part in this formation.

The ambulacral nervous cords, after having traversed the inner surface of the ambulacral zones and become gradually thinner, penetrate, in company with the ambulacral vessel, into the canal of the ocellar plate, and terminate there against the portion of the external integument which outwardly closes this canal. This nervous termination presents no traces of a crystalline lens, or of any optical apparatus justifying the retention for it of the name of eye given to it by Valentin and Forbes. I have not succeeded in demonstrating in it the least sensibility to light, whether artificial or solar, and concentrated by means of a lens. The spot of pigment described here is a pure fiction; in this respect the so-called oculiform points do not enjoy any privilege.

A series of branches spring, as is well known, at right angles from each side of the ambulacral trunk. Each of them issues by an ambulacral pore, penetrates into the ambulacral tentacle, traverses its length, and terminates beneath the sucking-disk at a pad serving as an organ of touch.

Histology.—There is no reason for establishing a division into ganglia and nerves in the nervous ring and the great trunks which start from it; all these parts have identically the same structure, and must be regarded as nervous centres.

Their brown coloration is due, not to scattered granules, as has hitherto been supposed, but especially to the presence of large irregular elongated cells (resembling the pigment-cells of the Batrachia) filled with brown birefringent bundles: the nucleus is very apparent; for its neighbourhood is destitute of pigment. I regard these cells as connective, seeing that I find them in other organs, especially in the walls of the aquiferous system, the membrane of the lantern, &c. The nervous elements proper have already been described by Baudelot and C. K. Hoffmann. They are fibrillæ of extreme tenuity and small bipolar cells. I have found that these fibres and cells form two very distinct layers. The inner layer presents only fibres; the outer layer (that which is turned towards the test) has a granular appearance. Examined under a high power it shows an immense number of very small cells, only measuring a few thousandths of a millimetre. These cells are so pressed against each other that at the first glance we seem to have to do with an epithelium; but on examining them with more attention, and especially by exerting a slight pressure on the tissue while still fresh, the cells separate from each other, and each of them shows two very thin prolongations, which, at a certain distance from the cells, present absolutely the aspect of the fibrillæ of the inner layer. The direction of these prolongations is variable. At the level of the median furrow presented by each of the ambulacral cords it is exactly transverse. We can then trace these prolongations even into the branches destined for the ambulacral tentacles. I may add that these cells are formed of a not very abundant homogeneous grey protoplasm surrounding a large clear nucleus. The cellular layer adheres intimately to the fibrous layer, so that they can only be separated from each other in the state of little fragments.

2. *Muscles.*—The most contradictory statements prevail with regard to the structure of the muscles of the sea-urchins. I have been able to ascertain that they are composed of very thin cylindrical fibres, perfectly smooth and homogeneous in the direction of their length. Thus, even by employing alcohol, osmic acid, hæmatoxylin, chromic acid, &c., I have not been able to discern the least trace of a transverse stria. These fibres present a fibrillar structure, and frequently one or more elongated nuclei applied to their surface; but they appear to be destitute of an enveloping membrane. They are birefringent and become vividly impregnated with colouring matters and osmic acid.

The fibres of the muscles of the lantern of Aristotle are implanted directly by a denticulated extremity upon the calcareous parts of the skeleton.

The muscles of the lantern and the muscular organs (intestine, ambulacral vesicles) undergo energetic contractions under the influence of electrical or mechanical excitation; but these contractions do not take place suddenly as in the case of striated muscles. It is very difficult to demonstrate the existence of the nerves which animate these muscles.—*Comptes Rendus*, Nov. 6, 1876, p. 860.

Physiological Experiments on the Functions of the Nervous System in the Echinida. By M. L. Fredericq.

By means of fine-pointed scissors five small cuts were made in the buccal membrane of an *Echinus lividus*, in such a manner as to divide the ambulacral nervous trunks near their origin in the collar. The ambulacral feet were not at all paralyzed; they moved in all directions and attached themselves to surrounding bodies; but the animal could no longer execute general movements or change its position, whilst other uninjured individuals could walk along the bottom of the aquarium and crawl up its glass front.

If an uninjured *Echinus* be turned so that its mouth is upwards, it moves its ambulacral feet until, in a few seconds or minutes, it will assume its normal position. After section of the ambulacral nerves the animal could no longer execute this combined movement, but remained indefinitely in its abnormal position. This is the effect of an insignificant mutilation. On the other hand the most serious lesions, if they do not reach the central nervous system, by no means prevent the urchins from using their ambulacral feet in the ordinary way; they turn themselves perfectly after many incisions into the buccal membrane or the test, if these are made in the intervals between the courses of the nerves, and even after the removal of a considerable portion of the upper hemisphere of the test, containing the anus, a portion of the intestine and genital glands, the terminal nerve-cords and ambulacral vessels. All these results lead to the conviction that the cords described as forming the nervous system are the means by which harmony of movement is produced. Lastly the galvanization of an ambulacral nerve by means of the electrical forceps and induction-coil constantly causes the immediate retraction of all the ambulacral feet of the zone.

The following facts seem to be in favour of the existence of a nervous plexus in the skin which covers the outside of the test. If a certain spot in this integument be wounded or pricked, the spines and pedicellariæ within a certain radius immediately lower themselves towards the point irritated, evidently for the purpose of defence. This experiment succeeds equally well with fragments entirely detached from the animal. It is in the thickness of the external skin that the means of communication between the irritated point and the muscles moving the spines and pedicellariæ are situated; for by cutting the integument with a fine scalpel, the space that takes part in the above defensive movements may be limited. The author, however, has apparently been unsuccessful in his search for this assumed nervous plexus.—*Comptes Rendus*, Nov. 13, 1876, p. 908.

On the Motile State of Podophrya fixa. By M. E. Maupas.

Claparède and Lachmann were the first to recognize the real organization of the Acinetina, for which they created the order of Infusoria Suctoria. These authors regarded them as essentially fixed organisms; and the Acinetina thus became isolated among their relatives.

The observations of the above-named naturalists upon the ciliated embryos of these Infusoria, with those of Stein, Cienkowski, and others, showed, however, that this isolation was not so profound as had been supposed at first: during their youth the Acinetina are motile and furnished with vibratile cilia.

The author's observations, which he regards as fitted to bring together more closely the Suctoria and Ciliata, were made upon *Podophrya fixa*, Ehr., which can at pleasure pass from the motile to the fixed state. They were made in November 1875 and October 1876 upon *Podophryæ* obtained from the rivulets of Frais-Vallon near Algiers.

Whether free or fixed, the body of *Podophrya fixa* is always more or less globular, sometimes quite spherical. The suckers are distributed pretty regularly over the whole body, except only a small region of the periphery, always corresponding to the part of the body where the contractile vacuole is situated.

After observing some of these *Podophryæ* for from half an hour to an hour, the author saw the suckers slowly drawn into the body; and at the same time the suckerless region became slightly depressed, forming a broad furrow which, becoming deeper, soon gave the body a reniform appearance. On the surface of this groove there appeared some approximated striæ, which, under a high power, were resolved into regular rows of little points or mamillæ, which increased rapidly, becoming elongated into short rigid points, not much thinner than the suckers. The latter continued to disappear more and more in the body. The furrowed region gradually increased on both sides until it formed a girdle round the body; and the points or mamillæ of this belt, becoming more and more elongated and slender, formed long and thin vibratile cilia which began to oscillate gently. The suckers had then almost entirely disappeared. The body then became elongated pretty rapidly, in such a fashion that the region on which the first rudiments of vibratile cilia appeared was at one of its extremities. This the author calls the *anterior* end. The body was at the same time depressed in a direction vertical to the plane of the ciliated belt, thus acquiring a more or less regular elongated form, slightly flattened, and ciliated only on its narrow periphery, the broad surfaces being quite destitute of cilia. The movements of the vibratile cilia at the same time became more distinct and caused some slight oscillation of the body. Lastly, the suckers retired completely within the body, the cilia vibrated more and more strongly, the elongation of the body was completed, and the *Podophrya* moved through the water turning upon itself, but with the *anterior* extremity always in front. In the case of stalked individuals the body was detached by a few feeble shocks or by turning two or three times upon itself. All these transformations occupied only half an hour.

The period of activity varies in length in different individuals. In becoming again immobile the *Podophrya* passes in inverse order through the stages above described: the suckers first appear; the body shortens and becomes broader; the vibratile cilia are retracted gradually; the body is gradually rounded, and in about twenty minutes resumes its globular form with its surface covered with long suckers. The same individuals were observed to pass several times through the whole series of metamorphoses. The author concludes that *Podophrya fixa* does not suit its name, as it is the most vagabond of known Acinetina; he regards it as an intermediate type uniting the Infusoria Suctoria to the true Infusoria Ciliata.—*Comptes Rendus*, November 13, 1876, p. 910.

Helix villosa, Draparnaud.

Mrs. David Robertson, of Glasgow, found four living specimens of this land shell, in August 1873, on the moors near Cardiff, Glamorganshire, while searching for Ostracoda in the ditches. It is an addition to our Mollusca. *H. villosa* inhabits Germany, the east of France, and Switzerland; and it often occurs at considerable heights above the level of the sea. The variety *alpestris* or *alpicola* of *H. arbustorum* has the same difference of habitat: this usually is an alpine mollusk; but it also lives on the banks of the river Lea, near Broxbourne, in Hertfordshire; and the Rev. T. Wiltshire found a specimen in my grounds at Ware Priory.—J. Gwyn Jeffreys.

On a new Species of Naultinus.

At the Meeting of the Wellington Philosophical Society on Nov. 11, 1876, the President, Dr. Buller, C.M.G., read the description of a new lizard of the genus *Naultinus*, and exhibited water-colour drawings of the adult and young, taken from specimens brought over from Nelson, and presented to him by Mr. Arthur Atkinson. The new lizard, for which the author proposed the name of *Naultinus pulcherrimus*, is beautifully marked in green and brown, the latter colour predominating. The green, which is very bright, is displayed in large diamond-shaped spots, arranged symmetrically on both sides of the spine, down the whole course of the back; the underparts are pale silvery brown; and on each side of the body there is a series of detached spots of white margined with green. The young of this species is of a bright pea-green colour, varied with transverse bands of paler green, and marked irregularly with minute specks of reddish brown. The author referred to the extreme variability of colour in *Naultinus elegans*, but pointed out that the present species (of which several other examples have been obtained) is distinguished by an orange-coloured mouth and tongue, these parts being always blue in the other. Apart from the general superficial colouring, which is very pronounced, he considered this a good specific character. He concluded with a general review of the genus *Naultinus* in New Zealand, in the course of which he mentioned that a large flat-headed species had been brought from The Brothers, where it formed the staple food of the tuatara. Both Dr. Hector and himself had come independently to the conclusion that this form was distinct from the well-known *N. pacificus*; but as Dr. Günther, the greatest living authority on the subject, had pronounced against it, there could be no doubt that it was merely a local form of the latter.

Dr. Hector said he quite agreed with the President that the orange-coloured tongue separated this lizard as a species from *Naultinus elegans*; otherwise it might have been taken as a variety of that form with the colours and markings greatly exaggerated. With regard to this large flat-headed species mentioned by Dr. Buller, he might state that he took specimens with him to England and submitted them to Dr. Günther. The type of Gray's *N. pacificus* in the British Museum was produced, and this was exactly the same; from which it would appear that our common tree-lizard is the aberrant form, and the island one the true *N. pacificus*. Whether these differences were considered of specific importance or not, he deemed it of the highest interest that descriptions should be obtained of every known variety.

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XV.—*Description of* Bdelloidina aggregata, *a new Genus and Species of Arenaceous Foraminifera, in which their so-called "Imperforation" is questioned.* By H. J. CARTER, F.R.S. &c.

[Plate XIII. figs. 1–8.]

Bdelloidina aggregata, n. gen. et sp. (Pl. XIII. figs. 1–8.)

Arenaceous, sessile, flat, composed of linear chambers successively applied to each other longitudinally on the same plane, more or less curved simply or tortuously; following the irregularities of the surface on which the species may be growing (Pl. XIII. fig. 1). Composition calcareous. Colour grey. Surface uniformly consisting of rounded grains of calcareous sand of various sizes below 5-1800ths inch in diameter, together with fragments of siliceous sponge-spicules set pearl-like in a minutely granular calcareous material, which thus serves as a cement to the larger portions (fig. 3). Furrowed by lines or grooves that indicate the form and extent of the chambers respectively (fig. 1, *b*), which vary much both in size and shape; tending irregularly though generally to a spiral, planiform aggregation. Presenting on the convexity or outer side of the last-formed chamber a series of circular foramina about 5-1800ths inch in diameter and 10-1800ths inch apart, arranged more or less regularly in a line from one end to the other (fig. 1, *a*, and fig. 5, *a*). Chamber constructed on all sides of calcareous sand, &c., similar to that of the surface (fig. 6); more or less interrupted in its cavity transversely by reticulated rugæ of the same material, which, in prominent relief, hanging down from the roof, produce an extremely irregular surface, owing to the large grains of sand of which the rugæ are composed, but the whole rendered smooth by sarcodic lining throughout; presenting a row of large apertures on each side, about the same size as, and arranged in a similar manner to those on the convexity of the exterior of the last-formed chamber (fig. 4, *b b*), which, as the latter is successively added, become the septal holes of intercameral communication (fig. 5, *a*); also presenting a great number of smaller holes varying in diameter below 2-1800ths inch, situated respectively in the deep interstices of the reticulated rugæ hanging from the roof (fig. 4); leading to equally irregular passages diminishing in size and sometimes branched as they extend towards the surface of the test (fig. 6, *c*, fig. 5, *b*, and fig. 7, *e*), where they appear to open in points not larger than 1-20,000th inch in diameter; at least such is the measurement of the closed dry and retracted sarcodic lining viewed in the latero-vertical section close to the surface, although the crevices among the sand-grains through which these points probably opened cannot themselves be recognized on the surface itself; floor of the chamber also more or less similarly foraminated and sulcated like the roof. Cavity of chamber often containing brown fragments of agglomerated sarcode and sponge-spicules. Size of entire specimen variable, the largest which I possess being about 1-6th inch in diameter and rather longer than broad (fig. 2). Chambers very variable in length below 1-60th inch, and equally variable in transverse diameter below the same size.

Hab. Marine, in excavations on the surface of a large globular mass of *Siderastræa*.

Loc. ? Coral reef.

Obs. The general form of this Foraminifer is, in miniature, that of a group of sucking, half-filled leeches on the human skin, hence the name (βδέλλα); and the composition of the test, consisting exclusively of calcareous material and fragments of siliceous sponge-spicules, seems to indicate that the coral on which the specimens were found grew on a "reef" where silex in no other shape could be obtained.

There is no doubt from this composition that it belongs to the Lituolida, or to that portion of the Arenaceous Foraminifera which hitherto have been considered "imperforate," simply because no pores on the surface could be detected by the microscope. The same might be said of the frustules of the Diatomaceæ even during active life, when they are in continued motion—with much more reason; for here neither sarcode nor holes can be seen; but no one would be so hardy as to make this assertion; and who has ever watched a *Lituola* in active life?

When, however, we observe the "labyrinthic" structure of Dr. Carpenter ('Introduction to the Study of the Foraminifera,' p. 144), homologous, in my view, with the shell-tubulation of Nummulites, traversing the walls of *Lituola canariensis*, D'Orb. (= *Nonionina Jeffreysii*, Williamson, 'Recent Foraminifera of Great Britain,' 1858, p. 34, pl. iii. figs. 72 and 73) (Plate XIII. figs. 26–29), it is evident that, although large in the greater part of their course, the tubular cavities of this structure become contracted *close to the surface*, and that this sudden contraction, short in itself and so short a distance from the surface, thus brings the external ends of the "labyrinthic" canals immediately into view on the slightest abrasion (fig. 27, *b*).

Admitting, then, that the shell-tubulation of Nummulites is but a counterpart of the "labyrinthic" canals, it is impossible to conceive that the ends of the latter should be brought so near the surface, if it were not intended that they should open there for the same purpose as in Nummulites. Moreover, how could the test of any kind of Foraminifera be added to externally if it were not for sarcodic filaments reaching the surface here the same as in Nummulites? Yet we learn from Dr. Carpenter ('Introd.' p. 140), that the Lituolida "can only put forth their pseudopodia from the terminal aperture," and that therefore "the affinities of the purely arenaceous types are essentially with the porcellaneous series" ('Introd.' p. 140). But who ever saw the "labyrinthic" structure (necessarily "labyrinthic" from the nature of the sandy material of which the test is composed) in the form of a porcellaneous Foraminifer, or, indeed, the shell-tubulation which is the indication to the pores on the surface? which pores, again, even here also might be so small as to escape notice without this indication; lastly, whoever saw a porcellaneous test among the Nummulites, to which *Lituola canariensis* in form is most nearly allied?

Here it should be remembered that the "pseudopodia" and the filaments of sarcode which pass through the surface of the test have totally different functions—the former for collecting food, and the latter chiefly for forming the shell-substance. Nowhere in Max Schultze's figures ('Ueber den Organismus der Polythalamien,' 1854), which are by far the best that were ever made, are the "pseudopodia" represented as coming from the foramina on the surface of the shell, except in fig. 22, tab. vii., where a few filaments are seen to come from the large apertures on the surface of a "young Rotalia." As a rule, the "pseudopodia" come from the great aperture at the end of the test in his figures—although of course, where there is a canal-system, they may issue also from its openings wherever these may be, either along the course of the septa or on the marginal cord as in *Operculina*.

The ferruginous colour, however, which pervades the test of *Lituola canariensis* is so much like that of the dried sarcode lining its cavities, while the test itself is composed of a heterogeneous assemblage of sand particles, fragments of siliceous sponge-spicules, &c., of different sizes, varying from immeasurable minuteness to large grains which may be seen with the naked eye, that it is not extraordinary that the pores of the "labyrinthic" canals, which probably are not larger than those of the Nummulitida, viz. about 1-20,000th inch in diameter (in *Operculina arabica*), should, under the circumstances, not be visible among the heterogeneously composed surface of *L. canariensis*,—where there is no tubulation to lead to them, the minute passages into which they open must necessarily be crooked from the coarse arenaceous material, as before stated, through which they pass, and they can only be sought for amidst the *minute* particles of the cementing sand by *reflected* light,—when they are but just visible on the surface of *Operculina*, where the structure is homogeneous and translucent, there is a tubulation to lead to them, their courses respectively are straight, and they can be sought for in the *centres of the tubes* respectively by *transmitted* light.

One of these obstacles, however, is got rid of in *Bdelloidina aggregata* by the materials of which the test of this species is composed being almost colourless, and therefore without the ferruginous tint that exists in *Lituola*; hence the ultimate extent towards the surface of the dried sarcode lining the "labyrinthic" canals can, by its dark brown colour, in the vertical section be distinctly seen and measured by the microscope, so far as a "point" can be measured. But even here direct observation of the surface does not enable us to recognize the pores of the "labyrinthic" canals, because the dark point which appears to be the sarcodic lining of the pore is retracted, and there can be nothing left but the bare crevice among the minute particles of which the cementing sand is composed to indicate the opening through which it was projected—although in the vertical section, where a lateral view of the "labyrinthic" canal can be obtained, the proximity of the point is distinctly seen so near the surface that it can hardly be doubted that it once opened there (fig. 7, *e*).

I therefore must demur to the tests of the Lituolida being regarded as "imperforate," and place myself on the side of

Prof. Williamson and the late Prof. Max Schultze, in considering *Lituola canariensis = Nonionina Jeffreysii*, not only as being perforate on the surface, but as being only an arenaceous form of *Nonionina* (now with *Operculina* very properly included in the family Nummulitida by Dr. Carpenter). By which I mean that the Arenaceous Foraminifera should not be separated from the tests of which they are but the arenaceous forms respectively. I do not mean to state that *N. Jeffreysii* is typically the same in structure as the "vitreous" *Nonionina*, but that it is so as far as the heterogeneous material of which it is composed will permit. ("Hyaline or vitreous," Introd. p. 44, are bad terms for the earthy Nummulitic character, although good for the test, generally minute, which is as transparent as glass.)

Indeed it would appear impossible to view the transverse section of *Valvulina* (fig. 23), whose test is partly composed of vitreous and partly of arenaceous structure (fig. 24, *b*, *c*)—that is, the former secreted by and the latter brought to the animal (by what? Not its "pseudopodia," but by the sarcodic filaments of the surface)—without assuming that the tubulation of the vitreous (fig. 24, *b*) is continued throughout the arenaceous layer (fig. 24, *c*), even if it were not distinctly visible in most species of this Foraminifer. But Dr. Carpenter, to get over this difficulty, would "assign to it [*Valvulina*] an independent position as the connecting link between the two" ('Introd.' p. 146)—that is, between the "Imperforate" or Arenaceous and the Vitreous or Perforate Foraminifera. To me this "connecting link" is an indication that the "two" should never have been separated in classification.

Scratch off the outer portion of a *Valvulina* (fig. 24, *c*), and a *Textularian* test makes its appearance (fig. 24, *b*); that is, a *Valvulina* is at first a *Textularia* and then a *Valvulina*. Scratch off even the thinnest portion of the surface of *Lituola canariensis*, and it directly, for reasons before mentioned, presents crevices or pores like those of *Valvulina* both in size and shape (fig. 27, *b*); or break open the test itself, and the intercameral holes of the septa (fig. 28, *a*), together with the tubulation of the walls (fig. 28, *b b b*), are, *mutatis mutandis*, the same as in *Nonionina* among the Nummulites. That is, the homogeneous composition and definite form of the cavities in the latter are exchanged for the heterogeneous composition and consequently ill-defined form of the cavities in the former (fig. 28, *a*, *b*), where most of the sand-grains composing the test are from ten to twenty diameters larger than that of the tube itself in *Operculina*, to say nothing of the pore in its centre.

In short, where the straight tubulation ends in *Valvulina* (fig. 24, *b*) the labyrinthic structure commences, by the narrow pore in the centre of the tube becoming continuous, *minus* the tube itself, with the wide irregular cavity of the labyrinthic structure, till the latter ends in a contracted crevice on the surface (fig. 25, *a*). It should be remembered that the columns of the former structure are the *tubes*, while their *cavity* only is the *pore* (fig. 24, *d*).

Why, if the tubulation in *Valvulina* is followed by the labyrinthic canals which open on the surface, should it not be so with *Lituola*, where the labyrinthic structure exists throughout?

Is it not, then, more consistent with nature to assume that the animal parts retain their functional arrangement and constitution although the material of the structure may be different? viz. that the septal holes remain for intercameral communication and the tubulation of the surface for the building-up of the test, whether the latter be vitreous or arenaceous, just as the chambers, doors, and fenestral openings of a house would differ if constructed of translucent homogeneous plaster, instead of enormous unhewn rocks of more or less opaque quartz. At least such is the contrast of the two under the microscope.

Still, it may be stated, "no openings on the surface can be seen in *Lituola*;" and this has already been granted. But are we to deny their existence simply because we cannot see them, when, as before stated, we cannot see the sarcode and the pores through which it is projected in the restless frustules of Diatomaceæ during active life? This in all probability is owing to the extreme tenuity of the one and the extreme minuteness of the other. And so it may be with the Lituolida.

In the family Nummulitida, among which, as before stated, *Nonionina* and *Operculina* are included, the pores are for the most part very minute—to wit, in the latter about 1-20,000th inch in diameter; while in *Textularia* they are comparatively large, being about 1-5400th inch in diameter, and in the porcellaneous tests not discernible at all.

But while they are large in *Textularia*, and equally so on the surface of *Valvulina*, where they appear in the shape of crevices between the calcareous grains of sand apparently at the expense of the minute particles of cement which bind together the large siliceous grains of the Lituolida, they may, from their smallness, easily escape notice in the latter, although they are perfectly evident in *Valvulina*. In short they appear to be absent even in *some* species of *Valvulina*; but it is difficult to reconcile *this* as fact, although they may not be visible here, when they are present in the other species.

Thus the question is reduced to whether, under the circumstances mentioned, we are justified in concluding that the test of *Lituola canariensis* as well as that of *Bdelloidina aggregata* is *im*perforate because we cannot see the pores on the surface.

I think not—and therefore maintain that it is better to adopt the more probable view that they are *perforate*, and not "imperforate," although it may be beyond our power to demonstrate the fact in all cases—moreover that the arenaceous forms are so nearly allied to the vitreous ones respectively that they should not be separated from them in classification. In support of which I cannot do better than conclude these observations with the following statement of one whose rare amount of practical experience among both the marine and freshwater Rhizopoda, together with his acute perception, constitutes him a valuable authority.

Dr. Wallich states:—"The inference which I venture to draw from these facts is, that if due allowance be made for the well-known proneness of the Protozoa, and notably of the Foraminifera, to become modified by local or accidental conditions, the Arenaceous character, taken by itself, ought not to be regarded as indicative of new (i. e. *generically* distinct) "*Types*"; but merely of a change in the material of which the shells are composed, resulting either from a deficiency in the supply of Carbonate of Lime, or an excess of power in the water of a particular locality to hold the Carbonate of Lime in solution. And I submit that this view derives support from the undeniable fact that the Arenaceous habit is to be seen in various degrees of development in the following large series of widely divergent Genera, namely, *Lagena*, *Bigenerina*, *Quinqueloculina*, *Textularia*, *Nodosaria*, *Uvigerina*, *Discorbina*, and even in *Globigerina* itself. Whilst the "rusty" colour said to be characteristic of *Lituola* proper, not only pervades the entire series in varying degrees, but presents itself also (as shall hereafter be shown) amongst the Freshwater Testaceous Rhizopods." ('Deep-sea Researches: Biology of *Globigerina*.' By G. C. Wallich, M.D. &c., p. 62. Van Voorst, 1876.)

I might here add that, being impressed with the idea that the testaceous freshwater Rhizopods (many of which from their rusty colour and arenaceous composition would, so far, be taken for Lituolida if found in the sea) possess the power of emitting sarcodic filaments from their surface for the purpose of forming their tests, I have occasionally seen twitching movements of the latter in the arenaceous forms, so like those witnessed in the Diatomaceæ that, being unable to discover the cause of this in any other way, I have set it down in both instances to the *sudden separation* of the free end of a sarcodic filament from the object to which it had, perhaps by some suctorial power, been attached.

Bdelloidina aggregata seems to approach nearest in form to *Peneroplis*, on account of the chambers being all on the same plane, continuous or uninterrupted by transverse partitions, linear in form and tending more or less to a spiral arrangement, with septa regularly perforated from one end to the other by holes of intercameral communication (figs. 4 and 5)—and perhaps by a disposition of the rugæ (which hang in prominent relief from the roof) to assume in some parts a transverse course, viz. across the chamber; although this would make it more like *Orbiculina adunca*, especially as, in some instances, there is also a tendency to a double row of holes in the septum. But from what has been above stated it will be seen that its general form is not near so like *Peneroplis* or *Orbiculina adunca* as *Lituola canariensis* is like *Nonionina*; while the uneven form and size of the sand-grains and consequent irregularity of the cavities both in *Lituola canariensis* and *Bdelloidina aggregata* are much the same, although the former is rusty and composed of quartzose sand &c., while the latter is colourless and composed of calcareous sand &c. Then it should be remembered that, as all the vitreous species of a genus are not represented by arenaceous forms, so there may be some of the latter which as yet have found no vitreous representatives: perhaps *Rhabdammina* and *Astrorhiza* may belong to the latter.

Since the above was written I have mounted a piece of *Bdelloidina aggregata* in which both the outer and inner surfaces of the chamber are *uninjured*, and can see the openings of the "labyrinthic" canals on the surface, both *through the latter* and *through the former*, by *transmitted light*. They are extremely minute, and situated deeply in among the minuter surface-particles, where they cannot be distinguished by *reflected* light any more than through the internal openings of the roof, and by testing with the direction of the light can be proved to be not owing to facet-reflection of any of the arenaceous particles. So this settles the question as far as *Bdelloidina* is concerned; and *B. aggregata* being exactly like *Lituola canariensis* in sandy composition and structure, it may fairly be assumed that all the Arenaceous Foraminifera have pores on the surface, and therefore that the "suborder," so far as it depends on imperforation, is *exploded*; while thus to separate animals, merely because they happen to construct their tests of foreign particles instead of calcareous material secreted by their own bodies, or both together, would be absurd.

EXPLANATION OF PLATE XIII. (figs. 1–8).

Fig. 1. *Bdelloidina aggregata*, n. gen. et sp., on a portion of *Siderastræa*, magnified four diameters. *a*, convex margin of the last chamber, along which are arranged the "pseudopodial apertures" (see fig. 5, *a*); *b*, lines marking the septal limits of the chambers respectively. Diagram.

Fig. 2. The same: square indicating natural size.

Fig. 3. The same: portion of surface, magnified to show arenaceous composition of the test. Scale 1-48th inch to 1-1800th inch.

Fig. 4. The same: horizontal section of two chambers (upper half), to show:—*a*, septum between the two chambers; *b b*, holes of intercameral communication in the septa; *c c*, roof of chambers respectively, and internal pore-canal openings analogous to those in the shell of Nummulites. Same scale. Diagram.

Fig. 5. The same: vertical section of a chamber longitudinally, to show:—*a*, holes of intercameral communication through the septum; *b*, pore-tubulation ("labyrinthic structure") of the roof or upper wall of the chamber; *c*, basal wall or floor. Same scale. Diagram.

Fig. 6. The same: transverse section of the chamber vertically, showing:—*a*, cavity; *b*, walls; *c*, pore-tubulation or "labyrinthic structure." Same scale. Diagram.

Fig. 7. The same: portion of fig. 5 more magnified, to show:—*a*, septum; *b*, hole of intercameral communication; *c*, basal wall or floor; *d*, roof of chamber; *e*, pore-tubulation or "labyrinthic structure" amidst the sand-grains of the upper wall or roof; *f*, dark line indicative of the sarcodic layer. Diagram.

Fig. 8. The same: portion of fig. 4, *c c*, more magnified, to show that the pore-canal openings are deeply sunk in the interstices of reticulated rugæ pendent from the roof. *a*, rugæ; *b*, pore-canal openings.

XVI.—*On the Locality of* Carpenteria balaniformis, *with Description of a new Species and other Foraminifera found in and about* Tubipora musica. By H. J. Carter, F.R.S. &c.

[Plate XIII. figs. 9–15.]

In my paper on the Polytremata (Ann. & Mag. Nat. Hist. 1876, vol. xvii. p. 199) the following statement is made respecting the habitat and locality of *Polytrema balaniforme* = *Carpenteria balaniformis*, viz.:—

"*Hab.* Marine, on the valves of *Mytilicardia calyculata* and other objects, viz. *Pecten*, *Porites*, &c.

"*Loc.* West Indies? Indian Ocean."

"West Indies" was conjectural; and although I have every reason for concluding that the *Mytilicardia* on which my specimen of *P. balaniforme* had grown had come off a sponge, it was equally conjectural where that sponge had come from originally.

I now find, however, that the type specimens of *Polytrema balaniforme* in the British Museum partly cover both valves of *Mytilicardia variegata* in company with *Polytrema miniaceum*, labelled " *Carpenteria*, Philippines."

There is also another specimen on one valve only of a *M. variegata*; and this, too, is in company with specimens of *Polytrema miniaceum*. It is labelled "*Dujardinia*, Mediterranean."

Going to " Case 38 " in the Shell-Room, we there find one specimen of *Mytilicardia variegata* with nothing upon it (it may have been *cleaned*)—and next to it a specimen from "Port Essington" (north coast of Australia), apparently bearing only the remains of *P. balaniforme*.

Close by may also be seen a specimen of *Mytilicardia calyculata*, labelled " Port Natal and Mediterranean ;" and in the drawer below, a specimen of *Mytilicardia variegata* covered with *Polytrema miniaceum*, but no *P. balaniforme*,—labelled " Red Sea."

Following Chenu's representations, I have stated that my specimens of *Polytrema balaniforme* are on *Mytilicardia calyculata* ; but I can see no difference between Chenu's figure of *M. calyculata* (' Manuel de Conchyliologie,' 1862, t. ii. p. 135, fig. 650) and my own specimen of this bivalve, which, again, is identical with that in the British Museum labelled *Mytilicardia variegata* ; yet the difference between this and *M. calyculata* in the British Museum is very evident, although not very great.

In the drawer of the Case mentioned is another specimen of *M. variegata* covered with *Polytrema miniaceum*, labelled " Port Essington ;" and a crab-claw submitted for my examination by Dr. Carpenter is also in the same state, but bearing among the specimens of *P. miniaceum* also one of *P. balaniforme*.

My inference, then, altogether is, that we should seek for specimens of *Polytrema balaniforme* on *Mytilicardia variegata* &c. from the *Polynesian Seas*.

It may be questioned whether *P. balaniforme* exists in the Mediterranean Sea, although *P. miniaceum* is abundant there and apparently in every sea within the parallels of 35° north and south of the equator.

From what has been above stated, the presence of *P. miniaceum*, on account of its red colour, might prove serviceable in finding out specimens of *P. balaniforme*, which, being colourless and very like a *Balanus*, are equally likely to escape notice, since the habitat of the latter is not confined to *Mytilicardia variegata* in the Polynesian Seas, but, according to the late Dr.

J. E. Gray, may be on *Porites*, *Cardita*, or *Pecten* (Proc. Zool. Soc. 1858, pt. xxvi. p. 266).

How far the specimen labelled "*Dujardinia*" above mentioned, on *Mytilicardia variegata* "from the Mediterranean," may be entitled to the generic distinction given to it by Dr. Gray (*op. et loc. cit.*), when it appears to me to differ only from *P. balaniforme* in the irregularity and obliquity of the reticulation on its surface, is a question which is thus answered. At the same time, while it appears to me to be only a variety of *P. balaniforme*, and I have stated that in all probability the latter is not to be found in the Mediterranean, even if *Mytilicardia variegata* exists there, the fact of the two having come from the Mediterranean is doubly doubtful.

(When desirous of obtaining the localities of the various specimens of sponges in the British Museum, the late Dr. Gray said to me, "You cannot depend for this on the statement in the 'Register;' for in many instances they have been purchased from 'dealers' or at sales." Certainly it is a great thing to know what does exist in the world; but the next wish is to know where it comes from, which hitherto has been too much neglected.)

After the foregoing observations on *Polytrema balaniforme* = *Carpenteria balaniformis* had been written, my kind friend, Mr. W. Vicary, of Exeter, lent me for examination a large globular specimen of *Tubipora musica* about as big as a man's head, said to have originally come from Australia, in and about which I found specimens of several species of Foraminifera, one of which, growing on the *Tubipora* itself, was so like *Polytrema balaniforme* that it was impossible to view it otherwise than as a species of this genus. Having resolved to describe and illustrate this species, it became necessary to name it; and in so doing the attempt to substitute "*Polytrema*" for "*Carpenteria*," made in my paper on the Polytremata, in the Ann. & Mag. Nat. Hist. of 1876 (vol. xvii. p. 201), for the reasons therein mentioned, proved to be attended by so many difficulties that I determined to revert to the old name of "*Carpenteria*" given to this Foraminifer by the late Dr. J. E. Gray (Proc. Zool. Soc. *l. c.*), still retaining it in the family of Polytremata, and, thus abandoning that of "*Polytrema balaniforme*" for "*Carpenteria balaniformis*," to make the new Foraminifer a species of this genus under the name of *Carpenteria monticularis*, which will now be described.

Carpenteria monticularis, n. sp. (Plate XIII. figs. 9–12.)

Monticular, with furrowed sides, jagged circumference and apertural apex; sessile. Composition calcareous, homogeneous (fig. 9, *a b*). Colourless, translucent. Surface even, uniformly covered with pores, traversed by longitudinal grooves extending from the summit to the circumference, indicating the limits of the chambers respectively (fig. 9 *d*). Aperture at the apex large, ear-shaped or spiral (fig. 9, *c c*), leading to a vertical columella, around which the chambers are situated, and into which they open alternately one after another, as they are successively developed on a spirally inclined plane extending from the base to the summit of the test. Chambers sac-shaped, conical, cylindrical or branched, dendriform (fig. 9, *b*), varying greatly in size, form, and arrangement; uniformly traversed throughout by large pore-tubes more or less closely approximated (fig. 12); chamber smooth within, often presenting *outside*, on *old* specimens, a raised network in relief, dividing the surface into an oblique reticulation whose interstices are irregular in size and shape. Size about one sixth inch in diameter; aperture about 1-60th to 1-30th inch in its longest diameter. Pore-tube about 1-1800th inch in diameter, varying in length with the thickness of the chamber-wall; pore itself about 1-5400th inch in diameter, or one third of that of the tube.

Hab. Marine. Growing on *Tubipora musica* and *Siderastræa*.

Loc. ? Australia &c.

Obs. The chief distinguishing character between this and *Carpenteria balaniformis* is the presence of the reticular framework *in* the substance of the shell or chamber-wall of the latter, within whose circular interstices the pore-tubes, although general at first, are subsequently circumscribed (fig. 13, *a*, *b*); while in *C. monticularis* there is no such framework, and therefore the pores are dispersed generally and uniformly throughout the structure (fig. 12). The oblique reticulation "in relief" appears to be only in old specimens, as before mentioned. It differs from *Polytrema utriculare* chiefly in the latter having a separate aperture to each chamber. The genus termed "*Dujardinia*" by Dr. Gray (*op. et loc. cit.*) appears to be a specimen of *Carpenteria balaniformis* on *Mytilicardia variegata* with this kind of oblique surface-reticulation, as above mentioned. So, perhaps, when more is known about this interesting genus, all these forms, including *Polytrema utriculare*, may be found to run into each other inseparably; for the illustrations, viz. fig. 9, *a*, *b*, given of *Carpenteria monticularis* are by no means representative of all the specimens that I possess, which for the most part are extremely irregular in form.

The varieties in which the chambers are branched or dendriform in their outer two thirds (fig. 9, *b*) very much resemble the chambers of *Planorbulina retinaculata* (Park. & Jones, Phil. Trans. 1865, pl. xix. fig. 2) and some limacine forms of *Planorbulina* from Australia that I possess. Like *Planorbulina*, too, the pore-tubulation is very large and distinct in all the species of *Carpenteria* that have come under my notice, which, together with *Polytrema miniaceum*, might all perhaps in their earlier forms be reduced to a single planorbuline cell commencing in an embryonal chamber (figs. 14–17), which is followed by a helical development subsequently lost in the acervuline heap of cells that are developed around it on passing into its ultimate form.

Although it is not so easy to recognize the earlier forms of *Carpenteria* as those of *Polytrema miniaceum* (from the red colour of the latter), there is the difference in form to help us (compare fig. 11 with fig. 4, Ann. & Mag. Nat. Hist. 1876, vol. xvii. pl. xiii.); and thus it seems desirable to give a description and representation of some minute specimens (three) existing, in company with *Carpenteria monticularis* and *Polytrema atriculare*, on the specimen of *Siderastræa* bearing *Bdelloidina aggregata*. These, which, having escaped notice before they were detected by the microscope, had become more or less injured, are situated on a patch of *Webbina* whose moniliform contort strings of chambers, composed of grains of white calcareous sand &c., contrast strongly with the delicate, thin, transparent, homogeneous, glass-like, foraminated film of which the aggregated tests of the young *Carpenteriæ* are composed (fig. 11), the most perfect specimen of which is about 1-60th inch in diameter, and consists of a conical hollow pillar with circular aperture (fig. 11, *a*) rising from a great number of long foraminated chambers arranged in a radiating manner around its base, so as to produce a disk-like figure with jagged edges caused by the unequal extension of the chambers (fig. 11, *b*). In each of the three specimens the last-formed or upper chambers are glassy and colourless (fig. 11, *b*), while the lower or previously formed ones (fig. 11, *c*) present a hair-brown colour, arising apparently from dried brown sarcode within them. Close to the patch of *Webbina* &c. is a specimen of *Bdelloidina aggregata*; and there are many pieces of *Polytrema miniaceum* and cinnamon-coloured groups of *Planorbulina* scattered about the rest of the coral.

Polytrema miniaceum, var. *album*.

Besides *Carpenteria monticularis*, the same piece of *Tubipora musica* bore specimens of red, cinnamon, and white varieties of *Polytrema miniaceum*, all branched, and so like each other that, but for the colour, no essential difference could be perceived between them; while a young specimen of the latter variety presented a distinct helical commencement from a primary or embryonal chamber, afterwards becoming lost in the acervuline group around it (fig. 14), like one kindly sent to me for examination by Dr. Carpenter; also a cinnamon variety presents a distinct embryonal cell, followed by an irregular helical development, finally surrounded by circles of chambers with straight radiating partitions (fig. 15), such as I have before figured in *Polytrema miniaceum* (Ann. & Mag. Nat. Hist. 1876, vol. xvii. pl. xiii. fig. 2), where the confused centre is also no doubt an irregular development of the helix. So that they all probably commence in this way; and where the colour does not assist, the irregular form of the chambers (fig. 14, *b*), together with the smaller size of the tubulation, may serve to distinguish the embryonic forms from those of *Planorbulina.*

In my paper on the Polytremata (Ann. & Mag. Nat. Hist. *t. c.* p. 206) I have stated that I possess several specimens of Australian *Orbitolites*, "in which the chambers are charged with embryos; the latter are all *elliptical* elongate." The "elliptical" form, I must say, always staggered me; but I now find that the largest of them present a line running through the long axis—which, together with the presence here and there of other minute Diatomaceæ, seems to indicate that they are all the frustules of a *Cocconeis.* The parasitic habit of this species is well known; and it is not improbable that in a still more minute form (for they only average 1-1800th inch in their longest diameter, with two to six in almost every chamber) they may have got into their present position through the stoloniferous apertures on the margin of the *Orbitolites.*

Planorbulina larvata (Parker and Jones, Phil. Trans. 1865, pl. xix. figs. 3, *a*, *b*).

The specimen of *Tubipora musica* also bore specimens of *Planorbulina larvata*, in a young one of which there is a distinct helical development from a primary embryonic chamber, afterwards followed by the usual forms (fig. 16); and in another instance a discoid regularly formed Foraminifer was found *outside* three distinct cells of *Planorbulina vulgaris* with their peculiar apertures (fig. 17, *b b b*, *c c*), which had been developed from the last of the helical chambers (fig. 17, *a*). To the former I have before alluded, as well as to the helical development, at first, of *Polytrema miniaceum*; and from them we learn that, however dissimilar the ultimate form of a Foraminifer may be, they all commence in the same way, viz. from a primary chamber or embryonic cell followed for a short distance by a helical development. Thus, like all other organized bodies, nothing is to be learnt beyond this from their commencement to predict what their ultimate forms respectively may be. That mystery of mysterious powers which presides over the future development, as well as the form of that development itself, is equally hidden from us in the *ovum* of all living beings—the latter until it makes its appearance, and the former probably for ever.

Hence all is unity in the beginning; and when it is considered that it would take 75 years 10 months and 10 days to ring the changes upon twelve bells or twelve varieties of the the unit, at the rate of 10 changes per minute, it does not seem strange that there should be so many varieties of living beings on the face of the earth—visual and auricular impressions considered correlatively.

The interior of the specimen of *Tubipora musica* was also found to contain a great number of loose Foraminifera, consisting of:—

Calcarina Spengleri, *C. hispida*, and *C. calcar*.

Tinoporus baculatus, De Montfort, and *T. vesicularis*, Carpenter, varieties *hemiphæricus* and *sphæroidalis*.

Valvulina (clavuline varieties), *Chiton*-like, vermicular, and Textularian.

Orbitolites, *Peneroplis*, *Orbiculina adunca*, *Heterostegina*, and *Dactylopora*.

The specimens of *Tinoporus vesicularis* are hemispherical and spheroidal respectively, depending upon their growing from a fixed or a free point: if from the former, they are sessile and hemispherical (fig. 19); if from the latter, free and spheroidal (fig. 18)—with a radiated structure in each instance, composed of conical columns of chambers (fig. 20), which chambers, being alternate in adjoining columns, the circumferential chamber of one of the columns is only half-developed (fig. 20, *d*, and 21, *e*), whereby the surface of the *Tinoporus* presents a pitted appearance, which, as the structure is very much like that of *Polytrema miniaceum*, might be taken for apertures of a canal-system; but a short examination will show that they only extend down to the next foraminated plate (fig. 21, *e*), and that *Tinoporus vesicularis* has no pseudopodial canal-system like that of *Polytrema miniaceum*, but is dependent entirely upon the foraminated plates of its chambers (fig. 21, *c*) for communication between the centre and the circumference, or the interior and the exterior.

Why Dr. Carpenter should have adopted De Montfort's name of *Tinoporus* for this genus, when he states (Introd. p. 223) that De Montfort considered *T. baculatus* as a variety of "*Nau-*

tilus (*Calcarina*) *Spengleri*" (which I shall show it to be hereafter), is to me inexplicable, seeing that the affinities of *Tinoporus vesicularis* are more with *Polytrema miniaceum*, from which, again, it is markedly different, as just stated, by possessing nothing even analogous to the pseudopodial canal-system of the latter.

There is as much difference between *Tinoporus baculatus* and *T. vesicularis* as there is between *Orbitoides* and *Orbitolites*. As *Orbitoides dispansa*, Sowerby, has a central plane of nummulitiform chambers arranged spirally with a convex, vertical, radiating development on each side of other chambers, of a compressed cellular form, intermixed with columns of solid shell-substance ending respectively in prominent tubercles on the surface and extending to the very margin of the disk, so has *Tinoporus baculatus* all this arranged around a *trochoid* spire. On the other hand, as *Orbitolites Mantelli*, Carter, has a central plane of orbitolitiform chambers (see Carpenter, Introd. pl. ix. fig. 8, *c' c' c' c'*, and compare with my figure, Ann. & Mag. Nat. Hist. 1861, vol. viii. pl. xvi. fig. 2, *b* and *g*) with a convex vertical radiating development on each side of other chambers of a compressed cellular form *without* the said columns of solid shell-substance, so does the structure of *Tinoporus vesicularis* extend in a radiating structure from an indistinct centre to the circumference (fig. 20, *b*; also see Carpenter, *op. cit.* pl. xv. fig. 3). The only means that *T. vesicularis* has of communicating with the exterior is, as before stated, through the foraminated plates of its chambers successively; while *T. baculatus* has a distinct system of interseptal canals for this purpose (Carpenter, *op. cit.* pl. xv. fig. 12).

All this the reader may find contrasted in two opposite columns of representations, side by side, in the Ann. & Mag. Nat. Hist. of 1861 (vol. viii. pl. xvi.), which, so far as *Orbitoides dispansa* and *Orbitolites Mantelli* are concerned, was all worked out by myself at Bombay in 1861, and published in the Ann. & Mag. Nat. Hist. before Dr. Carpenter's 'Introduction' of 1862. But Dr. Carpenter (Introd. p. 298, &c.) has thought proper to differ from me; and therefore I must leave the student of Foraminifera to decide which is right, merely observing that it is not satisfactory to be criticized by one whose observations show that he is not so well acquainted with the subject as yourself.

Tinoporus baculatus of De Montfort is, as before stated, a variety of *Calcarina Spengleri*. Out of the specimen of *Tubipora musica* have been obtained three species of *Calcarina*, viz. *C. Spengleri*, *C. hispida*, and *C. calcar*, together with *Tinoporus* *baculatus.* Each has a trochoid spire of chambers, from which circumferential spines are more or less projected horizontally, *but not all on the same plane*, as they come from the chambers of the *trochoid*; and all possess columns of solid shell-substance; but whereas in *Calcarina calcar* the pores or tubulation of the chambers open directly on the surface, in *C. Spengleri* they are prolonged into trumpet-shaped tubes whose open extremities in juxtaposition form the surface; and these in *C. hispida* are prolonged into points. "*Hispida*" is the designation given by Mr. H. B. Brady to this variety of *Calcarina* (Q. Journ. Micr. Sci. vol. xvi. p. 405, 1876), well represented by Dr. Carpenter (Introd. pl. xiv. figs. 6 & 7); while in *Tinoporus baculatus* the pore-tubulation of the chambers of the *trochoid* spire is continued to the surface through columns of cell-like chambers successively communicating with each other by pore-tubulation as in all other cases of the kind. The chambers appear to be alternate in adjoining columns, as in *Tinoporus vesicularis*: but here the resemblance ceases; for they are subtriangular or lunate in the vertical section, and not sub-square as in *T. vesicularis*; nor have I been able to see that they communicate with each other laterally in the same way as those of *T. vesicularis* (see fig. 21, *d*). All these may be minor differences; but when we find that *Tinoporus baculatus* possesses in addition a distinct system of interseptal canals circumscribing the chambers of the *trochoid* spire and apparently opening at the ends of the circumferential spines respectively, just as in *Operculina arabica* the canals of this system open on the surface of the marginal cord, it seems natural to conclude that if *Tinoporus baculatus* has no generic affinity with *Calcarina* it certainly has none with *Tinoporus vesicularis*.

On viewing the surfaces respectively of *Calcarina calcar*, *C. Spengleri*, and *C. hispida*, one cannot help being struck with their resemblance to similar ones on *Globigerina* and *Planorbulina*, wherein the simple pore-opening is often prolonged into a trumpet-shaped extension in the former, and a hispid or pointed form in the latter.

Dr. Carpenter evidently did not think the helix in *Tinoporus baculatus trochoid*, or he would not have applied the term "equatorial plane" to it (Introd. p. 227); and yet in the explanation to plate xv., with reference to fig. 12, he states that it is not distinguishable from *Calcarina*, using again the term "median plane" = "equatorial." Now no *trochoid* can have an equatorial or median plane; and as fig. 2 is stated in the explanation to represent a "section of the central portion of *T. baculatus* passing through the median plane," it seems to be a mistake; for half the chambers still possessing their tubulation shows either that the section had not passed through the "median plane," or that the helix is *trochoid*, which is really what the section does represent, judging from those that I have made myself of this Foraminifer.

EXPLANATION OF PLATE XIII. (figs. 9–29).

Fig. 9. *Carpenteria monticularis*, n. sp., on a portion of *Tubipora musica*. *a*, simple form; *b*, branched or dendritic form; *c c*, apertures respectively; *d*, lines or grooves marking the septal limits of the chambers. Magnified four diameters.

Fig. 10. The same: square indicating the natural size.

Fig. 11. The same: supposed embryonic form. *a*, prolonged tubular aperture; *b*, last-formed or upper chambers foraminated; *c*, lower or previously formed ones. Scale 1-48th to 1-1800th inch.

Fig. 12. The same: portion of surface to show the uniform pore-tubulation of the shell: same scale. Diagram. *a*, surface-ends of three pore-tubes, more magnified, to show the pore in the centre respectively: scale 1-12th to 1-1800th inch.

Fig. 13. *Carpenteria balaniformis*: portion of surface of the shell, to show the interrupted pore-tubulation, in contrast to that of fig. 12. *a*, circular interstices; *b*, reticulated framework; *c*, surface-ends of three pore-tubes, more magnified, to show the pore in the centre. Same scale as the foregoing respectively.

Fig. 14. *Polytrema miniaceum*, var. *album*: portion of basal layer, to show its commencement from an embryonic chamber in a helical form. *a*, embryonic portion; *b*, subsequently formed chambers. Scale 1-24th to 1-1800th inch.

Fig. 15. The same, var. *cinnamomum*, showing the same. *a*, embryonic portion; *b*, subsequently formed chambers. Scale 1-48th to 1-1800th inch.

Fig. 16. *Planorbulina larvata*, showing the same. *a*, embryonic portion; *b*, subsequently formed chambers. Same scale.

Fig. 17. *Planorbulina vulgaris*, showing the same, but with the embryonic portion *a*, *outside* the planorbuline chambers. *b b b*, planorbuline chambers; *c c*, their characteristic apertures. Same scale.

Fig. 18. *Tinoporus baculatus*, var. *sphæroidalis*, nat. size.

Fig. 19. The same, var. *hemisphæricus*, on a portion of *Tubipora musica*, nat. size.

Fig. 20. The same (spheroidal variety), much magnified, to show:—*a*, natural surface; *b*, hemispherical section; *c*, radiating columns of chambers; *d*, incomplete chambers. Diagram.

Fig. 21. The same: portion of the hemispherical section, more magnified, showing:—*a a a*, chambers; *b b*, partitions of solid shell-substance; *c*, foraminated or pore-tubulated plates; *d*, sides of the chambers pierced by one or more holes of intercameral communication; *e*, incomplete chamber. Diagram.

Fig. 22. The same, circumferential ends of three columns in juxtaposition, showing, *a*, the *in*complete chamber, and *b b*, the foraminated or pore-tubulated complete ones; corresponding with the diagram below.

Fig. 23. *Valvulina* —— ?, textularian, nat. size; from the specimen of *Tubipora musica*.

Fig. 24. The same: half of a horizontal or transverse section, seen from within, to show (in the right half only, the other having been left blank for convenience):—*a*, vertical view of the ends of the pore-tubulation on the septum; *b*, lateral view of the same, extending one third of the way through the wall of the test; *c*, the remaining portion formed of grains of calcareous sand, in the midst of which is the continuation of the pore-tubulation in the form of "labyrinthic structure," here omitted for perspicuity: scale 1-48th to 1-1800th inch. *d*, surface-end of pore-tube, more magnified, to show the pore in its centre: scale 1-12th to 1-1800th inch.

N.B. It should here be remembered that as the chambers are successively developed in *Valvulina*, the septum presents the same structure as the walls of the test—that is, that the upper or *inner* portion is pore-tubulated, and the *outer* or lower one arenaceous.

Fig. 25. The same: portion of surface magnified, to show, *a*, the angular pore-openings of the "labyrinthic structure" in the midst of the sand-grains. Diagram.

Fig. 26. *Lituola canariensis*, D'Orb., natural size.

Fig. 27. The same: magnified view, to show:—*a*, the large and small grains of quartz sand respectively of which the test is composed; *b*, the ends of the pore-tubulation or "labyrinthic structure" after slight abrasion of the surface. Diagram.

Fig. 28. The same: much more magnified, to show:—*a*, the holes of intercameral communication in the septum; *b b b*, the pore-tubulation or "labyrinthic structure" in the wall of the test; *c*, pseudopodial aperture; *d*, lines indicating externally the limits of the chambers respectively. Diagram.

Fig. 29. The same: portion of fig. 28, *d*, more magnified, to show the pore-tubulation or "labyrinthic structure" in the midst of the sand-grains composing the wall of the test. *a*, pore-tubulation; *b*, openings of the same on the inner surface of the wall; *c*, dark line indicating sarcodic lining; *d*, surface, consisting of large and small grains of quartz sand respectively, the latter forming a kind of cement to the former.

XVII.—*Descriptions of two new Genera and Species of Indian* Mantidæ. By Prof. J. Wood-Mason, Assistant Curator, Indian Museum, Calcutta.

Genus Danuria, Stål.

Subgenus 1. Danuria.

1. *Danuria Thunbergi*, Stål.

Hab. Port Natal.

2. *Danuria Bolauana*, Sauss.

Hab. Zanzibar.

3. *Danuria superciliaris*, Gerst.

Hab. Zanzibar.

Subgenus 2. Paradanuria, nov.

Eyes armed with a conical spine entirely surrounded by the faceted corneal membrane. *Legs*: the anterior ones long and slender, femora furnished with spines along their apical three fourths; tibiæ long and very slender, spined on the apical half of their length (5 spines on the outer, 11 on the inner edge); the four posterior ones very short, their femora strongly trifurcate at the apex, prismatic, their crested angles spinulose and furnished (the inner and lower ones) with triangular foliaceous lobes. *Supraanal plate* broader than long, triangular or short shield-shaped. *Cerci* foliaceous. *Organs of flight*? Otherwise as in *Danuria* (e. g. *Danuria Thunbergi*), all the known species of which are African.

Paradanuria orientalis, sp. nov.

♀ (nymph). Stone-coloured. Body greatly elongated, linear. Head horizontal, higher, or rather longer than broad; forehead and face in the same plane, the former with a large tubercle in the middle and with another minute one between this and the ocelli; ocular lobes of the vertex armed each with an obtuse tubercle representing the well-developed auricles of *D. Thunbergi*, the line of the vertex between these tubercles slightly concave; facial shield with its upper or posterior margin more produced in the middle than in the species mentioned. Eyes each with a conical spine, directed outwards and slightly backwards, at their upper and outer angles.

Organs of flight not yet developed, but probably much abbreviated in the perfect insect.

Prothorax apparently much as in *D. Thunbergi*, both in shape and ornamentation, but longitudinally deeply grooved on each side next to the lateral margins, and proportionally longer in the neck. Mesonotum and metanotum also longitudinally carinate. Abdomen linear, longitudinally carinate above, the keel and the sharp projecting points into which it is produced at the middle of the hinder border of each segment (including the supraanal plate) increasing in strength and size towards the apex; supraanal plate triangular or short shield-shaped, its lateral margins being arcuate. Cerci foliaceous, as long as the four terminal dorsal abdominal segments taken together, spatulate in outline as seen from the side, granulose, divided at the extremity into two rounded points by a broad but shallow notch, their upper edge thin, sharp, and exarticulate, their lower edge thick, transversely convex, and obscurely segmented.

Anterior legs long and slender; coxæ as in *D. Thunbergi*;

femora similarly shaped, but armed for the apical three fourths of their length; tibiæ very long and slender, of uniform width and perfectly straight up to the base of the terminal claw, armed with 5 spines on the outer edge, the basal two thirds of which are unarmed, and with 11 on the inner, rather less than the basal half of which is unarmed. Four posterior legs very short; the femora stout, slightly tapering at either end, with a transversely convex rib on each side between the upper and lower crests, prismatic, with each of the four angles slightly crested; the two upper crests minutely notched or spinulose here and there, and converging apically to form the strong triangular lobe that projects over the knees; the two lower ones are each also prolonged into a very sharp spine at their apex; the outer of them is simply, rarely, and minutely spinulose, but the inner is furnished with three subtriangular foliaceous lobes; tibiæ and tarsi slender and weak.

Male unknown.

Total length 53 millims.; length of antennæ 12; height of head 2·75; breadth of head 2·25; length of prothorax 15·33, of which the neck is 4, width of prothorax at dilatation 2, at base 1·33; length of meso- and metathorax 9; of abdomen 26, breadth of abdomen 2; length of cerci 3·33, breadth of cerci 1; length of fore coxa 8·5, femur 11, tibia (straight portion) 7·5; of intermediate femur 3·25, tibia 5; of posterior femur 4·75, tibia 5·25; tarsi all subequal, the intermediate ones the shortest.

Hab. Bangalore, Mysore. Collected by Private Thomas Reedy, of H.M. 45th Regiment, from whom I have received a number of interesting insects from the same district.

Genus Schizocephala, Serville.

Subgenus Didymocorypha, nov.

Body slender, sublinear. *Antennæ* inserted and constructed precisely as in *Schizocephala bicornis*, but not thickened at the base. *Head* very narrow and enormously elevated, the lateral or ocular lobes of the vertex being vertically prolonged in the form of two slender gradually tapering cones, which are in contact with one another throughout their whole length, occupying the whole of the vertex, so that the median lobe of this part is not developed and that the grooves bounding its lateral lobes meet upon the occiput at the basal junction of the cones. Ocelli minute and hidden, just as in *S. bicornis*. The *face* substantially as in this form and in *Oxyophthalma chalybea*. *Eyes* perfectly lateral, but little salient. *Prothorax* narrow, with its sides subparallel; its front and hinder margins straight, their lateral angles only being rounded off; its supracoxal dilatation and cervical groove hardly perceptible; its neck graduate, slightly narrowed behind the insertion of the fore legs, then widening again slightly to its base; its disk transversely convex, with a raised median line. *Organs of flight* ? abbreviated. *Legs* apparently constructed as in *Oxyophthalma gracilis*. *Abdomen* attenuated from base to apex; supraanal plate nearly as broad as long, shield-shaped. *Cerci* enormously long and stout, ensiform, segmented much as in *S. bicornis*, consisting of a few close-packed ill-defined basal joints, followed by eight distinct ones, gradually lengthening and narrowing from the first to the last.

Didymocorypha ensifera, sp. nov.

The single immature individual (♀ nymph) from which the above diagnosis has been drawn up measures:—

Total length 32 millims.; height of head 8, of which the horns are 5; breadth of head 2; length of antennæ 16; of prothorax 6, of which the neck is 1·75, width of prothorax at supracoxal dilatation 1·75; length of meso- and metathorax taken together 5; of abdomen 15; of cerci 9; of fore coxa 3, femur 4·5, tibia 2·5, tarsus 4.

Hab. I found the specimen in the flat country on the eastern flank of the Rajmahál hills at Teen Pahar, a station on the East-India Railway, about 6 miles south-west of the town of Rajmahál, on tall grass, probably *Saccharum spontaneum*, in company with *S. bicornis*.

XVIII.—*Descriptions of new Species of* Conidæ *and* Terebridæ. By Edgar A. Smith, F.Z.S., Zoological Department, British Museum.

In examining the collections of Conidæ and Terebridæ in the British Museum several very interesting forms have been observed which I have been unable to refer to any described species. Three of the Terebridæ were briefly mentioned in this Magazine (1875, vol. xv.), and were presented by Dr. J. Gwyn Jeffreys, F.R.S.; and seven others, collected by Colonel Pelly in the Persian Gulf, were most liberally placed in the national collection by the late Robert M'Andrew, Esq., F.R.S.

Conus brevis, sp. nov.

Testa breviter turbinata, superne acute angulata, minutissime coronata, striis distantibus subpunctatis (superne vix conspicuis ad basim confertioribus) insculpta, alba, dilute olivaceo-fusco irregulariter maculata; spira brevissima, concava, apice acuta, alba, maculis 5–6 fuscis radiantibus (supra anfractus modo ultimos 2) ornata; anfract. 11, vix exserti, minutissime et pulcherrime ad suturam coronati, striis duabus spiralibus ornati; apertura alba, angusta; labrum supra vix incisum.

Long. 19 mill., diam. max. 11.

Hab. ——?

The specimen on which this species is founded may not be quite adult; but the characters are so distinctive as to warwant its being described. On close examination the irregular maculations are seen to be of a pale olive-brown colour, longitudinally streaked with lines of a darker tint. I do not know of any species sufficiently closely allied wherewith to offer a comparison.

Conus croceus, sp. nov.

Testa angusta, elongato-subfusiformis, crocea; spiræ anfractus 10, planiusculi, liris spiralibus cincti, in anfr. inferioribus 3–4, superioribus 2 (ea ad suturam maxima, in anfr. superioribus nodulosa); spira recte conica; anfr. ultimus marginibus fere planis, costis spiralibus 28–30 fortibus, subacutis, sensim basim versus tenuioribus, munitus, et lirulis longitudinalibus numerosissimis in interstitiis concinne clathratus; apertura linearis, angustissima.

Long. 27 mill., diam. max. 9.

Hab. ——?

This species is at once recognized by its slender form, its uniform deep yellow colour, and by the strong spiral acutish ribs (about thirty) encircling the body-whorl, the interstices between them being prettily sculptured by numerous minute longitudinal lirations.

It is related somewhat to *C. vimineus*, Rve., in which, however, the transverse ribs are much finer, rounded, and more numerous. *C. longurionis*, Kiener, is another species of a similar type.

Conus propinquus, sp. nov.

Conus tenuisulcatus, Sowerby, Proc. Zool. Soc. 1873, p. 145, pl. 15. f. 2 (name preoccupied).

Hab. Mauritius.

Mr. Sowerby described a species of *Conus* under the name *tenuisulcatus*, in the 'Proceedings of the Zoological Society,' 1870, p. 256, pl. 22. f. 10, and again, in 1873, employs the same designation for a second species!

Conus inconstans, sp. nov.

Conus magellanicus, Küster (non Hwass), Conchylien, Cabinet, pl. 60. f. 2–3.

Testa turbinata, superne subacute angulata, transversim exiliter lirata, livido-fuscescenti-rosea, medio fascia alba, maculis fuscis interrupta, et lineis albis fusco notatis ad basim cincta; spira turrita, breviuscula, alba, apice rosaceo et maculis numerosis fuscis radiantibus picta; anfract. $8\frac{1}{2}$, primi $1\frac{1}{2}$ convexi, cæteri leviter exserti, supra levissime excavati, spiraliter exiliter striati, sutura inæquali divisi; apertura angusta; labrum superne vix incisum.
Long. 22 mill., diam. max. $12\frac{1}{2}$.
Var. testa roseo-coccinea, spira fasciaque mediana ut in typo præcedente.

Hab. ——?

The outlines of the body-whorl are slightly curved. In form this species is very like *C. speciosissimus*, Reeve; but the absence of coronations and the difference of coloration at once distinguish it.

Conus fuscomaculatus, sp. nov.

Testa oblongo-turbinata, subcylindracea, basi paululum attenuata, dilute carneo-purpurea, maculis quadratis fuscis seriatim digestis ornata, ad extremitatem basalem carneo-rubescens; spira fusca, concava; anfractus 12, spiraliter subtiliter striati, sutura albescente divisi, primi 6 exserti, basim versus angulati, cæteri planiusculi; anfract. ultimus superne obtuse angulatus (angulo albo), triente superiore lævi, inferius sulcis transversis validis subdistantibus insculptus, sulcis longitudinaliter tenuiter striatis; costæ inter sulcos basim versus albo nodosæ; apertura pallide purpurea.
Long. 37 mill., diam. max. 16.

Hab. ——?

This species has for its nearest ally *C. lynceus*, Sowerby. It is of the same form; but the transverse sulcations towards the base are deeper, and the ribs between them are roundish and nodulous, the nodules being whitish and separated by rich brown squarish spots; whereas in *C. lynceus* the spaces between the sulcations are flat and simple.

Terebra melanacme, sp. nov.

Ann. & Mag. Nat. Hist. 1875, vol. xv. p. 415.

Testa polita, subulata, dilute fuscescens, infra lineam suturalem zona alba, maculis parvis castaneis interrupta, ornata; apex nigrescens; anfract. 14?, primi 2 convexi, læves, sequentes 7–8 plani, longitudinaliter leviter plicati, cæteri plani, læves; anf. ultimi 3 linea impressa obscura paululum infra suturam cincti; anfr. ultimus quadratus ad peripheriam zona angusta alba cinctus.

Long. 17 mill., diam. 4.

Hab. Cape Sima, Japan (*Commander St. John*).

The above is probably the description only of the young state of a largish species; but the characters are so distinctive that it is not, I think, very hazardous to describe it. The black apex, the smooth whorls, the white zone dotted with chestnut below the suture, and the narrow white band round the last whorl easily define the species.

Terebra tricincta, sp. nov.

Testa parva, subulata, nitida, cornea; anfract. 14, primi 4 politi, convexi, cæteri medio concavi, cingulis 3 nodulosis (supremo *maximo* cingulum infrasuturale constituente, medio *minimo* supremo fere contiguo, infimo prope suturam) cincti; noduli costis longitudinalibus numerosis gracillimis (in anfr. ultimo 17–20 basi continuis) connexi; anfr. ultimus quadratus ad peripheriam liris 3 nodulosis et basim versus altera simplici cinctus; columella inferne oblique contorta, callo tenui livido labro juncta; canalis brevis, latus.

Long. 11 mill., diam. $2\frac{3}{4}$.

Hab. Persian Gulf (*Colonel Pelly*).

The uppermost of the three nodulous belts which encircle the whorls is considerably the largest; the intermediate one is merely a fine spiral liration, nodose at those points where it is crossed by the thin longitudinal ribs.

Terebra persica, sp. nov.

Testa parva, subulata, nitida, corneo-albida, versus apicem et anfract. ultimi basi purpurascens; anfr. 13?, primi 3 politi, convexi, cæteri medio concavi, costis longitudinalibus numerosis (in anfr. ult. 15–20 ad basim attenuantibus) utrinque nodulosis (nodulis superioribus majoribus cingulum infrasuturale partim constituentibus) instructi, et lirulis spiralibus super costas continuis 3–4 cincti; cingulum (in cochleis detritis supra nodulos obsolete) crebre striatum; sutura profunda; anfr. ultimus quadratus, ad peripheriam liris 3 cinctus, inferne tenuiter striatus; columella brevis, basi oblique contorta; canalis latiusculus, leviter recurvus.

Long. 12 mill., diam. 3.

Hab. Persian Gulf (*Colonel Pelly*).

Possibly the above may not be the dimensions of a full-grown specimen; but the style of the sculpture, which is constant in the twelve examples which I have examined, is quite different from that of any other species. The fine striations of the infrasutural belt and on the rest of the whorls, the three or four spiral lirations which are continuous over the ribs, which are nodose at each end, are the chief points of peculiarity.

Terebra bathyrhaphe, sp. nov.

Ann. & Mag. Nat. Hist. 1875, vol. xv. p. 415.

Testa subulata, fuscescens, costis nodulisque albidis variegata; anfr. 15, primi 3 convexi, læves, cæteri medio concavi, costis longitudinalibus utrinque nodulosis (in anfr. ultimo 18–20, versus basim sensim attenuatis medio nodulosis) instructi, et cingulis duobus nodulosis altero majore infra suturam canaliculatam, altero supra cincti, striisque transversis paucis ornati; anfr. ultimus quadratiusculus ad peripheriam zona albida obscura (in apertura fusca distinctiore) ornatus, inferne concinne spiraliter liratus; columella contorta, fusca; canalis recurvus.

Long. 25 mill., diam. 5.

Hab. Gulf of Yedo, Japan (*Commander St. John*).

The deeply channelled suture, the nodulous broadish belt below it and the narrow one above it, the nodules being connected by the upright ribs, are the chief points in the construction of this species. The coloration is rather obscure; for most of the examples I have seen have a slight chalky deposit on them.

Terebra albozonata, sp. nov.

Ann. & Mag. Nat. Hist. 1875, vol. xv. p. 415.

Testa subulata, dilute fusca, zona alba angusta ad anfractuum basim cincta, et circa peripheriam anfr. ultimi zona alba ornata; anfract. 12, primi 2 læves, convexi, cæteri fere plani, costis longitudinalibus numerosis, gracilibus, obliquis (in anfr. ult. 19–20 versus basim attenuantibus) instructi, incrementi lineis striati, et sulco unduloso spirali inæqualiter divisi, anfr. ultimus rotundatus; columella brevis; canalis brevis latus paululum recurvus.

Long. 25 mill., diam. 7.

Hab. Matoza Harbour, Japan (*Commander St. John*).

This species probably attains a much larger size than the above dimensions. The palish brown colour, with the narrow white zone at the base of the whorls and that around the periphery, and the numerous oblique ribs, which are divided above by a fine furrow, are the chief peculiarities. The nearest ally appears to be *T. badia*, Desh.

Terebra Pellyi, sp. nov.

Testa parva, subulata, dilute fuscescens vel purpurascens; anfract. 12, primi 2 globulares, politi, cæteri convexiusculi, costis longitudinalibus leviter arcuatis (in anfr. ultimo 12–15 versus basim attenuantibus) instructi, et sulco angusto, inter costas præcipue conspicuo inæqualiter divisi, et lira angusta supra suturam sed ei contigua cincti transversimque obscure (interdum obsolete) striati; anfr. ultimus circa peripheriam sulcis 1–3 ornatus; apertura parva; columella canalisque breves.

Long. 13 mill., diam. 3.

Hab. Persian Gulf (*Colonel Pelly*).

The two or three spiral furrows, of which the upper one is usually most conspicuous, around the periphery well define this species; and the liration which fills up the suture is also remarkable.

Terebra Grayi, sp. nov.

Terebra gracilis, Gray, Proc. Zool. Soc. 1834, p. 61 (name preoccupied for a fossil species).

Non *T. gracilis*, Reeve, fig. 131,=*T. spectabilis*, Hinds.

Non *T. frigata*, Hinds, Sowerby, i. pl. 44. f. 71.

Testa subulata, nitens, pallide cinerea, ad apicem basimque anfract. ultimi purpureo-fusco tincta; anfractus 16, subplani (minime convexi), costis longitudinalibus, distantibus, subacutis, leviter arcuatis, circiter 11, superne leviter nodulosis (in anfract. ultimo versus basim evanidis) instructi, et linea spirali profunda posteriore inæqualiter divisi, striisque spiralibus numerosis tenuibus inter costas insculpti; columella basi obliqua, fusco-purpurea.

Long. 24 mill., diam. $4\frac{1}{2}$.

Hab. ——?

Much confusion has unfortunately hitherto surrounded this species. Hinds associated with it a totally distinct species, applying thereto the name *frigata*. Deshayes continued this mistake; and Reeve, imagining he was correcting the error, fell into a worse one himself; for *he* has figured from Dr. Gray's collection a small specimen of *spectabilis* of Hinds under the name of *gracilis*. The specimen figured by Reeve (f. 131) was attached to a tablet in Dr. Gray's collection, in company with the *true* type; and thus, if Reeve had compared the two shells with the original description in the Proc. Zool. Soc., no such confusion could have arisen. The distant ribs, spiral striation, cinereous coloration, and purplish brown base of the *true T. gracilis* are characters which in no way apply to Reeve's shell, which has numerous ribs (fourteen), no spiral striation, and is quite differently coloured.

Terebra (*Myurella*) *fuscobasis*, sp. nov.

Testa parva, breviter subulata, nitida, alba, zona dilute fusca infra suturam cincta, et anfract. ultimi basi fusca; anfr. 10, primi 3 læves, politi, cæteri convexiusculi, superne paululum constricti, costis longitudinalibus acutis (in anfr. ultimo circa 12 versus peripheriam obsoletis) incrementique striis ornati, et sulco levi supra costas continuo superne divisi; anfr. ultimus magnus, lira acuta circa caudam cinctus; columella fusca.

Long. 11 mill., diam. $3\frac{3}{4}$.

Hab. Persian Gulf (*Colonel Pelly*).

This species has no spiral sculpture. The longitudinal ribs are thicker at the top; and being cut across by the narrow transverse furrow a little below the suture, the appearance of a narrow infrasutural belt is thus produced.

Terebra (Myurella) fuscocincta, sp. nov.

Testa parva, subulata, nitens, albida vel cornea, lineis duabus fuscis cincta, altera saturatiore paululum infra suturam, altera fere ad anfractuum basim; anfract. ultimi basis fusca; anfr. 10, convexiusculi, infra suturam leviter constricti, costis validis, acutis, arcuatis, superne subtubercularibus (in anfr. ultimo circiter 10 vix ad basim attenuantibus) instructi; columella brevis; cauda lira distincta cincta; canalis brevis, latus.

Long. 8 mill., diam. 2.

Var. anfr. planiusculis, costis rectis munitis.

Hab. Persian Gulf (*Colonel Pelly*).

This species is coloured somewhat like *pumilio*, but is at once distinguished from that form by the absence of the transverse striation and by the existence of fewer ribs. The upper brown line or band is quite at the top of the whorls in *pumilio*, whereas in the present species it is a little below the suture, colouring a slight depression or constriction which exists there.

The variety is allied to *tenera*, Hinds, which, however, is shorter, has fewer ribs, and wants the brown line near the base of the whorls and that around the periphery.

Terebra (Myurella) MacAndrewii, sp. nov.

Testa parva, breviter subulata, parum nitida, albida, zonis duabus (supera paululum infra suturam purpureo-nigricante, infera aliquanto suturam supra fuscescente costis albidis fere interrupta) cincta; anfract. 11, convexiusculi, superne leviter constricti; costis longitudinalibus parvis superne impressione spirali levi divisis (in anfr. ultimo 12–13 basi sensim attenuatis) instructi, et striis gracillimis, creberrimis, spiralibus ornati; anfr. ultimus zona tertia fuscescente infra peripheriam cinctus; columella brevis, purpurascens; labrum aliquanto expansum; canalis perbrevis, latus.

Long. $13\frac{1}{2}$ mill., diam. 4.

Hab. Persian Gulf (*Colonel Pelly*).

This is one of the very numerous and beautiful species presented to the British Museum by the late and deeply lamented

Robert M'Andrew, Esq. The slight blackish purple depression, a little below the suture, dividing the longitudinal ribs, forms an obscure nodulous infrasutural belt. The three exterior coloured bands, which are interrupted by the whitish ribs, are visible within the aperture in the form of three series of squarish spots.

Terebra (*Myurella*), *cognata*, sp. nov.

Testa subulata, dilute fuscescens; anfr. 12, primi 2 læves, convexi, lilacei, cæteri planiusculi, costis longitudinalibus rectiusculis (in anfr. ultimo circa 12 basi productis) instructi, et superne sulco parvo spirali inter costas præcipue conspicuo insculpti, lirisque transversis supra costas subobscuris cincti; anfr. ultimus quadratus, ad peripheriam zona angusta albida inconspicua ornatus; canalis brevis, aliquanto recurvus.

Long. 14 mill., diam. $3\frac{1}{5}$.

Hab. Persian Gulf (*Colonel Pelly*).

Allied to *polygyrata*, Desh.; but the transverse sculpture of the latter is coarser, as is also the infrasutural sulcus or punctured line.

Terebra (*Hastula*) *rufopunctata*, sp. nov.

Testa subulata, nitens, pallide olivacea, infra suturam zona angusta alba, et infra illam zona secunda livida cincta, et supra zonam albam punctis pluribus, parvis, rufis, notata; anfractus 12, primi duo læves, vitrei, convexi, cæteri plani, costis vel plicis tenuibus numerosis, acutis, versus basim anfractuum evanidis, ornati, sutura obliqua sejuncti; anfr. ultimus circa peripheriam albo zonatus, et infra illam zona livido-fusca cinctus; apertura parva; canalis brevissimus, latus, levissime recurvus; columella medio leviter arcuata, ad basim carina unica succincta.

Long. 22 mill., diam. 5.

Hab. —— ?

This species must not be confounded with *strigillata*, L., to which it has considerable likeness as regards the coloration. It may be at once distinguished by its acute plications, which do not extend to the bottom of the whorls, whilst those in the old species are quite flat and reach from suture to suture; and the body-whorl of the former is shorter than that of the latter.

Terebra (*Hastula*) *confusa*, sp. nov.

Terebra cinerea, Hinds (not of Born), Sowerby's Thesaurus Conchyliorum, vol. i. pl. 45. f. 130.

T. aciculina (part), Reeve (not of Lamarck), Conchologia Iconica, vol. xii. f. 121, *d*; varieties, f. 121, *c* & *f*.

In the 'Annals and Magazine of Natural History,' 1873, vol. xi. p. 262, I made a few remarks on a species of *Terebra* which had been referred by Messrs. Deshayes, Hinds, and Reeve (partly) to *T. aciculina*, Lamarck. Since writing the paper referred to I have had occasion to reexamine this species, and find that it is not in fact the Lamarckian shell. In his diagnosis, which appears almost as if it were extracted from Born's description of *T. cinerea* ('Index Musei Vindobonensis,' p. 267), from the similarity of language, he gives "albido-cinerea" as the colour of the species, which evidently in no way applies to the present species, which is of a more or less ashy-brown colour, banded with white beneath the suture, and also longitudinally streaked with brown, and has a white zone around the last whorl a little below the middle, which is also distinctly seen within the brown aperture.

M. Deshayes, in the second edition of Lamarck's 'Animaux sans Vertèbres,' vol. x. p. 250, remarks that Lamarck was wrong in changing Born's name *cinerea* to that of *aciculina* if his shell was the same as that of this author, and he considers Born's species identical with that described by Lamarck under the name of *Terebra cœrulescens*. This, however, is a palpable mistake; for the latter is a smooth shell without any striation or plication beneath the suture, differently coloured, and has the sutures indistinct ("suturis obsoletis," Lamarck), which arises from the fact of the whorls being encircled by a narrow callosity just above, but contiguous to, the suture, which peculiarity induced me to found the subgenus *Impages* for this and a few other species possessing the same characteristic.

The synonymy of *T. cœrulescens* and *T. cinerea* is as follows:—

Terebra (*Impages*) *cœrulescens*, Lamarck,

Animaux sans Vert. ed. 2, vol. x. p. 245; Kiener, Coq. Viv. pl. vi. f. 12, *a–c*; Sowerby, Thesaurus Conch. i. pl. xlii. f. 29; Reeve, Conch. Icon. xii. f. 26, *a–c*.
Buccinum hecticum, Linn. (part), Syst. Nat. ed. 12, p. 1206.
Limax fusca, Martyn (part), Universal Conch. iv. pl. 121. fig. on left.
Buccinum niveum, Gmelin, probably = *B. bifasciatum*, Dillwyn.
Var. = *T. nimbosa*, Hinds, Thesaurus Conch. i. pl. 42. f. 21; Reeve, *l. c.* f. 37; Kiener, *l. c.* pl. 6. f. 12, *d*, and pl. 7. f. 12, *e* (as *cœrulescens*, var.).

Hab. Tahiti, Philippine Islands; Red Sea.

Terebra (*Hastula*) *cinerea*, Born.

Buccinum cinereum, Born, Mus. Vindobon. pl. 10. f. 11, 12.
Terebra cinerea, Reeve, Conch. Icon. xii. f. 35.
T. aciculina, Lamarck (not of Hinds or Reeve), Anim. s. Vert. ed. 2, x. p. 250.

Var.= *T. castanea*, Kiener, *l. c.* pl. 7. f. 14.
Var.= *T. laurina*, Hinds, Thesaurus Conch. i. pl. 42. f. 27.
Var.= *T. stylata*, Hinds, *l. c.* pl. 44. f. 79.
Var.= *T. jamaicensis*, C. B. Adams, Contrib. Conchol. i. p. 58.

Hab. West Indies.

XIX.—*New and peculiar Mollusca of the* Patellidæ *and other Families of Gastropoda procured in the 'Valorous' Expedition.* By J. Gwyn Jefferys, LL.D., F.R.S.

Patellidæ.

Tectura rubella, Fabricius.

Patella rubella, Fabr. Fn. Gr. p. 386.

Body greyish-white, with numerous and close-set brownish streaks in front: *head* semicircular: *mouth* concave, opening horizontally, and puckered: *mantle* thick: *tentacles* awl-shaped, contractile, with blunt tips: *eyes* small, black, sessile on the tentacles at their outer base: *foot* oval. Sluggish.

Godhavn, 5–20 fms.; Station 4, 20 fms.; 5, 57 fms. (dead); Holsteinborg, 3–12 fms. Greenland (Fabricius and others). Spitzbergen (Torell)! Tromsö, Norway (M. Sars). Labrador (Packard, *fide* Whiteaves); Newfoundland (Verkrüzen)!

Young shells have a butotn-shaped (and not a spiral) apex, which turns to the broader and longer end, as in *Lepeta*; but in the latter genus the apex is spiral. The apex is strongly striated lengthwise, and resembles that of *Ancylus*.

In a Greenland specimen, which I received from Dr. Mörch, I found two fry with perfect shells enclosed in the concavity of the foot. Perhaps *T. rubella* may be the type of a distinct genus (say *Erginus*, from one of the Argonauts). I see no reason for changing the opinion which I expressed in the third volume of 'British Conchology,' p. 246, for retaining the generic name *Tectura* in preference to the later and objectionable name *Acmæa*, although Mr. Dall and the Rev. J. E. Tenison Woods prefer to use *Acmæa*.

Lepeta cæca, O. F. Müller.

Patella cæca, O. F. Müller, Zool. Dan. Prodr. p. 237. no. 2866.

Body of a pale yellowish colour, pinkish about the head: *mouth* round, opening vertically: *mantle* thick: *tentacles* awl-shaped, and thick: *eyes* none: *foot* oval, stout.

Off Godhavn, 80 fms.; Station 1, 175 fms.; 3, 100 fms.; 5, 57 fms.; Holsteinborg, 35 fms.; St. 13, 690 fms.

Circumpolar, and ranging southwards to the west coast of Scotland, Cape Cod, and North Japan, at depths of from 4 to 100 fathoms; also widely distributed in the Pliocene and newer Tertiary strata of northern regions. The apex in the young is spiral, incurved, and deciduous, and it resembles that of *Propilidium*; but in the latter the spire is persistent and has two turns instead of one; and *L. cæca* wants the internal septum.

Propilidium ancyloïdes, Forbes.

Patella? ancyloides, Forb. in Ann. Nat. Hist. vol. v. p. 108, pl. ii. f. 10.

Station 12, 1450 fms.; one dead specimen. 'Lightning' Expedition, 189 fms. 'Porcupine' Expedition, 1869, west coast of Ireland, 90–1366 fms.: 1870, Bay of Biscay, 220–1095 fms. British and Scandinavian. Mediterranean, off Rinaldo's Chair, 60–160 fms. Bay of Naples, 60 fms. (Acton)!

It is the *Rostrisepta parva* of Seguenza, a Pliocene fossil of Sicily.

Fissurellidæ.

Puncturella profundi *, Jeffr.

Shell conical, with a roundish-oval outline, thin, semitransparent, of a dull hue: *sculpture*, numerous longitudinal and equal-sized striæ, and still more numerous but minute and less raised concentric striæ, the intersection of which causes a very fine and delicate cancellation and a beading of the longitudinal striæ: *colour* brownish-white, becoming pale yellowish in dead specimens: *beak* smooth, incurved and twisted to the left, forming a minute spire of one whorl and a half: *slit* pear-shaped: *mouth* roundish-oval: *margin* very finely scalloped: *inside* glossy and somewhat nacreous: *plate* or septum large, triangular, thin, placed vertically in the middle, and occupying the lower third of the inside, so as to separate the anterior from the other half; it is not a vaulted sheath as in *P. noachina*, nor does it cover (although it apparently protects) the slit or opening at the top. L. 0·25. B. 0·2.

Station 12, 1450 fms.; dead specimens. 'Porcupine' Expedition, 1870, coast of Portugal, 740–1095 fms.

I have described the shell from a 'Porcupine' specimen. This differs from *P. noachina* in the size, shape, texture, sculpture, slit, and internal plate. It belongs to the genus

* Inhabiting the depths of the sea.

Fissurisepta of Seguenza (Ann. d. Accad. d. Aspir. Nat. 3ª ser. vol. ii.); but the only character which distinguishes *Fissurisepta* from *Puncturella* is the shape of the internal plate or septum. The spire in *Fissurisepta* is usually deciduous or worn away. The present species is allied to another undescribed species (*granulosa*), which I dredged in the 'Porcupine' Expedition of 1870 at a depth of 292 fathoms, and at Dröbak in Christianiafiord at 60 fathoms. In that species the longitudinal striæ are closely beaded, and there are no concentric or transverse striæ. *P. papillosa* and *P. rostrata* of Seguenza are two other 'Porcupine' species, and were found by Professor Seguenza in the Pliocene formation at Messina. The sculpture in all the species varies in being more or less coarse or fine, and is sometimes absent.

Scissurellidæ.

Scissurella crispata, Fleming.

Scissurella crispata, Flem. in Mem. Wern. Soc. vol. vi. p. 385, pl. 6. f. 3.

Station 5, 57 fms.; one living specimen. British and Scandinavian coasts, 7–300 fms. Greenland (Möller, Torell). Spitzbergen (Torell). Labrador (Principal Dawson, *fide* Packard). Gulf of Gascony, 40–80 fms. (De Folin). 'Lightning' Expedition, 170 and 189 fms. 'Porcupine' Expedition, 1869, west of Ireland, 164 and 173 fms.; one specimen is intermediate in size between the Scotch and Scandinavian forms: 1870, Bay of Biscay, 220–1095 fms.; Mediterranean, 51–207 fms. Fossil in the Pliocene formation from Norway to the Ægean archipelago.

S. angulata of Lovén is evidently the same as our species, and differs in its much greater size only. I dredged it at Dröbak in 1869, and subjoin a description of the animal.

Body milk-white, with a yellowish-brown tinge in front: *head* thick, snout-shaped: *tentacles* conical, ciliated: *eyes* small, on the outer base of the tentacles: *foot* bilobed and double-edged in front, abruptly pointed behind; tail or extremity pinched up, and grooved underneath: *pedal filaments* or appendages as in *Trochus*, but more numerous (8 at least on each side); they are angular and finely ciliated; each filament has at its base a white globular eye-spot. The slit serves for an anal or excretory duct; fæces worm-shaped, long, and of a dark brown colour, visible through the shell. Operculum chitinous, thin, and multispiral, with a central nucleus. The animal was shy or delicate, and died soon after being put into a glass phial of sea-water.

I regard *S. aspera* of Philippi as a variety of the present species. The height of the spire is an unreliable character.

Scissurella tenuis *, Jeffr.

SHELL forming a depressed cone with an expanded base, sloping to the periphery and slit, very thin, scarcely semitransparent, and rather glossy: *sculpture*, extremely numerous and fine curved longitudinal striæ, and equally numerous and fine concentric or spiral striæ, which by their intersection cause a regular but minute cancellation; the concentric striæ at the base are stronger and more distinct than the longitudinal striæ; the sculpture is of course interrupted by the peripheral slit and groove: *colour* pearl-white: *spire* greatly depressed: *whorls* 5, somewhat flattened below the suture; the last enormously exceeds in size all the others put together: *slit* central, long and broad: *groove* also broad, marked across by regular but rather distant curved striæ; edges sharp and upturned: *mouth* obliquely oval: *outer lip* thin: *inner lip* folded back and curved: *pillar* nearly straight, having a twisted fold in front of the *umbilicus*, which is small and narrow. L. 0·25. B. 0·2.

Station 12, 1450 fms.; two dead and imperfect specimens.

This differs from *S. crispata* and its varieties in its depressed shape, thinner texture, more delicate sculpture, the larger size of the last whorl in comparison with the others, the pillar being furnished with a fold, and in its narrower umbilicus.

Trochidæ.

Cyclostrema basistriatum †, Jeffr.

SHELL somewhat globular, resembling in shape a small *Trochus* of the *Margarita* section, thin, semitransparent, and glossy: *sculpture*, more or less numerous and fine spiral striæ, which cover different parts of the surface in different specimens; sometimes they occur on the base only and encircle the umbilicus, being in that case stronger; at other times the upper whorls have a single ridge-like stria at the top, so as to give an angulated appearance to the crown or summit; in the young the umbilicus is surrounded by a strong keel-like stria: *colour* whitish: *spire* raised: *whorls* 4, swollen; the last occupies three fourths of the spire; the first or topmost whorl is rounded and blunt: *suture* deep: *mouth* circular, slightly angular above: *umbilicus* rather narrow, but deep:

* Thin. † Striated at the base.

operculum smooth, having 6 or 7 whorls, which are divided by raised lines. L. 0·125. B. 0·1.

Station 13, 690 fms.; a single young and living specimen. 'Lightning' Expedition, 189 fms. 'Porcupine' Expedition, 1869, between the Orkney and Faroe Isles, 290 fms.: 1870, coast of Portugal, 740–1095 fms. Lofoten Isles, 200–300 fms. (G. O. Sars, as "*C. nitens*" of M. Sars); Bergen district, 50–400 fms. (Friele); Upper Norway (Lilljeborg, M'Andrew); Dröbak (Verkrüzen).

The description has been taken from Norwegian specimens. I would have substituted for *basistriatum* another specific name; but the present name has been adopted by Weinkauff in his 'Catalog der im europäischen Faunengebiet lebenden Meeres-Conchylien,' as well as by Friele in his 'Oversigt over de i Bergens Omegn forekommende skaldægte Mollusker,' on my authority. Probably *C. lævis* of Searles Wood, from the Coralline Crag at Sutton, which he refers to the *Delphinula lævis* of Philippi, may be the young of the present species. Philippi's species is unquestionably *C. serpuloides*.

C. basistriatum is not so globular as *C. Cutlerianum*, and is comparatively gigantic; the sculpture is coarser, and the operculum is smooth.

Molleria costulata, Möller.

Margarita? costulata, Möll. Ind. Moll. Grœnl. p. 8.

Body white, with a faint tinge of creamcolour or pale yellowish: *head* small and short, semicircular, and resembling that of the section *Margarita* of *Trochus*: *mouth* vertical, continually opening and shutting: *tentacles* elegant and feathery, but not ciliated: *eyes* rather large and round, placed on small bulbs or tubercles at the outer base of the tentacles: *foot* broad, squarish and double-edged in front, angular or bluntly pointed behind: the upper part of the foot has tentacular processes or filaments (four on each side), as in *Trochus*, which, however, are not ciliated in *Molleria costulata*, but are notched at the edges, and are conical and short; none could be detected in front of the foot, as stated by Möller in his description. His words are "Margaritis quidem affinis, ab illis propter peristoma continuum aperturæ et pedem animalis antice filamentis obsitum diversa est." The animal crawls rather quickly, but painfully.

Station 4, 20 fms.; 5, 57 fms.; Holsteinborg, 10 and 35 fms. Greenland (Möller). Iceland and Spitzbergen (Torell). Oxfjord, Finmark (M. Sars). 'Lightning' Expedition, 170 fms. Labrador (Dawson, *fide* Packard). St. John's Harbour, Newfoundland (Verkrüzen). Fossil in Norway, Sweden, Scotland, and the east of Ireland.

The genus *Molleria* differs from *Turbo* in the same way that *Cyclostrema* does from *Trochus*, *i. e.* in having a complete peristome. In *Molleria* and *Turbo* the operculum is calcareous, in *Cyclostrema* and *Trochus* it is chitinous.

Trochus cinereus, Couthouy.

Turbo cinereus, Couth. in Boston Journ. Nat. Hist. vol. ii. p. 99, pl. 3. f. 9.

Body yellowish-white: *head* semicircular and hood-like, notched at the outer edge; it is furnished with a small triangular lappet or flap on each side: *tentacles* cylindrical and thread-shaped, finely ciliated: *eyes* small, black, placed on short bulbs at the outer base of the tentacles: *foot* thick, squarish in front and bluntly pointed behind; it has 6 cirri or filaments on each side, which are ciliated like the tentacles, and are of different sizes and lengths.

Waigat Strait, 15–25 fms.; Station 4, 20 fms.; 5, 57 fms. West Greenland (Möller and others). East Greenland (Möbius). Spitzbergen, 5–15 fms. (Torell, Kroyer). Iceland (Steenstrup and others). Norway, 10–130 fms. (Sars and others). 'Lightning' Expedition, 170 fms. (dead). 'Porcupine' Expedition, 1869, 173 fms. (dead). Eastern coasts of North America, from Mackenzie River southwards to Cape Cod, 7–150 fms. Mexico (British Museum). Fossil in Norway and Sweden, Shetland, Scotland, Ireland, and Berwick Bay.

A Spitzbergen specimen of the variety *Grœnlandica*, Möller, measures $\frac{3}{4}$ of an inch in breadth. Specimens vary in the height of the spire as well as in the character of the sculpture. The outer layer in one of my Greenland specimens having been mostly removed by erosion, the surface of the inner layer presents a pearly appearance.

Fabricius appears to have considered this species a variety of his *T. cinerarius* (not Linné's species of that name), which is the *T. Grœnlandicus* of Chemnitz. Broderip and Sowerby's specific name *striata* (1829) has precedence of Couthouy's (1839) by ten years; but we have already a Linnean species of the same name. It is possibly the *Margarita arctica* of Leach; although his description in the Appendix to Sir John Ross's voyage (1819) is too vague for determination, and may apply to *T. Grœnlandicus*; it is "*M.* purpurascente carnea—tenuiter striolata, operculo testaceo."

I notice this and a few other species which are common in the arctic seas, because I am able to give a description of the animal.

Trochus umbilicalis, Broderip and Sowerby.

Margarita umbilicalis, Brod. & Sow. in Zool. Journ. vol. iv. 1829, p. 371.

Station 4, 20 fms. Davis Strait (Warham and Harrison, *fide* Hancock). Wellington Channel (Belcher). Lancaster Sound (Sir J. C. Ross). Loom Bay, Spitzbergen (Eaton)! Arctic Expedition, 1875, F. Pierce Bay, N. lat. 79° 25′, 15 fms.; Discovery Bay, N. lat. 81° 41′, 5½ fms.! Fossil in Kane Valley, N. lat. 82° 33′ (Feilden)!

Body yellowish: *head* horseshoe-shaped and prominent; *tentacles* thread-shaped, covered with very fine and close-set cilia: *eyes* on small bulbs at the outer base of the tentacles: *foot* long and slender; pedal filaments numerous, ciliated like the tentacles, each filament provided with an ocellus or eye-spot at its outer base; there are six on each side, and several other smaller (some of them double) filaments at the end or tail of the foot. The animal differs from that of *T. Grœnlandicus* (which is found with it) in having shorter and less slender tentacles, and in *T. Grœnlandicus* being destitute of caudal filaments.

It is Möller's variety *lævior* of *T. Grœnlandicus*; but I believe they are distinct species. I have specimens of each from Spitzbergen agreeing in size and the height of the spire. *T. umbilicalis* has a more expanded shape and thinner texture; and the umbilicus is always more open and wide. The sculpture varies in both.

Not *T. umbilicalis* of Da Costa, which is *T. umbilicatus* of Montagu, and *T. umbilicaris* of Pennant, but not of Linné. Such a ringing of the changes is inconvenient.

Trochus olivaceus, Brown.

Turbo olivaceus, Brown, Illustr. Brit. Conch. 1827, pl. 46. f. 30, 31 (no page).

Body milk-white: *head* semicircular, finely and regularly notched in front, and having on each side a small triangular lappet: *tentacles* thread-shaped and slender, covered with close-set and microscopic cilia: *eyes* placed on small bulbs at the outer base of the tentacles: *foot* broad, rounded and double-edged in front, bluntly pointed behind; appendages 3 on each side on the upper part of the foot, shortish, finely ciliated like the tentacles. Animal active.

Station 3, 100 fms.; 4, 20 fms.; 5, 57 fms.; Holsteinborg, 10 fms. Greenland (Möller)! United States, north of Cape

Cod! Nova Scotia, Newfoundland, and Gulf of St. Lawrence! Wellington Channel, 78 fms. (Belcher)! Arctic Expedition, 1875, N. lat. 81° 41′, 5½ fms.; F. Pierce Bay, N. lat. 79° 25′ (Feilden)! Spitzbergen, 25–40 fms. (Torell)! Norway, 350–400 fms. (Verkrüzen). Skye, 20–30 fms. (M'Andrew)! Fossil: Greenock (Ker, *fide* Brown); Uddevalla (Crosskey and Robertson)!

Height of spire variable. The minute spiral sculpture was not noticed by Brown or Möller.

This is the *Margarita argentata* of Gould (1841), *M. glauca*, Möller (1842), and *M. Harrisoni* of Hancock (1846); latter two from the types.

Trochus Vahli, Möller.

Margarita Vahlii, Möll. Ind. Moll. Grœnl. p. 8.

Station 4, 20 fms.; Holsteinborg, 12 fms. Greenland (Möller, Amondsen). Spitzbergen (Torell)!

"One of sea's rich gems."

Littorinidæ.

Littorina obtusata, Linné, var. *littoralis* or *limata*.

Godhavn and Holsteinborg.

Nerita littoralis, L., *Littorina palliata*, Say, and *L. limata*, Lovén, may be regarded as local and arctic varieties of the first-named species. I noticed this in the list of shells for Captain Burton's work on Iceland. *Nerita littoralis*, var. (β in the second edition of the 'Fauna Suecica'), is probably a variety of *Neritina fluviatilis*. *L. rudis* is even more polymorphous than *L. obtusata*.

Rissoa arenaria, Mighels and Adams.

Cingula arenaria, Migh. & Ad. in Boston Journ. Nat. Hist. iv. (1842) p. 49, pl. 4. f. 24.

Body yellowish-white, with a faint tinge of pink: *head* snout-like, rather long, and cloven vertically: *tentacles* club-shaped, ciliated at the tips only: *eyes* placed on the outer base of the tentacles: *foot* long, slender, rounded and double-edged in front, bluntly pointed behind; no caudal filament could be detected.

Godhavn, 5–20 fms.; Station 4, 20 fms.; Holsteinborg, 10–35 fms. Greenland (Eschricht, and coll. Möller)! Casco Bay, United States (Mighels and Adams). Newfoundland, and Vadsö in Finmark (Verkrüzen)! Spitzbergen (Torell)! Bohuslän, 30–40 fms. (Lovén, as *Rissoa Jeffreysi*)!

Smaller and more conical than *R. castanea*; the colour is pale yellowish-brown, instead of dark chestnut; and some specimens are "subplicate longitudinally," as described by Mighels and Adams.

The late Professor Stimpson changed the specific name to *Mighelsi*, on the ground that this species was not the *Turbo arenarius* of Montagu; but no shell of that name was even mentioned by Montagu. *Helix arenaria* of Maton and Rackett (*Turbo arenarius* of Turton) is *Odostomia decussata.*

Rissoa castanea, Möller.

Rissoa castanea, Möll. Ind. Moll. Grœnl. p. 9.

Body whitish, with a tinge of pale brown: *head* bilobed and prominent: *tentacles* club-shaped, ciliated at the edges and more distinctly at the tips: *eyes* on small bulbs at the outer base of the tentacles: *foot* oblong, squarish and double-edged in front, with angular corners, bluntly pointed behind; no caudal filament could be detected. Rather common.

Godhavn, 5–20 fms.; Station 4, 20 fms.; 5, 57 fms.; Holsteinborg, 10 fms. Greenland (Möller). Davis Strait, 30–70 fms. (Sutherland, *fide* S. P. Woodward). Gulf of St. Lawrence, New Brunswick, and Labrador (Whiteaves). Newfoundland (Verkrüzen). Iceland and Spitzbergen (Torell)!

Rissoa globulus, Möller.

Rissoa globulus, Möll. Ind. Moll. Grœnl. p. 9.

Body pale yellowish-white: *head* snout-like, bilobed or cloven vertically: *mouth* small and pursed up or contracted: *tentacles* club-shaped, serrated or notched at the edges, and having a few cilia at the tips: *eyes* round, black, on the outer base of the tentacles: *foot* proportionally long, rounded and double-edged in front, and bluntly pointed behind; no caudal filament observable. Very common. Feeds on *Laminariæ*. Swims on its back, and spins a byssal thread.

Station 4, 20 fms.; 5, 57 fms.; Holsteinborg, 3–35 fms. Greenland (Möller, Eschricht)! Casco Bay, United States (Mighels and Adams). Gulf of St. Lawrence (Whiteaves). Spitzbergen (Torell)! Vadsö, Norway (G. O. Sars).

Not *Cingula latior* of Mighels and Adams (Bost. Journ. Nat. Hist. iv. p. 48, pl. 4. fig. 22), a specimen of which I dredged on the coast of New England in 1871.

Turritellidæ.

Turritella erosa, Couthouy.

Turritella erosa, Couth. in Boston Journ. Nat. Hist. ii. (1839), p. 103, pl. 3. f. 1.

Body lemon-colour above, whitish underneath: *head* or snout long, cylindrical and flexible, wrinkled across, cloven in front, restlessly moving about: *tentacles* long, slender and flattened, with rather blunt tips: *eyes* black and round, sessile on the tentacles at their outer base: *foot* thick and long, rounded and double-edged in front, with ear-shaped corners or flaps, bluntly pointed behind: *opercular lobe* large and thin: *operculum* round and multispiral, with the nucleus in the centre; the edges of the whorls overlap, as in *T. terebra*. Not shy, and more tenacious of life than most of the other arctic Mollusca. This survived and crawled about in fresh sea-water, after being sifted from a heap of stuff, which had been dredged six days and was in a putrid state.

Godhavn, 5–80 fms.; Station 1, 175 fms.; 3, 100 fms.; 4, 20 fms.; 5, 57 fms.; Holsteinborg, 12 fms. Greenland (Möller, Amondsen). Gulf of St. Lawrence to Cape Cod, 20–106 fms. Spitzbergen (Torell)! Fossil at Bridlington!

The composition of the shell appears to be less compact or homogeneous than in its congeners, and to be peculiarly liable to the corrosive action of some acid in the sea-water. See the remarks of Mr. Justice Grove in the Introduction to 'British Conchology,' vol. i. pp. lii–liv. In full-grown shells the remaining top whorl is closed by a hemispherical plug of shelly matter, the apex never being perfect. The young is less conical and more cylindrical than *T. acicula*, and the sculpture is different. *T. Eschrichtii* of Middendorff, from Sitcha Island, is allied to the present species, but (judging from his description and figure) must be distinct.

It is the *T. clathratula* of Mr. S. V. Wood, 1848.

Turritella reticulata, Mighels and Adams.

Turritella reticulata, Migh. & Ad. in Boston Journ. Nat. Hist. iv. (1842), p. 50, pl. 4. f. 19.

Body yellowish-white, with a faint tinge of brown: *head* snout-shaped, thick and strong, cloven in front, and wrinkled across: *tentacles* awl-shaped; tips blunt; edges smooth: *eyes* placed on small bulbs at the outer base of tentacles: *foot* broad, triangular, squarish and double-edged in front, with drooping corners, rounded or bluntly pointed behind. Sluggish.

Station 1, 175 fms.; 4, 20 fms.; 5, 57 fms.; Holsteinborg, 10 fms. Greenland (Möller). Davis Strait, 30–70 fms. (Sutherland, *fide* S. P. Woodward). Gulf of St. Lawrence, 20–50 fathoms (Mighels and Adams, Whiteaves). Newfoundland (Willis). Nova Scotia (Stimpson)! Spitzbergen (Kröyer, Torell)!

T. lactea of Möller, 1842.

Scalariidæ.

Acirsa Eschrichti, Holböll.

Scalaria Eschrichti (Holb.), Möller, Ind. Moll. Grœnl. p. 10.

Station 4, 20 fms. Greenland (Holböll, Barrett)! Spitzbergen (Torell)! Murray Bay, Canada (Dawson). Eastport (Verrill). Newfoundland (Verkrüzen); a fragment! Fossil: coasts of Antrim and Aberdeenshire; Uddevalla; Canada (Bayfield, *fide* Lyell)?

In my list of species which I considered Greenlandic, but not North-American nor European ('Proceedings of the Royal Society,' vol. xxv. no. 173, pp. 193 and 194), I included this species from an oversight. It is both North-American and European. Mörch regarded his *Acirsa* as a subgenus of *Scalaria*; but I would venture to raise it to generic rank, for the following reasons. The lips of the mouth in *Acirsa* are not continuous and thickened, so as to form a peristome; the apex of the spire is blunt, instead of being finely pointed; and the peculiar variciform ribs of *Scalaria* are wanting.

Herr Weinkauff's collection of Algerian shells contains a ribless and worn specimen of *Scalaria crenata*, Linné, which, at first sight, looks like *Acirsa Eschrichti*, and was mistaken by the Marquis de Monterosato and myself for that shell (see his 'Notizie intorno alle Conchiglie Mediterranee,' page 40, and the 'Journal de Conchyliologie' for January 1877, p. 38); but on closer examination I find that the lips of the mouth in the Algerian shell are thickened and continuous, the whorls are convex instead of compressed and somewhat angulated at the base, and it shows traces of the punctate sculpture and infrasutural notches which are peculiar to *S. crenata*.

Synonyms: *S. borealis*, Beck (1839), probably, but without description; *S. undata*, Sowerby; *Turritella hibernica*, Waller. *S. subdecussata* of Cantraine (*Mesalia striata*, A. Adams) belongs also to the genus *Acirsa*.

Acirsa prælonga *, Jeffr.

SHELL having the shape of a long and graceful obelisk, rather solid, opaque, when living probably glossy: *sculpture*, numerous fine, curved, longitudinal striæ or riblets, and 5 thread-like spiral striæ on each whorl; of these last the bottom or suprasutural stria is the strongest and forms a keel round the base, which is smooth and somewhat excavated; the part below the suture (about one third of each whorl) is also destitute of spiral striæ; in one specimen the uppermost

* Very long.

of these striæ is more prominent than the three below it, so as to give an angulated appearance to the whorls; the two sets of striæ cross one another, the result being a faint cancellation; top whorls smooth: *colour* whitish: *spire* slender; apex blunt: *whorls* 12–15, convex, gradually enlarging: *suture* deep: *mouth* roundish-oval: *outer lip* thin: *inner lip* folded back a little at the base. L. 0·7. B. 0·125.

Station 12, 1450 fms.; two imperfect specimens. 'Porcupine' Expedition, 1870, off the coast of Portugal, 994 fms.; a single specimen.

One of the 'Valorous' specimens, which is fragmentary, measures 0·15 inch in breadth, and shows that the shell attains greater dimensions than those given in the above description. It is a very elegant species.

Pyramidellidæ.

Odostomia albula, Fabricius.

Turbo albulus, Fabr. Fn. Gr. p. 394.

Body milk-white, with a faint tinge of yellowish-brown: *head* snout-like, cloven in front, with smooth or plain edges; *tentacles* compressed, leaf-like or triangular, and folded inwards; the edges are microscopically notched or saw-like, but not ciliated: *eyes* small, sessile on the inner bases of the tentacles: *foot* rather short and thick, closely ciliated in front, with the cilia in active and incessant motion, squarish and having slightly angular corners, bluntly pointed behind: *operculum* ear-shaped, thin, paucispiral, marked with flexuous striæ, and similar to that of other species of *Odostomia*. The animal is very shy or sluggish.

Holsteinborg, 10 fms. Greenland (Fabricius, Möller). Spitzbergen Is-sound, 50 fms. (Torell)! North Japan (St. John); variety, anfractibus minus convexis! Some of the Japanese specimens have on the pillar a slight indication of the usual fold or tooth. Mr. A. Adams described this variety as *Menestho sulcatina*.

The specific name is too much like *albella*; but it may be more inconvenient to change it. Otherwise I would have proposed *Fabricii*.

I cannot distinguish this species from *Odostomia* by any generic character. The animal is similar; and the shell has the same heterostrophe and inverted apex. Möller says also that it wants the lingual membrane or odontophore. He also noticed the operculum, which Fabricius could not detect—"operculum nullum." It is the type of Möller's genus *Menestho*. Menke says, in his 'Zeitschrift für Malakozoologie' for 1844, page 12, that *Menestho* stands between *Scalaria* and *Velutina*. His allocation of other genera constituted by Möller are less happy: e. g. *Amaura*, between *Natica* and *Margarita*; and *Admete*, between *Mitra* and *Lottia*. It is certainly not the *Monoptygma* of Lea, which has an obliquely spiral fold on the pillar. Couthouy placed a North-American species (*striatula*), allied to the present, in Brown's genus *Pyramis*, the type of which is *Eulima subulata*. *Pyramis striatula* of Couthouy has been referred by Stimpson and Binney to the *Menestho albula* of Möller; but it is very much larger and more cylindrical, and the sculpture is different.

O. albula appears to be the sole representative in the Arctic seas of the numerous family of Pyramidellidæ.

XX.—*Description of* Niphargus puteanus, *var.* Forelii. By Alois Humbert*.

The existence of Amphipod Crustaceans living in wells and more or less deprived of visual organs was indicated in 1835 at Paris and in Germany. MM. P. Gervais and C. L. Koch, who were the first to discover them, referred them to the genus *Gammarus*. Some years later, Schiödte, who had discovered a species of the same group in the caverns of Carniola and Istria, perceived that these subterranean crustaceans deserve to form a distinct genus, to which he gave the name of *Niphargus*, which is now generally adopted.

A great number of memoirs have since been published upon these animals; and these have furnished us with much information as to their organization and geographical distribution. New species of the genus *Niphargus* and even new genera allied to the latter have been discovered, both in the subterranean waters of wells and caverns and in the sea. Finally, in 1869 M. F. A. Forel indicated for the first time the existence of blind Gammaridæ (*Niphargus*) in the depths of the lake of Geneva, and in 1873 he found the same animals in the lake of Neuchâtel.

Although we may say that our knowledge of the Crustacea of this group has been greatly extended, we must unfortunately add that the subject still presents many doubtful points, and

* Translated by W. S. Dallas, F.L.S., from an abstract by the author in the 'Bibliothèque Universelle: Archives des Sciences,' 15th January, 1877, pp. 58–75. The original paper appeared in the 'Bulletin de la Société Vaudoise des Sciences Naturelles,' tome xiv. (1876), pp. 278–398, pls. 6 & 7.

that the most divergent opinions are still entertained as to the value of the different specific and generic forms.

The *Niphargi* observed by Caspary, Hosius, and De la Valette-St.-George were described under the name of *Gammarus puteanus*, invented by C. L. Koch. Schiödte distinguished two other species in his genus *Niphargus*, which also includes this *Gammarus puteanus*. One of these, obtained from the Austrian caverns, is his *N. stygius*; the second, found in a well in England, is his *N. aquilex*. Spence Bate has introduced two new species under the names of *N. fontanus* and *N. Kochianus*. Costa has described a *Gammarus longicaudatus*. Joseph has indicated a new species from the caverns of Carniola under the name of *G. orcinus*. Czerniavski has described a *Niphargus ponticus* from the Black Sea. Lastly, we must also refer to an old species described by Leach under the name of *Gammarus subterraneus*. The genus *Eriopis*, established for a marine species (*E. elongatus*) found off the shores of Scandinavia at a depth of from 40 to 60 fathoms, seems to be synonymous with *Niphargus*. Finally we have to mention a very nearly allied but easily distinguishable generic group, the genus *Crangonyx*, Sp. Bate, the only known species of which (*C. subterraneus*) has been found in a well in England.

According to M. de Rougemont*, to whom we are indebted for the latest work published on this subject, a great part of these specific and generic names ought to disappear, as they apply only to different forms simply representing the successive stages of development of a single species. Among the specimens collected by him in a well at Munich, M. de Rougemont has found five distinct forms, which, however, are transformed one into the other. The first, which is from 2 to 4 millims. in length, corresponds with *Crangonyx subterraneus*, Sp. Bate, and *Gammarus pulex minutus* of Gervais. The second, varying between 3 and 6 millims., is the *N. Kochianus*, Sp. Bate. The third, measuring from 5 to 8 millims., is referred to the *Gammarus puteanus* of Caspary and Hosius. The fourth (12–14 millims.) is assimilated to the *N. fontanus*, Sp. Bate †. The fifth (12–18 millims.) is determined as the

* Philippe de Rougemont, 'Naturgeschichte von *Gammarus puteanus*, Koch,' Inauguraldiss., 8vo, pp. 40, Munich, 1875. More recently M. de Rougemont has published in French, under the title of 'Etude sur la Faune des eaux privées de lumière' (4to, with 5 plates, Paris, 1876), a memoir, which contains a translation of that above cited, together with a description of *Asellus Sieboldii* and observations on a *Hydrobia* found in a well at Munich.

† We reproduce this synonymy with great reserve, because there are contradictions between M. de Rougemont's text (p. 23) and his table of species (p. 29) with regard to the third and fourth forms.

N. stygius of Schiödte and the *N. puteanus* of Koch. To these five forms observed at Munich, M. de Rougemont adds a sixth found in a well at Neuchâtel, and measuring 33 millims. in length. Besides its colossal dimensions, the specimen from Neuchâtel is distinguished by a considerable number of joints (51) in the superior antennæ, and by the almost complete disappearance of the accessory flagellum, which only shows itself in the form of a mere spine.

It is to be regretted that the author, who has himself dredged *Niphargi* in the lake of Neuchâtel, does not tell us whether these Crustaceans fall under any one of the six forms which he establishes for the Gammaridæ of the wells.

M. de Rougemont was struck with the discovery in a single well of five different forms, and found it difficult to believe that five species so nearly allied to each other should live together in so limited a space. He sought in vain for small specimens representing the young condition of the larger forms. Out of about a hundred individuals he found none of the dimensions of 2–4 millims. which approximated to the form which attains 18 millims. He then asked himself, whence came these large individuals? and he arrived at the conclusion that these five forms are not species, but only different stages of development of one and the same species, namely *Gammarus puteanus*, Koch.

Thus, according to him, something of the same kind would take place here as in the case of the salmons, which, when they are not more than 6 inches long, already present completely developed reproductive organs and nevertheless continue to grow until they attain a length of 5 feet. In the *Gammari*, as in the salmons, characteristic forms would seem to make their appearance as the animal increases in age. This naturalist isolated certain forms, with the object of ascertaining whether they really underwent metamorphoses. His experiment was successful. He saw individuals pass by change of skin from the first form (*Crangonyx subterraneus*) to the second (*Niphargus Kochianus*); and he also observed the transformation of the fourth form into the fifth. Hence the author concludes that the genera *Crangonyx* and *Niphargus* must not be separated, since they only represent different states of one and the same species. He goes even further, and proposes the suppression of the genus *Niphargus*, which he regards as being nothing more than the result of a modification of *Gammarus pulex*.

The facts upon which M. de Rougemont relies are doubtless very curious and of much significance. It cannot be denied that we have in them observations worthy of the utmost attention on the part of zoologists. I think, however, that we cannot without reserve accept all the combinations of species and genera proposed by this author. Side by side with very interesting observations expounded most ingeniously, M. de Rougemont's memoir contains a certain number of weak points, which prevent our being completely convinced by it. In the first place the discordancy between different parts of the text with respect to the arrangement of the old species under the different forms observed leaves room for doubt as to the validity of the proposed identifications. Other things also increase our distrust in this respect. Thus fig. 4 on pl. i. represents the last two joints of a foot, reputed to be those of the two anterior pairs of the fourth, fifth, and sixth forms. Now if we compare this figure with that given by Bate and Westwood of *Niphargus fontanus*, it will be seen to differ completely. The species of the English authors would be still more difficult to recognize in fig. 3, which represents the second and third forms.

The figures of the two anterior pairs of feet of the first form are different from those given by Bate and Westwood for *Crangonyx subterraneus*; and it is the more difficult to decide whether M. de Rougemont really had this genus under his hands, because he does not tell us whether his specimens presented the entire telson and the last pair of feet with a single unjointed ramus, which are important characters serving to distinguish *Crangonyx*.

Lastly, my observations on the *Niphargi* of the Lake of Geneva do not agree with those of M. de Rougemont. Among the animals of this genus communicated to me by M. Forel, some are very small, measuring 2 millims. from the front of the head to the extremity of the last saltatory feet. These individuals ought therefore to take their place under the first form of M. de Rougemont, including all the specimens from 2–4 millims., and consequently correspond to *Crangonyx subterraneus*, Bate. But this is by no means the case. These young individuals undoubtedly present certain differences dependent on age, and consisting in a much smaller number of joints in the antennæ, a smaller quantity of setæ upon the different parts of the body, &c. But as to the generic characters properly so called, they are already well marked; and in particular *the first two pairs of feet have already the same form as in the adult, and the telson is deeply cleft.*

It seems to me, therefore, that whilst we must take account of M. de Rougemont's observations as furnishing a very valuable indication of the metamorphoses which the crustaceans of the group under consideration may undergo, we cannot yet definitely accept the changes which he proposes in the classification of the forms hitherto observed. I have therefore provisionally retained the genus *Niphargus*, modifying it and completing its diagnosis.

In the state of confusion which prevails at present among the species of this genus their determination is difficult, whether we accept the arrangement of Schiödte and Spence Bate, or, like De Rougemont, only regard the forms described as representing the successive phases of a single type.

The *Niphargus* of the Lake of Geneva, and that which I have found in a well in the environs of Geneva, although very different in size and presenting some slight differences of organization, did not seem to me to need separation otherwise than as varieties. This point once settled, I had to inquire whether the species was new, or whether it fell under one of those which were already described. It seemed to me to be quite distinct from *N. aquilex*, *fontanus*, and *stygius*, and, although more nearly allied to *N. Kochianus*, could not be confounded with it.

As to the six forms of M. de Rougemont, there is not one to which I could with any probability or confidence refer those which I have before me. The figure given by that author representing the last two joints of a foot of the fourth, fifth, and sixth forms, resembles these same parts in my specimens; but as I have already stated, that figure is not in accordance with some of those of the authors quoted.

It will be always difficult to arrive at a decided opinion with regard to the *Gammarus puteanus* of Koch, which is described and figured in a very unsatisfactory manner. Nevertheless the name given by Koch has been in a manner fixed in science by the memoirs of Caspary and Hosius, who have given very good figures of the species. Thus it seems to me that, until the contrary is proved, we may regard the name of *Gammarus puteanus* as applying to the species which has been described and figured by these two authors. Now it is to this that my two varieties seem to approximate most closely, notwithstanding slight differences in the proportion of the propoda of the first two pairs of feet. I have consequently adopted for the species the name of *Niphargus puteanus*, Koch, distinguishing each of the two local varieties, however, by a special name: the form from the Lake of Geneva is *Niphargus puteanus*, var. *Forelii*; and that found in a well at Onex, *N. puteanus*, var. *onesiensis*. I have completely described only the former, and contented myself with indicating the differences which exist between it and the second form by placing in a tabular form those which seemed to me well marked. A detailed comparison with the type of the preceding authors is impossible, because the latter has not been described with sufficient exactitude.

In my memoir there will be found a very detailed description of the species, founded upon the examination of a great number of specimens, which M. Forel had the kindness to furnish me with. I hope I have thus brought out characters derived from organs which are often too much neglected, at the same time avoiding the mention as specific of purely individual peculiarities. I shall content myself here with indicating some points in the organization of these crustaceans which seem to me more particularly to deserve the attention of anatomists.

Of the authors who have treated of the species of the genus *Niphargus*, some say positively that the eyes are deficient; others that they are without pigment and not apparent, which is as much as to say that they have not perceived them; others, again, describe them as yellow or as imperfectly formed. M. Plateau asserts that they exist, but are destitute of pigment. It appears, however, from his memoir that he did not see them, and only convinced himself of their existence by physiological experiments, which proved to him that the *Niphargi* were sensible of light. M. de Rougemont saw some irregular pigment-spots on the sides of the head; but he does not believe in the presence of an optical apparatus. For my own part, I have been unable to perceive the least trace of eyes or even of a deposit of pigment.

M. de la Valette-Saint-George described and figured some very small organs situated on the dorsal parts of the segments, and composed of a small capsule, from which issues a filament which bifurcates. I have examined these singular organs, to which I have given the name of *sensitive capsules*, in rather more detail, and ascertained that they occur not only on the segments, but also along the anterior margin of the head and on the first two joints of the peduncle of the superior antennæ. The capsule, placed beneath the chitinous envelope, is ovoidal, delicate, transparent, and open at both its poles. Through the exterior orifice issues a hyaline and homogeneous filament, which is straight for the greater part of its length, but is curved towards the end and has its extremity obliquely truncated. A fine dark line, probably indicating a furrow, commences near its origin, and runs as far as its distal extremity. At about $\frac{4}{5}$ of the length of the filament (that is to say, at the point where it begins to bend) a much finer filament detaches itself from the former, on the convex side of the curvature, at an acute angle. This secondary filament, which is very thin at its origin, soon becomes excessively slender and sometimes difficult to follow. Its length somewhat exceeds that of the principal filament. Sometimes only the parts that I have just described exist; but in other cases, which seem to me to be the most frequent, the complication is a little greater. Thus two or three secondary filaments often originate upon the principal one. I have also represented a filament of peculiar appearance, destitute of longitudinal furrow, and emitting from its extremity six or seven secondary filaments, which are slender from their origin, and one of which is particularly elongated.

It is absolutely impossible for me to form any judgment as to the functions of these capsules and their filaments; but, although I have been unable to ascertain the entrance of a nerve into their interior, I think they must have some sensitive function.

The antennæ have several kinds of sensitive organs. Besides the *sensitive setæ* which are organized like those of *Gammarus neglectus*, so well described by Sars, we find in them *olfactory cylinders*, *sensitive capsules*, *olfactory setæ*, and, lastly, what I have called *hyaline bacilli*. These last organs are usually borne by the joints in pairs, from the fourth joint of the flagellum (var. *onesiensis*), or the sixth (var. *Forelii*), to the sixteenth. The last joint also bears a bacillus; but this is much shorter than the others and of a more clumsy form. It is situated quite at the extremity of the joint, like the setæ in the midst of which it is placed.

The bacilli are of pretty uniform diameter throughout, being only a little constricted in their middle region, and slightly inflated in their terminal portion. Their extremity is rounded and completely closed. Their diameter at the base is equal to one half or two thirds of that of the peduncle of the olfactory cylinders; their length is not quite half that of the latter organs. They are entirely pale, without any apparent structure; no enveloping membrane can be distinguished in them. Standing in the same direction as the olfactory setæ and cylinders, they are nearly straight, presenting at the utmost a slight undulation. The length of these bacilli is from 0·033 to 0·038 millim.; that of the last joint is not more than from 0·008 to 0·018 millim. in length.

These organs perfectly resemble those figured by Sars upon the joints of the outer branch of the superior antennæ of *Mysis oculata*. This author only mentions them as "peculiar cylindrical appendages, of a very delicate nature, which occur along the inner border of the first part of this branch."

In a memoir on the sensitive organs of the antennæ in different Crustacea, Claus has figured an antenna of the second pair in a *Cypris*, in which the inner margin of the third joint bears an elongated spadiciform appendage which greatly resembles the hyaline bacilli of *Niphargus*. But in the *Cypris* this organ has, in the first half of its length, a chitinous wall of a certain thickness; and the author says that it is larger in the adults than in the young, and chitinized throughout its length, and then more resembles the organs of this nature that are met with in insects.

I do not know of other figures or descriptions that may be referred to these organs. It is very possible that they have been described in a memoir by Jarschinski*, which I have been unable to consult, and of which I must content myself with reproducing the title from the 'Zoological Record.'

On the inferior antennæ sensitive setæ, hyaline bacilli, and auditory setæ are also met with.

The buccal organs and the feet present extremely varied forms of setæ, the arrangement and number of which exhibit a remarkable constancy in the two varieties which have been comparatively studied.

This is not the place in which to enter into further details as to the structure of these Crustacea. I shall content myself, in conclusion, with reproducing the paragraphs in which I have treated of the habitat of the *Niphargus* of the Lake of Geneva, and discussed the problem of the origin of those crustaceans which inhabit waters destitute of light.

"What is the origin of the blind Gammarids which we find in wells, in caverns, and in the depths of seas and lakes? Such is the problem which cannot fail to force itself upon the minds of all who investigate these crustaceans. Two different solutions of it may be given. It may be assumed that these animals were created such as they are now, because, being destined to live in places deprived of light, they had no occasion for visual organs. This explanation, or, rather, this reply, formerly the only one admitted, now-a-days satisfies only a very small number of naturalists; and many powerful arguments may be brought to bear against it. It will be sufficient to cite a single one, namely the fact that other animals living under the same conditions of obscurity are furnished with perfectly organized eyes. Thus certain *Gammari* of Lake Baïkal, living between 50 and 500 metres, have the eyes well constructed and furnished with black pigment. The *Munidæ*, which are dredged in the sea at depths of 1000–1200 metres and more, have the eyes exceptionally developed and apparently extremely sensitive. The *Gnathophausiæ* dredged by the naturalists of the 'Challenger' between 1830 and 4020 metres have normal pedunculated

* F. Jarschinski, "On the Leydigian organs of the antennæ of the Crustacea Amphipoda," Premier congrès des naturalistes Russes à St. Pétersbourg, 1868, pp. 311–318 (in Russian).

eyes, and over and above these an accessory eye on each of the maxillæ of the second pair.

"The second solution, founded on the theory of transformation, assumes that these blind creatures originate from ancestors furnished with eyes, which have by degrees, under the influence of disuse, lost these organs, which have become useless. One of the best proofs in favour of this view may be drawn from the transitions observed in certain species. In some Gammarids of Lake Baïkal we can ascertain a tendency on the part of the visual organs to become less perfect in proportion as the animal inhabits greater depths. We may cite, as examples, *Gammarus Ussolzewii* (var. *abyssorum*) and *G. Borowskii* (var. *dichrous*, subvar. *abyssalis*). But this transformist explanation, which is now-a-days generally accepted, and which appears to me to be the true one, does not settle the whole problem. It may be asked, among other things, with regard to this or that blind species, whether its origin dates back to a very ancient epoch or is comparatively recent, whether it originated from extinct or from still existing forms. These questions have sometimes been settled by a dash of the pen; and, amongst others, this has been the case with the *Niphargi* of the caves and wells. Nevertheless the problem presents itself in a very complex fashion, and appears to me to necessitate a greater number of observations than we possess at present before it can be regarded as completely solved. I even believe that it is impossible now to arrive at any thing precise with regard to the origin of the *Niphargi*; we can only claim to indicate the probabilities, and to clear the ground by getting rid of some erroneous notions.

"The *Niphargus* of the Lake of Geneva lives at a depth of from 30 to 300 metres. Now, according to the observations of M. Forel*, the chemical action of the solar rays in the waters of the lake ceases to make itself felt in summer below 40 or 50 metres, and in winter below 80 or 100 metres. Consequently, although inhabiting an open sheet of water, this crustacean is subjected, throughout the greater part of the zone occupied by it, to the same conditions of obscurity as its congeners enclosed in wells or caverns. We seem, therefore, to be justified in concluding that it is under the influence of this obscure medium that our species has lost its visual organs. This is the explanation that has been proposed by the naturalists who have sought to account for the origin of the *Niphargi* of wells and caverns. Some have even gone still

* F. A. Forel, "Recherches photographiques sur la transparence de l'eau," Bull. Soc. Vaud. des Sci. Nat. 2^{e} sér. tome xiv. (1874) p. 24.

further and wished to derive them directly from *Gammarus pulex*. I cannot share in this last opinion, which seems to me to be that of a narrow Darwinism; and I think that, both with respect to the *Niphargus* of the Lake of Geneva and to those of other dark places, there are strong arguments to be brought against this theory of *G. pulex* becoming transformed into *Crangonyx* and *Niphargus*. The following are the chief of these objections:—

"1. So far as we know at present, *Gammarus pulex* only descends to a small depth from the surface; and there is a zone destitute of Gammarids, extending between the lower level at which we cease to find *G. pulex* and the upper level attained by the *Niphargus*. This fact would be very difficult to explain if the *Niphargus* originated from *G. pulex*. In this case, on the contrary, we ought to find representatives of this latter species at all depths, and even to meet with individuals establishing a passage between one form and the other.

"2. If the *Niphargi* originated from *Gammarus pulex*, and had in their youth, as asserted by M. de Rougemont, the form of *Crangonyx subterraneus*, we should find ourselves face to face with facts completely opposed to the general laws of development. We know, in fact, that the characters which separate two representatives of the same group are less marked in youth than in the adult state. Forms which resemble each other during the first phases of their development may subsequently diverge in a very striking manner. This embryogenic and phylogenic law is particularly verified among the Crustacea, in which affinities which are strongly marked in the larvæ almost entirely disappear in the adult animal. Now what do we see in the Gammarids before us?

"In the *Gammari* proper the last pair of saltatory feet are biramose; *Gammarus pulex* even has the two branches nearly equal. The *Niphargi* have these branches very unequal, but both of them still exist. In *Crangonyx*, on the contrary, there is only a single branch. The *Crangonyches*, therefore, in this respect, represent a type further removed from *G. pulex* than the *Niphargi*. We could understand, therefore, a development in which the second branch inherited from the ancestor would exist during youth, and afterwards disappear, by atrophy, at a more advanced age—in other words, a *Niphargus*-phase afterwards attaining the state of *Crangonyx*. The inverse of this (that is to say, a metamorphosis of the kind observed by M. de Rougemont) appears to us to be discordant with all that we know of the metamorphoses of the Crustacea.

"The same abnormal reversal of the laws of development would also be observed in the case of the telson, which is double in *Gammarus*, of a single piece but deeply cleft in *Niphargus*, and completely entire in *Crangonyx*. By adopting the theory of M. de Rougemont it would therefore be necessary to assume here that the *Niphargi* differ more in their youth than in their adult state from the *Gammarus pulex* from which they originated.

"3. If we consider that *Eriopis* ought to be united with *Niphargus*, it is difficult to understand how these marine Gammarids could have originated from the *Gammarus pulex* of the fresh waters, and get into the North Sea and the Black Sea.

"4. We find the *Niphargi* distributed over a great part of Europe in waters deprived of light, both in wells and caverns and at the bottom of lakes. On the other hand, in Lake Baïkal, so well explored by M. Dybowsky, who has found there ninety-seven species of Gammarids, including *Gammarus pulex*, no species of *Niphargus* appears to exist*. Nevertheless this immense lake presents depths much greater than those of the Lake of Geneva and the Lake of Neuchâtel; and the solar rays, which are more oblique in Siberia than in Switzerland, must make their action felt to a still less depth than in our waters. It may be added that the astonishing number of species which inhabit Lake Baïkal, and the variety of their forms, would tend to make us suppose that this vast sheet of water has a fauna more ancient than that of the Swiss lakes, and that the modificatory causes have consequently had more time there to act upon the species.

"These various considerations lead me to believe that *Niphargus* is an ancient genus descended from a form now extinct, as is evidently the case with *Proteus*, *Leptoderus*, *Anophthalmus*, &c. As to the question whether the *Niphargi* of the lakes are colonies originating from animals of the same genus which inhabit subterranean waters, or whether the reverse is the case, it is difficult to solve, and its solution is even complex. Assuming that the genus *Niphargus* appeared before the glacial epoch, it is impossible to say any thing about its place of origin. But, not to carry the question so high, and considering only the existing fauna, I should be disposed to think that our *Niphargi* of the Swiss lakes have originated from those which inhabit subterranean waters. Having reached the lakes, they would have acclimatized themselves in the depths which present the darkness that they seek. In this more or less obscure zone they found themselves under conditions which allowed them to exist; whilst in the illuminated zone they could not have escaped their enemies, or maintained the struggle against their near allies furnished with visual

* A *Crangonyx* is known from the subterranean waters of Kamtschatka.

organs. Considering the larger dimensions attained by the forms living in wells, it would seem that those of the lakes, although inhabiting much larger pieces of water, are in circumstances less favourable to their development, and are, in a manner, atrophied."

XXI.—*Hermaphroditism among the Parasitic Isopoda. Reply to Mr. Moseley's Remarks on the Generative Organs of the Parasitic Isopoda.* By J. Bullar, B.A., Trinity College, Cambridge.

In the January number of this Journal Mr. Moseley attacks some statements which I had made in a paper on the Generative Organs of the Parasitic Isopoda (Journ. of Anat. and Phys., Oct. 1876). He discredits my discovery of hermaphroditism in this group, and bases his arguments mainly on the supposition that the organs which I have described as testes are, in reality, spermatophores or parts of them.

Before answering Mr. Moseley's objections, I may perhaps be permitted to supplement my previous account of the anatomy of the testes by some facts which, though they do not fully elucidate the development of the spermatozoa, are, I trust, amply sufficient to demonstrate the untenable nature of Mr. Moseley's suggestions.

The testes in these animals consist of three pear-shaped bodies, each invested by a special membrane, which is constricted to form a narrow neck before becoming continuous with the wall of the ovary. In the case of *Anilocra mediterranea*, the narrow portion is elongated to form a short duct. Each of the testes receives at its free end a special bundle of blood-vessels. The testes usually contain numerous spermatozoa, which may be seen passing down along the outer border of the ovary into the vas deferens. In some cases, however, they contain few or no spermatozoa, and are filled with a cellular blastema, from which, doubtless, the spermatozoa are developed.

The position of the testes is so invariable and their structure so uniform, that it is incredible that, had Mr. Moseley seen my preparations (which, I need hardly say, I should have been only too delighted to have shown him, and thus have saved him the trouble of writing his communication) and not merely the drawings, he could have mistaken the testes for spermatophores.

The vas deferens is a narrow duct lined by a flattened epithelium; at its lower extremity it presents an enlargement, and opens into a distinct penis situated on the ventral wall of the last thoracic segment.

The oviduct, which is always present as well as the vas deferens, is a wide tube opening externally at the side of the body, in the segment in front of that which bears the penis. There are some remarkable facts connected with the openings of the generative ducts, for which I must refer the reader to my original paper.

I have never found any spermatozoa in the oviduct, as might have been anticipated if they had been introduced from without; in the vas deferens, as I have said, they are almost always present; and it seems scarcely probable that this duct has the function (without parallel in the animal kingdom) of transporting the spermatozoa from without into the ovary.

Before passing on to Mr. Moseley's objections, it may be well to point out how closely similar in structure are the male organs of the animals I have described to those of *Asellus aquaticus*, a unisexual Isopod which has been so well described and figured by Prof. G. O. Sars (Crust. d'Eau douce).

In order to prove his point, Mr. Moseley is obliged to make the supposition that the vas deferens and penis which I have described are rudimentary. That this is not the case seems to me to be amply proved by the facts (1) that they are quite as large as those found among the unisexual forms, (2) that the vas deferens is usually filled with spermatozoa, and (3) that in a specimen in my possession the spermatozoa may be seen in the act of escaping from the orifice of the penis.

Another objection brought forward by Mr. Moseley is the difficulty he experiences in understanding why spermatophores should be formed in a self-impregnating animal. The explanation which at once suggests itself is that the formation of spermatophores is so common amongst the Crustacea, that it is highly probable that they occurred among the unisexual ancestors of the parasitic Isopods, and that a tendency to their formation was inherited by their hermaphrodite descendants. Now, unless we can show that a spermatophore is a disadvantage to a self-impregnating animal, there is no difficulty in imagining that their formation might be continued.

The last objection brought forward by Mr. Moseley, founded on the immobility of the spermatozoa, is somewhat startling. He says "the immobility of the spermatozoa observed is a fact quite as much in favour of their having been introduced for some time and tired out, as freshly developed and functionally active." Now it is well known that motile spermatozoa are of very rare occurrence among the Crustacea, being found, according to Gegenbaur ('Anatomie Comparée,' p. 426), only in the Cirripedes. It seems that Mr. Moseley, in his anxiety to disprove my results, has had recourse to an hypothesis, viz. that these parasitic Isopoda differ from other Crustacea in having motile spermatozoa, which will be generally admitted to be more improbable than the existence of hermaphroditism in a parasitic animal.

XXII.—*Additions to the Coleopterous Fauna of Tasmania.* By CHARLES O. WATERHOUSE.

THE following Coleopterous insects have just been added to the national collection. In the collection from which they were selected were specimens of *Dorcadida bioculari*s, a species, I believe, not previously recorded from this locality.

MELOLONTHIDÆ.

Telura vitticollis, Er.

The male of this species appears never to have been recorded. It differs from the female in having the eyes very prominent, the club of the antennæ is composed of five long leaflets instead of three, and the elytra are more narrowed towards the base.

HETEROMERA.

Mordella felix, sp. n.

Atra; capite thoraceque aureo-tomentosis, hoc vitta media et utrinque puncto nigris; elytris macula basali fasciisque duabus (una ante medium angulata, secunda transversa ante apicem) aureo-tomentosis; pectore abdomineque albido maculatis.

Long. $2\frac{1}{4}$ lin.

Head and thorax clothed with golden pubescence, the former with a distinct longitudinal impressed line on the vertex; thorax with a round black spot on each side, and a central longitudinal black stripe which is interrupted anteriorly; the posterior margin lobed in the middle. Scutellum golden. Elytra with a short, scarcely oblique spot joining the base near the scutellum, a well-marked fascia a little before the middle in the form of a W, and a transverse spot before the apex, all golden. Underside clothed with whitish pubescence; a triangular spot on each side of the basal abdominal segments and the two anal segments black. Palpi, two basal joints of the antennæ, anterior femora and tibiæ, and spurs to the posterior tibiæ pitchy.

Hab. Tasmania. Brit. Mus.

LONGICORNIA.

PRIONIDÆ.

Tragosominæ.

ENNEAPHYLLUS, gen. nov.

Apical joint of labial palpi slightly elongate, subfusiform, truncate at the apex. Thorax transverse, with a small sharp upturned spine on each side. Scutellum parallel-sided at the base, narrowed at the apex. Elytra elongate, parallel, depressed, not spined at the sutural angle. Prosternum very narrow. Femora not dentate at the apex. Abdomen with the fifth segment emarginate at the apex in both sexes.

♂. Antennæ as long as the whole insect; third joint scarcely longer than the first; the fourth to tenth joints gradually become flatter and slightly increase in length, the third to tenth opaque, each emitting from the apex below a very long flat branch; the eleventh joint long, arched, lamelliform.

♀. Antennæ two thirds the length of the insect, slender and simple; the third joint as long as the two following taken together; the apex of the third and the following joints entirely poriferous below.

This genus should be placed between *Prionoplus* and *Tragosoma*.

Enneaphyllus æneipennis, sp. n.

Elongatus, parallelus, piceus, nitidus; elytris ænescentibus, crebre punctatis; corpore subtus femoribusque testaceis; pectore longe piloso.

Long. 12–15 lin., lat. $3\frac{3}{4}$–$4\frac{1}{2}$ lin.

Head and thorax very thickly and rugosely punctured; the latter a little broader than the head, flattened on the disk, with a single spine on each side. Elytra parallel, somewhat æneous, straight at the base, so that the shoulders, although rounded, are rectangular; the sides very finely margined, obtusely rounded at the apex, and with no sutural spine.

Hab. Tasmania. Brit. Mus.

British Museum, Feb. 20, 1877.

BIBLIOGRAPHICAL NOTICES.

Ostriches and Ostrich-Farming. By JULIUS DE MOSENTHAL, Consul-General of the South-African Republics for France, &c. &c., and JAMES EDMUND HARTING, F.L.S., F.Z.S., &c. With Illustrations. Trübner & Co., 1877.

THIS interesting work appears to have had its origin in the public demand for information consequent upon the exhibition at Vienna by Mr. de Mosenthal, as Commissioner for the South-African Colonies, of an assortment of ostrich feathers from tame birds, and a model of an artificial incubator. Desirous of laying the details of this new and important industry before the public, he was fortunate in obtaining the cooperation of Mr. Harting, who combines the attainments of a scientific naturalist with a flowing and popular style; and as the occasion seemed a favourable one for giving a brief and readable monograph of the Ostrich family, the result has been that what was originally intended to be a mere pamphlet has swelled to the dimensions of a volume of nearly 250 pages—a "process of evolution" of which the reader will, we think, have no reason to complain.

Of the two families, Struthionidæ and Apterygidæ, which make up the order Ratitæ, as at present existing, only the first furnishes members which have up to this time ministered in any important manner to the wants or luxury of man; and, looked at from the purely utilitarian point of view, only two of the five genera into which these families are subdivided have been of much service; for neither the Cassowaries nor the Emus have done more than provide meals and rude clothing for fast disappearing savages, whilst the Apteryx has hardly done even that. Mr. Harting has, indeed, slightly apologized for introducing them into the present work; but we think that under the circumstances he has not exceeded the privilege conceded to an author who is writing a popular treatise; and those who have never read the original accounts of the breeding and domestic economy of the Emu in confinement will doubtless take a lively interest in the present condensed reprint. To have left out the Apterygidæ would have marred the completeness of the monograph; and the space occupied is very brief; whilst it is undoubtedly an advantage to have an abstract of the latest information respecting the *Casuarinæ* in an accessible form, compiled from Mr. P. L. Sclater's papers in the 'Proceedings of the Zoological Society,' and illustrated with reproductions of the heads of the different species.

By far the most valuable portions of the work are undoubtedly those which relate to the Ostrich (*Struthio camelus*), respecting which a full and carefully compiled account is given; and the collation of the reports of various travellers, and the working-out of the geographical range of the species must have involved an immense amount of research on the part of Mr. Harting. We do not feel perfectly satisfied with the evidence adduced as to the occurrence of this species, either in a fossil or in a living state, in any part of India; nor do we consider that the identity of the North-African and Arabian ostrich with the South-African bird is definitely settled; for not only the difference in the plumage of the limited number of specimens available for examination, but also the constant distinctions in the character of the eggs, seem to point the other way. The distinctness of the two species has been upheld by Mr. P. L. Sclater, Mr. A. D. Bartlett, Mr. Gurney, and by that eminent practical authority the late Mr. Andersson, the noted African traveller, who is even inclined to increase the number of species to three, whilst on the other side are Drs. Finsch, Hartlaub, and Blasius junr.; so the matter must be left in abeyance until a larger series of specimens can be examined. An important step has lately been taken by Mr. de Mosenthal in shipping a pair of first-class Barbary birds to South Africa with the view of improving the breed of the Cape Ostrich; and comparison of the birds from the two extremities of the continent may tend to solve the question.

The Swedish traveller, Sparrman, more than a century ago, mentioned the fact of tame ostriches being kept by some of the farmers at the Cape; and Capt. Lyon, in 1820, mentioned the similar fact with regard to North Africa; indeed, up to the present time, a large portion of the feathers from Kordofan are known to be the produce of tame birds, all, however, hatched by female ostriches, and without the aid of an artificial incubator. With the increased demand for feathers it became plain to all reflecting minds that there was a great risk of the extermination of the wild birds at no distant period; and in 1859 the Acclimatization Society of Paris offered premiums for the successful domestication of the species in Senegal and Algeria, and for breeding ostriches in Europe. Prince Démidoff was to some extent successful at Florence; and similar experiments, with satisfactory results, were made at Marseilles, Grenoble, and Madrid. It was, however, reserved for the colonists at the Cape to carry out the plan on a large scale; and of the rapid rise and results of this new industry some idea may be formed when we read that, although only commenced in 1866, the number of tame ostriches at the census of 1875 amounted to no less than 32,247. Of these a considerable number have been hatched out by Douglas's incubator, by means of which Mr. John Noble succeeded in rearing in a single season from six ostriches (four hens and one cock) one hundred and thirty birds! This is a vast improvement upon the wholesale slaughter formerly necessary to provide plumes for the European market; for although the feathers of the wild birds have a crispness which no "tame feathers" possess, yet the demand for the second class is sufficient to make ostrich-farming a very profitable business. Contrast the state of things in the Argentine provinces, where the unfortunate Rhea, or South-American Ostrich, seems in a fair way of extermination, nearly half a million having been slaughtered annually for some years, without any compensation in the way of artificial production. Respecting the habits, manner of hunting, and the characteristic distinctions of the two species found in the southern portions of the American continent, a long account is given; and it is somewhat amusing (as throwing light upon many "trade" names) to learn that the best feathers of the Rhea are known as *Vautour* plumes, whilst the white and half-white ones are termed *gerbes indiennes*, or Indian sheaves. It is much to be regretted that the unenterprising half-breeds who inhabit a large portion of the River-Plate States should never have made any attempt to protect and foster these handsome birds; for the experiment of M. Vavaseur in France, after an experience of fifteen years in Uruguay, shows that in a civilized country, and one not in a state of chronic revolutionary disturbance, there is no difficulty in farming Rheas as well as Ostriches.

For further details we must, however, refer our readers to the work itself, every page of which is replete with interest, as well as really novel and valuable information.

On the Foraminifera of Barbadoes. (*Etude sur les Foraminifères de la Barbade, &c.*) By M. Ernest Vanden Broeck, &c. 8vo. 98 pages, with 2 plates. Brussels, 1876. (From the 'Annales de la Soc. Belge de Microscopie.')

This memoir on some recent Foraminifera collected by the late L. Agassiz at about 100 fathoms depth, near Barbadoes, in the West Indies, is of considerable interest on account of the careful treatment of the Microzoa under notice, the elegant and trustworthy illustrations, and the enlightened views of Foraminiferal classification and nomenclature which the author clearly and earnestly advances.

The series of forms is not numerous, but very interesting as varieties and subvarieties of well-known types; and these serve as a groundwork for a thoughtful exposition of the principles of classification adopted by Von Reuss in Germany and by Carpenter and others in England. The Foraminifera described and figured are:—

Lituola Soldani, *P. & J.*, var. intermedia, *nov.*
Dentalina obliqua, *L.*, var. sulcata, *Nils.*
D. nodosa, *D'Orb.*
D. communis, *D'Orb.*
D. communis, *D'Orb.*, var. obliqua, *D'Orb.*
D. communis, *D'Orb.*, var. annulata, *Rss.*
D. pauperata, *D'Orb.*
Marginulina glabra, *D'Orb.*
Cristellaria rotulata, *Lm.* (passing into C. vortex, *F. & M.*).
C. cultrata (*M.*).
Frondicularia alata, *D'Orb.*, var. sagittula, *nov.*
Frondicularia alata, *D'Orb.*, var. lanceolata, *nov.*
F. complanata, *Defr.*, var. concinna, *nov.*
Globigerina bulloides, *D'Orb.*, var. cretacea, *D'Orb.*
G. bulloides, *D'Orb.*, var. rubra, *D'Orb.*
Textularia trochus, *D'Orb.*
Verneuilina communis (*D'Orb.*).
Pulvinulina Menardii (*D'Orb.*), var. cultrata (*D'Orb.*).
Polymorphina lactea (*W. & J.*) and Truncatulina lobatula (*W. & J.*) are also described and commented upon.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

June 7th, 1876.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On the British Fossil Cretaceous Birds." By Harry Govier Seeley, Esq., F.L.S., F.G.S., Professor of Physical Geography in Bedford College, London.

In this paper the author gave an account of the remains of birds which have been collected from the Cambridge Upper Greensand.

Of the head, the only portion yet recognized is the part of the brain-case behind the parieto-frontal suture. It indicates a skull as large as that of the red-throated Diver, which it resembles in details of structure. The vertebral column is represented by lower cervical vertebræ, which have the centrum small and compressed from side to side. The dorsal vertebræ are also small, are rounded on the underside as in the Gannet, and often have the articular ends biconcave, or have a concavity in the centre of the saddle. There were transverse processes as in modern birds; and the ribs had a similar double articulation. The sacrum was unusually large, and included many vertebræ. Its anterior end resembles that of a Gull's sacrum, in being flattened or concave. The vertebræ are rounded anteriorly, and distinguishable from each other; but posteriorly they are blended, and resemble the postarticular part of the sacrum of the Diver. Some small vertebræ were thought to be caudal, and considered to be probably elements of the ploughshare.

No trace of any bone of the anterior limb has been detected; while of the hinder limb, the femur, tibia, fibula, and tarso-metatarsus are all known. The femur and tarso-metatarsus are the bones most like those of the Diver. The fibula is unusually large. The tibia has a moderate patelloid process, and shows resemblances to several water birds. The bones are so fragmentary that the size of the animal can only be given roughly as similar to that of the Diver, but with a shorter neck. The affinities of the animal are strongest with *Colymbus*. It also closely resembles Prof. Marsh's Cretaceous genus *Hesperornis*, and, like that genus, may be supposed to have had teeth. The species were described as *Enaliornis Barretti* and *E. Sedgwicki*. Some bones were also described thought to indicate birds in which the extremities of the bones remained unossified throughout life.

"On two Chimæroid Jaws from the Lower Greensand of New Zealand." By E. T. Newton, Esq., F.G.S., of H. M. Geological Survey.

The two jaws which were the subject of this communication form part of the collection of fossils from the Lower Greensand of New Zealand deposited in the British Museum by Dr. Hector. One of the specimens, a right mandible, was referred by the author to *Ischyodus brevirostris*, Ag., a species from the Gault of Folkestone, hitherto known only by name, no description or figure of it having been as yet published. Through the kindness of the Earl of Enniskillen, the original type specimen of this species was exhibited to the Society. The author then described a perfect mandible from the Cambridge phosphatic deposits, and stated that the examination of a large series of specimens showed a considerable variation in the form of the teeth in different individuals. The New-Zealand mandible was then compared with these British specimens, and was said to differ less from some of them than they did among themselves.

The second specimen, a small right maxilla, possessing but one tooth, and this of a peculiar form, was compared with the corresponding bone in *Ischyodus*, *Edaphodon*, *Elasmodus*, *Ganodus*, *Chimæra*, and *Callorhynchus*. The form of the tooth appeared to agree better with that of the last-named genus than with any of the others; and the author therefore proposed to call it, in allusion to the form of the tooth, *Callorhynchus Hectori*.

"On a Bone-bed in the Lower Coal-measures, with an enumeration of the Fish-remains of which it is principally composed." By J. W. Davis, Esq., F.L.S., F.G.S.

In this paper the author described a thin bed composed chiefly of remains of fishes, which rests immediately upon the "Better-bed Coal" of the Lower Coal-measures in Yorkshire. The bed varies from a quarter to five eighths of an inch in thickness, and is overlain by a thick bed of blue argillaceous shale, containing remains of plants. The author described the order of the deposits both above and below the "Bone-bed," and gave a list of the organisms of which remains are found in the latter, including species of *Gyracanthus*, *Ctenacanthus*, *Lepracanthus*, *Acanthodes*, *Pleuracanthus*, *Orthacanthus*, *Diplodus*, *Pleurodus*, *Helodus*, *Cladodus*, *Pœcilodus*, *Petalodus*, *Harpacodus*, *Ctenoptychius*, *Megalichthys*, *Holoptychius*, *Strepsodus*, *Acrolepis*, *Platysomus*, *Acanthodopsis*, *Amphicentrum*, *Rhizodopsis*, *Cycloptychius*, *Gyrolepis*, *Palæoniscus*, *Cœlacanthus*, and *Ctenodus*. The author also described spines which he regarded as indicating two new genera of Elasmobranchs—one probably allied to *Pleuracanthus*, and the other (*Hoplonchus*) allied to *Onchus* and *Homacanthus*. Bones belonging to the Labyrinthodont genus *Loxomma* are met with rarely in the deposit.

"Note on a Species of Foraminifera from the Carboniferous formation of Sumatra." By M. Jules Huguenin.

The author described some globular Foraminifera, belonging or allied to *Fusulina*, from a Carboniferous deposit containing *Producti* and *Phillipsiæ*, which occurs N.E. of Padang and S. of the Lake of Singkarak in Sumatra. The author described the structure of these fossils, which he compared with *Fusulina cylindrica* and *F. depressa*, and arrived at the conclusion that they belong to a new genus, to which perhaps the North-American *Fusulina robusta* also belongs.

June 21, 1876.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On the Discovery of Plants in the Lower Old Red Sandstone of the Neighbourhood of Callander." By R. L. Jack, Esq., F.G.S., and R. Etheridge, Jun., Esq., F.G.S.

The authors give an abstract of the various previous references to the existence of remains of land-plants in deposits of Old-Red-

Sandstone age, and mention the following localities in Scotland in which such remains have recently been discovered by them:—1. Buchanan-Castle Quarry, near Drymen; 2. Old Quarry, at small reservoir at Kilmahew; 3. Green Burn, Keltie Water; 4. Keltie Water, above Chapelrock; 5. Keltie Water, below Brackland Linns; 6. Quarry at Kames Farm, near Callander; 7. Quarry at Easterhill, near Gartmore; 8. Quarry in Cameron plantation, near Alexandria; 9. Turnpike road at Overballoch, Loch Lomond; and the localities from which the specimens noticed in this paper were obtained, namely a quarry $2\frac{1}{2}$ miles from Braendam House, and the south-west corner of Muir plantation, near Callander. The plant-remains are described as being of a very fragmentary nature, and as occurring in the two last-named localities in a deposit consisting of greenish-grey flags and thin-bedded sandstones about 500 feet in thickness, the best specimens being in the sandstone. They present the appearance of elongated flattened stems, about 1 inch wide on the average, sometimes represented only by casts, sometimes by black carbonaceous films. They are ornamented with a series of pucker-like depressions when seen from the interior, or with a number of wart-like eminences when viewed externally. The latter are the scars of the points of issue of the vascular bundles passing to the leaves. Along the margins are seen spines or thorn-like projections, which may be the leaves or their bases; these are apparently arranged in spiral rows. Some stems appear to show dichotomous branching. The authors discuss the relationships of these remains with other described Devonian forms, and regard them as most nearly allied to *Psilophyton princeps*, Dawson. They describe the plant with doubt as a species of *Psilophyton*.

"On an adherent Form of *Productus* and a small *Spiriferina* from the Lower Carboniferous Limestone Group of the East of Scotland." By R. Etheridge, Jun., Esq., F.G.S.

The author commenced by summarizing the different views that have been expressed by writers as to the mode of life of the *Producti*, and the function to be ascribed to the spines with which their shells are furnished, in order to show the uncertainty that prevails upon these points. He then described specimens of a small *Productus* found attached to encrinite stems and fragments of Polyzoa, in the shale over the No. 2 Limestone of the Lower Carboniferous Limestone group, chiefly in the neighbourhood of Dunbar. The shells are attached by having some of the spines of the ventral valve wound tightly round the bodies to which they adhere, sometimes singly, sometimes in clusters, the number of spines implicated in the adhesion varying from two to seven or more. The attachment took place during the life of the Crinoid, as evinced by the subsequent growth of the latter, leading in many cases to the more or less complete imbedding of the *Productus*. From the consideration of the characters presented by the more mature valves, the author stated that the nearest affinity of this species of *Productus* appears to be with *P. Wrightii*, Dav., but that it shows peculiarities allying it to *P. longispinus*, Sow., *P. scabriculus*, Mart., and *P. undatus*, Defr. He was not prepared to describe it as a distinct species, but suggested for it the name of *Productus complectens*, in allusion to its embracing habit, in case of its proving to be distinct.

The *Spiriferina* described by the author was compared by him with *S. cristata*, Schl., var. *octoplicata*, Sow., and with *S. insculpta*, Phill., from both of which it differs in certain characters; but as only one specimen has been met with, he refrained from founding a new species upon it. The specimen is from Fullarton Quarry, near Temple, Edinburghshire.

"Notice of the Occurrence of Remains of a British fossil *Zeuglodon* (*Z. Wanklyni*, Seeley) in the Barton Clay of the Hampshire coast." By Harry Govier Seeley, Esq., F.L.S., F.G.S.

In this paper the author described the remains of a species of *Zeuglodon* obtained by the late Dr. A. Wanklyn from the Barton Cliff, consisting of a great part of the skull, about the same size as that of *Zeuglodon brachyspondylus*, Müller. The bones preserved are the maxillary, frontal, and parietal bones. The left maxillary shows the remains of five teeth in a length of rather less than seven inches, the first two of which had simple conical crowns and a single fang; the sockets of these are elliptical. The third tooth is considerably compressed, with a sharp margin, which has four small denticles on each side of the large median denticle. The following teeth exhibit somewhat similar characters, and each possesses two fangs. A single tooth, resembling the canine of a Carnivore, was found with the specimen, and was probably one of those missing from the first sockets. The characters of the bones of the head were described in more or less detail: the frontal region is flattened, with a sharp crest continued along the parietal region, as in *Z. brachyspondylus*; but the crest is not flattened posteriorly into a narrow table, as in that species, nor is the parietal united with the frontal by a folded suture. The species, named *Z. Wanklyni* in memory of its discoverer, differs from all known species of the genus in the shortness of the interspaces between the teeth.

"On the Remains of *Emys hordwellensis*, from the Lower Hordwell beds in the Hordwell Cliff." By Harry Govier Seeley, Esq., F.L.S., F.G.S.

The remains described by the author consist of some fragments constituting the greater part of the plastron and carapace of a species of *Emys* obtained from a bed in Hordwell Cliff about 20 feet below that which has yielded the chief remains of *Crocodilus Hastingsiæ*, and about 10 feet above the brackish-water Upper Bagshot beds. The preserved portion of the carapace is 9 inches long; when perfect it was probably about 12 inches long and 10 inches broad. Its distinctive characters were said to be:—the broad, short gular scute, with sinuous sutures; the subtriangular nuchal scute; the subpentagonal first vertebral scute, broader than the succeeding quadrate vertebral scutes; and the concentric ornamentation left on the carapace and plastron by all the scutes. The author proposed for the species the name of *Emys hordwellensis*.

"On an associated Series of cervical and dorsal Vertebræ of *Polyptychodon* from the Cambridge Upper Greensand." By Harry Govier Seeley, Esq., F.L.S., F.G.S.

The author remarked upon the rarity of vertebræ of *Polyptychodon* in the Cambridge Greensand in comparison with the abundance of teeth, and stated that those collected do not appear to be the remains of more than two individuals, probably representing two species. One series from Haslingfield was described and figured by Prof. Owen in 1860; the other, somewhat smaller series, described in the present paper, is from the Huntingdon Road. The author described in detail the structure of the atlas and axis and of the five succeeding (cervical) vertebræ; nine dorsal vertebræ were also described.

"On *Crocodilus icenicus* (Seeley), a second and larger species of Crocodile from the Cambridge Upper Greensand." By Harry Govier Seeley, Esq., F.L.S., F.G.S.

In this paper the author described a cervical and a dorsal vertebra of a new species of Crocodile. The former is probably the last cervical. It is $2\frac{1}{4}$ inches long, and differs from that of existing Crocodiles in the large size of the parapophyses, the distinct anterior notch in the neural arch for the vertebral nerve, and the perfect convexity of the articular ball. The dorsal vertebra is the sixth or seventh; it measures $2\frac{1}{2}$ inches in length, and shows a depression and perfect convexity of the articular ball, which distinguish it from existing species. The animal was probably about 16 ft. long.

"On *Macrurosaurus semnus* (Seeley), a long-tailed animal with procœlous vertebræ, from the Cambridge Upper Greensand." By Harry Govier Seeley, Esq., F.L.S., F.G.S.

The author described a series of about 40 associated and nearly successive caudal vertebræ obtained from one of the deeper phosphatite workings on Coldham Common. The tail, when complete, probably included 50 vertebræ, and measured 15 feet in length. The articulations of the earlier vertebræ are procœlous; then they become nearly flat, then biconcave, and towards the end of the tail irregular. There are no chevron bones. The neural arch in the earlier part of the tail was supported on pedicles rising from the centrum, depressed and devoid of neural spine. The neural arches were of great antero-posterior extent and compressed. The author remarked that although the tail as a whole is more in accordance with the Lacertian type than with any other order of true reptiles, the combination of the procœlous character with the absence of chevron bones is unknown to him elsewhere. He added that the metapodium described and figured by him in 1871, under the name of *Acanthopholis platypus*, may perhaps belong to the foot of *Macrurosaurus*, in which case the latter would probably indicate a modification of the Crocodilian type, and the individual to which the tail belonged would have been about 30 feet long.

December 20th, 1876.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On *Pharetrospongia Strahani*, a fossil Holorhaphidote Sponge from the Cambridge Coprolite Bed." By W. J. Sollas, Esq., B.A., F.G.S.

The sponge described by the author, which had been long labelled as a *Chenendopora* in the Woodwardian Museum at Cambridge, is a fossilized siliceous sponge, characterized by an irregularly reticulate fibrous skeleton, the fibres of which in the living state were composed of a number of siliceous acerate spicules, lying parallel to each other and to the sides of the fibre. These spicules are still sufficiently well preserved to be figured and measured individually, though they have undergone a pseudomorphic change, by which their original composition has been exchanged for a calcareous one. A similar replacement has occurred in the case of various species of *Manon* and *Porospongia*; and this fact is of great interest, as showing that the extinct and anomalous order of Calcispongiæ, which these fossils were supposed to indicate, has no necessary existence, since their calcareous nature is a superimposed one, and their original structure agrees completely with that of existing siliceous forms, *Pharetrospongia Strahani* itself exhibits close affinities to an undescribed sponge now living in the Australian seas.

"On the Remains of a large Crustacean, probably indicative of a new species of *Eurypterus* or allied genus (*Eurypterus? Stevensoni*), from the Lower Carboniferous series (Cement-stone group) of Berwickshire." By Robert Etheridge, jun., Esq., F.G.S.

The fragmentary Crustacean-remains described in this paper are referred by the author to a large species of *Eurypterus*. They are from a rather lower horizon in the Lower Carboniferous than that from which *Eurypterus Scouleri*, Hibbert, was obtained. The animal was probably twice the size of *E. Scouleri*. The remains consist of large scale-like markings and marginal spines which once covered the surface and bordered the head and the hinder edges of the body-segments of a gigantic Crustacean, agreeing in general characters with the same parts in *E. Scouleri*, but differing in points of detail. For the species, supposing it to be distinct, the author proposes the name of *E. Stevensoni*.

January 10th, 1877.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On gigantic Land-Tortoises and a small Freshwater Species from the ossiferous caverns of Malta, together with a list of the fossil Fauna, and a note on Chelonian-remains from the Rock-cavities of Gibraltar." By A. Leith Adams, Esq., M.B., F.R.S., F.G.S.

The author described three extinct species of Tortoises from the Maltese rock-cavities, one of which was of gigantic proportions, and equalled in size any of the living or extinct land Chelonians from the Indian or Pacific islands. The characteristic peculiarity in the two larger species is a greater robustness of the long bones as compared with the denizens of the Mascarene and Galapagos islands with which he had been enabled to contrast them. The largest, on that account, he had named *T. robusta*; it rivalled the gigantic *Testudo ephippium* (Günther) in size, showing affinities to it in a few minor characters. A smaller species, *T. Sprattii*, and a small *Lutremys*, not distinguishable, as far as the few remains extend, from the recent *L. europæa*, besides many fragments of shields of tortoises of various dimensions, had been obtained. These Chelonians were found in conjunction with the remains of the dwarf Elephants and other members of the remarkable fauna collected by Admiral Spratt and the author in the ossiferous rock-cavities of Zebbug, Mnaidra, Benghisa, &c. The paper contained a list of the animal-remains hitherto recorded from the Maltese fissure caverns, including three species of dwarf Elephants, two species of *Hippopotamus*, two gigantic species of *Myoxus*, a gigantic Swan, and other animal-remains, and, further, a Note on some Chelonian-remains from the rock-fissures of Gibraltar.

January 24th, 1877.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On British Cretaceous Patelloid Gasteropoda." By John Starkie Gardner, Esq., F.G.S.

In this paper the author commenced by a general statement as to the classification of the forms to be described in it, which he referred to the families Patellidæ, Fissurellidæ, Calyptræidæ, and Capulidæ. He noticed 30 species, which are mostly of rare occurrence; and 19 of these were described as new. Four genera were indicated as new to the Cretaceous series, and one as new to the Cretaceous in England. The new species were *Acmæa formosa* and *plana*, *Helcion Meyeri*, *Anisomyon vectis*, *Scurria calyptræiformis* and *depressa*, *Emarginula puncturella*, *divisiensis*, *ancistra*, *Meyeri*, and *unicostata*, *Puncturella antiqua*, *Calyptræa concentrica*, *Crepidula chamæformis*, *Crucibulum giganteum*, *Pileopsis neocomiensis*, *dubius*, and *Seeleyi*, and *Hipponyx Dixoni*. Most of the Patellidæ were from the Neocomian, and the majority of the Fissurellidæ from the Upper Greensand; the species of the other two families were scattered through the series. The author referred to the indications of depth of deposit and other conditions furnished by these Mollusca, and also to the resemblance presented by many of them to certain bivalves common in the same rocks, which he regarded as a sort of mimicry.

"Observations on Remains of the Mammoth and other Mammals from Northern Spain." By A. Leith Adams, Esq., M.B., F.R.S., F.G.S.

The remains noticed in this paper were obtained by MM. O'Reilly and Sullivan in a cavern discovered at about 12 metres from the surface, in the valley of Udias, near Santander, by a boring made through limestone in search of calamine. They were found close to a mound of soil which had fallen down a funnel at one end of the cavity, and more or less buried in a bed of calamine which covered the floor. The cavern was evidently an enlarged joint or rock-fissure, into which the entire carcasses, or else the living animals, had been precipitated from time to time. The author had identified among these remains numerous portions, including teeth, of *Elephas primigenius*, which is important as furnishing the first instance of the occurrence of that animal in Spain. He also recorded *Bos primigenius* and *Cervus elaphus*?, and stated that MM. O'Reilly and Sullivan mention a long curved tooth which he thought might be a canine of *Hippopotamus.*

February 7th, 1877.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

"On new Species of *Belemnites* and *Salenia* from the Middle Tertiaries of South Australia." By Ralph Tate, Esq., F.G.S.

The author noticed the occurrence in deposits of supposed Miocene age in South Australia of a species of Belemnite (*Belemnites senescens*) and a *Salenia* (*S. tertiaria*). These fossils were obtained from Aldenga, twenty-six miles south of Adelaide, on the east coast of St. Vincent's Gulf, where the long series of sea-cliffs contains an assemblage of fossils identical with that of the Murray-River beds. The *Salenia* is especially interesting on account of the discovery of a living species of the genus by the naturalists of the 'Challenger.'

"On *Mauisaurus Gardneri* (Seeley), an Elasmosaurian from the base of the Gault at Folkestone." By Harry Govier Seeley, Esq., F.L.S., F.G.S.

The author described the skeleton of a great long-necked Saurian obtained by Mr. J. S. Gardner from the Gault of the cliff at Folkestone. The remains obtained included a tooth, a long series of vertebræ, some ribs, bones of the pectoral arch, the femur, and some phalanges, indicating a very large species, which the author referred, with some doubt, to the genus *Mauisaurus* of Dr. Hector, founded upon a Saurian from the Cretaceous formation of New Zealand. He gave it the name of *Mauisaurus Gardneri* in honour of its discoverer. A small heap of pebbles was found in the neighbourhood of the ribs; and it was supposed that these had been contained in the stomach of the animal.

MISCELLANEOUS.

Note on the Femoral Brushes of the Mantidæ. By Prof. J. Wood-Mason.

Since the abstract * of my paper on these structures and their use was published, I have been enabled to consult M. Stål's memoir † entitled "Orthoptera quædam Africana;" and I find that I have been anticipated as to the discovery—the brushes, or rather the setulose eminences which I call brushes, being thus described in a footnote to p. 382 of the work cited:—"In latere interiore femorum anticorum *Mantodeorum* adest apicem versus prope marginem inferiorem spatium parvum leviter convexum, oblongum, dense brevissimeque setulosum." M. Stål makes no suggestion as to the possible use of the brushes to the insects; but I have ascertained ‡ that they are exclusively used for keeping the eyes and ocelli in a functional condition, and that they are present in the young when these quit the egg.

A full account of my observations and experiments on numerous living specimens belonging to several genera (*Schizocephala, Pseudomantis, Hierodula*, &c.) will be given in my paper.

Calcutta, Dec. 22, 1876.

On the Development of the Antennæ in the Pectinicorn Mantidæ. By Prof. J. Wood-Mason.

The author shows that, down to the last change of skin but one, no difference is to be detected between the two sexes of *Gongylus gongylodes*, either in the form or in the proportional length of the antennæ, which in both male and female are identically the same simple and setaceous structures, consisting of two distinct basilar segments followed by a multitude of very short and ill-defined flagellar ones, but that shortly after this event these appendages in the male begin to thicken throughout that portion of their length which in the perfect insect is bipectinated, so as eventually to acquire a compressed spindle-shaped form; that this thickening is the outward manifestation of the growth going on beneath the

* P. A. S. B., June 1876, p. 123; and this Journal, vol. xviii. p. 438.

† Œfvers. af Kongl. Svenska Vetenskaps-Akademiens Förhandl. Stockholm, 1871, no. 3, sid. 375–401.

‡ P. A. S. B., August 1876, p. 170.

outermost layer of chitinous membrane (last skin), which, at an early date, *pari passu* with the formation of the new antennæ, tends to separate off from the rest, and thereafter serves as a capsule or sheath wherein the two series of pectinations are developed by a process of budding from the antennal segments between the basal 5 and the apical 12–15; that as the pectinations grow they press upon so as to distend the walls of the sheath, completely obliterating all traces of its previous segmentation; and that if the sheath be carefully dissected away when distention of its walls has proceeded almost to the bursting-point (last moult), the completely bipectinated antenna of the adult male is disclosed, but with the teeth of each comb all glued and compressed together and with the two striated plates thus formed apposed to one another at their free ends, so as to enclose a compressed spindle-shaped cavity.—*Proceedings of the Asiatic Society of Bengal*, December 1876.

On the Power possessed by certain Mites, with or without Mouths, of living without Food through entire Phases of their Existence or even during their whole Lives. By M. Mégnin.

The specimens of *Ixodes* found adhering to animals, to whatever species they may belong, are always fecundated females—a fact which the author has ascertained by the examination of hundreds of individuals obtained from dogs, cattle, sheep, horses, different species of rodents, birds, reptiles, &c. He has frequently found adhering to the lower surface of these sucking females, another very different small *Ixodes*, which is entirely coriaceous, and is the male, the lip of which, forming an obtuse triangle with salient lateral angles, is introduced into the subthoracic vulva of the female, and serves as a guide to the penis (which emerges from its base), and at the same time as a means of firm sexual union instead of the copulatory suckers met with in many other mites.

The *Ixodes* are oviparous, and deposit a considerable number of eggs, not by the mouth as Latreille believed, on the testimony of Chabrier, but by a subthoracic vulva which opens close to the base of the rostrum, as demonstrated by M. Lucas (Ann. Soc. Ent. Franc. 1836, p. 630); but the mode of life and organization of the larvæ are quite unknown. The author found on an African ox an enormous female *Ixodes* ready to lay, and was thus enabled to study her numerous progeny. Between May 22 and June 23 this female laid 12,000 eggs filled with a brownish yellow vitelline matter, composed of granular polyhedric or rounded cells of very variable diameters. The average diameter of the ovospherical eggs was $\frac{1}{2}$ millim.

The eggs hatched between July 25 and August 9, producing very active hexapod larvæ, with the rostrum apparently complete, an oval-triangular cephalothoracic plastron, furnished with a pair of eyes as in the mother, but quite destitute of stigmata and of the tracheary respiratory apparatus so visible in the adults. Five or six days before hatching, when the egg appeared still three fourths filled with the vitellus, the author saw the abdominal integuments of the larvæ formed, completely enveloping the vitelline mass; and he then saw the hard parts of the skeleton thicken and become darker in colour, the abdomen, which was at first spheroidal, become flattened and regularly festooned behind, and the stomach and its symmetrical cæca formed, circumscribing the vitelline matter, which was gradually retracted, furnishing the material for new organs. That the business of nutrition went on actively in the bodies of these larvæ was shown by their depositing upon the glass much white matter, which proved to consist of alkaline urates. The mother had also produced a large quantity of similar excrement. The author states that these larvæ lived and digested for three months without his being able to induce them to take any nourishment; they lived on the provision derived from their mother, which was contained in the stomach.

These larvæ undergo their metamorphoses and become adult, when the males seek the females, fecundate them, and die without taking any food, which, indeed, the conversion of their rostrum into an accessory organ of copulation would prevent their doing; the females, either during or after fecundation, attach themselves to animals, from which they absorb the quantity of blood which enables them to acquire sometimes ten times their original size, and provides the materials for their numerous progeny, even throughout life in the case of the males.

The mouthless Acarina, which have been formed into the genera *Hypopus*, *Homopus*, *Trichodactylus*, *Astoma*, &c., but which the author has shown to be nymphs, also live without food in an analogous manner. Their bodies are filled with a granular amorphous matter, a sort of highly vitalized sarcode, produced by the liquefaction of the internal organs, and especially the muscles of the larvæ; life is sustained without loss, since there are no evacuations, in consequence of the complete absence of anal, respiratory, or other apertures, during the whole of this phase of their existence. The adult form which succeeds this phase is remarkable (especially in the case of the adult female) for great voracity; but many of the males, like those of *Ixodes*, eat very little or not at all, and the author believes that the males of *Sarcoptes* belong to the latter category.

M. Mégnin remarks that this fact is by no means without a parallel, and mentions the Ephemeræ and the Œstridæ as furnishing cases in point. He also refers to the same category the astomatous and fertile form of the *Phylloxera* of the oak observed by M. Lichtenstein (Bull. Soc. Ent. Fr. 1876, p. 164).—*Comptes Rendus*, Nov. 20, 1876, p. 993.

Note on the Nidification of the Aye-Aye.
By MM. A. Milne-Edwards and A. Grandidier.

Any facts that may contribute towards a more complete knowledge of the aye-aye (*Chiromys madagascariensis*) deserve the attention of zoologists. This mammal, the affinities of which have been long disputed, is still very rare. Travellers have scarcely ever studied it in the living state; and the observations they have been able to make upon its habits and manners are almost insignificant; we therefore think it useful to indicate some new particulars as to its mode of life.

The aye-aye constructs in trees true nests resembling enormous ball-shaped birds' nests; and it is in the interior of these constructions that the female brings forth her young and nourishes it. We have just received one of these nests found by M. Soumagne, honorary consul of France in Madagascar, in the belt of forest situated halfway up the eastern slope of the great granitic mountain mass a short distance from Tamative. It is made with much care and art at the fork of several large branches of a dicotyledonous tree; its outer surface is formed of large rolled-up leaves of the *Ravinala* (or traveller's tree), which constitute a sort of impermeable covering and protect the interior, in which there is an accumulation of small twigs and dry leaves. The aperture is narrow and placed to one side. M. Soumagne surprised a female with her young one in this nest.

The most highly organized species of the Lemurine group (the Indrisinæ and true lemurs) always carry their young attached to the back or the breast, where it can easily reach the pectoral mammæ of the mother. The lower representatives of the order, however, are furnished with several pairs of mammæ, and they do not carry their young in this manner; they deposit them either in holes of trees (*Lepilemures* and *Chirogalei*) or in true nests (*Microcebi*). Each litter consists of several young, which remain for a considerable time confined to their retreat, without being able to accompany their parents. One of us has examined the nest of *Microcebus myoxinus*. It resembles on a small scale that of a crow, and is composed of small twigs interlaced, in the midst of which there is a depression with a bed of hairs, in which the young repose.

In its mode of nidification, therefore, the aye-aye closely approaches the more degraded representatives of the order Lemurina, and departs from the Indrisinæ and true Lemurs.—*Comptes Rendus*, Jan. 22, 1877, p. 196.

Note on the Phenomena of Digestion and on the Structure of the Digestive Apparatus in the Phalangida*. By Félix Plateau. (Abstract by the author.)

The 'Annals and Magazine of Natural History' have already given abstracts of several of my memoirs relating to the phenomena of digestion in the Articulata †. The present memoir is, properly speaking, only a detached chapter of a long series of researches on

* Bulletin de l'Académie Royale de Belgique, 45ᵉ année, 2ᵉ sér. tome xlii. p. 719, 1876.

† Annals and Magazine of Natural History, 4th series, vol. xvi. p. 152, (1875), vol. xviii. p. 355 (1876), vol. xviii. p. 437 (1876).

the digestion of the Arachnidans. The very special organization of the Phalangida permitted this separation.

It is not my intention to summarize here the anatomical part of my note; but I must say a few words on the arrangement of the digestive tube of the Araneida and of the Phalangida in order to show the bearing of the physiological results.

The Araneida, or spiders properly so called, are sucking animals. Their digestive tube comprises:—first, a buccal intestine entirely situated in the cephalothorax, and consisting of an œsophagus with chitinous walls, terminating with an apparatus of suction, accompanied by a series of five pairs of lateral cæca; then, in the abdomen, a middle intestine, followed by a terminal intestine. The middle intestine is here characterized by the fact that it receives on the right and left the excretory canals from the voluminous abdominal gland, hitherto called the *liver* in the Araneida. The terminal intestine, dilated into a reservoir, receives at its origin, as in all the Articulata, the crustaceans excepted, the Malpighian or urinary tubes.

We know by the works of Ramdohr, Treviranus, Tulk, Blanchard, &c., that the digestive apparatus of the Phalangida is quite different. Here the animal does not suck its prey, but devours it entirely. The digestive tube consists, in the first place, of a buccal intestine reduced to a short œsophagus; then of an immense median sac, into which open dorsally about thirty voluminous cæca filling nearly all the cavity of the body; lastly of a short terminal intestine, characterized, as I show for the first time, by the insertion of the Malpighian tubes. It is to be remarked that here the body is no longer distinctly divided into a cephalothorax and an abdomen, and also that, as in the Araneida, a certain number of cæca penetrate into the coxopodites of the feet.

All authors taking for their basis a simple resemblance of form, regard the cæca of the Phalangida as the analogues of the cephalothoracic cæca of the Araneida. This is for want of histological observations and above all of physiological experiments.

Experimental researches already far advanced have convinced me that the voluminous gland called the *liver* in the Decapod crustaceans, and which empties its products into the middle intestine of those animals, is nothing but the organ of secretion of the digestive liquid intended for the emulsion of the fats and for the solution of the albuminoids *. Recently M. Jousset de Bellesme has informed me that he has arrived at perfectly similar results; finally a number of experiments on the so-called *liver* of the Araneida †, the ducts of which also open into the middle intestine, have proved to me that

* I have already alluded to it in my 'Recherches sur les phénomènes de la digestion, etc. . . des Myriapodes,' p. 42, note 4.

† I take this opportunity of calling the attention of the reader to the importance of the results of my experiments on the Araneida. The memoir in which they, together with numerous other facts, are to be found, and which I hope to complete shortly, will, I hope, be read with interest.

this also was only a liver in appearance, that the liquid secreted was also the principal digestive liquid emulsionizing the fatty bodies, transforming the albuminoids into peptones and producing glucose at the expense of amylaceous matters.

The epithelium, consisting of voluminous cells, of the cæca of the Phalangida has the most analogy with the cellular elements of the supposed liver of the Araneida; but, what is more positive, the liquid secreted in abundance also transforms the feculents into glucose slowly, dissolves the albuminoids actively, and energetically emulsionizes the fats.

The cæca of the Phalangida are therefore not the analogues of the cephalothoracic suctorial sacs of the Araneida, but the evident analogues of their abdominal digestive gland. It results from this, (and direct observation also proves it), that the large median sac is the principal place for digestion, and consequently the middle intestine.

The Gourami and its Nest.
By M. Carbonnier.

I have of late years had the honour of making known to the Academy the curious and interesting habits of certain fishes of the group Labyrinthici. In these species, at the time of reproduction, the males become adorned with the most vivid colours, construct a nest to shelter the products of the spawning, and during the embryonic development, as also after hatching, give a careful and efficacious protection to their progeny—facts which indicate a highly developed instinct in these creatures, and reveal the existence of faculties of which they have heretofore been regarded as destitute. Among these are the *Macropodi* of China and the *Colisæ* of India. The study of another fish of the same family, the Gourami (*Osphromenus olfax*) has furnished me with subjects of no less astonishment and admiration.

The Gourami, an inhabitant of the fresh waters of China and India, is remarkable for the large size to which it may grow and for the goodness of its flesh, which renders it a valuable article of food.

My trials in former years not having given any result, I determined last spring to keep my fishes in a medium maintained artificially at a constant temperature of 25° C. (=77° F.), which it appeared to me must be suitable for their reproduction. With this view, my fishes were placed in an aquarium containing about 48 gallons of water. In a few days I saw the bodies of the males become adorned with vivid colours; they pursued each other, and seemed to struggle furiously for the possession of the females. I then selected the finest male, whose lips were tumefied in an abnormal fashion, and left him alone in the aquarium with a female which he seemed to pursue perseveringly. He soon commenced in one of the angles of the aquarium the formation of a nest of froth, which in a few hours attained a considerable size—6 to $7\frac{1}{4}$ inches in diameter, and 4 to $4\frac{3}{4}$ inches in height.

In the Chinese *Macropodus* the male draws directly from the outer air the bubbles which he emits beneath his frothy roof after having englobed them (in order to prevent their being absorbed) with the mucosity furnished by his buccal membrane. The mucous secretion does not seem to be formed in such abundance in the Gourami; hence my male found himself under the necessity of preparing his materials beforehand, then collecting those which appeared to him to fulfil the desired conditions, and carrying them to his nest. For this purpose he kept at the surface of the water, turning his back to the nest, and, drawing in the outer air, expelled it by degrees in front of him in the form of gaseous bubbles. The badly prepared bubbles burst, and there only remained those the envelope of which possessed the suitable consistency; these he then collected and carried into his nest.

At times the buccal secretion seemed to slacken, and the male could no longer elaborate his globules. He then descended to the bottom of the water to seek for some Confervæ, which he sucked and chewed for a few moments as if to excite and reawaken the activity of the mucous membrane.

The nest being completed, the male watched it with patient care, and whenever the female apppoached it he displayed his brilliant colours. At a given moment his body, by several simulated approaches, having acquired sufficient flexibility, he caught the female, and caused her to perform a first spawning; others speedily followed, and were renewed nearly forty times in three hours.

A *Macropodus* or a *Colisa* would not have been embarrassed about collecting the eggs and arranging them in the nest. My Gourami did not appear to understand taking them in his mouth; and in order to raise them to the surface he made use of a most curious stratagem. He rose to take in an abundant provision of air; then, descending, he placed himself well below the eggs, and suddenly, by a violent contraction of the muscles of the interior of the mouth and pharynx, he compelled the air collected there to escape by the gill-apertures. This air, infinitely divided by the branchial lamellæ and fringes, was, so to speak, pulverized; and the violence of the expulsion was such that it escaped in the form of two jets of a regular gaseous powder, which enveloped the eggs and conveyed them to the surface.

Nothing could be more curious to witness than this manœuvre of the male Gourami. He disappeared completely in the midst of a regular fog of air; and when the latter broke up he reappeared, bearing attached to the rugosities of his scales and fin-rays bubbles of air resembling thousands of little pearls.

The number of eggs produced during this spawning may be estimated at two or three thousand, out of which I only obtained six hundred hatchings, most of the eggs not having undergone the action of the fecundating principles.

The first period of incubation lasts three days; and then commences a series of modifications analogous to those which I have already noticed in other species. The tadpole swims with its belly in the air, and has the form of a ball terminated by a little tail; but after another period of three days (that is to say, six days after hatching) the embryonic development is completed, and already a certain number of the young fry venture to escape from under the paternal eye. The male pursues the fugitives; and a few jets of pulverized air shot in their direction soon bring them to reason and convey them again to the surface of the water. It is not until about ten days after their birth that the father begins to abandon them and leave them to wander at their own pleasure.

Five hundred and twenty young Gouramis hatched in my establishment in the month of July last, and, measuring at present from 3 to 6 centimetres in length, assure to us the definitive possession of this interesting and curious species of fish, which, among other advantages, possesses the faculty of spawning several times a year.—*Comptes Rendus*, Dec. 4, 1876, p. 1114.

Zoology of the 'Challenger' Expedition.

Mr. Alexander Agassiz, in a letter to the editors of 'Silliman's Journal' (dated Edinburgh, Dec. 18), states that he has found the material a wonderful collection, and was deeply impressed by the great amount of it, coming as it mainly does from the depths with which we formerly associated the idea of a lifeless desert region. He also gives the following information respecting the publication of the results. "The Admiralty is to publish the results; and the collections are to be worked up by sundry specialists:—Allman the Hydrozoa; Busk the Polyzoa; Dr. M'Intosh the Annelids; Thomson himself the Crinoids and some of the Sponges, the balance of the latter by O. Schmidt; Häckel the Radiolaria; Moseley, of the 'Challenger,' the Polyps; Murray, who was on the 'Challenger,' will work up the deep-sea bottoms and surface animals (Foraminifera, &c.); Günther the Fishes. Some of the groups are not yet determined upon; but the same persons who worked up the 'Porcupine' species will probably have charge of the 'Challenger' collection. Young Carpenter will work up the Comatulæ; Lyman will have the Ophiurans; and I shall bring over with me the Echini, and perhaps some other group of Echinoderms; so that the United States will have their fair share of the work."

Rate of Growth of Corals.

A remarkable piece of coral, taken off the submarine cable near Port Darwin, is spoken of by the 'Cocktown Herald.' It is of the ordinary species, about five inches in height, six inches in diameter at the top, and about two inches at the base. It is perfectly formed; and the base bears the distinct impression of the cable, and a few fibres of the coir rope used as a sheath for the telegraphic wire still adhering to it. As the cable has been laid only four years, it is evident that this specimen must have grown to its present height in that time, which seems to prove that the growth of coral is much more rapid than has been supposed.—*Silliman's American Journal*, February 1877.

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XXIII.—*On the Distribution of Birds in North Russia.—I. On the Distribution of Birds on the Lower Petchora, in North-east Russia.* By J. A. Harvie Brown, F.Z.S.

"Till every well-marked district, every archipelago, and every important island has all its known species of the more important groups of animals catalogued on an uniform plan and with an uniform nomenclature, a thoroughly satisfactory account of the Geographical Distribution of Animals will not be possible."

The following paper is intended as a companion paper to the fuller account published in 'The Ibis' for 1876*, and is intended to show in tabular form the distribution of the species met with.

In the Table further on I have indicated the points at which and the line along which we observed the different species, by perpendicular strokes in the columns devoted to the thirteen localities mentioned. As the preparation of this paper has necessitated a thorough reexamination of my journals, these strokes, marking the records of actual occurrence of the species at these points, may be held as trustworthy, no stroke having been drawn in the spaces unless there is a corresponding record in my journal. When these strokes are drawn *towards the sides* of the columns and not in the centres, they will be understood to indicate that the species were observed *between* the latitudes given, or may be regarded as generally distributed over the distance represented. I have also indicated the probable presence of these species at other localities by dotted lines (...). Where I have left a

* "Notes on the Birds of the Lower Petchora. By Henry Seebohm, F.Z.S., and J. A. Harvie Brown." Ibis, 1876, January, April, July, and October.

blank space, I have considered, either that the evidence I have is too unsatisfactory to enable me to arrive at any conclusion as to their presence or absence, or that the species are indeed absent from these localities *.

In Table II. I have used more elaborate signs to show the abundance or scarcity of the species in each of three districts: thus:—rare, ·|· ; once seen, / ; twice seen, // ; thrice seen, /// ; common, ‖; very common, ††; very abundant, ‡‡. This, I believe, will make the tables of more practical use for comparison with other tables of species further east or west than if they only represented the particulars shown in Table I.

If we look at this paper as having reference entirely to the distribution of species in their relation to the parallels of latitude, and entirely apart from meridians of longitude, and apart from the more devious lines of migration, we may of course conclude that though certain species do not pass, or are not found to be present at certain localities, nevertheless, in order to reach the higher latitudes at which we are able to record them, they must have passed through or been present at other localities upon these same parallels of latitude, to the east or west of our points of observation.

I have purposely avoided the question of longitudinal distribution at present, as our data for determining that, or even approaching to a determination, are too scanty. There remains an immense tract of ornithologically unexplored country in Northern Russia:—*first*, the Kola peninsula and west of the White Sea up to the Finnish frontier in the west, a land composed of vast tundra and forest and river; *secondly*, between Mezén † and Archangel in the west, and

* Negative evidence in matters of this kind is seldom very satisfactory; and I prefer to leave the question of their actual absence to be proved by future observations, to hazarding guesses as to their *probable* absence. Those who peruse the paper may draw deductions for themselves in this matter. I have even included such species as *Squatarola helvetica* in this class; but see a paper by me on migration (Proc. Glasg. Nat.-Hist. Soc. vol. iii. pt. 1, p. 44, 1875–76), and also Seebohm on the same subject in Rowley's Orn. Misc. (vol. i. pt. iv. p. 239).

† The neighbourhood of Mezén has been tolerably well explored. As early as 1841 Herr Bystrov collected at Mezén (see Brandt, "List of Skins of Mammals and Birds (62 species) sent by Herr Bystrov of Mezén to Zool. Mus. of the Academy," Bull. Sc. de l'Académie de St.-Pétersbourg, vol. x. 1842, p. 350); and of late years Mons. Ignati N. Piottuch has from time to time forwarded considerable numbers of specimens from that locality and from Archangel. Graf Hoffmannsegg and his assistant Herr Hencke also collected for some years in these districts; but little remains on record of their discoveries either there or on the Petchora, which they also visited about twenty years ago. There is a short notice by Hencke (Allgemeine deutsche naturh. Zeitung, 1856, p. 236, Dresden), and another immediately following by Hoffmannsegg, which, as far as I

the Petchora (say, between the meridians of 40° and 52° E. long); and *thirdly*, between the Petchora and the Ural Mountains, or to 70° E. long., in which latter is included the Bolshaya Zemlia of the Russians, or Arkya Ya of the Samoyedes. Until this vast area is partially or wholly explored by naturalists, we cannot hope to arrive at very satisfactory results, or even to form a satisfactory basis to work upon; there remains too large a country unexplored, and there are in consequence too few points at which observations have been made. That it is an interesting country I believe there can be little doubt; and this is indicated by the absence of certain species at Archangel which are present at Ust Zylma and *vice versâ*. The fauna of the Lower Petchora valley does not appear to retain such a purely western Palæarctic or European character as that of the Archangel district does. Thus *Budytes citreolus*, which literally swarms upon the banks of the Petchora and its islands north of the Arctic circle, is unknown at Archangel; and many other cases in point readily suggest themselves on perusal and comparison of the various papers on North-Russian ornithology. The question of interest is, Are the boundaries of the western and eastern Palæarctic subregions, as at present laid down, all-sufficient for zoological purposes? Is it possible to fix these boundaries with any thing like precision if so vast an area as that between the White Sea and the present presumed boundary remains (with the exception of one narrow strip) unexplored? I think the answer must be, "No" *.

Without, then, at this time, discussing further the question of eastern and western distribution, I return to the object of this paper, viz. the distribution of birds between Ust Zylma on the first great bend of the river Petchora, above its confluence with the sea, and the Golaievskai Islands, which form a fringing belt of sandbanks across the entrance of the Petchora Gulf, or Suchaye More (Shallow Sea) of the Russians, and which are about 300 miles to the northward of the former locality.

Before presenting a table of the species met with, I will

can learn, are all the records left by them, except a manuscript list of birds by the latter gentleman, mentioned by Mr. Wolley ('Ibis' 1859, p. 75), but which, as yet, I have failed to trace. Seebohm and I were told also by those who remembered them or travelled with them to the Petchora, that they kept no notes, but simply collected skins and eggs (see also 'Ibis,' 1876, p. 105). References up to date of other papers on North-Russian ornithology will be given in later parts of this paper.

* For the latest and fullest account of the Palæarctic region and its subregions see Wallace's 'Geographical Distribution of Animals,' vol. i. chap. x. p. 180; and for the presently accepted boundaries of the 'Siberian' and 'European' subregions, see p. 191.

first shortly describe the different kinds of country at the thirteen localities through which our line takes us, and indicate the time spent by us at each.

1. *Ust Zylma* (65° 26′ N. lat.), our starting-point, is situated on the east bank, on the elbow of land formed by the noble semicircular sweep of the river as it changes its course from westerly to almost due north. Behind the town, rising ground, cultivated hill-slopes, backed with pine-forest. On the west bank miles of meadows and willow-thickets, intersected by *kurias* or creeks and backwaters, through which the river Zylma flows from the westward. Beyond this pine-forests again appear, and, further off still, the dim low range of the Timan Mountains. We stayed here until the ice broke up and floated away (15th April to 10th June), and then proceeded down the river, stopping here and there to collect and cook our food.

2. *Habariki* (65° 47′ N. lat.).—About 26 miles lower down the river, and also situated on the east or right bank *.

Round the village are a few acres of cultivated land, not large enough, however, to tempt the large flocks of Lapland buntings to alight. Round this, old forest of pine and larch with undergrowth, and large marshes and woodland lakes caused by the overflow of the river in spring, when the ice breaks up (Ibis, 1876, p. 448).

We visited this locality for two days in winter, and again for three days in June, and also stayed for twenty-four hours when on our way down the river—April 29th to 30th; June 3rd, 4th, 5th, and 10th to 11th.

3. *Yorsa River* (66° 13′ N. lat.).—33 miles or so lower down the river, on the west or left bank. Here there was a continuation of the low swampy meadows, marshy hollows, and *kurias*, with willow, alder, and birch. On the east bank the pine-forest, we were told, comes north as far as a place called Bougáefskaya, between Habariki and the Arctic circle. The islands below Habariki are for the most part willow-, alder-, and birch-covered, like many parts of the banks.

We stayed here June 13th from 5 P.M. till June 14th at 2 P.M., long enough to give us some idea of the local fauna.

4. *Chuvinski* (66° 33′ N. lat.).—About 12 versts further down the river, situated on an island close to the east bank and almost upon the arctic circle. Here there were a few houses and a patch of cultivation, surrounded by birch-woods and willow-swamps.

We stayed here a few hours on June 14th.

* Habariki is really an island, but, being only separated from the fast land by a narrow branch of the river, for all practical purposes it may be reckoned as standing on the east shore of the river.

5. *Abrámoff* (66° 42′ N. lat.).—About 20 miles further down the river. Situated on the west bank. Here willow-swamps and birch-woods lately under the overflow of the river; a little to the southward the land rises at one place, and a few stunted pines are to be seen. The village is small and unimportant.

Stayed here a few hours on June 15th.

6. *Viski* (67° 15′ N. lat.).—37 miles lower down the river, and situated on the west bank close to the head of the delta—a considerable village, with some extent of pasturage for cattle. Surrounded by willow-thickets and birch of small growth. Some of the peasants are very wealthy; and the houses are good. Here also there is a good shop, where many necessaries can be purchased and some few luxuries.

We stayed here and in the neighbourhood from June 16th to 17th.

7. *Gorodok*, or *Pustozersk* (67° 31′ N. lat.).—About 27 miles lower down the river. "The town" (Gorodok) is situated on a circular bay, which is surrounded by a sandy waste and tundra covered with stunted birch and juniper, having in the hollows marshy-edged pools and willow-thickets. We did not go to the town, but encamped near the entrance of the circular bay and collected all night upon the sand-dunes and tundra.

Stayed here from evening of June 17th to June 18th at 4 A.M.

8. *Kuya* (67° 45′ N. lat.).—25 miles further down the river, on the east bank. Here there was sandy tundra, with dense growth of dwarfed willow, and a good deal of open pasturage for cows and a few sheep, and pools of water in the sandy ground. An island opposite was covered with willow-swamp, intersected by kurias and here and there open patches of long rank herbage.

Stayed here June 18th to 8 A.M. on the 19th.

9. *Alexievka Island* (N. lat. ?).—About 16 miles from Kuya. Situated about 1½ verst (1 mile) or less from the east bank. Willow-swamp and a few birches. About 40 versts of this kind of growth extend westward from Alexievka, covering the whole delta. On the east bank lies the true tundra, balmy with the scent of the aromatic dwarf rhododendron (*Ledum palustre*), brilliant with the flowers of the delicious "maroshka" (*Rubus chamæmorus*), luxuriant in its covering of minute arctic plants, mosses, sphagnums, and lichens, and glancing with innumerable lakes and pools of pure cold water.

Alexievka was our headquarters from June 20th to the end of our stay, August 2nd.

10. *Yooshina River* (N. lat. ?).—About halfway between

Alexievka and Stanovaya-Lachta (no. 11), or rather nearer the latter. Situated on the east bank. Here there is undulating prairie-like tundra with lakes and luxuriant growth in the hollows, of arctic brambles, willow-scrub, dwarf birch, grasses, carices, sorrel, *Veratrum album*, and wild geranium (*vide* Ibis, 1876, p. 447).

We stayed here a few hours on June 25th.

11. *Stanovaya-Lachta* (N. lat. ?).—26 miles lower down the river than Alexievka, not far from the promontory of Boluanskai Noss. This was the old lading-station of the Petchora Timber-trading Company. On the east bank. A few deserted huts, which we made habitable during our short visit. Around, level or undulating tundra, lakes, high banks to the river, and hills of some elevation on either side of the bay and further inland (*vide* Ibis, 1876, p. 447).

Stayed here from June 26th to evening of June 28th, and visited it also on July 6th and 30th.

12. *Dvoinik* (68° 28′ N. lat. and about 55° 55′? E. long.).—30 miles from Stanovaya-Lachta along the north-east coast of the fast land. On the coast of the Petchora Gulf north-east of the Boluanskai Bucht. Here, great extent of level tundra, salt-marshes and brackish inlets; drift-timber; wrecks of ships; sand-dunes and sand-hills, covered with Esparto grass; and rivers. In the distance, 25 versts off, the Pytkoff (five peaks) Mountains (*v.* Ibis, 1876, p. 297).

Stayed here from July 22nd to 30th in the hold of a wrecked sloop, which we made very habitable.

13. *Golaievskai Banks* (68° 58′ N. lat.).—About 54 miles north of Dvoinik, at the entrance of the Petchora Gulf. Here bare, almost level sandbanks, a foot or two above highwater-mark, and of considerable extent. Some said to be grass-covered and of slightly higher elevation (*v.* Ibis, 1876, p. 295).

We stayed here, on the islands nos. 3, 4 (so marked in Admiralty chart), for a few hours on July 13th–14th.

These thirteen localities are the places at which we did most of our collecting, and where all the species mentioned in the following table were procured.

I offer this paper not only as a slight contribution towards our knowledge of zoological geography, but also with the idea that if field-naturalists would keep somewhat similar records in other localities, workers at home might be materially assisted in their labours and studies of larger areas.

I have taken the hint from Mr. Wallace's grand work 'The Geographical Distribution of Animals.' In descending from the treatment of orders and families and genera in regions, to species in limited areas or districts, I have found it necessary to employ a few additional symbols, which I trust will be found easily intelligible and sufficiently to the point.

Tables showing Distribution of Birds in North-east Russia between Ust Zylma (65° 26′ N.) *and the Golaievskai Banks* (68° 58′ N. lat.).

Explanation of the Symbols used in the following Tables.—Absent, a blank space. Probable presence, ... Present, |. Rare, ‡. Common, ‖. Very common, ††. Exceedingly abundant, ‡‡. Once, twice, or thrice occurred, recorded, without doubt identified, or shot, ✓, ✓✓, ✓✓✓. Occasional, *. Doubtful records: a query in the columns.

	Table I., showing the fauna at 13 localities.														Table II., showing the fauna in 3 districts.			
	Time spent at each locality.	April 15 to June 10.	April 29–30. June 3, 4, 5. June 10, 11.	June 13–14, 5 P.M. to 2 A.M.	June 14.	June 15.	June 16–17.	June 17–18, 8 P.M. to 4 A.M.	June 18–19, 12 noon to 8 A.M.	June 20 to Aug. 2.	(June 25.)	(June 26–28.)	(July 22–20.)	(July 13–14.)				
	English miles.	→	26	33	12	20	37	27	25	16	→	26	30	51	306			
Species.	Localities and Approximate Positions.	Ust Zylma, 65° 26′ N.	Habariki, 65° 47′ N.	Yorsa River, 66° 13′ N.	Chuvinski, 66° 33′ N.	Abrámoff, 66° 12′ N.	Viski, 67° 15′ N.	Gorodok, 67° 31′ N.	Kuya, 67° 45′ N.	Alexievka, ?	Yooshina, ?	Stanovaya-Lachta, ?	Dvoinik, 68° 28′ N.	Golaievskai, 68° 58′ N.	Total	Ust Zylma to Chuvinski, 65° 26′–66° 30′.	Chuvinski to Alexievka, 66° 30′ to 68° ?	Alexievka to Golaievskai, 68° to 68° 58′.	'Ibis,' 1876.
		1	2	3	4	5	6	7	8	9	10	11	12	13		1	2	3	page
1. Aquila chrysaëtus (*L.*)		...	|													✓			110
2. Haliaëtus albicilla (*L.*)		|	|	..	...	|	...	...	...	|	..	...	|			‖	‖	✓	"
3. Pandion haliaëtus (*L.*)		...	|													✓			"
4. Buteo lagopus, *Brünn.*		...	... |	| ...												✓✓			"
5. Falco peregrinus (*L.*)		|	...	..	..	..	...	...	...	...	..	|				✓✓✓	...	‖	"
6. —— subbuteo (*L.*)		..	|													✓			111
7. —— æsalon[1] (*L.*)		|														‡‡			"

[1] Although Merlins were not again seen to the northward, there can be little doubt that they migrated abou the same time that the Snow-Buntings left Ust Zylma. How far north they go cannot be shown from our observations.

TABLE I., showing the fauna at 13 localities (*continued*). — TABLE II., showing the fauna in 3 districts (*continued*).

Species.	Time spent at each locality.	April 15 to June 10.	April 29–30, June 3, 4, 5, June 10, 11.	June 13–14, 5 P.M. to 2 A.M.	June 14.	June 15.	June 16–17.	June 17–18, 8 P.M. to 4 A.M.	June 18–19, 12 noon to 8 A.M.	June 20 to Aug. 2.	(June 25.)	(June 26–23.)	(July 22–30.)	(July 13–14.)					
	English miles.	→	26	33	12	20	37	27	25	16	→	26	30	54	306				
	Localities and Approximate Positions.	Ust Zylma, 65° 26′ N.	Habariki, 65° 47′ N.	Yorsa River, 66° 13′ N.	Chuvinski, 66° 33′ N.	Abrámoff, 66° 42′ N.	Viski, 67° 15′ N.	Gorodok, 67° 31′ N.	Kuya, 67° 45′ N.	Alexievka, ?	Yooshina, ?	Stanovaya-Lachta, ?	Dvoinik, 65° 25′ N.	Golaievskai, 68° 58′ N.	Total	Ust Zylma to Chuvinski, 65° 26′–66° 30′.	Chuvinski to Alexievka, 66° 30′ to 65° ?	Alexievka to Golaievskai, 65° to 68° 58′.	'Ibis,' 1876.
		1	2	3	4	5	6	7	8	9	10	11	12	13		1	2	3	page
8. Astur palumbarius (*L.*)		...	...	❘												✓			111
9. Accipiter nisus (*L.*)		❘														✓			"
10. Circus cyaneus (*L.*)		❘	... ❘	❘ ...	...	...	...	...	...	❘	...	❘				‖	✓	✓	"
11. Surnia nyctea (*L.*)		❘	...	...	...	...	...	...	...				❘			‖		✓	"
12. Asio accipitrinus, *Pall.*		❘	... ❘	❘ ...		❘										‖	❘		112
13. Bubo ignavus, *Forst.*		❘														✓✓✓			"
14. Dryocopus martius (*L.*)		❘														÷			"
15. Picus minor, *L.*		❘	❘	...	...	❘	❘									‖	‖		"
16. —— tridactylus, *L.*		❘	❘	...	❘	❘										‖	❘		"
17. Cuculus canorus, *L.*		❘	❘	❘ ...												‖			"
18. Corvus corax, *L.*		❘	...	...	...	❘	...	...	...	❘						‖	❘	❘	113
19. —— cornix, *L.*		❘	❘	...	...	❘	...	❘	❘	❘						††	††		"
20. —— frugilegus, *L.*		❘														✓			"
21. —— monedula, *L.*		❘														✓✓✓			"

22. Pica rustica (*L.*)	∣	∣	...	...	∣	...	∣							‖	∣		”
23. Perisoreus infaustus (*L.*)	∣	∣												‖			”
24. Passer domesticus (*L.*)	∣	...	...	...	...	...	...	∣	∣					‖	∣		114
25. —— montanus (*L.*)	∣	∣	...	∣	...	...	...	∣	...	...	∣			††	‖	✓	”
26. Pyrrhula major, *Brehm*	∣													·∣·			115
27. Carpodacus erythrinus (*Pall.*)	∣													✓✓			”
28. Corythus enucleator (*L.*)	∣	∣												‖			”
29. Fringilla montifringilla (*L.*)	∣	∣	...	... ∣	∣									‖	∣		116
30. Linota linaria (*L.*)	∣	∣	∣	∣	∣	∣	∣	∣	∣	∣	∣			‡‡	‡‡	‖	”
31. —— exilipes, *Coues*[1]	∣	∣	∣	∣	∣	∣	∣	∣	∣	∣	∣			‡‡	‡‡	‖	”
32. Emberiza citrinella, *L.*	∣													·∣·			”
33. —— pusilla, *Pall.*	∣	∣	∣	∣	∣	∣	...	...	∣					††	‖		”
34. —— schoeniclus, *L.*	∣	∣	∣	∣	∣	...	...	∣	∣					††	‖		117
35. Plectrophanes lapponicus (*L.*)	∣	...	...	...	...	...	...	...	...	...	...	∣		‡‡	...	‖	”
36. —— nivalis (*L.*)	∣	...	...	...	...	...	...	...	∣	∣	∣	∣		‡‡	...	‡‡	”
37. Alauda arvensis, *L.*	∣	...	...	...	...	∣								✓	✓		119
38. Otocoris alpestris (*L.*)	∣	...	...	...	...	...	∣	...	∣	...	∣	∣		‡‡	‖	‖	”
39. Anthus Gustavi (*Swinhoe*)[2]					... ∣	∣ ...	∣	...	∣						‖	‖	120
40. —— trivialis (*L.*)	∣													✓			121
41. —— pratensis (*L.*)	∣	...	...	...	...	...	...	...	...	...	∣			‖	...	·∣·	”
42. —— cervinus, *Pall.*	∣	...	...	...	...	∣	∣	...	∣	∣	∣	∣		‡‡	...	‡‡	122
43. Budytes viridis (*Gmel.*)	∣	∣	...	∣	∣									††			”

[1] In connexion with this puzzling group I may here mention that Mr. Dresser and Prof. Newton have at last succeeded in disentangling the synonymy and separating the species. Mr. Dresser writes to me on this matter that the bird we obtained in North Russia, very white in winter, with almost unspotted rump, usually larger in size than *L. linaria*, but varying a good deal, is *Linota exilipes* of Coues, and is a small form of *L. Hornemanni*, Holb.; further, that it is circumpolar in its distribution and is found in North Europe, North Asia, and North America, and appears to range further north than *L. linaria*. Mr. Seebohm and I can therefore lay claim to having added it to the European fauna.

[2] *Vide* ‘Ibis,’ 1877, p. 128.

TABLE I., showing the fauna at 13 localities (*continued*). — TABLE II., showing the fauna in 3 districts. (*continued*).

Species.	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	1	2	3	'Ibis,' 1876.
Time spent at each locality.	April 15 to June 10.	April 29–30. June 3, 4, 5. June 10, 11.	June 13–14, 5 P.M. to 2 A.M.	June 14.	June 15.	June 16–17.	June 17–18, 8 P.M. to 4 A.M.	June 18–19, 12 noon to 8 A.M.	June 20 to Aug. 2.	(June 25.)	(June 26–28.)	(July 22–30.)	(July 13–14.)					
English miles.	→	26	33	12	20	37	27	25	16	→	26	30	54	306				
Localities and Approximate Positions.	Ust Zylma, 65° 26′ N.	Habariki, 65° 47′ N.	Yorsa River, 66° 13′ N.	Chuvinski, 66° 33′ N.	Abrámoff, 66° 42′ N.	Viski, 67° 15′ N.	Gorodok, 67° 31′ N.	Kuya, 67° 45′ N.	Alexievka, ?	Yooshina, ?	Stanovaya-Lachta, ?	Dvoinik, 68° 28′ N.	Golaievskai, 68° 58′ N.	Total	Ust Zylma to Chuvinski, 65° 26′–66° 30′.	Chuvinski, to Alexievka, 66° 30′ to 68° ?	Alexievka to Golaievskai, 68° to 68° 58′.	
44. Budytes citreolus, *Pall.*		|	|	|	|	|	|	|	|	|	|				·|·	||	‡‡	page 123
45. Motacilla alba, *L.*	|	|	...	...	|	...	...	...	|						††	||	//	125
46. Turdus pilaris [1], *L.*	|	|	|	...	|	...	...	...	...	...	|				††	|	|	”
47. —— iliacus, *L.*	|	|	...	...	|	...	...	...	...	...	|				††	|	|	”
48. Cyanecula suecica (*L.*)	|	|	|	|	|	|	|	|	|	|	|				‡‡	‡‡	||	”
49. Ruticilla phœnicura (*L.*)	|	|													||			215
50. Saxicola œnanthe (*L.*)	|	...	...	...	...	...	...	...	...	...	...	|			||	...	|	”
51. Pratincola indica, *Blyth*	|	|													||			”
52. Phylloscopus trochilus (*L.*)	|	|	|	|	|	|	...	|	|	|	|	|			††	††	||	”
53. —— borealis (*Blas.*)	...	...	...	| ...											/			216
54. —— tristis (*Blyth*) [2]	|	|	...	...	...	...	...	... |	|	...	|				||	||	|	217
55. —— Gaetkei, *Seebohm*, n. sp.[3]	...	...	...	| ...											/			218
56. Acrocephalus schœnobænus	...	...	|	...,	|	|	...	...	|						||	||		”
57. Parus kamschatkensis, *Bp.*	|	|													|			”

58. —— cinctus, Boie.	|	|	...	... |	|									·|·	·|·		219
59. Ampelis garrulus, L.	...	|	| ...											|			”
60. Hirundo rustica, L.	|	|												††			220
61. Cotyle riparia, L.	... |	|	...	...	...	...	|	|						·|·	||		”
62. Lagopus albus, Gm.	|	...	...	...	...	...	|	...	|	|	|	|		·|·	||	††	”
63. Tetrao tetrix, L.	...	...	... |	| ...										✓			221
64. —— urogallus, L.	|	|												||			”
65. —— bonasia, L.	|	...												||			”
66. Charadrius pluvialis (L.)	|	...	...	...	...	...	|	|	...	|	|	|		||	||	||	”
67. Squatarola helvetica, Briss.									|	|	|	|			||	||	222
68. Eudromias morinellus, Briss.											|					·|·	289
69. Ægialites hiaticula (L.)	|	|	...	...	|	...	|	|	|	|	...	|		††	††	††	”
70. —— fluviatilis (Bechst.)	|	...	...	...	...	...	...	...	|					✓	✓		290
71. Hæmatopus ostralegus (L.)	|	...	... |	| ...	|									||	|		”
72. Phalaropus hyperboreus (L.)						... |	|	|	|	|	...	|			‡‡	‡‡	”
73. Totanus canescens, Gm.	|	|												||			291
74. —— glareola (L.)	|	|	... |	| ...	|	...	...	...	|	...	|			††	|	|	”
75. —— fuscus (L.)		|												††			292
76. Actitis hypoleuca[4] (L.)		|	| ...	...	|									·|·	·|·		”
77. Terekia cinerea, Güld.	|	|	|	|	|	|	|	|	|					††	††		”
78. Limosa ægocephala (L.)												|				✓	”
79. Machetes pugnax (L.)	|	|	...	...	...	... |	| ...	|	|	|	|	|		††	††	††	”

[1] In our paper in the 'Ibis' (1876, p. 125) we mention this as "common as far as Stanovaya-Lachta." This is not strictly accurate, as, though seen in some numbers at that place, it was not seen so abundantly at intervening localities to the southward.

[2] We traced this interesting species as far as the island opposite Stanovaya-Lachta, where we heard its easily recognized note on June 28, after leaving the latter place.

[3] *Vide* 'Ibis,' 1877, p. 92.

[4] *Vide* 'Ibis,' 1876, p. 292. We again met with the species a little further to the north, near Abrámoff.

Table I., showing the fauna at 13 localities (*continued*). — Table II., showing the fauna in 3 districts (*continued*).

Species.	Ust Zylma, 65° 26′ N.	Habariki, 65° 47′ N.	Yorsa River, 66° 13′ N.	Chuvinski, 66° 33′ N.	Abrámoff, 66° 42′ N.	Viski, 67° 15′ N.	Gorodok, 67° 31′ N.	Kuya, 67° 45′ N.	Alexievka, ?	Yooshina, ?	Stanovaya-Lachta, ?	Dvoinik, 68° 28′ N.	Golaievskai, 68° 58′ N.	Total	Ust Zylma to Chuvinski, 65° 26′–66° 30′.	Chuvinski to Alexievka, 66° 30′ to 68° ?	Alexievka to Golaievskai, 68° to 68° 58′.	'Ibis,' 1876.
Time spent at each locality.	April 15 to June 10.	April 29–30. June 3, 4, 5. June 10, 11.	June 13–14, 5 P.M. to 2 A.M.	June 14.	June 15.	June 16–17.	June 17–18, 8 P.M. to 4 A.M.	June 18–19, 12 noon to 8 A.M.	June 20 to Aug. 2.	(June 25.)	(June 26–28.)	(July 22–30.)	(July 13–14.)					
English miles.	→	26	33	12	20	37	27	25	16	→	26	30	54	306				
	1	2	3	4	5	6	7	8	9	10	11	12	13		1	2	3	page
80. Tringa subarcuata (*Güld.*)												|						293
81. —— alpina, *L.*									|	...	...	|	|				‡‡	"
82. —— minuta, *Leisl.*												|					††	294
83. —— Temminckii, *Leisl.*	|	|	...	...	|	|	|	|	|	...	|	|			††	‡‡	||	308
84. Calidris arenaria (*L.*)												|	|				||	"
85. Scolopax gallinago (*L.*)	...	|	...	...	|	|									||	|		309
86. —— major (*Gm.*)	...	|	|	...	|	... |	| ...	|							|	††		310
87. Numenius phæopus (*L.*)	|																	311
88. Grus cinerea, *Bechst.*	|																	"
89. Cygnus musicus, *Bechst.*	|	|	|	|	|	|	|	|	|	|	|				††	††	|	437
90. —— minor, *Pall.* [1]	...	...	...	...	...	...	...	...	...	...	...	|			?	?	||	438
91. Anser segetum, *Gm.*	|	...	...	...	...	... |	| ...	...	|	|	|	|			||	||	||	441
92. Anas clypeata, *L.*	...	...	...	...	...	... |	| ...	...	...	...	|							442
93. —— crecca, *L.*	|	|	|												||			443
94. —— acuta, *L.*	|	|	|	|	|	|	|	|	|	...	|	|			‡‡	††	||	..

97. —— cristata (*L.*)						—	— ...	—							//		445
98. Clangula glaucion (*L.*)	—	—												—			”
99. Harelda glacialis (*L.*)......								—	—	—	. —	—	—		=	‡‡	”
100. Œdemia fusca (*L.*)											—					//	448
101. —— nigra (*L.*)	—	— ...	... —	— ...	—	...	...	...	—	—	—	...	—	=	=	††	447
102. Mergus albellus, *L.*	...	—												=			448
103. —— merganser, *L.*	...	—													—	=	450
104. —— serrator, *L.*									—	—	...	—					”
105. Sterna hirundo, *L.*			... —	— ..	—	— ...	—	—	— ...	—	...	—		=	=	=	451
106. Larus canus, *L.*	—	—	... —	— ...	—	...	...	—	—					=	=		”
107. —— affinis, *Reinh.*	—	—	—	—	—	—	—	—	—	—	—	—		††	††	††	452
108. —— marinus, *L.*								—	—	...	...	—			‡‡	†	”
109. —— glaucus, *L.*												—	—			††	453
110. Stercorarius crepidatus, *Gm.*									—	...	—				—	=	”
111. —— parasiticus, *L.*								... —	—	—	—	—			—	‡‡	454
112. Eudytes septentrionalis (*L.*)	...	—	— ..	...	...	...	...	....	...	...	—			/	...	=	455
113. —— arcticus (*L.*)	...	—	...	...	...	...	...	...	...	...	—	—		=	...	††	”

[1] We have every reason to believe that this species also passed Ust Zylma, though we had no opportunity of positively identifying it until we obtained the bird at Meekitza (*vide* 'Ibis,' Oct. 1876, p. 440).

Upon an examination of the above Tables it will be seen that the fauna of North-east Russia, as observed by Mr. Seebohm and myself, is represented at each of the thirteen localities as nearly as possible as shown below (p. 290).

In adding up under each class I have, when the horizontal strokes are drawn towards the sides of the columns, ranked the species under "Probably present" in these columns: example—(column 1, species 61,) *Cotyle riparia*, though not seen at Ust Zylma, was seen not very far down the river below it. This distinction may seem unnecessarily precise; but I have thought it better to be exact in these minute points as far as possible, in a paper such as the present, *because*, in many cases, reason may be adduced for absence or a very local distribution. In this case of *Cotyle riparia*, for instance, the absence of sandbanks and suitable haunts may account for it.

SUMMARY I.

Name of locality.	Number of Species actually recorded.	Number of Species probably present though not recorded by us.	Probable total of Fauna of each locality.	Number of Species, balance absent or probably absent, or with insufficient data for record.	Total observed.
Ust Zylma	72	20	=92	and 21	113
Habariki	50	33	=83	„ 30	
Yorsa River	18	50	=68	„ 45	
Chuvinski	14	48	=62	„ 51	
Abrámoff	35	26	=61	„ 52	
Viski	16	40	=56	„ 57	
Gorodok	20	33	=53	„ 60	
Kuya	25	30	=55	„ 58	
Alexievka	41	15	=56	„ 57	
Yooshina	23	21	=44	„ 69	
Stanovaya-Lachta	37	11	=48	„ 65	
Dvoinik	31	1	=32	„ 81	
Golaievskai	5	0	= 5	„ 108	

SUMMARY II.

Number of Species in district between Ust Zylma and Chuvinski.	Number of Species in district between Chuvinski and Alexievka.	Number of Species in district between Alexievka and Golaievskai.
94	61	55

out of total avifauna of 113

XXIV.—*Description of some Sponges obtained during a Cruise of the Steam-Yacht 'Argo' in the Caribbean and neighbouring Seas.* By Thomas Higgin, F.L.S.

[Plate XIV.]

Last winter Mr. Reginald Cholmondeley, of Condover Hall, Shropshire, chartered the 'Argo,' a new steam-yacht of over 700 tons burthen, for a voyage to the West Indies, with the primary object of increasing his already fine collection of birds; but desiring to extend the advantages of the trip to the Liverpool Museum, he courteously invited the Committee to name a gentleman to accompany him as his guest on behalf of that institution; and the Rev. H. H. Higgins of Rainhill, so well known as an enthusiastic and devoted worker for and supporter of the Museum from its foundation, was selected for this complimentary and important work. The yacht left the Mersey early in January 1876, and returned in May following, having visited most of the West-India Islands, the coast of Central America, the southern shore of the Gulf of Mexico, Florida, and the Bahamas.

The sponges now described and figured form part of the valuable collection brought home by Mr. Higgins; and it is a matter of great satisfaction that in one of them, perhaps the most beautiful in form, an opportunity is afforded of naming it after him generically and thus connecting his name permanently with the expedition and its results, while it may express in a slight degree our sense of the obligations under which he has placed us by so many years of patient work at the Museum, and in the interests of natural history and science generally during his long residence in the neighbourhood of Liverpool. I shall commence, then, with the species *Higginsia coralloides*, which may be considered as typical of the genus *Higginsia*.

Higginsia coralloides, n. g. et sp. (Pl. XIV. figs. 1–5.)

General form flabellate, consisting of lobate compressed branches of irregular and luxuriant growth, united clathrously or continuously, rising from a short dense stem; surface deeply furrowed in a vertical direction, the ridges between the furrows being narrow and in the young growths serrated with tooth-like projections, passing in the older portions into rounded or tubercled prominences, thus giving the sponge (which now in its dried state is white) its peculiarly coral-like appearance.

The structure is a spiculiferous network of lozenge-shaped reticulation, in which the spicules are held firmly in position by tough hardened sarcode, not generally enclosed in this horny material, but cemented together by it where they touch or cross each other, the fibre being echinated by smooth spicules which project from its interior into the interstices at various angles, and the surface hirsute. Spicules of two kinds—namely, smooth acerates forming the skeleton-structure, and spined acerates, chiefly confined to the sarcode and the surface of the sponge. The skeleton-spicule is a smooth, stout, curved acerate, whose ends are slightly bent outwards, measuring 0·025 inch in length by 0·001 inch in the middle, its strongest part (fig. 2), associated with which are fine slender straight acerates in small quantity, sometimes longer than the others, measuring only 0·0002 inch in diameter (fig. 3). The spicules of the sarcode are likewise acerate and only slightly bent, variable in size, but averaging in their largest forms 0·008 inch in length by 0·00025 inch in diameter in the middle, found generally throughout the sponge, but especially in the furrows of the surface, where they are congregated together in masses and lie in a horizontal position.

Size of specimen 7 inches in height, with a similar breadth; length of stem from basal attachment to first lateral projection $1\frac{1}{2}$ inch, diameter of stem 1 inch by $\frac{5}{8}$ to $\frac{3}{4}$, diameter of flabellate portion $\frac{1}{2}$ to $\frac{5}{8}$ inch.

Colour, in its present dried state, cream-white.

Loc. Carinage Harbour, Grenada, West Indies.

This beautiful sponge, which is the only example of the species in the 'Argo' collection, was obtained by the Rev. H. H. Higgins from Mr. Thomas G. Rowley of St. George's, Grenada, and is said to have been got by diving. As regards its skeleton, it is in excellent preservation and very perfect; but it has been carefully cleaned and consequently has lost much of its sarcode, together, probably, with many of the spined acerates, which in the living state existed in large quantities in the form of a matted surface-covering, since, as before stated, masses of them still remain in the furrows.

Although this sponge is the only example of the species in the 'Argo' collection, the genus is represented by other specimens in the Liverpool Museum, and also by several sponges from South Africa in the British Museum. In all cases the skeleton-structure is made up of smooth spicules, either of the acerate form only, or of acerates and acuates in varying quantities, more or less bent rather than curved in the centre; and the fibre is always more or less echinated, the spicule of the sarcode being in every instance a spined acerate.

All the specimens so far known are, with one exception, flabelliform; and most are characterized by the presence of the tough horny material usual in sponges of this family. The individuals of the genus brought together from different localities resemble each other so much that the differences between them appear only sufficient to make them varieties of one and the same species. Those in the Liverpool Museum from the west coast of Africa, therefore, have had given to them a distinctive name having reference only to the locality whence they were obtained, whilst the one from the south-west of Ireland, though differing in form, has been regarded as the British representative of the genus.

Higginsia coralloides, var. *liberiensis*.

Two sponges possessing spicules similar to those of *H. coralloides*, but differing from it in size, colour, and texture, brought by Captain Davis from Cape Palmas, where they had been obtained by dredging, were presented to the Liverpool Museum some months ago by Mr. R. J. Keen, one of our most indefatigable collectors and contributors. They are fan-shaped, of the same growth and form as the Grenada sponge, but are of a dirty yellowish-brown colour, and the largest does not exceed 3 inches in height. The hardened sarcode, which holds together the spicules composing the skeleton-network of these sponges, is *not* of the same tough nature as that generally found in sponges of this order; and though the stem has the usual dense appearance, there is a comparative absence of the tenacity which is ordinarily a characteristic feature in the Echinonemata. The skeleton-spicule is a smooth bent accrate, measuring 0·026 inch in length by 0·0013; and the subskeleton-spicule is a straight, smooth, hair-like spicule of the same form, but of greater length; while the sarcode spicule is a spined accrate, sometimes gradually curved but oftener bent elbowlike in the middle, measuring 0·003 inch in length by 0·00025 at its thickest part.

Higginsia coralloides, var. *arcuata*.

This sponge, regarded as the British representative of the West-Indian species, was obtained by the Rev. H. H. Higgins whilst on a visit to the south of Ireland about three years ago, and brought home in spirits before any others of the same genus had come into the possession of the Liverpool Museum. It is not of erect growth, like the others, but was found growing on the rock in masses of about 2 inches in diameter by 1 to 1½ inch in thickness, of a fleshy nature and deep brown-red colour. The main lines of the skeleton-structure consist of smooth, bent, acerate spicules extending vertically from the base, and connected by secondary lines at various angles, both being echinated with spicules; while the surface-covering consists of a thick layer of dark-coloured sarcode (shrunk much by drying), which is thickly strewn with small spined acerates lying in it confusedly in a horizontal position. The smooth acerates are 0·012 inch by 0·00025, and the spined acerates 0·0003 by 0·000143 inch respectively. Thus they are less than half the size of those of *H. coralloides.*

Loc. Bantry Bay, Ireland.

Colour dark brown-red.

Respecting the other known species of the genus, Mr. Carter states that "there are several specimens in the British Museum of a sponge which came from Port Elizabeth, in South Africa, that can only be considered a variety of *Higginsia coralloides.* They are flabelliform, compressed, clathrous, stipitate, composed of branches radiating from a hard stem, which, subdividing, anastomosing, and covered with short erect laminæ interuniting interruptedly between themselves, give to the whole a dendriform clathrous aspect. Colour reddish brown-yellow, almost white when washed out. Texture compact, hard. Spicules of two kinds, viz. echinating or flesh-spicule and skeleton or axial. The former small, acerate, and spined throughout; spines erect. The latter, or larger, of which there are two forms, viz. smooth curved or bent in the centre, acerate and acuate respectively, mixed with long sub-skeleton-spicules of the same form but straighter."

Higginsia would form a genus of Mr. Carter's group Pluriformia, in the first family of Echinonemata, namely *Ectyonida.*

Donatia parasitica, n. sp. (Pl. XIV. figs. 6–8.)

When examining *H. coralloides* for its spicule complement, the presence of globostellate spicules with conical pointed rays, and of smaller stellates with capitate spined rays, was always observed; and so constantly were these spicules found in greater or less quantity in every part of the sponge examined, that they might have been erroneously grouped with the spicules proper to it, had not Mr. Carter strongly expressed the opinion that they were probably only accidental and would prove to belong to a sponge similar to that noticed by him in connexion with *Polytrema* on a crab's claw (Ann. & Mag. Nat. Hist. 1870, vol. v. p. 392). A diligent search was therefore made, and the crevices of the nullipore were carefully examined; and at length a small laminiform sponge was found, which proved to be the species which had supplied the stellate spicules to the erect sponge. Only one patch of this sponge, however, could be discovered, though it must have been abundant in the neighbourhood, and may have existed in quantity on the nullipore, but had been removed by cleaning; the one example of the species remaining, however, is so far uninjured and undisturbed that its original form and mode of growth can be easily observed.

It consists, in its dried state, of a thin layer of sarcode very densely charged with stellate spicules, whose rays are smooth, pointed or spino-capitate respectively (figs. 6 and 7), while the surface of the sponge bristles with the pointed shafts of erect, long, spinulate spicules arranged separately but near each other, with their large ends imbedded in the sarcode amongst the stellates. The spino-capitate rayed spicules are half the size of the smooth pointed or conically rayed ones, which measure rather more than 0·001 inch, rays included; and the spinulate spicules, which are subterminally inflated, are in their largest forms 0·02 or $\frac{1}{50}$ inch in length by $\frac{1}{3500}$ inch in diameter.

The spiculation of this sponge denotes its relationship to the Suberitida, in which family there is less hesitation in placing it since Mr. Carter has expressed the opinion (Ann. & Mag. Nat. Hist. 1876, vol. xviii. p. 229) that the spiculous suborder of Carnosa, viz. Gumminida, will eventually be found to pass into the suborder Suberitida. Its forms of spicules respectively indicate a close alliance to those of *Tethya lyncurium* (Johnston), which is also sometimes found laminiform in growth; and therefore it must be regarded as a species of the genus *Donatia* (= *T. lyncurium*) constituted by the late Dr. J. E. Gray (Proc. Zool. Soc. 1867, p. 541).

As regards spicules a similarity also exists between this sponge and *Columnitis squamata*, Schmidt (Grundzüge einer Spongienfauna des Atlantischen Gebietes, p. 25, Taf. v. figs. 3, 4), which possesses a subterminally inflated spinulate spicule basally imbedded in sarcode, charged with globostellates with conically pointed rays, and with other stellates whose rays are abruptly terminated; but it is difficult from Dr. Schmidt's description and figures to recognize any essential difference between *C. squamata* and the British examples of *T. lyncurium*, which it resembles so closely in its spiculation and in the section of the cortical layer so well seen in Dr. Schmidt's fig. 3. This sponge, therefore, seems clearly to find its proper place in the genus *Donatia*.

Its spicules closely resemble those of Mr. Carter's sponge on the crab's claw, the stellates being exactly the same both in form and size; but the pin-like spicules of Mr. Carter's sponge have ovate not subterminally inflated heads, and they are not much more than half the size of those in the specimen found in connexion with *Higginsia coralloides*, as I learn from a mounted fragment of the former kindly sent to me by Mr. Carter for comparison.

When looking for this sponge, small portions of another interesting species were found on the nullipore, to which some allusion has already been made by Mr. Carter in his observations on *Hymeraphia microcionides* (Ann. & Mag. Nat. Hist. 1876, vol. xviii. p. 391). It has been seen only in very small quantity; but its remarkable spiculation renders a passing notice of it desirable. It is laminiform in growth, the thin sarcodous layer being full of spined quadriradiate spicules (fig. 9) closely packed together, amongst which are based long acuates erect, making the surface hirsute; no flesh-spicules. With it was seen a fragment of a variety of *Dercitus niger*, which Mr. Carter has also observed as often found in company with a boring *Cliona* (Ann. & Mag. Nat. Hist. 1876, vol. xviii. p. 410). His valuable guidance, too, in distinguishing species of obscure forms (communicated in his observations on the sponges dredged up on board H.M.S. 'Porcupine') having rendered the reading of the spiculation of genera so much more easy and plain than formerly, and also having so much facilitated the separation of different species found growing together, I have no doubt that Mr. Carter is right in regarding this sponge as a species of *Hymeraphia* with some characteristics of *Microciona*.

Halichondria birotulata, n. sp. (Pl. XIV. figs. 11–15.)

In the October issue of the 'Annals' (1876, ser. 4, vol. xviii. p. 315) Mr. Carter records some additional observations on the flesh-spicules of *Halichondria abyssi*, and refers to a sponge from the West Indies, of which several good examples now exist in the Liverpool Museum, about to be described under the specific name *birotulata*. The specimens thus alluded to form part of the 'Argo' collection.

Soon after the publication of Mr. Carter's description of *H. abyssi* (Ann. & Mag. Nat. Hist. 1874, vol. xiv. p. 245) some fragmentary portions of a branched littoral sponge of a dark brown-purple colour were brought from Jamaica by Capt. J. A. Perry, apparently very nearly allied to Mr. Carter's deep-sea species; and being new, efforts were made (unattended, however, with any success) to obtain whole specimens from that locality, the only example known being a very fine one in the possession of Dr. Allen of that island, from which the fragments of branches mentioned had been obtained. In the mean time the Rev. H. H. Higgins had secured by means of a diver several examples of the species at Puerto Cabello, on the coast of Caracas, some of which he preserved in spirit, while the rest were brought home in a dried state. The acquisition of these specimens shows us the sponge growing under different outward forms, and affords the opportunity of careful examination of the species.

Its peculiar feature, as its specific name denotes, is the birotulate flesh-spicule hitherto only observed in *Spongilla* and some of the hexactinellid sponges, viz. *Hyalonema*. Although extremely minute, the form of this spicule is precisely that of the large one familiar to us in *Hyalonema*, from which it only differs in size and in the number of rays forming the umbrella-like heads. In his remarks (*loc. cit.*) Mr. Carter observes that the minute flesh-spicule in *H. abyssi* (considered by him to be the "embryonic form" of the large one with bent shaft) is a complete birotulate, "each dome-shaped or umbrella-like head of which is composed of twelve spines webbed together," exactly like that which is found in the West-Indian littoral sponges, in which, however, it only appears in the minute form, and in them, therefore, must be considered to be a maturely developed spicule.

In form *H. birotulata* is massive, lobate, with uniformly even but roughly reticulated surface, extending laterally into irregular lobes, or into long, procumbent, straggling, compressed branches, which unite where they touch and cross each other, or into numerous pyramidic erect prominences growing close together and united at the base, crumb-of-bread-like and of dark brown-purple colour. The skeleton-structure is an areolar multispicular network, the main lines of which extend from the base towards the surface, or in the direction of the long axis of the branch, gradually tending outwards and ending abruptly in lengths free for some distance from subsidiary fibre, and thus producing aculeate surface-prominences. The dermal sarcode, which is strengthened with a quantity of fine acuate spicules lying in it confusedly, has a dull glaze when dry; it is not pierced with numerous small pores, but the openings in it are all rather large, making it difficult to distinguish the incurrent from the excurrent orifices where the latter are not larger than the others. In the growing portions the dermal sarcode is supported on the projecting ends of the skeleton-fibre; but in the older parts the subdermal cavities have lost their surface-covering of sarcode, and the sponge thus becomes pitted or honeycombed in appearance. Thin sarcode densely charged with the peculiar flesh-spicule tympanizes the interstices of the network, dividing the mass into the usual cavities, which cavities communicate with each other by means of the ordinary sphinctral openings in these sarcodic expansions. The skeleton-spicules are of two forms, namely a subcylindrical one, which is curved at the distance of one third of its length, sometimes found pointed at the long end so as to form a curved acuate, and a long fine straight acuate spicule not only associated with this, but found also in considerable numbers in the dermal sarcode. The subcylindrical spicule (fig. 12) measures 0·0068 inch in length by ·0003 at its thickest part; and the long fine acuate (fig. 13) is 0·01 inch long by 0·0002 inch in diameter. The flesh-spicule is of one form only, viz. a minute birotulate, each umbrella-like extremity of which is divided into twelve rays or ribs connected with each other and with the shaft by the usual falciform expansions (figs. 14 and 15), measuring 0·00053 inch in length, the diameter of the heads being $0{\cdot}0001\dot{6}$ inch and the diameter of the shaft one tenth of that of the heads. This minute flesh-spicule is liable to be passed over and its beauty and form unobserved; for the composition of the umbrella-like head is not *distinctly* seen with a lower power than a $\frac{1}{7}$th objective. Mr. Laurence Hardman of Rock Ferry, who kindly undertook to verify the counting of the number of rays or flukes, was fortunate enough to discover on the slide submitted to him a few rotulate extremities broken off from their shafts and lying flat on the cover, the form of which was beautifully seen under a $\frac{1}{20}$th. The finding of these heads in this convenient position rendered the counting of the rays easy, and enabled a correct drawing of an end view of one of them to be made (fig. 15).

Size. The specimens from the Spanish main are of the massive and pyramidic form. In the latter the erect growth is not more than 3 inches in height, with a base of from 2 to 3 inches in diameter; while among the massive forms, which cover pieces of coral, the largest specimen has a basal attachment of 6 to 7 inches, and extends laterally in an irregular lobe 5 to 6 inches. The branched form, known to us only by the specimen in the possession of Dr. Allen of Jamaica, is stated by him to extend to the distance of 2 feet from its root or base, the diameter of the branches not exceeding 1 inch by $\frac{1}{2}$ to $\frac{3}{4}$ inch.

Loc. Puerto Cabello, Caracas, and Bay of Kingston, Jamaica.

In the 'Argo' collection there are some specimens of a branched sponge from Nassau resembling the Jamaica example in outward form, colour, skeleton, and structure, possessing a skeleton-spicule of slender cylindrical form, but lacking altogether the flesh-spicule. In them the horny element is rather more developed than in Dr. Allen's sponge, and it yet remains to be considered how far they are related to *H. birotulata*; they will therefore be more particularly referred to when the rest of the collection comes to be described.

EXPLANATION OF PLATE XIV.

Fig. 1. *Higginsia coralloides*, half actual size, after a photograph by Mr. John Chard, Liverpool Museum.

Fig. 2. Smooth bent acerate skeleton-spicule of same, scale 0·001 to 0·0625 inch.

Fig. 3. Smooth straight acerate subskeleton-spicule of same, scale 0·001 to 0·0625 inch.

Fig. 4. Spined bent acerate surface-spicule of same, scale 0·001 to 0·0625 inch.

Fig. 5. Same spicule, scale 0·001 to 0·125 inch.

Fig. 6. Smooth conically spined stellate spicule of *Donatia parasitica*, scale 0·0002 to 0·08$\dot{3}$ inch.

Fig. 7. Spino-capitately rayed spicule of same, scale 0·0002 to 0·08$\dot{3}$ inch.

Fig. 8. Subterminally inflated spinulate spicule of same, scale 0·0004 to 0·041$\dot{6}$ inch.

Fig. 9. Entirely spined quadriradiate spicule of *Hymeraphia* unnamed, scale 0·0002 to 0·041$\dot{6}$ inch.

Fig. 10. Bent acuate spicule of same sponge, scale 0·0004 to 0·041$\dot{6}$ inch.

Fig. 11. *Halichondria birotulata*, short branch, actual size, from a drawing by my daughter, Eva Higgin.

Fig. 12. Subcylindrical skeleton-spicule of same, scale 0·0004 to 0·0625 inch.

Fig. 13. Acuate subskeleton-spicule of same, scale 0·0004 to 0·0625 inch.

Fig. 14. 12-rayed birotulate flesh-spicule of same, five rays only at each end shown, to avoid confusion of lines; scale 0·0005 to 1 inch.

Fig. 15. End view of one of the umbrella-shaped extremities of same spicule, scale one 1900th to 1 inch.

XXV.—*On the Structure of the Lower Jaw in* Rhizodopsis *and* Rhizodus *. By R. H. Traquair, M.D., F.G.S., F.R.S.E., Keeper of the Natural-History Collections in the Museum of Science and Art, Edinburgh.

Among the detached and broken-up remains of the Coal-measure fish known as *Rhizodopsis sauroides*, one of the most frequently observed is a bone of a somewhat narrow and elongated form, truncated and somewhat expanded at one extremity, which may be assumed to be the anterior, and pointed at the other or posterior. One margin, nearly straight,

* Read before the Royal Physical Society of Edinburgh, Feb. 21, 1877.

save just in front, where it shows a slight convexity, is set with a single row of small pointed teeth of nearly uniform size; but the anterior extremity bears in addition a single more or less incurved laniary tooth, much larger than the others, and also more internal in its position; the opposite margin, thin and sharp, displays a gently flexuous contour. Seen from the inner aspect, the anterior extremity of the bone presents a conspicuous thickening, in which the large laniary is socketed, and which at the dental margin passes into a delicate ledge, which runs back for some distance along the roots of the smaller teeth.

This bone, whose external form has been well described by Messrs. Hancock and Atthey*, was considered by them to be the *præmaxilla* of *Rhizodopsis*, being obviously distinct from another well-known dentigerous bone, which is indisputably the maxilla, and closely resembles in form the maxilla of *Megalichthys*. To all appearance it would also seem to be distinct from the mandible, the margins of which "are nearly parallel," and which displays, besides a large laniary tooth in front, "three or four others placed along the ramus, in a line within the small teeth."

With the bones described by Messrs. Hancock and Atthey as the præmaxilla, maxilla, and mandible of *Rhizodopsis*, every student of carboniferous ichthyology must be familiar. The interpretation of the first of these as "præmaxilla" has been accepted by the Messrs. Barkas†, and, so far as I am aware, has remained hitherto unquestioned. Nevertheless the accuracy of its determination as such was to me a matter of doubt from the first. It is true the bone in question does in some measure remind us of the elongated præmaxilla of Teleostei of the most specialized type, in which that element, loosely articulated with the front of the skull, extends backwards so as to shut out the now edentulous maxilla from the edge of the mouth (*Perca*, *Gadus*, &c.). But as *Rhizodopsis* is a Crossopterygian ganoid of the type possessing two dorsal fins and subacutely lobate pectorals, one would naturally expect that its præmaxillary bones would resemble in form and relations those of its natural allies, whether rhombiferous or cycliferous, in all of which, whose cranial osteology is sufficiently known, each præmaxilla is comparatively small and short, firmly fixed to the front of the cranial shield, and, in fact, very unlike the bone of *Rhizodopsis* which has been

* Ann. & Mag. Nag. Hist. 1868, ser. 4, vol. i. pp. 350, 351.

† 'Manual of Coal-measure Palæontology,' by T. P. Barkas (London, 1873), p. 24, pl. ii. fig. 61; W. J. Barkas in 'Monthly Review of Dental Surgery.'

so interpreted. How to fit this bone into the præmaxillary region was to me somewhat puzzling; and, accordingly, to find it *in situ* in the head of the fish was an object to be attained, before giving-in adherence to the views usually maintained regarding it.

A short time ago my friend Mr. Ward of Longton, to whose liberality in lending specimens from his magnificent collection I am on this, as on other occasions, so largely indebted, sent me a number of unusually good examples of the head of *Rhizodopsis* preserved in nodules of hard ironstone from the Coal-measures of Fenton in Staffordshire. One of these displays the entire extent of the gape on both sides of the head. Each maxilla measures here $1\frac{1}{10}$ inch in length; the upper margin is injured; but the lower, bearing one row of small teeth, is quite intact; the anterior extremity shows the little articular process projecting upwards and forwards as in the similarly shaped maxilla of *Megalichthys*. Now, placed between and articulating with the anterior extremities of the right and left maxillæ, while they are joined with each other in the middle line, are two small dentigerous bones forming the front edge of the mouth below the snout. Each of these two bones is nearly as high as long, these measurements being respectively $\frac{4}{10}$ and $\frac{5}{10}$ inch; they are firmly fixed to each other and apparently also to the front of the cranial shield: the teeth, which in this specimen are seen attached to them, resemble those of the maxilla; but in another example there are traces of others somewhat larger. That we have here the true *præmaxillæ* is beyond all doubt; some other signification must therefore be found for the bones hitherto considered such. Turning now to the mandible, both rami of which are displayed in the specimen under description, we find that over a considerable area the bony matter of the outer aspect has flaked off, leaving behind it a pretty sharp cast with sutural lines. On close examination a suture is now seen commencing near the posterior extremity of the upper margin of the jaw, and, passing gradually downwards and forwards, marks off as *dentary* an element precisely the counterpart in shape of the reputed præmaxilla. The pointed extremity is placed backwards, the enlarged one forwards, the toothed margin upwards. The rest of the outer surface of the mandible is composed of at least three additional bony plates, separated from each other by sutures which pass obliquely forwards and upwards. The posterior and largest of these, covering over the articular region of the jaw, may be perhaps equivalent to the *angular* element, though it also occupies very much the place of a *supraangular*; the other two, in front of the latter and below the dentary, may be called *infradentary*; and there is also some evidence of a fourth, small plate on the lower margin of the jaw, separating here the angular from the first infradentary for a little distance*.

In another specimen, compressed vertically and showing the top of the head, both maxillæ are seen, forming the upper margin of the mouth, while, forming its lower margin, both dentaries are seen on the edge of the nodule, here retaining their bony substance and external sculpture. Their contour proves beyond a doubt that the dentary element of the mandible of *Rhizodopsis* is undistinguishable from the bone hitherto reckoned as præmaxilla, but which I have already shown cannot possibly be so. The very same thing is most clearly shown in a shale specimen belonging to Mr. Plant of Salford, in which a vertically compressed head is seen from below; so that I have no hesitation in affirming the identity of the bones in question.

Here, however, an objection to this view may be raised. The mandible of *Rhizodopsis* when perfect, as in most of the specimens from Fenton now before me, shows not merely one large tooth in front, but two or three additional ones behind it and internal to the series of small teeth, though, as stated by Messrs. Hancock and Atthey, these additional larger teeth "are seldom present." What has become of these in the detached dentary, if such be the real nature of the reputed præmaxilla?

A ready explanation of this is found in the structure of the lower jaw of certain Old Red Sandstone "Dendrodonts," in which the laniary teeth are not attached to the dentary bone proper, but to a series of accessory "internal dentary" pieces articulated to its inner side†. Should this be also the case with the posterior laniaries of the mandible of *Rhizodopsis*, then, in cases where its elements are broken up and separated, these additional pieces will also get detached, and the absence of all but the anterior laniary in the isolated dentary bone will thus be amply accounted for.

The material at hand not furnishing me with absolute proofs of this condition in *Rhizodopsis*, I now turned to its

* That these sutures on the outer surface of the mandible in *Rhizodopsis* have not been previously observed is fully accounted for by the difficulty of tracing the line of demarcation between constituent and closely united osseous elements, in cases where we have to deal with a granulated or otherwise ornamented external bony surface. Such lines of demarcation are more easily determined where the bones are seen from the inner surface, or where a sharp cast in hard ironstone of that inner surface has been preserved.

† See Pander's 'Saurodipterinen, Dendrodonten, &c. des devonischen Systems,' pp. 41–43, tab. x. figs. 2, 3, 4, 14, 22.

gigantic ally, the *Rhizodus* of the Scottish Lower Carboniferous strata. I had previously observed the not uncommon occurrence of detached dentigerous bones belonging to *R. Hibberti*, which had exactly the same shape as the so-called præmaxillæ of *Rhizodopsis*, and, like them, frequently bear only one laniary, the large one in front. On now carefully examining the exterior of several more or less perfect mandibles, it became at once evident that the bone in question was nothing more or less than the dentary element, the rest of the outer surface of the jaw being formed by several additional bony plates quite analogous to those occurring also in *Rhizodopsis*. In *Rhizodus* there are four such additional plates: of these the posterior one, covering up the articular region, is probably equivalent to the angular element, though, indeed, occupying also the position of a supraangular; while in front of it, below the dentary, and forming the lower margin of the jaw, are three others, diminishing in size from behind forwards, and separated from each other by sutures passing obliquely forwards and upwards, and to which, as in *Rhizodopsis*, the name of *infradentary* may be applied.

Several detached specimens of the dentary bone of *Rhizodus* in the Edinburgh Museum exhibit its inner surface, which is also conformed just as in the corresponding element, the so-called præmaxilla, of *Rhizodopsis*. The upper margin, comparatively thin, is set with one row of small teeth; but at the symphysial extremity the bone shows a great thickening, the anterior part of which is marked by a very rough area for articulation with the bone of the opposite side. In this thickening is implanted the anterior great laniary, behind and close to which is another socket, usually empty, sometimes occupied by a "twin" tooth *. There are also in the Museum several jaws seen from the internal aspect and in which the posterior laniaries are present; but being imbedded in hard ironstone, the surface of the bone is so injured as to render recognition of sutures a matter of difficulty: they show, however, very clearly that these posterior laniaries are implanted in a thickened ledge, somewhat nodulously enlarged round the base of each, and continuing backwards the symphysial thickening of the dentary proper—this ledge with its teeth being totally absent in the detached dentaries above alluded to. I now selected for special preparation two jaws, seen from the outer surface, and fortunately imbedded in a rather soft laminated clay. The first of

* The more posteriorly situated laniaries of *Rhizodus* occur also occasionally double.

these was a portion of a comparatively small jaw, $3\frac{1}{4}$ inches in length, and broken across $\frac{3}{4}$ inch behind the stump of the second laniary; and by softening the matrix with water, I succeeded in completely detaching it and cleaning its inner surface. The surface of the bone being here quite intact, I obtained a clear proof of the fact which I had anticipated, viz. that the second laniary tooth is attached to a separate piece of bone articulated by a distinct suture to the anterior thickening of the dentary, and having its outer surface in apposition with the flat inner surface of the dentary behind that thickening. The next jaw was a larger one, measuring 14 inches in length, showing three entire laniaries and the stump of a fourth, the articular extremity being, however, unfortunately broken off. Having covered up the outer surface of the specimen with a sufficient mass of Portland cement, I turned it over and worked down upon it from the other side, the preparation thus obtained entirely corroborating the conclusions previously arrived at. The large teeth are seen to be borne upon a thickened ledge, diminishing in strength from before backwards, the anterior part of which is the previously described symphysial thickening of the dentary proper, and carries the first great laniary; the suture between that and the anterior of the accessory internal dentary pieces bearing the second laniary is distinctly seen; but posteriorly the separation of the others is obscured by the obstinate adherence to the bone of a thin layer of the matrix, which cannot be thoroughly cleared off without injuring the surface. My attention was next directed to a block of the same laminated clay containing several bones of *Rhizodus*. From this I succeeded first in extracting the anterior half of an isolated dentary bone, that of the right side, showing the stump of the symphysial laniary with the adjoining empty socket. Then, lying about 2 inches from it in the same block, I observed a piece of bone bearing a large tooth, which, on being in like manner extracted entire, proved to be nothing more or less than the *detached* accessory piece carrying the second laniary of the same jaw, and would have fitted perfectly on to the dentary found beside it, had not the latter been a little distorted by crushing. Finally, several vertical sections through another mandible led to the very same result—namely, that the laniary teeth behind the great anterior one are attached to bone which is quite distinct from that of the dentary proper; and as the piece to which the second laniary is attached has occurred quite isolated, we may very safely assume that the third and fourth had also each a piece for themselves.

Summary.

The general results of the researches briefly detailed above may be summed up as follows.

The mandible has, as far as ascertained, essentially the same structure in *Rhizodopsis* as in *Rhizodus*. In both, the *dentary* element is narrow and pointed posteriorly, its upper margin bears one row of small teeth, while at the symphysis it is peculiarly thickened where it bears the first or anterior laniary. This bone, turned upside down, has, in *Rhizodopsis*, been previously considered to be the præmaxillary; the last-named element of the skull of that fish has now, however, been ascertained to be a different bone, which is quite similar in form and relations to the præmaxilla in other Crossopterygii.

The laniary teeth behind the anterior one are borne upon separate *internal dentary* ossicles, which, when the constituent elements of the lower jaw are broken up and separated, will also become disarticulated and dispersed. This is absolutely proved in *Rhizodus*, and may be considered morally certain in *Rhizodopsis*, though a clear view of the inner aspect of the complete mandible of the latter, with the posterior laniary teeth *in situ*, has not yet been obtained.

Below the dentary the inferior margin of the jaw is formed by a series of *infradentary* plates, while posteriorly the articular region is covered by a plate corresponding in position apparently both with the *angular* and *supraangular* elements. I may add that, in one specimen of *Rhizodopsis*, I have seen very distinct evidence of a *splenial*.

The great complexity of the structure of the mandible in these forms and in the allied "Dendrodonts" of the Old Red Sandstone need not astonish us when we take into account the remarkably segmented splenial of the recent *Amia*, or the similarly segmented maxilla of *Lepidosteus*.

XXVI.—*Description of a new Form of* Ophiuridæ *from New Zealand.* By EDGAR A. SMITH, F.Z.S., Zoological Department, British Museum.

[Plate XV.]

THERE are three specimens of this very remarkable form of Ophiuridæ in the British Museum—one presented by Major

Greenwood in 1850, and the two others by Captain Stokes, R.N., in 1855.

In general aspect it reminds one at once of the genus *Ophiocoma*, possessing a granular disk similar to that which obtains in that genus; and the characters of the arm-plates and of the *true* arm-spines are also congeneric; but the difference of the oral slits (rimæ) and the presence of two or more short flattened spines or scales which overlap one upon another and upon the uppermost true arm-spine, thus keeping them almost in a horizontal position, are characters which may be considered of sufficient importance to separate generically this curious species. The mouth-organs, namely the teeth proper, tooth-papillæ, and the jaws or framework which supports them, are exactly similar to those of the genus *Ophiothrix*; also the oral fissures are precisely like those of that genus—that is, are more in the form of wide holes than narrow slits as in *Ophiocoma*; and the first ambulacral tentacles are just within the rimæ and without scales. The side mouth-shields are likewise of the same character as in *Ophiothrix*, and are situated along the lower margins of the oral shields, as is almost invariably the case in that genus. However, the granular disk not showing radial shields, and the presence of mouth-papillæ, are differences which easily dissociate the present genus from it.

OPHIOPTERIS *, gen. nov.

Disk covered with a granulous skin as in *Ophiocoma*; teeth, tooth-papillæ, oral and adoral shields, and the mouth-fissures as in *Ophiothrix*; oral papillæ present; brachial shields and true spines similar to *Ophiocoma*; the arms provided with 2–3 compressed imbricating scales or compressed spines above the uppermost spines; two genital slits; ambulacral scales present.

Ophiopteris antipodum, sp. nov.

Disk roundly subpentagonal, somewhat lobed between the rays, closely and coarsely granulated on the dorsal surface, and beneath on the interbrachial spaces covered with crowded short spines; rays $4\frac{1}{2}$–5 times as long as the diameter of the disk; oral shields small, somewhat heart-shaped, with a slight point both on the inner and aboral sides; madreporic shield distinct, larger than the others, and lobed a little on each side; side

* ὄφις a snake and πτέρις a fern. The rays call to mind the appearance of certain kinds of ferns.

mouth-shields irregular, narrow, lying along the lower margins of the orals, and not quite meeting within; mouth-papillæ about six to each mouth-angle, three on each side, small, not at all conspicuous; tooth-papillæ very numerous, arranged in six vertical rows above, gradually diminishing until there are but two series where they meet the teeth; they extend far within the mouth, so that the teeth are not visible; the papillæ of the outer rows are a trifle longer than the intermediate ones, and increase in size as they approach the teeth, and those at the upper end of the tooth-column are very small and irregularly clustering. Teeth 5, subequal, roundly truncated at the ends and thicker in the middle than at their lateral edges.

Lower arm-plates at the border of the disk about twice as broad as long, gradually becoming proportionally longer as the end of the arm is approached; their form is irregularly heptagonal, the two sides towards the mouth sloping to a slight point; on the aboral side they are faintly excavated in the middle, and arcuately sloping on each side of this slight sinus towards the lateral margins, which are also concave; upper arm-plates remarkably flat, twice as broad as long, and gradually, like the lower ones, becoming proportionally longer towards the end of the ray; in form they are transversely oblong, sharply pointed on each side, the points fitting in between the very narrow lateral plates; the latter just meet below between the lower arm-plates, but not quite above; arm-spines in four series (near the disk sometimes five), the lowest the shortest, the uppermost but one the longest, and the other two about equal in length, but the uppermost one the stoutest; all the spines are rather flattened, not acutely pointed, and much compressed at the tips and truncated. Above the base of each spine of the uppermost series are two (here and there three) short, broad, compressed spines or scales one upon another, the one nearest the lateral spine the largest and about a fourth its length; one tentacle-scale, small, roundish; genital slits two in each interbrachial space, extending from the margin of the disks to the oral shields.

The colour above is uniformly dull brown, and beneath the rays and ray-spines rather paler. The interbrachial spaces below are dark like the dorsal surface.

Diameter of the disk about 26 millims.; width of upper arm-plates 3, of lower ones $2\frac{1}{2}$; length of longest spine $5\frac{1}{2}$.

Remarks. The form of the mouth-shields is subject to considerable variation. In the largest specimen they are almost as long as broad, whilst in a smaller one they are much broader than long.

The chewing-apparatus might be said to consist of a great number of teeth of various sizes. The lowest ones, five in number, one above another, are very much larger than the rest; above these are two, side by side, about half the size of the preceding, which are the commencement of the two series which bound the cluster of minute teeth (tooth-papillæ) on either side; and they gradually diminish in size upward. The teeth or papillæ between these series are very small and arranged above in four vertical rows, then lower down in three and two series, and gradually diminish downwards within the mouth to a single papilla. The mouth-papillæ are very small indeed, short, cylindrical, and vary from three to five on each side of each of the five mouth-angles or tooth-columns. They are hardly distinguishable from the tooth-papillæ, as they are situated close together near the apex of the column.

EXPLANATION OF PLATE XV.

Fig. 1. Upper surface, of natural size.
Fig. 2. Lower surface.
Fig. 3. Part of underside of an arm, enlarged.
Fig. 4. Part of upperside.
Fig. 5. A Madreporic shield: *b, c,* two forms of oral shields.

XXVII.—*The* Vates Ashmolianus *of Westwood, the Type of a new Genus of* Mantidæ. By Prof. J. Wood-Mason.

Æthalochroa, gen. nov.

♂ ♀. Sexes alike. Body greatly elongated, linear. Head small, rather higher than broad; vertex of considerable antero-posterior extent, its lateral lobes produced into a conoidal boss behind each eye, the central division of its median lobe with a low transversely convex elevation (answering to the well-developed process seen in *Blepharis* and *Phyllocrania*) ending abruptly over the ocelli; eyes much as in *Blepharis mendica*, but not quite so forwardly projecting; ocelli slightly oval, conspicuous, prominent, mounted on short pillars, in the male distinctly differentiated into pupil and iris; facial shield broader than high, pentagonal, inclining to be trefoil-shaped, its upper margin slightly produced to a projecting point in the middle, with a faint ridge on each side near and parallel to the lateral margins; "chaperon" strongly transversely carinate. Antennæ short and setaceous. Prothorax greatly elongated, strongly carinate or roof-shaped above, the two sides of the disk being almost plane and very steep, covered above and below and on the edges with minute sharp granules, slightly and gradually widening from the supracoxal dilatation, not only to its base but also to its apex, which is broadly rounded off; supracoxal dilatation large, rounded-angulate. Organs of flight well and equally developed in both sexes, but when closed hardly extending beyond the apex of the fourth segment of the abdomen; their marginal areæ subcoriaceous, opaque; their posterior areæ membranous and hyaline; tegmina with the basal third of the marginal area rather suddenly dilated and covered with dense, sharply defined, and prominent polygonal reticulation; the discoidal nervure of the wings simple. Legs short and stout: the anterior ones a little weaker than the rest; the coxæ triquetrous, with the posterior angle rounded off, and the anterior developed into a slight foliaceous lobe at the apex, as in *Danuria*; femur curved, its upper margin being concave, convex both on the inner and on the outer face, but especially on the latter, its lower margin spined along the apical three fourths (five spines set wide apart on the outer edge and on the inner), and angulated at about the junction of the basal and middle third of its length, the joint gradually increasing in depth, both from the apex and from the base, up to this point; tibia slender, slightly curved, faintly crested towards the apex along its upper margin, armed with eight or nine spines on the inner edge, the basal half of which is unarmed, and with five on the outer, the apical fifth only of which is armed; terminal claw acuminate, rather abruptly hooked: four posterior legs strongly cristate and furnished with foliaceous lobes; femora prismatic, the angles of the the prisms crested, three of the crests (the two lower ones and one of the upper ones) developed into a foliaceous lobe close to the apex, the lateral knee-lobes short and stout, but sharply pointed; tibiæ triquetrous, the angles strongly crested, especially the upper one, which is developed into a foliaceous lobe along its basal half; femora equal in length to the tibiæ in all four posterior legs. Abdomen linear; the ventral segments all with a short sharp carina, ending in a sharp point at the middle of their hinder margins, and with their surface symmetrically wrinkled, the terminal one extending by about a third of its length beyond the supraanal plate; dorsal segments with a raised median line, which is produced to a point at the hinder end of each, and increases in strength to the extremity of the abdomen; supraanal plate short, twice as broad as long, rounded at the extremity. Cerci broadly foliaceous, truncate at the apex.

Æthalochroa Ashmoliana, Westwood.

Vates Ashmolianus, Westwood, Ann. & Mag. Nat. Hist. vol. viii. p. 272; Arcana Entomol. 1843, vol. ii. p. 52 (note †).

"Fuscus, capitis vertice rotundato, antennis gracillimis, prothorace longissimo (long. unc. $1\frac{2}{3}$) angusto, lateribus serrulatis; tegminibus et alis abdomen haud tegentibus, illis pallidis griseo et fusco parum variis nubecula fusca basin versus, venisque nigro strigatis; alis hyalinis, costa maculisque nubeculaque basin versus brunneis; cercis analibus latis foliaceis; pedibus 4 posticis brevibus, femoribus fere ad apicem 3-foliatis tibiisque ante medium supra parum foliatis. Long. corporis unc. $4\frac{1}{3}$. Habitat in India orientali."

The following are the measurements of a dried specimen of the male and of a female preserved in alcohol:—

Total length, ♂ 100, ♀ 115 millims.; length of prothorax ♂ 33, ♀ 40—of which the neck is respectively, ♂ 7·6 and ♀ 9·5; width of prothorax at supracoxal dilatation, ♂ 4·5, ♀ 5·6—at hinder extremity, ♂ 3·6, ♀ 4·5; length of abdomen, ♂ 46, ♀ 52; width of abdomen at middle, ♂ 3·5, ♀ 5; length of tegmina, ♂ 45, ♀ 55; width of tegmina across middle, ♂ 9, ♀ 11; length of wings, ♂ 42, ♀ 52; of fore coxa, ♂ 15, ♀ 16·5; of femur, ♂ 16·5, ♀ 19·75; of tibia (from base to insertion of tarsus), ♂ 12, ♀ 15; of immediate femur, ♂ 12·5, ♀ 15·5; of tibia, ♂ 12·5, ♀ 15·5; of posterior femur, ♂ 15, ♀ 19; of tibia, ♂ 15, ♀ 19; of antennæ, ♂ 23, ♀ 18; of cerci, ♂ 7·5, ♀ 8·5; width of cerci, ♂ 2, ♀ 2·6.

Hab. I am indebted for the female of this fine and remarkable insect to my friend Dr. T. R. Lewis, who captured it in the garden attached to the General Hospital in Calcutta; for the male to Mr. C. V. Marshall, by whom it was taken at Berhampur, near Murshidabád, in Lower Bengal.

XXVIII.—*Hermaphroditism in the Parasitic Isopoda. Further Remarks on Mr. Bullar's Papers on the above subject.* By H. N. Moseley, Fellow of Exeter College, Oxford.

Mr. Bullar does not appear to strengthen his position materially in his reply to my remarks on his paper on the "Generative Organs of the Parasitic Isopoda" (Journ. of Anat. and Physiol., Oct. 1876, p. 118), in the March number of this Journal.

There seems to be no proof that the small masses of tissue figured by Mr. Bullar as testes are in reality organs of such nature; and it is on this point that the whole question of hermaphroditism or unisexuality must be decided. The testes of *Asellus aquaticus*, on the external resemblance of which to the supposed testes of his parasitic forms Mr. Bullar relies, have an unusually marked and characteristic histological structure. They contain very large mother cells, in which the long filaments of the developing spermatozoa are coiled in bundles. Although Mr. Bullar has examined his Isopods in all stages, and in the fresh as well as prepared conditions, he gives no evidence as to any such structure in the supposed testes of these animals: he merely says that the organs "are filled with a cellular blastema, from which *doubtless* the spermatozoa are developed."

It seems to me that the absence of positive evidence that the spermatozoa are thus developed constitutes a serious flaw in the chain of evidence by which Mr. Bullar seeks to establish his conclusion. Testis-tissue is not by any means a difficult object for histological observation; and since it is evident, from the detailed description which Mr. Bullar gives of the minute structure of the ovaries in his Isopods, that he has carefully studied the histology of their generative organs, he could hardly have overlooked definite testis-structure had such existed in the objects which he terms testes.

I cannot but consider that it will be more prudent to await further evidence before accepting as demonstrated the fact that the members of the subfamily of the Cymothoinæ alone amongst Isopods are hermaphrodite—although, were this conclusion confirmed, it would be of great interest, and might be considered as paralleled by such instances as the hermaphroditism of the Serranidæ amongst fishes.

XXIX.—*Descriptions of three Homopterous Insects in the Collection of the British Museum.* By Arthur Gardiner Butler, F.L.S.

Platypleura, Amyot & Serville.

Platypleura nicobarica, n. sp.

Allied to *P. fulvigera* from the Philippines, but larger, with the tegmina longer, the whole of the spots crossing the coriaceous area testaceous, those crossing its apex smaller; the blackish transverse spots considerably smaller; wings longer, the subapical transverse fulvous fasciole replaced by three or four decreasing longitudinal fulvous streaks; pronotum considerably broader, its lateral angles more oblique, and therefore more prominent. Length of body 10 lines, expanse of tegmina 3 inches 1 line.

Nicobars (3 examples). Type, B.M.

We have three examples of *P. fulvigera*; so that I am satisfied of the constancy of the characters by which the two species are separated.

COSMOSCARTA, Stål.

Cosmoscarta Buxtoni, n. sp.

General form of *C. xanthorhina*; above purplish black; head somewhat prominent, centrally grooved in front; ocelli small, placed in deep excavations on either side of a central carina, which runs to the back of the thorax, the latter granulose, barely wider than the closed tegmina, with a distinct marginal ridge, a feeble oblique depressed line on each side, near the posterior border; tegmina with the basal two fifths almost covered by a broad oblique ochreous band, which crosses the corium; a narrow, nearly perpendicular, transverse vermilion band just beyond the end of the corium; body below blackish piceous; legs chocolate-brown. Length 9 lines, expanse of tegmina 18 lines.

Sumatra. Type, B.M.

This and the succeeding species were obtained by Mr. E. C. Buxton in his recent trip to Sumatra.

Cosmoscarta sumatrensis, n. sp.

Allied to *C. octopunctata*, but at once distinguished by the much greater width of the thorax and scutellum, more prominent head, duller coloration, the black ventral surface of the abdomen, as of the whole body below; above testaceous; thorax shining, very convex in the centre, subdiaphanous and depressed at the sides; tegmina crossed by black spots, as in strongly marked examples of *C. octopunctata*; legs testaceous. Length 10 lines, expanse of tegmina 20 lines.

Sumatra. Type, B.M.

XXX.—*Notice of a Barbel from the Buffalo River, British Caffraria.* By Dr. A. GÜNTHER, F.R.S.

MR. H. TREVELYAN has recently sent to the British Museum several specimens of a small species of barbel from the Buffalo River which appears to be undescribed. Although the length of the largest specimen does not exceed 4 inches, dissection shows that individuals of that size are fully adult.

Barbus Trevelyani.

D. 10. A. 8. L. lat. 34. L. transv. 6/3½.

Barbels two only, of small size. The osseous dorsal ray is very slender, stiff, with very minute, almost imperceptible posterior serrature. Three longitudinal series of scales between the lateral line and ventral fin. Body oblong, its depth being two sevenths or one fourth of the total length (without caudal), the length of the head one fourth. The depth of the head is less than its length without snout. The diameter of the eye is one fourth of the length of the head, and rather less than that of the snout, or than the width of the interorbital space (which is somewhat convex). Snout rather obtuse; mouth inferior, small. Dorsal fin of less height than the body, commencing a little behind the origin of the ventral, its first ray being equidistant between the end of the snout and the root of the caudal. Anal small; caudal rather deeply forked. The pectoral does not extend to the ventral. A narrow dark band runs along the middle of the side, and terminates in a round blackish spot at the root of the caudal.

XXXI.—*Descriptions of some new Species of Reptiles from Madagascar.* By Dr. ALBERT GÜNTHER, F.R.S., Keeper of the Zoological Department, British Museum.

[Plate XVI.]

THE novelties described in this paper were contained in some small collections recently received by the British Museum from Madagascar. As regards the localities, M. Grandidier has kindly informed me that Anzahamaru is the name of a small village, most probably close to Mahanoro, and that it is a name very common throughout Madagascar, meaning a locality where there are many country-houses. Mahanoro is a short distance south of Tamatave.

Acontias holomelas. (Pl. XVI. fig. A.)

Middle of the body surrounded by 31 series of scales; 140 scales in the series running from the chin to the vent. Length of the rostral shield half that of the snout, the part below the nasal slit being shorter than that above it. The first three upper labials nearly as high as long, the third being below the eye. Vertical longer than broad. Four præanal scutes, the two middle ones being the largest. Entirely black.

The length of the body of our largest specimen, without the tail, which is more or less injured, is nearly 6 inches.

From Anzahamaru.

Gongylus melanurus.

Rostral shield with an upper undulated margin; supranasals in contact with each other; frontal broad, single, with a straight posterior margin; vertical large, bell-shaped, narrower in front than behind, with an excision in the middle of its hind margin, the small central occipital fitting into the excision; one pair of occipitals.

Nostrils situated entirely within the rostral shield; postnasal smaller than loreal. Six upper labials, the fourth being the largest and situated below the eye.

Front lower labial narrow, followed by a single mental, which is broader than long. Six lower labials.

Eyelid scaly. Ear-opening small, round.

Body surrounded by 26 longitudinal series of scales. There are 82 transverse series of scales between the mental and the vent, which high number sufficiently indicates the slenderness of the body.

Four præanal scales, the two central ones being the largest.

Fore limbs extremely small, with a longitudinal groove on the side of the body, into which they can be received when the animal is burrowing underground. When laid forwards they scarcely reach the ear-opening. Toes very short, third and fourth equal in length. The hind limb and toes very short, the second and fifth toes equal in length, the fourth one fourth longer than the third.

Upper parts brown, sometimes black, sometimes brown mottled with darker. Abdomen whitish. Tail generally entirely blackish.

			millim.
Distance of the snout from the eye			$3\frac{1}{2}$
,,	,,	ear-opening	8
,,	,,	fore limb	17
,,	,,	vent	60
Length of tail (restored)			ca. 70
,,	fore limb		$7\frac{1}{2}$
,,	third front toe		1
,,	hind limb		12
,,	fourth hind toe		$3\frac{1}{2}$

Three specimens from Anzahamaru; one specimen from Mahanoro.

Gongylus melanopleura.

Rostral shield low, narrow, with an upper straight margin; supranasals in contact with each other; frontal nearly as long as broad, subtriangular, with an undulated posterior margin; vertical large, bell-shaped, much narrower in front than behind, with an excision in the middle of its hind margin, the central occipital fitting into the excision. One pair of occipitals.

Nostrils situated entirely within the rostral shield; post-nasal smaller than loreal. Six upper labials, the fourth being the longest and situated below the eye.

Front lower labial small and narrow, followed by a single mental of a pentagonal shape. Six lower labials.

Eyelid with a transparent disk. Ear-opening small, round.

Body surrounded by 25 longitudinal series of scales; there are 54 transverse series of scales between the mental and the vent. Four præanal scales, the two central ones being the largest.

Fore limbs extremely small, with a postaxillary groove not well developed. When laid forward they do not reach the ear-opening. Toes very short, third and fourth equal in length. The hind limb short with very short toes, the second and fifth being equal in length, and the fourth one fourth longer than the third.

Upper parts brown, sprinkled with black. Sides towards the back black, this colour forming a band ill-defined below and margined with white above.

Lower part of sides dotted with black. Abdomen whitish.

			millim.
Distance of the snout from the eye			3
,,	,,	ear-opening	8
,,	,,	fore limb	15
,,	,,	vent	50
Length of tail			$53\frac{1}{2}$
,,	fore limb		8
,,	third front toe		$1\frac{1}{3}$
,,	hind limb		14
,,	fourth hind toe		$4\frac{1}{2}$

One specimen from Anzahamaru.

Chamæleon gallus. (Pl. XVI. fig. B.)

Allied to *Chamæleon nasutus*. Snout with a long, pointed, flexible appendage (in the male), which is covered with large soft tubercles. Head compressed, without median crest. No spines whatever along the median line of the back; no crest along the belly. Body uniformly granular, without larger scales. Head and occiput covered with smooth, small, polygonal shields. Toes very short, with very small claws.

Coloration without particular markings.

Of this small species we possess only one example, 93 millims. long, the nasal appendage being 7, and the tail 45 millims.

Mahanoro.

Rana inguinalis.

Head rather longer than broad, with the snout pointed, and with the loreal region high and subvertical. Canthus rostralis angular; nostril immediately below it, nearer to the end of the snout than to the eye. Tympanum two thirds the size of the eye. Vomerine teeth inconspicuous, between the choanæ, which are rather small, round. Skin nearly smooth, without folds. Limbs and toes slender. First and fourth toes longer than the second; third longest. Toes broadly webbed, the web reaching the penultimate phalanx of the fourth toe; the third and fifth toes equal in length. Metatarsus with one small tubercle. Upper parts brownish grey, with small subsymmetrical brown spots; a subtriangular brown spot between the eyes. A blackish band below the canthus rostralis and the supratympanic fold. A deep-black spot in the inguinal region. Limbs with brownish cross bars. Lower parts whitish.

	millim.
Length of body	34
,, fore limb	23
,, first finger	$5\frac{1}{2}$
,, second finger	$4\frac{1}{2}$
,, third finger	7
,, fourth finger	5
,, hind limb	64
,, metatarsus	$9\frac{1}{2}$
,, fourth toe	17
,, fifth toe	13

One specimen from Anzahamaru.

Callula notosticta. (Pl. XVI. fig. C.)

Snout short, rather pointed, with distinct canthus rostralis. Limbs of moderate length. Disks well developed, especially on the three outer fingers and fourth toe. Inner finger shortest; third toe longer than fifth. Metatarsus without tubercle; toes not webbed. A fold of the skin runs from the superciliary margin along the middle of the side towards the inguinal region, separating the pink coloration of the back from the dull yellowish of the lower parts. Upper parts subsymmetrically marbled with light brown; two or three pairs of whitish dots edged with black on the back, the most constant being that corresponding to the extremities of the sacral apophyses. The front pair are minute, between the eyes; others, very minute, are scattered in the coccygeal region. Sides of the head blackish. Young specimens nearly uniform pink above.

	millim.
Length of body	35
,, fore limb	22
,, first finger	$2\frac{1}{2}$
,, second finger	3
,, third finger	5
,, fourth finger	$3\frac{1}{3}$
,, hind limb	48
,, metatarsus	$7\frac{1}{2}$
,, third toe, measured from metatarsus	10
,, fourth toe, ditto	14
,, fifth toe, ditto	9

Two specimens from Anzahamaru; one from Mahanoro.

M. Grandidier has most kindly allowed me to examine the specimens of *Callula* (and other reptiles) recently named by him; he himself has expressed his doubts as to the propriety of referring these frogs to the Indian genus *Callula*, in which I fully agree with him. They are undoubtedly adult specimens of his highly interesting genus *Dyscophus* (a Discoglossoid). Singularly enough the discovery of *Callula notosticta* reestablishes the fact that *Callula*, or at least a form most closely allied to it, really occurs in Madagascar.

XXXII.—*New and peculiar Mollusca of the* Eulimidæ *and other Families of Gastropoda, as well as of the Pteropoda, procured in the 'Valorous' Expedition.* By J. Gwyn Jeffreys, LL.D., F.R.S.

Eulimidæ.

Eulima stenostoma, Jeffr.

Eulima stenostoma, Jeffr. in Ann. & Mag. Nat. Hist. 3rd ser. ii. p. 128, pl. v. f. 7.

Station 6, 410 fms. Shetland, 75-90 fms. (J. G. J.). Norway, 50–400 fms. (Lovén and others). 'Porcupine' Expedition, 1869, 64–114 fms.: 1870, English Channel, 358–690 fms.; Mediterranean, 1456 fms. Ægean, 310 fms. (Spratt)! Palermo, 210 mètres = nearly 114 fms. (Monterosato). Gulf of St. Lawrence, 166 fms. (Whiteaves)!

Naticidæ.

Natica affinis, Gmelin.

Nerita affinis, Gm. Linn. Syst. Nat. ed. 13, p. 3675.

Body yellowish-white, with fine streaks of purple at the upper sides of the foot: *mantle* thick, folded over the umbilicus or basal cavity of the shell: *tentacles* conical and pointed, turned back on the front edges of the shell at its mouth: *eyes*, none observable: *foot* large, roundish-oval.

Variety *occlusa*.

Natica occlusa, S. V. Wood, Mon. Crag Moll. (1848) p. 146, tab. xii. f. 4*a*, *b*; Suppl. (1872) p. 76, t. iv. f. 11.

Body pale yellowish, with a purplish tinge or slight streaks of the latter colour on the back of the foot: *head* large, hood-shaped, indented in the middle: *mantle* thick, spread over the back of the shell: *tentacles* conical and finely pointed, wide apart, and separated by a rather thin veil: *eyes*, none perceptible: *foot* enormous and very voluminous, broad and cloven in front, expanding greatly on each side, and rounded behind.

Variety *vittata*.

Body milk-white: *head* forming a broad and bilobed snout: *tentacles* conical, pressed by the head-flaps against the front of the shell, and for the most part concealed; tips pointed: *eyes* not to be detected: *foot* large, thick and broad, folded inwards at the sides, rounded in front, and bluntly pointed behind. Sluggish. Floats with its foot uppermost.

Godhavn, 5–20 fms.; Station 4, 20 fms. (var. *vittata*: globosa, spira extensa, vittis duabus purpureis distantibus ultimum, una cum penultimo, anfractum cingentibus); 5, 57 fms. (var. *occlusa*); Holsteinborg, 12 fms. (var. *vittata*) and 35 fms.; Station 7, 1100 fms. (fragment); 13, 690 fms. (operculum). Arctic seas, in both hemispheres, and Norway, 20–450 fms. 'Porcupine' Expedition, 1869, 74–345 fms. (var. *lactea*: minor, ovata, alba, spira extensa): 1870, coast of Portugal, 994 fms.; Mediterranean, Adventure Bank, 92 fms. (young). One of the most common and characteristic fossils of the newer Tertiary and Quaternary formations in the north of

Europe and America, and indicative of glacial conditions; it has a vertical range of 1840 feet.

This species varies considerably in the comparative height of the spire and in the angularity or compression of the whorls below the suture. The variety *occlusa* attains a large size, one of my specimens measuring $1\frac{3}{10}$ inch in length, and $1\frac{1}{10}$ in breadth; another specimen, from Spitzbergen, is nearly as large. *N. russa* of Gould is apparently a variety also of *N. affinis*. The synonyms are:—*N. clausa*, Broderip and Sowerby; *N. consolidata*, Couthouy; *N. septentrionalis* (Beck), Möller; and *N. janthostoma*, Deshayes. I have taken the descriptions of the animals from my note-book; they somewhat differ.

A very young shell of another species of *Natica* occurred in Station 9, 1750 fms. It resembles the fry of *N. grœnlandica*, but has one whorl less, the last is more expanded, and the apex is flattened. Should an adult specimen be found, it might be named *sphæroides*.

Solariidæ.

*Seguenzia formosa**, Jeffr.

Seguenzia formosa, Proc. Roy. Soc. vol. xxv. no. 173, pp. 200, 201 (woodcuts).

Shell globosely conical, rather thin, semitransparent, nacreous and glossy: *sculpture*, sharp keel-like spiral ribs or ridges, of which there are two on the middle of the body-whorl (besides ten thread-like riblets on the base) and one on the middle of each of the other whorls; there is also a slighter rib immediately below the suture; between the ribs the surface is covered with numerous and delicate curved striæ, which turn alternately in different directions, so as to give a flexuous character to this part of the sculpture; the striæ between the infrasutural and peripheral rib turn to the left, while those between the peripheral and the next rib (or in the upper whorls between the rib in the middle and the base) turn to the right; the same alternate order is to a great extent observable as to the direction of the striæ on the base of the last whorl; these striæ are crossed by fine close-set spiral lines, producing a reticulated appearance; all the whorls are similarly sculptured except the top whorl or apex, which is smooth: *colour* pearly-white: *suture* marked by the uppermost rib: *spire* turreted: *whorls* 7, somewhat convex, gradually enlarging; the last takes up three fifths of the shell; apex globular:

* Beautiful.

mouth large, indented by the spiral ribs: *outer lip* thin, prominent, and deeply scalloped: *inner lip* thick, folded back on the *pillar*, which is short and incurved; at the bottom of the pillar is a small but sharp tooth-like projection, below which is a short and abrupt notch, like that of *Cerithium*: the *groove* or slit on the upper part of the last whorl, and opening from the mouth (which characterizes the genus), is wide and deep, terminating in a curved indentation: *base* somewhat concave, but imperforate or without any umbilicus: *operculum* none. L. 0·2. B. 0·15.

Station 12, 1450 fms.; 16, 1785 fms. (fragment). 'Porcupine' Expedition, 1870, off the coasts of Portugal, 718–795 fms. 'Challenger' Expedition, Station 56, S.W. of Bermudas, 1075 fms.! Gulf of Mexico, 325 fms. (Pourtales)! Fossil in the Pliocene formation at Trapani in Sicily as *S. monocingulata* (Seguenza, MS.).

The peculiar and exquisite sculpture is not unlike that of *Adeorbis subcarinatus*. My only specimen which contained the animal was in vain sacrificed at the altar of science in the hope of detecting an operculum.

Seguenzia carinata *, Jeffr.

Seguenzia carinata, Proc. Roy. Soc. vol. xxv. no. 173, p. 201.

SHELL forming a depressed cone, thin, transparent, glossy, but not nacreous: *sculpture*, a sharp keel round the periphery, a thread-like spiral rib below the suture of each whorl (varying in position), numerous but slight flexuous striæ below the rib, and in some specimens minute close-set curved longitudinal striæ on the upper whorls; the base is smooth, or marked only with microscopic lines of growth: *colour* glassy: *suture* rather deep: *spire* short: *whorls* 7, compressed, slightly shouldered by the infrasutural rib; the last whorl is disproportionally large, and the first is globular: *mouth* narrow, rhomboidal, angulated in the middle by the keel, and below by the base of the pillar: *outer lip* thin: *inner lip* filmy, spread on the base: *pillar* very short and incurved; it is furnished near the bottom with a small tooth-like process, below which is a short notch: *groove* broad, apparently not deep; it occupies the middle of the body-whorl between the suture and the peripheral keel: *umbilicus* narrow but deep, exposing all the whorls, encircled and defined by a slight rib. L. 0·125. B. 0·175.

Station 13, 690 fms. 'Porcupine' Expedition, 1870, Bay

* Provided with a keel.

of Biscay, 718–1095 fms. 'Challenger' Expedition, west of Fayal, Azores, 1000 fms.

Velutinidæ.

Pilidium radiatum, Sars.

Capulus radiatus, Sars, Beretning om en i Sommeren 1849 foretagen zoologisk Reise i Lofoten og Finmarken, p. 64 (1850).

Body milk-white: *mantle* very thick, covering one third of the mouth of the shell: *tentacles* club-shaped, slender, compressed or flattened, contractile, closely striated across at the tips, and thickly covered with short cilia: *eyes* placed on small bulbs near the outer base of the tentacles: *foot* oblong, proportionally small, rounded and double-edged in front, and bluntly pointed behind. Very sluggish, and exudes a large quantity of stringy slime. Adhering to a dead shell.

Station 5, 57 fms. (a single specimen); Holsteinborg, 12 fms. (a young shell). Spitzbergen (Torell)! Finmark (M. Sars)! Sea of Okhotsk (Middendorff)! Japan (A. Adams). Aleutian or Fox Islands, N. Pacific (Dall)! Fossil: Uddevalla and Kuröd, Sweden (Hisinger, J. G. J.); Moray Firth (Robert Dawson)! Montreal (Principal Dawson).

Synonyms: *Pilidium commodum*, Middendorff, 1851; *Piliscus commodus* and *Piliscus probus*, Lovén, 1859; *Capulus dilatatus* and *C. depressus*, A. Adams, 1860 and 1864.

Through the kindness of Professor G. O. Sars and of Dr. L. von Schrenck I have lately been able to compare with my specimens from Davis Strait the typical specimens of *Capulus radiatus* and *Pilidium commodum* from the Christiania and St. Petersburg Museums. All of them exactly agree with each other, as well as with my fossil specimens of *Piliscus probus* (Lovén) from Uddevalla. Sars's Norwegian shell and mine from 57 fathoms in Davis Strait are marked with coloured streaks, which radiate from the apex or crown, while the others are not streaked or coloured.

The generic name *Pilidium* was published by Middendorff in his 'Malacozoologia Rossica,' 1849. Professor Forbes gave the same name for *Tectura fulva* in the Report of the British Association for 1849, published in 1850; and *Pilidium* was described in 1853 by Forbes and Hanley as their generic name for the last-mentioned shell. The late Professor Sars substituted, in 1858, the generic name *Capulacmæa* for his *Capulus radiatus*. Professor Lovén, in 1859, proposed *Piliscus*. Possibly *Capulus fallax* of Mr. S. V. Wood (a Crag fossil) may be another species of *Pilidium*.

Cancellariidæ.

Cancellaria viridula, Fabricius.

Tritonium viridulum, Fabr. Fn. Gr. p. 402.

Body milk-white: *head* furnished with a long and prominent veil: *tentacles* contractile, thread-shaped, rather long and slender, smooth, with blunt tips, diverging at an angle of 45°: *eyes* placed on the top of short stalks, at the outer base of the tentacles, with which the eye-stalks are united: *foot* large, triangular, and long, squarish and double-edged in front, and bluntly pointed behind; edges uneven: *pallial fold* (lining the basal groove of the shell) very short and thick. No operculum. Active; crawls out of the water. It emits a greenish liquid on being touched with a camel's-hair brush—a habit that reminds one of *Planorbis corneus*, which gives out a purple liquid when irritated.

Holsteinborg, 30 fms.; Station 13, 690 fms. (fragment). Spitzbergen, 5–15 fms. (Kröyer, Torell, Eaton). White Sea (Middendorff). Iceland, 80 fms. (Mörch). Norway, 20–300 fms. (Sars and others)! 'Lightning' Expedition, 500–550 fms. 'Porcupine' Expedition, 1869, north of the Hebrides, 114–345 fms.: 1870, Channel slope, 305–567 fms. Labrador, 40–50 fms. (Packard). Gulf of St. Lawrence, 30–40 fms. (Whiteaves)! N.E. coasts of the United States, 20–150 fms. Behring Strait (Wosnessenski). N. Japan, 48 fms. (St. John)! Fossil: Red and Coralline Crag, and Bridlington; Christiania (Crosskey and Robertson)!; Labrador (Packard).

I cannot perceive any difference between *Cancellaria* and Möller's genus *Admete*, except in the former having stronger folds or plaits on the pillar; these were not noticed by Fabricius in his description of the present species. The apex in *C. cancellata*, however, is peculiarly sculptured, and somewhat resembles that of *Columbella haliæeti*.

Synonyms: *Murex costellifer*, J. Sowerby; *Admete crispa*, Möller; *Cancellaria buccinoides*, Couthouy; *C. Couthouyi*, Jay, Gould.

Cerithiidæ.

*Cerithium procerum**, Jeffr.

Shell pyramidal, solid, opaque, and glossy; base slightly concave: *sculpture*, curved longitudinal ribs, of which there are about 30 on the last and 20 on the next whorl; the three

* Long.

uppermost whorls are nearly smooth; the base is irregularly marked with flexuous striæ, these being an extension of the ribs; the periphery of the last whorl is encircled by a spiral ridge, which is continued on all the other whorls, and defines the suture; under a microscope may be detected also traces of numerous slight spiral lines between the ribs: *colour* pale yellowish-white: *spire* tapering; apex twisted obliquely, and extended: *whorls* 13–14, somewhat convex; the last occupies about a third of the shell: *suture* distinct, but not deep: *mouth* narrow and rhombic, with a wide groove at the bottom, where it forms an imperfect canal, which bends abruptly to the left: *outer lip* incurved and thin: *inner lip* filmy: *pillar* short and flexuous, with a sharp edge. L. 0·4. B. 0·1.

Station 12, 1450 fms.; a dead specimen. 'Lightning' Expedition, between the north of Scotland and the Faroes; a fresh and living specimen, but the operculum is not visible.

Buccinidæ.

Buccinum grœnlandicum, Chemnitz.

Buccinum grœnlandicum, Chemn. Conch. Cab. x. (1788) pp. 177, 182, tab. 152. f. 1448.

Body lemon-colour, more or less closely speckled and mottled with purplish-brown: *head* short; intertentacular veil indented in the middle: *tentacles* sharply pointed: *eyes* black, seated on offsets or short tubercles, one at the outer base of each tentacle: *foot* extensile, squarish in front, and bluntly angular behind: *siphonal tube* long, cylindrical, and narrow: *opercular lobe* round, with projecting edges. Active.

Godhavn, 5–20 fms.; Station 4, 20 fms.; 5, 57 fms.; Holsteinborg, 12 fms. Davis Strait (Fabricius and others). Melville Bay, 140 fms.; and Port Kennedy, 15 fms. (Walker). Port Foulke, in Smith Channel or Sound (Hayes, *fide* Stimpson). Gulf of St. Lawrence, 5–250 fms. (Principal Dawson, Whiteaves)! Coasts of N.E. America (Gould and others)! Newfoundland (P. P. Carpenter)! N. Pacific (Middendorff and others). Spitzbergen (Torell)! Iceland (Mörch). Norway (G. O. Sars and others)! Russian Lapland (Middendorff). Fossil in our Red Crag and newer Tertiaries = *B. tenerum*, J. Sowerby.

Extremely variable in shape, size, texture, sculpture, and colour. I regard the following as synonyms, or as representing some of the varieties:—*B. undatum* of Fabricius (not of Linné), *B. undulatum* of Möller, *B. cyaneum* of Beck, *B. Donovani* of Gould (not of Gray, which is *B. glaciale* of Linné), *B. tenebrosum* and *B. sericatum* of A. Hancock; apparently

B. fusiforme of Kiener, from a specimen in the Massena Collection. Another variety of the present species in Möller's collection at Copenhagen is named "*Tritonium Humphreysianum.*" It is also probably the *B. boreale* of Gray (in the 'Zoology of Capt. Beechey's Voyage'), which he refers to a species said to be so named by Leach in the Appendix to Sir John Ross's first voyage; but I can find no such name in that Appendix. *B. grœnlandicum* of Hancock is a variety of *B. glaciale.*

The spawn-capsules are smaller than those of *B. undatum*, and are sometimes attached to the stalks of seaweeds and to the shells of *Balani.*

B. undatum is apparently rare in the arctic seas, although it is occasionally found with *B. grœnlandicum.*

Buccinum ciliatum, Fabricius.

Tritonium ciliatum, Fabr. Fn. Gr. p. 401.

Godhavn, 5–20 fms.; Holsteinborg, 10–35 fms. Greenland (Fabricius and others). Murray Bay, Gulf of St. Lawrence, 112 fms. (Principal Dawson, Whiteaves)! Spitzbergen (Torell)! White Sea and the coasts of Russian Lapland (Von Baer, Middendorff); it is the latter's variety *boreale* of *B. tenebrosum* of Hancock.

It is the *B. Mölleri* of Reeve, whose *B. ciliatum* is *B. grœnlandicum.* The *B. ciliatum* of Gould is apparently a variety of the last-named species.

Buccinum tenue, Gray.

Buccinum tenue, Gray in Zoology of Beechey's Voyage, p. 128, t. 36. f. 19.

Body white with a yellowish tinge, and irregularly speckled with purplish-brown: *head* broad; intertentacular veil straight or having an even edge: *tentacles* conical, bluntly pointed: *eyes* round, black, placed on small oblong bulbs at the outer base of the tentacles: *foot* large and thick, rounded and double-edged in front, acute-angled behind: *siphon* or pallial tube cylindrical, rather strong and stout, slit along its whole length: *penis* folded and compressed, speckled above like the rest of the body. Rather sluggish, but not shy.

Godhavn, 5–80 fms.; Waigat Strait, 15–25 fms.; Station 1, 175 fms.; 3, 100 fms.; 5, 57 fms.; Holsteinborg, 10–35 fms. Greenland (Möller and others). Gulf of St. Lawrence, 50–60 fms. (Whiteaves). Newfoundland (Totten, *fide* Stimpson)! Spitzbergen (Torell, Eaton)!

B. scalariforme (Beck), Möller; *B. tortuosum*, Reeve; perhaps also *B. boreale* of Broderip and Sowerby, from Kamtschatka. My largest specimen is more than 2½ inches long.

Muricidæ.

Trophon clathratus, Linné.

Murex clathratus, Linn. Syst. Nat. ed. 12, p. 1223.

Body pale yellowish-white: *tentacles* slender, but rather short: *eyes* small, placed at the top of stalks which are nearly as long as the tentacles and are united with them: *foot* large, squarish and double-edged in front, with angular corners, rounded or bluntly pointed behind: *siphon* consisting of a short and tubular fold. Shy.

Godhavn, 5–20 fms.; Waigat Strait, 15–25 fms.; Station 4, 20 fms.; 5, 57 fms.; Holsteinborg, 12–35 fms. 'Porcupine' Expedition, 1869, off the Hebrides, 165–580 fms. North Polar seas, Spitzbergen, Iceland, Norway, White Sea, N.E. and N.W. coasts of America, at depths of from 20 to 120 fms. North Japan, 3–48 fms. (v. Schrenck, St. John).

Var. *truncata*. Godhavn, shore; St. 4, 20 fms.; 5, 57 fms.; Holsteinborg, 12–35 fms. 'Lightning' Expedition, 189 and 530 fms. 'Porcupine' Expedition, 1869, 85 fms. British and Scandinavian coasts, and Iceland. *Buccinum* (*truncatum*), Ström.

The typical species and variety are common fossils in our newer Crag and in all the post-Tertiary beds of northern Europe: the former is especially characteristic of glacial conditions; and the latter has been noticed by Seguenza as occurring in the older Pliocene at Messina. *T. clathratus* was first noticed and figured by Linné in his 'Wästgota-Reise' (1747), from Uddevalla.

I am now convinced that Lovén was right in uniting *T. clathratus* and *T. truncatus*, although the latter is a very distinct variety. The difference consists in the comparative number of ribs, thickness, convexity of the whorls, and the size. My largest specimen of the typical form measures an inch and a quarter in length.

The synonyms are inconveniently numerous, viz. *Murex bamffius*, Donovan; *M. peruvianus*, J. Sowerby; *M. multicostatus*, Escholtz; *Fusus lamellosus*, Gray; *F. scalariformis*, Gould; *Tritonium Gunneri* (a variety), Lovén; and *Murex lamellatus*, Philippi. Mörch cites also *Tritonium Rossii*, Leach; but I cannot verify the reference.

Trophon Fabricii, Beck.

Trophon Fabricii (Beck), Möller, Ind. Moll. Grœnl. p. 14.

Godhavn, 80 fms.; Station 1, 175 fms.; 5, 57 fms.; 12, 1450 fms. (a fragment); Holsteinborg, 35 fms. Greenland (Fabricius and others). Wellington Channel (Belcher)! Gulf of St. Lawrence (Whiteaves). Spitzbergen (Torell)! Iceland (Mörch). Norway (Koren, Friele). Fossil: Wexford (Sir Henry James); Lancashire "drift" (Darbishire); possibly also from the "Middle Glacial" formation, as *T. mediglacialis* of S. V. Wood.

It is the *Tritonium craticulatum* of Fabricius, but not *Murex craticulatus* of Linné, which is another species of *Trophon*. Our *T. barvicensis* is allied to the present species, as well as to *T. muricatus*.

*Fusus attenuatus**, Jeffr.

Fusus attenuatus, Proc. Roy. Soc. vol. xviii. no. 121 (1870), p. 434.

Shell spindle-shaped, solid, opaque, rather glossy; the periphery is bluntly angulated in a half-grown specimen: *sculpture* consisting of numerous spiral impressed lines, and of minute close-set and slight lines of growth: *colour* ivory-white: *epidermis* thin and smooth, pale yellowish-white: *spire* long and slender, tapering to a very blunt and regularly spiral point, which is not mamillar or twisted: *whorls* 8–9, compressed, especially below the suture; the last occupies about two thirds of the shell, when viewed with the mouth upwards; the topmost whorls are nearly equal in breadth: *suture* distinct, but not channelled nor deep; it is defined by a thickened edge: *mouth* oblong, acute-angled above; its length, including that of the canal, is about two fifths of the shell: *canal* open, rather long and straight: *outer lip* thin, smooth inside: *inner lip* filmy: *pillar* flexuous: *operculum* ear-shaped, yellowish-brown, curved on the outer side, and incurved towards the base on the inner side; it is marked with a few slight impressed lines, which radiate upwards from the terminal nucleus. L. 2·25. B. 0·85.

Station 13, 690 fms. (a dead specimen). 'Porcupine' Expedition, 1869, off the west of Ireland, 1180–1215 fms. (young specimens and a fragment); Bay of Biscay, 1207 fms. (one living and one dead specimen).

My description is chiefly taken from the living 'Porcupine' specimen.

Differs from *F. propinquus* and its variety *turrita* in being much larger, having a slighter sculpture, a smoother and thinner epidermis, a more tapering spire, compressed whorls, a straighter and more open canal, and a more cylindrical and blunt apex.

* Diminishing, as regards the spire.

Fusus berniciensis, King.

Fusus berniciensis, King in Ann. & Mag. Nat. Hist. xviii. p. 246 (1846).

Var. *elegans*, Station 13, 690 fms. This variety was dredged in the 'Porcupine' Expedition, 1869, off the north of Scotland, in 155–632 fms., and previously by me in Shetland, in 78–100 fms. Another extreme variety (which has a shorter spire and swollen whorls, and is a thin and delicate shell) was dredged in the same expedition, in 203–290 fms.; and it was procured in the late Norwegian Expedition. The latter variety may be called *inflata*. The typical form was dredged in the 'Porcupine' Expedition of 1869 and 1870, Bay of Biscay, at depths of from 90 to 690 fms. 'Lightning' Expedition, 189 and 500 fms. Yorkshire, Northumberland, Aberdeenshire, Shetland, Norway, and Arcachon, 50–140 fms.

It is the *Tritonium islandicum* of Lovén, not *Fusus islandicus* of Chemnitz.

Fusus Sabini, Gray.

Buccinum Sabinii, Gray in Suppl. to App. of Parry's first Voyage p. cxl (1824).

Body milk-white: *tentacles* awl-shaped and slender: *eyes* placed on bulbs at the outer base of the tentacles: *foot* broad and thick, semicircular and double-edged in front, with short angular corners, rounded behind. Active, and crawls out of the water.

Station 6, 410 fms.; a young living specimen (this was erroneously named *F. fenestratus* in my Report to the Royal Society, Proc. vol. xxv. no 173, pp. 183 and 189): also St. 1, 175 fms. (fragments); 12, 1450 fms. (fragments). Davis Strait (Hancock and others). Melville Bay, 100 fms. (Walker). Gulf of St. Lawrence (Whiteaves)! Baffin Bay and Behring Strait (Gray)! North Pacific (Wosnessenski). Spitzbergen (Torell)! Iceland (Mörch, as *F. tortuosus*). White Sea and coasts of Russian Lapland (Baer, Middendorff). Vadsö, Finmark (G. O. Sars, Verkrüzen). Fossil: Bridlington (Leckenby)!

Synonyms: *F. tortuosus* and *F. spitzbergensis*, Reeve; *F. ebur*, *F. togatus*, and *F. Pfaffii*, Mörch. The epidermis is usually smooth; but in one of my Spitzbergen specimens it is finely and closely ciliated. The same difference is observable in the epidermis of *F. propinquus*, *F. pygmaeus*, and *Buccinum grœnlandicum*. The comparative length and curvature of the canal are variable characters.

Pleurotomidæ.

Pleurotoma pyramidalis, Ström.

Buccinum pyramidale, Ström, in Nov. Act. Dan. iii. p. 296, f. 22.

Body pale yellowish-white, with a faint tinge of purple in front: *tentacles* rather short but slender, contractile: *eyes* small, placed on angular projections on the tips of stalks, which are thicker than the tentacles and are united with them for about three fourths of their length: *foot* long, double-edged and squarish in front, with angular corners; bluntly pointed, and occasionally cloven, behind: *siphon* short. Active.

Godhavn, 5–20 fms.; Waigat Strait, 15–25 fms.; Station 4, 20 fms.; 5, 57 fms.; Holsteinborg, 10–12 fms.; St. 7, 1100 fms. (fragment). 'Lightning' Expedition, north of the Hebrides, 189 fms. West Greenland (Möller). East Greenland, 4–30 fms. (Möbius). Spitzbergen, Iceland, Faroe Isles, Novaya Zemlya, and Norway. Labrador to Cape Cod, 4–107 fms. Fossil: Norwich Crag (S. P. Woodward), and all our post-Tertiary deposits, as well as those of Scandinavia and Canada.

The longitudinal ribs on the shell are sometimes more or less wanting; and the colour varies from chocolate to milk-white. Spawn-capsules hemispherical and membranous.

Fusus rufus of Gould, not *Murex rufus* (*Pleurotoma*) of Montagu; *F. pleurotomarius* of Couthouy; and *Defrancia Vahlii* of Beck, according to Möller.

Pleurotoma bicarinata, Couthouy.

Pleurotoma bicarinata, Couth. in Boston Journ. Nat. Hist. vol. ii. p. 104, pl. i. f. 11 (1839).

Body white, with a faint tinge of yellow: *head* small: *mouth* bulbous, cloven lengthwise: *tentacles* rather short but slender, club-shaped at their tips or points: *eyes* small, black, placed on thick stalks, which are united with the tentacles for three fourths of their length at their outer base: *foot* thick and broad, double-edged and gently curved in front, with slight angular corners; bluntly pointed, squarish, or else more or less indented behind: *siphon* cylindrical, of moderate length, slit throughout, with a wide and folded-back opening. Active and not shy.

Godhavn, 5–25 fms.; Waigat Strait, 15–25 fms.; Station 4, 20 fms.; 5, 57 fms. (var. *pallida*); Holsteinborg, 10–12 fms. Greenland (Möller and others)! Wellington Channel (Belcher)! Gulf of St. Lawrence (Whiteaves). North-Atlantic coasts of United States, from low-water mark to 50 fms. (Mighels and others)! Spitzbergen (Torell)! Iceland (Mörch, Verkrüzen)! Norway, 5–250 fms. (G. O. Sars and others)! 'Lightning' Expedition, 170 fms. 'Porcupine' Expedition, 1869, off the west of Ireland, 420 fms.; north of the Hebrides, 203–345 fms.

There are at least four varieties, viz. *violacea* of Mighels and Adams (not of Hinds), and *cylindracea*, *Beckii*, and *livida* of Möller (ex typ.), all published in 1842. *P. Beckii* of Reeve, in Cuming's collection, is a very different and tropical species. Specimens from 57 fathoms are of a pale colour, and those from deeper water are white. Allied to the variety *livida* is *P. gigas* of Beck, which is *Bela lævigata* of Dall, and probably *P. schantaricum* of Middendorff. Reeve renamed the present species *P. grœnlandica* and *P. rugulatus*: he supposed that it was the *Defrancia suturalis* and *D. rugulata* of Möller; but the latter gave no such names to any of his species. Apparently not *P. bicarinata* of S. V. Wood.

Pleurotoma rubescens, Jeffr.

Holsteinborg, 10 fms. (a single but living specimen). Described in Proc. Roy. Soc. vol. xxv. p. 183.

Pleurotoma decussata, Couthouy.

Pleurotoma decussata, Couth. in Boston Journ. Nat. Hist. ii. p. 183, pl. iv. f. 8 (1839).

Godhavn, 5–20 fms.; Waigat Strait, 15–25 fms.; Station 3, 100 fms.; 5, 57 fms. Greenland (Möller, Mörch)! N.E. America, from the Gulf of St. Lawrence to Cape Cod, 10–64 fms. 'Porcupine' Expedition, between the north of Scotland and the Faroes, 560 fms.

I have now been able to ascertain that this species is the same as *Defrancia viridula* of Möller (1842); and I was therefore wrong in supposing that the latter was not American (see Proc. Roy. Soc. vol. xxv. p. 189). It is the *P. scalaris* and *P. leucostoma* of Reeve, who imagined that Vahl had described them under the names of *Defrancia scalaris* and *D. reticulata*; but Vahl did nothing of the kind. I would not have noticed Reeve's numerous mistakes if Mörch had not recognized his so-called species.

Pleurotoma tenuicostata, M. Sars.

Pleurotoma tenuicostata, Sars in Vid. Selsk. Forhandlinger for 1868, p. 259.

Station 12, 1450 fms. 'Lightning' Expedition, 500 and

550 fms. 'Porcupine' Expedition, 1869, off the west of Ireland, 420 and 664 fms.; south of the Faroes, 125 fms.: 1870, Bay of Biscay, 305–717 fms. Upper Norway, 40–300 fms. (G. O. Sars, Friele)!

This pretty little species will soon be described and figured (tab. 17. f. 1) by Professor G. O. Sars. Both he and his late father most obligingly sent me specimens for comparison with mine. A variety occurs in which the longitudinal ribs are replaced by spiral ridges, as in the type of *P. bicarinata*.

Not *Raphitoma tenuicosta* of Seguenza.

Pleurotoma Pingelii, Beck.

Defrancia Pingelii, Beck, Möll. Ind. Moll. Grœnl. p. 13 (1842).

Body pale yellowish-white, with the front of a purplish hue: *tentacles* thread-shaped, rather short: *eyes* on the bulbous tips of thick stalks, which are united with the tentacles on the outside: *foot* long, squarish and double-edged in front, with angular corners; deeply and evenly cloven or forked behind: *siphon* lining the canal, short and broad.

Godhavn, 5–20 fms.; Waigat Strait, 15–25 fms.; Station 5, 57 fms.; Holsteinborg, 10–30 fms. Greenland (Möller and others)! N.E. America, from the Gulf of St. Lawrence (Whiteaves) to Cape Cod (Mighels and others), 4–430 fms. Spitzbergen (Torell)! Iceland (Mörch)! Upper Norway (M'Andrew, Sars)!

Fusus cancellatus of Mighels and Adams, 1842.

Pleurotoma cinerea, Möller.

Defrancia cinerea, Möll. Ind. Moll. Grœnl. p. 13.

Station 5, 57 fms. Greenland (Möller)! Spitzbergen (Torell)! Iceland (Mörch). 'Porcupine' Expedition, 1869, between the north of Scotland and the Faroe Isles, 290 fms.

My largest specimen is $\frac{9}{10}$ of an inch long.

Pleurotoma declivis, Lovén.

Tritonium declive, Lovén, Ind. Moll. Scand. p. 13.

Station 5, 57 fms. Norway, 30–60 fms. (Lovén and others)! 'Lightning' Expedition, 189 fms. 'Porcupine' Expedition, 1869, between Norway and the Faroes, 64–560 fms.: 1870, Channel slope, 567 fms. (fragment).

My largest specimen is $\frac{6}{10}$ of an inch long.

Var. *angustior*. Narrower and smaller. 'Porcupine' Expedition, 1869, 345 fms. West Finmark (G. O. Sars)!

Pleurotoma elegans, Möller.

Defrancia elegans, Möll. Ind. Moll. Grœnl. p. 13.

Body milk-white. Animal sluggish or shy.

Godhavn, 5–20 fms.; Station 5, 57 fms.; Holsteinborg, 10 fms. Greenland (Möller and others)! Gulf of St. Lawrence (Whiteaves)! Iceland (Torell)! Fossil at Bridlington (Leckenby), as *P. elegantior* of S. V. Wood!

My largest specimen is $\frac{11}{10}$ of an inch long.

Through the kindness of Dr. Mörch and Professor Lovén I have had the advantage of examining and comparing the types of *P. cinerea*, *P. declivis*, and *P. elegans*; and I regret that I cannot adopt the view which Professor G. O. Sars is inclined to favour, that all these may be one species. I have not yet seen any connecting link between them; and they all occurred to me in the same haul of the dredge at Station No. 5, in the 'Valorous' Expedition, off Holsteinborg. Of course, opinions of naturalists must differ as to the lines of demarcation which separate one species from another in any genus, and likewise as regards allied genera. *Pleurotoma* has been divided by some modern conchologists and palæontologists into a great many genera, although, in my opinion, on insufficient grounds There ought to be at least one distinctive and fixed character, and no transitional or intermediate forms. *P. cinerea* attains the greatest size; the whorls are more convex, the last is larger in proportion to the rest, and they are not angulated below the suture, as in the other two species; the longitudinal ribs are more numerous than in *P. declivis*; there are at least twice as many spiral striæ, and the sculpture is never cancellated, as in *P. declivis*. The smallest species is *P. elegans*; the whorls are abruptly angulated at the tip; the ribs are more numerous, oblique, and prominent than in *P. cinerea*, and the striæ are fine and close-set.

Pleurotoma turricula, Montagu.

Murex turricula, Mont. Test. Brit. (1), p. 262, t. 9. f. 1 (1803).

Godhavn, 5–20 fms.; Waigat Strait, 15–25 fms.; Station 1, 175 fms.; 3, 100 fms.; 5, 57 fms.; Holsteinborg, 10–30 fms. Melville Bay to Cape Cod, and Spitzbergen to Arcachon. North Japan (St. John)! Depths 10–150 fms. Fossil in our Red and Norwich Crag, and in all the post-Tertiary beds of Great Britain, Scandinavia, and Canada.

The sculpture is extremely variable. Having before me a great number of specimens from various parts of the North Atlantic, and after a careful examination and comparison of the types of several so-called species, both recent and fossil, I am convinced that the following must be considered synonyms of the present species—*Defrancia nobilis*, *scalaris*, and *Woodiana* of Möller, *Tritonium roseum* of M. Sars, *Bela americana* of Packard, and *P. Dowsoni* and *robusta* of S. V. Wood. *P. harpularia* of Couthouy may be distinct; but it is questionable. Donovan published his specific name *angulatus* in the same year as Montagu; and that name might be adopted if Brocchi's name *turricula*, given in 1814 to a fossil and sub-Apennine species of *Pleurotoma*, be not changed. But it seems a pity to disturb the name by which the present species is so well known. *Bela* constitutes only a section or division of *Pleurotoma*; and consequently that will not help us.

Pleurotoma exarata, Möller.

Defrancia exarata, Möller, Ind. Moll. Grœnl. p. 12.

Godhavn, 5–20 fms.; Waigat Strait, 15–25 fms.; Station 1, 175 fms.; 5, 57 fms.; Holsteinborg, 10–30 fms. 'Porcupine' Expedition, 1869, off the west of Ireland, 164–1230 fms. Greenland (Möller and others)! Iceland (Mörch). Norway (Lovén and others)! Eastern coasts of North America (Couthouy, Whiteaves, and others)! Fossil: Red Crag (A. Bell). Labrador (Packard).

Closely allied to some of the varieties of *P. turricula*; but the canal is shorter and the base broader.

Reeve called this species *P. Mölleri*; and he stated that it was the *Defrancia lactea* of Möller, a name which is not to be found in the work of the last-named author.

Pleurotoma Trevelyana, Turton.

Pleurotoma Trevellianum, Turton in Mag. Nat. Hist. vii. p. 351 (1834). See 'British Conchology,' iv. p. 398, as to the emendation of the specific name.

Var. *Smithii*. Shell smaller; ribs more prominent, but not extending below the upper half of the body-whorl, and sometimes altogether wanting; infrasutural keel stronger; spiral striæ slighter, and consisting of impressed lines; there is no reticulation.

Station 4, 20 fms.; 5, 57 fms.; Holsteinborg, 10–12 fms. Massachusetts Bay (Stimpson)! Gulf of St. Lawrence (Whiteaves)! Newfoundland (Verkrüzen)!

The typical form inhabits the North Atlantic, from Spitzbergen to Yorkshire, and from Port Kennedy to the Gulf of St. Lawrence, at depths of 6–189 fathoms. Dr. Philip Carpenter has recorded it from the west coast of North America. It is one of the usual glacial fossils of Great Britain, Scandinavia, and Canada. Captain Feilden found it in the recent Arctic Expedition, in a raised sea-bed in Kane Valley, in 82° 33′ north latitude. *P. Trevelyana* has a narrower base, and is therefore more fusiform than *P. exarata*; and the spire is shorter than that of *P. turricula*, which gives the present species a more oval shape. It is the *P. reticulata* of Brown (1827), and *P. decussatum* of Macgillivray. Brown's name has priority of all the others, but may be regarded as obsolete.

Bullidæ.

Cylichna alba, Brown.

Volvaria alba, Brown, Ill. Conch. G. B. & I. pl. xxxviii. f. 43, 44 (1827).

Station 1, 175 fms.; 4, 20 fms.; 6, 410 fms. (living); Holsteinborg, 12 fms. 'Lightning' Expedition, 189 and 530 fms. Swedish Arctic Expedition, 1868, 1400 fms.! 'Porcupine' Expedition, 1869, west coast of Ireland, 420–1366 fms. (living at the last-mentioned depth): 1870, Bay of Biscay, 795–994 fms. 'Challenger' Expedition, off the Azores, 450 and 1000 fms. Norwegian Arctic Expedition, 1876, 1180 fms.! From Cape York to Cape Cod, and from Spitzbergen and Novaya Zemlya to Shetland, at depths of from 7 to 300 fathoms. West coast of North America (P. Carpenter). North Japan, 35–48 fms. (St. John)! Fossil in the Norwich Crag, the older Pliocene of Sicily, and the newer Tertiaries of Great Britain, Scandinavia, and N.E. America; Arctic Expedition, 1875–6, Kane Valley, 82° 33′ north latitude (Feilden)!

I mention this common arctic species to show the range of hydrographical distribution and depth. In some specimens the crown is more or less truncated; and in others the minute and close-set spiral striæ are absent.

It is the *Bulla triticea* of Couthouy, *B. corticata* of Möller, and *C. nucleola* of Reeve.

Utriculus obtusus, Montagu.

Bulla obtusa, Mont. Test. Brit. (1), p. 223, t. 7. f. 3 (1803).
Var. *turrita*. *Bulla turrita*, Möll. Ind. Moll. Grœnl. p. 6.

Body milk-white, semitransparent, covered with microscopic tubercles: *head* snout-shaped, prominent, being of the same breadth as the foot in front, so as to appear united with it: *tentacles* triangular and broad, separated by the head-flap: *eyes*, none perceptible: *foot* large, wedge-shaped in front and cloven behind.

Godhavn, 5-20 fms.; Station 5, 57 fms.; Holsteinborg, 10 fms.

The distribution of this species and its varieties is very extensive, from Spitzbergen to the Adriatic, and all along the eastern coasts of North America from Wellington Channel to Cape Cod. Its habitat ranges from low-water mark to 114 fathoms, and it especially frequents brackish water. Fossil in the Norwich Crag, and in the newer Tertiaries of Scandinavia, Great Britain, and Germany.

The shell varies remarkably in length and constriction, as well as in the extension or prominence of the spire; but specimens from various localities are found to pass one into another. The arctic, North-American, and Norwegian form (*Bulla pertenuis* of Mighels) is smaller, shorter, broader, and more cylindrical than our estuarine and typical form. The *Bulla turrita* of Möller closely resembles and corresponds with the variety of the present species which I described and figured as *Lajonkaireana*. Writers on British shells formerly gave several other names, which may now be considered obsolete. Brusina described a small variety, having a depressed spire, from Dalmatia, as *Cylichna leptoneilema*.

A small fragment of another species occurred at Station 12, 1450 fathoms. It consists of the anterior portion of a short cylindrical shell, which is of a milk-white colour, glossy, and marked with slight and rather distant spiral striæ or rather impressed lines; the sculpture does not extend to the crown; the apex is semiglobose, and sunk within a sharp obliquely encircling ridge. The species may be called *lacteus*. I also dredged a young specimen of this species in the 'Porcupine' Expedition of 1869, off the west coast of Ireland, at a depth of 1443 fathoms.

Utriculus substriatus *, Jeffr.

SHELL represented by a single specimen, which was unfortunately broken in sifting the dredged material. It resembles *Bulla hyemalis*, Couthouy, = *Amphisphyra globosa*, Lovén, = *Utriculopsis vitrea*, M. Sars, except in being smaller, shorter, and equally broad throughout, instead of barrel-shaped; the crown is consequently longer in proportion, and not so much raised at the point; but the especial difference consists in this being beautifully sculptured, and not smooth like the other species; besides a few coarse spiral ridges the whole surface is closely and microscopically striated in the same direction. L. 0·1. B. 0·075.

Station 9, 1750 fms.

* Somewhat striated.

Utriculus hyalinus, Turton.

Bulla hyalina, Turton, in Mag. Nat. Hist. vii. p. 353 (1834).

Station 5, 57 fms. 'Porcupine' Expedition, 1869, west of Ireland, 183 fms. From Spitzbergen (Torell) to the Egyptian coast of the Mediterranean (Schneider); Madeira and the Canaries (M'Andrew); Davis Strait to Cape Cod. Depths 10–150 fms. One of the glacial fossils of Scotland and Scandinavia.

U. minutus and *U. candidus* of Brown, and possibly also his *U. pellucidus* (1827); but although these names are prior to that given by Turton, not one of them has been adopted by subsequent authors. In the second edition of Brown's work, published in 1844, he describes "*U. hyalina*" of Turton as a different species. It is the *Bulla debilis* of Gould (1840), and *B. subangulata* of Möller (1842).

Actæon exilis, Jeffr.

Actæon exilis, Jeffr. in Ann. & Mag. Nat. Hist. ser. 4, vol. vi. p. 85 (1870).

Station 12, 1450 fms. (fragments). 'Porcupine' Expedition, 1869, west of Ireland, 1215 fms.; 1870, Channel slope and Bay of Biscay, 227–994 fms.; Mediterranean, 92–1456 fms. Ægean, 210 fms. (Spratt)! Off Malta, 300 fms. (Nares)! Palermo, about 100 fms. (Monterosato). Fossil in the older Pliocene of Sicily (Seguenza).

One of the 'Valorous' fragmentary specimens indicates a much larger size than usual. The operculum in 'Porcupine' specimens agrees with my description of that of *A. tornatilis* in the 4th volume of 'British Conchology,' pp. 432–3.

Scaphander puncto-striatus, Mighels and Adams.

Bulla puncto-striata, M. & A. in Proc. Bost. Soc. Nat. Hist. i. p. 49 (Nov. 1841).

Body yellowish, with an edging of reddish-brown round the hood in front and about the mouth. In all other respects like *S. lignarius*.

Station 12, 1450 fms. (fragments); 13, 690 fms. (living). 'Lightning' Expedition, 189 fms. 'Porcupine' Expedition, 1869, west of Ireland, 420–1380 fms.: 1870, Channel Slope, 539–690 fms.; Bay of Biscay, 740–1095 fms. 'Challenger' Expedition, off the Azores, 1000 fms. Iceland (Torell). Norway (Lovén and others)! Shetland (J. G. J.). North-eastern coasts of United States (Mighels and others). Palermo (Monterosato). Depths 20–300 fms. Fossil in the older Pliocene of Sicily (Seguenza).

Specimens vary somewhat in shape, some being more oval than others; the punctures differ in size, and the rows in comparative distance. The North-American and 'Challenger' specimens represent a smaller, stouter, and shorter form; and off the coast of Portugal both forms with intermediate gradations were obtained in the 'Porcupine' dredgings.

This species is the *S. librarius* of Lovén, 1846.

NUDIBRANCHIATA.

I obtained very few of this order; and those are widely distributed in northern seas. I subjoin short descriptions of the following three species from my note-book.

Eolididæ.

Eolis salmonacea, Couthouy.

Eolis salmonacea, Couth. in Bost. Journ. Nat. Hist. ii. p. 68, pl. i. f. 2 (1839).

Body oblong, yellowish-white: *head* prominent and broad, rounded in front, with small side-lappets or processes: *mouth* vertical, continually opening and shutting: *tentacles* 4; upper pair longer than the lower ones, serrated or notched at their edges, and retractile; lower pair contractile, widely separated from the upper pair: *eyes* very small, sunken and subcutaneous, placed in front of the upper pair of tentacles: *mantle* protecting the whole body, and covered with numerous and close-set club-shaped papillæ or tubercles, which are arranged down the sides; these are irregular in size, but become shorter and smaller at the edges of the mantle and at the end of the body; each papilla has a brown stripe (as a nucleus) down its centre; they are retractile, like the upper pair of tentacles; the extremities or tips appear to be open: *foot* long, rounded and double-edged in front, contracted and pinched up behind at the vent or tail. Active and hardy; floats in a reversed position or on its back.

Station 4, 20 fms. (a young individual). It is of course North-American; but its range is doubtful.

The synonymy is very confused. It appears to be the *Doris papillosa* of Fabricius, but not of Linné, *Æolis papilligera* of Beck, and *Æolidia bodocensis* of Möller, not *Doris bodoënsis* of Gunnerus.

Dorididæ.

Doris repanda, Alder and Hancock.

Doris repanda, A. & H. in Ann. & Mag. Nat. Hist. ser. 1, ix. p. 32 (1842).

Body oblong, lemon-coloured: *mantle* thickly covered with small round tubercles of different sizes: *dorsal tentacles* retractile, short, elegantly convoluted or fluted in an obliquely spiral direction, one on each side near the front; they are of a light brown colour: *eyes* not discoverable: *foot* oblong: *vent* or anal opening small, fringed. Floats on its back. Spawn deposited on the stalks and fronds of *Fucus nodosus*.

Godhavn, 5 fms. From Spitzbergen (Kröyer, *fide* Mörch) to Calvados in the North of France (Fischer).

According to Lovén this is the *D. obvelata* of O. F. Müller.

Doris bilamellata, Linné.

Doris bilamellata, Linn. Syst. Nat. ed. 12, p. 1083 (1767).

Body yellowish-white: *mantle* thick, streaked or blotched with brown, and covered with numerous tubercles of different sizes: *head* of the same breadth as the foot, and semicircular: *tentacles* retractile, pale orange, laminated in two unequal divisions: *eyes*, none observable: *foot* large, rounded in front, and bluntly pointed or angulated behind: *vent* encircled by numerous tentacular processes which vary in size and length and are retractile. Floats in a supine position. Spawn semiconvoluted.

Station 4, 20 fms.; Waigat Strait, at low water. Greenland and Iceland to the north-west of France, and on the eastern coasts of the United States.

For the synonymy see the late Mr. Alder's remarks in 'British Conchology,' vol. v. p. 90; to which may be added, on Mörch's authority, *D. muricata* of M. Sars, not of Müller.

PTEROPODA.

Shells of these oceanic "butterflies" were found everywhere during the expedition in deep water; and a few species were taken alive in the tow-net. Among the former I may mention *Limacina reticulata*, D'Orbigny (*Spirialis clathrata*, Souleyet, = *Peracle physoïdes*, Forbes, = *S. recurvirostra*, A. Costa), *L. balea*, Möller, *L. retroversa*, Fleming, and *L. bulimoides*, Souleyet, besides well-known species of *Carolina* (*Hyalæa*) and *Clio* (*Cleodora*). The only Pteropod which I consider new to science will be now described; and although all the specimens consisted of fragments only, the species is very distinct and peculiar.

*Limacina helicoides**, Jeffr.

SHELL like a reversed *Helix nemoralis*, extremely thin, opaque, brittle, and glossy: *sculpture*, a few delicate spiral striæ, and close-set microscopic lines of growth: *colour* brownish-yellow: *spire* depressed, not flat: *whorls* 4, rather convex: *suture* slight but distinct: *mouth* irregularly and narrowly oval, rounded on the outside, acute-angled above, and pointed below: *pillar* twisted, furnished at its base a little way inside with a sharp and curved ridge, which corresponds with a keel on the outside: *umbilicus* none. L. 0·5. B. 0·4.

Station 12, 1450 fms. 'Porcupine' Expedition, 1869, west of Ireland, 1215 fms.: 1870, Bay of Biscay, 740–1095 fms.

Clionidæ.

Clione borealis, Pallas.

Clione borealis, Pallas, Spic. Zool. x. p. 28, t. i. f. 18, 19 (1774).

BODY long and slender, pinkish or reddish-brown about the front and tail; liver brown; the middle portion and the rest of the body are gelatinous and veined lengthwise; the whole surface is irregularly covered with microscopic tubercles: *head* transversely oval, separated from the middle of the body by a short and thick neck; it is furnished with 6 bulbous processes (3 on each side), which are of a bright pink colour; these are plain and not armed with suckers or cups, and they do not project beyond the head: *mouth* semiglobular, the lips being placed lengthwise: *tentacles* 2, projecting like horns on each side of the head at the top; they are conical and finely pointed, retractile within sheaths, as in *Doris*, not armed with any suckers: *eyes* none: *fins* or foot-lobes 2, broad, leaf-shaped, membranous, and delicately reticulated; below the fins are two appendages, which may serve as a second or lower pair of tentacles; these appendages are triangular, and folded close to the body, where they assume the shape of a human heart: *tail* pinched up, and ending in a fine point; it is speckled with minute black dots. Very active and hardy, unceasingly flapping its fins and wriggling its tail, by means of which it swims rapidly. My account does not agree with any of the descriptions and figures of this remarkable mollusk as given

* Resembling a *Helix*.

by modern writers; I except Fabricius's description, which is admirable.

Disco harbour and Waigat Strait. Only two or three specimens could be found.

Clione borealis has a wide range as regards longitude, from Novaya Zemlya to the eastern coasts of North America. It is said to abound in arctic seas during the summer and autumn, and to be the principal food of the right whale.

It is the *Clione papilionacea* of Pallas, *Clio limacina* of Phipps, *Clio retusa* of Müller and Fabricius (not of Linné), and *Clio Miquelonensis* of Rang. The date of publication by Pallas and Phipps is the same. *Clione borealis* was first noticed and figured by Martens in his voyage to Spitzbergen and Greenland, under the name of the "Sea May Fly."

Since the publication in the 'Annals' of my former papers on this subject I have had some additional information, and become aware of a few slight omissions, which enable me to add a short supplement.

Montacuta Dawsoni. Newfoundland (Verkrüzen).

Kellia symmetros. A single valve, much larger than the specimen which I have described, was procured by Mr. Friele in the recent Norwegian Expedition at a depth of 488 fathoms.

Cadulus tumidosus. A small variety was dredged in West Norway by Professor G. O. Sars, who considers it a distinct species, and proposes to name it *propinquus*.

Trochus umbilicalis. Cape York, 10 fms., and Port Kennedy (Walker).

Rissoa castanea. White Sea (Middendorff).

Turritella erosa. Syn. *T. polaris* (Beck), Möller.

Turritella reticulata. Melville Bay, 80–100 fms. (Walker).

Odostomia albula. Gulf of St. Lawrence, 20 fms. (Whiteaves).

I have now fulfilled my pledge to the Royal Society with respect to the Mollusca of the 'Valorous' Expedition.

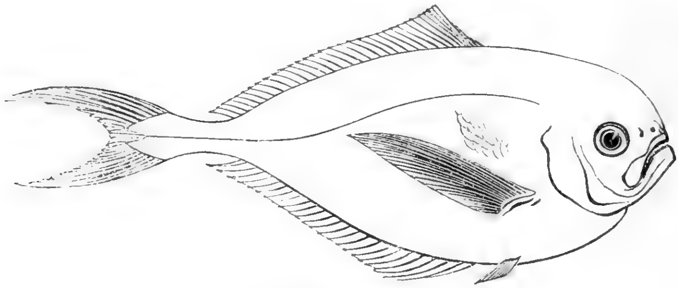
XXXIII.—*Notes on New-Zealand Ichthyology.* By James Hector, F.R.S., C.M.Z.S.

Brama squamosa. C.M.

Toxotes squamosus, Hutton, Trans. New-Zealand Inst. viii. p. 210.

D. 3–35. V. 2–29.

The type of the above was presented to the Colonial Museum by W. T. Travers, F.Z.S.; but the second fresh specimen now figured shows that it must be referred to the genus *Brama*, on account of its general oval form, its subulate acute teeth, with a stronger second row in the lower jaw, long dorsal fin extending forwards to over vertical of the pectorals and ventrals, with three short spines confluent with the soft dorsal, which, as also the anal, is enveloped in dense scuta, its moderate, very oblique, almost vertical gape and dilated maxillary, doubly excised; caudal fin with elongate acuminate lobes.



Brama squamosa.

The genus *Brama* has been transferred in Dr. Günther's work from the order Squamipinnes to the Scomberoids; and it was probably the scaly vertical fins of this fish which induced Capt. Hutton to seek for its allies among the former order. As a species it differs very little from Ray's Brama (*Brama Raii*, Cuv.).

a. Dried specimen. Cook's Strait (Tylor), 1875.

b. Fresh specimen, stuffed. Wellington Harbour, 1875. Total length 19 inches.

Upeneichthys Vlamingii (Cuv. and Val.). C.M.

(Red Mullet.)

D. 1 | 7–9. A. 1 | 6. L. l. 29. L. t. $\frac{2}{6}$.

Length thrice and two thirds the height, which equals the length of head. Scales twice the vertical diameter of the eye, which is one third the length of snout; first dorsal less in length of base than the second by the diameter of the eye; base of second dorsal, length of pectoral, and ventral each equal to length of head. First dorsal spine less than the diameter of eye; second equal to length of head. Barbels reach nearly to the vertical from the extremity of the operculum.

Upper part of body dusky violet, variegated with yellow and azure blue, blending into pale crimson with golden and azure-blue streaks on lower part of body. Head with blue streaks descending on the snout. Fins brownish purple, with varied markings of pink, yellow, and azure blue, the latter being distinct, and the two former blending into the ground-colour; each scale with a violet patch in the centre. Iris golden yellow. Two silvery streaks; and a granulated patch below the eye. No black bands on the side of the body

Teeth of jaws minute, in a double row, with some slightly stronger teeth in front of upper jaw. No palatine teeth. Young with three teeth on each side in distinct patches.

In the coloration, general form, and divided vomerine teeth, this fish is very similar to *Upenoides Vlamingii*, but the absence of teeth on the palatine bones places it in Bleeker's genus *Upeneichthys*. Distinguished from *U. porosus* of the Australian seas by the absence of any black lateral streak.

Specimen (in spirit) from outside Wellington Harbour. Total length 16 inches.

Beryx affinis, Günth. Cat. i. 13. C.M.

D. 7 | 12. A. 3 | 12. V. 1 | 7. L. l. 44. L. t. 6 | 12.

Height equal to length of head and one third total length. Operculum with two spines. Pectoral is one fifth the total length. Eye situated high, its diameter being one fifth the length of the head, and exceeding that of the snout; two nasal apertures close in front, the posterior being the larger. Intermaxillaries carry fine teeth on the sides and a group of large teeth on each side of a mesial notch, into which a projecting group of large teeth on the lower jaw fit.

Colour crimson pink, paler beneath.

A dried specimen collected by Mr. Robson at Cape Campbell; total length 18 inches. This fish agrees well with Dr. Günther's species, of which he gives a very minute description in the work above quoted. It inhabits also the coast of Australia.

Dinematichthys consobrinus, Hutton.

Capt. Hutton's type is in the Colonial Museum. He does not mention the presence of two minute spines in front of the dorsal. If these are present in the other specimens, the genus will have to be placed in the curious intermediate family of

Gadopsidæ. In the Cat. Col. Mus. 1870, I recorded the occurrence of *Gadopsis marmoratus* in New Zealand; but it has dropped out of subsequent lists, being only represented in the collection by a drawing made of a specimen got on the east coast.

XXXIV.—*Observations on the* Coccosphere. By G. C. Wallich, M.D., Surgeon-Major Retired List H.M. Indian Army.

[Plate XVII.]

The history of what may be termed the Coccosphere question is a remarkable one. Seventeen years ago I pointed out, as the result of actual observation, that the "coccoliths," which had been discovered three years previously by Professor Huxley in soundings from the Atlantic, are not independent structures, but merely cast-off appendages of the Coccosphere-cell. Yet, from that period to the present, the physiological relation existing between these two integral portions of one and the same organism has remained shrouded in mystery. Since 1868 a number of elaborate observations have been published, both here and abroad, on the characters and supposed affinities of the various forms of "coccolith." But, unfortunately, the value of these observations has been materially diminished, owing to their being based on one or other of the following essentially fallacious assumptions:—namely, that the "*coccolith*" itself is a "cell;" that it is an independently developed and independently living structure; and that, as a "*coccolith*," it is capable of taking part in any subsequent vital combination.

These assumptions have possibly had their origin in two statements made by Prof. Huxley:—the first, in 1858*, that "*coccoliths* somewhat resemble single *cells* of the plant *Protococcus*;" the second, ten years later, namely in 1868†, that the varieties of "*coccoliths*" named by him "*Discoliths* and *Cyatholiths* stand in the same relation to the protoplasm of *Bathybius* as the *spicula* of sponges or of *Radiolaria* do to the soft parts of these animals." It is true that in the same paper Prof. Huxley noticed three alternative "possibilities" in relation to the *cocco-*

* 'Deep-sea Soundings in the North Atlantic,' made in H.M.S. 'Cyclops,' Commander Dayman, in 1875. Appendix, Report on Soundings, by Prof. Huxley, p. 64.

† "On some Organisms living at Great Depths in the North Atlantic Ocean," by Prof. Huxley, F.R.S., 'Quart. Journ. Microsc. Science,' Oct. 1868, p. 210.

spheres. But any one who carefully studies his remarks must, I think, conclude that, on the whole, he was disposed to give "*Bathybius*" the benefit of the doubt, and to regard the *coccospheres* as subsidiary productions due to "the coalescence" of the "*coccoliths*"—a view, which then, as now, I venture most respectfully to contest. For although the supreme interest that centred in the "*coccoliths*" has waned since they ceased to constitute the bones of *Bathybius*, we must not forget the important part already played by them in the construction of certain rocks, and which they still continue to play in the construction of certain oceanic deposits. I may be pardoned therefore for seeking to redeem the coccosphere-question from the chaos into which it has drifted, and for suggesting that had the fact indicated by me in a paper "On the *Polycystina*" (read at the Royal Microscopical Society in 1865), namely that I "had met with *coccospheres* as free floating organisms in tropical seas" in 1857, been recognized as I think it ought, Sir Wyville Thomson would have abstained, in 1872 *, from casting unmerited doubts on my view regarding the true relation of the "*coccoliths*" to the *coccospheres*, and, in 1874, from adopting and publishing that view as a new and original observation made on board the 'Challenger' †.

From first to last in my published writings on the subject, I have never made the statement so persistently attributed to me (and which involves a contradiction of the opinion really entertained and expressed by me), namely that "sometimes the coccoliths are found aggregated into spheroids" (see 'Lay Sermons,' "On a Piece of Chalk," by Prof. Huxley, 5th edit. 1874, p. 186) ‡, but have invariably adhered to the opinions

* "Sometimes the '*Coccoliths*' are found aggregated on the surface of small transparent balls, and these, *which seemed at first to have something to do* with the production of the 'coccoliths,' Dr. Wallich has called '*coccospheres*.'" (Sir Wyville Thomson, 'The Depths of the Sea,' 1872, p. 413.)

† "I need only say that I believe *our* observations have placed it beyond a doubt that the 'coccoliths' are the separated elements of a peculiar calcareous armature which covers certain spherical bodies (the 'coccospheres' of Dr. Wallich)." (Sir W. Thomson, 'Proceedings Roy. Soc.' vol. xxiv. No. 154, Nov. 1874, p. 38.)

‡ See also 'The Microscope,' 5th edit. 1875, p. 464, where Dr. Carpenter speaks of "the larger spherical *aggregations* first observed by Dr. Wallich, and designated by him as *coccospheres*;" and at p. 466, "The coccospheres are made up *by the aggregation of bodies* resembling cyatholiths." As (in the 'Introduction to the Study of the Foraminifera,' 1862, pp. 46–7) Dr. Carpenter quoted almost *in extenso* both the description and figures of "*coccoliths*" and *coccospheres* given by me in 'The Annals' of July 1861, it is difficult to see how he could so completely have misunderstood what I both described and figured.

of which a correct *résumé* is given in my paper "On Deep-sea Protozoa" ('Monthly Micr. Journ.' Jan. 1869)—namely, that after a careful and long-continued study of these organisms, whether occurring as free floating inhabitants of the surface-waters of the Indian Ocean and mid-Atlantic, as components of the present deep-sea deposits, in a fossil condition in the post-tertiary earths, or as living organisms in the British Channel, I have never deviated from the opinion that the free *coccoliths* are derived from their parent *coccospheres*. In some deep-sea deposits, as stated by Prof. Huxley, free *coccoliths* undoubtedly occur in overwhelming number as compared with the *coccospheres*; but it is equally true that *coccospheres* are, at times, present in great abundance, whereas free *coccoliths* are comparatively scarce. Coupling these facts with the very important one, that perfect *coccospheres* are to be met with of every intermediate size between the $\frac{1}{5000}$ and $\frac{1}{830}$ of an inch in diameter, I am induced to believe that the free *coccoliths* are, *in every instance*, formed on, or *pari passu* with, the spheroidal cells on which they rest, *their state of attachment to these cells being their normal as well as pristine condition*. That they revert at any future stage of their history, after once becoming free, to their original composite state, there is no recorded evidence forthcoming to prove. (In an appended footnote it was stated that "some of the *free-floating coccospheres are oblong*.") Lastly, I stated (*loc. cit.*) (with reference to the "granular zone" which Prof. Huxley described as *possibly* forming a normal portion of the coccolith), that "amongst the immense numbers of coccospheres which had been examined both in the recent state and in the preserved though still recent material of the soundings, I had never met with any proof that this zone exists as an integral portion of the structure; nor had any evidence presented itself" that the "granular zone" is any thing more than an accidental accretion, *or that its presence is due to any inherent condition without which the organism would be incomplete.* ("On Deep-sea Protozoa," 'Monthly Micr. Journ.' Jan. 1869, pp. 35 and 36).

Having thus far shown that there is no reason to suppose that the *Coccosphere* is a secondary formation, resulting in any way from an "*aggregation*" of independently developed "*coccoliths*," but that the balance of evidence is altogether in favour of the view that the "*coccoliths*" are normally developed upon, and simultaneously with, their parent *coccosphere*, I have now to state the grounds on which I base the opinion that the "*coccolith*" presents none of the characters of a true "*cell*."

Although Prof. Huxley, in his first brief notice of the coccoliths (already referred to as having appeared in 1858) described the "*coccolith*" as being somewhat like a single cell of the plant *Protococcus*," he has nowhere asserted that it is a cell. In his paper describing *Bathybius* ('Quart. Journ. Micr. Science,' Oct. 1868, p. 207) he alludes to "*a central corpuscule*," and says, "*there is in its centre a clear and transparent space*," adding that "sometimes, as Dr. Wallich has already observed, the clear space is divided into two. This appears to occur only in the largest of these bodies; but I have never observed any further subdivision of the clear centre, nor any tendency to divide on the part of the body itself." In the same paper Prof. Huxley pointed out, for the first time, the double or *shirt-stud*-like figure of the "*coccoliths*," a feature which I had altogether overlooked, owing, doubtless, to my attention having been chiefly directed towards the *Coccosphere* as a whole.

Now *every thing* depends on a correct interpretation of what Prof. Huxley describes as the *central corpuscule* and the *clear space* at its centre. He says, "Suppose a couple of watch-glasses, one rather smaller than the other; turn the convex side of the former to the concave side of the latter; interpose between the centre of the two a hollow spheroid of wax, and press them together: these will represent the upper and lower plates and the central corpuscule" (loc. cit. p. 207). This description is most closely borne out by Prof. Huxley's figures. To facilitate my explanation, I have reproduced three of his figures in the Plate which accompanies this paper—namely, figs. 13 H, 14 H, and 15 H. It will be seen from these, that if we apply his experimental illustration of the two watch-glasses and the hollow spheroid of wax, where there is *one* clear space in the centre of the central corpuscule, we should have to employ either two hollow spheroids of wax, or one spheroid with two cavities in it, to represent the *coccolith* in which two central clear spaces occur; and so on, whatever the number of central clear spaces may be. To my mind this does not by any means give a correct idea of the appearances; which, on the contrary, indicate that the central clear space or spaces are either single or double perforations in the external disk—its "markings," as it were—and nothing more. They have, therefore, no physiological significance, and certainly do not represent any thing that can be called a cell. See Plate XVII. fig. 10, which gives a diagrammatic sectional view of a coccolith. There is no evidence forthcoming, that I am aware of, to show whether the *stem* of the stud (*i. e.* the intermediate piece between the two disks), is or is not continuous with the disks. As the appearance of concentric rings is constant, being observable even in the fossil coccoliths, I presume the stem must be continuous with the disks.

Instead of the watch-glasses and hollow spheroid of wax, imagine a shirt-stud made of colourless glass, with a minute shallow hole drilled at the centre of the *larger* of its two disks, which (as in the case of the coccolith) would constitute the outer disk. Imagine this glass stud to be enveloped in transparent varnish or any glairy fluid. On looking down upon it we should see (fig. 5, *b*) a minute central ring formed by the edge of the minute central hollow; external to, and at a little distance from this, a second ring (*c*), formed by the outline of the *stem* of the stud; again, a little external to this, a third ring (*d*), formed by the outline of the smaller of the two disks of the stud (*e*); and lastly, the marginal outline. Of course the multiple "central clear-spaces" might be imitated by drilling a corresponding number of holes in the outer disk (see Plate XVII. fig. 7). Now here we should have precisely the same appearance of concentric rings and central spaces as we find in the "*coccolith*;" and what is more, they would have a similar origin. Of course the only difference observable in looking down on the *coccolith* or the glass stud from the direction of the inner or smaller disk, would be that the "central clear space" would be somewhat less distinct, whereas the outline of the smaller disk would be more distinct.

I have now to refer to Mr. Carter's views as embodied in his paper on "*Melobesia unicellularis*" (Annals and Mag. Nat. Hist., Mar. 1871). Let me, however, at once confess that whilst I dissent, *in toto* (for reasons already assigned), from the view that the "*coccolith*" is, in any sense, "*a cell*," I am quite prepared to adopt Mr. Carter's opinion, if he will permit me, as applicable to the parent and entire structure, namely the *coccosphere* with its "*coccoliths*." The only difficulty I see in the way of regarding the *Coccosphere* as a protophyte, resides in the remarkable evidence of its relationship to certain Foraminifera, furnished by the discovery (at first in one or two specimens only, but afterwards in many) of shells so regularly studded with *coccoliths*, as to suggest the idea that the chambers originated as *coccospheres* *. One thing would seem certain, that this regularity is incompatible with the supposition that the *coccoliths* got into their position accidentally. How then, did they attain it? I once asked Mr. Carter if he could explain the matter; and he obligingly sent

* See my observations on this subject, and accompanying figures in 'The Annals,' for July 1861, p. 55; and in the 'Monthly Microscopical Journal,' for Jan. 1869, pp. 37, 38.

the best explanation I have as yet come across, though even this has a weak point in it. It was, that the animals of the Foraminifera probably employed the *coccoliths*, which abound in the mud, instead of sand or other particles for the strengthening of their shells, as we know to be the habit of a large number of the Foraminifera that live at the bottom of the deep sea. But, although the sparse kind of tessellation with large mineral particles here and there on the shell is undoubtedly characteristic of some species (as for example *Proteonina* and *Buliminia*; and, as I have elsewhere shown to be the case in certain deep-sea Foraminifera as well as freshwater testaceous Rhizopods, "the selective and adaptive power" exhibited in the material and workmanship of the shells is simply marvellous), in the shells now under notice the arrangement of the *coccoliths* appears almost *too* like that observable on the *coccospheres* to render it easily intelligible how the animal of the Foraminifer could have so exactly "mimicked" it. On the other hand, there is a piece of evidence which would seem to support Mr. Carter's view of unicellular algal affinity (supposing it to be extended to the *coccosphere*), namely, an appearance of "dehiscence" which presents itself not unfrequently in the large oblong *coccospheres* met with in tropical seas, and so invariably occurs, at one end only, as to negative the idea of its being accidental (See Plate XVII. fig. 4).

Mr. Carter suggests that the "loose type" of coccosphere described and figured by Prof. Huxley may "be a still more developed form of the *sporangium* or coccosphere, perhaps undergoing dehiscence" (*loc. cit.* p. 189). He will, however, I know, pardon me saying that it is going too far ahead of the evidence to assume that the coccosphere *is* a sporangium at all; for if it be, out of the multitudes I have seen, none has ever departed from the sporangial phase, either in those met with at the top or at the bottom of the ocean. But a glance at the curious object I have depicted (Plate XVII. fig. 18), which I have repeatedly met with in some parts of Bengal, will at once show that Unicellular Algæ do undoubtedly assume a sporangial condition in accordance with that which Mr. Carter must have had in his mind's eye when he suggested that the coccosphere might be a sporangium. My specimen is, I believe, the sporangial condition of a branching stipitate form of *Ankistrodesmus*, each of the kidney-shaped bodies being a frond.

Figures 1 to 4 (see Plate XVII.) represent the only two species of *Coccosphere* I have hitherto met with :—the spherical one being the ubiquitous oceanic form, which I propose to call *Coccosphæra pelagica*; the oblong species, which is not so common by any means, being, so far as my experience goes, confined to tropical or subtropical seas. I propose to name it after Mr. Carter, *Coccosphæra Carterii.*

The following are the characters of the two species:—

Genus Coccosphæra (Wall.).

1. *Coccosphæra pelagica* (Wall.).

Cell spherical, hyaline, with a distinct membranous wall. Cell-contents, a perfectly colourless glairy protoplasm. *Coccoliths* generally more or less elliptical, numbering from 16 to 36, arranged side by side, and, in the normal state, not overlapping. Central aperture of *Coccolith* single, margin of external disk finely and radially striate. Internal disk plain.

Diameter of *Coccosphere* ranging from $\frac{1}{5000}$ to $\frac{1}{830}$, of an inch. Length of *Coccoliths* from $\frac{1}{9000}$ to $\frac{1}{1000}$ of an inch.

Habitat. Free-floating, Indian Ocean and North Atlantic; and (dead) in North Atlantic muds. Always most abundant where the *Globigerinæ* are in greatest profusion, and the deposit of the purest kind.

2. *Coccosphæra Carterii* (Wall.).

Cell oblong. Long diameter about twice that of short diameter. Cell as in *C. pelagica*. *Coccoliths* varying in number from 16 to 38, more or less oblong, with two central apertures arranged lengthwise, margin finely and radially striate. Internal disk plain. Length of *Coccosphere* from $\frac{1}{1000}$ to $\frac{1}{800}$ of an inch. Length of coccolith from $\frac{1}{5000}$ to $\frac{1}{1000}$ of an inch.

Habitat. Free-floating, Indian Ocean, and Mid-Atlantic. (N.B. I have not observed any intermediate form between the spherical and oblong.)

It only remains for me to add, that I have not referred in the course of the preceeding observations to the highly important researches of Sorby, Oscar Schmidt, Haeckel, Gümbel, and others, simply because my own inquiries have been directed principally towards an aspect of the subject upon which they have hardly touched at all—my object having been to sustain the accuracy of my own observations, not to question that of others.

Note on Gromia. I hasten to correct an oversight on my part, which I have at all events the satisfaction of knowing has been shared by Dr. Carpenter and other writers.

Since the publication of my paper "On *Gromia* as the type of Foraminiferal Structure" ('Annals' Feb. 1877), I have seen it incidentally stated that "nuclei" had been observed in *Gromia* by Max Schultze. On turning to Dr. Carpenter's 'Introd. Study Foram.' pl. iv. fig. 13, I found, as I expected, the figure of a highly magnified view of a mass of sarcode, containing two spherical granular masses, the explanatory description being as follows:—"Nuclear bodies? [*sic*] imbedded in the sarcode of *Gromia*. After Schultze." Not having Schultze's work to refer to, it is out of my power to say whether these bodies represent true *nuclei* or merely *sarcoblasts*. But be this as it may, if the credit of the discovery of a nucleus in *Gromia* be due to Schultze, most cheerfully do I cede it to that distinguished observer.

EXPLANATION OF PLATE XVII.

Fig. 1. *Coccosphæra pelagica* (Wall.), with its complement of *coccoliths*.

Fig. 2. Cell-wall of same, showing distinct membranous outline; most of the *coccoliths* having been thrown off.

Fig. 3. *Coccosphæra Carterii* (Wall.).

Fig. 4. The same in the *dehiscent* (?) condition.

Fig. 5. *Coccolith* of *C. pelagica* seen from external aspect; showing the radiate striation on margin of outer disk, and the central depression which constitutes the "central clear space" of Huxley.

Fig. 6. *Coccolith* of *C. Carterii*; side view, showing the *two* central depressions and radiate marginal striæ, together with the inner disk and intermediate piece.

Fig. 7. The same, as seen from its external aspect, this being, in short, a front view of the outer disk. Here also the two button-hole-like depressions are shown.

Fig. 8. Circular *coccolith* of *C. pelagica* occasionally met with.

Fig. 8 *a.* A specimen of a form of *coccolith* occasionally but rarely occurring, in which there is no central depression, but apparently an aperture close to the margin of the outer disk.

Fig. 9 D. Diagrammatic, enlarged, side view of coccolith of *C. pelagica*.

Fig. 10 D. Diagrammatic vertical section of same, showing the central depression (*a*), in external disk: *s*, the stem; *e d*, the inner disk.

Fig. 11 D. Diagrammatic front view of the outer disk of same: *a*, the central depression, the "central clear space" of Huxley, and "nucleus" of other writers; *b*, the innermost ring, indicating the margin of this depression; *c*, the ring indicating the outline of the intermediate piece, or stem uniting the two disks; *d*, the ring indicating the margin of the inner disk; *e*, the outline of the outer disk itself. *Possibly* these are the rings referred to in Prof. Huxley's Report of 1868, when describing the *coccoliths* as "curious rounded bodies, to all appearance consisting of several concentric layers surrounding a minute clear centre."

Fig. 12 S. This figure is copied from fig. 20, plate 16, appended to Prof. Oscar Schmidt's paper "On Coccoliths and Rhabdoliths" Annals & Mag. Nat. Hist. Nov. 1872, translated by W. S. Dallas, F.L.S. It is described in the text (p. 367) as "a decided coccolith with a dorsal shield, as may be ascertained by placing it on its edge, the dark non-granular part, *b*, representing the granular zone, and the clear spaces in it; *a, divided medullar space without central granules*."

Figs. 13 H, 14 H, and 15 H. Three figures copied from the plate accompanying Professor Huxley's paper; described as "Cyatholiths from the Atlantic Mud." The central corpuscle with its clear space, *a*, in the centre is shown in figs. 13 and 14. The "granular zone," *g z*, is shown in fig. 15.

Fig. 16 represents a two-celled or chambered *coccosphere*—being apparently the first stage in the formation of the *coccolith*-covered *Textulariæ* and *Rotaliæ* which have been described by me in former papers, and of which mounted specimens are extant.

Fig. 17. A *coccolith* of *C. Carterii* as seen in preserved specimens, an aggregation of granules being observable around the stem between the outer and inner disks, the so-called "granular zone" of authors.

Fig. 18. Sporangium of a protophyte from Bengal, probably allied to *Ankistrodesmus*: *a*. the globular colourless and transparent sporangial cell; *b b b*, the kidney-shaped fronds of same. These never have a *flagellum* or cilia, and are not zoospores.

N.B. In figs. 5, 7, and 11 D the letters indicate the same portions of the structure.

MISCELLANEOUS.

On Anguillula intestinalis, *a new Nematoid Worm, found by Dr. Normand in subjects attacked by Diarrhœa of Cochin China.* By M. Bavay.

In the *post mortem* examination of a man who died of diarrhœa of Cochin China, Dr. Normand found a very small worm, which he sent to me as distinct from my *Anguillula stercoralis**, which, however, was associated with it in the intestine. Having subsequently met with it in four other cases, I have ascertained that it is really distinct; and I think it useful to give a description of it.

I have been unable in this Nematoid to distinguish the arrangement of the muscular bands; and although I have examined more than two hundred individuals, I have never seen any spicula; hence it is impossible at present to fix its position in the modern classifications, such as that of Schneider. I shall therefore give it provisionally the generic name of *Anguillula* (*sensu latiori*), and distinguish it by the specific name *intestinalis*.

Length of the adult	2·200 millim.
Average breadth	0·034 ,,

Thus *Anguillula intestinalis*, with a less average breadth than that

* See Ann. & Mag. Nat. Hist. ser. 4, vol. xviii. p. 507.

of the adult *Anguillula stercoralis*, is almost three times as long; its length is 65 times its breadth.

The body, a little attenuated in front, terminates rather suddenly behind in a conical tail, the point of which is very distinctly rounded and even a little widened at the extremity. With a sufficient magnifying power, the surface appears very finely but very distinctly and regularly striated transversely throughout its whole length.

The mouth presents no corneous armature, but only three very small lips. It gives access to a nearly cylindrical œsophagus which occupies about one fourth of the length of the animal, and presents neither inflations nor striæ; this is followed by an intestine, with which it would be very easily confounded but for a sudden change of tint. This intestine extends nearly to the extremity of the body; but it almost ceases to be visible in the middle part, which is occupied by a very elongated ovary.

The vulva is situated at the posterior third of the animal; and in its vicinity the uterus contains five or six elongated ova, isolated from each other, and becoming a little confused in proportion as they are more distant from the vulva.

The anus, a transverse cleft, is situated towards the base of the tail. The ova and viscera are of a greenish yellow colour, rather opaque, and very finely granular in appearance.

All the individuals hitherto observed were ovigerous females, or they presented no sexual organs, either male or female, even though they were of considerable size. All were dead, or at least motionless; they were abundant in the duodenum, but less frequent in the jejunum, and did not reach the ileon. On one occasion they were numerous, as well as *Anguillula stercoralis*, in the fluids proceeding from the stomach.

In the materials in which the worm is found, fragments of it containing eggs often occur: sometimes these eggs are found isolated and recognizable by their elongated form; in some the embryo is in course of formation, and then presents a very remarkable row of dorsal cells; in others the embryo is more advanced and even makes two complete turns.

In the evacuations of three diarrhœic patients which we kept in order to trace the development of *Anguillula stercoralis*, we found in a few days certain larvæ differing from those of that species. They were more elongated, with a cylindrical œsophagus descending nearly to the middle of the body, and a tail which, instead of terminating in a fine point, was, as it were, truncated at the extremity. Although the rearing of these larvæ could not be carried far enough to prove incontestably their identity with *Anguillula intestinalis*, we have scarcely any doubt upon this point. In fact, two of the patients who presented this form in their evacuations have since died, and their *post mortem* examination furnished the adult form; the third patient is still living. We have sought it in vain in a man who came from Cochin China three years ago, and in whose intestine *Anguillula stercoralis* was very abundant.

In all, we have met with this worm six times; and five of the patients who presented it are dead. It would perhaps be premature to deduce grave consequences from this; and the species is infinitely less abundant than *Anguillula stercoralis*.—*Comptes Rendus*, Feb. 5, 1877, p. 266.

On Filaria hæmatica. By MM. O. Galeb and P. Pourquier.

The authors have dissected more than two hundred dogs in search of this parasite. They cite one of their observations in disproof of the verminous diathesis assumed by some writers. In a pregnant bitch the heart was stuffed with adult *Filariæ*; and its blood showed thousands of embryos, which also occurred in the blood of the fœtus. The mother, therefore, furnishes the starting point for the migrations of the parasites, the embryos which float in the blood of the mother terminating in a slender point which enables these microscopic worms to pierce the tissues and penetrate into the placenta, from which they pass into the circulation of the fœtus.

The identity of the embryos swimming in the blood with *Filaria hæmatica* is proved by the dissection and microscopic examination of the adult female *Filaria*, which shows in the oviduct free embryos exactly like those of the blood. Hence the authors conclude that *Filaria hæmatica* is viviparous.

The adult parasites always reside in the right cavities of the heart or in the pulmonary artery; but their presence in this situation may always be ascertained by the examination of a small portion of the blood of the dog.

The female parasite attains a length of 30–32 centimetres (12 to $12\frac{4}{5}$ inches); the male is smaller and more slender, about half the length of the female. More than a hundred of these parasites may exist in the same animal. Sometimes they produce no symptoms, but in other cases cause serious disorders, such as dropsies, which kill the animals. The authors promise a detailed memoir upon this parasite.—*Comptes Rendus*, Feb. 5, 1877, p. 271.

On the Intimate Phenomena of Fecundation. By M. H. Fol.

The radiate structure of the vitellus has been long since described by various authors. I may cite in chronological order Derbès, who observed it very well in *Echinus*, Gegenbaur in *Sagitta*, Krohn, Leuckart, Kowalewsky, Kupffer in the Ascidia, and, finally, Balbiani in the Araneida. The relations of this structure with cell-division, however, remained unknown, as the authors last cited continued to accept the division pure and simple of the cytoblast. M. Hubert Ludwig has just shown that in this respect the Araneida behave like the Geryonidæ.

A second step of the greatest importance has just been made in the knowledge of these primordial phenomena. M. O. Hertwig has shown, in his fine memoir on the first development of the Echini, that the spermatozoid penetrates into the ovum, and enters into the composition of the nucleus of the fecundated ovum. I have repeated M. Hertwig's observations and can warrant their correctness, excepting some details which will appear from my own description. The body of the spermatozoid, when it has entered the vitellus, appears to amalgamate with the vitelline protoplasm to form a clear spot, which becomes the centre of a system of radiating striæ. For this spot I adopt the term *pronucleus*, proposed by M. E. van Beneden; and I shall call it the *male pronucleus*. This male pronucleus traverses the vitellus to mingle intimately with a *female pronucleus*, which is situated at the moment of fecundation in the part of the vitellus opposite to that through which the spermatozoid penetrates. Derbès and M. O. Hertwig regard this female pronucleus as identical with the Purkinjean spot of the ovule before its maturity. I reserve my opinion upon this point, which I have been unable to elucidate. From the fusion of these two pronuclei results the nucleus of the fecundated ovum, which is afterwards segmented in the manner described by me in a previous note.

In tracing the development of the *Echinus*, one is struck by the complete absence of any polar corpuscle. This evidently constitutes a very exceptional case in the animal kingdom. In the immense majority of cases the ripe ovule possesses a large germinal vesicle, which only disappears at the moment of fecundation (*Sagitta*), or a little later (*Pterotrachæa*, *Asterias*, &c.). This germinal vesicle is immediately replaced by a system of filaments arranged in a double star, absolutely as in a cell which prepares to divide, only this system is situated quite close to the surface of the ovum. The more peripheral star then issues from the vitellus to constitute a polar corpuscle, which may divide after its escape: most frequently it remains entire, and the star remaining in the interior of the vitellus divides into two stars, one of which issues to constitute the second polar corpuscle. The substance expelled in this manner represents the greater part of the germinal vesicle enveloped by a little vitelline protoplasm. The opinion of Œllacher as to the origin of these corpuscles in the Trout finds a brilliant confirmation in these facts. The last star that remains in the vitellus collects to form a pronucleus.

At this moment I have observed in *Sagitta* and various Gasteropoda a clear spot which forms at the opposite pole of the vitellus. This spot is surrounded, in *Sagitta*, by a star of protoplasmic filaments. It moves in the direction of the spot where the other pronucleus is placed. During this movement of translation we see very clearly, in *Sagitta*, that the centre of the star occurs in front of the clear spot, and that the latter is passively drawn along. On its arrival close to the other pronucleus, hitherto motionless, this star moves more rapidly, the pronucleus is drawn towards the clear spot, and these two elements fuse together to form the nucleus of the fecundated ovum. These phenomena singularly resemble those observed by M. O. Hertwig and myself in the *Echinus*. If I were to judge of them by analogy, I should say that the clear spot with its star is the male pronucleus; but I have no direct proof of this. MM. Auerbach and Bütschli have already observed this movement of the two vesicles starting from the two opposite poles of the vitellus to become fused together; but M. Auerbach did not perceive that these phenomena only take place after the issue of the polar corpuscles, and M. Bütschli confounds the fusion of the two pronuclei with the amalgamation of the various vacuoles which constitute the female pronucleus.

In *Asterias*, according to the observations of MM. R. Greef, E. van Beneden, and myself, and in the Gasteropoda, the Purkinjean spot dissolves in the germinal vesicle, which in its turn disappears to give place to a double star, which has already been observed by M. Bütschli.

Here we have two distinct cases; and I add a third. In *Dentalium*, according to M. Lacaze-Duthiers, the polar corpuscles effect their escape even before the ovum is fecundated; and in *Asterias*, according to M. R. Greef, the germinal spot and vesicle disappear in the deposited but not fecundated ovum, and the parthenogenetic development of the Starfish only differs by its slowness from the development of the fecundated ovum. M. R. Greef did not observe the formation of two pronuclei; but I have seen them in the fecundated ova of *Asterias*.

Seeking a clue to the interpretation of all these data, we are led to distinguish, in the first place, two well marked cases. In the first case, which is that of *Echinus*, the ovule, at the moment of its deposition, is already destitute of its germinal vesicle, and only possesses a female pronucleus; this becomes, fused, in consequence of fecundation, with a male pronucleus containing the substance of the spermatozoid; and development takes place without previous expulsion of polar corpuscles. In the second case, which is that of the great majority of animals, the ovule, when deposited, still possesses a germinal vesicle and often a germinal spot. These two elements disappear, and the greater part of their substance is expelled from the vitellus in the form of corpuscles, the remainder entering into the composition of a female pronucleus. In the ova which are developed by parthenogenesis, it would appear that this female pronucleus plays the part of a nucleus, and segmentation commences. In the fecundated ova there is formed, at the pole opposite to that at which the female pronucleus is situated, a second pronucleus, which I believe may be regarded as containing the substance of the spermatozoid. These two pronuclei fuse together and the segmentation commences. The principal difference between these two cases would therefore consist in the earlier or later period of the disappearance of the germinal vesicle.

MM. E. van Beneden and Bütschli have already attempted to reduce all these phenomena to a common scheme, but without taking into consideration the observations of M. O. Hertwig, which they regard as erroneous. My supposition seems to me to refer all the phenomena at present ascertained to a single fundamental process, and not to be contradicted by any known fact.—*Comptes Rendus*, Feb. 5, 1877, p. 268

On the Vitality of certain Land Mollusks. By Robt. E. C. Stearns.

I submit for the inspection of the Academy a living specimen of *Bulimus pallidior*, Sby., one of nine given to me by Prof. George Davidson, who collected them at San José del Cabo, Lower California, in March 1873.

These snails were kept in a box undisturbed until June 23, 1875, when I took them out, and, after examination, placed them in a glass jar with some chickweed and other tender vegetable food, and a small quantity of tepid water, so as to make a warm humid atmosphere. This hospitable treatment induced them to wake up and move about after their long fast and sleep of *two years, two months, and sixteen days.* Subsequently all died but this, which seems to be in pretty good health, though not very active.

It may be remembered that I mentioned before the Academy, at a meeting in March 1867, an instance of vitality, in a snail (*Helix Veatchii*) from Cerros Island, even more remarkable, the latter having lived without food from 1859, the year when it was collected, to March 1865, a period of *six years.*

The famous specimen in the British Museum, which is cited in the books, *Helix desertorum*, had lived within a few days of four years, fastened to a tablet in one of the cases, when discovered to be alive.

Helix desertorum, as the specific name implies, is found in arid and sterile areas in the continents of Africa and Asia, and has, as will be perceived, a wide distribution. From the former continent, I have specimens from Egypt; and it also ranges through Arabia in the latter.

The *Bulimus* from the mainland of the peninsula of Lower California, and *Helix Veatchii* from Cerros or Cedros Island, off the coast on the ocean side of the same, come from within the same physical environment, being comparatively a limited distance apart.

The *Helix* belongs to an interesting and peculiar group, probably varieties of one species, which includes, at present, the following names—(1) *Helix areolata*, Sby., (2) *H. Veatchii*, Newc., (3) *H. pandoræ*, Fbs., and (4) *H. lævis*, Pfr. Other forms geographically approximate may hereafter, on further investigation, be referred to the same lineage.

Of the above, (1) *H. areolata* was the first described; or I should say that this appears by the date to be the first name bestowed upon any member of the group. This species has been quoted from Oregon, and (4) *H. lævis*, from the Columbia river, in both cases erroneously. The figures in 'Land and Freshwater Shells of North

America'*, p. 177, are too elevated and globose for the typical *areolata*; but the larger figures faithfully represent *H. Veatchii*. Elevation and rotundity are insular characteristics in this group; and *areolata* is comparatively depressed. It is found in considerable numbers on the uplands around Magdalena Bay, which is on the outer or ocean shore of the peninsula, in latitude about 24° 40′ N.

Bulimus pallidior, which is pretty generally distributed through Lower California, from Cape St. Lucas northerly, has also erroneously been credited to San Diego in California proper. It is arboreal in its habits, at least during the winter season, and frequents the Copaiva trees. It has been said to inhabit South America, *which is probably incorrect*; and the locality "San Juan," mentioned in 'Land and Freshwater Shells,' on p. 195, where a good figure of this species may be seen, should be *San Juanico*, which is on the *east* side of the peninsula, in latitude about 27° N.

The great importance of particularity in habitat will be at once perceived when I state that there are no less than *three* other localities on the west coast of America, *north* of the place cited, all of which are referred to in various scientific works which have come under my observation as "San Juan;" and there are perhaps as many more San Juans *south* of that especially quoted herein, on the westerly coast of America, in the Central and South-American States.

Attention is directed to the fact that the three species herein mentioned as exhibiting extraordinary vitality, belong to geographical areas which receive only minimum rainfall, or which are, in simple language, nearly rainless regions.

Within such areas vegetation is exceedingly limited, even in favourable seasons; and the presence and growth of the annual plants is, of course, dependent upon the rainfall: this last occurring infrequently, makes the food supply of land-mollusks and other phytophagous or vegetable-eating animals exceedingly precarious.

It is highly probable that a careful investigation in this direction will lead us to the conclusion that the land mollusks which inhabit arid areas have, through selection, adaptation, and evolution, become especially fitted for the contingencies of their habitat, and possess a greater degree of vitality or ability to live without food than related forms in what may be considered more favourable regions, and, through and by reason of their long sleep or hibernation (*more properly, æstivation*), with its inactivity and consequent immunity from any waste or exhaustion of vital strength, are enabled to maintain their hold upon life when animals more highly organized would inevitably perish; and we are furnished with an illustration, in the instances cited, how nature works compensatively, when we institute a comparison with the opposite condition of activity and the food required to sustain it.—*Proceedings of the California Academy of Sciences*, October 18, 1875.

* Smithsonian Misc. Coll. No. 194.

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XXXV.—*Malacological Notes.* By ROBERT GARNER, F.L.S. &c.

IT seems to be a task neither easy nor free from doubt, to assign a proper place in the Animal Kingdom to the Mollusca, or, when their proper place is found, to fix their boundaries as a subkingdom. It is evident that animals, both as they exist now and as they have succeeded each other in past geological time, are marked by different degrees of elaboration; and this leaves room for the doctrine of derivation from simpler primordial forms of the higher. This increasing differentiation in the animal kingdom is also tacitly kept in view in taxonomy; hence Mammalia are placed highest in the whole animal series, and Mollusca in the non-vertebrate division of it.

But the above greater or less elaboration, though a primary consideration in general classification, is not by any means the sole one. Were it so, and were we assured that one of the higher forms is descended by an undeviating development from one of the simpler, we ought to have, tracing the former through the course of its formation, a summary of all organology, which we have not. Strong are the influences which the conditions of life (ethological as they are termed) exert on the course of development; or, in other words, great are the variations necessary to modify an organism for change of habitat, food, or climate, or for its protection. Along with the general plan and its greater or less elaboration upon which animals are formed, there are therefore revealed secondary types of formation, which, whether realities or abstractions, must be imported into classification. Thus, in animals nearest the boundaries of the vegetable kingdom, the special character of life-force of the latter seems not extinct, causing a rayed or ramose disposition and a tendency to budding in their mode of increase; or we may say that animal life presupposes the vegetable, being itself but the manifestation of the same endowment in a higher form—just as, according to some, psychological phenomena are superadded to, or developed from, the physiological*. Again, amongst the disturbing influences which affect whole series of animals, the nature of their locomotion must be reckoned; for to an adaptation for this and for aerial or aquatic life can probably be referred many aberrations, such as metamorphosis or alternation of generations; and hence it is that a more regular ascent from the simple to the complicated animal ought to be seen when we confine ourselves to one form of life, say the aquatic.

The same aberrations render it difficult to trace the phylogeny of an animal—that is, to show from what antecedent form, extinct or existent, it originated, and through what phases its species passed. We see enough in nature to recognize, as already alluded to, one general plan of formation; and at the origin of all animals, or in the embryo stage, there is, as the rule, much sameness—and first either a division or a budding of a pullulating plasm, or an origin from the union of a simple cell and microzooid; but remarkable differentiations and variations occur early, almost withdrawn from our observation, and their *rationale* not always understood. It is true that a more or less intimate segmentation of the yelk of the ovum in all Invertebrata produces the *morula* form, preceding all development; but there is no complete uniformity further, and the variations remain unsystematized. The *morula* or granulated sphere may become hollow, and then be invaginated, so as to form a sacciform *gastrula*, so called; and Haeckel considered this to be the animal stock-form; but even in the cases where it prevails the *morula* may be first changed into a flat *planula*, and the sacciform disposition be attained, somewhat differently, by its flexure†. The cavity may also form in the interior, without any flexure or invagination, or with the latter imperfect; and in the normal *gastrula* it does not follow that the primary opening becomes the mouth, or the primary cavity or *blastocele* the permanent stomach; and before any cavity

* Mr. Spencer teaches that the processes of morphological differentiation conform to the same general laws in the one kingdom as in the other ('Biology,' vol. ii.).

† Salensky, "On Haeckel's *Gastræa* Theory," Ann. & Mag. Nat. Hist., Jan. 1875.

forms at all, or contemporaneously, or closely following it, the molluscous shell, foot, and ciliated velum may appear, either in the above forms of development or in another, where upon the segmented *morula* a *germ-lamella* makes its appearance, in which the formative cleavage process is very active, so that the lamella grows quickly and surrounds the other residuary part of the yelk, which in some cases, as in *Sepia*, but not in the Argonaut, constitutes a large fund of sustenance for the young embryo*. As we have above observed, many of these and other modifications cannot, with our present knowledge, be reduced to a consistent system, nor can the succeeding stages always be so. Thus, for ourselves, an ascidian is manifestly allied to a bivalve mollusk, as much as the latter is to a gastropod, and we hold that morphology suffices to prove this; yet, on the other hand, very different are the early forms of the two, though in this case appropriate enough—one qualified for preliminary locomotion, the other, it may be, to immediately fix itself; indeed the former larva is so tadpole-like that it has been considered by Schmidt and others, as is well known, to foreshadow the vertebrate animal, though it is probably truly included in the molluscous community, its appendage comparable, it may be, to the tail of the *Carinaria*, to the *flagellum* of some bivalves, or even to the foot of the developed animal†. The *veligerous* stage, pretty general in, though not peculiar to, gastropods, seems a form well adapted for their dispersion, and indeed, in certain species, may perhaps be said to continue through life. Here the embryo is furnished with a ciliated disk or *velum*, and an external spiral shell is formed with an *operculum* attached to the foot, a shell even existing in the larva of the ultimately naked species; but in such naked species as have an internal shell (the Pulmonata having also other peculiar modifications in their development ‡) it is intradermal. With respect to the Cephalopoda, Owen says, "were growth superinduced at any arrested stage of cephalopodic development, no known inferior order of mollusk would result." With oneness of the animal plan in general, purpose is only accomplished by much variation and adaptation, as well as suppression or development of the homologous organs, even

* "Developmental History of Mollusca," by Prof. E. Ray Lankester, Phil. Trans. vol. clxv. There is a clear and succinct account of the embryology of the Gastropod by M. A. Giard, Ann. & Mag. Nat. Hist., April 1876.

† Mr. Huxley compares the posterior prolongation of *Carinaria* to that of *Strombus*, considering it to represent the *metapodium*.

‡ These peculiarities are observable in the eggs of *Helix aspersa*, easily procurable, or better in the West-Indian *Bulimi*. See also Woodward's 'Manual,' p. 287.

at the early stages of life; and with so many embryological irregularities, or what at present seem such, what can we do as regards classification but avail ourselves of plain morphological data? With others of the advanced school M. Giard is somewhat severe on the homologists, yet he dwells on the very strong action of the exterior, as, for instance, in "the convergence of types by pelagic life"*.

In the following paper the Bryozoa or ciliated polypes are, with some reserve, included with the mollusks, nor is much said respecting the lowest class of true mollusks, the Ascidiæ; it is the less needful, therefore, to dwell, as a prelude, on the manifestation of the composite, branched and rayed vegetative tendency in these two classes, trenching upon the confines of the molluscous subkingdom. In the latter (in *Salpa*, for instance), though, for us, mollusks, we have remnants of all these tendencies, as well as of alternation of generations—tendencies all predominant in still lower animals, as, for instance, in the plant-like infusorial *Vorticella*, or in the more minute but proliferous and branched *Dinobryon*—almost equally common in our pools, but less easy to detect or examine, as it swims freely about, mimicking the oceanic creature last named, the *Salpa*; in fact, it may be observed, *en passant*, that the Infusoria, so called, in a *broad sense*, stand alone within the animal cosmos. Their minute size, depending perhaps on a unicellular origin, and answering to that of the Desmids in the vegetable kingdom, constitutes almost a primary characteristic; and they present faint resemblances to other animals of several orders: they have the vibratile organs, or *cilia*, so common in mollusks, capable of effecting locomotion through the water in their own minute bodies, but bringing the water to the animal for respiration and for the conveyance of nutrient particles in the mature mollusk; some also (the Foraminifera) form shelly coverings, which simulate those of the same animals.

Animals have been arranged† into those which are centrally and those axially developed—that is, either in a radiate or a longitudinal fashion: with the former the Mollusca, as already intimated, cannot be well made to agree; with the latter they correspond no better. They have little of the axial arrangement of an annelid, and not always, though generally, bilateral symmetry, confining ourselves to the animal in contradistinction to the vital organs. Upon the whole, flexure *super se*, rather than any other plan, predominates, and prevails upwards in a great degree from the bryozoon to the cuttlefish,

* 'Revue des Sciences Naturelles,' March 1875.

† 'Principles of Biology,' Spencer, vol. ii.

due perhaps to the necessary arrangement of the inlets and outlets of the body in such animals as are encased and protected by a shell or in other ways. Mr. Spencer attributes the jointed form in the great subkingdom Articulata to repetition or budding, yet of a less mechanical origin than the jointed but adaptive disposition of the Vertebrata. Notwithstanding this low vegetative characteristic of the Articulata, if it hold good, they and Mollusca are commonly considered to form two parallel zoological divisions, rather than one concatenated series. Upon the whole, the Mollusca approach nearer to the Vertebrata, as will become evident hereafter; but the Articulata are highly developed for locomotion, which ensures perfect mechanical structure and symmetry; they are less generally aquatic, and often adapted for aerial movement, to which last the Mollusca cannot fairly be said to attain; they also evince wonderful powers of what looks like observation and purpose. At the same time the Mollusca present varied means of locomotion and of domiciling themselves; and their intelligence may be greater than our means of observation enable us to ascertain; the locomotion, however, with the exception of that of the pelagic swimmers, is generally of a simple kind, mere gliding or creeping rather than walking, the organs being formed with greater reference to hydraulics than mechanics. They are anchorites accommodated to their cells, sensitive rather than locomotive unities, seldom having any repetition of parts of an analogous kind, but commonly possessing, as already observed, more or less of that lateral duplicity present in all animals above the Radiata—though, indeed, in the Gastropoda this is liable to be interfered with by an atrophy of one side. Altogether a mollusk is a typical reality, showing either an origin from some primary molluscan root, or a uniformity of special plan throughout their own subkingdom. As a rule there may be said to be seen in them, as we have them at present, an ascent from their lowest to their highest forms, without any great *hiatus*—in this, more than in their geological sequence, agreeing with the theory of the derivation of one kind from another.

If we are to trace up the Mollusca to their origin, their biological pedigree, we shall, it is commonly held, arrive at the Bryozoa, or rather, to our mind, at the lowest Ascidiæ. It seems far-fetched to form an alliance, as Cuvier did, between the *Teredo* and the articulate *Lepas*, though there is an obvious analogy between the valves and adductor muscles of the last and those of a bivalve mollusk—one of those curious resemblances often occurring in nature between animals far removed from each other, evincing, on the one hand, relationship to the environment, and on the other unity of plan throughout. What is a little remarkable in this last example, instancing a kind of duplex structure, is that in the development of the cirripede the articulated disposition is primary and internal, the molluscan (if such it may be termed) the reverse. Darwin considers that the cirripedes present no real affinity with any other non-crustaceous animals; but some have seen in their pedunculated and sessile genera an affinity, on the one side, to the Brachiopoda and the Rudista respectively, and in these last to certain ordinary mollusks on the other. The first conclusion we scarcely admit; the last we do.

The ciliated tentacular crown or *lophophore* of the Bryozoa much more resembles that of some tubicolous annelids than the branchial cavity of the Ascidia, though the young bryozoon (*Plumatella*) is somewhat like the bivalve in the early stage, the egg-covering separating into two oval plates or valves. There are other external resemblances of Mollusca to lower or higher animals, analogous rather than homologous or homogenetic, but brought about purely to meet peculiarities of the circumstances of life (that is, special excess of those externals which nevertheless are set down as determining, in a gradual way, all animal development whatever), either by an adaptation to, or a modification by the same. Such are the resemblances of some aberrant mollusks to tubicolous annelids, or of a *Chiton* to an *Oniscus*—resemblances totally disregarded, but whether philosophically so some might doubt.

The mollusk, notwithstanding its frequent tendency to a flexure *super se*, is at other times, when unfurnished with a shell, of the more normal animal form, oval or elongate, with an undivided foot or muscular disk below abdominally, a protective mantle above dorsally, and the viscera enclosed between. The form, however, is generally much modified to accord with the shelly valves of the conchifer or bivalve, or the spiral shell of the univalve. It is only as we ascend that a head is developed (Cephalophores).

The Ascidiæ, then, we are disposed to consider as the lowest of the Mollusca and the progenitor of them, though not of the Brachiopoda; these are Acephala closely allied to the others, the bivalves. The tentacles, at the orifice of the respiratory sac, are, when they exist, but secondary to the sac, which has the true branchial structure of the higher Acephala, frequently with branchial or labial folds, like the pallial sac of the bivalve. This differs from the views of several living biologists, but has the support of Mr. A. Hancock*. The

* Journ. of Linn. Soc. vol. ix. (1868) p. 343.

tentacles just mentioned are analogous to those surrounding the orifices of the respiratory tubes in bivalves; and that enigmatical part, the endostyle, may represent the crystalline style applied to its use (mechanical support), or at least so much of it as is retained after the loss of the larval appendage. The larval Ascidian, or the Appendicularia, constitutes a very indifferent vertebrate—the tail in the latter bent forwards at an acute angle to the body or towards the mouth, and its nervous cords (if such they be) seeming scarcely continuous with the cephalic ganglion, and having alternate instead of opposite ganglia, more unlike the vertebrate or articulate type in this respect than are the nerves in the arms of the Sepia or Argonaut *.

Bivalves would differ little from the Ascidiæ, provided the test and mantle of the latter were slit; but in the former the branchiæ are more differentiated and the circulatory organ more perfect, shelly valves and muscles to close them are superadded—also a foot in most species, developed according to the amount and kind of locomotion required. There is in bivalves no true head; but the mouth is furnished with lips and two laminated and ciliated palps on each side, distinct from the branchiæ but of similar structure, the lips proper sometimes specialized (as in *Pecten*).

Amongst bivalves the above remarks only partially apply to the Brachiopoda, which, if we endeavour to trace their genetic affinities, present us with some difficulties. They have been considered to have the same relationship to, or descent from, the Bryozoa as the Lamellibranchiate bivalves; but if so, it must be in a different line, and without the intervention of the Ascidiæ. It may be questioned what relation the upper and lower valves of Brachiopods bear to the right and left valves of the ordinary Lamellibranchiates. The crossing of the principal adductor muscles in the *Lingula*, and their median union in some *Terebratulæ*, the compression of the body and arms or tentacles in Brachiopoda generally, in the opposite direction to the arrangement of the body and corresponding parts in the Lamellibranchiata, the perfect lateral symmetry in the former, and a tendency to division, seen in *foramina*, notches, or *septa*, in several species (as in *T. diphya*), whilst there is often a difference, in some respect or other,

* "On the Genus *Appendicularia*," by E. L. Moss, Linn. Trans. vol. xxvii. part 2. See also Ussow's Zool.-Embryol. Investigations (by Dallas), Ann. & Mag. Nat. Hist., Feb. and May 1875. The last writer is decidedly against the molluscous nature of the Ascidia; and so are others; but the validity of this opinion depends upon the accuracy of minute and difficult researches upon the nervous ganglion and other parts, and the opposite conclusions of Mr. Hancock are perhaps as reliable.

between the anterior and posterior portions of the valves in Lamellibranchiata, are facts which seem to favour the idea that the dorsal valve, for example, of a brachiopod is not analogous to the right or left valve of an ordinary bivalve, but rather to the anterior portions of the two valves united together, and so *vice versâ.*

The fossil Hippurites and Rudista, with such forms as *Dianchora* and *Podopsis*, appear to have had most affinity in form and structure, amongst bivalves, with the Chamadæ—branches of the same stock, one passed away, the other still flourishing, therefore the affinity rather collateral than derivative. One or both valves may have put on the spiral form, the former case in the Spherulite, and the latter in *Diceras*; or one of them may have become elongated and multilocular, as in the Hippurite and, indeed, in some oysters. Such a spiral form, or such an elongation, must be attended with a division of the connecting ligament or cartilage, just as we see in *Isocardia* or, in a different form, in *Gryphæa.* Further, if the shell-forming mantle becomes expanded at the circumference all round, as in *Chama*, there will be a tendency for both hinge-teeth and cartilage to become central, a circumstance which has apparently taken place in many of these curious fossils. They have other peculiarities of the valves difficult to account for.

But however explained, whether from descent, relationship, or modification for or by externals, the *Anomia* appears to be a transitional form between the attached brachiopod (*Crania*, *Orbicula*) and the ordinary bivalve; the oblique position of the mouth, the non-marginal situation of the shell-nucleus, the very short intestine, the lengthened, narrow, and loose palps or labial appendages (which are confluent with the branchiæ), the complex muscular system, the ovigerous mantle, and the notched valve would seem to show as much, as well as the structure of the shell in some allied species. The plug may be the homologue of the byssus or pedal plate of *Arca* on the one side, and of the brachiopodous pedicle and *deltidium* on the other. A very small foot exists; but there is a very long crystalline body, having apparently a mechanical use to support the unusually detached mantle-lobe. We see in these transitional bivalves a tendency to diverge from the symmetry which preponderates in the class throughout; for when certain other species show the same tendency, it is generally with some relation to the nature of the hinge. Though the brachiopod is very distinct in many ways from the bivalve, we are not convinced that the arms of the former do not perform the office of branchiæ.

The boring or burrowing Lamellibranchiates are often very aberrant—*Pholas* especially in its hinge, the valves and mantle being reflected at the *umbones*, and there being often a row of underlying cells here, with *fimbriæ* of the mantle lodged in them; muscular fibres (the anterior adductor) cross from valve to valve at this part; and we should suppose that the valves are opened somewhat, as well as closed, by the voluntary efforts of the animal. *P. dactylus* has several shelly plates covering the reflected part of the mantle, *P. candidus* only one, but in addition a weak ligament. The valves have a tendency to become otherwise disintegrated in these boring bivalves; a calcareous enveloping tube is often formed, and the true valves are much diminished in proportion in *Xylophaga* or *Teredo*, or even become incorporated with the tube. The body is often strangely elongated, as in the last species. The Teredo or ship-worm is a remarkable example of how much ordinary type may be modified to meet external conditions. Notwithstanding its extreme elongation it is in every respect a true lamellibranchiate; thus the alimentary canal is reflected over the posterior adductor muscle as usual, though to be so it has to ascend within a few lines of the anterior extremity. It has, however, two new parts, *spatulæ* or palettes, guarding the posterior siphons, curiously imbricated and possibly a dismemberment of the valves, analogous to what we shall see in *Chiton*. In the mature Teredo the shelly enveloping tube has, in the neighbourhood of the palettes, imperfect partitions, and it becomes closed at the other extremity. The internal processes or spoons seen in the small valves support and protect the foot and viscera, help to keep together the valves, and give attachment to muscles; the heart is not perforated by the rectum, and, with its auricles, is of the shape of the inverted letter Y. *Xylophaga* has commonly no palettes; but the foot has a central *papilla* with an orifice, more developed, however, in *Pholas crispata*; and here the curved crystalline style is inserted, having itself a hard calcareous nucleus; this must support the foot; and it is possible that there may be a vent here, in the wood-borers, for some softening fluid from the stomach. Though the writer broached the idea that ciliary action, or rather the consequent currents of water, constitute especial agents in the burrowing powers of mollusks &c., and that the fleshy and ciliated foot, aided, it may be, by hard particles, has furthermore much to do with it, yet he was not blind to the existence of other adaptations to aid, at least, in the perforation of timber.

The anterior extremity of *Aspergillum* (watering-pot shell) is still more modified, the valves being curiously fused with the tubular shell, which has also a perforated disk or rose in front, in which is a small central slit for the attenuated foot, and also having a ray of shelly tubules around the margin. These animals, compared with ordinary bivalves, and with tubicolous annelids, are another instance showing the difference between homology and analogy, the latter occurring, as observed already, in very different animals where the circumstances of life are similar. Like *Teredo*, *Aspergillum* is in every respect a bivalve conchifer, with the mantle, however, closed in front, but having there a thickened muscular disk with tentacular processes for the perforations above mentioned, and also giving exit to the foot, as does the corresponding shelly plate. We should suppose that the animal lives buried in fine sand or mud, in which its rayed fringe must secure it, as the expanded foot of some other bivalves does.

With the exception of *Aspergillum* and one or two allied genera with fused valves, adductor or *janitor* muscles are general in bivalves, and also peculiar to them—unless we hold Oken's theory that the operculum of Gastropods is in reality one of the altered valves of the bivalve, in which case the retractor muscles of the former may also include the adductors*. The muscles of attachment of *Patella*, *Fissurella*, *Hipponyx*, *Navicella*, *Sigaretus*, and *Haliotis* show the transition from the retractor pedal muscles of the bivalve to the more or less united and contorted muscle of the spiral gastropod. There is sufficient resemblance between an *acephalous* and a *cephalous* mollusk to proclaim them of the same division of the animal kingdom; but the latter, with its more or less marked head, has generally its nervous system more concentrated into a brain or cephalic ganglion, with defined auditory sacs, more developed eyes, and, in some, organs of smell. In Acephala, when mature, no eyes, except the *ocelli* at the margin of the mantle, exist. The lips and labial palps of bivalves are transmuted in Gastropods to subulate or flattened tentacles, or sometimes into supra- or infraoral disks or processes. Horny jaws of varied form, median or lateral, but the representatives of the beak of the cuttlefish, and a spiniferous tongue or *odontophore* (Huxley) may exist, the latter almost universally, though it does not appear to have been found in the *Pyramidellæ*. The hooks or teeth from this tongue do not lose their form when boiled in nitric acid or when calcined, but vitrify with potash, which is perhaps conclusive as to their siliceous nature. The branchiæ are so varied in position that they were chosen

* This theory is strongly advocated by Macdonald, Journ. Linn. Soc. vol. v. no. 18. He considers the operculum to be homologous with the right valve (see further on).

by Cuvier to distinguish the separate families. They are generally protected by a shell, and are of course *en liaison* with the heart, as the latter is, more or less, with the alimentary canal; indeed we should have before observed that in the Lamellibranchiates the ventricle is commonly traversed by the rectum, this arrangement being either an advance upon the disposition seen in still lower animal forms, where the intestine is enveloped by the general reservoir of the blood, or, as has been thought, due to the young bivalve being the result of the union of twin embryos. It is probable, as may be traced in their vascular arrangement, that the branchiæ in mollusks are normally four in number, as we see them in bivalves and again in *Nautilus*; the two of one side, however, are combined into a single one in most Gastropoda, and in some *Arcæ*, *Anatina*, *Solemya*, and other bivalves; or one only, altogether (homologically *duplex* however), may exist, as in other Gastropods, its fellow of the opposite side being more or less undeveloped. Are the pair of branchiæ found in the dibranchiate Cephalopoda the representatives of the four branchiæ of the tetrabranchiate *Nautilus*? or have we the rudiments of the wanting pair, or simply of the corresponding cardiac parts, in the anomalous appendages of the lateral hearts, which, however, are wanting or little developed in *Octopus*? The monobranchiate *Aplysia* has an aortal appendage. Some of the Gastropoda have pulmonary sacs instead of branchiæ, and others (*Ampullaria* and perhaps some littoral species) have both*.

The position of the branchiæ in *Patella* and *Chiton* (Cyclobranchiata) is analogous to that in the bivalves, to which mollusks these Gastropods form the natural transition; but the ventricle of the heart has not the intimate connexion with the rectum, though both heart and rectum are situated at the posterior extremity of the body in the latter genus. Not so in those allied genera where the branchiæ have ascended wholly or partially above the neck (Scutibranchiata)—*Fissurella*, *Emarginula*, and *Haliotis*; for here the ventricle and rectum are in union, as in the bivalve. In *Haliotis* and *Sigaretus* one branchial plume is commonly less than its fellow; and in *Haliotis* the inequilateral composition of the shell is indicated by the row of foramina. In *Calyptræa* and its congeners the smaller of the branchiæ has disappeared; and in this last case, probably, the shell is correspondingly the expanded representa-

* The circumpedal fringe of *Patella* has doubtless a branchial function; but we do not deny that the animal, when exposed by the receding tide, may take air into the supradorsal cavity, though this rather appears to be the renal organ.

tive of but one valve of the bivalve, and not of two, as we think is the case with *Patella* and *Fissurella*. In *Dolabella* one valve is developed, the other all but gone.

Perhaps the normal position of the vent in Gastropods, where there is no flexure *super se*, is, as in most other animals, towards the opposite extremity to the mouth; *Onchidium*, *Doris*, and *Chiton* (representatives of the pulmonate, naked-gilled, and cover-gilled Gastropods) are examples of this: but, as said before, the branchiæ and their accompanying heart are in especial relation with the shell; and as this develops, the tendency is for the concomitant removal of branchiæ and vent forwards and to the right (Pleurobranchiata), or especially forwards (Prosobranchiata). This transference may be seen to take place progressively, in the Pulmonata, in *Onchidium*, *Testacella*, *Limax*, and *Helix*, in the Nudibranchiata, in *Doris*, *Eolis*, and *Pleurobranchus*, in the Cyclobranchiata and Scutibranchiata, in *Chiton*, *Microschisma*, *Fissurella*, *Emarginula*, *Gadinia*, and *Natica*—a remarkable transposition of parts!

The shell, then, of the *Patella* corresponds to the two conjoined valves of a lamellibranchiate bivalve; they are less conjoined in *Fissurella*, *Emarginula*, and *Haliotis*, in which last is perhaps seen, as already observed, the division into right and left valves in the row of foramina and the long fissure of the mantle. The spiral form becomes progressively more pronounced in *Crepidula*, *Calyptræa*, and *Sigaretus*; and this is accompanied by a want of development on one side affecting heart, branchiæ, and other organs. Indeed, with respect to the spiral univalves the preceding paragraph requires some qualification; for in them the torsion of the body and the great development of one side (the right) causes the frequently single branchial tuft to be carried to the left, accompanied by the heart.

We have always felt disposed to receive the theory held by Adanson, Oken, Dr. Gray, and Macdonald, with respect to the normal spiral Gastropod. The latter writer shows the correspondence and resemblance between the operculum and the univalve shell. He looks upon the muscles connecting the operculum with the spiral shell as the adductors of the dimyary bivalve, and perhaps also combining the representatives of those fibres which serve to retract the foot. He supposes the body of the bivalve, now occupying the left valve, to revolve from left to right on its longitudinal and transverse axis, in both cases moving through a quarter of a circle. There is no violence done to fact here; the greatest requisition demanded appears to be the flexure or displacement forwards of the *termini* of the intestine and excretory organs, which circumstance we see to have evidently taken place in *Fissurella*, *Haliotis*, *Gadinia*, &c. But no account is taken of the effect of the transposition on the size &c. of the organs in the above theory; and, judging from the character of the torsion which has taken place, we are disposed to think that it is the *right* valve which preponderates, and not the *left*, although the tendency to the spiral form which we see in some bivalves, as *Isocardium*, tallies best with the dextral direction of the spire in ordinary Gastropods. Mr. Owen expresses himself as adverse to this view, principally from the existence of the operculum from the first in the embryo. In a few cases the operculum, or *clausium*, may be a dismemberment of the columella or, tantamount, of the posterior portion of a patelliform shell. The operculum of *Navicella*, for instance, is formed by the posterior reflection of the afterpart of the shell-mantle; and it answers to the shell of *Crepidula*, or the columellar portion of the univalve *Calyptræa*; in *C. Dillwynii* there is the same part, but curved, and free at its margins, though attached to the apex of the shell; in *C. rudis* this has become a complete cup, whence the name *cup-and-saucer limpet*; whilst in the pretty little *C. sinensis*, or *Chinese bonnet*, the lamina goes to form the inner part and *columella* of a spiral shell. In *C. rudis* it is puzzling to understand how the inner cup is formed; it perhaps answers to an open columella; the formation of the other species is more intelligible. In ordinary cases the operculum is formed on a distinct pallial *lamina* at the back of the foot, occasionally connected above with the shell-pallium, as in some Turbinidæ. If we reject Oken's view altogether, we are driven to suppose that the curiously modified operculum is the homologue of the byssus of bivalves. In *Phasianella* there is an equal development of both branchiæ, separated by a septum, as in many Cephalopoda; and yet here, with little internal derangement, we have an operculum—this being somewhat adverse to the above theories, though it might be accounted for in the modern mechanical way, the further from the centre of rotation the greater the tendency to divide.

Two patelliform shells, then, very similar in form, may belong to animals of quite different families: one may cover a diœcious and carnivorous mollusk with only a single branchial process, and a heart with simple auricle and ventricle, with the intestine opening on the right side (*Calyptræa*, *Crepidula*, and *Hipponyx*); another a monœcious and phytophagous animal, with two symmetrical branchial organs, and heart with double auricles and perforated ventricle (*Fissurella*). In the first case one of the branchial laminæ and the corresponding side of the body appear to have become atrophied; and here we are to suppose that the shell, as seen from above, is homologically univalve, with a strong tendency to become spiral, in fact so strongly centrifugal in *Calyptræa* as to have carried the heart into an unusual position, and almost to have disintegrated the shell; whilst in the second case the whole conformation of heart, branchiæ, foot, muscles, and organs of generation agrees so certainly with that of bivalves, that we must have in one of these molluscous shells the two shells of the bivalve in union. In *Patella* the branchiæ continue situated at the sides of the foot, though the heart is to the left, whilst the rectum opens on the right side of the neck; in *Emarginula* the pedal fringe is but rudimentary, and the true branchiæ are seen above the neck—a disposition (in the last respect) normal in most univalves; but in this case the ventricle is perforated by the rectum. *Calyptræa* and, more markedly, *Hipponyx*, being often fixed on very irregular surfaces, have the power of levelling for themselves a foundation by the secretion of a shelly pedestal. It is puzzling to say how this is formed, or with what part in other mollusks it is homologous. It must either be the representative of the byssus, or, more probably, what appears to be the foot-disk is in reality an opercular surface secreting the support, which is consequently marked with muscular impressions. There are lappets in front of the disk in these genera; correspondingly the anterior dorsal disk in *Sigaretus* is not homologous with the similar anterior dorsal surface of *Bullæa*; the situation of the mouth shows this.

The form of the univalve shell, due primarily to original plan, or, in other words, to an adaptation of ways to ends, depends, secondarily and immediately, on the form of the mantle-opening, on its inclination from the action of the foot, and on the relative activity of its circumference with respect to the secretion of the shelly matter. An increasing tube would be prolonged in a straight line or nearly so, if the mantle at the circumference were equally active and not unequally inclined, as, for example, in *Dentalium*, which is in all respects near to the Gastropods lately dwelt upon, *Fissurella*, &c.; but, on the contrary, it would be more curved if one side were more active or more extensile. *Vermetus*, *Siliquaria*, and *Magilus* have an unequal deposit at first, and are then spiral; afterwards the shells become disjoined and approach the straight line. In *Patella* the whole circumference of the mantle secretes and grows almost equally and rapidly, hence the depressed conical form; whilst *Capulus* is at first less rapidly expanded, with the axis of increase changing somewhat, whence it attains its peculiar form and is named "Hungarian bonnet." A similar formation, but less gradual and more anterior, produces such shells as *Navicella*, already dwelt upon; whilst, if the mantle expands laterally instead of totally in front, we have the corresponding form of the river and lake *Ancylus*, or of the internal shells of *Aplysia*, *Limax*, and *Bullæa*. If the lower or inner part of the mantle does not secrete at all, the spiral shell can have no *labium* or inner lip, and no inward pillar or columella, the axis of rotation. In *Scalaria*, but for the opposite reason, the shell has no material axis, there being an approach to the disjoined *Vermetus*. The shape of a transverse section of the spiral tube of a shell (that of the angular-edged *Trochus* for instance, or of the rounded *Turbo*) is due to the shape of the bend in the edge of the mantle. The oblique direction of the mouth of a shell, and consequently the produced spire, are owing, as alluded to before, to the extra development of the component right valve. A rotation on the same plane (as seen in the Nautilus and sometimes in *Planorbis*) and the slow or rapid increase in the diameter of the whorls occasion the preceding ones to be apparent (*Ammonites*) or covered-in (*Bellerophon*). In *Conus* the mantle-opening is disposed in the opposite direction to what is most usual, and still more so in *Ovula* or *Cypræa*, being in the same line as the foot, and not transverse or diagonal to it; and the consequence is, that the last whorl more or less covers up the spire of the shell, which, however, in some cases, appears to become absorbed. In *Chiton* the valves, except the last, answer to the anterior part of the shell of a *Patella* or *Hipponyx*, in some species of which there is a tendency for the successive laminæ to separate. The shell-umbo appears to be the middle of the last valve in *Chiton*. There is also in *Chiton* as in *Nerita* some tendency of the pedal nerves to put on the disposition seen in Articulata; and the auricles communicate with the elongated ventricle by two or three openings on each side (*Chitonellus*). The intestine has been described to go in a straight line from head to vent, but is in reality, in some species, more convoluted than in any other mollusk*.

The shell of the Nautilus and also of the Argonaut appear to correspond in external form, and excepting the multilocular character of the former, to those of the spiral Gastropods, though, from the symmetrical disposition of the animals, and the restoration of the branchiæ to their original bilateral and

* Perhaps the truest approach in a molluscan to the Articulata is in several tectibranchiate species, as *Akera bullata*, where the posterior *somite* of the body is so distinct as to have its separate pair of ganglia, irrespective of those for the supply of the vital organs.

abdominal situation, these shells may be considered abdominal rather than dorsal, and revolute or reversed as to the direction of the spire. The siphon here is not situated dorsally but ventrally; and the back of the head is directed towards the spire—the reverse of what it is in Gastropods, *Planorbis* for instance. But the shell or bone (so called) of the Sepia rather answers to the dorsal plate of the pteropodous shell, as also the fossil *Beloteuthis*; and what is the expanded portion of the Nautilus-shell is scarcely developed at all in the Sepia, though more so in *Belosepia*. No doubt the light spongy laminated part of the *os sepiæ* represents the hydrostatic cells of a Nautilus and Ammonite and the phragmacone of the Belemnite or of *Spirulirostra*; the wavy lines seen by the lens on the *septa* of the *os sepiæ* answer somewhat to the wavy sutures of Ammonites, showing at least similarity of construction histogenetically. In *Spirulirostra* we have a form connecting *Sepia* with *Spirula* and *Nautilus*, as *Conoteuthis* appears to do the Belemnite with *Loligo*. *Turrilites* must have had an unequal lateral development, like Gastropods*.

In certain tectibranchiate mollusks, as *Gastropteron*, *Aplysia*, *Bullæa*, *Aceras*, and *Ianthina*, we have a transition from the Gastropods to the Pteropods, either the foot or mantle being developed more or less into swimming-organs, whence they might be arranged as natatory gastropods. The Pteropoda proper, though perhaps at present not at their zenith of development, at least as regards size, appear in type to constitute a characteristic class, and upon the whole a transition between the two whose morphology has been dwelt upon, though their likeness to the young veliferous Gastropod may induce others to think differently. With *Sepia*, for instance, *Hyalæa* may be compared in respect of shell, also as regards the abdominal situation of the branchiæ. *Limacina* scarcely differs from *Hyalæa* except in having a spiral shell and the pedal lamina a little more specialized. The tentacles of *Clio* and *Pneumodermon* are apparently transitional in structure to the arms or feelers of Cephalopods. Pteropoda correspond with Gastropods as to the dextral position of the rectum; but the heart is also dextral or rather abdominal, and they vary somewhat as to the openings of their androgynous generative organs†. Four of the six cephalic ganglia lie in

* The Ammonite appears to have been furnished with an operculum. The Argonaut-shell has been compared to the ovigerous float of *Ianthina*: perhaps it has not been conclusively shown by Madame Power what part mainly secretes it, the veliferous arms or the mantle; if the former, we might consider it to answer to a developed operculum.

† The above we believe to be correct; but there is some confusion in descriptions.

Clio above the œsophagus, but the reverse in *Hyalæa*, *Cleodora*, and *Pneumodermon*. Fins are especially developed, but only the rudiment of a foot; they swim rather than creep. The high position here accorded them systematically rather depends, it will be seen, upon type or external morphology than upon structure. Eyes are to be seen in *Hyalæa*; and Eschricht showed them to exist in *Clio*; there are also dark points on the cerebral ganglion of *Cleodora*, which must be corresponding organs. *Carinaria*, though not considered to be a pteropodous animal, can scarcely be better placed as a Gastropod. In it the greatly developed vital or vegetative organs of the mollusks generally are dwindled in bulk. The pretty shell covering the viscera is curiously carried above the elongated cylindrical body of the animal, which has caudal and abdominal fins developed, the latter being the transmuted foot, with a little sucker and pore at its posterior part. It has very developed eyes; and we may observe little reddish ear-sacs with their nerves floating internally behind and below these eyes.

As far as we have yet described, *form* rather than structure has, in a few instances, faintly assimilated the Mollusca to the Vertebrata; but apparently we see a true structural approach to them in the Sepia. If there is any thing in the lower mollusks which is a shadow of vertebrate structure or of a notochord, we might fix upon the crystalline style, acting as a *fulcrum* of locomotion, though its connexion with the stomach and its gastric lamina remind us, on the other hand, of the lingual plate and ribbon of the higher mollusks. Strange modifications of an organ these, if they are such! but organs *are* curiously modified in many cases to perform different functions.

There are in some carnivorous Gastropods, as well as in *Chiton* &c., cartilaginous pieces supporting the lingual apparatus; and the cephalic ganglia of other species are enveloped in an almost cartilaginous tissue. In Cephalopoda, besides the shell, there are internal cartilages answerable to the internal skeleton of the Vertebrata; the Sepia, for instance, has a cartilaginous expansion, holding and supporting the brain, eyes, and organs of hearing, besides giving passage to many nerves and vessels, and having in front a *trochlea* for the mediate tendon of a binocular muscle, the orbits still further completed by supplementary laminæ. There is another cartilaginous lamina in front at the root of the arms, others in the neck, and cartilaginous *acetabula* at the base of the siphon, into which prominences of the mantle fit—a curious arrangement to give the parts fixity during the respiratory movements. There are also two lengthened sword-like cartilages at the side, where the semicartilaginous rays of the long fins begin, reminding us much of the similar parts in a skate. *Octopus* has not the cups at the base of the siphon; but it has two cartilaginous styles in the sides of the mantle; these last are absent in the argonaut. The siphon in the Octopodidæ has not the valve which is present in the Sepiadæ. This siphon may be seen in the Gastropoda to arise from the body rather than the mantle, and so in the Cephalopoda.

Besides the internal skeleton the Cephalopods are furnished with other new or more developed organs—their curious beak, for instance, reminding us of birds or of some reptiles or fishes, but, in fact, a further development of parts of other mollusks similarly situated, as already alluded to. In these, too, the molluscous foot is broken up or differentiated and resolved into arms or tentacles, which are furnished with peculiar suckers or hooks. We see this disintegration in some Gastropods and Pteropods, and at the same time its transference to the head, forming a *mentum* or *propodium* (*Ampullaria*, *Sigaretus*, *Natica*), or fin-like side lobes or *epipodia* (*Bullæa*). *Bullæa* also presents us with a tentacular lobe or supercephalic disk. With the above transposition the arms and tentacles in Cephalopods are very specially developed, whether as the cupuliferous arms and tentacles of ordinary species, or as the less formidable sheathed tentacles of the Nautilus.

The circulation in mollusks undergoes a progressive complication, much as it does in the Vertebrata. They have been described as being destitute of true veins; but this is far from the case, though these veins may communicate with sinuses to which even the external element may have access, and such cavities may be the media of absorption or nutrition rather than the veins primarily. The circulation is already well provided for in the Lamellibranchiates, as much so in Gastropods; and it is very remarkable for its perfection in the highest mollusks. These circulatory, like the other vital organs, are probably originally double or bilateral, and become single by development, somewhat the reverse of what is the case in Vertebrata; thus in bivalves the auricles, and less frequently the ventricle, continue more or less parted, or the ventricle envelops a length of the rectum, as already observed. Some *Arcæ* and *Pectunculi* have two hearts; *A. auriculifera* but one, of the shape of an inverted M. The blood is returned from the system in part directly to the heart, in part through the medium of the branchiæ, the latter portion also appearing to have previously circulated through the renal organ; but the dibranchiate Cephalopoda are peculiar in having two auxiliary branchial hearts between the system and the branchiæ.

Near the branchiæ, most commonly, are located the organs of excretion. The lamellar mucous gland, seen in *Buccinum* in the branchial chamber, is probably homologous with those of the female Sepia; there are also glandular parts for the secretion of the purple or other colouring-matter, sometimes simply a diffused gland in the mantle, whilst sometimes the colouring liquid is received into a vesica as in *Sepia*, *Doris*, or some *Purpuræ*; also renal organs, the latter opening, in the branchiated Gastropods, at the far recess of the branchial cavity, but by a long duct in the pulmonate animal. They are near the mouth in *Bullæa*, and open between the branchial processes in *Chiton*, near the double ovaries, but variously in bivalves*—sometimes in them into an aquiferous chamber or double pleural sac, which also, according to Prof. Rolleston, often communicates with the pericardium. These renal organs commonly secrete little round concretions. The organs themselves are less concentrated in Cephalopods; but the tufts on the veins and bile-ducts are, we think, their homologues, excreting and not absorbing (at least entirely and solely), the excretion being sometimes seen in the form of yellowish glittering particles in the sac in which the tufts float, and which sac communicates with the circumambient fluid by two orifices, and also, in the opposite direction, with other membranous cavities containing the viscera, or which are in apposition to the spongy laminæ of the shell in the Sepia. Water no doubt has access to these cavities, and perhaps to others situated about the head in Cephalopoda (*Tremoctopus* or male Argonaut)†, though the subocular pores in Sepia seem to be excretory, and to lead down to glands situated beneath the eye. Water has access likewise to the dorsal sinuses mentioned as existing in bivalves, and into their foot by means of the median pedal pore in some species, or the lateral pseudo-oviducts in others; or into the laminæ of the mantle, as seen in opening a common *Anodon*.

From the lowest mollusk to the highest there is the same plan of nervous system, very different from that of the vertebrate or articulate animal. The first nervous centre that appears is the respiratory or branchial‡, presiding over the respiratory inlet and outlet in the Ascidia, and situated between the two orifices. Then the labial ganglia appear, in the oyster for instance, and give off cords, which communicate with the last, and, with their own uniting one, form a ring round the mouth. In such bivalves as possess a foot another ganglion or ganglionic pair supplies it, also communicating with the labial ganglia, so that the ring becomes two-corded

* Linn. Trans. 1836.

† The species examined was perhaps *Tremoctopus*.

‡ A disputed point, however.

below. The organs of sight and smell, when they exist, are supplied by the labial or oral ganglia, which unite above in the higher forms into what may be called, in this case, the cerebrum or cerebral ganglion, whilst the acoustic sacs are connected with the lower ganglia. As we ascend, other ganglia, or centres of nervous action, are formed; thus a sympathetic system appears, of which the principal centre is a large ganglion (*Sepia*), or several smaller ones (*Doris*), on or near the stomach (gastric), connected through nerves running along the alimentary canal with two or more (six in *Doris*) small pharyngeal ganglia, situated on the buccal mass, and through them with the cerebral ganglia, and also having branches connected with internal respiratory nerves, these last forming one or more branchial ganglia at the root of the branchiæ, and descending from the respiratory or lower and hindmost part of the cerebral ring. Probably the small pharyngeal or buccal ganglia exist in all Gastropods and Cephalopods. Pallial or external respiratory nerves also originate a little outside the internal ones, superadded to them, and especially belonging to the mantle, the inhalant and expelling sac, and forming the remarkable star-like ganglia so plainly seen on each side within the mantle in all dibranchiate Cephalopods. This pallial nerve in the Sepia thus reminds one somewhat of a spinal nerve, as it has ganglionic branches for the sac and non-ganglionic ones for the fin. There are special nerves from the same part of the cerebral centre for the siphon. In the Cephalopoda these nerves, which supply the branchiæ and respiratory sac or mantle, internal and external respiratory, descend symmetrically from the cephalic ganglion on either side the vent in front, and at an equal distance from the middle line. Bivalves, as well as *Chiton* and *Doris*, agree in this symmetrical arrangement; but in the ordinary spiral Gastropods (*Natica* or *Neritina* for instance), owing to the torsion of the mantle, the vent has risen to the right side above the neck, the left pallial or external respiratory nerve has followed in the same direction under the œsophagus, and the pallial ganglion, which it forms, is on the right side, whilst the right nerve crosses over the digestive canal to the left side preceding the right branchial appendage, the left (often atrophied) remaining in position, as in *Nerita*, or dwindled away. The pallial opening and also the siphon are correspondingly displaced. Two branchial nerves and ganglia (internal respiratory) exist, as already mentioned, in the dibranchiate argonaut and cuttlefish, with two ganglia in the course of each nerve in the first; but there is but a single nerve for the single gill in many Gastropods. *Aplysia* has sometimes only one ganglion, in other species two, to supply its duplicate but conjoined branchial process and the protective mantle; and the nerve crosses, as just described. In *Bullæa aperta* there is but one ganglion in the posterior or respiratory section of the body; in *Akera bullata* there are three. Thus as the animal ascends there are specific cerebral ganglia immediately connected with the above functional nerves and ganglia. The posterior respiratory part of the lower portion of the cerebral ring is always divided from the anterior part, presiding over locomotion, by the transit of the aorta; or, rather, it is divided from the more anterior part of the posterior centre, which supplies the siphonic nerves in the Sepia, by the entry inwards of the vessel through the cerebral ring, whilst that anterior respiratory part is separated from the still more anterior locomotive centre by its exit. The pharyngeal ganglia are seen in the higher mollusks to be connected both with the sub- and supraœsophageal centres; in *Patella* they send forward little nerves, going to the lips and mouth, where they form two other little ganglia (olfactory); or the latter may occur as a large ganglion (*Sepia*) intermediately between these pharyngeal ganglia and the brain. Taste and smell appear to be connected with the last two pairs of ganglia, hearing with the lower part of the cerebral ganglion, sight with its upper part. The smell in the snail (*Arion*) may be located in the whitish surface under the mouth, though some think it resides in the tentacles. In some Cephalopoda, as in *Sepia*, the membranes (olfactory?) surrounding the beak are much developed. The organs of sight often appear as mere specks on the brain itself, when the skin is pervious to light (*Scyllæa, Doris*).

To facilitate a boundless production appears to be the first object followed out in the structure of the reproductive organs of Mollusca. A second is evoked by the necessity which there is for at least an occasional union between different individuals of the same species, even when each contains in itself the essential organs of both sexes (monœcious).

A third object is but a part of the first, an arrangement for the dispersion or safety of the young individuals till they attain a suitable *habitat.* The simple form of multiplication, budding, or, more simple still, self-division, is, as said before, a mode of increase only seen in the lowest mollusks, or rather molluscoids; and in them only can we find any trace of what has been called *alternate generation*, and which perhaps depends upon the provision made to attain the third object above mentioned. In some bivalves (in the fixed oyster, the scallop, and in some freshwater mussels) the essential male and female glands appear without doubt to be combined in the same individual (hermaphrodite); yet we suppose that, from the antipathy of Nature to self-impregnation and from the difference of the period when the two glands mature and discharge their secretions, the ova are commonly fertilized from a foreign source, and that it takes place after they are discharged, commonly in the pallial cavity. Such species are perhaps at one time functionally male, at another female. The embryo has sometimes means of transport, as the cercariform larva of Tunicata or the ciliated young of Gastropoda, by which it seeks a suitable habitat; whilst the sedentary species, on the contrary, are often fixed for safety by a byssus, formed by an especial gland, the trace of which may be found, even in the adult *Anodon*, between the surface of the foot and the pedal ganglion, in the form of a brown, waxy, concentric, globular body. In all the above and in *Patella* or *Chiton* the essential glands of reproduction are very simple; but in other species, though still hermaphrodite or monœcious, as *Helix* or *Lymnæus*, they have many and very curious accessories; yet here the sexual union of two individuals is necessary, or at least most common.

The more locomotive bivalves, as *Cardium edule*, or the sea-mussel, have sexes distinct (diœcious), also a great number of Gastropods and Cephalopods; and union of these takes place either immediately or, in some Cephalopods, as is now well known, by means of a *hectocotylus*. There has been question respecting the little gland situated at the ending, or rather beginning, of the double set of organs of the monœcious Pulmonifera (*Helix* and *Lymnæus*), whether it is an ovary or testis, or the two combined, and whether the corresponding extremity of the shorter set of the duplicate organs is an ovary or simply an albuminiparous organ*. The first gland, imbedded in the liver at the end of the spire, was considered to be the ovary by Cuvier; but, according to Meckel, it includes both ovary and testis, with distinct though combined oviduct and *vas deferens*; and of this opinion we have now no doubt. The fact may be easily verified by pressing the gland and duct between two glasses, and submitting the object to the lens; and, from the movement of the spermatozoa, it is a truly wonderful object. In *Onchidium* this gland visibly consists of two others, quite disjoined; and in all mollusks it is connected with the external male organ, but never, we think, without first communicating with the semitransparent organ, now sup-

* The substance of which it is composed, however, is not coagulable by heat, but swells up and is very viscid in water. Bichloride of mercury and alcohol coagulate it.

posed to combine the *matrix* and albuminiparous gland, called testis by Cuvier. This double communication, with the imperfect separation of the vas deferens from the matrix (*Helix*), may effect the transference of both ova and spermatozoa to the matrix in default of impregnation from without. Perhaps, in the sluggish nature of the animals, and in their liability to be isolated, we may see a reason for this arrangement; and we think that there is no longer much special mystery in their generative economy. The *vesicle* is a reservoir or spermatheca, as is the *long companion tube* present in some Helices, and in which *post coitum* the *ligula* is found also. This just mentioned ligula or chitinous strap, being a *spermatophore* or carrier of the spermatozoa, is formed in the long appendix or *flagellum* attached to the male organ, whilst the *dart* (or two darts, *H. virgata*), so curious in itself, and still more so from the way in which it is used*, is formed by the fimbriated glands at the base of the muscular sac, in which it is contained when not in use. Other branchiate univalves (*Onchidium*) have the same organ, but less developed. Equally curious with the above, or more so, is the arrangement in respect of this function in the Cephalopoda, though in some of them the fertilizing material seems to be transmitted directly, through the medium, however, of spermatophores (corpora Needhami), tantamount perhaps to the curious spermatophores of *Paludina* amongst Gastropods. It may be mentioned, as an instance how much allied species may differ with respect to this function, that the genus *Bythinia*, so near to *Paludina*, has only the ordinary spermatozoa. Endosmosis has a remarkable effect on these last bodies†. In some of the Cephalopoda one of the arms is, as now well made out, transformed into the spermatophore or *hectocotylus*, becoming detached and left within the mantle or sac of the female, and maintaining its position by means of its suckers, the filiform extremity insinuating itself into the orifice of the oviduct. In a small *Loligo* we think we traced a duct leading from the male gland to the modified arm or hectocotylus‡; and we have several times found the

* It is commonly found in the recipient animal near the insertion of the narrower or upper conjoined oviduct and vas deferens—that is, near the termination of the companion tube of the vesicula. The author principally follows his own observations here as elsewhere, but may refer to two excellent papers:—Saunders, Quart. Journ. Micr. Science, Oct. 1866; and Newton, ib. Jan. 1868.

† Report of Brit. Assoc. Aberdeen.

‡ In some species the duct is seen to run up on the outside of the arm in a superficial cutaneous fold; in most species it is one of the right arms, in a few one of the left, which is hectocotylized (Woodward).

filiform processes amongst the discharged ova of Argonaut, at first, indeed, mistaking them for parasites; and in two specimens of *A. hians*, and in another species, we have taken the hectocotylus from the mantle-sac, in which they lay crossways, overhung by the imperfect septum of that cavity. *Sepiola*, *Sepia*, and *Loligo*, discharging their ova enveloped in albuminous matter, moulded into different forms, have large albuminiparous glands, answering to those of Gastropods, though more externally situated. The Argonaut has two genital outlets in the female and also in a supposed male specimen, whilst *Octopus* in the male, and the Decapoda in both sexes, have only one.

In the separation of the male gland from its corresponding external organ in some Gastropods to distant parts or extremities of the body (the latter being frequently connected with the right tentacle), in the connexion between the two by means of an internal vas deferens or by an external groove, so often seen, and in the formation of the spermatophore (*Helix*), we are led to conclude that the curious hectocotylus is not quite so isolated and unique a phenomenon as at first appears, but that a synthetical comparison might be made, with more or less success, in this particular, as in others in the Mollusca generally—a comparison which we have endeavoured to make, and such as may be traced, taking other vital organs and functions for comparison (the digestive system for instance, already well described by Cuvier), through the whole of the Invertebrata, and indeed through all animals—enough to show us that no animal has been produced having no relations to the others, or, in other words, upon a different plan to that of its fellows.

XXXVI.—*On the Final Stage in the Development of the Organs of Flight in the Homomorphic Insecta.* By Prof. J. Wood-Mason, Deputy Superintendent of the Imperial Museum, Calcutta.

> "La dernière mue développe subitement les organes du vol dans toute leur étendue par une transformation vraiment merveilleuse et encore inexpliquée, car on ne comprend pas comment des organes aussi volumineux peuvent être renfermés dans les petites gaînes où ils se forment pendant la période de nymphe."—H. de Saussure, *Mission scientifique au Mexique et dans l'Amérique Centrale, Recherches zoologiques*, vi[e] partie, 1[e] sect., *Études sur les Orthoptères*, 1872, p. 224.

When an insect quits the egg it has no wings, nor the slightest rudiments of such, these making their first appearance at one of the earlier changes of skin as slight prolongations of the posterior angles of the dorsal arcs of the two hindermost divisions of the thorax, the mesothorax and the metathorax. These prolongations are so many duplicatures or flattened evolutions of the integument—the chitinous membrane that covers them above and below and on the edges being in direct continuity with that which covers the insect's body, being, in fact, part of it, and the intermediate cellular layer which produces this chitinous membrane being similarly continuous with that which underlies the skin of the rest of the insect's body. They increase in size slightly at each successive moult, soon acquiring a definite triangular form and the principal nervure dividing the wing into its two principal areæ; but, relatively to the future wings, they are small and insignificant even at the last moult, at which the organs of flight are suddenly developed to their fullest extent. If a wing-rudiment be examined just prior to a change of skin, it is found that its external chitinous covering has separated off so as to be easily detachable from a new wing-rudiment that has formed beneath it, and that this new wing-rudiment lies quite flat within its sheath (as the portion of the chitinous external layer which covers it may be called after its detachment). The new wing-rudiments are found to lie similarly flat within their sheaths at every change of skin down to and including the last but one, into the interval between which and the last it is that the growth of the wings from small and insignificant rudiments to their full extent is compressed. The penultimate change of skin accomplished, new wing-rudiments are produced in due course from the cellular layer; and at the time when their sheaths first become detachable from them they, like all their predecessors, lie extended quite flat within these sheaths; but the detachment of these is no sooner completed than they* commence to grow with great rapidity. The first outward and visible signs of the growth that now ensues are the thickening of the prolongations (which up to this time were thin plates with thin and sharp edges closely embracing the insect's body, but which now gradually become biconvex masses with thick and blunt edges standing out from it) and the gradual obliteration of the principal nervure. The walls of the sheaths eventually become distended to such a high degree of tenuity and consequent transparency under the enormous pressure thrown upon them by the rapidly growing wings, that it is possible to see, even without dissection, the manner in which these are forced

* *I. e.* the wing-rudiments.

to arrange themselves in so limited a space: it can be clearly seen that the wings have thrown themselves into a multiplicity of closely packed transverse folds, representing increments of growth in length, and that these, again, have disposed themselves, in groups, in wavy (longitudinal) folds representing growth in breadth; so that the wings, plaited and folded up in this complex manner, present a superficial resemblance to the surface of a much-convoluted brain or to a portion of a transverse section of a Labyrinthodont tooth.

This mode of development of the wings obtains in all Orthopterous insects, upon larvæ of which these observations are mainly based—at least in some Neuroptera (*Termes*), and probably universally in the groups which Westwood, years ago, collectively termed the Homomorphic Insecta.

XXXVII.—*Note on the "Tubulations Sableuses" of the Étage Bruxellien in the Environs of Brussels.* By H. J. Carter, F.R.S. &c.

[Plate XVIII.]

In the 'Annales de la Société Malacologique de Belgique,' t. ix. pl. iii. 1874, M. A. Rutot published an excellent paper on the "Grès Fistuleux et Tubulations Sableuses de l'étage Bruxellien" in the environs of Brussels, chiefly dwelling on the fossil sponge-spicules found about them; and thus attention has been directed to these interesting objects, which otherwise might have remained in abeyance for an indefinite period.

Knowing the interest which I have taken in the Spongida both recent and fossil, my kind friend M. Ernest Vanden Broeck, of Brussels, obtained from M. Rutot a copy of his paper, and, together with some of the sand containing the sponge-spicules, forwarded the same to me in April 1876, following it (as I had expressed an opinion somewhat different from the conclusions to which M. Rutot had arrived) by a box containing several specimens of the "tubulations sableuses" themselves, for my examination.

These specimens, which were preceded by a letter and sketches from M. Vanden Broeck explanatory of the contents of the box &c., reached me in August 1876; and having had many engagements to fulfil since them, my examination of them has necessarily been postponed to the present time (Feb. 1877).

There are eighteen specimens of the "tubulations," with specimens also of the sand from the deposit ("*Grès lustrés*") in which they are vertically imbedded. (According to M. Rutot, *op. cit.*, the "Bruxellien étage" consists, from below upwards, of:—1, conglomérat siliceux; 2, grès lustrés; 3, grès calcarifères; 4, couche roulée à *Nummulites lævigata.*) And although the specimens are all, with the exception of one (which is without the "concretionary crust," to be hereafter mentioned), more or less fragmentary, still there is quite enough for me to give the following description of them, which seems to indicate the kind of organism of which they are now alone the fossil representatives.

As a preliminary measure, it is desirable to premise a description of the *exterior* (since I do not like to destroy the fossil by breaking it open) of that exceptional specimen which appears to me to be almost perfect (Pl. XVIII. fig. 1). It is cylindrical in form, a little more than 18 centims. long by 3 centims. broad in its greatest diameter, which is the middle of the lower half (I shall assume henceforth that the pointed extremity is the *lower* or posterior portion), slightly sigmoid, and unequally pisiform-tuberculous on the surface throughout except at the extremities (fig. 1, *a a a*). The upper half or 9 centims. has much the same diameter throughout, viz. 3 centims., ending in a truncated extremity above, which shows that the tuberculous surface is the outer part of a layer formed upon a solid central cylinder $1\frac{1}{2}$ centim. in diameter (fig. 1, *b*); while the lower half becomes gradually inflated towards its centre, which, as above stated, is 3 centims. in diameter, after which it diminishes rather rapidly to a point that is *not in the line* of the vertical axis, but turned to one side of it, and characterized on one half by a smooth, *un*tuberculated, somewhat spiral depression, which ends in the point (fig. 1, *c*). Thus constituted, the whole presents a slightly sigmoid cylinder truncated at the upper, and pointed at the lower end, of equal size throughout the upper half, and inflated towards the centre in the lower one, with a generally unequal, pisiform-tuberculous surface. In composition it consists of sand-grains (quartzite) held together by a white calcareous chalky cement; so that *this* specimen might have originally come from the upper part of the strata alluded to in M. Rutot's paper (p. 4 of the separate copy).

We will divide the "tubulation sableuse" as M. Rutot has done, into three portions, which I would term, respectively, the central cylinder, the tuberculous layer, and the concretionary crust—the two former being proper to the fossil, and the latter derived from the deposit in which it is imbedded.

Central cylinder.—This, which is structureless and composed of quartz-sand more or less agglutinated together by semicrystallization into the form of quartzite, may be circular (fig. 7, *a*) or oval (fig. 8, *a*) in the transverse section, thus indicating its general shape in this respect. The largest fragment of the former that I possess, when extricated from the tuberculous crust, is 10 centims. long and 8 millims. in diameter throughout, so that there is no diminution in size from one end to the other (fig. 5); and each end having been truncated by fracture in this as well as in all the other fragments sent to me (which so far are alike), shows that none of them possess the *natural* extremities of this form, which, from what has been premised, in the typical specimen, as well as that which will be presently mentioned, shows at least that, in its *natural state*, one end is reduced to a point. The surface of the circular form presents a trapezoidal or quadrangular subcircular reticulation of grooves, which surrounds the cylinder and in the most perfectly formed portions has a scaly appearance, in which the interstices are equal, having two angles opposite and longitudinal, and the other two opposite and transverse, with a distance of 7 millims. between each of the " two angles " and a convex area respectively (fig. 5, *a*). With the exception of this form varying in diameter with age, I can state no more of it. Not so, however, with the oval or compressed form, which is lobed or segmented longitudinally, 18 centims. long and 8 by 15 millims. in transverse diameter (at least such are the dimensions of my best specimen, fig. 2, *c c*); for although truncated by fracture above like the rest (fig. 2, *d*), it terminates below or behind in a naturally pointed extremity (fig. 2, *e*), and presents throughout its whole length a linear central groove (fig. 2, *g*), from the anterior portion of which (in fig. 3, *f f*) the remains of several smaller grooves in succession, at equal distances of about a centimetre each, may be seen extending outwards, backwards, and downwards, resembling altogether, in position and direction, the dorsal vessel and its lateral branches in an Annelid, unless the latter be likened to the grooves between the segments.

Branched form.—In another specimen of the same length but of the " circular " form, truncated by fracture at each end, and irregularly sigmoid in its general course (fig. 4, *c c*), four similar cylinders branch off from the main one in different directions and apparently from different and opposite parts of the main cylinder, each of which terminates, after curving outwards for a distance of 3 centims., in an abrupt end also truncated by fracture, but rather of a compressed or oval form, 6–8 millims. in its longest diameter (fig. 4, *d d d*). After this, viz. 7 centims. further on, two other cylinders of a similar kind branch off in different directions (fig. 4, *d*), in all six; but as, in each instance, one passes out behind, it cannot be represented in the drawing; while the main cylinder in its course also presents several nodular excrescences which look like the gemmiparous commencements of more branches (fig. 4, *e*). This specimen has very much the appearance of both the circular and compressed cylindrical forms conjoined—that is, the former embracing the latter; but the *whole* was encased within *one* and the same tuberculous layer, sending off processes to cover the branches respectively.

Here it should be observed that although the branching has not been observed in any Annelid of the present day, still the process of gemmiparous reproduction is not altogether absent in the Annelidans (ex. gr. *Nais cirrhatula*), in which, it is true, the anterior segments here and there pass into heads successively, while those in the intervals become the bodies of the new animals. Is it possible that a lateral instead of longitudinal multiplication could have taken place in the older Annelidans, although hitherto not found in recent ones?

Again, although our knowledge of what is going on at the present day is the best interpreter of what has taken place during past ages, still the amount of this interpretation must be in proportion to the amount of that knowledge; and although many forms have existed in past ages which do not exist at the present day, and *vice versâ*, there are modifications on both sides which can easily be admitted without doing violence to the principle first enunciated. May it not have been so here, viz. that a *branched gemmiparous Annelid* may have previously existed?

Tuberculous layer.—While, however, there is a great difference in the form of the "central cylinder" and its varieties, viz. circular, oval, and branched, *all are without exception* surrounded by the same kind of tuberculous layer (fig. 1, *a a a*, fig. 2, *b b b*, &c., also figs. 6, 7, and 8, *b*); and this, although corresponding internally to the surface of the cylinder, is deeply pisiform externally, where it is in contact with the "concretionary crust" of sand derived from the deposit in which the "tubulation" is imbedded (fig. 2, *a a a*, and figs. 7 and 8, *b b*). Its composition, where solid and still united or in direct contact with the cylinder (figs. 6, 7, and 8), is the same as that of the latter, viz. almost purely arenaceous, indicative of its having been part of the animal itself; but in most instances this material has become so friable that the whole of the disintegrated grains mixed up with isolated fossil sponge-spicules in a beautiful state of preservation, which cover it, as will be seen hereafter, can be shaken out of the "tubulation," leaving its mould only between the cylinder and the concretionary crust of sand outside (fig. 2, *b b b*). It is therefore to this mould or impression of the pisiform surface left in the inner side of the concretionary crust that we must chiefly look for the exact form of the pisiform surface of the tuberculous layer; and here we shall find a cancellated appearance that, in the form and dimensions of its scale-like divisions, *where most symmetrical or perfect*, indicates a surface exactly like that on the central cylinder already described (fig. 4, *f*, and fig. 5, *a*), only that the grooves between the pisiform tubercles are much deeper, and therefore the convexities of these eminences (that is, of the interspaces) much more prominent, so as, indeed, to present the general tubercular pisiform character mentioned (figs. 6, 7, and 8). Thus the average distance, perhaps, between the summit of the pisiform eminences and surface of the cylinder is about a centimetre (fig. 2, *f*); and this gives the thickness of the tuberculous layer, which varies very much according to locality and circumstances, being least in thickness pesteriorly or round the pointed end (?tail) of the cylinder; while the grooves between these eminences in many cases reach down nearly to the central cylinder, with which, as before stated, they are in direct contact (figs. 7 and 8); and in one specimen that I have, some of the lateral eminences are conical, one centimetre long, and project outwards on both sides at right angles to the compressed cylinder (fig. 2, *f*), still further giving it the appearance of an Annelid; while another specimen of the "compressed" cylinder presents a lobate or segmented appearance (fig. 3).

Concretionary crust.—Nothing more need be stated of this than that it is derived from the deposit in which the "tubulations" are imbedded, and, although causing the latter to assume different forms *outside*, in no way indicates the condition of the interior (fig. 2, *a a*, &c.); hence the necessity of breaking open this crust or case cautiously before the form presented by the fossil itself can be seen and described. M. Vanden Broeck states that he has found specimens of the "tubulations sableuses" *one metre* in length, and that some are pyriform, of which I have fragments of the outer case only; but as the tuberculous layer and the concretionary crust are by no means certain indications of the form of the central cylinder, which may be either circular or oval, it would be advisable to ascertain if the latter is in size and shape like one of *these*—that is, *not* pyriform. As to length, Lamarck states of *Aspergillum* (that is, upon the fragments of *A. vaginiferum* brought home from the Red Sea by Savigny), that " Il doit avoir plusieurs pieds de longueur " ('Anim. sans Vertèbres,' ed. 1818, vol. v. p. 430).

Fossil sponge-spicules.—The fossil sponge-spicules so well selected and represented in the plate accompanying M. Rutot's excellent paper (*op. et loc. cit.*) are, for the most part, in a detached and fragmentary state, consisting of an indefinite number of kinds and forms from as many different sponges, mixed up with the tests of minute Foraminifera, fragments of minute Echinodermata, the disks of Diatomaceæ, and grains of quartz-sand, all of which occupies the *intervals between* the pisiform eminences of the tuberculous layer and between their summits respectively and the concretionary crust—that is, coats the former generally (fig. 8, *c*),—the tuberculous layer itself, as before stated, having been observed, where still adherent to the central cylinder (fig. 6 *b*), to be composed of the same quartzite material as the latter. Hence the mixture of spicules &c., which is nearly the same in each " tubulation " (as I have ascertained by examination, having carefully kept that belonging to each separate), must have been gathered up by the surface of the tuberculous layer, and that, too, with a partiality for such material, as it does not exist so plentifully in the deposit in which the tubulation is imbedded, as testified by the composition of the concretionary crust. At the same time, as the accumulation of spicules &c. must have been going on more or less *pari passu* with the growth of the tuberculous layer, the latter might also have been more or less composed of such material.

To describe the sponge-spicules in detail (which, being detached in the friable material, are easily picked out with the point of a hair-pencil) would occupy more time than I now have at my disposal; and therefore I shall premise the few observations I may have to make on them generally with the statement that, after repeated efforts, I have not been able to find any thing more important in this respect than is contained in the plate accompanying M. Rutot's paper; hence constant allusion will be made to his figures.

Hexactinellida. Among the fragments of the siliceous skeletons of the Vitreohexactinellida there are, at least, two forms (Rutot, pl. iii. figs. 31–34), one of which is much more abundant than the rest; and this presents the lantern-like or octahedral form of the knot of *Myliusia Grayi* ('Annals,' 1877, vol. xix. pl. ix. fig. 10, &c.), but so far different that the fibre between the knots is microspined, and the spines, instead of being scattered irregularly over the fibre as in *M.*

Grayi, are gathered into short, broken, circular lines. (This form is equally common to the Ventriculites and *Cœloptychium*, but with *long* spines).

LITHISTINA. Among the remains of the siliceous skeletons of the Lithistina, which are by far the most abundant and most perfect in species and different forms of spicules respectively (Rutot, figs. 9–11, 22–26, 43, 45, and 46), is one (fig. 9) which is very like the surface or dermal large spicule of *Corallistes* (*Dactylocalyx*) *Bowerbankii*; while the more complicated stellate forms (figs. 43, 45, and 46), each of which has a short pointed vertical shaft, indicative of its surface-origin (generally broken off), are equally numerous, varied, and beautiful in their forms.

GEODINA. Small siliceous balls (Rutot, figs. 36 and 37), "zone-spicules" (figs. 12, 13, and 20, 21), "forked" and "anchor-heads" respectively (figs. 16–18), and "body-spicules" (figs. 1–4), indicate the presence of *Geodia*, as well as that of *Stellettina*, of which, respectively, there are, in all probability, the remains of several species. That form of "zone-spicule" (figs. 20 and 21) which has a curved shaft in addition to produced furcate arms expanded florally and frequently very unequal in length, abounds also in the Upper Greensand of Haldon Hill, near Exeter, to which, together with the other spicular elements of *Geodia*, I have given the name of *Geodia haldonensis* ('Annals,' 1871, vol. vii. pl. x. figs. 67 and 68). It is equally common also in the cavities of English chalk-flints; but I have never seen any sponge of the present day bearing the zone- or large furcate spicules like it; so this species may have ceased to exist.

DONATINA. The globo-stellates of two kinds of *Donatia* appear to be present, as indicated by their forms respectively—of which fig. 35 is one; and the other is like the globo-stellate of the present day in *D. lyncurium*, which is also common in the cavities of the chalk-flints in England.

OPHIORHAPHIDITES is also common here (Rutot, figs. 5 and 29), as well as in the Upper Greensand of Haldon Hill, and existing at the present day ('Annals,' 1876, vol. xviii. p. 458.)

DIATOMACEÆ. The disks of a cycloid diatom are very abundant (figs. 38, 39, and 39 *a*, *b*), presenting two forms, viz. one simple like a flat drum, and the other the same, but with depressions on it, in the form of a "Maltese cross," extending from the centre to the circumference on both sides, in such a way that the prominent or raised parts on one side correspond to the depressions on the other, thus giving the edge, when viewed laterally, an undulated appearance like *Cyclotella*

Kützingiana, which, according to Smith (Synop. Brit. Diatom. vol. i. p. 27, pl. v. fig. 47), is sometimes simple like a flat drum and at other times undulated, as above stated of the fossil diatom. This undulation is not uncommon in the frustules of the Diatomaceæ, ex. gr. *Actinocyclus undulatus* and *Cymatopleura*. Besides the presence of this diatom in great numbers, there are fragments of beaded strings very like those of *Melosira*, often, when the moniliform divisions have become separated, simulating the siliceous balls of a *Geodia*, which they exceed greatly in number.

I have not seen any spicules of the genus of fossil sponges to which I have given the name of "*Monilites*," so common in the Upper Greensand of Haldon Hill ('Annals,' 1871, vol. vii. pl. ix. figs. 44–47), and common also under the "acuate and short-shafted three-armed headed forms," respectively, in the cavities of the chalk-flints in the south of England ('Annals,' 1874, vol. xiv. p. 253), also present in the remains of the chalk in the north of Ireland (Wright, 'Belfast Nat.-Hist. Club Report,' 1875, pl. ii. figs. 4 and 5), unless M. Rutot's fig. 21 be one. Nor have I ever seen any *recent* sponge bearing spicules of this kind.

Having thus described the "tubulations sableuses," we arrive at the consideration of what they originally were; and here we must, to a great extent, depend on inference and conjecture.

In the first place the vertical position of these fossils (sometimes, according to M. Vanden Broeck, "1 mètre" in length), with their small end or tail downwards, in an *arenaceous* deposit, together with the tubular form, is more characteristic of an Annelid than of any other animal; while the forms of the internal structures respectively are *still more* characteristic of this kind of animal. To assume that any invertebrate, such as a sponge, continued living during the time that a "*metre*" of this arenaceous material was being deposited, seems impossible, while an Annelid, or *Aspergillum*, indeed, might bore down this distance in a very short period.

Again, the central cylinder and its markings are almost identical in form, size, and composition with those of *Trachyderma serrata*, Salter (Quart. Journ. Geol. Soc. Lond. vol. xx. part 3, no. 79, Aug. 1, 1864, p. 288, pl. xv. fig. 9, *a*, *b*), common in the Silurian quartzite pebbles of this beach (Budleigh-Salterton, Devon). But then the tubes or cylinders here are aggregated, while the "tubulations sableuses" appear to be solitary.

In the oval or compressed cylinder, too, we have the lobular form indicative of original segmentation, and the linear depression in the median line extending throughout the body, resembling that of the dorsal vessel of an Annelid, together with a similar appearance of the lateral branches in one part, if they are not due to the grooves of segmentation, and, lastly, a conical tail; while the typical specimen, first described, presents a cylindrical form of the same size in the upper half and inflated in the lower one, with the anterior extremity truncated and the posterior reduced to a point—the core or axis consisting of a distinct cylinder and the surface tuberculated.

But, although the axial cylinder when extricated from the tuberculous layer, is almost exactly like that of *Trachyderma serrata*, what are we to deduce from the all-enveloping tuberculous layer itself and the circular cylinder *with branches*? To me they are without analogy, although the rest of the facies, together with their having, in some instances, gone down into the arenaceous deposit a whole metre in length, is characteristic of an Annelidan type and habit.

Phillips instituted the genus *Trachyderma* (Mem. Geol. Survey, vol. ii. pt. i. p. 331, pl. iv. figs. 1–4) for two species, viz. *T. coriacea* and *T. squamosa*. Of the former it is stated that the rings on the cylinder are "protuberant or tubercled" (fig. 1), and of the latter that they "rise at regular distances into short small cariniform projections;" while Salter (*l. c.* fig. 9, *a*) shows that the Budleigh-Salterton (Silurian) fossil possesses the remains of a series of inclined conical lateral processes arranged serrately. So that in the latter there was something beyond or outside the central cylinder, which central cylinder, as in the common earthworms (*Terricola*), probably represents the alimentary canal only, *i. e.* without the annulated integument, while the tuberculous layer might have been analogous to the branchial tufts in *Arenicola piscatorum* among the Dorsibranchiata.

Be this as it may, under the circumstances it seems best to consider this fossil, provisionally, as a new type of Annelids, for which I would propose the name of *Broeckia*, after M. Ernest Vanden Broeck of Brussels, who has taken such trouble in sending me the specimens. The genus would then stand thus:—

Genus Broeckia.

Broeckia bruxellensis. (Pl. XVIII. figs. 1–8.)

Fossil cylindrical, truncated in front, abruptly pointed or conical behind, tuberculated on the surface; upper half equal in transverse diameter throughout; lower half gradually inflated towards the middle (Pl. XVIII. fig. 1). Composed of a central cylinder surrounded by a tuberculous layer; cylinder circular or compressed (oval) in transverse section; the former presenting on its surface a corrugated reticular lineation, whose interstices, elongated transversely, are, where most regular, trapezoidal; the latter, or compressed form, lobed or segmented longitudinally, and presenting a median linear depression, extending from one end to the other, with similar depressions at equal distances laterally extending outwards, backwards, and downwards. Often branched. The whole surrounded by a tuberculous structure whose surface is unequally pisiform, and whose crevices or intervals between the pisiform projections reach down nearly to the central cylinder. Pisiform tubercles, where most regular, presenting the same kind of trapezoidal arrangement as that seen on the surface of the cylinder, only much exaggerated, with a tendency to subdivision by inflection of the sides, through which the trapezoidal form becomes more or less obliterated; pisiform tubercle sometimes conical and extending outwards at right angles to the cylinder laterally (fig. 2, *f*); the whole incrusted with a layer of fossil sponge-spicules of different forms and belonging to many different species, chiefly fragmentary and mixed up with minute Foraminifera, the remains of minute Echinodermata, cycloid Diatomaceæ, and quartz sand. Size variable, about 20 centims. in length; central cylinder variable below, 2 centims. in diameter; tuberculous crust about a centimetre thick towards the centre and upper part, less towards the tail. Branched form equally invested by the tubercular structure, which is prolonged upon the branches respectively. Composition varying with the situation, *i. e.* either entirely of quartz sand, or calciferous quartz sand or argillaceous quartz sand.

Formation. Étage Bruxellien or Mid-Eocene.

Locality. Environs of Brussels.

Obs. The presence of the sponge-spicules and other minute organisms is, of course, contingent upon their presence in the sea-bottom when the animal was growing. Thus in some specimens, stated by M. Vanden Broeck to have come from a fine sandy argillaceous deposit in the Lower Eocene ("Sable Yprésien (niveau du London Clay) à Luttre")—which, from their form, appear to me to be identical with the "tubulations sableuses" of the étage Bruxellien or Mid-Eocene about Brussels—there are no remains of spicules or any other organism that I can see; while the composition of the fossil, being exactly that of the deposit in which it was imbedded, as well here as in the quartz sand, seems to indicate that the latter must have been composed of some soft and perishable organic substance; for if it had been hard and calcareous like that of coral, it could not have been replaced by the quartz sand of the deposit. Of course, also, the variety of specimens from which the above characters have been taken is limited, and therefore open to alteration by those who may have the opportunity of observing an unlimited number on the spot.

Lastly, as regards the presence of sponge-spicules being indicative of that of *distinct* species of the Spongida. Had this been the case, in the first instance, viz. where the spicules had been *formed by the sponge itself*, they would have been all of one kind, more or less entire and regularly arranged. On the contrary, they are of fifty or more different kinds and forms belonging to as many different species of sponges, nearly all more or less fragmentary and thrown together most confusedly. Still this heterogeneous assemblage, including all sorts of other minute organisms, might be exactly the case with the arenaceous sponges (ex. gr. *Dysidea*), which *do not form* their own spicules, but, for the sake of obtaining solid material for their skeletons, take in every thing of the kind that impinges upon their surface. But this is done by the *Dysideæ* in a massive, amorphous, lobed form, while the tuberculous layer of the "tubulation sableuse," as before stated, has, where most regular, a defined pattern on its surface, is chiefly composed of pure quartz sand like that of the cylinder and surrounding deposit, and is only *coated* by a layer of the spiculiferous heterogeneous material mentioned. Like, therefore, as the cylinder and its tuberculous crust in *Broeckia bruxellensis* is to a fossil sponge of this form, the detail is totally opposed to such an inference.

Considered apart, however, the great number of these spicules thus brought together, their variety, state of preservation, and the easy way in which they are extricated from the friable material with which they are combined, render them a striking and valuable records of the orders and species of the Spongida which existed at that epoch and in this locality.

EXPLANATION OF PLATE XVIII.

N.B. All these representations are of the natural size, and in their outline almost facsimiles of the objects themselves.

Fig. 1. *Broeckia bruxellensis,* nov. gen. et spec., divested of the concretionary crust. *a a,* tuberculous layer; *b,* central cylinder; *c,* posterior or pointed extremity.

Fig. 2. The same: partly covered by the concretionary crust, which has been split open to show the interior. *a a,* concretionary crust; *b b b b,* mould of the tuberculous layer left in the concretionary crust; *c c*, central cylinder (compressed or oval form); *d*, fractured anterior extremity of the same; *e*, posterior extremity or tail more or less covered by the tuberculous layer; *f*, eminences of the tuberculous layer of a conical form attached to the central cylinder, ? annelid-like; *g*, central longitudinal depression simulating dorsal vessel; *h*, commencement of a ? gemmiparous branch.

Fig. 3. The same: fragment of a central cylinder, broken (compressed form) to show its ? segmented appearance, &c. *a a*, remains of concretionary crust; *b b*, mould of tuberculous layer therein; *c c*, portions of tuberculous layer adherent to the cylinder; *d d*, central cylinder, showing the segmented appearance; *e*, central longitudinal depression simulating position of dorsal vessel; *f f*, lateral linear depressions simulating positions respectively of lateral vessels or segmental grooves; *g*, line of fracture; *h*, portion whose *other* side is represented in fig. 6.

Fig. 4. The same: branched form. *a a a a*, concretionary crust; *b b b b*, casts and moulds respectively of tuberculous layer; *c c*, ? parent circular cylinder; *d d d d*, branches truncated respectively; *e*, ? gemmiparous projection or commencement of new branch on circular cylinder; *f*, form of the cells of that portion of the concretionary crust taken off *g*, where these cells (=*mould* of the tuberculous layer) are most regularly formed; *h h*, compressed cylinder.

This specimen looks as if the *circular* branched cylinder (*c c*) were in contact with the *compressed* form (*h h*), all of which was enclosed within one and the same tuberculous layer, which was prolonged sheath-like upon the branches respectively.

Fig. 5. The same: central cylinder (circular form) divested of the tuberculous layer to show the transverse reticular lineation. *a*, form of depressed reticular lineation with slightly raised or convex interstices (scale-like) where most regular.

Fig. 6. The same: the other side of that portion of fig. 3 marked "*h*," to show the form of the tuberculous layer when divested of the concretionary crust and still adherent to the central cylinder. *a*, central cylinder (compressed form); *b b*, tuberculous layer; *c c*, situation of sponge-spicules.

Fig. 7. The same: transverse section of a central cylinder (circular form), and its tuberculous layer divested of the concretionary crust, showing the relative position of the two former. *a*, central cylinder; *b*, tuberculous crust. Diagram.

Fig. 8. The same: transverse section of a central cylinder (compressed form), to show the same. *a*, central cylinder; *b b*, tuberculous layer; *c c*, incrustation of sponge-spicules &c.

XXXVIII.—*Revision of the Lepidopterous Genus* Cleis, *with Descriptions of the new Species.* By Arthur G. Butler, F.L.S. &c.

The genus *Cleis* is nearly allied to *Callidula*, *Tyndaris*, and *Cleosiris*. These four genera appear to me to be an aberrant group of the family Hypsidæ, and should be placed between the true Hypsidæ and the Melameridæ.

The following is a list of the species hitherto described or represented by specimens in the collection of the British Museum.

1. *Cleis dichroa.*

Damias dichroa, Boisduval, Voy. de l'Astrolabe, i. Lep. p. 260. n. 3 (1832–35).

Mysol (*Wallace*). Coll. B.M.

Originally described as coming from "Offack and Bourou." The chief peculiarities of this species consist in the orange band of primaries commencing at the base of the costa as a slender border, and the uniformly brown secondaries.

2. *Cleis arctata*, n. sp.

Allied to the preceding; purplish brown: primaries with a fulvous band, beginning very narrow at the middle of the costal margin and terminating on the outer margin, the lower half of which it occupies; its inner edge irregularly excised, its outer edge regular and oblique: secondaries with a narrow fulvous marginal band, which fades away before reaching the apex; fringe brown: underside clearer and brighter in colour; the band of primaries commencing at the base of costa, which it borders to the centre; its inner edge also regularly serrated; the band of secondaries also tapering off gradually, not obscured as on the upper surface: body below bright ochreous. Expanse of wings 1 inch 4 lines.

Ké Island (*Wallace*). Type, B.M.

This is a very well-marked species.

3. *Cleis evander.*

Papilio evander, Cramer, Pap. Exot. iv. pl. cccxxxi. figs. F, G (1782).

Amboina and Ceram (*Wallace*).

Quite distinct from *C. melaxanthe*, with which Walker placed it.

4. *Cleis propinqua*, n. sp.

Allied to *C. evander*, but with the bands wider and deeper in colour, that of secondaries nearly twice as wide. Expanse of wings 1 inch 5 lines.

♂, Ternate; ♀, Celebes (*Wallace*). Type, B.M.

A local representative of the preceding species.

5. *Cleis plagalis.*

Cleis plagalis, Felder, Reise der Nov. Lep. iv. pl. cvii. fig. 22 (1874).

Aru.

6. *Cleis erycinoides.*

Cleis erycinoides, Felder, Reise der Nov. Lep. iv. pl. cvii. fig. 23 (1874).

Ternate (*Wallace*). B.M.

7. *Cleis fasciata*, n. sp.

♀. Above deep purplish brown; primaries crossed beyond the cell by a rather narrow oblique orange band, from the subcostal nervure to just below the second median branch, both margins of this band irregularly serrated; secondaries crossed by a slightly broader discal band, its inner edge sinuated between the nervures to the radial vein, above which the band is slightly broader to the second subcostal branch, whence it tapers to near the costa; palpi orange, spotted with black: wings below with the band of primaries wider towards the costa than on the upper surface; a continuous submarginal lilac line; pectus and legs orange, venter with a central longitudinal pale ochreous stripe. Expanse of wings 1 inch 6 lines.

Ternate (*Wallace*). Type, B.M.

Readily distinguished from the preceding by the position and width of the orange bands, that of the primaries crossing the wing just beyond the discoidal cell, that of the secondaries having the brown border beyond it of double the width.

8. *Cleis aruana*, n. sp.

Above chocolate-brown; primaries crossed immediately beyond the cell by a rather broad ochreous band from the subcostal to the first median branch; secondaries crossed from the inner margin to the first subcostal branch by a broad irregular terminally tapering ochreous patch, its central area almost circular: wings below with the ochreous areas paler and clearer; the basal half of costa in primaries orange; a dot in each of the discoidal cells and a squamose subapical spot in primaries lilac; body below ochreous. Expanse of wings 1 inch 6 lines.

Aru (*Wallace*). Type, B.M.

In coloration above this is most like *C. versicolor*; in the position of the band of primaries it agrees best with *C. fasciata*.

9. *Cleis versicolor.*

Cleis versicolor, Felder, Reise der Nov. Lep. iv. pl. cvii. fig. 24 (1874).

Dorey (*Wallace*). B.M.

In the coloration of the under surface this species somewhat resembles *Callidula*; in structure, however, it agrees with *Cleis*. I believe the *Agonis lycænoides* of Felder to be a slightly aberrant form of *Cleosiris*, to which genus the following species are referable—*C. erycinoides* (of Walker), *C. anchora*, *C. Felderi*, and *C. catamita*.

10. *Cleis posticalis.*

Cleis posticalis, Guérin, Voy. Duperrey, Atlas, Ins. pl. 18. f. 5.
Damias melaxanthe, Boisduval, Voy. de l'Astrolabe, p. 260. n. 2 (1832–5).

Duke-of-York Island (*Rev. G. Brown*). B.M.

Our example was recently presented to the collection by F. Du Cane Godman, Esq. The allied genus *Callidula* contains four species, *C. petarius*, *C. abisara*, *C. sakuni*, and *C. jucunda*; the genus *Tyndaris*, *T. erycinata* (the male of which is figured by Felder as that sex of his *T. lætifica*) and *T. lætifica*.

The *Damias elegans* of Boisduval is probably congeneric with the *Nyctemera subaspersa* of Walker, for which, therefore, I shall provisionally retain the name. *N. subaspersa*, although coloured somewhat like *Secusio annulata*, has long, slender, filiform antennæ, and is more nearly allied to *Cleis*.

XXXIX.—*On the* Elateridæ *of New Zealand.* By D. SHARP.

IN this paper I have put together descriptions of all the beetles belonging to the family Elateridæ I have been able to procure from New Zealand, and have indicated their structural characters in a manner which, although very imperfect, will, I believe, allow the names and affinities of most of the species to be determined without much difficulty.

I have included under the Elateridæ four or five species of Eucnemidæ; for though several able entomologists consider the Eucnemidæ to be a distinct family, I am unable myself to consider them such so long as the present extension is granted to the Elateridæ. The Eucnemidæ, in fact, possess no point of real distinction from the Elateridæ: the form of the head (which is usually relied on to separate the two families) is not a sufficient character; for it undergoes various modifications in both the Eucnemidæ and Elateridæ, and in some species of Eucnemidæ its structure is more different from that of the typical members of the family than it is from that of the Elateridæ. Taking the term Elateridæ, then, in this wide sense, I have been able to distinguish about sixty-two species (one of these species, however, is from the Chatham Islands). This must be considered a large number; for in Great Britain we have only sixty-six species; moreover the number of New-Zealand species will probably be greatly increased. Indeed there exist already two species which I have not been able to procure, viz. *Drasterius nigellus*, White (which is a Eucnemid), and *Elater lateristrigatus* of the same author. I have satisfied myself as to the names of the previously described species by an examination of the type specimens in the collections of the British Museum and E. W. Janson, Esq.

These sixty-two species may, it appears to me, be arranged in twenty-one groups or genera; and though I have wished very much to avoid making new generic names, I have unfortunately been obliged to propose such in the case of eleven of the groups; these names are *Thoramus*, *Amphiplatys*, *Panspæus*, *Aglophus*, *Lomemus*, *Mecastrus*, *Parinus*, *Geranus*, *Protelater*, *Neocharis*, *Talerax*.

I must give an explanation of the terms I have used in describing the structure of the head. By the term forehead I mean all the upper surface of the head except the anterior part, and this latter I call the clypeus. It is this anterior part that undergoes so much variation in the family: sometimes it is abruptly deflexed so as to be placed quite at right angles to the forehead, and is sometimes even more or less bent inwards under the forehead, while in other cases this clypeus appears to be merely an extension forwards of the forehead in quite the same plane as it; and in such cases it is often not easy to trace the line of demarcation between the two. By antennal spaces I allude to the depressions in which the cavities or points of insertion of the antennæ are placed. These antennal spaces are situated in the outer portion of the clypeus; and when they extend inwards they occupy more or less of its space and so alter its form. Lacordaire called these spaces in the Buprestidæ "antennary cavities;" but that term ought, I consider, to be used for the actual depression or cavity in which the basal joint of the antenna is inserted. He considered these "antennary cavities" to be of great importance for the classification of the Buprestidæ, but to be unimportant in the Elateridæ. In this latter point I think he was mistaken; the antennal spaces appear to me to be of much importance in the Elateridæ as well as in the Buprestidæ.

As points of general interest, it may be remarked that these sixty-two species of New-Zealand Elateridæ show great variety of structure, and yet that they indicate a very isolated fauna. All the species are peculiar to these islands, except one or two that have probably been introduced from Australia by means of the commercial communications between the two countries; but, as a whole, I am inclined at present to the opinion that the relationship of the fauna (I speak here only of the Elateridæ) is nearer to that of Chili than to that of any other country, and that after Chili Australia must be ranked as offering the next greatest affinity.

The forms I have described under the generic name of *Protelater* are of great interest from the peculiar structure of their head, which is of so unspecialized a character, that with but little modification it might be transformed into the head of a Throscid or Eucnemid; while at the same time it is satisfactorily connected with the other Elateridæ, I consider, by another series of New-Zealand species here described under the generic name of *Geranus.*

Now, as the modifications in the formation of the head offer the most important basis for a classification of these insects (Elateridæ, Eucnemidæ, Throscidæ), we might seem entitled to come to the conclusion that *Protelater* is a primitive form or synthetic type. If we do so, however, we are met with this striking fact, that this *Protelater* does not show any near approach in the structure of its head to the ordinary Coleoptera, but, on the contrary, is more different from them in that respect than are many other members of the family (e. g. *Corymbites*, *Lacon*, and their allies). If, then, we were to allow ourselves to suppose that *Corymbites* and *Lacon* were descended from such a form as *Protelater*, we should be obliged to admit that the process of evolution of their head has been one of convergence to the average Coleopterous type, rather than one of divergence from it. Interesting as this result would be, I do not think we are justified in attaching much importance to it; for the homologies of the parts of the head in different groups of Coleoptera is a question that has scarcely been touched; and if, as it is supposed, the head of an insect consists of three or more coalesced segments, each of which segments is itself composed of numerous parts, it is clear that the interpretation of the structure of the head in any one selected coleopterous form must be a very difficult one; and with so many parts to begin with, it would be very hazardous to conclude that two heads which should appear to be similar have been arrived at by a similar series of modifications.

My thanks are due to Captain Broun, of Tairua, and C. M. Wakefield, Esq., now of Uxbridge, for the most important contributions to the material from which I have drawn up this paper.

1. *Thoramus Wakefieldi*, n. sp.

T. niger, sat nitidus, breviter et æqualiter fusco pubescens; prothorace crebre punctato, angulis posterioribus haud divergentibus; elytris subtiliter striatis, interstitiis æqualibus, subtiliter punctatis, apice subrotundatis; antennis articulis secundo et tertio brevibus, sed hoc quam illo paulo longiore; sutura intercoxali profunda. Long. $21\frac{1}{2}$–29 m. m.

This species is characterized by its comparatively large size, uniform and even pubescence and punctuation, by the short but yet not extremely abbreviated 3rd joint of the antennæ, and by the front anterior angle of each of joints 4–10 of the antennæ being acute but not prolonged.

Oxford, Feb. 1873; Dry bush; Christchurch; Hokitika; Rangiora; Akaroa, Dec. 19, 1874. The species varies considerably in size; one small specimen is marked in Mr. Wakefield's collection as found on a hill-top at Akaroa by Mr. Fereday. The species also occurs in the Northern Island, as some portions of a specimen have been received by Mr. Lawson from his brother at Auckland.

Mr. Wakefield has brought back, in spirit, specimens of the larvæ and pupæ of this species; these I describe below:—

Larva 38 m. m. long., 8 m. m. lat. (on 9th and 10th segments), of thirteen segments, including the head; of these the head is fuscous or pitchy, and the two following segments are more or less infuscate, the other segments whitish; the 2nd segment as large as the 3rd and 4th together, the 8th to 10th segments are the broadest. Front of head deeply emarginate in the middle, the emargination furnished in front with a band of cilia, and in the middle with a horny prominence, terminating in three short teeth, one of which is placed above the other two. Antennæ three-jointed*, and with a membranous probably retractile support, the apical joint very slender. Mandibles rather long, acuminate, simple; upper surface of head with coarse but not very numerous punctures. Maxilla elongate, and furnished at the apex with a four-jointed palpus; labial palpi two-jointed. Dorsal segments, especially 4–8, more or less punctured, the punctures bearing short hairs. The 13th dorsal segment small, furnished towards the apex with rough, coarse, hard, brown tubercles, each of which bears several hairs; the apex is prominent on each side, the prominence being surmounted by a robust double tubercle; thirteenth ventral segment swollen at its

* The antennæ of the Elaterid larvæ are described by Perris and Lacordaire as 4-jointed; but it seems to me that the supposed basal joint is merely a membranous projection or support, and shows no trace of an articulation at its base.

base into a very large fleshy tubercle or false foot: the position of this foot and the form of the ventral segment cause the apical segment to be directed upwards in the two specimens of this larva before me.

This larva in its general characters agrees with those of the Elateridæ described by Perris in the "Insectes du Pin maritime" (Ann. Soc. Ent. France, 1854); but the dorsal plate of the last ventral segment appears to be less divergent in its structure from the other plates than is usual.

Pupa about 26 m.m. long, showing twelve dorsal segments besides the head, the first of which is quite of the form of the prothorax of the perfect insect, but bears on each side of the front a long slender tentacle; the scutellum of mesothorax very distinctly developed, the metanotum also largely developed. The dorsal plates of the hind body are distinctly differentiated, the hind angles of the 3rd, 4th, 5th, and 6th segments being very prominent and hard; the membrane between the dorsal and ventral plates of the 6th segment is elevated at its hind margin so as to form a kind of ear-like cavity, which forms the anterior wall or protection of a very deep depression at the outer side and base of the 7th segment, this depression being limited behind by a strong elevation of the dorsal plate of the 7th segment; the terminal (9th abdominal) dorsal plate bears at its apex on each side two slender spines, the upper one of which is short and simple, while the lower one is very elongate, and bears one or two short spines. On the under surface the trophi, antennæ, legs, elytra, and wings are very prominent. The hind body shows ten ventral plates; of these the seven basal ones correspond with the dorsal plates, the 7th differing, however, considerably in form from the others, it being much less transverse and greatly rounded behind; the 8th plate is not so largely developed as the corresponding dorsal plate, while the 9th and 10th plates are small and protected by the projecting sides and apex of the 9th dorsal plate.

The peculiarities of this pupa seem to be the peculiar structural fossa on each side of the base of the 7th abdominal segment, and the presence of an exposed supernumerary ventral plate. In the perfect insect only five ventral segments are to be seen: a comparison of the pupa with the perfect insect renders it evident that the 7th ventral plate of the pupa is the 5th or apical segment of the perfect insect; thus the diminution in the number of ventral segments has occurred at both extremities of the hind body—the first and second plates having disappeared at the base, while the 8th, 9th, and 10th at the extremity have become internal.

Mr. Wakefield informs me that these larvæ and pupæ "were taken from a fallen log of matai or black pine, near Christchurch. The larvæ were abundant in the log. I cut several perfect insects out of the same tree. The larva is very fierce; and one which I took home in the same box with a larva of *Prionoplus reticularis* made short work of the latter."

2. *Ochosternus Parryi*, Cand.

O. niger, sat nitidus, breviter et æqualiter, fere sparsim fusco pubescens; prothorace crebre fortiter punctato, angulis posterioribus vix divergentibus; elytris subtiliter striatis, interstitiis æqualibus, subtiliter punctatis, apice subrotundatis; antennis articulis secundo et tertio brevibus, sed hoc quam illo paulo longiore; interstitio meso-coxali angusto, sutura minus distincta. Long. 17–21 m. m.

This species, though closely allied to *Thoramus Wakefieldi*, is smaller and much narrower in proportion; this difference in form is accompanied by a greater approximation of the intermediate coxæ, and a more complete suture between the middle processes of the meso- and metasternum. The structure of the antennæ is similar in the two species.

Christchurch, found by Mr. Wakefield, but only three specimens; a fourth very small individual has been discovered by Mr. Fereday in the same neighbourhood.

Obs. Several specimens of this species are in Mr. Janson's collection, named by M. Candèze "*Ochosternus Parryi* ♀;" but I have seen no specimen which would enable me to form an opinion as to what form M. Candèze considered to be the male of *O. Parryi*.

3. *Thoramus obscurus*, n. sp.

T. niger, sat nitidus, breviter et æqualiter fusco pubescens; prothorace crebre punctato; elytris subtiliter striatis, interstitiis æqualibus, crebrius punctatis, apice subrotundatis; antennis articulis secundo et tertio brevissimis, hoc quam illo paulo breviore, articulis 4–10. angulo apicali interno leviter producto; interstitio meso-coxali lato. Long. 19–21 m. m.

This species is rather closely allied to *Thoramus Wakefieldi*, but is smaller and less elongate in form; this, in conjunction with the rather broad intercoxal space, the very abbreviated third joint of the antennæ, and the evenly distributed pubescence, will readily distinguish it from the other allied forms; the false joint at the apex of the antennæ is rather elongate, and very distinctly marked off.

Found by Mr. Wakefield near Christchurch (three specimens), and at Akaroa, Dec. 19, 1874 (one specimen).

It is possible that this species may prove to be the male of *Thoramus Wakefieldi.*

4. *Thoramus Feredayi*, n. sp.

T. angustulus, niger, minus nitidus, fusco pubescens; prothorace crebre fortiter punctato; elytris subtiliter striatis, interstitiis æqualibus et fere æqualiter pubescentibus, parcius punctatis, apice subrotundatis; antennis articulis secundo et tertio brevissimis, articulis 4–10. angulo apicali interno longius producto; interstitio meso-coxali sat lato, sutura profunda. Long. 18 m. m.

This species will be pretty certainly distinguished by the above characters. The pubescence of the upper surface is rather longer and more scanty on the thorax than it is on the elytra; and when the 2nd, 4th, and 6th interstices on the latter are carefully examined, it is seen that near the apex their pubescence and punctuation are slightly more scanty than on the adjoining ones.

Also found at Christchurch by Mr. Wakefield, but only two individuals.

At Mr. Wakefield's request I have named this species in honour of R. W. Fereday, Esq., of Christchurch, N. Z., by whom several of the Elateridæ communicated to me by Mr. Wakefield were captured.

5. *Elater lævithorax*, White.

E. niger, nitidus, parce pubescens; prothorace parce fortiter punctato; elytris subtiliter striatis, striis ad apicem obsoletis, interstitiis parce punctatis, inæqualiter pubescentibus; interstitio mesocoxali prominulo, sutura obliterata. Long. 15–19 m. m.

Mas antennis elongatis, articulis secundo et tertio brevissimis, 4–10. apicibus internis longe productis.

Fem. antennis sat brevibus, articulis secundo et tertio brevibus, 4–10. apicibus internis acutis sed vix productis.

The prominent intercoxal space and the complete amalgamation of the middle meso- and metasternal processes, readily distinguish this species from its allies; the structure of the apex of the elytra, which are not acuminate, will at a glance prevent its being mistaken for *Elater acutipennis* and its allies.

Found at Wellington by Messrs. Fereday and Wakefield, in Feb. 1868 and Feb. 1875, and sent by Mr. Edwards under the number 1338, but without special locality.

Obs. Elater punctithorax, White, is to be sunk as a synonym of this species, according to my notes made when examining the types in the British Museum.

Group 1.—The following are the structural characters by which species Nos. 1, 2, 3, 4, and 5 may be identified :—

Forehead quite straight in front, slightly overhanging the perpendicular clypeus, so that a very distinct step exists between the forehead and the labrum ; antennal spaces very small, broadly separated ; antennæ with joints 2 and 3 but little developed, 4–10 always at least serrate internally, sometimes with anterior internal angle much prolonged, 11th joint with a more or less distinct terminal appendage or false joint. Mesosternal cavity and its suture with the metasternum variable. Tarsi simple and linear, the 4th joint rather long, though a good deal shorter than any of the others ; coxal plate of hind coxæ well-developed throughout, its trochanteral portion quite twice as long as its femoral. Elytra not acuminate. Species of large size.

The nearest ally I can point out for these species is the Chilian *Diacantha nigra*, Solier. Candèze locates this Chilian insect in his subtribe Elatérites. Only one of the five New-Zealand species I am alluding to was known to this writer, viz. the *Ochosternus Parryi* ; and in his work it is placed in the subtribe Ludiites, being associated with the *Elater zealandicus* to form the genus *Ochosternus.* This, however, is certainly erroneous; for the form of the front of the head of *Ochosternus Parryi* will not allow it to be either correctly associated in one genus with *Elater zealandicus* or located in the Ludiites. On the contrary the species appears to me to be, as I have said, allied to *Diacantha nigra*, from which it differs by the more largely developed antennæ, by the more elongate clypeus, and by the more raised borders of the mesosternal cavity. The five New-Zealand species agree in most respects; but *Elater lævithorax* departs considerably from the other four species by its much-raised mesosternal cavity, and by the nearly obliterated intercoxal suture.

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6. *Metablax Brouni*, n. sp.

M. colore variabilis, elongatus, nitidus, inæqualiter albido pubescens ; prothorace angulis posterioribus divergentibus, intra latera depresso, dense punctato, et evidenter sparsim pubescente, medio nitido fere impunctato ; elytris apice acutis, obsolete striatis, interstitiis alternis magis pubescentibus, tertio ad basin leviter prominulo ; sutura intercoxali omnino carens ; tarsis articulis 2–4. subtus apicibus membranaceis sed vix prolongatis. Long. 23–25 m. m.

The acuminate elytra and the entire absence of any suture between the middle coxæ at the junction of the meso- and metasternal processes, taken together, readily distinguish this species from all the others yet known from New Zealand. The pubescence is very easily removed, and specimens are sometimes nearly completely denuded. The colour varies greatly, from nearly black to nearly red.

This species is apparently confined to the North Island; and the only exact locality I can mention is Tairua, whence two specimens have been sent me by Captain Broun.

Obs. The specimens I have seen in the collections of the British Museum and Mr. Janson show that both White and Candèze mixed this species with the following one under the names of *Elater acutipennis* and *Blax acutipennis* respectively; but, forming my opinion from White's description and figure, I have applied his name to the following species.

7. *Elater acutipennis*, White.

E. colore variabilis, elongatus, sat nitidus, evidenter et inæqualiter albido pubescens; prothorace angulis posterioribus divergentibus, intra latera depresso, dense punctato et evidenter pubescente, medio sublævi, crebre subtiliter punctato; elytris apice acutis, leviter sulcatis, sulcis pubescentibus, interstitio tertio ad basin prominulo; sutura intercoxali distincta; tarsis articulis secundo et tertio subtus apicibus breviter membranaceo-lobatis. Long. 18–23 m. m.

This species greatly resembles *Metablax Brouni*, but is very readily distinguished by the junction between the meso- and metasternum being still represented by a distinct suture; the alternate interstices are in this species very distinctly depressed and densely pubescent; and in fresh specimens these pubescent furrows offer a striking contrast to the shining and impunctate interstices between. The pubescence, however, is very readily removed. The colour in this species is also very variable. The sexual distinctions are apparently slight.

The species is widely distributed in New Zealand, but apparently rare. Tairua (*Broun*); Riccarton; Akaroa, Jan. 1873 (*Wakefield*); Rockwood (*Powell*).

8. *Elater approximans*, White.

E. niger vel nigro-piceus, angustulus, sat nitidus, sparsim brevissime albido pubescens; prothorace angulis posterioribus divergentibus, ad latera crebre subtiliter punctato et magis evidenter pubescente; elytris apice acutis, evidenter striatis, striis (præsertim externis) latis, crebre irregulariter punctatis; sutura intercoxali bene distincta. Long. 13–15 m. m.

Mas thorace paulo angustiore, mesosterni foveæ lateribus minus elevatis, angustis.

Fem. mesosterni foveæ lateribus crassis, fortiter elevatis, fere horizontalibus.

This species is a very distinct one, not likely to be confounded with any other. The sexual disparity in the structure of the mesothoracic cavity is highly interesting, and is such as in other cases is considered characteristic of distinct genera; in the female the tarsi also are stouter than in the male and their lobes more distinct, the antennæ also are less elongate.

A pair of this species has been sent me from Tairua by Captain Broun as No. 190.

9. *Elater cinctiger*, White.

E. ferrugineus, prothorace elytrisque versus latera vitta lata testacea; parce brevissimeque pubescens; elytris ad apicem acutis, evidenter æqualiterque striatis, striis fortiter punctatis, interstitiis sparsim punctatis; subtus crebre punctatus, mesosterni foveæ lateribus haud elevatis, obliquis, nullo modo horizontalibus.

Mas angustulus, thorace elytris angustiore, angulis posterioribus divergentibus, medio nitido. Long. 10–13 m.m., lat. fere $2\frac{1}{2}$ m.m.

Fem. latior, thorace elytris latiore, angulis posterioribus vix divergentibus, medio fortiter punctato. Long. 13–$14\frac{1}{2}$ m.m., lat. fere 3 m.m.

The sexual discrepancies are here again very remarkable; the greatly developed thorax of the female gives it the aspect of a minute *Chalcolepidius*.

Sent from Auckland and Tairua by Messrs. Lawson and Broun, but rare; the female especially rare. The species is probably confined to the Northern Island.

Group 2.—The species nos. 6, 7, 8, and 9 exhibit the following structural characters:—

Forehead curved in front, very distinctly separated from the clypeus, which is slightly unfolded, but still subperpendicular; antennal spaces more or less extended inwards, but their boundaries ill defined, the labrum only attached at the sides to the clypeus, so that in the middle there appears to be a kind of space or gap over the labrum: the limits between the forehead and clypeus in the middle ill-defined. Joints 2 and 3 of antennæ not much developed; joints 4–10 not serrate; appendicular extremity of 11th joint short and but little marked. Prosternal sutures duplicate. Mesosternal cavity and its suture with the metasternum variable. Coxal plate of hind coxa short, and gradually and slightly longer towards the trochanter, so that there is no limit between the trochanteral and femoral portions. Tarsi with the 4th joint short but quite distinct, the apices of the 1st to 4th joints beneath more or less membranous and prolonged. Elytra acuminate. Species of large or moderate size.

This group in New Zealand is abruptly marked off from group 1 (*Thoramus*) by the form of the head, tarsi, and coxæ, and by the acuminate elytra; its affinities are undoubtedly with the South-American *Semiotus*; and one of the species, *Metablax Brouni*, must be considered specially allied to that genus. It is a remarkable fact, however, that the elevation and horizontality of the mesosternal cavity, which forms one of the most pronounced features of *Semiotus*, is in the New-Zealand species *Elater approximans* the subject of sexual disparity; while the disappearance of the suture behind this cavity is subject to difference in closely allied species; and yet Candèze considered this latter character of such importance that he used it as the essential character of his subtribe Chalcolépidiides.

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10. *Amphiplatys Lawsoni*, Janson, *in litt.*

A. brevis, latiusculus, brunnescens vel fuscescens, prothorace sæpe nigricante, tenuiter pubescens, indistincte punctatus, sat nitidus; antennis pedibusque testaceis; prothorace parcius punctato, angulis posterioribus elongatis sed vix divergentibus; elytris brevibus, fere estriatis, obsolete punctatis. Long. 3 m. m., lat. $1\frac{1}{4}$–$1\frac{1}{2}$ m. m.

This species may readily be distinguished from the other known small New-Zealand Elateridæ by its short broad form and the peculiar structure of its antennæ; these are rather short and stout, and a good deal thicker towards the apex, and are bilaterally symmetrical; that is to say, a line drawn along the middle of the antennæ would pass through the articulations from joints 4–11.

I first received this species from Mr. Lawson, who appears to have found a few specimens near Auckland; lately Captain Broun has sent me a specimen with the No. 20 attached, and the information "Only found amongst decaying vegetable refuse and rubbish in the domain at Auckland; inactive."

Group 3.—This species, No. 10, besides the peculiar antennæ, shows the following structural characters:—

Forehead broadly rounded in front, and limited by a very well-marked, though not much raised carina, which is quite even throughout, not being at all more raised at the sides or depressed in the middle; clypeus inflexed-perpendicular, much overhung by the edge of the forehead; antennæ widely separated, without antennal spaces; last joint of maxillary palpi securiform. Prosternal sutures deeply duplicate; chin-piece well developed, prosternal process nearly straight; mesosternal cavity oblique-perpendicular, its sides not raised; side wings of metasternum very short. Tarsi rather short, but basal joint of the posterior ones as long as the three following together; 3rd and 4th joints very short, but furnished beneath with rather long membranes; claws very small. Coxal plate consisting of a rather large trochanteral portion, but with the femoral portion entirely wanting; so that the trochanteral portion covers the trochanter, but the femur is entirely exposed.

The genus is allied to *Cryptohypnus*.

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11. *Betarmon gracilipes*, n. sp.

B. niger, angustulus, pedibus tenuibus fusco-testaceis; oculis fortiter prominulis; prothorace elongato, elytris angustiore, subtiliter sat crebre punctato, subtiliter pubescente; elytris fere opacis, leviter striatis, sed striis perspicue punctatis, brevissime pubescentibus; antennis articulo tertio quam secundus fere minore. Long. 4–4½ m. m.

The black colour, slender legs, and peculiar form of the thorax are quite sufficient characters to distinguish this little species.

This insect was sent from Auckland by Mr. Lawson; and I have recently received an individual taken at Tairua, and with No. 40 attached, from Captain Broun.

12. *Betarmon frontalis*, n. sp.

B. colore variabilis, rufescens, plus minusve infuscatus, elytris indistincte fusco-vittatis, abdomine nigricante, antennis fuscis, basi testacea; angustulus, minus nitidus, evidenter pubescens; thorace, crebre minus subtiliter punctato, angulis posterioribus elongatis, acutis, bene divergentibus; elytris sat profunde striatis; antennis articulis secundo et tertio vix abbreviatis. Long. 4¼ m. m.

This little species has much the appearance of a small *Betarmon picipes*, the sculpture, pubescence, general form, and colour being all somewhat similar.

Found at Tairua by Captain Broun.

13. *Betarmon lætus*, n. sp.

B. læte rufo-testaceus, elytris testaceis, plus minusve fusco-vittatis, antennis extrorsum fuscis; sat angustus, subnitidus, evidenter pubescens; thorace crebre punctato; elytris sat profunde striatis; antennis articulis secundo et tertio haud abbreviatis; corpore subtus rufo-testaceo, concolori. Long. 5 m. m.

This is very similar to *Betarmon frontalis*, and may perhaps be only an extreme form of it, for that species is evidently very variable; but the bright colour of the two individuals before me seems to distinguish it pretty distinctly.

Tairua (Captain Broun).

14. *Betarmon obscurus*, n. sp.

B. fusco-testaceus, antennis fuscis, basi testacea, pedibus pallidis, abdomine nigricante; opacus, evidenter pubescens; prothorace dense subtiliter punctato denseque pubescente; elytris profunde striatis; antennis articulis secundo et tertio vix abbreviatis. Long. $4\frac{1}{2}$–$5\frac{1}{2}$ m. m.

This species varies somewhat in colour; the thorax is generally darker than the elytra, the breast is reddish, and the ventral segments nearly black except at the base and extremity: though very similar to *Betarmon frontalis*, it may always be distinguished by its finely, densely, and evenly punctured thorax.

"On various shrubs at Tairua; active; not uncommon."—*Captain Broun.*

Group 4.—Species 11, 12, 13, and 14 show the following characters:—

Antennæ slender, subfiliform, 2nd and 3rd joints moderately or well developed. Forehead rounded in front, and limited by a raised carina, which is distinct throughout its whole width; clypeus inflexed-perpendicular, short and overhung by the forehead, antennal spaces not marked. Prosternal sutures simple; prosternal process horizontal. Mesosternal cavity oblique-perpendicular, its sides not in the least raised. Metasternum elongate. Tarsi slender, with their joints simple; 4th joint small, but not minute. In *Betarmon gracilipes* the coxal plates are short throughout their whole breadth, the trochanteral portion being not twice as long as the very short femoral portion; in the other three species the trochanteral portion is broader, and the femoral nearly completely absent.

I think there is no doubt about the affinity of these species, their nearest recorded ally being apparently the European *Betarmon*, from which they differ only in some details of structure.

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15. *Panspæus guttatus*, n. sp.

P. minutus, angustulus, nigricans, prothoracis angulis posterioribus maculisque quatuor in elytris, antennis pedibusque testaceis, antennis extrorsum fuscis; prothorace minus elongato, obsolete punctato, nitido sed evidenter pubescente; elytris striatis, striis internis sat profundis, externis obsoletis; macula testacea humerali elongata, altera anteapicali magna. Long. 2 m. m.

This very minute insect is one of the smallest of the Elateridæ, it being rather longer and narrower than the European *Cryptohypnus minutissimus.*

Sent from Tairua by Captain Broun, who says that it is evidently very rare, and that he has only found three individuals.

Group 5.—The two specimens of this minute insect are in bad condition, and I cannot ascertain thoroughly all their characters; but they show one peculiarity which in itself is sufficient to mark them off as a distinct genus, viz. that along the underside of the thorax, close to and parallel with its border, is a longitudinal furrow, such as is seen in many Eucnemides; besides this I can say that the forehead is rounded in front and limited by a raised line, the clypeus is extremely reduced and concealed, the femoral portion of the coxal plate pretty well developed, the trochanteral portion short and only a little longer than the femoral portion. The tarsi are small, simple, and slender. The relationship appears to be with *Betarmon.*

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16. *Aglophus modestus*, n. sp.

A. angustulus, sat nitidus, evidenter pubescens, fulvo-castaneus, pedibus testaceis; antennis elongatis, tenuibus, articulis secundo et tertio conjunctim quarto fere æquali; prothorace brevi, parcius punctato, angulis posterioribus haud divergentibus, subuncatis; elytris regulariter striatis, striis evidenter punctatis, interstitiis obsolete punctatis. Long. 6–7 m. m.

The male is more slender than the female. The species has much the appearance of our European *Adrasti* and *Dolopii.*

I have seen but few specimens of this species; they have been sent me by Captain Broun from Tairua, with No. 13 attached, and the information that it is an autumnal species and inactive.

Group 6.—This species presents a combination of structural characters such as to require its isolation from the other New-Zealand allies. The forehead is much curved in front, so as to be somewhat produced in the middle, it is sharply defined by a scarcely elevated line, which overhangs the clypeus, so that there is an abrupt step between the front and the labrum; the antennal spaces are very obscure; the antennæ are slender, with 2nd and 3rd joints only moderately developed. The prosternal sutures are not distinctly duplicate, and are not open in front, but show there a peculiar sinuation. The prosternal process is short, and is abruptly and greatly bent upwards immediately behind the coxæ. The middle coxæ are only narrowly separated; the mesosternal cavity shows no distinct lateral edge, and is quite depressed; its opening behind is narrow and ill-defined, and does not reach the intercoxal suture; the posterior portion, however, is prolonged backwards as a broad shallow depression on the hind part of the mesosternal process. The femoral portion of the coxal plate is excessively short, in fact linear; the trochanteral portion is moderately large. The tarsi are moderately short, and all the joints are simple; the 4th is small but not minute.

I think the genus should be placed near *Betarmon*, from which it differs strikingly by the prosternal process and mesosternal cavity.

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17. *Lomemus pilicornis*, n. sp.

L. angustulus, minus nitidus, evidenter pubescens, niger, prothoracis angulis posterioribus pedibusque testaceis, tibiis versus apicem fuscis; antennis elongatis, tenuibus, sed intus serratis, longius pilosellis, articulis secundo et tertio brevissimis, quam quartus conjunctim multo brevioribus; prothorace antrorsum angustato, crebre fortiter punctato, sat elongato, angulis posterioribus subuncatis; elytris striatis, striis punctatis, apice summo obsoletis, interstitiis punctatis. Long. 5 m. m.

The pilose antennæ, the black colour, with yellow legs and hind angles of the thorax very readily distinguish this species.

Three specimens have been cut out of a tree-stump at Tairua by Captain Broun; one of them he sent me with the No. 13 attached.

18. *Lomemus pictus*, n. sp.

L. angustulus, evidenter pubescens, sat nitidus; antennis tenuibus, fuscis, basi testacea, articulis secundo et tertio sat brevibus, conjunctim quarto æqualibus; capite nigro, fortiter profundeque punctato; thorace sat elongato, antrorsum leviter angustato, fortiter punctato, rufo, macula magna discoidali nigricante; elytris testaceis, sutura margineque externo nigris, striatis, striis punctatis; corpore subtus fusco-rufescente, prothoracis lateribus testaceis; pedibus pallide testaceis. Long. 5 m. m.

Allied pretty closely to *Lomemus pilicornis*, but readily distinguished by the less pilose antennæ and the colour, and presenting some slight structural differences: the antennæ are differently formed; but I have not sufficient specimens to enable me to decide whether this is more than a sexual character.

I have received two very damaged specimens from Captain Broun as No. 32, but without any information as to habits.

19. *Lomemus suffusus*, n. sp.

L. angustulus, fere parallelus, sat nitidus, evidenter sed breviter pubescens, niger, antennis fuscis, pedibus fusco-testaceis; elytris sordide testaceis, sutura margineque externo vage nigricantibus; antennis intus subserratis, articulis secundo et tertio conjunctim quarto vix æqualibus; capite fortiter punctato; prothorace elongato, minus fortiter et crebre punctato, nitido, angulis posterioribus nullo modo divergentibus, angustius testaceis; elytris evidenter striatis, striis punctatis. Long. $5\frac{1}{2}$ m. m.

This species, though closely allied to *L. pilicornis* and *L. pictus*, can be readily distinguished by the considerably less developed punctuation of the thorax; this part is also longer in proportion.

Captain Broun has sent a single specimen from Tairua as No. 31.

20. *Lomemus flavipes*, n. sp.

L. angustulus, subparallelus, sat nitidus, niger, evidenter fusco-pubescens, pedibus testaceis; antennis tenuibus, fere filiformibus, articulis secundo et tertio minus abbreviatis, conjunctim quarto æqualibus; prothorace elongato, crebre subtiliter punctato; elytris subtiliter striatis, striis evidenter punctatis, interstitiis crebrius rugulosis. Long. 7 m. m.

This species may be readily distinguished from *L. obscuripes* by its considerably more elongate form and its more finely punctured thorax and paler pubescence; it has extremely the appearance of our small European *Limonii*, *parvulus* and *minutus*.

I have seen but a single individual, which was sent from Auckland by Mr. Lawson.

21. *Lomemus similis*, n. sp.

L. angustulus, sat nitidus, evidenter pubescens, niger, pedibus fusco-rufis; antennis elongatis, crassiusculis, intus serratis, articulis secundo et tertio perbrevibus quam quartus conjunctim duplo brevioribus; prothorace elongato, crebre sat fortiter punctato; elytris evidenter striatis, striis ad apicem distinctis, interstitiis crebre rugulosis. Long. $4\frac{1}{2}$ m. m.

This species may be readily distinguished from the following as well as from the preceding species by the fact that the forehead is slightly more prolonged in the middle, so that its front margin, instead of forming an even curve, is slightly sinuate on each side: in colour and appearance it is extremely similar to *L. obscuripes*, but is only half the size.

I have received a single individual of this species from Tairua, whence it was sent me in sawdust by Captain Broun.

22. *Lomemus obscuripes*, n. sp.

L. angustulus, sat nitidus, evidenter pubescens, niger, pedibus fuscis; antennis elongatis, crassiusculis, intus serratis, articulis secundo et tertio perbrevibus quarto conjunctim fere duplo brevioribus; thorace crebre fortiter punctato, antrorsum leviter angustato; elytris minus elongatis, evidenter striatis, striis ad apicem distinctis, intestitiis crebrius rugulosis. Long. fere 6 m. m.

Sent from Auckland by Mr. Lawson.

23. *Lomemus elegans*, n. sp.

L. angustulus, sat elongatus, evidenter pubescens, sat nitidus, læte fulvo-testaceus; antennis, capite, scutello, prosterno medio pectoreque nigris; antennis (basi fuscis) elongatis, intus serratis, articulis secundo et tertio perbrevibus, quarto conjunctim duplo brevioribus; prothorace antrorsum angustato, crebre fortiter, minus profunde punctato; elytris evidenter striatis, striis ad apicem indistinctis. Long. $7\frac{1}{2}$ m. m.

Of this pretty species a single individual was sent me some time ago in spirit from Tairua by Captain Broun.

24. *Lomemus collaris*, n. sp.

L. angustulus, sat elongatus, evidenter pubescens, sat nitidus, niger, prothoracis angulis posterioribus elytrisque fulvo-testaceis, pedibus testaceis; antennis elongatis, intus serratis, articulis secundo et tertio perbrevibus, quarto conjunctim duplo brevioribus; thorace antrorsum angustato, crebre sat fortiter punctato; elytris striatis, apice extrorsum fuscescentibus. Long. $6\frac{1}{2}$ m. m.

Two individuals of this species have been found by Mr. Wakefield at Christchurch.

Group 7.—These species (Nos. 17 to 24) show characters to a considerable extent similar to those of *Aglophus mo-*

destus; the head is almost similarly formed; the antennæ, however, are always more or less serrate; the thorax is more elongate, the prosternal sutures are narrowly open in their anterior part and are not sinuate in front; the prosternal process is short, and is bent up in *Lomemus pilicornis*, but is longer and nearly straight in *L. obscuripes*; the intercoxal space is narrow, and the mesosternal cavity is narrow, ill-limited behind, its posterior extremity very far from the intercoxal suture; the space separating these two parts is longitudinally grooved. The femoral portion of the coxal plate is short, the trochanteral portion moderately long; the 4th joint of the tarsus is minute, the 3rd simple or obscurely emarginate at the extremity. Species of small size.

I have had so few examples of these small species at my disposal that I cannot deal in a full and satisfactory manner with their structural details; and it is probable that a thorough examination would show that I have left together in one group species which may ultimately form several distinct groups: they may, however, be distinguished from the species of *Aglophus* by the different prosternal sutures, by the less diminished femoral portion of the hind coxal plate, and the less developed 3rd and 4th joints of the tarsi.

[To be continued].

XL.—*Description of three new Species of Lizards from Islands of Torres Straits.* By Dr. A. Günther.

A collection of reptiles made by the Rev. S. MacFarlane for the British Museum, at Somerset and in the islands of Torres Straits, contained the lizards enumerated in the following list. Unfortunately no record was made, or has reached us, as regards the particular islands where the specimens were collected.

1. *Odatria prasina*, Müll.
2. *Lialis punctulata*, Gray, together with *L. leptorhyncha*, Ptrs., the specific distinctness of which is very doubtful.
3. *Cryptoblepharus pœcilopleurus*, Wiegm.
4. *Hinulia striatula*, Steind.

5. *Carlia Macfarlani*, sp. n

Scales round the middle of the body in 25 longitudinal series; 45 in a series between the chin and vent. The anterior frontal forms a long suture with the rostral and a short one with the vertical, which is small, smaller than the anterior occipital; a small central occipital fitting into a notch of the anterior. Six upper labials, the fourth being below the eye. Ear-opening minute. The fore leg does not reach beyond the eye if laid forwards; the third finger longest. Brown above, white below. Sides with a black, white-edged band, beginning from the eye and lost on the tail. This band is much more distinct in young than in old specimens.

	millim.
Distance of the snout from the eye	3
,, ,, ear	7
,, ,, shoulder	12
,, ,, vent	30
Length of tail	47
,, fore leg	8·5
,, hind leg	12

This species should be compared with *Lygosoma novæ-guineæ*, which has been very shortly noticed by Meyer in Berlin. M.B. 1874, p. 132.

6. *Mabouia macrura*, Gthr.
7. *Cyclodus carinatus*, Gthr.
8. *Tropidolepisma striolatum*, Ptrs.
9. *Heteropus fuscus*, D. & B.

10. *Thecadactylus australis*, sp. n.

Closely allied to *T. rapicauda*. Upper parts covered with very small, granular, smooth scales, which become more prominent and rougher on the forehead and snout. Eleven upper and ten lower labials. Scales of the lower parts as small as those of the upper; those on the throat minute. The scales in the præanal region somewhat larger, each perforated by a pore. Root of the tail, behind the vent, swollen (in the male?), the swollen portion covered with large hexagonal scutes. Tail (reproduced) cylindrical, with narrow verticilli. Upper parts brownish violet, marbled with reddish. Lower parts whitish.

	millim.
Distance from the snout to the eye	12
,, ,, ear	28
,, ,, shoulder	45
,, ,, vent	105
Length of tail	60
,, fore leg	30
,, hind leg	40

The occurrence in Australia of a genus hitherto believed to be peculiar to tropical America is the more significant as this genus is sharply defined from other members of the family of Geckoids, and the resemblance between the single American and Australian species is very great indeed.

11. *Peripia torresiana*, sp. n.

Back uniform granular, without any tubercles. Scales in the middle of the belly in about 40 longitudinal series. Tail strongly depressed, but with rounded sides, finely granular, and with large subcaudals beneath. Number of the upper and lower labials varying from seven to nine. Front lower labial short, much broader than long, with a pair of elongate chin-shields behind. Light grey above, with some indistinct round white spots. Tail with brownish rings.

	millim.
Distance of the snout from the eye	7
" " ear	15
" " shoulder	24
" " vent	70
Length of tail	75
" fore leg	20
" hind leg	26

12. *Gymnodactylus Arnouxii*, Dum.
13. *Chlamydosaurus Kingii*, Gray.

XLI.—*Notes on Stony Corals in the Collection of the British Museum.* By Dr. F. Brüggemann.

In these notes I intend to publish a series of preliminary notices of some of the more remarkable novelties which I determined during my examination of the large collection of corals in the British Museum, as well as other remarks, especially on synonymy and geographical distribution of forms previously known. They will be of a miscellaneous character, and are not intended to be given in a strictly systematic order.

My thanks are due to Dr. Günther, keeper of the Zoological Department, for kind assistance, by which my studies have been greatly facilitated.

I. Description of two new Species of Turbinariidæ.

1. *Turbinaria bifrons.*

Corallum consisting of thin, vertical, variously plicate plates, which are covered equally on both sides with calicles. Corallites arranged rather quincuncially (the oblique series being most pronounced), distant by about the length of their diameter, small, excessively short cylindrical (so as to appear nearly immersed), slightly oblique, the opening directed towards the edge of the leaf, the proximal part of the wall a little more projecting. Cells open, very shallow. Septa crowded, equal, generally 18–20 in number, narrow, with straight inner edge, the lateral surfaces delicately spinulous. Columella oviform, rather compact. Cœnenchyma moderately dense, longitudinally striate and delicately echinulate on the surface. Thickness of corallum, on the average, 3–4 millims.; diam. of calicles 2 millims., their height $\frac{1}{2}$ millim.

Hab. Unrecorded. B.M.

This species is distinguished at the first glance by being everywhere bifacial. In the other species there may be found occasionally one or two calicles budding on the outer surface of the corallum, or stout branches rising from the centre; in some of them, especially *T. frondens* and *T. peltata*, there occurs also a peculiar mode of plication, giving to the folded parts the aspect of bifaciality. But in the latter instance there is always a distinct suture on the ridges, separating two well-marked rows of calicles, while nothing of this kind is indicated in the present species. The corallites are in their general aspect much like those of *T. crater*, but less crowded, smaller and more oblique.

The single specimen seems to be only one half of the whole corallum, which apparently formed a hemispherical cluster of upright plates terminating at equal heights and obtusely rounded at their summits. The plates scarcely coalesce where they meet; below they are united to a somewhat spreading basal expansion. The height of the corallum is five inches; the greatest diameter, nearly eight inches.

2. *Astræopora expansa.*

Corallum attached by a short pedicel, expanded, flat crateriform; under surface covered to the very edge with a well-developed concentrically striate epitheca. Calicles irregularly scattered, generally placed at great distances from each other, small, rather deep, immersed, or with the margin only slightly projecting. Septa unequal, 12 in number, quite rudimentary in the upper half of the cell. Cœnenchyma abundant, deposited in nearly continuous thin horizontal layers, which are united by straight perpendicular trabeculæ, so that a vertical section shows a regular network, the square interspaces of which are $\frac{1}{2}$ millim. in diameter. Surface spongious and echinulate, rather scantily covered with very thin, short, upright spines. Diameter of cells 1 to 1½ millim., their depth about 6 to 10 millims.

Hab. Unrecorded. B. M.

In the only specimen the outline figure of the upper surface is kidney-shaped, the corallum being deeply emarginate where it had been fixed to the ground. The greatest diameter is nearly 8 inches, the height 4 to 5 inches, the greatest thickness 1 inch.

This species differs from all its congeners in its mode of growth, in the ample development of the epitheca, and in the structure of the cœnenchyma. The echinulation of the surface is more delicate, and the cells are smaller and more distant, than in either of the other species (perhaps with the exception of *A. palifera*, which I have not seen).

The genus *Astræopora* now comprises five species, three of which were already known to Lamarck; the fourth was described and figured by Dana as *A. pulvinaria* (U.S. Expl. Exped., Zooph. p. 415, pl. 29. fig. 3), and afterwards enumerated as *A. profunda* by Verrill (in Dana, 'Corals and Cor. Isl.,' Appendix).

Astrea stellulata of Lamarck (Hist. Anim. s. Vert. ii. p. 261) and *Gemmipora fungiformis* of Michelin (Mag. Zool. 1840, Zooph. pl. 2) do not belong to this genus. The first is not determinable; and even if it should prove to be a distinct species, it ought to be renamed, because Lamarck meant to describe the totally different *Madrepora stellulata* of Ellis and Solander. *Gemmipora fungiformis* is one of the earliest stages of *Turbinaria peltata*; the only difference which might be pointed out from the description and figure is the extreme porosity of the cœnenchyma. But this condition is evidently due to the mode of preparation, and is frequently found in a similar degree in specimens of this and the other species of *Turbinaria*.

II. Remarks on the Species of Seriatopora.

1. *Seriatopora lineata.* B.M.

Millepora lineata, Linnæus, 1758 and 1767.
Madrepora seriata, Pallas, 1766; Ellis & Solander, pl. 31. figs. 1, 2.
Seriatopora subulata, Lamarck, 1816; M. Edwards.

The *Millepora lineata* of Linnæus is evidently the same as the *Seriatopora subulata* of Milne-Edwards (but neither of Ehrenberg nor of Dana). Linnæus's description answers exceedingly well to this species, and is even much more to the point than Lamarck's unsatisfactory diagnosis. Pallas may have included several species under his *Madrepora seriata*;

but nearly all his statements apply best to the above, a recognizable figure of which was given by Ellis and Solander.

To the description in M.-Edwards's monograph might be added that the species is easily distinguished by its straight, rather thick branches. The septa are comparatively well developed, and generally six in number, those of the second cycle being rudimentary or wanting. Columella represented by a very slight longitudinal elevation.

Hab. Indian Ocean (*Lamarck*).

I do not know where to place the *Seriatopora lineata* of Milne-Edwards, which is decidedly not the *Millepora lineata* of Linnæus. Esper's *Millepora lineata*, again (and perhaps also Dana's *Seriatopora lineata*), is different; his figure seems to represent a rather abnormal branch of *S. spinosa*, taken from the circumference of the corallum. Dana, and after him Milne-Edwards, quote as a synonym of their *S. lineata* a "*Seriatopora subulata*, var." of Lamarck (Hist. Anim. s. Vert. ii. p. 282); but there is no variety whatever mentioned in Lamarck's work.

2. *Seriatopora cervina.* B.M.

Porites cervina, Lamarck; M.-Edwards, Cor. iii. p. 314.
Seriatopora cervina, M.-Edwards, *t. c.* p. 312.

There is a specimen of *Seriatopora* in the Museum which may belong to this little-known species. In its mode of growth it is very similar to the preceding; the branches, however, are thinner, the terminal branchlets slenderer and slightly curved, and the calicles placed in less regular rows. Septa nearly obliterate. Columella moderately developed, cristiform.

This is in some respects an intermediate form between *S. lineata* and *S. hystrix*.

Hab. Indian Ocean (*Lamarck*); Australia (*J. B. Jukes* in B.M.).

3. *Seriatopora hystrix.* B.M.

Seriatopora hystrix, Dana; M.-Edwards.

Differs from the preceding in having the corallum evenly convex and rather fasciculate, the branches more crowded but less coalescing, evenly furcate, the terminal branchlets upright, stout, and strongly curved, the septa of first cycle better developed.

Hab. Feejee Islands (*Dana*); Samoa Islands (*Rev. S. J. Whitmee* in B. M.).

4. *Seriatopora pacifica.* B.M.

Corallum forming rather lax, not fasciculate clumps, very ramose. Branches subangular, of moderate thickness, much divaricate, but scarcely coalescing, ramified at nearly right angles; branchlets more or less horizontal, straight, slender, needle-pointed. Calicles small, in rather irregular rows, those of the same row distant by nearly the length of their diameter; the interspaces on the average double as broad as the rows. Cells slightly vaulted and labiate; their edges strongly prominent, fimbriate. Septa of first cycle moderately well developed. Columella low, thick, somewhat pointed. Surface of cœnenchyma rather smooth, granulate. Diameter of principal branches about 5 millims., of branchlets at their base 2 millims., of calicles two thirds of a millim.

Hab. Feejee Islands (*F. M. Rayner* in B.M.).

This species is remarkable by being much more arborescent than its allies, a character arising from the fact that the ramification is not evenly dichotomous, but generally only one of the branchlets attains a larger size and continues to divide. From *S. hystrix* it differs in its mode of growth and in the thinner and more angular branches. In the broad and flat interspaces between the rows of calicles, and in its mode of ramification, it shows some resemblance to *S. spinosa.*

5. *Seriatopora caliendrum.* B.M.

Seriatopora caliendrum, Ehrenberg; Dana; M.-Edwards.

This species forms large clumps of subparallel and more or less perpendicular branches, these being thin and slender, but rather obtuse at their summits.

Hab. Red Sea (*Ehrenberg*), Tur near Sinai (*Häckel*); Madagascar (B.M.). A variety is recorded by Dana from the Sooloo Sea, under the denomination *S. caliendrum,* var. *gracilis*; and there is a specimen in the Museum collection marked "Navigators' Islands," which I am not able to separate as a distinct species.

There appear to exist intermediate forms between this and the preceding, and again between the latter and *S. hystrix,* which in its turn comes very near to *S. cervina.* However, the material in the Museum is not extensive enough to ascertain the nature of these transitions, especially with regard to the question how far they coincide with the geographical distribution, or whether they represent merely individual peculiarities.

6. *Seriatopora octoptera.* B.M.

Seriatopora octoptera, Ehrenberg; Dana; M.-Edwards.

A very distinct species, whose characters have been well pointed out by Milne-Edwards. It is distinguished from all its allies by the very obtuse tops of the branches.

Hab. Red Sea (*Ehrenberg*), Tur near Sinai (*Häckel*); Singapore (*Dana*); Sooloo Sea (*Dana*).

7. *Seriatopora valida.*

Seriatopora valida, Ehrenberg, M.-Edwards.

To judge from the descriptions, this seems to be very near to *S. caliendrum.* From the following species it differs in having the branches crowded and often coalescing, the calicles small, and the surface of the cœnenchyma granulate.

8. *Seriatopora Güntheri.* B.M.

Corallum fasciculate, but rather lax on account of the scarce ramification of the principal branches, nearly spherical in general outline. Branches slender, gradually tapering, rarely coalescing at the base; angles of ramification very acute, on the average 30°–40°. Terminal branchlets long, slender, subulate, six-winged at the summit. Calicles extremely crowded, disposed in regular series, those of the same row touching each other; the interspaces between the rows narrow, distance generally much less than one half of the diameter of the calicles. Cells large, circular, placed somewhat obliquely, but only slightly vaulted; their edges not very prominent, fimbriate. Septa entirely obsolete. Columella well developed, thin, lamelliform. Surface of cœnenchyma strongly echinulate. Diameter of principal branches, on the average, 4 millims., of calicles 1 millim.

Hab. New Guinea.

This elegant species, to which I have the pleasure of attaching Dr. Günther's name, has a peculiar aspect on account of its mode of growth, as well as of its crowded, large, and open cells, the latter being rather ocelliform in their general appearance. This combination of characters serves to distinguish it readily from all the allied species.

9. *Seriatopora elegans.* B.M.

Seriatopora "subulata," M.-Edwards, Atl. Règn. Anim. Cuv., Zooph. pl. 81. fig. 2.

" Pocillopora acuta," M.-Edwards, Hist. Nat. Cor. Atlas, p. 11, pl. F 4. fig. 2.

Seriatopora elegans, M.-Edwards, *op. cit.* vol. iii. p. 312.

This is one of the best-marked species. Its principal characters are in the thick, slender, pointed, and not much ramified branches, the large and vaulted calicles, which are distinctly seriate only towards the apical parts of the branches, the very prominent upper edges of the cells, and the nearly total obliteration of the septa.

Hab. Singapore (*M.-Edwards*) ; China (B.M.).

10. *Seriatopora stricta.* B.M.

Corallum fasciculate, in general outline hemispherical. Branches subterete, straight, subulate, moderately crowded, divaricate, coalescing at their bases; angle of ramification, on the average, 60°. Calicles large, on the greater part of the corallum almost entirely irregularly dispersed, circular, immersed, their edges on the same level, equally and slightly prominent; those of the terminal branches in distinct but ill-defined rows, moderately crowded, average distance about three fourths of their diameter, rather oblong, vaulted, their edge coarsely fimbriate, and in its upper part strongly labiate. Septa entirely obsolete. Columella moderately developed, linear, compressed. Surface of cœnenchyma densely and delicately spinulous, becoming more coarsely echinulate and at last granulate towards the base. Diameter of calicles 1 millim.

Hab. Cape of Good Hope.

Differs from most of its congeners in the irregular disposition of the calicles, in which respect it agrees most with *S. elegans*. From this, however, as well as from the other species, it is distinguished by numerous characters.

11. *Seriatopora spinosa.* B.M.

Millepora "*lineata,*" Forskål ; Esper.
Seriatopora "*subulata,*" Ehrenberg ; Dana.
Seriatopora spinosa, M.-Edwards.

This, again, is an easily recognizable and well-defined species, distinguished at the first glance by its angular and verrucose branches : this aspect is produced by the broad and flat interspaces between the rows of calicles, the latter being much crowded in each row and strongly projecting.

I am not aware that this species has been found anywhere else than in the Red Sea, where it was first discovered by Forskål, who gave a good description of it.

12. *Seriatopora ocellata.*

Seriatopora ocellata, Ehrenberg ; M.-Edwards.

Were it not for the larger calicles, I should without hesitation declare this species (which was established on a worn fragment from an unknown locality) to be identical with *S. spinosa*.

XLII.—*Description of a new Species of* Portunidæ *from the Bay of Bengal.* By Prof. J. Wood-Mason, Deputy Superintendent of the Indian Museum, Calcutta.

Goniosoma hoplites, n. sp.

The whole animal is covered with a short and dense pubescence, which is developed into cilia on the edges of the legs and between the epibranchial teeth. The carapace resembles that of *Neptunus gladiator* in the distribution of its granulated lines and elevations. The antero-lateral margins are armed with six teeth; the first two small, similar, close together, and rather obtuse; the third and fourth larger, sharper, curved a little forwards, and broad-triangular; the fifth rather smaller than these, but similarly shaped; the last very sharp and long, about thrice the length of any of the rest. Front divided into eight teeth arranged in pairs; or into four bilobed ones, each lateral tooth being subdivided into two nearly equal and similar lobes, the outer one of which forms the intra-orbital angle, each median tooth into two unequal and dissimilar ones, the external and smaller of which is directed slightly outwards and has its extremity rounded off, but the internal and larger has its external angle obliquely cut away and its internal angle rounded off; the two median teeth are separated from one another by a fissure shallower and narrower than those which divide them from the lateral ones. Posterior angles each produced straight outwards to a strong and blunt process, the posterior edge of which is in the same straight line with the hinder margin of the carapace; and the emarginations for the reception of the bases of the swimming-legs are in consequence much deeper than usual. Chelipedes and legs agree with those of *Goniosoma callianassa*, Herbst, except that the meropodites of the former have a sharp spine at the very extremity of their posterior crest and only two spines in front, that the spine on the internal margin of the carpopodites is very long and acuminate, and that the immovable finger has at the base but four transversely convex ridges instead of five, the central rib to be seen on the under surface of this part in *G. callianassa* being absent—that the thighs of the walking-legs are a little thicker at base and all have the lower and posterior crest produced at the apex to a sharp spine, and that the penultimate joint of the swimming-pair is obviously denticulated below.

Length of the carapace 15·5 millims., breadth 28·5; breadth of the hinder margin 12·5; length of the last epibranchial spine 3·5.

Hab. Madras.

XLIII.—*New Coleopterous Insects from Queensland.* By Charles O. Waterhouse.

Longicornia.

Prionidæ.

Analophus, gen. nov.

Mandibles short, convex, curved, furnished on the inner side with a single strong tooth. Head large, convex. Antennæ about half the length of the body; the first joint short, pear-shaped, the third two thirds the length of the first, but slender, the fifth to eleventh gradually increasing in length. Thorax scarcely broader than the head, transverse, with no lateral margin, only marked by a fine line. Prosternum broad and flat. Legs not spinose; tarsi short and narrow, the third joint bilobed.

Closely allied to *Mallodon*, from which I have separated it on account of the thorax not being expanded into a lateral ridge.

Analophus parallelus, sp. n.

A. elongatus, parallelus, convexus, piceus; capite magno, convexo, medio canaliculato, discrete fortiter punctato, collo subtiliter creberrime punctato, pone oculos fortiter granoso; thorace longitudine $\frac{1}{3}$ latiore, antice haud profunde emarginato, lateribus parallelis, angulis posticis rotundatis, disco nitido parce punctato, medio longitudinaliter impresso, lateribus opacis creberrime subtiliter punctulatis, guttis duabus nitidis notatis; scutello lævi; elytris thorace parum latioribus subparallelis, nitidis, basi discrete punctatis, lateribus apiceque rugulosis; pedibus rufo-piceis, nitidis, haud spinosis.

Long. 16 lin., lat. $5\frac{1}{2}$ lin.

The head and thorax are pitchy black. The thorax has the lateral margin indicated by a fine interrupted line, which terminates at the posterior angles in a slight crenulated ridge. The base has a slight emargination on each side of the scutellum. The whole underside is opaque and finely and densely punctured as the sides are above. The abdomen is shining.

Hab. Queensland. Brit. Mus.

Brachytria varia, sp. n.

B. nigrescens; capite crebre punctato, rufo-flavo; thorace rufo-flavo, postice angustato, punctis nonnullis adsperso, disco utrinque puncto nigro; elytris ad apicem fumosis, maculis tribus (sæpe conjunctis) flavis.

Long. 7 lin.

This species is at once separated from *B. gulosa*, Newm., by the thorax being almost devoid of punctures, and with no sharp angle at the side; besides the two discoidal spots, the posterior angles below, and sometimes the hind margin, are black. The elytra are rather dull, coarsely punctured, tricostate, with a large yellow spot below the scutellum, and one on each lateral margin about the middle, as in *B. gulosa.* The sternum and the base of the abdomen are sometimes yellowish.

Hab. Sydney. Brit. Mus.

Brachytria picta, sp. n.

B. nigra, nitida; capite thoraceque margine antico ochraceis, hoc fere lævi, medio haud ampliato, postice angustato; elytris postice angustatis, tricostatis, crebre punctatis, medio pallide flavo-notatis, humeris sanguineis, apice fumoso; femoribus apice ochraceo-annulatis; abdomine basi piceo.

Long. $6\frac{1}{2}$ lin.

The colours of this species would probably vary; but the following characters will serve to distinguish it from *B. varia*:—Eyes scarcely prominent. Thorax regularly arched, with no impressions towards the anterior and posterior angles, scarcely broader across the middle than in front, narrowed behind, but not angular at the sides. The punctuation of the elytra is much the same; but the punctures are not so confluent at the apex. The metasternum is very closely and somewhat coarsely punctured in the middle, less closely but distinctly punctured at the sides; whereas in *B. varia* the metasternum is finely punctured, and not much more closely in the middle than at the sides.

Hab. Queensland. Brit. Mus.

Obrida comata, Pascoe.

Specimens of this species have just been received from Queensland, some with entirely black legs and antennæ, others with them entirely red.

PHYTOPHAGA.

Cassididæ.

Hoplionota dorsalis, sp. n.

H. breviter oblonga, subnitida, flava; thorace dorso piceo, utrinque plagis duabus punctatis, lateribus flavis profunde haud crebre punctatis; scutello nigro; elytris disco piceo, crebre fortiter punctato, elevationibus nitidis instructo, marginibus piceis macu-

lis quatuor flavis notatis, profunde haud crebre punctatis; corpore subtus flavo-testaceo.
Long. 3–3⅓ lin., lat. 2½–2⅗ lin.

Head pitchy brown, opaque, but with no distinct punctuation; epistoma truncate in front, narrowed towards the eyes, with the front margin obscure yellow. Thorax pitchy in the middle, dirty yellow at the sides; disk with four strongly punctured shallow impressions, the sides deeply but not thickly punctured. Scutellum black, or nearly so. Elytra as long as broad, very slightly rounded at the sides, bluntly rounded at the apex, pitchy brown, the discoidal part rather darker, especially the raised parts; the margins have four large yellow spots, one on each side about the middle, and another on each side of the apex: each elytron has a small tubercle on the shoulder, and between this and the scutellum a carina turned outwards posteriorly; in the middle there is a rather strong trigonal tubercle, from the angles of which two very short carinæ are directed forwards, one towards the lateral margin, and one long ridge directed backwards nearly to the apex; this ridge is raised in the middle; between this ridge and the lateral margin there are two small tubercles.

Hab. Queensland, Mackenzie River. Brit. Mus.

BIBLIOGRAPHICAL NOTICE.

Annual Report of the United-States Geological and Geographical Survey of the Territories, embracing Colorado and parts of adjacent Territories, being a Report of Progress of the Exploration for the year 1874. By F. V. HAYDEN, United-States Geologist. 8vo. 508 pages, with numerous Plates and Maps. Washington, 1876.

THE work of the officers of the United-States Geological and Geographical Survey presents frequently features of considerable difficulty. In the sparsely populated areas of the West the parties intrusted with the duty have to be specially organized both for subsistence and scientific work, inasmuch as their labours are often conducted in territories where no assistance can be obtained from the locality surveyed. Thus the Colorado survey, conducted by Dr. Hayden, was separated into seven divisions, to each of which was assigned special duties—as the topographical and geographical section, those for the primary triangulation and photography, as well as a quartermaster's department, on which devolved the transport and supply. Each of these divisions consisted further of a complete staff of scientific observers, comprising botanists and meteorologists, as well as those more directly concerned in the actual work of surveying.

This complete and careful organization has produced the excellent results told in the valuable volume before us; and the carefulness of this work, as well as the number and excellence of the illustrations, reflects considerable credit on the department to whose energy we are indebted for this valuable addition to scientific knowledge.

Starting from Denver on the South Platte river, where the headquarters were established, the various divisions examined and mapped that portion of the territory extending, roughly speaking, from North Park to rather further south than the valleys of the Gunnison and Arkansas rivers, or between the 38° and 40° 30′ parallels of north latitude, and between the 105° and 108° meridians of west longitude—thus comprising the mountainous district of the North and South Park, Elk, Sawatch, and Colorado frontier ranges.

"This new area presented all the different forms of surface-erosion peculiar to a granite, sedimentary, and lava country, making it an exceedingly interesting study, both for its topography and geology. The great lava mesa at the head of the White River is cut by deep cañons that penetrate far into the plateau, dividing the mesa into what appear isolated masses, but which are all connected. One isthmus, from 3 to 12 feet in width and 125 in length, connected a plateau of several miles extent with the main mesa. The highest portion of this mass is on the east side; and from the base of the almost continuous cliffs which border it the country descends in long, timbered slopes to the broad open area of Egeria Park, lying between them and the Park range."

It was examined, Dr. Hayden states, "in the usual manner of the survey"—a carefully coloured geological map, showing the distribution and extent of the rocks, together with numerous sections and memoranda relative to the abundance and occurrence of the economical deposits, being prepared; and then this is adapted to a careful trigonometrical survey of 4 miles to the inch, with 200-feet contours. This latter is reduced one half for publication.

Speaking generally, "the older metamorphic rocks, such as the granites, schists, &c., of probably Archæan age, in which alone the precious metals and minerals of Colorado have been found, and which form the foundations on which all the bedded rocks, sandstones, limestones, &c. of the country rest, are brought to the surface and exposed only along the folded ridges of the Park range, and in the bottoms of a few cañons in some of the southern tributaries of the White River and of the neighbouring tributaries of the Grand." Along the northern portions of the district, and in the extreme west, the surface of the country is mainly composed of Cretaceous rocks, either horizontal or only slightly undulating. The coal, a fairly good lignite, lies in the upper, middle, and lower portions of this group, in definite horizons; but it improves in quantity and quality to the westward. It is in the south-eastern portion, however, near the Grand and Eagle rivers, that the sedimentary rocks, among which occur quantities of limestone and extensive deposits of gypsum, are most folded and contorted; and this is especially well illustrated by the clever drawings that illustrate the report.

As a rule these are merely outline sketches, with but little shading; so that, though they are still most picturesque, nothing is sacrificed to mere artistic effort, but every undulation is so carefully indicated, and the lithological character even of the rocks so well shown, that the nature of the country, both topographically and geologically, can be most easily and satisfactorily studied. It must not be imagined from this that regular geological charts are neglected. On the clearly printed surveys, in which the most intricate contouring of the mountain-ranges never becomes indistinct or obscure, the boundaries of the various deposits are indicated in colours.

But even here there is an improvement on the ordinary method of manipulation. The colour is never dense; generally only one tint is used; but the different deposits are represented very legibly by cross-hatching, continuous lining, chain-dotting, and other methods; so that the clearness of the *plan* is never interfered with.

A remarkable and most complicated fold occurs in the Elk range, and is illustrated by a group of sections at page 70, and an excellent explanatory figure of the causes of the apparently confused arrangement of the strata affected. The upheaval of the area, in parts sudden and abrupt, has led to the cracking of the axis of the fold, and the falling-in and overlapping even of the upper strata; while at the extremities there appears to have been a more prominent and extensive displacement, producing such fissuring of the material as to lead to an extensive weathering and consequent exposure of the lower beds; but this has not been continuous throughout the mountain-range produced. The complicated faults so formed can be at once grasped by an examination of the effective sketch illustrative of the phenomenon. In fact the services of skilful draughtsmen are everywhere apparent. The isolated weather-worn pinnacles of the great valleys, the sombre scenery of the profound cañons, the grand picturesqueness of the mountain of the Holy Cross, on whose sides the snow-filled crevices are arranged in the form of the sacred symbol, the effects of the protection afforded by the hard bands of rock in softer materials, as in the "Monument Park," are all portrayed with effective artistic skill, and still without any apparent sacrifice of truthfulness of appearance; and the value of such sketches as a compound of section-drawing and almost a bird's-eye view is fully exemplified.

In Palæontology, with the exception of seven diagrammatic plates of plants from the Cretaceous beds, the book has no illustrations; but perhaps it is scarcely fair to expect a lengthened account of the fossils characterizing the different groups in a general geological history such as this is. The two monographs (by Leo Lesquereux) on fossils in this report deal (1) with the plants by which the age of the Tertiary lignitic formations may be determined, and (2) with the Cretaceous flora of the Dakota group, those specimens only being figured which are illustrative of the "new materials obtained from this remarkable formation," and which comprises some rare Araliæ, Sequoiæ, and Menispermites.

Not the least interesting chapter in the book is one by Mr. W. H. Jackson, on the curious traces of ancient human occupation that are found along the cliff-sides and escarpments in the extreme south-western portion of the Territory. Grouped or singly along these slopes, some near the highest flood-level of the stream, others at considerable elevations above it, are ruins of stone buildings of various sizes and in various stages of decay. They are constructed of stones about 4 inches square by 7 and 12 inches wide, cemented with clay, and divided into rooms 8 or 10 feet square. Some were of two stories, castle-like in form, and provided with squared windows; but, except abundant fragments of coarse pottery, no other relics of these bygone races could be discovered among the ruins. Their chief peculiarity is their situation. Generally high up on the cliff-side, at the base of the more vertical portions, these buildings, often enclosing the entrances to caves and fissures, though at other times quite separated from the rock, are always difficult of access. The inhabitants had evidently much to fear from hostile tribes; and the position of the buildings, coupled with the fact that they can be at times with difficulty distinguished from the natural stone, indicates that the ancient tribes had selected this inhospitable site for the sake of security. But history tells us that even this effort was vain. Mr. Ingersoll, writing about the aboriginal races of Colorado, asserts that originally they inhabited all the country as far west as the head-waters of the San Juan, and lived peacefully, cultivating with rude implements of stone and wood the fertile valleys of the streams, where they pastured their flocks and herds. But about 1000 years ago their neighbours, the Utes, broke up these peaceful encampments. Driven by slaughter and forays, they retired to the more inaccessible fastnesses of South-west Colorado, and there dug reservoirs and built the watch-towers, of which the relics only remain. And here they stood at bay; but "their foes came, and for one long month fought and were beaten back, and returned day after day to the attack as merciless and inevitable as the tide. Meanwhile the families of the defenders were evacuating and moving south; and bravely did their protectors shield them till they were all safely a hundred miles away. The besiegers were beaten back and went away; but the narrative tells us that the hollows of the rocks were filled to the brim with the mingled blood of conquerors and conquered, and red veins of it ran down into the cañon." The Moquis of Arizona are their descendants. Even these desolate wilds tell a tale of human suffering and aggression that can unfortunately find its parallel in every nation's history.

A special Report on the Mollusca of the region, and Reports on the Topography and Geography, and a good index are also given. The completeness of the volume, and the painstaking care with which a work presenting no ordinary difficulties has been so successfully performed, reflect the highest credit both on the Government that directed its execution, and the able body of scientists to whom its carrying out was intrusted.

MISCELLANEOUS.

Zoology of the 'Challenger' Expedition.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—A notice of the "Zoology of the Challenger Expedition" appeared in your No. for March 1877, and has excited much surprise. It was in the form of an extract from a letter which Mr. Alexander Agassiz addressed to the Editors of 'Silliman's Journal,' dated Edinburgh, Dec. 18, 1876. In this letter the scientific world is informed that the 'Challenger' collections are to be distributed for description in a very extraordinary manner, and "so that the United States will have their fair share of the work." In fact the *Echini, Ophiurans, Radiolaria*, and *Spongida* (almost the most important groups to the zoologist and palæontologist, and dredged up in the grand British expedition at great cost) are to be handed over to distinguished naturalists abroad.

I address you on this subject at the instance of a very considerable number of Fellows of learned societies, and, by permission, in the name of those gentlemen whose work in relation to those groups is well known. I state unhesitatingly that not one English writer on the *Echini, Spongida*, or *Radiolaria* has been communicated with by Sir Wyville Thomson, in whose hands the Government have placed the direction of the results of the Expedition; they one and all have been passed over with contemptuous neglect. For a great nation to send out expensive expeditions and then to distribute the results for determination and description to foreign naturalists, however distinguished, without considering and employing its own naturalists, is rather characteristic of this age of depreciating criticism; but it is a proceeding which can only be tolerated upon a preposterous application of the idea of catholicity in science and the fact of the incompetence of national investigators.

An assumed deficiency of competent naturalists in Great Britain is, in fact, the only excuse for distributing the collections after the fashion adopted by the "Director;" for the stretching of the idea of brotherhood in science, under the circumstances of the Expedition, is silly. I would direct the attention of the Director (whose apparent ignorance of the work of his fellow countrymen would seem to disqualify him for his position) to the pages of the Palæontographical Society's works, and to those of the Zoological, Geological, and Linnean Societies during the last decade. He will find that a Royal Medallist obtained this honour for researches amongst the Protozoa; he will find that an English palæontologist, who has paid great attention to the *Echini*, has given a classification of their main groups which is accepted everywhere; and he will find younger observers who have given plenty of evidence of their only wanting the opportunity to become very distinguished. There is no deficiency of competent workers amongst us.

As a perfectly independent naturalist, I protest most decidedly against Sir Wyville Thomson's course of action, and denounce it as unjust and unpatriotic; and in this protest I am joined, as will be proved shortly, by nearly every scientific man with whom I have communicated. I doubt whether Sir Wyville Thomson is justified by the instructions of the Government regarding the disposal of the Collections; but this question will be settled when the correspondence is moved for in the "House." In conclusion, I wish, in my own name and on behalf of those naturalists who act with me, to express our admiration of the labours of the distinguished men who are mentioned by Mr. A. Agassiz, and our thorough appreciation of his own genius and liberality. We can only regret that these gentlemen have been placed, by no fault of their own, in a position so invidious that they can hardly occupy it conscientiously.

Yours, &c.,

P. Martin Duncan, F.R.S.,
Pres. Geol. Soc.

April 20, 1877.

On the Modifications undergone by the Ovum of the Phanerocarpal Medusæ *before Fecundation.* By M. A. Giard.

We shall take as a type the ovum of *Rhizostoma Cuvieri.* This fine Medusa is thrown up in great abundance, during the whole autumn, on the beach at Wimereux, together with *Chrysaora hyoscella* and some other Acalephs.

The smallest ova taken from the ovary are formed of a transparent vitellus containing a germinal vesicle and a nucleolus. We do not yet recognize in them any enveloping membrane. As the ovum increases in size its transparency diminishes; the vitellus becomes charged with deutoplasm, and the germinal vesicle less easy to appreciate; at the same time a very delicate vitelline membrane, closely applied to the vitellus, may be distinguished at the periphery. In a later stage the ovum presents at its periphery a series of spherules equally distributed over its whole surface, filled with a perfectly hyaline substance, and separated from the external membrane by a thin layer of granular protoplasm, identical with that which occupies the centre and covers the germinal vesicle. An optical section of the ovum may then be roughly compared to that of a young stem of a plant at the moment of the appearance of the first circle of vascular bundles which divide the parenchyma into three parts—one central, another peripheral, and the third radial (uniting the two former). The hyaline spherules increase rapidly, become tangential to one another, at the same time that they reach the vitelline membrane. Under a low power it appears as if the vitellus were surrounded by a layer of cells which project rectangularly at its periphery. Under a higher power it is seen that the central granular protoplasmic mass is united to the vitelline membrane by a multitude of little columns, widened at their two extremities, like the columns formed in a cavern by the union of the stalactites and stalagmites. These little columns are formed by a less granular protoplasm than that of the centre of the ovum.

Lastly, at the moment when the ovum arrives at maturity, the little columns are ruptured, leaving no traces except slight thickenings of the vitelline membrane at the points where they were attached. We have then, therefore, a central granular mass in which the germinal vesicle is no longer directly observable, and round this mass a transparent zone which separates it from the vitelline membrane.

Prof. Harting has seen, in the ova of *Cyanea Lamarckii* and *C. capillata*, the stage in which the little columns exist *; but not having completely followed the preceding phases, he has given an erroneous interpretation of the appearances observed. He regards the ova of the *Cyaneæ* as furnished with a vitelline membrane of considerable thickness and pierced with a great number of pores leading from the outside to the interior, such, he says, as are met with in the ovum of some Mammalia, perhaps in all, and also in the ovum of many Teleostean fishes, in which, however, these pores acquire much more considerable dimensions. It is evident that these supposed pores are nothing more than the columns of clearer protoplasm above mentioned. In this way the suppositions of Harting with regard to the physiological function of these pores also fall to the ground. He believed them to serve for the respiration of the ovum, and perhaps also for the passage of the spermatozoids.

The preceding observations were made at Wimereux during the month of September 1875. They are a part of a set of researches, still unfinished, on the development of the Medusæ; and I have only decided to publish them now because they appear to me to acquire a much greater generality and importance than I at first supposed, in consequence of the magnificent researches of Weismann † on the ovum of the Daphnoideæ.

Weismann has observed a process precisely similar to that just described, in the formation of what he calls the shell (*Schale*) of the winter egg of the genera *Polyphemus*, *Sida*, and *Daphnella*. It is remarkable that, in this case, as in that of the Medusæ, the ovum undergoes a tolerably long incubation in a special medium furnished by the maternal organism.

The excretion of the hyaline vesicles, which takes place all over the periphery of the vitellus of the ovum of *Rhizostoma*, may in other animals be confined to one point of the surface; the phenomenon would then take on the appearance of the issue of excreted globules. Considering this process, we may inquire whether the phenomenon so often noticed of the rejection of a certain part of the vitellus at the moment of the maturation of the ovum must be regarded as equivalent in all animals in which it has been observed. Bütschli has shown most clearly that the polar corpuscles of the ovum of *Limnæus*, *Succinea*, *Nephelis vulgaris*, and *Cucullanus elegans* originate by the process of cell-division. I may add

* Niederländisches Archiv, Bd. ii. Heft iii.

† Zeitsch. für wiss. Zool. Bd. xxviii. Heft 1 & 2.

that this is the case also in *Salmacina Dysteri* and the *Spirorbes.* In these different animals the excreted corpuscles have the value of *rudimentary cells* having an atavic signification, and cannot properly be called polar corpuscles. This name, on the contrary, applies to the non-cellular materials, which, being rejected by the vitellus, serve for the formation of the accessory organs of the ovum; for example, the shell or the vitelline membrane. Such are the hyaline vesicles of the ovum of *Rhizostoma Cuvieri.*—*Comptes Rendus,* March 19, 1877, p. 564.

Vertigo Moulinsiana, Dupuy.

This interesting and local little land-shell has been lately discovered by Mr. Henry Groves, while botanizing, in a small marsh between Winchester and Southampton. See 'British Mollusca,' i. p. 256, and v. (Suppl.) p. 160. Mr. Groves's specimens are rather more swollen or barrel-shaped than mine from the west of Ireland; and they agree exactly with some Danish specimens, for which I am indebted to the kindness of Dr. Mörch, as well as with the descriptions and figures of Dupuy and Moquin-Tandon. Küster and Kreglinger called it *V. Charpentieri*, after a MS. name given by Shuttleworth. Heyneman described it as *V. ventrosa*, and Westerlund as *Pupa Lilljeborgi.* Dupuy's name (*Moulinsiana*) dates from 1849, and has priority.—J. Gwyn Jeffreys.

Sponges Dredged up on board H.M.S. 'Porcupine' in 1869–70, *Returned. By* H. J. Carter, F.R.S. &c.

By reference to my communication on Sponges dredged up on board H.M.S. 'Porcupine' in 1869–70 ('Annals,' 1876, vol. xviii. p. 226), it will be observed that they were *then* in my possession; and being the property of the Nation, I have now to add what I have done with them, which will be told by the following letter:—

(Copy).

"'The Cottage,' Budleigh-Salterton, Devon.
24th March, 1877.

"My Dear Thomson,—I have this day forwarded to the address you gave me in your letter of the 14th inst., viz. '1 Park Place, Edinburgh' (carriage unpaid, as they came to me), three boxes containing all the Sponge-specimens (both wet and dry), dredged up on board H.M.S. 'Porcupine' in 1869–70, which you sent in 1872, excepting about as much as would fill a hen's egg, which has been chiefly used in their examination.

"I took the boxes (also addressed 'To Scotland *viâ* Midland Railway') to the office of the Bristol and Exeter line in Queen Street, Exeter, *myself,* and saw the clerk write 'Van Rail' on each of them, stating that they would reach their destination on Monday next, which I trust may be the case—and safely, too, as, to insure this, all reasonable care has been taken in packing and addressing them both *outside* and *in.*

"The covers have been screwed on, so that there will be no occasion to use force in opening them; and each box has been corded both for further security and for furnishing them with a handle respectively, whereby they may be removed from place to place easily and without any excuse for turning them upside down.

"The boxes respectively contain *all* the Jars you sent me, viz. 108, and the same JARS too, with their contents respectively, exactly as I received them, *minus* the quantity above mentioned; but with the addition of a few small bottles into which respectively some of the smaller Type specimens have been put to avoid confusion. And, although all have had their stoppers tied down where necessary, yet as these do not in all instances fit tightly, and a few of the smaller Jars have been laid on their sides for convenience, while their contents respectively are only just covered by spirit with the usual bit of muslin, it seems to me desirable that they should be unpacked directly after their arrival, and sufficient spirit added to prevent the occurrence of mildew, whereby, for accuracy of detail, the minute examination of a sponge is destroyed.

"Each Jar has *my* 'running number' on it *outside*, besides the same number in pencil on vellum loose *inside*. The Type specimens respectively, in each Jar too, are labelled on the latter *outside*, and ticketed *inside* with the letters 'T. S.' in pencil, also on vellum.

"Moreover, I herewith enclose a MS. Catalogue of all the Jars and the dry specimens respectively, in which also the 'running number' of the Catalogue will be found to correspond with that on the Jars &c., respectively, as follows:—The first column contains the 'running number;' the second the figures on the *original* label of the Jar when it reached me, which were *then fortunately* copied, as they are now, in many instances, obliterated; the third column bears a list of the Sponge-specimens contained in each Jar, with the Type specimens written in *red ink* for distinction, and the rest in common dark ink—the former ticketed as above mentioned, and the latter *un*ticketed, as it is assumed that these, which have been long since described and illustrated, will be easily recognized. Lastly, the fourth column, headed 'Remarks,' is intended for further elucidation of the specimens, as well as to indicate the volumes &c. of the 'Annals and Magazine of Natural History,' respectively, in which the Type specimens have been described and illustrated.

"It also seems to me advisable that *all* the Type specimens should at once be taken out from their Jars respectively and put into Jars of their own by themselves; for some of them are in great plurality, dispersed throughout the collection, and others single or at present unique; whereby they would be ready for distribution, as you state that 'they will be sent to the British Museum with the "Challenger" collections.'

"Finally, the dry specimens will be found in the same two little boxes in which they came to me, inclosed in one of those mentioned, also numbered in accordance with the list at p. 39 of the Catalogue.

"A 'Postal Card' addressed to myself, with the words 'All has arrived safely" written on it, is also herewith enclosed to save you trouble in sending this acknowledgment to me by return of post if convenient, after the receipt of the Boxes, with these words alone, or instead of them any other observation you consider necessary.

"As stated to you before, I can vouch for the accuracy of what I have published respecting the Type or New Specimens among these Sponges; and that is all that Science requires or can demand, either from my head or my pocket, *gratuitously*.

"I am, my dear Thomson,
Yours very truly,
(Signed) Henry J. Carter."

"*To*
Professor Sir Wyville Thomson,
20 *Palmerston Place,*
Edinburgh."

Of the Boxes having reached their destination I had notice by the receipt of *the* "Postal Card" on the 28th March, signed "C. Wy. T.," and stating that they had "arrived all right," but had "not" been "opened." So far I am no longer accountable for these specimens.

Budleigh-Salterton, April 25, 1877.

On the first Phenomena of the Development of Echinus miliaris. By M. A. Giard.

The important controversies to which the investigation of the first development of the egg of the Echinodermata have given rise have led me this winter to undertake a series of researches upon the common urchin of the shores of the Boulonnais, *Psammechinus miliaris*. As a term of comparison in some difficult points I had the eggs of the common starfish (*Asteracanthion rubens*). The spawning ceases in both species towards the end of March.

The methods employed by me are those of direct observation and of coloured preparations. The latter were especially useful for the observation of the *caryolytic figures* (Auerbach) or *amphiasters* (H. Fol). I obtained excellent results by employing acetic acid, ammoniacal carmine, and picric acid, applying these reagents successively and in very small quantities. The preparations thus obtained are very beautiful; but, unfortunately, they cannot be preserved more than a few days.

Besides the mucous envelope the egg of *Echinus miliaris* possesses a very delicate vitelline membrane, and this even before fecundation, as has been asserted with regard to allied species by O. Hertwig and Perez. A little while before maturity the germinal vesicle presents the reticulum characteristic of old nuclei. The nucleolus contains an irregular nucleolinus. When the egg is mature, the germinal vesicle quits the central point and enters upon re'rogression. Its elements, mingled with those of the nucleolus, form an amœboid mass with more or less torn outlines, which soon attains the periphery of the vitellus, when it divides into two parts, producing a caryolytic figure. One of the stars is directed towards the centre of the egg, and very rapidly acquires the form of a rounded nucleus. It is this nucleus that O. Hertwig regards as the germinal spot, which has escaped the transformation affecting the germinal vesicle. We shall, like H. Fol, call it the *female pronucleus*. This nucleus always appeared to me smaller than the nucleolus of the egg—an observation which appears to me difficult to reconcile with the opinion of O. Hertwig. Moreover I have frequently met with ova in which the Wagnerian spot was no longer visible, and in which the female pronucleus did not yet clearly present the nuclear appearance. On the other hand, it is incorrect to say that the *female pronucleus* has no genetic connexion with the nucleolus of the ovule, seeing that the substance of that nucleolus, mixed with that of the germinal vesicle, serves for the formation of the first *amphiaster*, which gives birth to the female pronucleus.

By examining, without reagents, a great number of eggs recently deposited and not yet fecundated, we observe very interesting facts. The egg presents two little cumuli of a protoplasm clearer than the rest of the vitelline mass. These two cumuli may be variously placed with respect to each other; but very generally they are placed at the extremities of one diameter. One of them originates at the expense of the brother star of the female pronucleus; this star forms an unequal caryolytic figure, the small star of which becomes the cumulus in question; this cumulus, lastly, produces the first polar globule; the second originates subsequently from the first. The polar globules are very small in the urchin, and, moreover, they disappear very rapidly; lastly, they do not remove far from the surface of the vitellus, and it is therefore possible that in *Toxopneustes lividus* they may have escaped the notice even of so practised an observer as O. Hertwig.

I have said that in order to make these observations it is necessary to take recently deposited eggs: the deposition may be induced at will in several ways. The same phenomena may also be observed, however, in ova taken directly from the genital gland; but in operating thus we are exposed to a source of error. In fact, with the liquid of the perivisceral cavity a certain number of the amœboid elements which float in that liquid are very frequently removed; and these elements, by attaching themselves to the surface of the vitelline membrane, which is intimately applied to the vitellus, may simulate vitelline cumuli or even polar globules. All confusion is avoided by taking deposited eggs, and following them step by step for some time up to the moment of fecundation.

As soon as the egg is brought into contact with the spermatozoids, the latter apply themselves by their heads over the whole periphery of the membrane, and impress upon the vitelline sphere a very rapid gyratory movement. The vitelline membrane, hitherto very close to the surface of the vitellus, separates from it by degrees; and, in consequence, the second cumulus, the apex of which adheres to the membrane, is drawn out into a cone, uniting the vitellus to the surface. As no spermatozoid is seen to penetrate between the vitelline membrane and the vitellus, round which there exists a large clear space, I incline to think that the second cumulus serves for the passage of the spermatozoid, either by the apex of the cone terminating at a pore in the membrane, or (which appears to me more probable) by the fecundating act consisting essentially in a diffusion of the male protoplasm through the membrane at the point where this is directly in contact with the female protoplasm—that is to say, at the apex of the cumulus.

The protoplasmic cone uniting the membrane with the vitellus soon detaches itself from the membrane and reenters into the vite-line mass. By employing colouring substances the egg then presents three nuclei, two situated near one pole of the egg, the other at the opposite pole. Of the former two, the superficial one is the nucleus which, by dividing, forms the polar globules; the other, more deeply seated, is the female pronucleus; the nucleus formed at the opposite pole, which is at first superficial, is the male pronucleus, which, starting from the point where the cumulus of fecundation was situated, directs itself towards the centre of the egg to meet with the female pronucleus, with which it enters into conjugation to form the first nucleus of segmentation. I do not think that the nucleolus of the male pronucleus can be regarded as the unmodified head of a spermatozoid.

It seems to me that the numerous spermatozoids fixed upon the membrane of the egg, and which appear to have no function, are not quite without influence on the act of fecundation. The gyratory movement which they give to the egg, a movement so easily detected in the Echinodermata, the Ascidia, and a great many other animals, perhaps assists in favouring the progress of the two *pronuclei* towards the centre of the egg. I have frequently remarked that the eggs which had not turned for a certain time were developed irregularly, and sometimes even did not enter into embryonic evolution.

Is the existence of a cumulus of fecundation peculiar to the Echinodermata? Prof. de Lacaze-Duthiers, in his splendid monograph of *Dentalium*, figures in the egg of that mollusk a mamilla situated at the pole opposite to the polar globules, and which may perhaps have the same signification as the cumulus of the urchin. However the eminent zoologist declares that he could not say whether this mamilla is visible before the arrival of the spermatozoids.

In the common starfish the cumulus of fecundation is more difficult to see than in the urchin; but, on the other hand, the polar globules are much more apparent, and their production presents more clearly the picture of a cell-division with unequal products.—*Comptes Rendus*, April 9, 1877, p. 720.

Obituary.

John Leckenby, Esq., F.G.S., F.L.S., died at Scarborough on the 7th of April, 1877, in the 63rd year of his age. He was an excellent and zealous naturalist, and deservedly possessed the esteem of all his numerous friends and correspondents. Yorkshire has lost in him one of her best men of science. Mr. Leckenby became a contributor to the 'Annals' in 1858; and his last communication was made, in conjunction with Mr. Marshall, in December 1875. He also published papers on local geology in the 'Quarterly Journal of the Geological Society' and the 'Geologist' in 1859.

THE ANNALS

AND

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[FOURTH SERIES.]

No. 114. JUNE 1877.

XLIV.—*On the Variability of the Species in the case of certain Fishes.* By Dr. V. Fatio*.

Several authors have of late years demonstrated the influence of the surrounding medium upon organisms, and indicated in various particulars the variability of the species.

The *struggle for existence* and *natural selection* especially are no longer subjects of doubt with many zoologists.

A change in such or such a condition of existence almost always superinduces a parallel modification in such or such an organ, the mode of action of which is more or less affected; and this first translation of the external influences necessarily draws after it corresponding disturbances in several other parts characteristic of the species.

Darwin, in his work on the Origin of Species, gives the name of *correlative variation* to this kind of reaction of a modified part upon other corresponding parts, and demonstrates sufficiently by numerous examples that the changes which have taken place in an individual may be reproduced and multiplied by heredity. Häckel distinguishes direct or immediate influences, acting upon the individual, and indirect or mediate influences, which only become perceptible by heredity. This latter author even devotes a whole chapter of his 'Natural History of Creation' to this subject, under the title of "Laws of Adaptation."

* Translated by W. S. Dallas, F.L.S., from the 'Bibliothèque Universelle: Archives des Sciences,' tome lviii. p. 185.

Several naturalists have already more or less studied and described the series of transformations which, under the influence of the variability of the conditions of existence, have gradually modified, sometimes the actions, and sometimes the forms of certain animals and plants, often sufficiently to render unrecognizable the traits of relationship which ought to unite individuals which, at the first glance, are completely different.

The particular point to which I desire here to call attention will not, therefore, find its interpretation in an entirely new order of ideas. However, as each new stone added to the edifice of an opinion cannot fail to be of use, I think I ought to take advantage of some of my most recent observations to expound succinctly some reflections which have by little and little grouped themselves in my mind since I have investigated the Swiss Vertebrata and their variability under different conditions.

A conscientious zoologist can no longer establish new species so easily as heretofore. Many apparently distinctive characters fall to the ground or lose more or less of their importance before a thorough study of possible modifications. Each character calls for serious discussion; it is necessary to seek, if not the limits of variability, at least the points which, under such or such an ensemble of appreciable conditions, seem to be the most solid.

It is, in fact, to the narrowness of the limit ascribed to the species in the old definitions, and to the often inconsiderate multiplication of specific types apparently different, that we owe in a great degree the confusion which now reigns either in certain parts of classification, or in the minds of many people who seek, in different directions, the foundation of truth.

The species is very difficult to define or to limit; for a group of individuals similar to each other, exactly like a certain individual, attributed to such or such a species, seems to be nothing more in reality than *the actual expression, under certain given conditions, of a form taken upon such or such a step of the animal scale*, or upon such or such a branch of a genealogical tree*.

* The subject of which alone I wish to treat here is too restricted to lead me to launch out now upon the hypotheses as to the derivation of the original types. Science in general and palæontology in particular cannot yet offer us any definitive solution of this question. I have nothing to do, therefore, at present with the question whether there have been several animal scales, or whether a single scale has been at first composed

Whether it belongs to a single primitive tree or to one of the descendants of the latter in the forest of beings, the bud, species or variety, which terminates a branch must always possess the power of yielding more or less to the exigencies of a variable medium, and of being able to produce thus new modifications of greater or less importance, themselves endowed, in their turn, with greater or less variability and vitality.

Most authors who desire to give an absolute definition of the species, generally invoke, as evidence of stability, the difficulty of intercrossings between distinct species, and the comparative sterility of the hybrids thereby produced, as also the facility with which, on the other hand, the races derived under our eyes from a single stock multiply together. These difficulties, however, which are often exaggerated, frequently seem to result from the desire to unite, for certain advantages, organisms endowed with useful qualities of too opposite a nature. In the two cases we are at a very different distance from the parent form; it is necessary, as Besnard has already indicated, to be able to make one's choice, or to return further back in the ramifications of the genealogical tree. It is probably for an analogous reason that it is usually the lower types that present most possible modifications or combinations. A longer duration of the influences, by more profoundly altering the organisms, evidently diminishes the sentimental attraction, if we may so call it, that a similarity of appearance must necessarily favour, and at the same time renders a perfect combination of the organism of the two individuals selected less easy to be effected in a manner sufficiently complete to become productive.

It is impossible not to see here the existence of two general laws opposed to one another and constantly struggling one against the other, and which, according as they are called by circumstances to predominate over one another, maintain the species within relatively immutable limits, or, on the contrary,

of a single step. In other words, I cannot decide whether the genealogical tree of living creatures was planted with all its smallest branches, as Agassiz thought, or whether a primordial cell, in place of a seed, originally gave birth to a genealogical tree which, at first an aquatic plant, gradually extended its branches upon the solid ground, and, growing larger and larger, put forth all the branches which now-a-days constitute the totality of the known and unknown organisms on the face of the globe, according to the views of some disciples of Darwin, Rolle, Häckel, and others. It matters little to me, in fact, in the ascertainment of the variability of an existing species, whether I assume the existence of one or several seeds, whether I see a single tree constantly increasing in size, or perhaps still believe in the existence of a whole forest of genealogical trees, sprung from the seeds of a single plant, but from germs which have fallen successively under different conditions.

urge it towards constant variability. *There seems to exist a law of hereditary resemblance which tends always to keep to the specific type, and a law of variability by adaptation, destined, on the contrary, to modify every organism with the object of fitting it to new conditions of existence.*

Differences and variations of medium being incontestable, it is irrational to try to prove the stability of the species by closing our eyes to one whole side of the question, citing only those cases in which the first of the above laws has gained the victory, either directly or by return or atavism. *In the study of the variation of the species, in order to be impartial, we must, I think, commence by fully recognizing the importance of the first of the two opposing laws, and freely accepting it, from the first, as a sort of brake preimposed upon future modifications.*

While attributing great variability to the species, we must not, however, I think, refuse proper names to all the more or less different forms of creatures in various classes. Natural history and classification have need of these distinctive designations, which become, as it were, so many heads of chapters and *cadres* for observations. Now-a-days, indeed, there are many distinguished naturalists who see no inconvenience in complicating the binary nomenclature by the creation of a special name for each variety. The accumulation of names is not, in fact, dangerous, if we always take care to indicate the relations or affinities which bind together two forms nominally separated.

It has been said that it is the richest genera which furnish the greatest amount of examples of variation by adaptation; this observation would, I think, be better represented by the very simple remark that it is the largest genera which include the most false species founded upon local varieties.

I have often been struck with finding in several large genera a species at once much more widely distributed, and much more subject to vary, than the others, even in a very restricted space. The red frog, in the genus *Rana*, and the common toad in the genus *Bufo*, among the Batrachia, as well as the trout in the genus *Salmo*, and the roach in the genus *Leuciscus*, among fishes, may, among others, furnish us with striking examples of cases of this kind.

Such species, a sort of predominant branches, must be regarded as the parents or stocks of several other so-called species, more or less deviated, in different directions and in different countries; they are the type and, as it were, the centre of a natural group of forms, all of which resemble them in different degrees.

Although called upon to vary, more or less, and with time, in certain countries, when in spreading it has met with new exigencies, the species may nevertheless remain relatively fixed, or vary comparatively little in the same locality or in analogous media, so long as the conditions are not sufficiently modified. This is what led the illustrious Cuvier to say, and up to a certain point with justice, "Experience seems to show, on the contrary, that, in the actual state of the globe, varieties are confined within very narrow limits; and so far as we can go back into antiquity, we see that these limits were the same as at the present day."

I have already several times recognized and indicated, in certain widely distributed species belonging to various classes of our Vertebrata, nascent divergences in some part or other of the animal. These variations, more and more strongly marked until they reach adaptation through the persistence of the influences and heredity, constitute what I call *tendencies*, or the origin of new bifurcations upon a genealogical branch. Often perceptible in certain individuals in a very limited field of observation, they increase more and more in other countries with the augmentation of the first small dissimilarities of condition, and thus advance towards *temporary maxima*, which in various places have received different specific names.

The origin of these divergences may be, according to circumstances, attributed to a persistence of the characters of youth, or to the predominance of the distinctive features of one or the other sex, or to the reproduction by heredity of a quasi-accidental anomaly, or, again, in consequence of the struggle for existence, to new exigencies of the conditions of life. I have particularly indicated, in the number of the 'Archives de la Bibliothèque Universelle' for September 1876, the coexistence, in the waters of the Lake of Geneva, of three very distinct tendencies in the forms ot the roach (*Leuciscus rutilus*). Each of these three varieties (deep, elongated, or thick) already indicates, with a primary modification of the general form, more or less strongly marked correlative deviations in several of its characters.

Without going beyond the restricted bounds of our own ichthyological fauna, I might cite several other cases of varieties of one and the same species living thus almost side by side, although kept distinct by exigencies of medium, which are often badly interpreted. It may suffice for me, in this connexion, to refer to the example of our freshwater trout, which, according as it is more or less confined to small streams or to the deeper waters of our lakes, presents a facies so different as to have passed hitherto for two perfectly distinct species in the eyes of most ichthyologists. It is well known that the size of the basin and the relative abundance of alimentation have much influence on the dimensions of the animal. The little brook-trout, which most zoologists still distinguish under the name of *Salar Ausonii* (on the ground of its small size, its thickset form, the shortness of its nose, the comparatively larger dimensions of its eye, and some peculiarities in its dentition), is, in fact, in my opinion, nothing more than a form of the great trout of our lakes, which is called, according to circumstances, *Trutta lacustris*, *T. Schiffermülleri*, *Fario Marsiglii*, or *Salmo lemanus*. Most of the characters proposed for its distinction are those of the early age of the fish. In a small stream the trout, which cannot grow for want of room, arrives at an advanced age retaining more or less the characters of infancy. It would be still more surprising to meet with trout of 30 lb. in a few inches of water. Moreover I have already remarked several times that the fishes—such as the perch (*Perca fluviatilis*) and the chub (*Squalius cephalus*), for example—which inhabit the cold and poor waters of some of our small elevated lakes in the Alps, also usually retain several of the characteristic features of youth, their size also being small.

Many naturalists, misunderstanding the natural affinities which bring together allied species, although at present perhaps separated by very important geographical boundaries, have gone so far as completely to deny the production of races in organisms in a free state. Faivre, among others, following Godron, unhesitatingly maintains that variations and races are very rare among plants and animals in a wild state. This author appears to me, in particular, to place himself in flagrant contradiction to direct observation when he says, for example, "The races found under these conditions are exceptional, to such an extent that many naturalists do not hesitate to call in question their existence."

Wallace, holding an exactly opposite opinion, published in 1858 a very interesting memoir on the tendency of varieties to depart indefinitely from the original type. Trautschold also, in 1861, drew a somewhat different conclusion from analogous observations: according to the latter, "The varieties which unite two species have also the power of modifying themselves in more than two directions; but the result obtained by the changes effected in a third direction must not be regarded as a simple variety, it must take rank as a new species." The first author perhaps exaggerates, while the second may seem to wish to specify a little too much; however, it none the less appears, from what they say, that to them, as to me and many others, variability is becoming more and more evident.

A variety duly ascertained may be regarded, according to the point of view that we take up, *either as a bond between two so-called recognized species, or as a tendency towards the creation of a new form.*

The question as to the existence of a limit to the variability of the species appears difficult to settle; nevertheless it may be remarked that, for the perpetuation and constant augmentation of a deviation at one point, the gradual establishment of a certain necessary equilibrium in the correlative variations is required. A rapid modification of an organ which, in consequence of internal incompatibilities or external contrarieties, is not followed quickly enough by corresponding changes in other parts of the organism, will almost always superinduce either an arrest of the transformation in this direction, or the extinction of the new divergent form, whether we regard the latter as a species, as a variety, or simply as an abortive shoot on a genealogical branch.

A great number of observations tend to prove more and more that, in the struggle for existence, natural selection always gives the victory to the best organized, and that the case of the strongest is always the best. Influenced in various directions a species will give origin to several more or less different offshoots; and only those will long persist which may be sufficiently strong to bend, *without excess and in an equilibrated manner*, to the various exigencies of different conditions.

There is therefore a limit, in a certain sense; but this limit, being due to a rupture of equilibrium, and often accidental, is wider or narrower for the different varieties; and each of the latter, by departing more and more from the type, always runs the risk of meeting reverses in some part or other of its organization when in a false direction.

A natural barrier, even when very narrow, sometimes suffices to establish differences, striking enough at the first glance, between two allied forms. If, in the examination of a great number of individuals taken under the two conditions, we can still perceive the transitional steps which explain the series of transformations, we must, I think, for the time, regard these two still divergent or parallel forms only as local races of the same species; but, on the contrary, if one or several important steps are wanting in the scale of comparisons, we may regard these two opposed forms as different species, until evidence to the contrary is produced.

These first two cases have often occurred to me in the comparative investigation of the fishes in the Swiss lakes of the north and south of the Alps. But there is a third case, with regard to which I must here say a few words—namely, the rare case in which we find suddenly, and as it were by chance, among a great number of individuals of two derivations, and sufficiently constantly different to appear to belong two species, an individual which, in one of the geographically separated forms, resembles the other form in all its characters, so as actually to be mistaken for it, and thus betrays the heredity or identity of origin.

I may cite, as a curious example of this last case, the discovery that I made in the lake of Lugano of a bleak (*Alburnus*) which, south of the Alps, perfectly recalls the form proper to our representative of the genus north of that chain. It is well known, in fact, that hitherto all ichthyologists have recognized the bleak of the Ticino and of Italy as completely and specifically distinct from that which inhabits the waters which have their source north of the Alps. Now the specimen in question, found among hundreds of similar individuals of *Alburnus alborella*, presents, both in size and coloration, and in its various forms and proportions, nearly all the characters regarded as distinctive of our *Alburnus lucidus*. Never before has such a bleak been noticed as inhabiting the Italian waters; and it would be very difficult for me to explain under what influence this reversion can have been produced. However, in presence of this revocation of consanguinity, I can now do no otherwise than regard *Alburnus lucidus* and *A. alborella*, which at first sight are very distinct, as two races, the one northern, the other southern, of one and the same species. Although it would appear that we must go back very far to find the epoch at which these two supposed species lived under the same form, under identical conditions, it none the less seems that we have to do here with *a complete case of atavism, though of very distant date.*

The partisans of the variability of species have laid much stress on the study of the variations of domestic animals. Deformations produced accidentally or by artificial selection are, in fact, comparatively easy of demonstration in subjects necessarily submitted to our observation; but the appearance in free creatures of modifications superinduced by natural selection, or at any rate by influences independent of the will of man, being always more difficult to seize, it seems that the study, under natural conditions, of a divergence of any kind in any organ must also possess its interest and value.

Let us confine ourselves now to the study of the modifications introduced by circumstances into the organs of prehension, and endeavour to trace as far as possible some of the correlative compensations necessarily superinduced in other parts of the organism. We may even reduce our field of observation to the investigation of these organs in certain fishes, as indicated in the title of this note.

To attain the same end, nature must sometimes employ, according to circumstances, very different means; moreover, even with identical means, it often happens that, under different circumstances, the correlative modifications are not effected alike, sometimes in different individuals of the same species, sometimes in the different parts of the same individual.

The organs of prehension, so varied in the animal kingdom, being, in the fishes, represented by the mouth alone, one can easily understand the influence that may be gradually exerted upon the arrangement and proportions of this buccal cleft in the first place, and then upon the whole organization of the individual, by the modifications introduced into the actions and "*gymnastic*" of the animal by the necessarily different mode of prehension to which it must adapt itself in order to procure its nourishment in one condition or position or another —above or below it, at the surface or the bottom of the water, for example.

A mere glance at a few marine fishes will amply suffice to show us many different aspects of the buccal pieces appropriated to one mode of prehension or another; we have only to consider, for example, the comparative forms of the body, or of the limbs and jaws, in the genera *Xiphias*, *Histiophorus*, *Centriscus*, and *Belone*. But under conditions more like those of our own country, the freshwater species may also show us various forms of the mouth adapted to different uses. As I shall have to revert to these, I shall confine myself here to referring *en passant* to the case of *Toxotes jaculator*, which takes its prey at the surface, and often even provokes the fall of the insects on which it feeds by projecting a drop of water at those which are placed above the liquid. For this purpose this fish has the lower jaw considerably prominent and turned up, and at the same time the fins placed far enough back to allow the entire head of the animal to be easily kept raised into the air. If I cared to go beyond the class which particularly occupies our attention I might also recall the fact that those birds which are condemned, without swimming, to seek their nourishment at the bottom of the water, have the legs, the neck, and the beak all greatly elongated; whilst in those which, like the snipe, for example, are called upon to rummage beneath them, not at the bottom of the water, but only in the firm ground, the legs, naturally, do not follow the beak in the necessity of elongation. It would be easy also to cite other examples already indicated among the Mammalia, especially in certain races of cattle; but we will not go beyond our self-imposed limits.

My business is only to demonstrate *that the general laws of adaptation which presided over the formation of types, continue always to exercise their influence upon all individuals in different conditions**.

Moreover I think that, in such investigations, we must not seek too far for our points of comparison; for, with its purpose and its organization, each type also appears to have its own tendencies to variability, may be as a predominant direction for the possible modifications in a certain medium. In other words, *each species, or each group of allied forms, appears to me, in our country and under certain conditions, to vary preferently towards such or such a given point.* The parts more easily influencible constitute for the species at once the weak point from the side of classification, and the strong point as regards facility of adaptation, force of resistance, and power of extension.

It is evident that, according to the nature of the persistent exigencies of the medium, it will be sometimes one and sometimes another of the organs of relation that will be first called upon to become modified; but it is no less true that *in each species we shall always find, in a given medium, a particular character which is more subject to vary or more prompt to become modified.* The exact determination of the character which, being the first modified, has reacted upon all the others, has always appeared to Darwin excessively difficult; and yet *it is upon the study of the variable preponderance of the*

* The history of our globe, painfully elaborated by geology and palæontology, seems to be more and more in accord with zoology and physiology upon this point. After leading us, in the forms of organisms, through a whole series of successive modifications corresponding to the different geological epochs and the different exigencies of the media of the latter, palæontology has shown us, in fact, how, in sequence of a change of stratum and of conditions of existence, many forms have often disappeared, whilst some only continued to exist. In consequence, perhaps, of a too rapid transformation of the conditions of life, those only have been able to subsist which were sufficiently prepared or modified to be able to sustain a rupture of equilibrium fatal to many others. Although we cannot always so easily understand the sudden appearance in a new stratum of an entirely different fauna, I do not doubt, in common with some authors, that by gradually piercing the obscurity which necessarily envelops the variability of creatures long since lost, we shall succeed in explaining these apparently sudden and complete changes without having recourse to the necessity of a new creative intervention.

different characters that the more or less rational establishment of genera and species in great part depends.

The great functions of life, nutrition and reproduction, naturally govern this selection of the more or less influencible parts. According as the preservation of the individual or the perpetuation of the species is brought into question by the changes of medium, it is evidently also among the external organs which serve one or the other that the modifiable character the best fitted to effect the adaptation will be selected. The degree of complaisance, or, on the contrary, the exigencies of these two essential functions, allow more or less latitude to such or such an organ which brings them directly into relation with the outer world.

Although only considering the question from one of its sides, and devoting ourselves more particularly to the investigation of certain parts specially useful for the preservation of the individual, we nevertheless cannot here help recognizing, as it were, *a brake imposed upon the too rapid modifications of one organ by the exigencies of another—may be, as a new struggle in view of a more or less stable equilibrium, until perfect adaptation.*

As I have said, the whole organism of an individual must be able to bend itself to the more or less sudden changes necessitated in the modification of gestures or habits by the apparition of a new exigency, and follow in an equilibrated manner the transformations effected in the organ of relation which was first called upon to vary.

If we were to select as examples of struggle between external and internal organs in certain fishes, on the one hand, the eye or the mouth as displaying the appetites, and, on the other, the air-bladder as above all subjected to the conditions of temperature or pressure of the medium, we should soon find several curious cases of ruptures of equilibrium, both accidental and normal, and injurious, sometimes to the individual, sometimes to the species.

Among others, we know that in the perch (*Perca fluviatilis*), suddenly drawn up by the line from the depths of our lakes, the air-bladder, being too rapidly transported from a considerable pressure to a much smaller one, is suddenly distended in an extraordinary manner, projecting itself into the mouth, and sometimes even driving out a part of the digestive organs. We also know that the pike (*Esox lucius*), when carried, by its voracity, too rapidly from the deeper towards the superficial strata of the water in pursuit of prey, is forcibly retained at the surface by an exaggerated development of the swimming-bladder, and often perishes in consequence of this injury, which in this case is quite voluntary.

In these two instances a too rapid change of conditions leads to a rupture in the equilibrium of the organism, and often involves the death of the individual. The elastic fibres of the air-bladder, too rapidly distended, can no more resume their empire and exert a sufficient compression; and this would not have happened in consequence of slower and more gradual transitions.

But the principal purpose of the air-bladder is not, apparently, to condemn the species to an invariable habitat; the function of this organ is rather, by pressing against the backbone, to keep the individual in the normal position proper for its preservation. Other examples will enable us to understand the importance of this function from the point of view of the preservation of the deviated race, and the comparative action either of certain organs of relation upon the bladder, which is at once a moderative agent and one of equilibrium, or of the latter upon the position of the individual, and thereby upon some of its external forms.

Every one is acquainted with the goldfish or gold carp (*Carassius auratus*), which normally exhibits oblong forms like those of the carp, but to which the Chinese have found the way to give the most curious shapes. By cleverly taking advantage of the smallest accidental deformations, and instigating and exaggerating monstrous tendencies by subjecting the fish to abnormal conditions, the adroit inhabitants of the celestial empire have actually succeeded in manufacturing goldfish with double and triple fins, with a quasi-spherical body, and with the eyes excessively prominent, or often borne upon a longer or shorter pedicle *.

M. Carbonnier, of Paris, has already remarked that the equilibrium is very unstable in the quasi-globular varieties of the goldfish, and that, after arriving at a certain age, many of the young fishes of this form must perish, from being forcibly kept in a position which scarcely allows them to feed, some of them with the head turned upwards, many with the head turned down. Two years ago I had the opportunity of seeing in the aquaria of this learned observer several adult globular goldfish with more or less prominent eyes, in which the very different arrangement of the mouth particularly attracted my attention. Two of these appeared to me to be especially interesting.

One of them, with a spherical form and a comparatively short backbone, presented a very turned-up snout and a very

* It is believed that this last variety, which has received the name of the telescope-fish, may be produced by causing the light to reach the fish only from a single point.

oblique mouth; it could hardly take any food, except above it or at the surface of the water. The other, which was also globular and had a very oblique mouth, but with a still shorter backbone, remained completely turned over on its back, with its large belly upwards. The latter, it seems, had commenced by being like the other; then, at a certain moment, the air-bladder being more and more displaced by the pressure of the vertebral column, and the centre of gravity shifted, the animal was completely turned over.

It appeared that the reversed goldfish, when food was offered to it after a long fast, could still take nourishment by great exertions, and that, under the influence of this temporary counterpoise in the digestive tube, it could maintain itself for a certain period, and by considerable efforts, in a quasi-normal position, but only to allow itself soon afterwards to be turned upside down again by the air-bladder.

In consequence of a compulsorily abnormal position, the head and then the backbone had gradually been deformed, until the arrival of a moment when, the equilibrium being broken and the fins being unable any longer to struggle sufficiently, the air-bladder intervened to put a forced term to the primary external modifications.

I have for some time observed, in one of the aquaria of M. E. Covelle at Geneva, a very curious pathological case, to a certain extent parallel to that of the goldfish, in an adult rudd (*Scardinius erythrophthalmus*). For about three months this fish has remained at the bottom of the aquarium, always lying upon its right side. The air-bladder, which can no longer press against the backbone, now forms a very apparent swelling upon the left side. In consequence of a paralysis produced, after a fall, in the anterior dorsal muscles of the right side, there took place, by degrees, first an increasing atrophy of the above-mentioned right lateral muscles, and afterwards a gradual deviation of the vertebral column. At present the paralysis has reached the level of the ventrals, and the caudal portion of the body is recurving by little and little towards the back. Nevertheless this fish can still, by great exertions, like the reversed goldfish, take and digest the food that is put from time to time within its reach. Although meagre, it appears to be in very good health, except for its paralysis; its respiratory movements, although rather rapid, are comparatively normal; and the free pectoral fin, during this compulsory repose, nevertheless moves continually, as if to ventilate the branchiæ or agitate the water in the vicinity of those organs. The coloration of the body and fins is perfectly good, and does not seem at present to indicate any impoverishment.

While the air-bladder, which presses against the left flank, keeps the animal lying down, and it is by this means more and more twisted, the eyes are subjected to very different conditions and to very unequal use: the right eye, applied to the bottom, remains in its normal vertical position with regard to the axis of the head; but the left eye, thus condemned to look always upward, turns more and more in order to see round it as much as possible in a horizontal direction. The fish has not been three months in its present position; and yet the globe of the eye, more and more elevated on the frontal side, has already made more than one eighth of a turn, or an angle of 45° to its normal position. Without desiring to make too forced a comparison, one cannot help thinking of the Pleuronectid fishes, which ordinarily repose upon one side, and in which, as is well known, the two eyes, which are at first symmetrically arranged, gradually come together, during development, upon the same side of the animal.

Lastly, from the study of the pathological case of this fish, we may further draw a fresh proof of the fact, which has already been several times demonstrated, *that the will is never free, or that a deformation, even when accidental and ever so small, seems always to be multiplied, in the direction of variability, by an unpremeditated will.* In fact, if, after having struggled in all directions to take its food, the rudd by chance falls upon the left flank, the disagreeable pressure exerted by the bottom upon the displaced air-bladder, and the instability given to it by the convexity of this side of its body, invariably urge the fish to quit this position (which nevertheless would tend to reestablish equilibrium in its organism), and to make effort after effort until it succeeds in replacing itself on its right flank, in a position which tends constantly more and more towards deformation.

Led by such data, either as to the effect of deformations of the mouth, the head, and the body upon the air-bladder, or inversely as to the influence of the latter upon external form, or as to the probable action of differences of pressure and temperature upon the gas contained within the body of the fish, I have lately, with the cooperation of M. Covelle, and in one of his aquaria, twice made an experiment, which on both occasions gave nearly identical results.

We gradually warmed the whole mass of water in the vessel, to see the effect of temperature upon the relative position of various fishes, some destitute of an air-bladder, others provided with such an organ either closed or possessing a communication with the exterior. The experiment was made upon bullheads (*Cottus gobio*), perch (*Perca fluviatilis*), tench

(*Tinca vulgaris*), gudgeons (*Gobio fluviatilis*), spirlins (*Alburnus bipunctatus*), and minnows (*Phoxinus lævis*). The first time we gradually raised the temperature of the water in two hours from 10° to 28° C. (from 50° to 82°·4 F.); the second time, in an hour and a half, from 9½° to 27° C. (from 49°·1 to 80°·6 F.).

The bullheads, which are without an air-bladder, never ceased to repose upon the gravel at the bottom; but after the temperature had been raised 6°–8° C. (10°·8–14°·4 F.), the perch, with their closed air-bladder, began to depart a little from the bottom, where they had at first remained nearly motionless. At the first moment the warming of the water gave rise to great agitation; but, the first surprise passed, quiet was restored, and we could then see all the fishes, except the bullhead, struggle with their fins to prevent their being carried towards the surface. As soon as the organs of motion were in repose, the animal rose more or less rapidly, like a balloon, without, however, appearing externally to be in the least inflated or deformed. The Cyprinidæ, furnished with an air-bladder having an external communication, ascended and descended alternately; and it seemed to me that the young struggled with more difficulty than the adults*. Some adult tench and a gudgeon in particular appeared much less influenced than some little tench, which were constantly being forced up towards the surface. At 22° C. (=71°·6 F.) one perch (from 7 to 10 centims., or from 3 to 4 inches long) kept about midwater in the aquarium; at 25° or 26° C. (77° or 78°·8 F.) they went willingly very near the surface; finally the head, being less elevated, was often turned more or less downwards. At 27° or 28° C. (=80°·6 or 82°·4 F.) the agitation again became general; several fishes appeared ready to perish; and we stopped the experiment, being unable to follow the action of the temperature upon creatures which were, so to speak, stupefied.

In the first experiment the introduction into the midst of the liquid of a vase of aquatic plants very rapidly restored quietude to the fishes which were agitated by an increasing suffocation. The second time we had fewer made ill, owing to our leaving a plant in the water during the whole experiment.

Although the fish, and especially those in which the air-

* This would seem to indicate that the capacity and importance of the air-bladder are greater in early youth than in the adult state; for we know that, in some fishes, the duct of communication with the exterior is rather obliterated with increasing age; and I have always remarked that the fins are comparatively larger in the young than in the old.

bladder is not closed, can evidently react more or less against slowly increasing differences of temperature or pressure, it is none the less probable that important diversities in pressure, and rapid or considerable changes of temperature, must have much influence upon the gestures of the individual under different conditions and in different seasons, and thereby more or less upon its external form and appearance*.

I may state, in passing, that in these two experiments we had the opportunity of ascertaining, in a very striking manner, that all the fishes heated (towards the end of January, when they were pale in colour) rapidly acquired, as the temperature increased, a much more brilliant coloration, somewhat analogous to the nuptial livery. The bullheads, which were at first whitish underneath, became almost black on the throat and belly; the perch and tench acquired very brilliant metallic reflections; the spirlins displayed a fine violet band at the upper part of the flanks; and the minnows already presented here and there on their lower surfaces the red coloration specially characteristic of the season of amours. When placed, after the experiment, in water at 9° or 10° C. (48°·2 or 50° Fahr.), these very rapidly lost all their temporary brilliancy.

Returning, now, to the consideration of fishes under normal conditions or in freedom, I may remark, first of all, that the species of the families with a mixed diet or omnivorous, and with an air-bladder in communication with the exterior, have always appeared to me more subject to vary, as to the form of the buccal organs or organs of prehension, than the fishes of exclusively animal or vegetable diet confined with them under the same conditions. Elsewhere, in another medium, it might be the latter that would vary most in this particular, or, perhaps, some other part would be called upon to vary first of all. A rule established upon such principles for one family will necessarily always be subject to apparent exceptions in another group.

Among other things we shall very speedily remark that *the plan of the modifications of the buccal cleft varies, in fishes, in diverse orders, even under similar conditions, according to the kind of gymnastic which may be permitted by other organs, such as the fins or the air-bladder.* The smelt, which takes

* It would be interesting to investigate, by a thorough study of all the gestures of the fish in different circumstances and at different seasons, why sometimes a certain species has a more or less developed air-bladder, whilst another, belonging to the same genus, is, on the contrary, destitute of that organ.

its food especially above it or at the surface of the water, will have the snout turned up and the mouth very oblique; while the sharks, which also most frequently hunt at the surface, will, on the contrary, in general have the mouth completely inferior. But in these two cases it is in the preponderant intervention of other organs that we must seek the explanation of the differences of modifications. The former of these fishes, with the organization of its fins, can with difficulty struggle against the influence of the air-bladder, which tends to retain it in the horizontal position; the latter, destitute of air-bladder, can, on the contrary, not only easily keep a portion of the head out of water, and the mouth open at the surface, but can also turn or twist in various directions, thanks to the arrangement of the organs of locomotion and the unequal development of the lobes of the caudal fin. I might select, nearer home, what may be called parallel examples, among the fishes which, in contrast to the above, live and hunt preferently at the bottom of the water. According as these are required to take their food most frequently from above, in front of, or beneath them, and according as the different developments of the air-bladder or the fins permit one position or another in the act of prehension, we shall usually see in them, with a slightly different situation of the eye, a more or less oblique arrangement of the buccal cleft, which is then superior, horizontal, or inferior. Compare, among others, in these respects, our goby, the bullhead, and our barbels.

It would not be difficult to multiply these examples, even in different classes; but I prefer still to limit myself in order now to compare fishes more similar to one another in form, and to establish here a parallel between various Cyprinidæ, leading different modes of life, and the various forms of one and the same species, according as the latter is subjected to one or another condition of existence. For this purpose I select a family all the members of which are equally provided with an air-bladder in communication with the exterior, and which consequently must be able to pass with more facility from one pressure to another.

If I compare, among others, our various representatives of the genera *Alburnus*, *Scardinius*, *Leuciscus*, *Abramis*, *Chondrostoma*, *Tinca*, *Carpio*, and *Barbus*, I see at once that to an habitual station more or less near the surface or the bottom of the water, there usually corresponds a more or less oblique arrangement of the buccal cleft, sometimes almost superior, sometimes completely inferior. I then remark that with a slightly different diet, most frequently necessitating the prehension of food above, in front of, or beneath the individual, the form of the mouth also varies more or less in the fishes which generally live between these two extremes or in mid-water. Lastly, as corollaries of these first modifications dependent on habitat, I may recall the gradual apparition at the sides of the mouth, in our bottom-feeding Cyprinidæ, of tactile organs, more or less developed barbels. It must not be forgotten that, notwithstanding its constant communication with the exterior, the air-bladder, which is a little variable in position and proportions, may here exert an influence, up to a certain point, upon the general form of the fish and its mode of gymnastic, by pressing more or less against one part or another of the individual. Under the influence of the agents which superinduce the transformations of the mouth, we also see appear other correlative modifications in various parts of the animal—among others, in the greater or less declivity of the head, in the more or less convex or depressed form of the back and belly, in the variable compression of the sides, in the situation and proportions of the eye with regard to the forehead, and finally in the relative position and the development of certain fins.

These various tendencies to adaptation may be, I repeat, very different in other families, in which the equilibrium of the organism rests upon other foundations; or they may be accompanied by new modifications affecting other parts, such as the nature of the integuments for example.

Our barbel, which chiefly seeks its nourishment beneath it, on the bottom or in the mud, has the mouth opening below and furnished with barbels, the eye comparatively small, and the base of the anal fin rather short; the bleak, which, on the contrary, most frequently snatches its prey at the surface or above it, has the mouth oblique, opening more or less upwards, and destitute of barbels, with a large eye and the base of the anal fin comparatively elongated. The rudd and the roach, which most commonly seek their food at midwater, although the mouth is oblique in the former and quasi-horizontal in the latter, and without barbels in both, have nevertheless the anal and dorsal fins of nearly equal importance, and a body usually rather deeper than the species above indicated as inhabiting extreme situations. A certain resemblance of general form (which, however, is variable for each of these species in different media) may be due to a similitude of habitat in an average medium; but the examination of the grinding-plate and of the pharyngeal teeth betrays a marked preference for aliments of different natures, and consequently modes of prehension which are probably also somewhat different. The carp and the bream are recognizable at once by the great comparative basal extension of the dorsal in the former, and the anal in the latter. The carp, which keeps close to the bottom more constantly than the bream, possesses barbels, while these are wanting in the latter, which, on the other hand, has the two lobes of the caudal pretty constantly unequal.

The *Chondrostoma* ("nase") and the tench, which, in various points of view, constitute exceptions among our Cyprinidæ, show us here, again, new modifications in the organs relating to the mode of alimentation. Required generally to take its food from beneath it, the nase, like our barbel, has the mouth plainly inferior and the anal comparatively short; but, being destined to an almost exclusively vegetable diet, and accustomed rather to graze upon, than to rout up the bottom, it has no occasion for barbels; and its lips are instead furnished with a horny and trenchant sheath. Although willingly keeping at the bottom, the tench, which is more omnivorous than the carp and the barbel, and consequently requires to take its nourishment in more varied positions, shows at the same time a rather oblique mouth and a small lateral barbel; but in it the inferior fins are a little more powerful, and the eye, in order to look in different directions, possesses a mobility and a facility of projection which does not occur in any other of our Cyprinidæ.

It would require a very great number of comparative observations to determine to what degree of dependence each of these organs is subject, and which of them, under different circumstances, is first called upon to vary.

We might, I believe, push much further this comparative investigation, which I now only indicate in passing. The careful examination of the various dentitions, for example, has often shown me an intimate and very natural relation between the different forms of the teeth or of the pharyngeal plate, which betray the predominant nature of the diet, and a certain modification of the internal or external framework, in view of a peculiar gymnastic in the act of prehension.

Our bleak (*Alburnus lucidus*), being especially insectivorous, the habitual station of that fish, and the means of which it must make use in order to obtain such or such a prey of predilection, must vary, it would seem, with different conditions and circumstances, and thereby exert more or less influence upon the form of the mouth, the sole organ of prehension. In connexion with this I have observed that the majority of the bleak which inhabit certain of our rivers present a deeper or more compressed form of body, a less turned-up snout, and consequently a less oblique mouth than most of those which live more habitually in some of our lakes. Now in our transparent lakes (the lake of Geneva for example) we may very often see these graceful little Cyprinidæ hunting in numerous bands, and snapping up right and left at the surface of the water the little insects of various sorts that the winds or other accidents beat down upon it daily; whilst we less frequently observe these fishes at the very surface in the moving, less transparent, shallower, and colder waters of several of our streams, such as the Rhine for example. It is difficult to avoid comparing these graceful little fishes with the active swallows, which, like the bleak, so often go in search of small insects close to the surface of the ground or over the mirror of our lakes. We may fairly ask whether meteorological influences, to a certain extent analogous with those which impel the swallows alternately towards the ground or the surface of the water, and to great altitudes in the air, may not also, in different media, present the bleak with their favourite food, according to circumstances, at the surface or at a lower level in the water.

According as the mouth, in order to adapt itself to the most habitual circumstances in a given medium, becomes more or less oblique, the back or the belly are, on the contrary, depressed or elevated, at the same time that the body becomes elongated or shortened.

Heckel's theoretical line, which passes through the extremity of the mouth and the middle of the caudal, displays these opposite deviations at the first glance, according as it passes at a greater or less height with respect to the centre of the eye and the summit of the back. The employment of this line may be equally valuable in showing the degree of certain deformations in fishes, as that of the two lines determining the facial angle in other animals; but it is a great pity that Heckel and, in imitation of him, several ichthyologists have too often attributed a specific value to the data obtained by this mode of mensuration.

It is easily understood that a modificatory influence like that of which I have just spoken, however minute it may be, but acting upon the individual from early youth, might in time, and by multiplying itself by reproduction, affect a species very profoundly under uncertain conditions.

The action of the deformatory agents already mentioned appears to me to be constant and regular enough; however, like every other rule, this also, I repeat, may present apparent exceptions, which a conscientious study of the circumstances and conditions of medium peculiar to each locality can alone satisfactorily explain.

It is always difficult to determine what is the preponderant influence, and consequently in what direction the first modifications will take place. I can easily understand the error of Blanchard, who has distinguished specifically, under the name of *Alburnus mirandella*, our elongated bleak of the lake of Geneva from the deeper ones of the French rivers. Nevertheless I cannot yet so easily explain the causes of the comparatively deeper form of the bleak which Heckel originally and erroneously distinguished under the name of *Alburnus lacustris* from the Neusiedler and Platten lakes, as I do not sufficiently know the nature and relative importance of the conditions of medium proper to those two lakes.

In fact the modificative and conservative agents opposed to each other may be of very diverse natures. Under influences of medium or local conditions we must include, in the case of our fishes, the depth of the medium, the degree of pressure, the transparency or the possible light, the surrounding temperature, the nature and origin of the water, the composition of the bottom, the faunas and floras of the region, the climate or the usual meteorological conditions of the locality, and, lastly, many other circumstances which are often difficult to appreciate.

I may here refer to the case of the *Leuciscus rutilus* of the Bruniger lake, of which I spoke in the number of the 'Bibliothèque' for September 1876, and which, in consequence of the retreat of the water of this little basin upon an almost entirely rocky bottom, was compelled to go to the surface in search of the vegetable and animal débris which were carried there by the winds. I stated that the body of this fish had by degrees become more elongated, with a very pale coloration, and that the mouth had acquired a more oblique position.

If I have dwelt so much upon this side of the variability of our fishes, and in particular of our bleak, it is because analogous cases, sometimes wrongly interpreted, also occur frequently in other genera, and have very often served for the establishment of numerous false species.

From all that has been stated, it would seem that we may derive, on the one hand, fresh proofs in support of the constant variability of the species under a concourse of favourable circumstances, and, on the other, the indication of certain limits imposed upon the modifications possible in a given direction under the influence of a peculiar, too predominant condition. In other words, it appears that in default of sufficient time, or of a relative equilibrium in the different influences of the medium, the series of correlative modifications cannot be effected in a durable manner, and that from time to time we witness, as it were, a rupture or a recall to order which is sometimes fatal.

If an organ is too rapidly modified by a particular preponderant influence for the rest of the organism to follow it continuously in an equilibrate manner, it frequently happens, either that the progress of the variability is arrested in this first direction, or that the variety in course of formation is extinguished under these new conditions.

Nature, fortunately, is not so hasty as man in her requirements; she has had and still has ample time in which to work.

XLV.—*Descriptions of several African and Australian Lepidoptera in the Collection of the British Museum.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

FOUR of the new species here described have recently been selected from a small collection, of great interest, made at Lake Nyassa by F. A. A. Simons. This collection was especially rich in two species of *Papilio* (*P. porthaon* of Hewitson, a butterfly new to the Museum series, and *P. nyassæ*, here described); there were also several forms of the difficult genus *Teracolus* (but chiefly identical with those from Natal), several species of *Acræa* (one of which will probably prove to be new to science), a few obscure little species of *Lycæna* and *Pamphila*, a little black-and-white *Liptena*?, and several very striking moths.

The Rockhampton collection contained (besides the beautiful Sphinges here described) several obscure forms of Noctuites and Crambites, an example of *Catopsilia hinda*, and other named species which were previously desiderata to the Museum.

RHOPALOCERA.

1. *Mycalesis Simonsii*, n. sp.

♂ ♀. Wings above sandy yellow, with a straight, transverse, pale-bordered, light brown postmedian line across both wings; costal and apical areas of primaries red-brown, particularly in the female, the base and outer border more or less tinted with the same colour; the margin and a submarginal line darker brown; two white-pupilled black ocelli, one small towards the apex, the other large between the first and second median branches: secondaries with six more or less strongly indicated discal black dots; outer margin red-brown; female with a slender submarginal red-brown line. Under surface pale rusty reddish, mottled with ferruginous; the basal area bounded externally by a pale-bordered postmedian ferruginous line, deeper in colour than the basal area; a marginal line, and indications of a submarginal line, ferruginous: primaries with the ocelli less distinct than above, an additional smaller indistinct ocellus above and below the subapical one: secondaries with an irregular ferruginous line crossing the cell; discal dots more distinct than above, more or less pupillated with white. Expanse of wings 1 inch 10 to 11 lines.

Lake Nyassa. Type, B.M.

Allied to *M. eliasis.*

2. *Teracolus mutans*, n. sp.

Allied to *T. vesta*; the markings above the same, but the coloration quite different, linking it to *T. protomedia*, *T. coliagenes*, &c.

Wings above sulphur-yellow, the base shaded (but not broadly) with lilacine gray; primaries tinted towards the base with pale salmon-colour; otherwise as in *T. vesta.* Expanse of wings 2 inches.

Lake Nyassa. Type, B.M.

My prediction respecting the unbroken chain of nearly allied species in this genus is being rapidly fulfilled; since the publication of my paper on *Teracolus* we have received no less than five of the missing links appertaining to this section of the genus alone.

3. *Teracolus argillaceus*, n. sp.

Allied to *T. vesta*, but smaller, whiter at the base, much less dusted with blackish; markings the same: below with the apical area of primaries and the whole of the secondaries, excepting a slightly yellowish central band (enclosed by the two central angular bars), reddish clay-colour; darker markings below much less distinct. Expanse of wings 1 inch 7 lines.

Natal (*Buxton*). Type, B.M.

This species is intermediate between *T. vesta* and *T. chrysonome*, although most nearly allied to the former of the two. We have two examples; and Mr. Buxton tells me that he has others amongst his duplicates. From the upper surface alone it might be mistaken for a pale form of *T. vesta*; but the coloration of the under surface is very distinct.

4. *Papilio nyassæ*, n. sp.

Intermediate between *P. policenes* and *P. antheus*: green and black. Markings of the primaries as in *P. policenes*, excepting that the bands which cross the cell are zigzag, as in

P. antheus; markings of the secondaries above as in *P. antheus*, excepting that the band which crosses the cell from costa to anal spot is broad, as in *P. policenes*, and the submarginal grey patches are broader. Wings below pale silky greyish brown; the green markings paler than above, and for the most part bordered internally with black: secondaries crossed near the base by two equally broad brown bands parallel to the abdominal margin; *no black spot in the cell*; a red-bordered subcostal black spot as in *P. antheus*; *no pale greenish spot* below the carmine subanal bars, as in *P. policenes*; the grey patches broader and with narrower black borders. Expanse of wings 3 inches 9 lines.

Lake Nyassa. Type, B.M.

This and *P. porthaon* seem to be the commonest butterflies of the district.

HETEROCERA.

5. *Chœrocampa indistincta*, n. sp.

Primaries above whity brown, with a slightly deeper cloud over the lower half of the discal area; the whole wing irrorated with blackish scales, which become dense and linear towards outer border; a black dot at the end of the cell; three parallel oblique pale brown discal lines from inner margin to second subcostal branch, whence they appear to form an abrupt angle inwards to costa, but become very indistinct; a short apical dusky dash, secondaries smoky brown; costal area silky whitish; anal angle whitish; external border narrowly greyish white, irrorated with brown: head and thorax olivaceous, bordered with white; abdomen pale pinky brownish or sordid flesh-colour, whitish at the sides. Primaries below sordid flesh-colour, the basal area, excepting the costa, dusky; the remainder of the wing irrorated with blackish; a broad pale outer border; a black subcostal spot towards apex: secondaries flesh-colour, whitish towards abdominal margin, irrorated with greyish atoms; traces of two central parallel transverse lines, the outer one indicated by black dots upon the nervures: body below pinky whitish. Expanse of wings 4 inches 2 lines.

Rockhampton, Queensland. Type, B.M.

The primaries above, when looked at from the side, have a silky greyish appearance, but from the front they have a sandy tint; the outer border is broadly but very indistinctly paler.

This species is most nearly allied to *C. gonograpta*; it is also allied to *C. deserta* and *C. punctivenata*: in the absence of the lateral black spot at base of abdomen it agrees best with *C. deserta*.

6. *Daphnis magnifica*, n. sp.

Allied to *D. pallescens*, but considerably larger, altogether deeper in colour, with the abdomen distinctly banded; the secondaries with a broad waved central pale band, and without a pale external border.

Primaries above almost as in *D. hypothous*, but more sharply defined, the transverse pale pinky band across the basal third of twice the width and clearer in tint; the pale postmedian area broader, more arched, clearer and paler; the irregular area near external angle brown, varied with slaty grey: secondaries cream-colour, slightly obscured (with the exception of the basal and costal areas and a slender waved transverse discal line) with pale greenish grey; a broad irregular central band, not reaching the costa or the anal angle, black-brown, surrounded and interrupted by dark greenish grey; a broad external border deep purplish brown, shading off internally and at apex into greenish grey, and intersected near anal angle by a slender pale submarginal line: head and collar dull lilac, intersected by lines of testaceous; antennæ yellow; thorax dull lilac, varied behind with olive-green, and with lateral tufts of testaceous hair; metathorax olive-green, broadly bordered behind with white; tegulæ olive-green, with a broad creamy white external border and a slender internal testaceous margin; abdomen dorsally pinky greyish, the basal segment olive-green, the remaining segments, excepting the last, with lateral oblique converging olive-green bars; the terminal segment grey, crossed by an olive-brown horseshoe-like band; the four basal segments bordered with creamy whitish in front; abdomen laterally much more pinky in tint than the dorsal surface: below with the general aspect of *D. hypothous*, the markings much the same, but altogether darker and of a purple tint, none of the bright red so prevalent on that species being present. Expanse of wings 4 inches 9 lines.

Rockhampton, Queensland. Type, B.M.

The most magnificent of all the species of *Daphnis*.

7. *Phægorista formosa*, n. sp.

Allied to *P. agaristoides* from West Africa, but readily distinguished by the markings of the primaries; the internal border black to the base, the large triangular ochraceous patch on the basal area darker and tinted with rose-colour; the oblique white or pale yellow band of primaries replaced by a very broad, almost semicircular, bright ochreous patch; the hastate spot near the external angle replaced by a triangular bright ochreous spot: the band across the base of the abdomen reddish. Expanse of wings 2 inches 5 lines.

Lake Nyassa. Type, B.M.

A very beautiful and distinct species, reminding one of *Eusemia superba.*

8. *Anaphe ambrizia*, n. sp.

♂. Allied to *A. reticulata*, but considerably smaller, the primaries narrower, silky white, the bands comparatively broader and darker, the two streaks from the outer margin much more convergent, leaving a very small spot of the ground-colour between them at their internal extremities; secondaries paler, silky stramineous; thorax (like the bands of primaries) chocolate-brown; head tawny with blackish vertex; tegulæ pale yellow; abdomen pale ochreous, with the hind margins of the segments dark brown. Expanse of wings 1 inch 5 lines.

Ambriz (*Monteiro*). Type, B.M.

Readily distinguished from *A. reticulata* and *A. panda* (which is probably only a variety of the same) by its smaller size, darker markings, and differently coloured body. *A. reticulata* is well figured by Herrich-Schäffer under the name of *Arctiomorpha euprepiæformis.*

The genus *Anaphe* seems to be best placed between *Marana* (to which several species described under the generic name of *Teara* are referable) and *Numenes.*

9. *Saturnia flavida*, n. sp.

Allied to *S. apollonia*, with the same general character of markings, but the ground-colour of the wings sulphur-yellow, the two lines indicating the limits of the central band wide apart throughout their entire length, the ocelli of the primaries smaller and therefore agreeing better in size with those of the secondaries, the outer border of a more rosy tint, with the pink and white submarginal band of oval spots better defined, the inner transverse line of secondaries well defined, the body (especially of the female) darker and of a more decidedly testaceous colour. Expanse of wings ♂ 3 inches, ♀ 3 inches 1 line.

Zambesi. Type, B.M.

This is decidedly the most attractive species yet described; it is smaller and altogether more brilliantly coloured than *S. apollonia*: the male example has a curious modification of the left primary, the outer line of the central band being deeply excavated near the costa, so as to make room for a semicircular, red-bordered, pink spot.

XLVI.—*On* Ascodictyon, *a new Provisional and Anomalous Genus of Palæozoic Fossils.* By H. ALLEYNE NICHOLSON, M.D., D.Sc., F.R.S.E., and R. ETHERIDGE, Jun., F.G.S.

[Plate XIX.]

THE curious little fossils for which we propose the generic title of *Ascodictyon* are parasitic in their habits, and are found adhering to the shells of Brachiopods, the exterior of corals, or the stems of Crinoids. We are acquainted with at least three distinct forms, one of which occurs in the Carboniferous rocks of Scotland, whilst the other two have been detected in the Devonian deposits of North America. In all the members of this group the organism, though visible to the naked eye, can only be properly examined by means of the microscope, and consists of minute calcareous vesicles, the walls of which are more or less extensively perforated by microscopic foramina. The vesicles or "cells," whatever their shape or arrangement may be, are always hollow; but they exhibit no definite aperture, save the very minute pores just spoken of. In some cases they open into one another by short contracted necks or stolons, thus forming a loosely reticulate network; whilst more typically they are arranged in regular, usually stellate clusters, which in turn are united with one another by delicate thread-like hollow tubes, which often ramify and anastomose.

The above being the general characters of *Ascodictyon*, a provisional generic diagnosis may be framed as follows:—

Gen. char. Organism composite, parasitic, adherent on foreign bodies, composed of numerous calcareous cells or vesicles, the walls of which are perforated by a greater or less number of microscopic foramina, but which possess no single large aperture. The cells may be united almost directly by the intervention of short tubular necks; or they may be disposed in clusters connected with one another by hollow filamentous tubes, which usually anastomose, and which in some cases, at any rate, are likewise perforated by microscopic pores.

As before remarked, the genus, so far as our present knowledge goes, is confined to the Devonian and Carboniferous periods; and the following are the characters of the three species with which we are as yet acquainted.

Ascodictyon fusiforme, Nich. and Eth., Jun. (Pl. XIX. figs. 7, 8.)

Spec. char. Colony composed of fusiform, sometimes pyriform calcareous vesicles, which vary in length from a third of a line to more than half a line, and which have their walls perforated by numerous circular microscopic foramina, covering the whole surface, and placed about their own diameter, or rather more, apart. The cells are produced by budding from one another directly, and are connected by short, contracted, tubular stolons in such a manner as to form an open network.

Obs. A. fusiforme is readily distinguished from *A. stellatum* by the fact that the vesicles are directly connected with one another, that they are not arranged in clusters, and that the pores are, on the whole, of larger size, and show no traces of a linear arrangement, whilst the vesicles themselves are also of larger size. The absence of a clustered arrangement and of a network of connecting filaments equally separate this species from *A. radians*, with the additional distinction that the pores are distributed over the whole surface instead of being confined to a single median row on each vesicle. When the vesicles of *A. fusiforme* are fractured, they are seen to contain a large central cavity; but there are no traces of any other opening in each except the numerous minute pores. These pores sometimes exhibit the appearance of being elevated above the general surface; but it is difficult to say how far this appearance may not be deceptive. Owing also to the adherent habit of this and the other members of the genus, and the small size of the vesicles, we have been unable to examine specimens by the method of transparent sections, and can therefore offer no observations on the minute structure of the chamber-wall.

Form. and Loc. Hamilton formation (Middle Devonian), Widder, township of Bosanquet, Ontario. Rare, and adherent on *Spirifera mucronata*, Conrad.

Collected by, and in the cabinet of, Prof. Nicholson.

Ascodictyon stellatum, Nich. and Eth., Jun.
(Pl. XIX. figs. 1–6.)

Spec. char. Colony composed of ovoid or pyriform calcareous vesicles, varying in length from one fifth to one third of a line, and usually disposed in stellate clusters, each containing from three to six cells, or sometimes more. The walls of the vesicles are perforated by microscopic foramina, usually showing a distinctly linear arrangement. The clusters are connected together by creeping filamentous tubes, the free surfaces of which are perforated by a single row of minute foramina, and which generally anastomose so as to form a network.

Obs. In its youngest stage (Pl. XIX. fig. 6), *A. stellatum* presents itself simply in the form of scattered oviform or pyriform calcareous vesicles attached to the exterior of foreign bodies. When mature, it consists of similar vesicles combined into clusters, generally of three to six in each, these being connected by ramifying and anastomosing tubular stolons (Pl. XIX. fig. 1). The new vesicles are produced from the sides of the stolons, or are budded forth in rosettes from the nodal points where the stolons intersect one another. The rosettes may be comparatively remote; in other instances they become so aggregated together as almost to constitute a continuous crust. The walls of the vesicles are perforated by minute apertures (Pl. XIX. fig. 2), which are generally arranged in lines, and are not so numerous as in *A. fusiforme*, whilst they can only with difficulty be detected in specimens infiltrated with carbonate of lime. The vesicles are seen, on fracture (fig. 5), to be hollow; and they may coalesce in the centre of each rosette, or there may be a central chamber, the nature of which we have been unable to determine. The connecting tubes or stolons are also undoubtedly hollow; and they carry a single row of pores (fig. 3) on their free surfaces, though these openings can only be detected in well-preserved specimens. The stolons may arise from one another, from the central points of the rosettes, or occasionally by direct prolongation from the distal extremity of a vesicle (Pl. XIX. fig. 4).

In the fact that the vesicles are, typically, disposed in rosettes, and are connected together by a creeping network of tubes, *A. stellatum* resembles *A. radians*. It is, however, readily distinguished from the latter species by the ovoid or pyriform shape of the vesicles, and the fact that there is always more than a single row of pores to each vesicle.

Form. and Loc. Not very rare in the Hamilton formation (Middle Devonian) of Widder, township of Bosanquet, Ontario. Parasitic on *Spirifera mucronata*, Conrad, and *Cyrtina hamiltonensis*, Hall.

Collected by, and in the cabinet of, Prof. Nicholson.

Ascodictyon radians, Nich. and Eth., Jun.
(Pl. XIX. figs. 9–11.)

Spec. char. Colony composed of elongated vesicles, broad at their bases, thickened out in the middle of their length, and gradually attenuated towards their extremities, disposed in stellate clusters or rosettes. The bases of the tongue-like or somewhat fusiform vesicles are placed round a central circular depression; and their length varies from a sixth to more than a fourth of a line. Each rosette consists of from ten (sometimes fewer) to fifteen or twenty vesicles; and the free surface of each carries a single median row of excessively minute, somewhat slit-like, closely approximated pores. The rosettes are connected together by delicate creeping filaments, which may spring from the bases of the rosettes or from the attenuated extremities of the vesicles, and which generally anastomose, so as to form a network or mycelium.

Obs. In its general structure and arrangement this species is related to *A. stellatum*, though sharply distinguished by the very elongated form of the vesicles and the presence of but a single row of pores on each. All the rosettes, when well preserved, show a circular central cavity or depression, with a distinct bounding wall; but we have been unable to make out the true nature of this or its relation to the vesicles. When the vesicles are very numerous, they are smaller in size than when the rosette consists of fewer; but in all cases each shows a dark median line, which, when highly magnified, resolves itself into a line of minute close-set pores (fig. 11). The stolons may ramify and form a network; or a single stolon, proceeding directly from the end of a vesicle in one rosette, may be prolonged at once into the attenuated termination of a vesicle belonging to another rosette (fig. 10, *a*). Weathered specimens show clearly that the vesicles are traversed by a long tubular cavity, corresponding in form with the shape of these structures themselves; and they sometimes show what appear to be apertures at their bases. The stolons also are, doubtless, tubular, and they probably carry a median row of pores on their free faces, though we have not been able to determine either of these points to our satisfaction.

There appear to be two well-marked varieties amongst the forms which we have placed under *A. radians*:—

Var. *a*. Vesicles few, lobate, and larger than in *b*.

Var. *b*. Vesicles very numerous, smaller and finer than in *a*, and the individuals always more crowded together.

Form. and Loc. Boghead Quarry, near East Kilbride, Lanarkshire, in shale of the Calderwood series, L. Carboniferous Limestone group.

Collected by, and in the cabinet of, Mr. James Bennie, Edinburgh.

Systematic Position and Affinities.

After a very careful examination of a considerable number of specimens of the singular organisms which we have grouped together under the name of *Ascodictyon*, and after taking the opinion of several of our fellow workers, we are still unable to express a positive opinion as to their precise zoological position and relationships. The Scotch specimens were shown to the late Dr. Strethill Wright, who was unable to throw any light upon their nature. The same specimens have also been examined by Prof. Huxley, F.R.S., who, after considerable hesitation, suggested that they might be Protozoans. Our own opinion was at first in favour of their Foraminiferal affinities, as indicated by their calcareous walls and the presence of microscopic foramina, combined with the absence of any aperture to each cell. Our friend Mr. H. B. Brady, F.G.S., however, after a protracted examination of both the Scotch and the American forms, has arrived at the conclusion that they cannot be referred to this group. As regards the Scotch specimens (*A. radians*), this distinguished authority, in a letter addressed some time ago to one of the present writers, says, "I suspect they are rudimentary portions of rooted Crinoids, but am not at all sure. There has been, in some of them, a central pillar growing perpendicularly to the stellate roots." At this time, however, Mr. Brady had not the advantage of having the American specimens for comparison; and the unquestionable generic identity of *A. radians* and *A. stellatum* renders this hypothesis as to the affinities of the former clearly untenable, to say nothing of the fact that we should still have to find an explanation for the foramina.

Leaving the Foraminifera out of sight, the only other group that suggests itself prominently as one to which these problematical organisms might be referred is that of the Polyzoa. In their perforated walls they present a close resemblance to many of the Cheilostomatous Polyzoa, especially to some of the *Lepraliæ*; and their general habit and mode of growth would also favour this view. On the other hand, it seems difficult to reconcile this view as to their affinities with the unquestionable fact that the cells or vesicles have no other means by which the internal cavity is placed in communication with the exterior, except the microscopic pores in the walls.

Some of our American specimens (*A. fusiforme* and *A. stellatum*) were kindly submitted by Mr. H. B. Brady to the Rev. Mr. Hincks, who suggested that they were possibly allied to the recent *Anguinariæ*. Our *A. fusiforme* certainly presents a close superficial resemblance to the creeping base of *Anguinaria* (*Ætea*) *spatulata*; but in the absence of any evidence in the fossils of the existence of erect cells with distinct apertures for the polypides, it would be hazardous to regard this suggestion as being more than a conjecture. The only other recent forms to which we can find any likeness with *Ascodictyon* are some of the Sertularians (e. g. *S. pumila*), there being a decided resemblance between the thread-like fibres which creep along the foreign bodies to which these organisms are attached, and which connect the polypiferous shoots, and the netted stolons of *A. radians* and *A. stellatum*. In other respects, however, the structure of *Ascodictyon* is by no means Hydrozoal. Upon the whole, therefore, we can only leave the question as to the systematic position of *Ascodictyon* in the meanwhile undecided, in the hope that future researches may enable us to find a definite niche in the system for these interesting fossils.

We are much indebted to our friend Mr. James Bennie for the loan of his beautiful specimen of *A. radians*.

EXPLANATION OF PLATE XIX.

Fig. 1. Portion of a colony of *Ascodictyon stellatum*, Nich. & Eth., Jun., growing upon the hinge-area of *Cyrtina hamiltonensis*, Hall, magnified 10 diameters.

Fig. 2. A single group or rosette of the same, enlarged 20 diameters. The connexion of the vesicles with one another and with the basal stolons is here hidden by adherent matrix.

Fig. 3. Portion of the creeping stolon of a colony of the same, highly magnified, showing the single row of pores along the free face.

Fig. 4. Two rosettes of the same species, enlarged 25 diameters. The lower rosette is complete; but one of the vesicles is partially fractured, showing its internal cavity, and another has its extremity directly prolonged into a stolon.

Fig. 5. A single rosette of the same, enlarged 30 diameters. In the centre of the rosette is a central chamber (?); and several of the vesicles have their internal cavities exposed by fracture.

Fig. 6. Four detached young (?) vesicles of the same, growing on the hinge-area of *Cyrtina hamiltonensis*, Hall, greatly enlarged.

Fig. 7. Portion of a colony of *Ascodictyon fusiforme*, Nich. & Eth., Jun., growing upon the mesial fold of *Spirifera mucronata*, Conrad, enlarged 15 diameters.

Fig. 8. A single cellule of the same, enlarged 30 diameters.

Fig. 9. Fragment of the stem of a Crinoid, to which is attached a colony of *Ascodictyon radians*, Nich. & Eth., Jun., of the natural size.

Fig. 10. A single rosette of the same, magnified 30 diameters. At *a* a stolon given out by the extremity of one of the vesicles is seen to connect itself directly with the corresponding extremity of a vesicle belonging to another rosette.

Fig. 11. A single vesicle of *A. radians*, magnified to show the central line of pores.

XLVII.—*On the* Elateridæ *of New Zealand.* By D. Sharp.

[Continued from p. 413.]

25. *Mecastrus convexus*, n. sp.

M. niger, nitidus, evidenter pubescens, convexus; prothorace parcius minus fortiter punctato, angulis posterioribus leviter divergentibus; elytris stria suturali integra, in dimidio basali seriebus punctorum, interstitiis subtiliter punctatis. Long. 9–9½ m. m.

Mas antennis nigris, crassiusculis, intus fortiter serratis, articulis secundo et tertio brevissimis; abdominis apice vix rufescente.

Fem. antennis fusco-rufis, tenuioribus, intus leviter serratis, articulis secundo et tertio minus abbreviatis, conjunctim quarto paulo brevioribus; abdominis apice rufescente.

This species may be readily distinguished from the preceding ones by its more convex form, and by the apical half of the elytra being quite free from striæ.

Discovered at Auckland by Mr. Lawson. Recently an individual has been sent me from Tairua by Captain Broun as No. 28, and the information that the species occurs on *Leptospermum* and is extremely active and difficult to capture.

26. *Mecastrus vicinus*, n. sp.

M. niger, nitidus, evidenter pubescens, convexus; prothorace parce subtiliter punctato, angulis posterioribus vix divergentibus; elytris stria suturali integra, in dimidio basali seriebus punctorum, interstitiis subtiliter punctatis. Long. 6½ m. m.

The only individual I have seen is a male; it is excessively similar to No. 25, but is a good deal smaller and has the middle coxæ separated by a considerably narrower interval.

Westland.

27. *Mecastrus discedens*, n. sp.

M. niger, sat nitidus, evidenter pubescens, subdepressus; prothorace crebre fortiter punctato, angulis posterioribus leviter divergentibus; elytris leviter striatis, striis ad apicem vix distinctis, interstitiis crebre subtiliter punctatis. Long. 7–9 m. m.

Var. elytris versus humeros plaga testacea.

Mas antennis crassiusculis, articulis secundo et tertio brevissimis, articulis 4–10. intus fortiter serratis.

Fem. antennis tenuioribus, articulis secundo et tertio brevibus, 4–10. intus subserratis.

I think I am right in considering the above forms the sexes of one and the same species; but I am not quite sure about it.

Akaroa, 19th Dec. 1874; Westland; west coast (*Wakefield*).

Group 8.—These three species (Nos. 25, 26, and 27), again, show a considerable relationship with the species to which I have given the generic name *Lomemus*, but are larger in size, and appear to connect the *Betarmon* allies with the "Elatérites" of Candèze: the prosternal sutures are obscurely or not duplicate and are scarcely open in front; the mesosternal cavity is broader than in *Lomemus* (Nos. 17–24); and though the posterior part of the cavity is acuminate and ill-defined, and does not reach nearly to the suture, yet its plane of direction is less horizontal. The femoral portion of the hind coxal plate is more developed, so that there is a quite gradual passage from it to the longer trochanteral portion.

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28. *Monocrepidius exsul*, n. sp.

M. fuscus, tomentosus, opacus; antennis pedibusque flavis, his sat elongatis, filiformibus, articulo tertio quam secundus paulo longiore, his conjunctim quarto æqualibus; prothorace dense punctato, angulis posterioribus elongatis, acutis, sat divergentibus; elytris fortiter striatis, densius pubescentibus. Long. 11–13 m. m.

This species is allied to the Australian *Monocrepidius rectangulus*, but is smaller and more delicately sculptured. As it has only been found at the port of Wellington, it is possible it may have been introduced into New Zealand; I do not think, however, that it is a described species.

Wellington, Feb. 1875 (*Mr. Wakefield*).

Group 9.—The following structural characters will enable the New-Zealand entomologists to readily identify this form:—Antennæ slender, filiform. Forehead wide in front and only slightly curved, without raised margin, but overhanging the very short clypeus; antennal spaces wanting; the cavities widely distant. Prosternal process long, slender, and straight. Mesosternal cavity elongate and narrow, quite parallel-sided, extending back to quite the intercoxal suture, its side margins very thin and scarcely raised. Femoral portion of hind coxal plate well developed, but much shorter than the rather long trochanteral portion. Tarsi with 3rd joint well developed; 4th joint underneath large, membranous, above grooved almost to its base for the insertion of the 5th joint.

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29. *Cryptohypnus Powelli*, n. sp.

C. subdepressus, tenuissime pubescens, niger, antennis fusco-testaceis, pedibus testaceis; antennis tenuibus, sat elongatis, articulo tertio elongato, secundo longiore quarto fere æquali; prothorace lateribus rotundatis, basin versus angustato, angulis posterioribus minutis acutis, crebre subtiliter punctato, medio canaliculato; elytris distincte striatis, interstitiis nullo modo elevatis, obsolete rugulosis. Long. 7–9 m. m.

The female is rather larger than the male, and has the hind angles of the thorax, though acute, not at all prolonged.

Craigie-burn: found by Mr. Powell.

30. *Cryptohypnus humilis*, n. sp.

C. subdepressus, tenuissime pubescens, niger, antennis pedibusque testaceis; prothorace lateribus rotundatis, ante basin constricto, angulis posterioribus gracilibus peracutis, sat elongatis, fortiter divergentibus, crebre subtiliter punctato, medio canaliculato; elytris sat profunde striatis. Long. 7–9 m. m.

Though extremely similar to the preceding species, this may be readily distinguished by the more prolonged hind angles of the thorax. The differences between the sexes seem to be very slight: the female is rather larger, and has the thorax a little more dilated at the sides.

Wellington, Feb. 1875 (*Wakefield*).

31. *Cryptohypnus frontalis*, n. sp.

C. subdepressus, tenuiter pubescens, niger, nitidus, antennis fuscis, pedibus testaceis, femoribus obscurioribus; fronte antice in medio abrupte depressa; thorace elongato, ante basin leviter constricto, angulis posterioribus sat elongatis, crassioribus, vix divergentibus, subtiliter sat crebre punctato medio indiscrete canaliculato; elytris subtiliter striatis, striis punctatis, interstitiis parce subtiliter punctatis. Long. $5\frac{1}{2}$ m. m.

I have seen but a single specimen, from Lake Guyon, kindly given me by Mr. Pascoe.

32. *Cryptohypnus longicornis*, n. sp.

C. elongatus, angustulus, fuscus, evidenter pubescens, antennis fusco-testaceis, basi cum pedibus testaceis; prothorace elongato, ante basin leviter constricto, angulis posterioribus elongatis, crassioribus, vix divergentibus, dense subtiliter punctato, medio ante basin canaliculato; elytris subtiliter striatis, interstitiis crebre subtiliter punctatis. Long. 8 m. m.

I have seen but a single mutilated individual, which was sent me by Henry Edwards, Esq., under no. 1330.

33. *Cryptohypnus thoracicus*, n. sp.

C. latior, minus depressus, niger, tenuiter pubescens, tibiis tarsisque testaceis; thorace latiusculo, latitudine haud minore quam longitudo lateribus ante basin sat constrictis, angulis posterioribus tenuibus, sat divergentibus, crebre evidenter punctato, sat distincte canaliculato; elytris sat profunde striatis, interstitiis crebre punctatis. Long. $8\frac{1}{2}$ m. m.

A single individual has been sent me by Mr. Wakefield; it was found at Kelly's Creek by Mrs. Foster.

Group 10.—These five species (Nos. 29, 30, 31, 32, and 33) appear to be very closely allied structurally to the northern *Cryptohypnus depressus* and *hyperboreus*. The following structural characters will enable them to be readily identified:—Forehead curved in front, the clypeus in the middle nearly or entirely wanting, so that, though the forehead presents a sharply defined edge in front, the labrum is placed immediately beneath it; antennal spaces distinct, but much concealed by the horizontal edge of the forehead, and widely distant from one another in the middle; antennæ filiform. Prosternal process rather long and straight. Mesosternal cavity rather broad, formed by broad but not in the least raised edges, reaching back to the intercoxal suture. Trochanteral portion of coxal plate well developed, but the femoral portion nearly completely absent. Tarsi moderately long, with all the five joints well developed and simple.

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34. *Chrosis polita*, n. sp.

C. elongata, angusta, nitida, nigra, parcissime pubescens, pedibus piceis; thorace pernitido, elongato, quam latiore multo longiore, parce punctato; elytris profunde striatis, striis fortiter punctatis, interstitiis fere lævis, apicibus haud prolongatis, subrotundatis; prosterni lateribus dense punctatis; lamina coxali angusta, margine interne nullo modo sinuato; tarsis elongatis, gracilibus, subtus haud dense pubescentibus. Long. $12\frac{1}{2}$ m. m.

The very narrow, parallel form, the very highly polished prothorax, excessively scanty pubescence, and the almost impunctate interstices of the elytra very readily distinguish this species from its allies, even without any examination of structural characters.

Tairua, but very rare; one individual found by Captain Broun under a log near Pipi Creek, and three others under bark in the same locality.

Obs. The two specimens sent me by Captain Broun are, I am pretty sure, the two sexes, though they are extremely similar to one another; they both show the peculiarity of a well-marked notch or emargination at the apex of the last ventral segment.

35. *Chrosis reversa*, n. sp.

C. sat elongata, minus parallela, nigra vel picea; thorace quam latiore paulo longiore, disco obsolete punctato; elytris latius striatis, striis externis evidenter punctatis, interstitiis subconvexis, crebre punctatis, apicem versus evidenter attenuatis, apicibus ipsis angustis, haud vel vix prolongatis, angulis internis haud vel vix spinosis; prosterni lateribus nitidis impunctatis; abdomine parce punctato; lamina coxali interne evidenter latiore, sed margine posteriore supra trochanterem tantum obsoletissime emarginato. Long. 16–17 m. m.

The polished impunctate sides of the prosternum readily distinguish this species.

Described from a single specimen sent by H. Edwards, Esq., under no. 1337; one of two individuals sent by the same gentlemen under no. 1340 I believe to be the female of the species, though it is very much broader and has the thorax considerably larger and broader. A second individual, which I believe to be a variety of this same sex, is in Mr. Wakefield's collection from the Otira pass.

36. *Chrosis barbata*, Candèze.

C. nigricans, colore variabilis, sæpe rufescens, minus parallela, breviter fusco-pubescens; thorace latitudine longitudinem æquante, crebre punctato; elytris leviter striatis, striis evidenter punctatis, interstitiis crebre punctatis, apicem versus evidenter attenuatis, apicibus haud prolongatis, vel simplicibus vel obsolete spinosis; prosterni lateribus crebre punctatis; lamina coxali interne evidenter latiore, margine posteriore supra trochanterem tantum obsolete emarginato; antennis pedibusque minus elongatis. Long. 13–19 m. m.

This is an exceedingly variable species. It is closely allied in structure to our European *Elater impressus*; and the small specimens are somewhat similar to it in appearance, but have the elytra much more attenuate posteriorly.

Very widely distributed; I have seen specimens from Otago and Auckland and various intermediate localities.

Obs. M. Candèze described this species as being found in New Holland; but Mr. Janson believes all the specimens are from New Zealand; so that it is very doubtful whether the species exists in Australia.

37. *Chrosis elongata*, n. sp.

C. fusca, elongata, minus parallela, evidenter laxe fusco-pubescens; thorace paulo longiore quam latiore, crebre punctato; elytris leviter striatis striis punctatis, interstitiis crebre subtiliter punctatis, elongatis, apicibus attenuatis et prolongatis, angulo externo magis prominulo, minute spinoso; prosterni lateribus crebre punctatis; lamina coxali interne evidenter latiore, margine posteriore supra trochanterem sat evidenter emarginato; antennis tarsisque gracilibus, elongatis. Long. 16 m. m.

This species comes very close to extreme forms of *Chrosis barbata*, but is more elongate in form, and has the tarsi especially more elongate.

Sent from Auckland by Mr. Lawson; and also received from Mr. Edwards, but without number.

Group 11.—Species 34, 35, 36, and 37 exhibit the following characters :—

Clypeus short, quite unfolded and extended, so that the forehead is not limited at all from the clypeus in the middle, and the large labrum is almost on the same level as the forehead; antennal spaces very indistinct and very widely separated from one another. Antennæ with 2nd and 3rd joints elongate. Prosternal process broad and stout, not curved upwards behind the coxæ. Mesosternal cavity with strongly elevated borders; these attain the intercoxal suture, and their hinder portions are quite horizontal. Coxal plate with trochanteral portion a good deal longer than the femoral portion, the long portion occupying about half the whole width, and thence gradually narrowed till it meets the episternum. Tarsi with all the joints simple and well developed, the fourth, however, a good deal shorter than the third.

It is doubtful whether the genus *Chrosis* be distinct from *Corymbites* as defined and limited by Candèze. Indeed our European *Elater impressus* (*Corymbites impressus*, Candèze), appears more nearly allied to the New-Zealand *Chrosis barbata* than it is to the *Elater aulicus* and other European *Corymbites*.

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38. *Elater zealandicus*, White.

E. robustus, niger, fusco-pubescens, sat nitidus; antennis minus elongatis, intus leviter serratis, articulo secundo brevissimo, tertio sat elongato haud serrato; prothorace crassiusculo, antrorsum convexiusculo, postice latiore, angulis posterioribus subuncatis, fortiter plicatim elevatis, margine laterali anterius a supra occulto, crebre æqualiter punctato; elytris striatis, striis fortiter punctatis, interstitiis crebre subtiliter punctatis, apicibus conjunctim rotundatis. Long. 16–20 m.m.

I have examined a considerable number of examples, and find only slight sexual differences in the structure. The statement of M. Candèze that the male has the antennæ pectinated and is the *Elater punctithorax*, White, is erroneous. The *Elater punctithorax* of White is the same species as his *Elater lævithorax* (*vide* no. 5 of this paper); the male of it has the antennæ pectinated, but the species is very different in structure from *Elater zealandicus*.

Auckland, Tairua, Wellington. According to Captain Broun's observations the species is of crepuscular or nocturnal habits.

Group 12.—The following are the chief structural characters of *Elater zealandicus*:—

Forehead curved in front, but without the least raised carina, in the middle of the front depressed, so that the clypeus is very small; and though it is almost vertical, yet it forms only a very slight step between the forehead and the labrum; antennal spaces large, but yet rather broadly separated. Antennæ serrate, with short 2nd joint. Prosternal process thick, slightly curved upwards. Mesosternal cavity with very thick strongly elevated borders, the posterior portions of which are horizontal and quite on a level with the metasternum; the sides of the cavity are not parallel, but quite narrow near the intercoxal suture. Trochanteral portion of coxal plate a little broader than the femoral portion. Tarsi with all the joints well developed and simple, the 4th shorter than the 3rd.

This form is readily distinguished from the species I have called *Thoramus* by the curved front edge of the forehead and the large antennal spaces. Candèze has associated the *Elater zealandicus* with *Ochosternus Parryi* in one genus, which he calls *Ochosternus*; but he has fallen into so much error about these two species, that his definitions of the genus had better be withdrawn.

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39. *Corymbites antipodum*, Candèze.

C. elongatus, angustus, fuscus, antennis pedibusque testaceis, densius breviter griseo-pubescens; antennis filiformibus, elongatis, articulo secundo sat elongato, sed quam tertius fere duplo breviore; prothorace elongato, lateribus parallelis, fere dense punctato; elytris angustis, apicibus attenuatis, plus minusve emarginatis et spinosis, subtiliter striatis, interstitiis subtiliter fere dense punctatis; pedibus elongatis, tarsis longissimis. Long. 11–15 m.m.

Christchurch; several specimens communicated by Mr. Wakefield.

40. *Corymbites dubius*, n. sp.

C. elongatus, sat angustus, nigricans, antennis fusco-testaceis, pedibus testaceis, breviter minus dense griseo-pubescens; antennis tenuibus, filiformibus, sat elongatis; prothorace elongato, crassiusculo, lateribus subparallelis, crebre punctato; elytris leviter striatis, apicibus sat attenuatis, fere integris; pedibus gracilibus, tarsis sat elongatis. Long. 16–17 m. m.

Christchurch; found by Mr. Wakefield.

Obs. In Mr. Janson's collection there is an insect allied to this species, and labelled as being the type of *Corymbites antipodum* ♀; but I do not myself think it likely that the *C. dubius* is the female of *C. antipodum*; and I am almost sure that Candèze's ♀ type represents another distinct species.

41. *Elater strangulatus*, White.

E. elongatus, angustulus, fuscescens, densius pubescens, vix nitidus; antennis elongatis, tenuibus, filiformibus, thorace multo longioribus, articulo secundo sat elongato, tertio quam iste duplo longiore; oculis subglobosis; prothorace longiore quam latiore, dense fortiter punctato, angulis posterioribus elongatis, divergentibus, carinatis; elytris subtiliter striatis, striis evidenter punctatis, interstitiis crebre punctatis, apice attenuatis et muticis; pedibus elongatis, tarsis gracilibus. Long. 17 m. m.

Tairua, a single individual sent by Captain Broun as no. 175; also a mutilated individual from Auckland. They are probably both males.

Obs. I think I am right in considering the type of White's *Elater strangulatus* to be a specimen of the above described species.

42. *Elater myops*, White.

E. elongatus, angustulus, rufescens, densius pubescens, vix nitidus; antennis elongatis, tenuibus, filiformibus, thorace multo longioribus, articulo secundo sat elongato, tertio quam iste duplo longiore; prothorace longiore quam latiore, fere dense punctato, angulis posterioribus elongatis, vix divergentibus, carinatis; elytris subtiliter striatis, striis externis evidenter punctatis, interstitiis crebre punctatis, apice attenuatis; pedibus elongatis, tarsis gracilibus. Long. 13 m. m.

This and the preceding species are similar in appearance to our elongate European species of *Athous*, but have the elytra more elongate and attenuate behind. The present species is smaller and narrower than *Elater strangulatus*, and paler in colour, and presents a slight difference in the structure of the mesosternal cavity; in *Elater myops* the hinder border of the cavity is distinctly more elevated than the middle portion, whereas this is scarcely at all the case in *Elater strangulatus*.

Tairua; sent by Captain Broun as no. 18.

Group 13.—The form of the head is in these species that described in Group 11; but the present species differ from those of that group by the form of the prosternal process and mesosternal cavity. The former is but little (*Corymbites antipodum* and *C. dubius*) or not at all (*Elater strangulatus* and *myops*) bent upwards; and the saltatorial mucro is much prolonged. The borders of the mesosternal cavity are not elevated; the cavity does not extend to the intercoxal suture; its hind portion is rounded; and the portion of the mesosternum between the opening and the intercoxal suture is somewhat, but only slightly, depressed. Most of the other characters resemble those of Group 11.

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43. *Elater olivascens*, White.

E. subænescens, longius griseo-pubescens, pedibus flavis; antennis rufescentibus, tenuibus, minus elongatis, haud serratis, articulis secundo et tertio subæqualibus a sequentibus vix discedentibus; prothorace minus gracili, postice latiore, subtiliter punctato; elytris profundius striatis, striis externis punctatis, interstitiis parce subtilissime punctatis, apicibus minute spinosis. Long. 9–11 m. m.

This species is abundant at Auckland and Tairua, and is found on *Leptospermum*.

Obs. This species has also been called *Chrosis æneola* by Candèze.

44. *Corymbites agriotoides*, n. sp.

C. rufo-fusculus, longius griseo-pubescens, antennis pedibusque testaceis; illis tenuibus, simplicibus, articulis secundo et tertio elongatis, sequentibus similibus; prothorace convexiusculo, margine laterali indistincto, parcius minus subtiliter punctato; elytris striatis, sed sculptura pubescentia obtecta, apicibus fere muticis. Long. $6\frac{1}{2}$–$9\frac{1}{2}$ m. m.

This is a very variable species, and closely allied to *Elater olivascens*, but may be readily distinguished by the different colour, narrower form, more convex prothorax, &c.

Abundant at Auckland and Tairua; found on shrubs.

Group 14.—The form of the head is here again as in Groups 11 and 13; but these two insects cannot be very well arranged with the first of these groups, because the hinder parts of the sides of the mesosternal cavity are less elevated and horizontal; while from Group 13 they differ by the cavity being less depressed in its posterior part and approaching closely to the suture: from both groups these two species moreover differ in the fact that the hind coxal lamina is of nearly one length throughout, the trochanteral portion being not at all elongate.

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45. *Amychus Candezei*, Pascoe.

A. latus, obscurus, omnino opacus, nigro-fuscus, submarmoratus, parcius breviterque setosulus; antennis brevibus, rufescentibus, articulis secundo et tertio quam sequentes longioribus, 4–10. subæqualibus haud longioribus quam latioribus; prothorace magno, elytris latiore, angulis posterioribus elongatis, crassis, nullo modo divergentibus, ecarinatis; elytris latiusculis sed apicibus attenuatis, et ibidem parce subseriatim punctatis. Long. 15 m. m., lat. $5\frac{1}{2}$ m. m.

Chatham Islands. I have seen but a single individual, which was kindly given me by Mr. Wakefield.

Group 15.—The structure of the head in *Amychus Candezei* is that of the *Corymbites* forms, as described in Groups 11, 13, and 14. The prosternal sutures are not open, but the flanks as it were overlap the central piece. The prosternal process is broad, and is abruptly bent upwards (?) immediately behind the coxæ, so that it appears at first to be absent. The mesosternal cavity is very broad, quite rounded, and very deep posteriorly; and its borders are nearly horizontal and approach closely to the very deep intercoxal suture. The coxal lamina is very short; but its femoral portion is distinct throughout, and there is also a distinctly differentiated trochanteral lobe, though it is both short and narrow. The tarsi are stout and rather short, all the five joints well developed and simple, the 4th being only a little smaller than the 3rd. I think the species should be placed very near *Corymbites*; but as I fancy the prosternal process may have been deformed in the only individual I have examined, I do not feel very clear as to its characters.

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46. *Parinus villosus*, n. sp.

P. sat latus, minus elongatus, posterius angustatus, nitidus, sed longius irregulariterque albido pubescens, rufescens, elytrorum sutura lateribusque indistincte nigro-vittatis, subtus potius nigricans; antennis sat gracilibus, intus vix serratis, articulo secundo quam tertius paulo longiore; capite parvo, oculis prominulis; prothorace haud elongato, lateribus curvatis, angulis posterioribus crassis, intus curvatis; parcius et sat fortiter punctato; elytris nullo modo striatis, sed evidenter sat crebre punctatis, humeris longitudinaliter carinatis. Long. 7–9 m. m.

The long conspicuous pubescence, the thick incurved hind angles of the thorax, and the entirely unstriated elytra readily point out this species from the others.

Auckland; sent by Mr. Lawson and Captain Broun, but apparently rare.

Group 16.—The following are the structural characters of *Parinus villosus*:—

Head small, forehead much rounded in front, with short, ill-limited, almost perpendicular clypeus, but without any carina either in the middle or at the sides; antennal spaces small, but yet extending inwards, and separated from one another by only a narrow space. Antennæ slender, with 2nd and 3rd joints well developed. Prosternal sutures bearing a broad and deep depression extending backward for nearly half their length. Prosternal process short and stout. Hind part of mesosternal cavity with elevated quite horizontal sides, and approaching closely to the intercoxal suture. Coxal lamina short throughout, and without trochanteral lobe. Tarsi with the 3rd and 4th joints with membranous lobes underneath; the lobe of the 3rd joint very obscure, but that of the 4th joint quite distinct, the joint itself being very short on the upperside.

The nearest ally of this insect is the Australian *Hapatesus hirtus*, Cand.; the most important character for distinguishing the two from one another is the difference in the tarsal conformation.

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47. *Lacon variabilis*, Cand.

L. depressus, latiusculus, omnino opacus, fuscus, setis crassis brevissimis parce vestitus; antennis brevibus, articulis 4–10. intus serratis; prothorace subquadrato, angulis posterioribus haud productis, subrectis; elytris fortiter seriatim punctatis, interstitiis 1. 3. 5. 7. paulo elevatis. Long. 10–14 m. m.

This species varies much in size and colour, but cannot very well be mistaken.

Abundant under stones and logs near Auckland. The specimens quite agree with South-Australian individuals of the species; and I suspect it has been introduced by means of maritime traffic into New Zealand.

Group 17.—The characters of the genus *Lacon* are well known. *L. variabilis* may be readily distinguished from all the other known New-Zealand Elateridæ by the prosternal sutures being quite open for half the length of the thorax, so as to receive and conceal the antennæ; this character is approached only by *Parinus villosus*; but *Lacon variabilis* may be distinguished at a glance from it by the tarsi having the fourth joint well developed and not at all lobed beneath, and by the form of the front part of the head, which is almost that of the *Corymbites* group.

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48. *Limonius collaris*, Pascoe.

L. thorace pedibusque testaceis, antennis abdomineque rufis, elytris pectoreque nigricantibus vel fuscis; antennis elongatis, serratis, articulis secundo et tertio conjunctim quarto æqualibus; prothorace minus elongato, antrorsum angustato, haud longiore quam latiore, angulis posterioribus vix divergentibus, sat crebre punctato; elytris apicem versus fortiter attenuatis, apicibus minute spinosis, fortiter striatis, striis evidenter punctatis. Long. $6\frac{1}{2}$–9 m. m.

The species is rather variable. The female is generally larger than the male and more convex, has the antennæ rather less serrate, and the elytra very often of an obscure red colour; and it has generally the under surface nearly of a uniform red colour.

This species has been sent from Auckland by Mr. Lawson, and from Tairua by Captain Broun, who informs me that he meets with it occasionally on *Dodonæa viscosa*.

49. *Geranus crassus*, n. sp.

G. testaceus, elytris fulvis, antennis nigricantibus, prothorace medio, prosterno plagis duabus, metasterno lateribus, coxisque posterioribus fuscis; antennis minus elongatis, articulis secundo et tertio conjunctim quarto fere æqualibus; prothorace convexo, sat crebre fortiter punctato, angulis posterioribus sat divergentibus; elytris striatis, striis fortiter punctatis, interstitiis parcius punctatis et pubescentibus. Long. 14–15 m. m.

This is the broadest and most robust species of the group.

I think the two individuals before me are male and female, though they exhibit but slight differences.

Drybush, Nov. 21, 1873 (*C. M. Wakefield, Esq.*).

50. *Geranus fulvus*, n. sp.

G. testaceus, elytris fulvis, antennis nigricantibus, prothorace medio late, prosterno plagis duabus, metasterno lateribus, coxisque posterioribus fuscis; antennis sat elongatis, articulis secundo et tertio conjunctim quarto fere æqualibus; prothorace sat elongato, antrorsum evidenter angustiore, crebrius fortiter punctato, angulis posterioribus divergentibus; elytris striatis, striis fortiter punctatis, interstitiis parce punctatis et pubescentibus. Long. 14 m. m.

This species, though extremely similar to *Geranus crassus*, is narrower and has the thorax rather differently shaped and the antennæ less widely separate.

The only individual I have seen was sent me by H. Edwards, Esq., as No. 1149.

51. *Geranus similis*, n. sp.

G. testaceus, elytris fulvis, antennis nigricantibus, prothorace medio, prosterno plagis duabus, metasterno lateribus, coxisque posterioribus fuscis; antennis sat elongatis, articulis secundo et tertio conjunctim quarto haud æqualibus; prothorace crebre fortiter punctato, angulis posterioribus sat divergentibus; elytris striatis, striis fortiter punctatis, interstitiis parcius punctatis et pubescentibus. Long. $11\frac{3}{4}$ m. m.

This species is extremely similar to *Geranus crassus*, but is only half the size, and has the front of the head between the antennæ considerably more reduced.

Taken at Foster's Creek by Mrs. Kelly. I have seen but a single individual.

52. *Elater lineicollis*, White.

E. fulvus, thorace medio fusco profundius longitudinaliter impresso, elytris lateribus, antennis, prosterno vittis duabus, metasternoque lateribus nigris, tarsis geniculisque plus minusve infuscatis; antennis elongatis, intus evidenter serratis, angulis internis anterioribus productis, articulis secundo et tertio brevibus, conjunctim quarto multo brevioribus; prothorace sat elongato, antrorsum evidenter angustato, fortiter fere dense punctato, minus nitido; elytris ad humeros latiusculis, apicem versus fortiter angustatis, evidenter striatis, striis fortiter punctatis. Long. $9\frac{1}{2}$–$10\frac{1}{2}$ m. m.

This species is readily distinguished from its allies by the very short 2nd and 3rd joints of the antennæ. From the specimens before me I judge that the sexual differences are very slight.

Tairua and Christchurch, and probably widely distributed. Captain Broun informs me that it is "not uncommon at Tairua."

Obs. Acroniopus grandis (Redtenbacher, 'Novara Reise,' Coleopt. p. 96) will prove, I think, to be this species or a closely allied one.

Group 18.—Species 48–52 show these characters:—

Forehead produced between the antennæ, and terminating with a small abruptly inflexed portion over the labrum, this portion representing, as I consider, the clypeus; labrum very small and scarcely to be seen; antennal spaces rather large and very deep, almost circular, widely separated from one another by the produced forehead; antennæ either nearly filiform or strongly serrate. Prosternum moderately long, with excessively abbreviated chin-piece; lateral sutures open for one third or one half their length; prosternal process short and stout. Middle coxæ moderately distant; mesosternal cavity with thick but not raised borders; hind coxal lamina as long at its external portion as at its internal one, so that there is no trace of a trochanteral lobe. Tarsi slender, basal joint as long as the three following together; the 3rd and 4th joints with a produced membrane on their underside. In these insects the structure of the head is intermediate between that of the *Protelater* group and that of the ordinary forms of the Elateridæ.

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53. *Protelater elongatus*, n. sp.

P. elongatus, angustus, densius pubescens, colore variabilis, rufescens, plus minusve infuscatus, et in elytris vage plagiatus; antennis sat elongatis, vix serratis, articulis secundo et tertio sat elongatis conjunctim quarto fere longioribus; capite dense subtiliter punctato et pubescente; prothorace valde elongato, subcylindrico, angulis posterioribus divergentibus, elongatis, testaceis, fere dense punctato, fusco, fere subæneo, dense flavo-pubescente; elytris elongatis, minus discrete striatis, sed interstitiis alternis versus apicem magis elevatis; coxis intermediis bene separatis. Long. 7–10½ m. m.

This species appears to be extremely variable in size and a good deal in colour and markings.

Christchurch, Akaroa, 19th Dec. 1874; Tairua. Captain Broun informs me that this species is rather common on the outskirts of the forest at Tairua.

54. *Protelater Huttoni*, n. sp.

P. elongatus, angustus, pubescens, rufescens, supra præsertim in thorace, magis obscurus; prothorace elongato, subcylindrico, angulis posterioribus elongatis, valde divergentibus; coxis intermediis fere contiguis. Long. 8 m. m.

This species is extremely similar to the preceding one, but it has the middle coxæ nearly contiguous.

The only individual I have seen was found in Otago by Captain Hutton.

55. *Protelater guttatus*, n. sp.

P. sat elongatus, angustus, subcylindricus, fortiter punctatus, tenuiter pubescens, haud nitidus, nigricans vel infuscato-rufus, antennarum basi, pedibus, prothoracisque angulis posterioribus testaceis, elytris plus minusve distincte testaceo signatis; antennis sat elongatis, subserratis; prothorace dense, fortiter profundeque punctato, angulis posterioribus sat divergentibus; elytris fortiter seriatim punctatis, sed vix striatis. Long. $5\frac{1}{2}$–6 m. m.

The female is rather broader than the male, but otherwise scarcely differs.

Sent from Auckland by Mr. Lawson. I have also lately received a specimen from Captain Broun as No. 42, and with the information that it was found on trees at Cabbage-Tree Swamp, Auckland.

56. *Protelater picticornis*, n. sp.

P. sat elongatus, angustus, fortiter punctatus, tenuiter pubescens, vix nitidus, rufescens, antennarum basi, articulis tribus ultimis pedibusque testaceis, antennis medio, prosterno, thoracisque vittis duabus nigricantibus, elytris oblique fusco-plagiatis, maculis magnis ante apicem testaceis; thorace crebre, fortiter profundeque punctato, sat nitido, angulis posterioribus divergentibus; elytris fortiter seriatim punctatis. Long. $5\frac{1}{2}$ m. m.

This species approaches closely to the reddish varieties of *Protelater guttatus*, but has the apical joints of the antennæ yellow, and shows also some slight structural differences; the middle coxæ are a little closer, the metasternum is less advanced between them, and the mesosternal cavity is not quite so parallel-sided and is rather broader in its hind part.

A single specimen was sent me by Captain Broun some time ago as No. 199; but I do not know whether it was found near Auckland or Tairua.

57. *Protelater opacus*, n. sp.

P. sat elongatus, angustus, fortiter dense punctatus, opacus, evidenter pubescens, rufescens, prosterno medio diluto, lateribus infuscatis, antennis nigris, basi, pedibus, prothoracis angulis posterioribus, elytrisque macula ante apicem testaceis; prothorace dense fortiter punctato, opaco, elongato, angulis posterioribus divergentibus; elytris fortiter profundeque seriato-punctatis, vix striatis, opacis. Long. $5\frac{1}{2}$-6 m. m.

This species, though closely allied to *P. guttatus* and *P. picticornis*, may be distinguished by a glance at the underside of the thorax, which is pale along the middle, with the flanks infuscate; it is considerably duller above, the elytra are palish red at the base, with the apical half darker reddish and a pale yellow spot placed in this darker part; these markings on the elytra vary considerably in their definiteness.

Two individuals have been sent me from Tairua by Captain Broun; and I have seen others in Messrs. Pascoe's and Wakefield's collections from the same source.

Group 19.—These species have the following characters:—Forehead greatly produced between the antennæ, the produced portion with a slightly thickened lateral edge, these edges towards their anterior part divergent, so as to form a portion of an under margin to the large and deep antennal spaces; the labrum is small, but quite visible between the divergent processes at the termination of the forehead. The antennæ are slender and but little serrate; chin-piece of thorax very short, truncate in front, separated by a short wide notch from the front angles of the prosternum. Thorax elongate and subcylindric, its process thick and straight; mesosternal cavity rather broadest at its hind part, with thin, sharp edges, which are directed downwards. Middle coxæ moderately or only slightly separated. Coxal lamina slightly longer outside than inwardly. Tarsi with 3rd and 4th joints with membranous lobes.

Though the structural characters of these species are on the whole very similar to those of Group 18 (*Geranus*), yet the laterally dilated front of the forehead points out the present group as an interesting connecting link between them and the Eucnemides. The peculiar narrow form and elongate cylindric thorax of the species give them a facies by which they may be readily recognized.

These interesting insects have an undescribed ally in Chili, which, Mr. Janson informed me, was considered by Candèze not to be a member of the Elateridæ. But I think there is no doubt that these New-Zealand species may be placed in the Elateridæ; they offer, however, an important obstacle to the separation of the Throscidæ and Eucnemidæ from the Elateridæ as distinct families. The structure of their head is, in fact, such that by a little modification it might be transformed into the head of a Eucnemid or a Throscid.

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58. *Neocharis varia*, n. sp.

N. supra rufescens, dense variegato-tomentosa; antennis basi apiceque rufescentibus, medio fuscis; subtus fusca, pronoti lateribus abdomineque rufescentibus; pedibus testaceis; prothorace dense punctato, conspicue variegato-pubescente, anterius medio leviter impresso, disco utrinque vage infuscato, et densius subtiliusque punctato; elytris densius punctatis, punctis basin versus parcioribus, stria suturali dimidiata apice profunda et hamata, perconspicue variegato-pubescentibus. Long. 5 m. m.

The prosternal sutures in this species are not (or scarcely perceptibly) impressed in front. I think I have the sexes before me; and if so, the differences are slight.

A single individual has been sent me from Tairua by Captain Broun; and there are others from the same source in the possession of Messrs. Wakefield and Pascoe.

59. *Neocharis pubescens*, n. sp.

N. rufo-fusca, variegato-tomentosa, pedibus testaceis, antennis basi apiceque minus læte rufescentibus; prothorace crebre, fortiter, æqualiterque punctato, pubescentia minus variegata; elytris crebre punctatis, conspicue variegato-pubescentibus, stria suturali dimidiata, apice profunda et hamata, et ad basin striarum obsoletarum rudimentis. Long. 5 m. m.

Though very similar to the preceding species, this has the thorax darker and rather more coarsely and deeply punctured, and the prosternal sutures have in front a large and deep impression.

I have seen but a single specimen, which was sent me from Tairua by Captain Broun.

60. *Neocharis simplex*, n. sp.

N. angustula, nigra; thorace antrorsum angustato, parce punctato et pubescente, nitido, pubescentia grisea; elytris crebre subtiliterque punctatis, densius pubescentibus, pubescentia fere concolori, stria suturali tantum postice impressa, apice hamata perprofunda. Long. 4 m. m.

The only individual I have seen is no doubt a male; it has the antennæ very long (3 millims.), but little serrate internally, with the 2nd and 3rd joints subequal, together shorter than the 4th.

Received from Captain Broun; but I have no information as to exact locality.

61. *Neocharis concolor*, n. sp.

N. nigra; thorace antrorsum sat angustato, parce punctato, et pubescente, nitido, pubescentia grisea; elytris minus elongatis, subparallelis, posterius minus angustatis, apice rotundatis, sat dense fusco-nigro pubescentibus, nullo modo striatis, sed seriebus punctorum sat distinctis, interstitiis crebre subtiliter punctatis, serie suturali ad apicem impressa. Long. $3\frac{3}{4}$ m. m.

The male has the antennæ very elongate (3 millims.), stout and strongly serrate; 2nd and 3rd joints about equal and very short, together shorter than the 4th joint. In the female the antennæ are shorter (2 millims.), rather stout, but not serrate; the 3rd joint is a little longer than the 2nd, so that the two together are rather longer than the 4th joint.

The species, though extremely similar to *Neocharis simplex*, may be distinguished at a glance by the rows of distant punctures on the elytra.

This species has been sent from Tairua by Captain Broun.

Group 20.—Species Nos. 58 to 61 have the following characters:—

Antennæ very approximate at their insertion; front of the head much dilated laterally below the antennæ, so as to leave an oblique depression near the eye, in which the basal joint of the antennæ is received when retracted. Labrum not visible, the front of head being terminated by a sharp edge, behind which the labrum is concealed. Thorax short, without chin-piece, without grooves for antennæ, with a short process, which is curved upwards behind the coxæ. Mesosternal cavity short and broad. Lamina of hind coxæ without trochanteral lobe. Tarsi simple, with all the joints simple, or with the 4th very obscurely emarginate, basal joint as long as the three following together; 5th joint either very or moderately short.

The position of these insects is evidently in the Eucnemides, near the European and North-American *Xylobius* and *Hylochares*.

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62. *Talerax distans*, n. sp.

T. angustulus, subparallelus, rufo-castaneus, pubescens, sat nitidus; oculis magnis; prothorace subquadrato, angulis posterioribus elongatis, antrorsum subangustato, sat crebre et fortiter punctato, nitido; elytris subtiliter sat crebre punctatis, punctis vix seriatis, sine stria suturali, sed ad apicem foveis profundis. Long. $4\frac{1}{4}$ m. m.

In the male the antennæ are very long ($3\frac{3}{4}$ millims.), while in the female their length is only 2 millims.

Taken by Captain Broun at Tairua on *Leptospermum*, and sent to me as Nos. 35 and 36.

Group 21.—This species has the head formed much as in *Neocharis*, but the mouth-piece depressed in front, so that the minute transverse labrum is visible. Antennæ with very short 2nd joint and very elongate 3rd joint. Thorax beneath with a very broad deep lateral groove, which starts in front, right across the prosternal suture, and then crosses to the outside of it, so that the sutural line is rendered very indistinct by this groove; the groove is bordered externally by a raised line, which at first sight might be mistaken for the line of the prosternal suture. Hind coxal lamina much produced over the trochanters. Tarsi slender, with 4th joint minutely lobed.

This species should be placed in the Eucnemides; but I cannot point out any near ally for it at present.

XLVIII.—*Description of a new Species of* Phasmidæ *from the Malay Peninsula.* By Prof. J. Wood-Mason, Deputy Superintendent, Indian Museum, Calcutta.

Lonchodes valgus, sp. nov.

♀. Body about the same length and thickness as that of *L. artemis*, Westw., cylindrical, obsoletely granulated above and below, with a fine raised median dorsal line extending from the apex of the mesothorax to the end of the penultimate abdominal segment. Antennæ (tips broken off) moderately long and fine-setaceous; basal joint large, dilated, oval, longitudinally carinate above. Head short, thick, and very convex, its disk sloping to the insertion of the antennæ and to the occiput, from which it widens to the eyes; armed with a pair of great spoon-shaped oval horns, the front margins of which are straight and the hinder arcuate, and the apices of which are slightly bilobed. Eyes small. Mesothorax slightly tapering in front, the metathorax widening slightly to the insertion of the posterior legs. Penultimate dorsal segment of the abdomen with a rugose boss at its hinder extremity; the last carinate, grooved to the base, and divided at the apex by an emargination into two rounded lobes. Supraanal plate concealed. Cerci minute, conical. Operculum shaped much as in *L. cuniculus*, Westw., but not quite reaching the extremity of the abdomen. Fore femora serrated along the upper crest; intermediate and posterior ones curved, the former very strongly so; all subtriquetrous and armed below near the apex with a strong triangular tooth, and above with one or two spinules on each crest; the intermediate femora have also a well-developed foliaceous lobe at the base of the lower and inner crest. Tibiæ all triquetrous, slightly curved, and provided with a sharp foliaceous carina along the middle of the under surface. Tarsi also all triquetrous; the first joint in fore legs expanded above into a sharp foliaceous crest and longer than the rest taken together; in the intermediate legs the first tarsal joint is equal to the last three, in the posterior to all the rest. Colour dark brown, with two pale longitudinal dorsal stripes: the legs and the horns variegated with luteous.

Male unknown.

Total length 5 inches 3 lines; head 2·5 lines; prothorax 2; mesoth. 11; metath. 10; abdom. 27+6=33; fore femur 15·5, tibia 18, tarsus 4·75; intermediate femur 9·75, tibia 9·75, tarsus 3·75; posterior femur 12·5, tibia 12·5, tarsus 4.

Hab. Perak, Malay peninsula. Communicated by Dr. G. E. Dobson.

This species belongs to the same group as *Lonchodes amaurops* and *uniformis*, Westw., *crawangensis*, De H., *verrucifer*, W.-M., and *brevipes* and *spinicollis*, G. R. Gray, &c., the last of which only it resembles in the peculiarly curved condition of the thighs.

April 13th, 1877.

XLIX.—*Diagnoses of new Species of* Pleurotomidæ *in the British Museum.* By Edgar A. Smith, Zoological Department.

The various genera or groups of Pleurotomidæ require thorough revision; for at present they are badly described and their limits unrecognizable. The following species are placed provisionally in those sections of the family which are usually accepted, as I have not yet completed the investigation of the whole of the collection.

Pleurotoma amicta.

Testa solida, fusiformis, alba, epidermide tenui flavescente amicta, spiraliter lirata vel carinata, incrementique lineis oblique striata; anfract. 14–15, superiores tricarinati, prope suturam canaliculati (carina mediana duplici, supra et infra sculptura peculiari quasi corrugata ornata), inferiores 2–3 carinis 5–6 cincti, anfr. ultimus pluricarinatus; spira elongata, crassa, acuminata; apertura breviuscula, superne elongato-ovata in canali breviusculo leviterque obliquo et recurvo producta, longitudinis testæ $\frac{2}{5}$ æquans, intus tenuiter lirata; labrum tenue, margine crenulatum, superne ad carinam duplicem anguste fissum; columella suboblique tortuosa, lævigata.

Long. 50 mill., diam. 15.

Hab. Sandwich Islands.

This species is remarkable for the numerous subequal keels or lirations, none of them being very large. A double one a little above the middle of the whorls has above and below it a very peculiar style of sculpturing, consisting of a kind of puckering of very short and oblique thread-like lines.

Pleurotoma Nelliæ.

Testa fusiformis, turrita, alba; anfr. 12, supra valde excavati, inferne angulati, infra suturam carinis duabus parvis contiguis cincti, et versus basim tuberculis longitudinaliter oblongis rectis (in anfr. ultimo ad 16) seriatim coronati, et striis spiralibus in excavatione sed præcipue inter tubercula ornati; anfr. ultimus infra tuberculorum seriem liris validis (superioribus 2 quam cæteræ majoribus) succinctus; apertura cum canali longitudinis testæ $\frac{1}{2}$ æquans; labrum tenue, superne ad excavationem incisum; canalis elongatus leviter obliquus, paululum retrorsus.
Long. 31 mill., diam. 10.

Hab. Mauritius.

A species of charming form and purity, with whorls strongly excavated above, and a row of upright oblong tubercles encircling their bases, and two small contiguous keels around them just below the suture.

Pleurotoma ceylonica.

Testa fusformis, griseo-albida, infra suturam maculis rufis variegata et circa anfract. ultimi medium flammulis elongatis inferne productis ornata; anfract. $10\frac{1}{2}$, primi $1\frac{1}{2}$ vitrei, politi, convexi, cæteri paululum infra suturam concavi, cingulis spiralibus 6 granosis succincti (tertio a summo quam cætera minore), sutura distincta, fere canaliculata, discreti; anfr. ultimus cingulis ad 20 succinctus; columella levissime tortuosa; apertura intus fascia unica rufescente ornata, longitudinis testæ $\frac{1}{2}$ haud æquans; labrum tenue, medio prominens, superne ad cingulum parvum anguste sed haud profunde incisum; canalis mediocriter elongatus, leviter recurvus.
Long. 19 mill., diam. $6\frac{1}{2}$.

Hab. Ceylon.

The entire surface of this species consists of spiral contiguous series of granules; the third row from the top of the whorls being smaller than the others produces a depression in that region.

Pleurotoma acutigemmata.

Testa cylindraceo-fusiformis, fusco-flava; spira elongata, acuta; anfr. 12–13, medio carina maxima, acuta angulati, ad suturas carinati (carina superiore undulata), supra carinam maximam serie spirali granulorum acutorum cincti; anfr. ultimus paululum infra medium contractus, carinis 12–13 et inter has striis spiralibus exilibus ornatus; apertura parva, basi angustata, longitudinis testæ $\frac{1}{3}$ fere æquans, intus liris intrantibus 4–5 munita; labrum tenue, medio prominens, supra carinam maximam fissura latiuscula sed haud profunde incisum; columella leviter sinuata, callo tenuissimo induta; canalis mediocriter brevis, vix recurvus.

Long. 22 mill., diam. fere 7.

Hab. —— ?

It is with considerable hesitation that I apply a name to this form, on account of its close relationship with *jubata*, Hinds. The chief differences are the narrower form, larger tubercles, and shorter canal, in the latter character bearing the same relation to *jubata* as *cingulifera* (Lamarck) does to his *albina*.

Pleurotoma retusispirata.

Testa elongato-subfusiformis, dilute purpurascens, ad apicem obtusum saturatior; anfract. 8, primi 2 (nucleus) vitrei, politi, globosi, sequentes 5 bicarinati (carina superiore duplici) liraque intercurrente nodosa cincti, inter carinas liris longitudinalibus confertis, tenuibus ornati, sutura canaliculata discreti; anfr. ultimus ad peripheriam rotundatus, deinde contractus caudam brevem formans, carinis ad 12 subæqualibus succinctus; apertura parva, longitudinis testæ $\frac{1}{3}$ paulo superans, intus sulcata, sulcis costis externis respondentibus; labrum margine levissime incrassatum et crenulatum, paululum supra medium fissura parva incisum; columella medio plicis duabus minutis (superiore fere obsoleta) munita, ad basim dextrorsum curvata ac infra labrum descendens; canalis brevis, recurvus.

Long. $7\frac{3}{4}$ mill., diam. $2\frac{1}{2}$.

Hab. —— ?

The present species has for its nearest relative *P. violacea*, Hinds, from which it differs in form somewhat; the apex is blunter; and there is but a single nodose liration around the middle of each whorl, whereas Hinds's species possesses two.

Pleurotoma cognata.

Testa elongato-subfusiformis, luteo-albida, versus apicem dilute purpurea, carinis albis cincta, et inter carinas striis tenuibus longitudinaliter insculpta; spira perelongata, acuta, lateribus rectis; anfract. 12?, sutura carinata sejuncti; primi 4? (abrupti), sequentes 7 medio concavi, carinis duabus validis, remotis, et inter carinas liris 2 exilibus, cincti; anfr. ultimus basi contractus, caudam brevem formans, carinis ad 12 (quarum superiores 3 maximæ) cinctus; apertura alba, angusta, basi paululum contracta, longitudinis testæ $\frac{1}{3}$ æquans; fissura minime profunda, inter carinas primam secundamque sita; labrum tenue, margine crenulatum; columella medio obsolete uniplicata; canalis brevis, obliquus, leviter reflexus.

Long. 24 mill., diam. 7.

Hab. Australia.

This species has a close relationship to *P. violacea*, Hinds, from which it differs, however, in colour, the number of carinations, and the more produced spire. It is still more nearly allied to *P. vallata*, Gould, from which it differs only in size and the presence of only one plication on the columella, whereas *P. vallata* possesses two. It may be merely the adult of the latter species.

Pleurotoma antipodum.

Testa breviter fusiformis, dilute carneo-fusca, transversim albo-carinata ac inter carinas longitudinaliter tenuissime lirata; anfract. $7\frac{1}{2}$, primi $2\frac{1}{2}$ politi, læves, sequentes 4 superne ad suturam carina duplici et paululum infra medium altera longe maxima (supra et infra quam sunt liræ intercurrentes graciles 1–2) cincti; anfr. ultimus magnus versus basim contractus, carinis præcipuis ad 9 (quarum ea paululum supra medium longe maxima) aliisque (circiter 6) minoribus circa caudam succinctus; apertura oblonga inferne contracta, intus lævis, longitudinis testæ $\frac{1}{2}$ fere æquans; labrum tenue, margine haud crenulatum supra carinam maximam late sed minime profunde incisum; columella tortuosa, callosa, nitens; canalis brevis, recurvus.

Long. 10 mill., diam. 4.

Hab. New Zealand.

This species, which consists of but few whorls, is chiefly remarkable for its short fusiform shape and the prominent keel around the whorls a little below the centre.

Pleurotoma multiseriata.

Testa acuminato-ovata, lutea (interdum purpureo-fusca): anfract. 10, primi 2 læves, politi, cæteri planiusculi, infra suturam tuberculorum parvorum serie duplici, infra eam liris spiralibus 1–2 gracilibus, infra quas circa medium tuberculorum majorum serie duplici secunda, et infra hanc liris 1–2 ex nodulis parvis factis succincti; anfr. ultimus liris nodosis circiter 15 ornatus; apertura liris tenuibus 5–6 intrantibus, haud ad labri marginem extendentibus, munita, longitud. totius $\frac{4}{9}$ adæquans; columella fere recta; labrum tenue, paululum infra suturam distincte incisum; canalis perbrevis, recurvus.

Long. 15 mill., diam. 5.

Hab. Ceylon, Persian Gulf, and China Seas.

Sometimes the rows of granules on the body-whorl are alternately larger and smaller.

Pleurotoma albofasciata.

Testa oblonga, subcylindracea, rubro-castanea, zona unica alba infra carinam undulatam ornata; anfract. 12, convexiusculi, medio angulati, carinis tribus cincti, suprema juxta suturam duplica, mediana maxima nodulis acutis 9 instructa, infima prope suturam sita, inter carinas spiraliter striati; anfr. ultimus infra carinam maximam 12-carinatus, carinis inferioribus 5 parvis circa caudam sitis; apertura parva, intus liris tenuibus 5–6 ornata, longitudinis totius $\frac{1}{3}$ haud æquans; collumella callo tenui induta, superne juxta suturam tuberculata; labrum tenue, ad carinam mediocriter incisum; canalis brevis, recurvus.

Long. 22 mill., diam. 8.

Hab. Sandwich Islands.

The central keel is formed of sharp, compressed, transverse tubercles. The space between it and the lower keel is white.

Pleurotoma zealandica.

Testa valida, ovato-turrita, carneo-albida; spira acuminata, gradata, apice fuscescente; anfract. 10, primi $2\frac{1}{2}$ politi, vitrei, convexi, cæteri convexiusculi, superne carinati et decliviter complanati (gradibus radiatim fortiter striatis), sulcis 2–3 (supremo maximo, oblique fortiter striato) insculpti; anfr. ultimus magnus, aliquanto inflatus, basim versus contractus, sulcis circiter 12 fortibus, longitudinaliter striatis, ornatus; apertura fusca, ampla; columella fuscescens, medio arcuata, inferne obliqua, cum labro canalem brevem leviter recurvum constituens; cauda carina parva, fusca circumdata; incisura latiuscula, haud profunda, paululum supra labri medium sita.

Long. 23 mill., diam. supra labrum 9.

Hab. New Zealand.

This species is remarkable for the tabulated whorls, the tabulations being very strongly radiately striated, and sometimes furnished with a spiral liration, and the conspicuous sulcations encircling the body-whorl. The slit in the labrum is situated just below the broad furrow which grooves the upper part of the whorls.

Pleurotoma (Drillia) chocolatum.

Testa fusiformis, nitens, saturate purpureo-fusca, zonis angustis tribus modo supra costas parentibus ornata; anfract. 12, primi 2–3 convexi, læves, cæteri superne concavi, deinde convexiusculi, infra excavationem costis rotundatis paucis (in anfr. ultimo 9 ad peripheriam obsoletis) instructi, striis exilibus paucis spiralibus, sed haud in concavitate, insculpti; anfr. ultimus infra peripheriam valde angustatus, ubique transversim striatus vel liratus; apertura intus purpureo-fusca, longitudinis testæ ad $\frac{2}{5}$ æquans; labrum tenue, medio extans; sinus mediocriter profundus; canalis obliquus, recurvus.

Long. 21 mill., diam. 7.

Hab. Goza Harbour, Japan.

The dark chocolate-colour, with the three yellowish spots which are slightly nodulous on each rib, and the smooth concavity at the upper part of the whorls are very distinctive characters.

Pleurotoma (Drillia) subochracea.

Testa elongata, fusiformis, turrita, rubido-ochracea; anfract. 13, supra valde excavati, deinde convexi, infra excavationem costis plicosis (in anfr. ultimo 14 fere ad basim continuis) instructi, liris tenuibus supra costas subnodosis et albis (in anfr. penult. 5, in ultimo circiter 22) et striis gracillimis numerosis incrementique lineis ornati; sutura marginata; apertura carneo-alba, superne ovata, inferne in canalem mediocriter elongatum producta, longitudinis totius $\frac{3}{7}$ adæquans; labrum extra costa validissima incrassatum, in excavatione sinuatum; columella tortuosa, callosa, superne tuberculo parvo munita; canalis recurvus.

Long. 39 mill., diam. 11.

Hab. China seas (probably).

This handsome shell is very characteristically coloured. The reddish-ochre colour is uniform, except where the transverse lirations cross the ribs or plications, where they are white and slightly nodulous. The excavation is well defined by the sudden termination of the ribs.

Pleurotoma (Drillia) mindanensis.

Testa elongate ovato-fusiformis, turrita, sordide albida, inter costas supra ac infra fusco maculata; anfractus 12, primi 3 convexi, læves, politi, cæteri superne leviter excavati, medio angulati, deinde concaviusculi, propeque suturam aliquanto constricti, costis perobliquis flexuosis suturas attingentibus (in anfr. ultimo circiter 13 versus basim obsoletis) instructi, et liris 4–5 gracilibus supra costas prominentioribus subnodulosisque succincti; anfract. ultimus ad peripheriam obtuse angulatus, albidoque zonatus, inferne fuscescens, liris numerosis ornatus; apertura longitudinis totius $\frac{3}{7}$ æquans; labrum tenue, margine crenulatum, medio prominens, prope suturam valde incisum; columella paululum contorta, superne tuberculata; canalis leviter recurvus.

Long. 29 mill., diam. 9.

Hab. Island of Mindanao, Philippine Islands.

The ribs in this species are flexuous and very oblique and continuous up the spire; but whether this latter be a constant character I cannot say, as but a single example is at hand. The obtuse angulation of the body-whorl at the periphery gives it a squarish aspect.

Pleurotoma (Drillia) rotundicostata.

Testa acuminato-fusiformis, apice acuto, dilute fuscescens, epidermide tenui flavo-olivacea amicta; anfr. 12, convexiusculi, superne paululum constricti, costis rotundatis validis, superne versus suturam attenuatis (in anfr. ultimo 7 ad peripheriam evanidis) instructi, sutura simplici undulata sejuncti, liris spiralibus 3–4 supra costas aliquanto incrassatis striisque aliis cincti; anfract. ultimus infra peripheriam valde constrictus, in caudam elongatam productus, ubique spiraliter liratus; apertura angusta, longit. totius $\frac{3}{7}$ adæquans, intus fuscescens; sinus minime profundus; canalis elongatus, recurvus.

Long. 21 mill., diam. 6.

Hab. ——?

The few roundish ribs are broadest at the lower ends and gradually diminish upwards. The operculum is unguicular, with a groove running lengthwise from the apex to the superior margin.

Pleurotoma (Drillia) latisinuata.

Testa fusiformis, turrita, dilute luteo-fuscescens (interdum omnino nivea); anfract. 12, superne excavati, medio carinati et angulati, infra angulum oblique plicati, plicis haud ad suturas extendentibus (in anfr. ultimo circiter 14 fere obsoletis), liris spiralibus elevatis albis (in anfr. superioribus 3–4, in ultimo ad 12) suprema quam cæteræ majore in medio anfractuum, et striis gracilibus inter liras ornati; apertura lata, sordide albida, longitudinis testæ fere $\frac{1}{2}$ æquans; labrum superne valde et latissime sinuatum, paululum post marginem costa tuberosa incrassatum; columella callo tenui induta, prope suturam tuberculata; canalis mediocriter elongatus, leviter recurvus.

Long. 50 mill., diam. 35.

Hab. China.

This species is allied to *P. flavidula*, Lamk. The upper half of each whorl is nearly smooth, as the plications extend scarcely beyond the central large spiral liration which marks the angulation of the whorls. Sometimes, this lira being double, the whorls are less acutely angular.

Pleurotoma (Drillia) nodilirata.

Testa fusiformis, turrita, albido-cornea; anfract. 11, superne concave excavati (excavatione arcuate striata), medio obtuse angulati, infra suturas carina tenui marginati, infra excavationem costis obliquis modice validis (in anfr. ultimo circiter 12 basi fere continuis) instructi, liris spiralibus præcipue super costas elevatis (in anfr. superioribus 5–6, in ultimo circiter 20 subnodulosis) cincti; anfr. ultimus basi attenuatus; apertura angusta, longitudinis totius fere $\frac{1}{2}$ æquans; columella recta, crasse callosa; labrum extra valde incrassatum; sinus modicus; canalis angustus, reflexus.

Long. 25 mill., diam. 8.

Hab. Philippine Islands.

The spiral lirations in this species are particularly prominent, especially upon the ribs, where in the body-whorl they are developed into little nodules.

Pleurotoma (Drillia) variabilis.

Testa clavate fusiformis, subrimata, fusco-lutea, rubro-fusco notata præcipue infra suturam; anfract. 12, supra concavi, medio angulati, infra excavationem costis subtubercularibus inferne versus suturas fere obsoletis (in anfr. ult. 10 haud ad basim attingentibus) instructi, liris spiralibus 3–4 (in anfr. ultimo circiter 15 subgranosis) lineisque aliis tenuibus cincti; anfract. ultimus subquadratus, basi modo paululum constrictus; apertura intus lævis pallide rosacea, longitudinis totius $\frac{2}{5}$ adæquans, callo superne tuberculoso induta; canalis brevissimus, recurvus; sinus latus profundiusculus; labrum extra incrassatum.

Long. 34 mill., diam. 10.

Var. Testa alba, fusco sparse punctata.

Hab. —— ?

This species is remarkable for the squarish body-whorl and the very short canal and aperture. The lirations, where they traverse the plications, are whitish.

Pleurotoma (Drillia) Atkinsonii.

Testa ovato-fusiformis, flavescens, ad apicem fusca, inter costas roseo-fusco maculata; anfract. 11, convexi, superne paululum excavati, superne ad suturam oblique crenulati, costis rotundatis, supra fere obsoletis (in anfr. ultimo 8–9 basi desinentibus) instructi, liris validis supra costas leviter incrassatis (in anfr. superioribus 6–7, in ultimo circiter 16) succincti, undique incrementi lineis obliquis ornati; apertura intus saturate fusca, longitudinis totius $\frac{6}{13}$ æquans; labrum extra costa ultima maxima incrassatum, intus roseo-album; columella livido-fusca, callo tenui amicta, supra tuberculo parvo munita; sinus mediocris; canalis brevis, recurvus, aurantiaco-fusco tinctus.

Long. 26 mill., diam. 8.

Hab. —— ?

The lines of growth in this species are particularly apparent. The ribs on the body-whorl are slightly nodose at their lower part, where the spiral lirations cross them.

Pleurotoma (Drillia) angusta.

Testa angusta, elongata, fusiformis, dilute luteo-fusca, apice caudaque alba (interdum omnino alba); anfract. 9, apicales magni, rotundati, cæteri convexi, infra suturam leviter concavi, costis confertis tuberculosis obliquis superne suturas vix attingentibus (in anfr. ultimo 15, paululum infra peripheriam desinentibus) instructi, sulcis spiralibus (in anfr. superioribus 5–6, in ultimo circiter 16) insculpti; apertura parva, longitudinis testæ $\frac{1}{3}$ adæquans; labrum tenue, prope suturam leviter sinuatum; canalis breviusculus.

Long. 20 mill., diam. $5\frac{1}{2}$.

Hab. China Sea.

In this species the nuclear whorls are unusually large, the rest are convex and only slightly excavated at the upper part. The ribs are deeply cut across by the spiral sulcations, and thus become nodulous, four or five nodules existing on a rib.

Pleurotoma (Drillia) incerta.

Testa fusiformis, alba; anfract. 12, primi 2 vitrei, convexi, cæteri superne decliviter concaviusculi, deinde convexi, costis leviter obliquis superne versus suturas obsoletis, in anfr. superioribus inferne incrassatis (in anfr. ultimo 10 paululum peripheriam infra desinentibus, una aliquanto post labrum maxima inflata) instructi, liris striisque spiralibus et incrementi lineis obliquis undique ornati; apertura longit. totius ad $\frac{3}{7}$ æquans; labrum tenue, margine crenulatum; columella subrecta, callo superne aliquanto incrassato induta; canalis modice elongatus, recurvus.

Long. 25 mill., diam. 7.

Hab. New Guinea.

The spiral lirations in this species are about six in number in the upper whorls, and twenty in the last; they do not exist in the depression at the upper part of the whorls, which is only finely striated.

Pleurotoma (Drillia) multilirata.

Testa ovato-fusiformis, lacteo-alba, versus apicem dilute lilaceo tincta; anfract. 10, primi 2 vitrei, convexi, cæteri medio angulati, supra concave excavati, sutura simplici discreti, costis obliquis plicæformibus medio incrassatis supra ac infra attenuatis, supra vix suturam attingentibus (in anfr. ultimo 10 ad peripheriam obsoletis) instructi, ubique transversim striati et tenuiter crebreque lirati, liris 3–4 quam cæteræ majoribus, supra plicas aliquanto incrassatis, incrementi lineis striati; apertura longitudinis totius $\frac{5}{11}$ æquans; labrum tenue, superne sinu parvo incisum; canalis latus, brevis.

Long. 23 mill., diam. $7\frac{1}{2}$.

Hab. Port Jackson?

The transverse lirations are very numerous and regular.

Pleurotoma (Drillia) consociata.

Testa oblonga, subturrita, flavicans; anfract. 10? (apice fracto), superne ad suturam carina duplici cincti, infra hanc concave excavati, deinde costis crassis 6 (in anfr. ultimo paululum infra medium evanidis) instructi, liris spiralibus 4 supra costas prominentibus in interstitiis subobsoletis (in anfr. ultimo circa 16) cincti; apertura long. totius $\frac{5}{12}$ æquans; columella rectiuscula, callo tenui induta; canalis brevis, recurvus; sinus mediocriter profundus.

Long. 24 mill., diam. 8.

Hab. —— ?

This species differs from *P. crenularis*, Lamk., in the shorter last whorl and the uniform colour; and the spiral lirations are scarcely continuous between the ribs as in *P. crenularis*.

Pleurotoma (*Drillia*) *intertincta*.

Testa elongata, fusiformis, albida, inter costas fusco maculata; anfract. 13, modice convexi, infra sed juxta suturam carina valida subacuta valde undulata (interdum fusco-punctata) sejuncti, costis rotundis, hic illic una varicosa quam cæteræ majore (in anfr. ultimo 8 prope peripheriam obsoletis) instructi, liris spiralibus valde elevatis supra costas continuis et prominentibus (in anfr. superioribus 2, in antepenult. et penult. 3, in ultimo circiter 14) clathrati, undique striis paucis incrementique lineis ornati; anfr. ultimus infra peripheriam zona fusca ornatus, cauda aliquanto elongata, alba terminatus; apertura intus alba, longitudinis testæ ad $\frac{3}{7}$ æquans; columella leviter torta; labrum margine crenulatum, superne infra carinam valde sinuatum; canalis paululum recurvus.

Long. 28 mill., diam. 8.

Hab. China Seas and Philippine Islands.

The prominent spiral lirations are acute and prominent where they cross the ribs, which are rather large and stand out white in contrast with the brown maculations in the interstices.

Pleurotoma (*Drillia*) *maorum*.

Testa fusiformis, turrita, dilutissime rosea, inter costas præcipue circa medium fusco strigata; anfract. $8\frac{1}{2}$, primi $1\frac{1}{2}$ convexi, læves, sequens convexiusculus, spiraliter liratus, cæteri superne concave excavati, prope suturam marginati, deinde convexiusculi, costis confertis leviter obliquis superne ad excavationem obsoletis instructi (in anfr. ultimo 16, prope medium evanidis), liris spiralibus 7, circa medium tribus quam cæteræ minoribus cincti; anfract. ultimus liris circiter 15, his ad medium subdistantibus, ornatus, inferne in caudam subelongatam productus; apertura elongata, longitud. totius $\frac{3}{7}$ paulo superans; canalis subelongatus, angustus; sinus mediocris, in excavatione situs.

Long. 21 mill., diam. $6\frac{1}{2}$.

Hab. New Zealand.

This species must not be confounded with *P. novæ-zealandiæ*, Rve. The form of the whorls, the elongate canal, and different position of the sinus are characters which easily define this form.

Pleurotoma (Drillia) Prattii.

Testa fusiformis, turrita, dilute fulva; anfract. 10, superne excavati, medio rotundate angulati, costis obliquis rotundis (in anfr. ult. 9 ad peripheriam sensim desinentibus) instructi, ubique spiraliter exiliter striati, sutura leviter marginata; anfr. ultimus magnus, post labrum valde tuberose incrassatus, striis spiralibus magis profundis incrementique lineis ornatus; apertura angustiuscula, carnea, longitudinis totius fere $\frac{1}{2}$ æquans; sinus magnus, latus, prope suturam situs; canalis leviter obliquus et recurvus; columella tuberculo calloso parvo superne munita.
Long. 27 mill., diam. 8.

Hab. —— ?

The few rounded oblique ribs, which do not extend to the suture above, and the uniform bright reddish brown or fulvous colour are the characters which chiefly distinguish this species.

Pleurotoma (Drillia) excavata.

Testa fusiformis, turrita, lutescens; anfr. 9, primi 2 læves, cæteri superne valde oblique excavati, medio obtuse angulati, longitudinaliter costati, costis ad excavationem finitis (in anfr. ultimo 14 infra medium desinentibus), liris spiralibus (iis in excavatione exilioribus quam inferiores) supra costas incrassatis cincti; apertura longit., totius ad $\frac{9}{20}$ æquans; sinus mediocriter profundus, proxime ad suturam situs; canalis paululum elongatus, recurvus; columella rectiuscula, callo tenui amicta.
Long. 20 mill., diam. $6\frac{1}{3}$.

Hab. —— ?

The ribs do not extend into the excavation or concave depression at the upper part of the whorl; and the five or six lirations encircling it are finer than those below it.

Pleurotoma (Drillia) concolor.

Testa elongata, fusiformis, turrita, rubido-fusca (interdum purpureo-fusca); anfract. 13, primi 2 convexi, læves, cæteri superne concavi, medio angulati, costis longitudinalibus supra versus suturas obsoletis (in anfr. ultimo circiter 11 basi obsoletis) instructi, et in anfractuum dimidium inferius liris elevatis spiralibus 3 (in anfract. ult. ad 6) supra costas nodulosis clathrati, ubique striis spiralibus gracillimis incrementique lineis flexuosis ornati; sutura undulata, aliquanto incrassata; apertura angusta, longitudinis testæ ad $\frac{1}{3}$ æquans; labrum tenue, margine crenulatum, intus læve, superne paululum infra suturam late profundeque incisum; columella subrecta, callo tenui induta, tuberculo parvo juxta suturam munita; canalis latiusculus, leviter recurvus.
Long. 43 mill., diam. 11.

Hab. Moluccas and China.

This species is of uniform reddish or purplish brown; the upper half of the whorls is concave and devoid of spiral lirations, which exist only on the lower portion.

Pleurotoma (*Drillia*) *digna*.

Testa ovato-fusiformis, sub epidermide tenui flavo-olivacea cæruleo-cinerea; anfractus 9, leviter convexi, costis obliquis superne nodosis 13–14 (in anfr. ultimo versus labrum subobsoletis et prope peripheriam evanidis) instructi; anfr. ultimus sulcis angustis pluribus circa basim insculptus; apertura fusca, albo-bifasciata, longitudinis totius quam $\frac{1}{2}$ paulo minor; labrum tenue, ad marginem album, superne minime profunde sinuatum; columella versus basim callo albo induta; canalis breviusculus, latus.
Long. 26 mill., diam. 9.

Hab. California.

The colour beneath the epidermis of a specimen in good condition is a bluish ash; but in worn examples the upper part of the whorls and the middle of the body-whorl are broadly banded with brown; and these bands are seen in the aperture of all specimens. A slight furrow or depression extends around the whorls a little below the suture, and, traversing the ribs, causes their upper ends to be nodulous. The sinus in the labrum is situated at the termination of this depression.

This species belongs to a group of Pleurotomidæ which includes several Californian forms, viz.:—*P. inermis*, Hinds; *incisa*, Carpenter; *penicillata*, Cpr.; *mœsta*, Cpr.; *aurantia*, Cpr.; *erosa*, Schrenk; and *lirata*, A. Adams.

Pleurotoma (*Clionella*) *Bornii*.

Testa elongata, subturrita, albida, strigis rufis inter costas ornata, epidermide cornea olivacea induta; anfract. 8? (apice abrupto), planiusculi, paululum infra suturam linea impressa bipartiti, leviterque constricti, longitudinaliter costati, costis interstitia æquantibus, numerosis (in anfr. ultimo ad 18), striis spiralibus exilibus obsolete striati; apertura ovata, longitudinis totius $\frac{1}{3}$ æquans, superne acuminata, basi canali brevissimo leviter recurvo terminata; columella medio leviter arcuata, vix tortuosa; cauda brevis, carina circumdata; labrum tenue, superne paululum infra suturam haud profunde sinuatum.
Long. 40 mill., diam. 12.

Hab. Cape of Good Hope.

This species is closely allied to the well-known *P. sinuata*, Born. It differs, however, in being covered with a paler epidermis, in having below the suture a raised girdle formed by a depression or constriction around the whorls, and also in the style of coloration.

Pleurotoma (Clionella) Krausii.

Testa turrita, albida, maculis punctulisque purpureo-fuscis præcipue super anfractuum dimidium superius variegata, epidermide tenuissima viridi-olivacea induta; anfract. 9–10, medio excavati, deinde angulati, superne læves, inferne costis subnodosis (in anfr. ultimo ad 12) instructi, striis spiralibus exilibus ubique ornati, sutura undulata marginata discreti; apertura albida, fusco maculata, longitudinis testæ $\frac{2}{5}$ æquans; labrum tenue, paululum infra suturam leviter sinuatum; canalis brevis, obliquus; columella arcuata.

Long. 29 mill., diam. 10.

Hab. Cape of Good Hope.

This species is easily recognized by the short subnodulous ribs, which occupy scarcely the lower half of the whorls, the depression round the middle and the raised band above, and the manner of coloration, the purplish-brown maculations being somewhat flexuous in the depression. Its nearest relation is *P. semicostata*, Kiener.

Pleurotoma (Clionella) bipartita.

Testa elongate ovato-fusiformis, sub epidermide tenui griseo-olivacea dilute rubescens vel albida, lineis gracillimis confertis dilute fuscis longitudinaliter picta, et strigis obliquis subremotis fuscis infra suturam ornata; anfract. 10, plani, medio sulco spirali bene definito minime profundo sed latiusculo exsculpti, infra sulcum plicis nodosis obliquis (in anfr. ultimo fere obsoletis, in superioribus ad 12) instructi; anfract. ultimus magnus, longitudinis totius $\frac{4}{7}$ æquans, infra peripheriam striis spiralibus paucis circiter 7–8 cinctus; apertura intus dilute purpureo-carnea, longitudine testæ $\frac{2}{5}$ æquans, basi late canaliculata; columella arcuata, superne callo nodulosa, parvo, munita; labrum tenue, ad sulcum aliquanto profunde scissum.

Long. 34 mill., diam. 12.

Var. Testa anfr. ultimi costis obliquis haud obsoletis sed ad peripheriam desinentibus.

Hab. South Africa, Port Elizabeth.

This very distinct form is peculiar for the manner in which the whorls are divided into three parts. Below the suture exists a raised band, whitish, streaked obliquely with brown; below this runs a shallow furrow nearly as broad as the fillet; and again below the sulcus are oblique subnodulous ribs which occupy nearly half the whorl, these ribs disappearing almost entirely in the body-whorl.

Pleurotoma (Clionella) subventricosa.

Testa ovato-fusiformis, carneo-albida, zona lata irregulari circa anfractuum partem inferiorem ornata; anfract. 8, convexiusculi, superne paululum infra suturam sulco angusto leviter constricti, infra sulcum costis subrotundatis (in anfr. ultimo flexuosis inferne desinentibus circiter 14) instructi, striis spiralibus remotis paucis (in anfr. ult. ad 12) insculpti; anfr. ultimus subventricosus, testæ $\frac{4}{9}$ æquans; apertura intus fuscescens, basi oblique lateque canaliculata, longitudinis totius $\frac{4}{9}$ æquans; labrum tenue, superne ad sulcum leviter sinuatum; columella medio arcuata, basi obliqua.

Long. 26 mill., diam. 10.

Hab. South Africa.

This shell, although without a locality attached, in all probability inhabits the Cape of Good Hope, having with some species from there such a general resemblance as to warrant the supposition; the brown band occupies about half the whorls, not quite reaching the upper ends of the ribs.

Pleurotoma (Clionella) platystoma.

Testa elongata, turrita, flavescens (interdum pallide rosco-fusca), superne juxta suturam et mediane inter nodulos dilute fusco notata; anfract. 7, primi 2 convexi, papillares, læves, cæteri superne ad suturam margine incrassato leviter nodoso, deinde concavi, medio angulati, infra angulum plani, circa medium nodulorum parvorum obliquorum (ad 13) serie unica ornati, spiraliter striati, striis subdistantibus 10–12, in anfr. ultimo circiter 24, incrementi lineis obliquis striati; apertura lata, subquadrata, longitudinis testæ totius fere $\frac{5}{13}$ æquans; sinus latus, mediocriter profundus; columella callo tenui induta; canalis apertus, brevissimus.

Long. 13 mill., diam. 5.

Hab. Cape of Good Hope.

The two apical whorls are remarkably large. The faint nodules at the top of the whorls and the more distinct ones around the middle have faint dots of brown between them; and the spiral striæ are interrupted by them.

L.—*On* Rupertia stabilis, *a new Sessile Foraminifer from the North Atlantic.* By G. C. Wallich, M.D., Surgeon-Major Retired List, H.M. Indian Army.

[Plate XX.]

It will, I think, be conceded that a special degree of interest attaches to the Foraminifer about to be described, when I state that it not only represents a well-marked new genus, but is one of the very few forms as yet discovered whose peculiarities of structure point to their being sessile inhabitants of the bed of the ocean.

The specimens were obtained by me in 1860, in three soundings taken on board H.M.S. 'Bulldog,' on opposite sides of the southern extremity of Greenland—the depth in the three localities varying from 108 fathoms on the east coast, to 1205 fathoms on the west. In each locality the number of specimens was considerable, and the condition of the shells such as to indicate their perfect freshness at the time they were brought up from the bottom. Partly owing, however, to the impossibility of carrying on microscopic work during such tempestuous weather as prevailed whilst the 'Bulldog' cruised in those latitudes, and partly to my having been deceived by the resemblance observable in the outline of the neck and margin of the disk of the new form to a monstrously developed species of *Uvigerina*, it did not receive the attention it deserved, but remained stored away in my collection until 1874, when, on re-examining my North-Atlantic materials, I at once perceived that it was both specifically and generically new.

Nevertheless, fully recognizing in the daily increasing distaste for the undue multiplication of types one of the most salutary results of modern biological teaching, and feeling disinclined to rely too far on my own opinion, I made up my mind to defer sending forth any observations on the subject until that opinion should be confirmed and strengthened by some thoroughly experienced and trustworthy authority on the Foraminifera. Under these circumstances I submitted my specimens, figures, and brief memoranda, to my able and obliging friends Professors Rupert Jones and Parker. Their report, which reached me a few days ago together with my embodied memoranda, I now, with their permission, publish.

I have named the new form after Prof. Rupert Jones, *Rupertia stabilis*, in recognition of the obligation he has laid me under, not only on this but on former occasions when I have sought his counsel on questions relating to the Foraminifera.

Rupertia stabilis, Wall. (See Pl. XX.)

"A chambered hyaline Foraminifer of the Rotaline group, subpyriform, with an irregular lumpy outline, like some of the asymmetrical Puffballs, and somewhat resembling an inverted *Ascidia mamillata*. The shell is fixed by a relatively large basal disk, and raised on a thick cylindrical neck or pedestal, usually straight, but sometimes slightly curved, from which several spacious chambers swell upwards and outwards, with an imperfect spiral arrangement, resulting in the often top-heavy, lopsided, and asymmetrical outline of the full-grown shell. Young individuals are simply subglobular and pedunculated." (The disk, from the earliest stage of the shell, attains its full dimensions, the neck being of nearly the same diameter as the disk, whilst the upper part is merely rounded off, as shown in figs. 5 and 6 of the accompanying Plate.—G. C. W.)

"The shell-wall is essentially vitreous and rather coarsely tubular; but the tubules become obsolete over and near the sutures, leaving tubuliferous tracts with glassy interspaces. In places the shell grows opaque and sometimes becomes covered with particles of mineral matter or minute Foraminifera and broken sponge-spicules."

(Here, then, as in a very large number of the deep-sea Foraminifera, we have the arenaceous structure supplementing, and in some cases entirely superseding, the normally calcareous shell of the species.

The older chamber-walls generally appear to be formed of two or even three layers secreted one over the other. Sometimes the inner layer is opaque and closely resembles opal glass, the tubules distinctly opening out into the interior. The vitreous layer occurs externally to this. In the last-formed and largest chamber the vitreous is the only layer, the tubules then looking like minute white stars with a central pore in each. *The disk is quite imperforate.*—G. C. W.)

"Each chamber has a large, transverse, lunular slit in front, this simple aperture being arcuate and forked at one end, as shown in fig. 11. The chambers are superposed, with little or no overlapping for the most part. A secondary coating of shell-wall is here and there seen creeping down the neck towards the glassy base. The basal disk has usually some obscure, minute, opaque lobules about its centre; but the greater portion of its area is glassy and apparently structureless, the substance presenting the sugar-candy-like aspect so often observable on the bases of the fixed Foraminifera. Even when only one large chamber is present the disk seems to have been already formed; and it does not subsequently increase in area.

"In its relation to other Foraminifera, this fungus-shaped form stands between *Planorbulina* and *Globigerina*, and, as to its shell-structure, like *Carpenteria*. In its semi-opaque condition it imitates the habit of *Pulvinulina*, which sometimes becomes imperforate over broad tracts, and coated with a glassy layer perforated by large pores here and there.

"Instead, however, of spreading out sessile chambers in a compound tent-like arrangement, like *Carpenteria*, this subcylindrical lobulated Foraminifer raises its chambers high up, with somewhat of a Bulimine twist, on a broad-based peduncle."

The associated Foraminifera (as determined by Professors Rupert Jones and Parker) are:—

Biloculina ringens (thick).	*Pulvinulina auricula* (large).
Lituola scorpiurus (nodosarine).	*Discorbina globularis.*
Textularia sagittula.	*Nonionina scapha* (large).
—— *agglutinans.*	—— *striatopunctata* (large).
Cristellaria rotulata (large).	*Polystomella crispa* (large).
—— *ariminensis* (large).	(*Entosolenia marginata*, var., G. C. W.)
—— *coronata* (large).	

Professor Rupert Jones also informs me that he "cannot help thinking the obscure lobulate spots in the centre of some of the disks may be a very small primordial spire of the very earliest-formed chambers, this being possible, probable, and quite in accordance with Planorbuline characteristics." I have completely failed to detect any thing like such an approach to a spiral or minute chamber-like arrangement in two carefully dissected specimens which appeared most likely to exhibit it, had it really been present. It is, however, quite possible, as Prof. Jones says, that this structure may be disclosed when a sufficiently large number of disks is examined.

Height of the mature shell from $\frac{1}{24}$ to $\frac{1}{18}$ of an inch. Diameter of disk about $\frac{1}{50}$ of an inch.

EXPLANATION OF PLATE XX.

Fig. 1. Erect view of a mature shell of *Rupertia stabilis*, showing the disk in profile and the slit-like aperture of the last-formed chamber.

Fig. 2. Oblique view of a specimen of the same, in which the neck is bent and the face of the disk presents itself.

Fig. 3. The most erect form in which this Foraminifer occurs, the aperture being on the opposite side to that depicted.

Fig. 4. Another specimen, showing the irregular growth sometimes met with.

Figs. 5 & 6. Young specimens, showing the contour of the primordial chamber.

Fig. 7. View from upper surface of the young specimen depicted in fig. 5, showing the position of the aperture.

Fig. 8. Disk of the same.

Figs. 9 & 10. Two views of a specimen in which two masses of mineral are firmly imbedded in the shell-substance.

Fig. 11. View from above of the last-formed chamber of an adult specimen, in which the arcuate and forked aperture was observed.

Fig. 12. A specimen in which the entire surface was thickly covered with extremely minute Globigerine and other foraminiferal shells and fragments of sponge-spicules.

Fig. 13. A perfectly "*arenaceous*" but broken specimen. No other specimen of this kind was discoverable in the material.

BIBLIOGRAPHICAL NOTICE.

The Ancient Life-History of the Earth. By Prof. H. A. Nicholson, M.D., D.Sc., &c. 8vo. Pp. 408, with 270 woodcuts. Blackwood: Edinburgh, 1877.

The author well defines this work as "a comprehensive outline of the principles and leading facts of palæontological science." It differs from many of the books already written on palæontology; for it is not unfairly weighted with the over-treatment of any one favoured subject—it is not devoted to the mere enumeration or to a very special illustration of all the fossils of each formation—it is not a mere popular sketch of the organic beings of the past—it is not shackled with hesitations about old philosophies—but is written evidently with a full personal knowledge of the subject-matters, a good acquaintance with what our continental and American fellow-workers have said and done, and in an open-minded but far from rash scientific spirit, seeking truth for truth's sake, enlightened sometimes by the doctrine of evolution, and sometimes feeling for that "deeper and higher law" which has ruled nature with still greater power.

In his concise introductory sketch of "the laws of geological action," our excellent teacher opportunely and with justice warns us that the Huttonian reaction against pure *Catastrophism* carried geologists too far, and that "Catastrophes" must be allowed for, though the general truth of the doctrine of *Continuity* is to be fully admitted.

The President of the Geological Society of London also, in his late Address, has done good service to science in urging geologists to think more of the evidences and theoretical aspects of "Catastrophes," and to be less strongly influenced by the Uniformitarian reaction than they have been of late years.

The definition of Palæontology, its "scope and materials," and a sketch of what is meant by "fossiliferous rocks," with concise descriptions and useful illustrations, will prove useful to students and general readers. The "chronological succession of the fossiliferous rocks" is treated of in a short but sound and philosophical chapter; and "the breaks in the geological record," and "the biological relations of fossils," are equally good.

The main body of the work is, of course, "historical palæontology;" and this is carried out with great judgment, full information carefully condensed, conscientious treatment of obscure fossils, and a sound knowledge of both palæontology and physical geology. Each system, from the Laurentian to the Post-pliocene, has its fossils and life-history treated of in succession.

Of the numerous woodcuts, some are new; and, though the others have been used in earlier books, they are carefully chosen and well-applied; and the majority are inscribed with their original source.

A very useful bibliographic list of the more important books and papers having reference to each system of formations is appended to the successive chapters on the great periods; and a generalized section is given for each of the great series in England or elsewhere.

The concluding chapter, on "the Succession of Life upon the Globe," is well worthy of attention. The general appearance of *succession* and *progression* among living things of all recognizable time—the apparent exceptions to these phenomena—the gradual introduction and extinction of faunæ and floræ in most instances—the apparently almost sudden incoming and disappearance of such groups as the Graptolites and Trilobites—and the apparently sudden appearance of Hippuritidæ, of the Dicotyledonous flora, and, indeed, of the Cambrian fauna, are treated of in a clear-sighted philosophic spirit, glad to gather all that is known, and waiting and working for further light.

A tabular view of the chief divisions of the animal kingdom is given in the Appendix. A careful Glossary and full Index complete this well-arranged and well-printed book, which we cordially recommend to geologists and other naturalists.

MISCELLANEOUS.

Zoology of the 'Challenger' Expedition.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—Since I wrote you on the subject of the distribution of the 'Challenger' collections for description and study, a distinguished naturalist has moved in the House of Commons for the instructions given by the Treasury to Sir C. Wyville Thomson. The Treasury (courting, as I know they may well and safely do, the fullest inquiry) have ordered the whole correspondence to be printed; and it will be in hand shortly.

An important letter has already been communicated to a public department; and as I have seen it, I can now write on a matter in which my hands were formerly tied. The arrangements of the 'Challenger' expedition were superintended by a Circumnavigation Committee, which reported at last to the Council of the Royal Society; so that when the Treasury asked for the advice of that body, one of the secretaries was instructed to write, embodying the suggestions of the Committee. I need hardly say that this was carefully and faithfully done; and now the letter advising the Government can be seen, and I trust that I am not transgressing in stating that extraordinary care was taken in it to do what was best for science and just to Sir C. Wyville Thomson. After carefully reading this letter, now public property, I have no hesitation in stating that, unless a meaning be placed upon the wording of one part of it which is utterly irreconcilable with another, the sole responsibility for his course of action rests with Sir Wyville Thomson.

In this letter the specimens collected by the 'Challenger' are divided into two groups—the occasional, which do not bear specially on the objects of the expedition, and those which are "the *pièces justificatives* of a large part of the results of the investigations of the 'Challenger.'" With regard to the disposal of the first set, it is stated, "*They* [the Council of the Royal Society] *are, however, convinced that, both in the interests of science and in view of economy, no arrangement could be better than that proposed by Sir C. W. Thomson; according to which the work will be done by the highest authorities in their respective subjects in the country, while the naming of the specimens will involve no expense to the Government.*"

The second and more important collection is recommended to be dealt with as follows:—"*They* [the Council of the Royal Society] *hope that their Lordships will see fit to leave the collection mentioned under 12 e in his* (Sir W. C. T.'s) *charge, to be worked out under his direction.*"

On turning to paragraph "12 *e*" I find the following:—"*That the whole of the remainder of the collection, including marine invertebrate animals, samples of the bottom, samples of water for physical and chemical examination, remain under my charge as heretofore; my chief assistant, Mr. Murray, keeping a check-list of the whereabouts of all the specimens placed temporarily for any purpose out of my custody, so that, in case of my lapsing, he may be familiar with the whole arrangement. That a complete type-series of all species be selected by me as soon as they are determined and described and sent to the British Museum; the duplicates remaining in my hands to be afterwards distributed according to the instructions of their Lordships.*"

The letter, of which these quotations form a small part, was dated December 8, 1876. The Treasury then instructed Sir Wyville Thomson. They will insert a sum not exceeding £4000 in the estimates (1877–78) to provide for working out the collections included in paragraph 12 *e* (see *ante*).

It is not probable that the Treasury sanctioned Sir Wyville Thomson's course of conduct; and it is quite evident that no Government would subsidize foreign naturalists to do the work of competent British investigators. The conduct of the Government has been most liberal; and therefore, in supporting their patriotic wish to advance science, it is absolutely necessary to thoroughly open up the question of Sir Wyville Thomson's administration in its widest sense. I wish, therefore, to inform you regarding the disposal of the collections and the money.

The Sea Mammals have been, or are to be, offered to Prof. Turner; the Birds to Dr. Sclater; the Fish to Dr. Günther; the Cephalopoda to Prof. Huxley; the Gasteropoda and Lamellibranchs to the Rev. R. B. Watson; the Brachiopoda to Mr. Davidson; the Ostracoda Copepoda to Mr. G. S. Brady; the Rhizopoda to Mr. H. B. Brady; the Isopoda to Mr. H. Woodward; the Cirripedia to Mr. C. Darwin (?); the Annelida to Dr. M'Intosh; the Gephyrea to Prof. Ray Lankester; the Bryozoa to Mr. Busk; the Hydromedusæ to Dr. Allman; the Corals to Mr. Moseley; the Crinoidea to Sir Wyville Thomson; the Echinoidea (probably, but I do not write certainly, the Asteroidea) to Mr. A. Agassiz; the Ophiuroidea to Mr. Lyman; the Spongida to Prof. O. Schmidt; the Radiolaria to Prof. E. Haeckel; the higher Crustacea to Prof. Claus; and the Alcyonaria to Prof. Kölliker, to whom they have long since been sent. Mr. Murray is a permanent assistant; Mr. Wild's excellent artistic services are retained; and Mr. Pearcey is also employed. Sir Wyville Thomson, I again assert, has sent or proposes to send, the most important of the collections abroad for description. The general and geological value of the groups sent to the two American and four German naturalists is infinitely greater than that of all the others.

In the above list one misses some familiar names, such as Carpenter, Gwyn Jeffreys, Norman, T. Wright, Carter, Rupert Jones, Spence Bate, Archer. Of course no one from the British Museum, except Mr. Woodward and Dr. Günther, is included; nor is there mention of any of the very rising young naturalists and palæontologists who are doing such admirable work at Cambridge. One would have thought that there was somebody at Glasgow or at St. Andrew's who was worthy of consideration.

The Director, *as he gives up much paying work*, will receive £500 for the year and £1 a day travelling expenses. Mr. Murray and Mr. Wild will receive £400 a year each. The discretion of the "Director is to be used in paying" those specialists who are working up the different departments. But, doubtless, as those of us who "worked up" the results of the deep-sea dredgings of the 'Porcupine' expedition did it gratuitously, no call for money will be made by any one now at work except for simple expenses. When the Government bring forward the motion of supply they will be informed that their liberality has been far in excess of the requirements of the case.

I forward you the vouchers for my statements.

Yours, &c.,

May 25, 1877. P. Martin Duncan.

We append a remarkable paragraph which appeared in 'Nature' of the 17th ult. It is as follows:—

"We regret to see what we must characterize as an unwarranted attack made upon Sir Wyville Thomson in the current number of the 'Annals and Magazine of Natural History,' as to the disposal of the specimens obtained by the 'Challenger' expedition. Dr. Martin Duncan appears to have taken for granted that an extract of a private letter, which some indiscreet friend of Mr. Alexander Agassiz published in 'Silliman's Journal,' and which then found its way into the English journals, is 'official.' He would have done well to have ascertained whether this was really the case before allowing himself to comment on Sir Wyville Thomson's proceedings in such severe terms. So far as we are aware, out of the many naturalists actually engaged to work out the results of the 'Challenger' expedition, only *three* are not Englishmen, two being Americans, and one German. These three gentlemen are of the very highest repute in their respective branches; and Sir Wyville Thomson has, in our opinion, done well for science to secure their services."

The Editor of 'Nature' seems to have a curious notion of the application of words. In what manner, except by an expression of his own opinion, does he attempt to show that the letter from Prof. Duncan, which appeared in our last number, contained an "unwarranted" attack? In what sense he uses the word "official" we are at a loss to understand. It is not usual in such cases to talk of "official" statements and communications. The only question seems to be whether the statements published in the 'American Journal' for February last were or were not "true;" and we were informed by Prof. Duncan that he had fully satisfied himself upon this point, by direct communication with Sir Wyville Thomson, before he wrote his letter. From the wording of the letter from Mr. Alexander Agassiz, as printed in the 'American Journal,' it is perfectly clear that the letter in question was addressed by Mr. Agassiz to the Editors of that Journal, or to one of them; and hence that gentleman himself must be held guilty of the indiscretion pointed out by the Editor of 'Nature.' But in what does the indiscreetness consist? Mr. Agassiz's statement was undoubtedly indiscreet if there was any thing in the transaction that required concealment. Are we to infer that such was the case? Indiscretions appear not to be peculiarly the produce of the western shore of the Atlantic.

On a Newt from the Darjiling Hills. By Prof. J. Wood-Mason.

At the February Meeting of the Asiatic Society of Bengal, Prof. Wood-Mason exhibited a specimen of a newt which he had detected in a small collection of insects and other objects recently made by Colonel G. B. Mainwaring in the Darjiling hills and said:—"The specimen is in the highest degree interesting, not only as being the first example of a tailed amphibian that has ever been found in India, but also as being an individual of the remarkable species described by Dr. J. Anderson (P. Z. S. 1871, p. 423) from specimens obtained by him around the little Chinese town of Nantin and in various other parts of the same region. *Tylototriton verrucosus*, as the animal has been called by Dr. Anderson, lives, in Western China, in flooded rice-fields, but in Sikkim, according to Colonel Mainwaring, in damp situations amongst decaying leaves and sticks. There is, however, nothing remarkable in this difference of habit; for the common eft of Europe is not unfrequently to be found on dry land at some distance from water under logs of wood, there being no necessity for the Urodelous Amphibia, after they have passed through that stage of their existence during which they are provided with external gills for aquatic respiration, to keep to the water. The entire order of tailed Amphibia is confined to the temperate parts of the northern hemisphere; but two species have already been described from countries the fauna of which is largely leavened by Indo-Malayan forms,—*Cynops chinensis* having been recorded from near Ningpo, and *Plethodon persimilis* from Siam. This occurrence of a newt within the limits of the Oriental region is far from being without a parallel in other groups of animals also—*Nectogale* (*vide* W. T. Blanford, P. A. S. B. 1876), *Anurosorex*, probably also *Crossopus*, and a host of animals, vertebrate and invertebrate, extending still further southwards, being only to be looked upon as stragglers from the Palæarctic region or as outposts of it, to use the happy phrase of Dr. Günther. The only other form of newt at all resembling *T. verrucosus*, in which horny matter, accumulated at the points where the ends of the ribs press against the external integument, forms on each side of the middle line of the body along the upperside of the flanks a conspicuous row of great rough horny tubercles, is *Pleurodeles*, in which these bosses are sometimes so highly developed as to have given rise to the incorrect notion that the ends of the ribs projected freely through the skin.—*Proceedings of the Asiatic Society of Bengal*, February 1877.

On the Value of certain Arguments of Transformism derived from the Evolution of the Dentary Follicles in the Ruminants. By M. V. Pietkiewicz.

In a communication made to the British Association in 1839, Goodsir announced that he had discovered in the jaw of the calf and lamb the germs of incisors and canines, and even of a molar, intermediate between the abortive canine and the molars which normally exist in those animals. Geoffroy Saint-Hilaire had previously described abortive dentary germs in the lower jaw of *Balæna mysticetus*. The naturalists, and the partisans of the theory of transformism, Darwin especially, grasped at this idea, which, in conjunction with data furnished by comparative anatomy and palæontology, enabled groups of animals previously separated to be brought into relation.

Thus the dental formula of the ordinary Ruminants is I. $\frac{0}{3}$, C. $\frac{0}{1}$, M. $\frac{6}{6}$, and that of the omnivorous Pachyderms (such as the wild boar and the hippopotamus) I. $\frac{3}{3}$, C. $\frac{1}{1}$, M. $\frac{7}{7}$. But two or three genera of Ruminants possess upper canines; and their formula is I. $\frac{0}{3}$, C. $\frac{1}{1}$, M. $\frac{6}{6}$; and the camels and llamas have, in addition, a pair of very distinct upper incisors, giving them the formula I. $\frac{1}{3}$, C. $\frac{1}{1}$, M. $\frac{6}{6}$. According to M. Paul Gervais these last when young have two pairs of upper incisors, one of which has disappeared in the adult; the young animals would have the formula I. $\frac{2}{3}$, C. $\frac{1}{1}$, M. $\frac{6}{6}$. M. Gervais does not doubt that at a still earlier age a third pair of upper incisors might be found in these animals, the dental formula of which would then be the same as that of the Pachyderms, less one molar, viz. I. $\frac{3}{3}$, C. $\frac{1}{1}$, M. $\frac{6}{6}$.

The *Dinotheria* and *Amphitraguli*, the latter regarded as Ruminants allied to the chevrotains, have seven molars—that is to say, the same number as the Pachyderms. Thus among the Ruminants fossil species were already known having the same dental formula as the Pachyderms, and living species of which the formula was almost identical; and Goodsir's discovery, giving the ordinary Ruminants at a certain age the same formula as the Pachyderms, enabled the two groups to be approximated. Here was one of the results of the hypothesis of the unity of plan in nature, or a confirmation of the transformist theory, the abortion of the organs being explained by their disuse and the gradual establishment of this anomaly by adaptation and heredity.

The author says that, wishing to verify an opinion which enjoyed so much credit in science, he was surprised to find nothing to justify it. In a long series of preparations from embryos of cattle and sheep, from the earliest period of embryonic life up to the time when the fœtus is 30 centims. long in the sheep, he was never able to ascertain the presence of follicles, nor even of any trace of the *epithelial lamina*, the commencement of all follicular development.

Goodsir's error arose from the false idea he entertained of the development of the follicles; and, in fact, at the commencement of his researches, the author fell into the same error himself. In sections made quite at the anterior part of the upper jaw in the ox and sheep, there is on each side of the median line an epithelial sac which separates from the mucous membrane of the mouth to bury itself in the jaw. The mucous layer of Malpighi, uninterrupted, forms its outer covering; whilst in its interior there is a polyhedral epithelium in every respect like that of the middle layers of the buccal epithelium. Thus formed, this little sac would seem to constitute the commencement of the follicle; but by making sections of the same jaw further and further from the front, the little sac is seen to lose its relations with the buccal mucous membrane, and acquires the form of a circular canal, approximating to the mucous membrance of the nasal fossæ. Soon a cartilaginous tube appears round this canal; and then a ridge containing vessels is formed at its upper part. It is Jacobson's organ as described by Gratiolet.—*Comptes Rendus*, March 12, 1877, p. 508.

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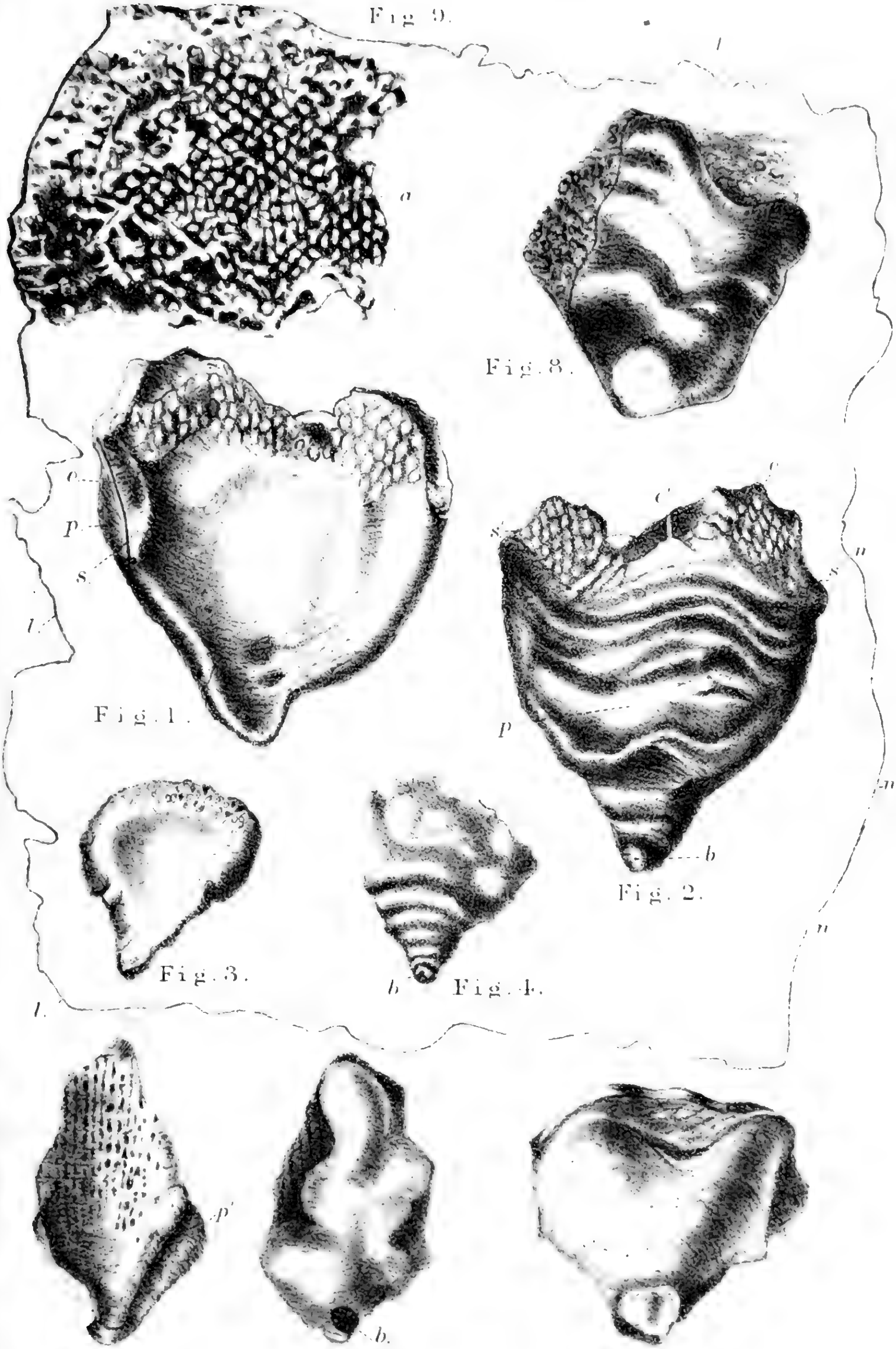
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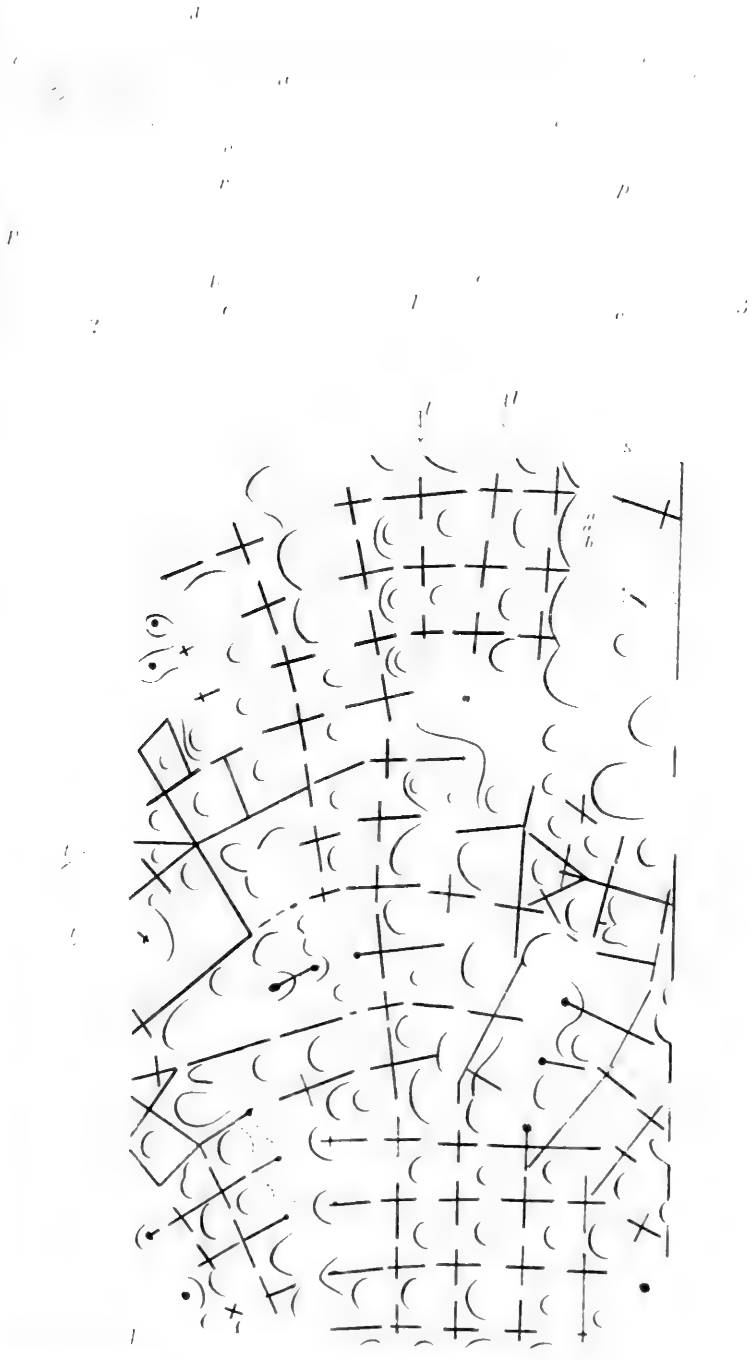

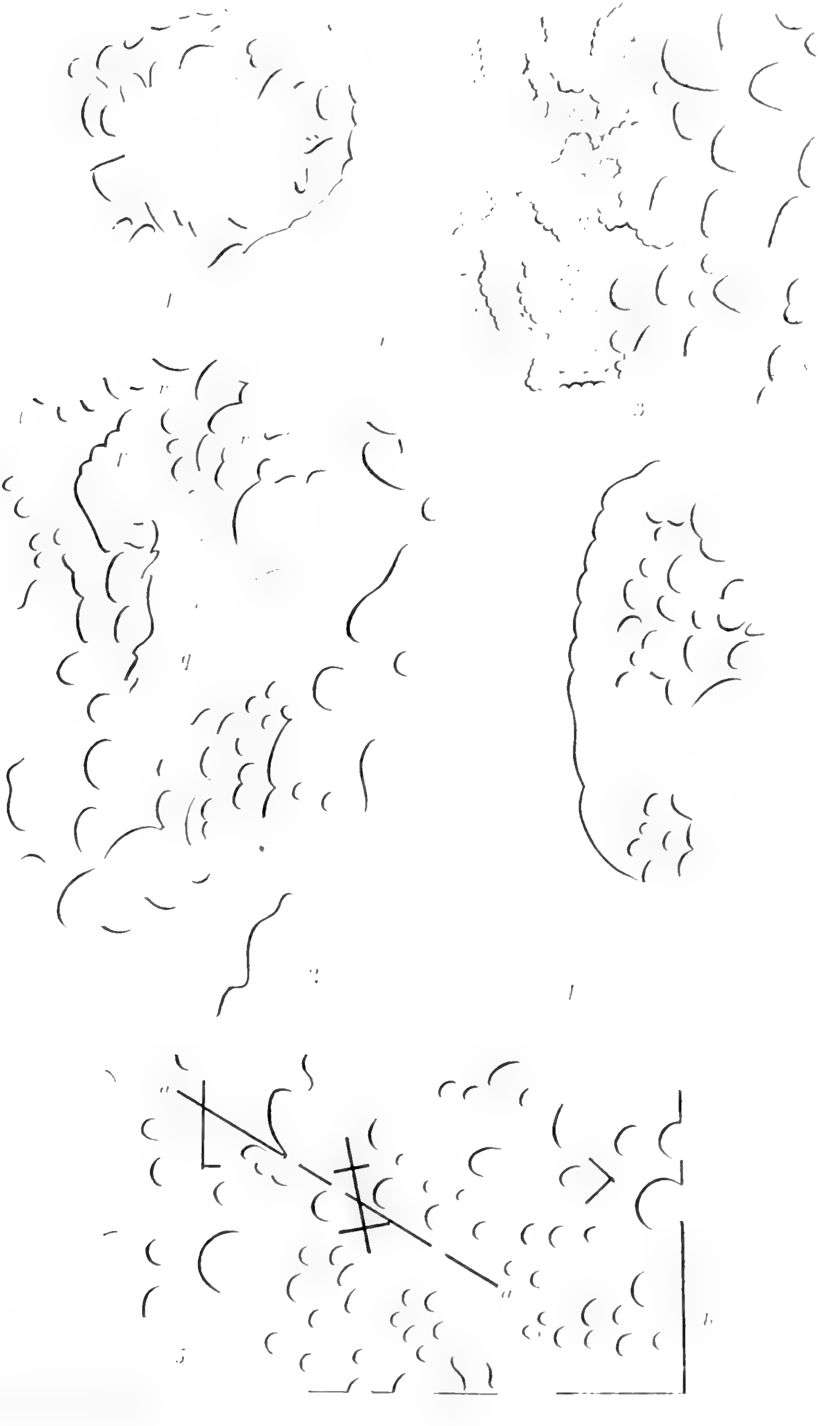

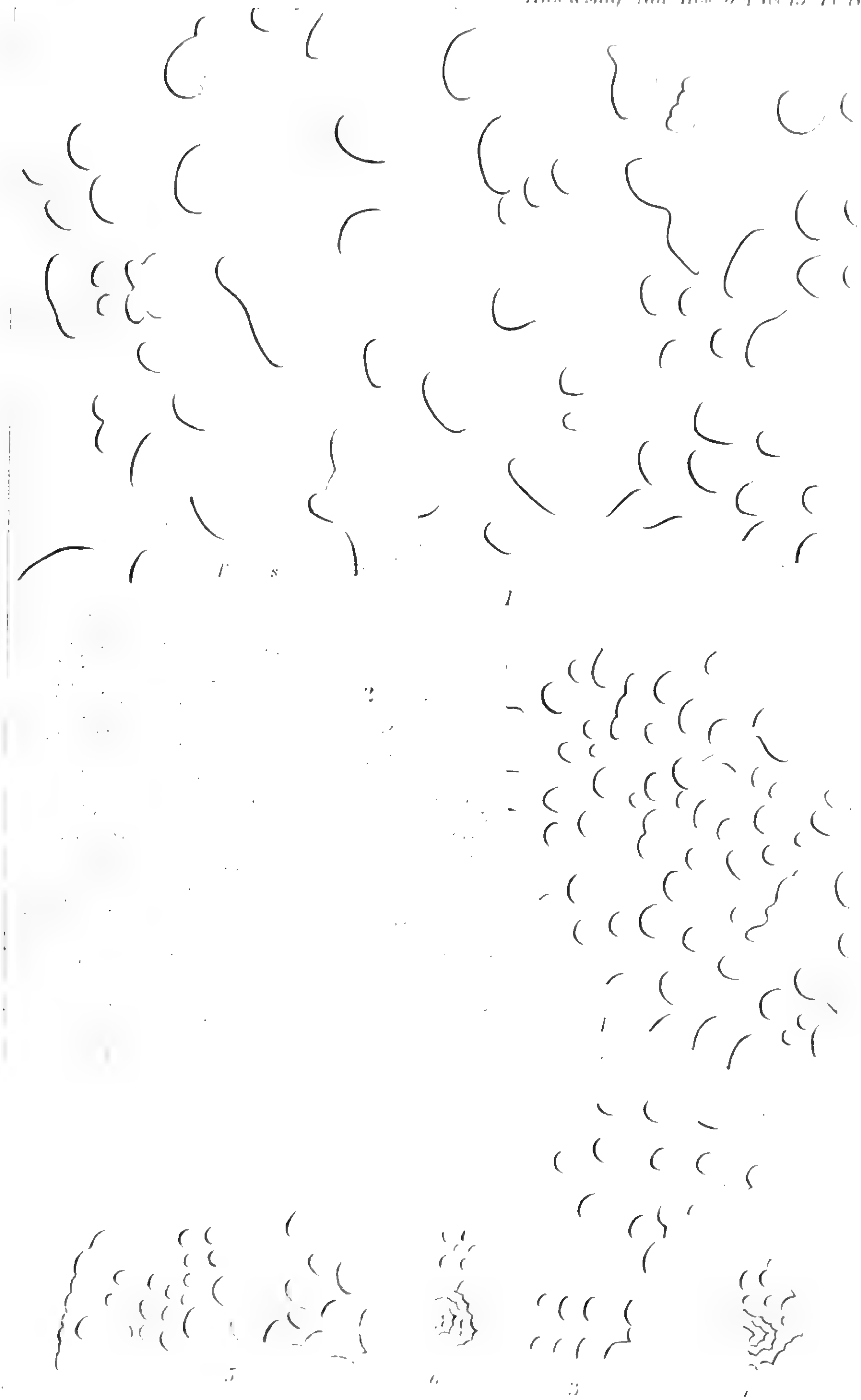

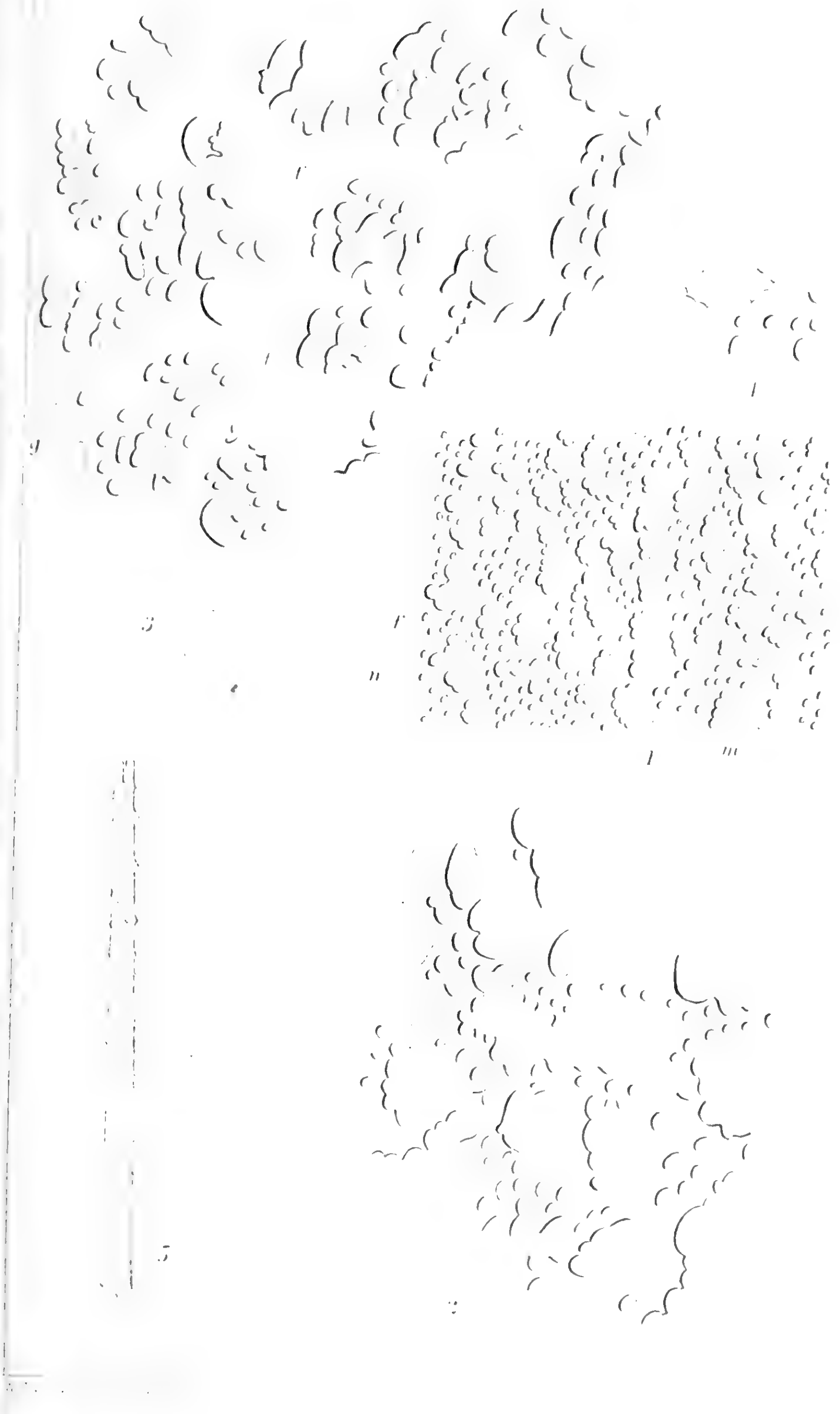

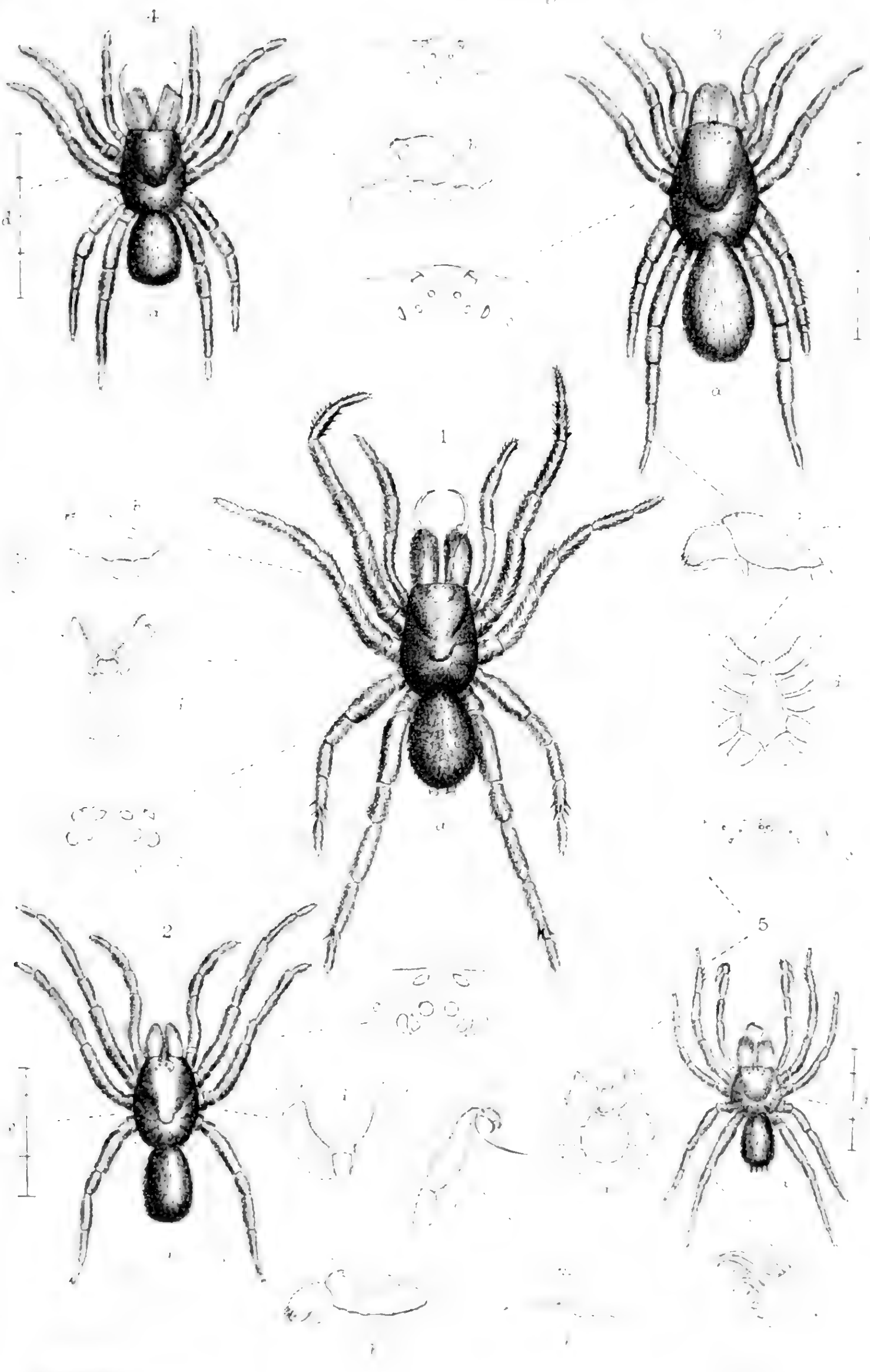

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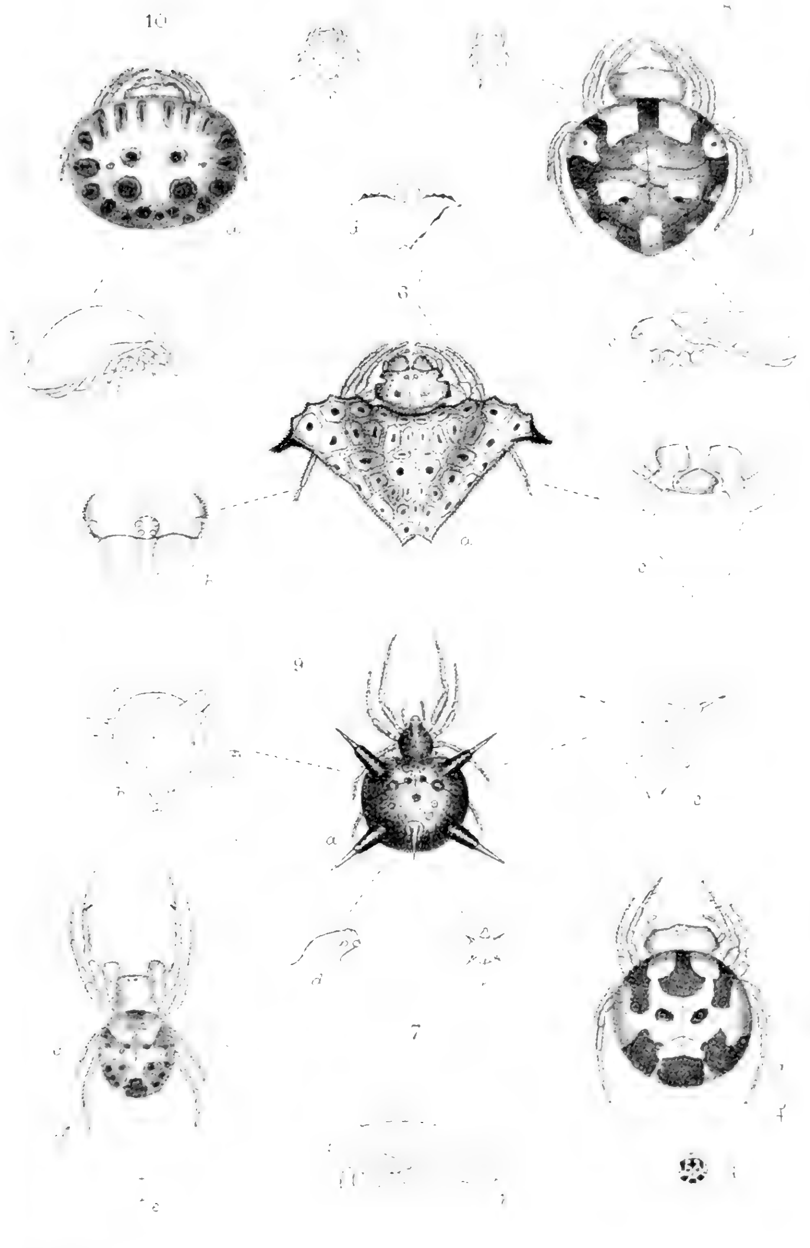

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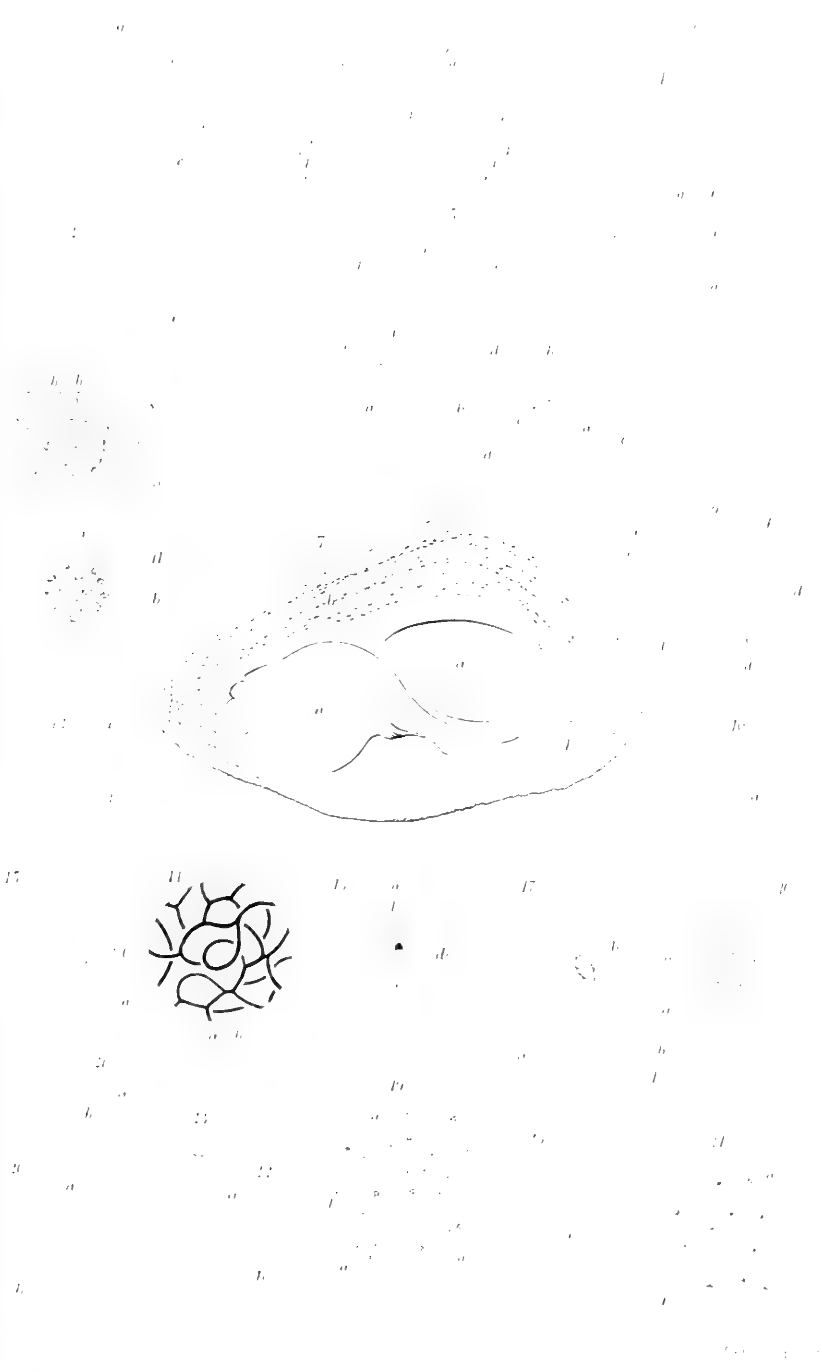

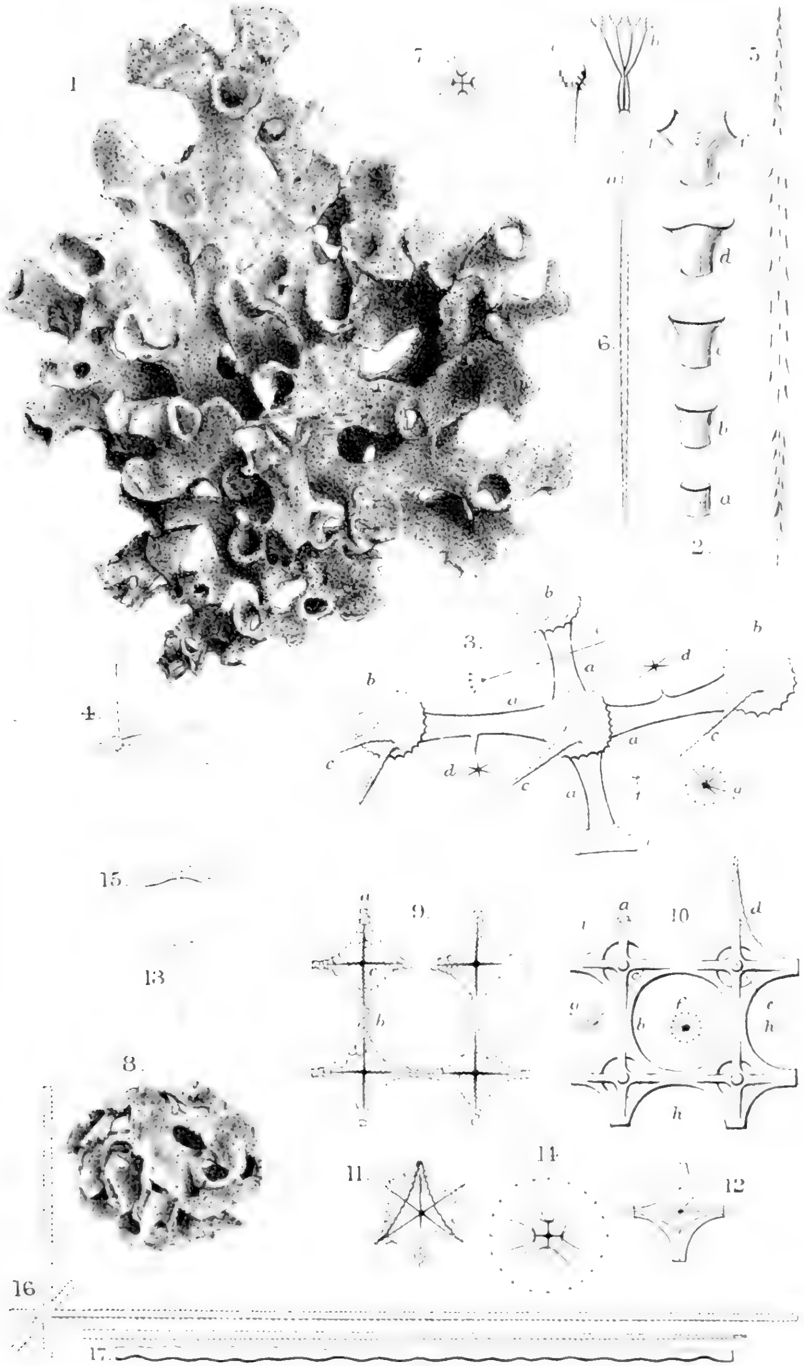

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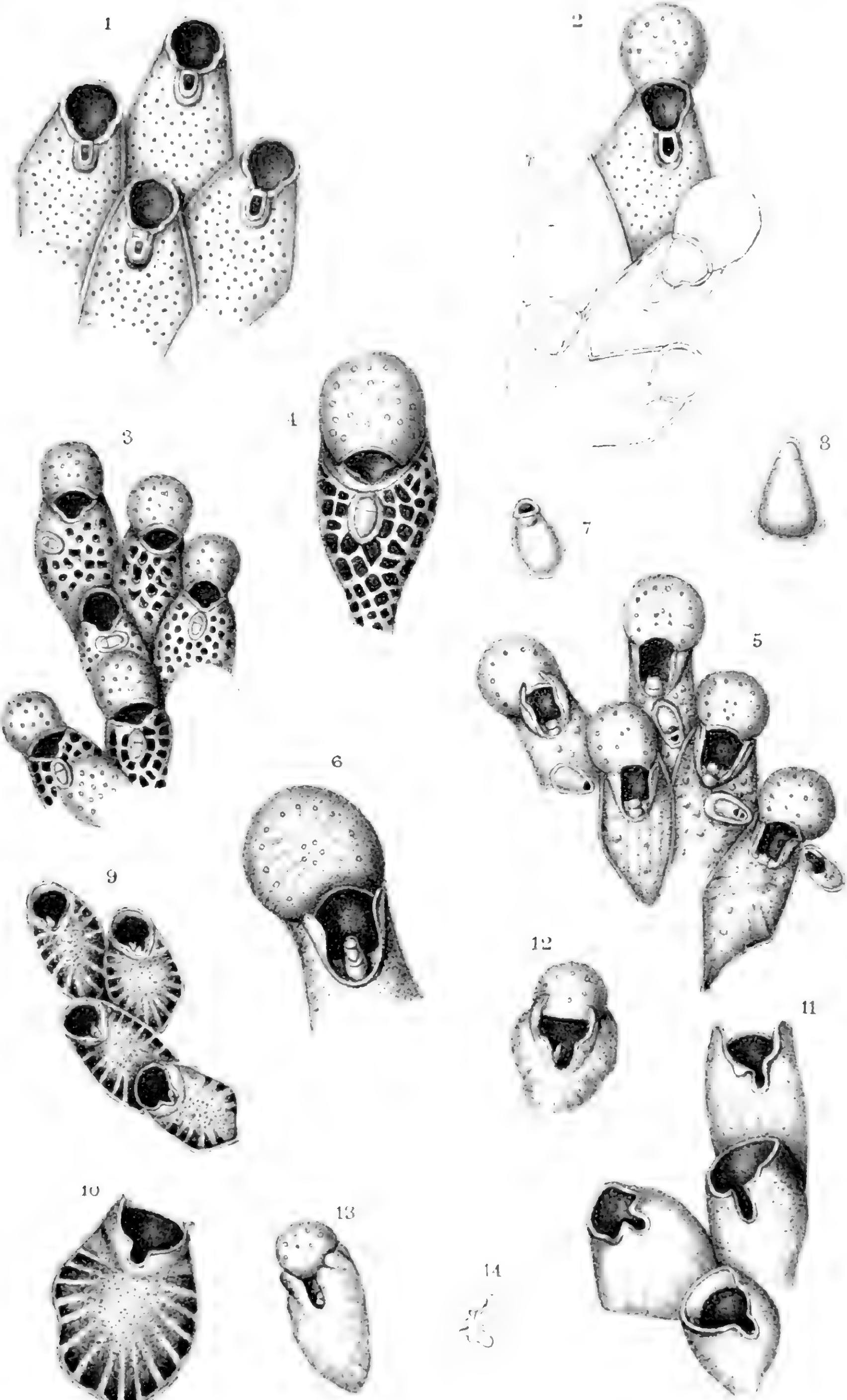

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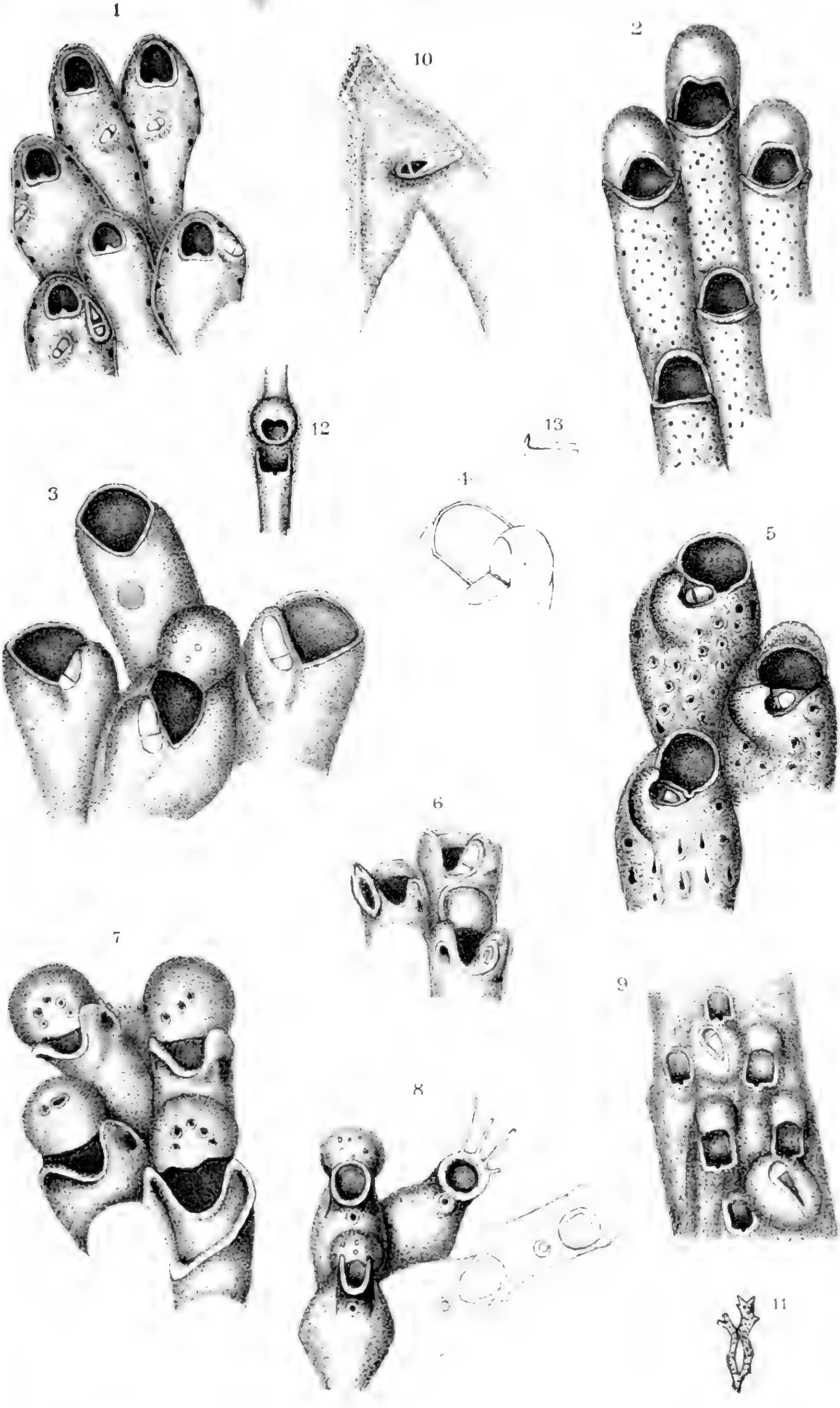

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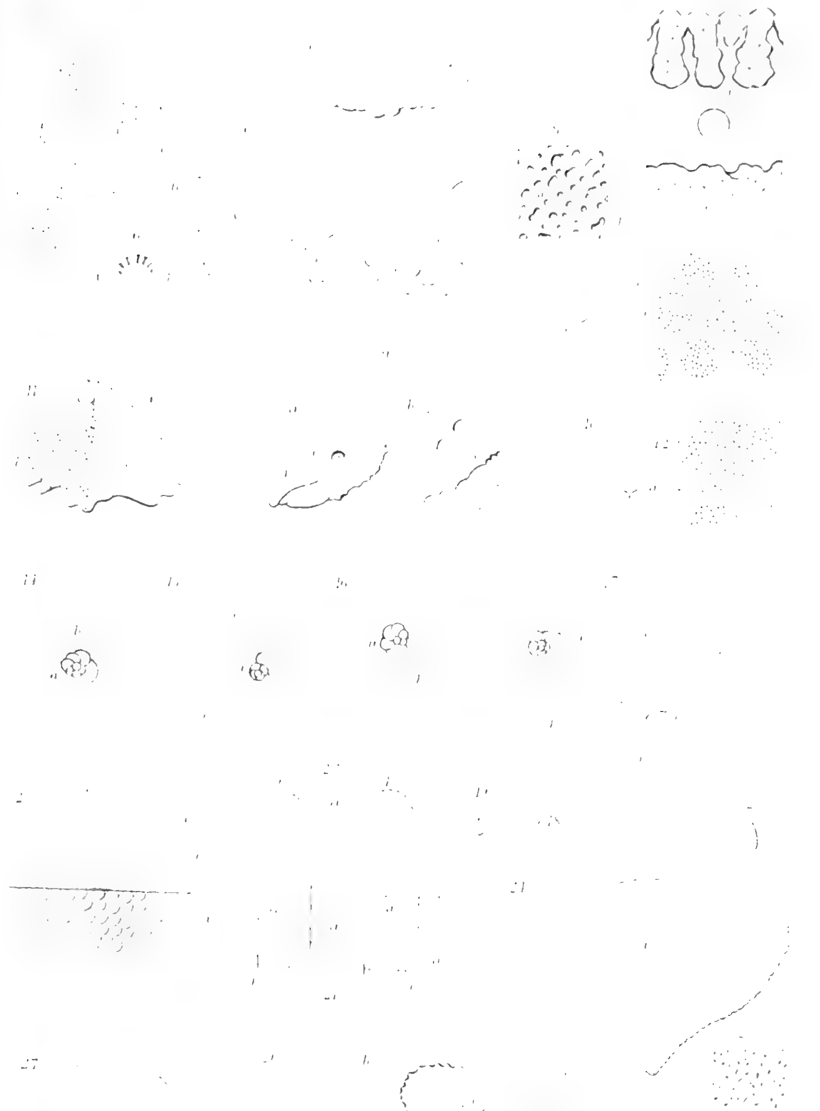


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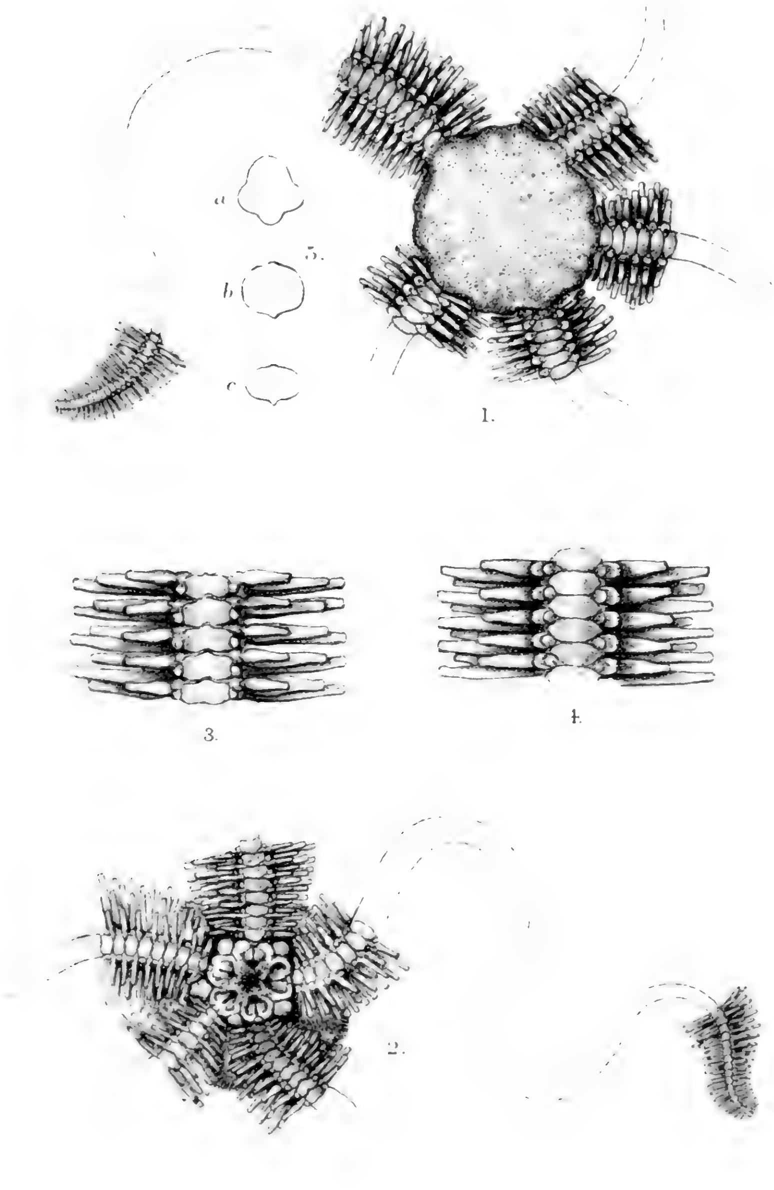
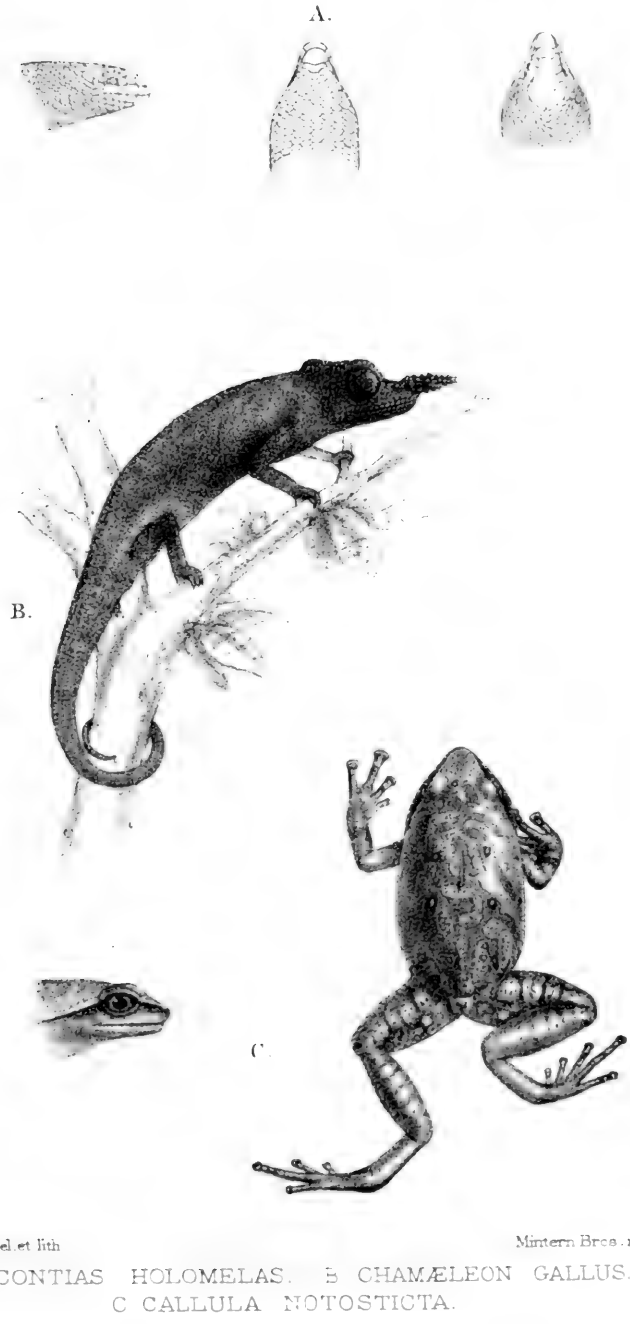


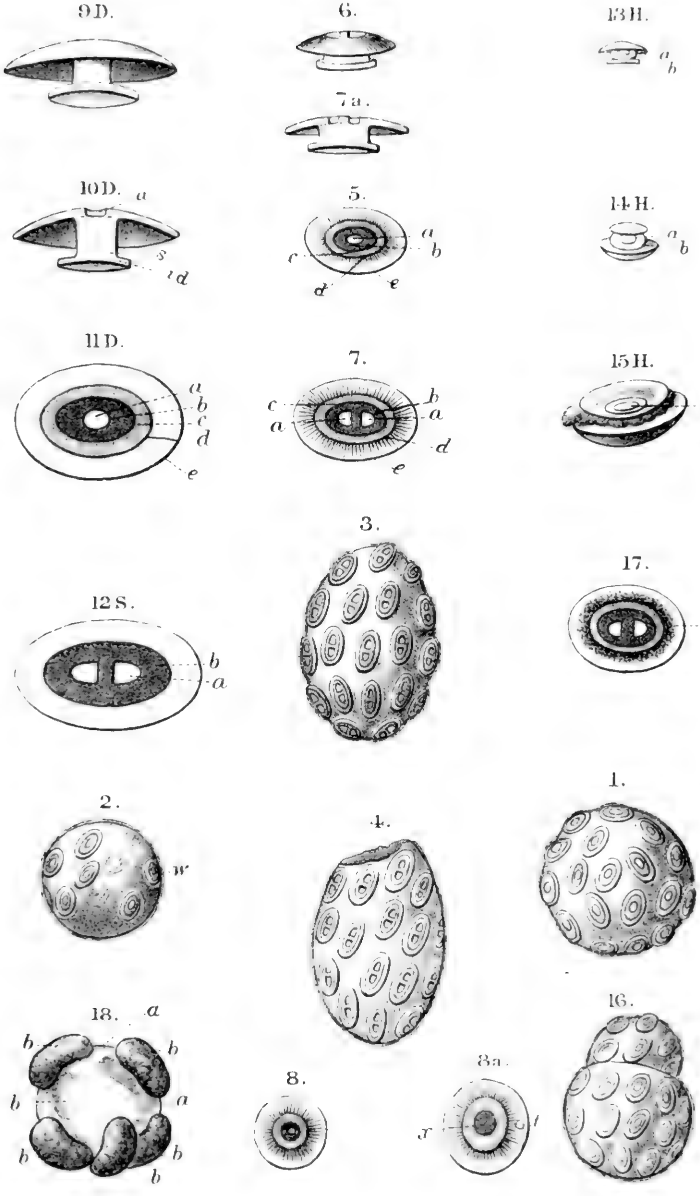
C. Berjeau del. et lith.

Mintern [illegible]



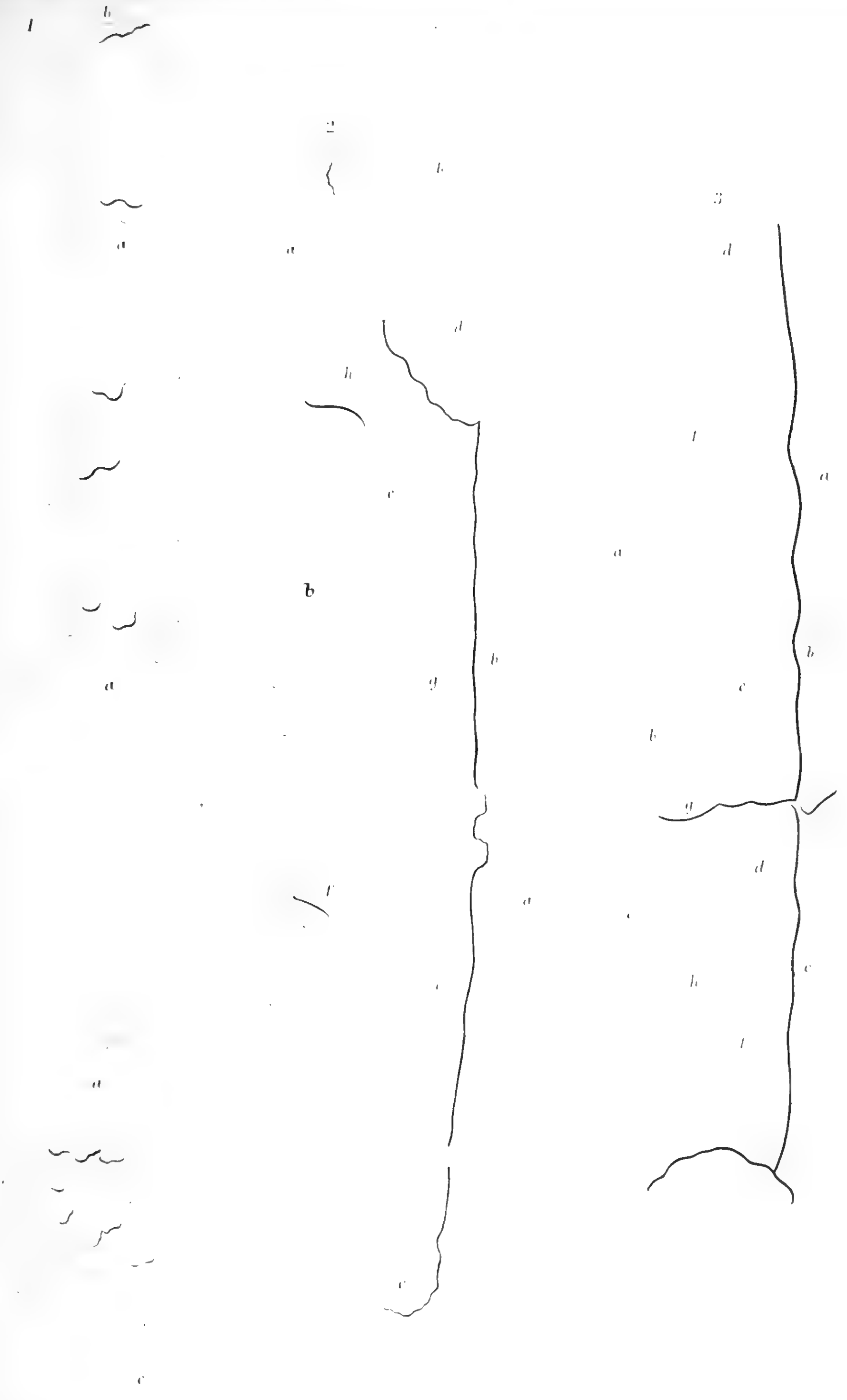
R. Mintern del. et lith. Mintern Bros. imp.

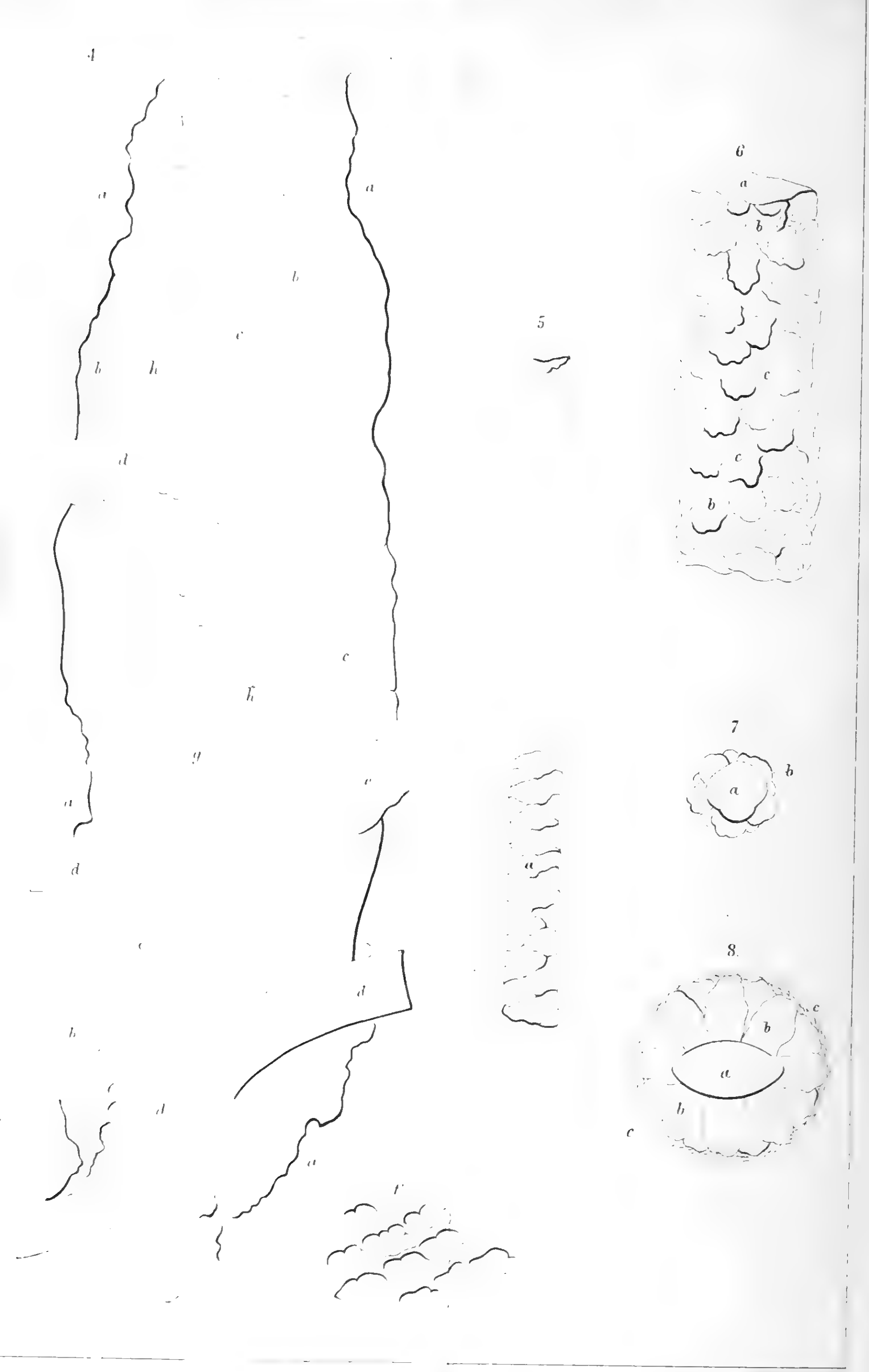
A. ACONTIAS HOLOMELAS. B. CHAMÆLEON GALLUS.
C. CALLULA NOTOSTICTA.



G. C. Wallich del.

Mintern Bros imp.

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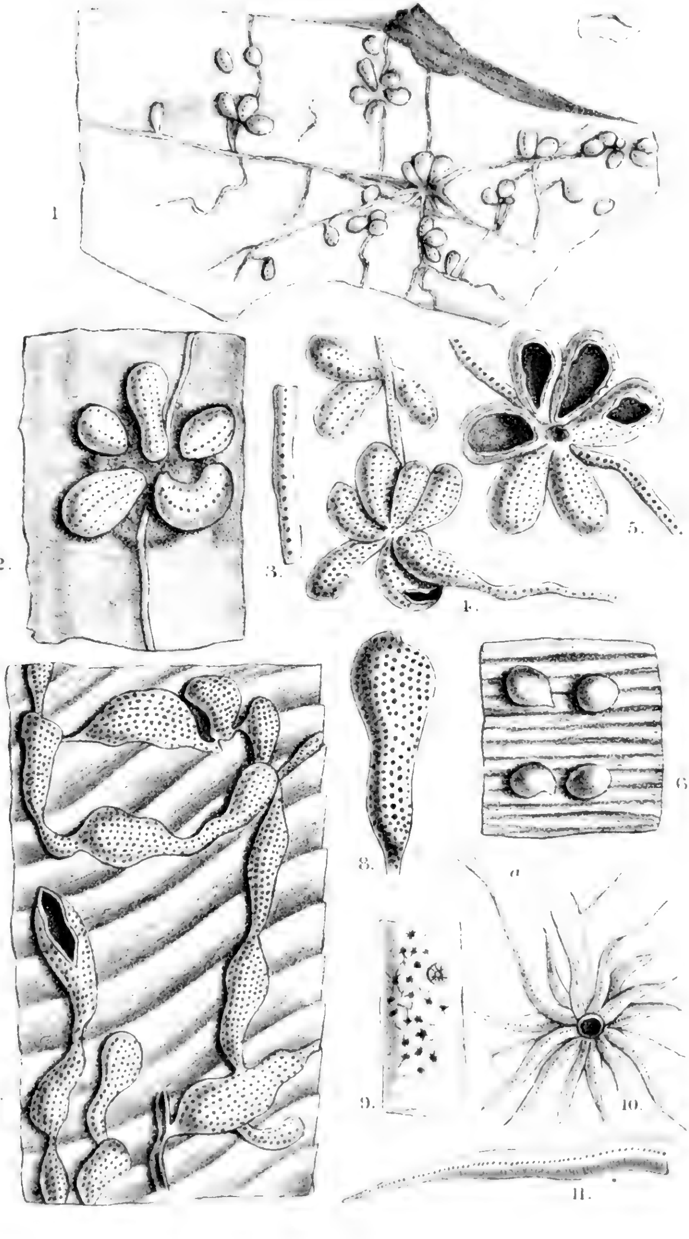
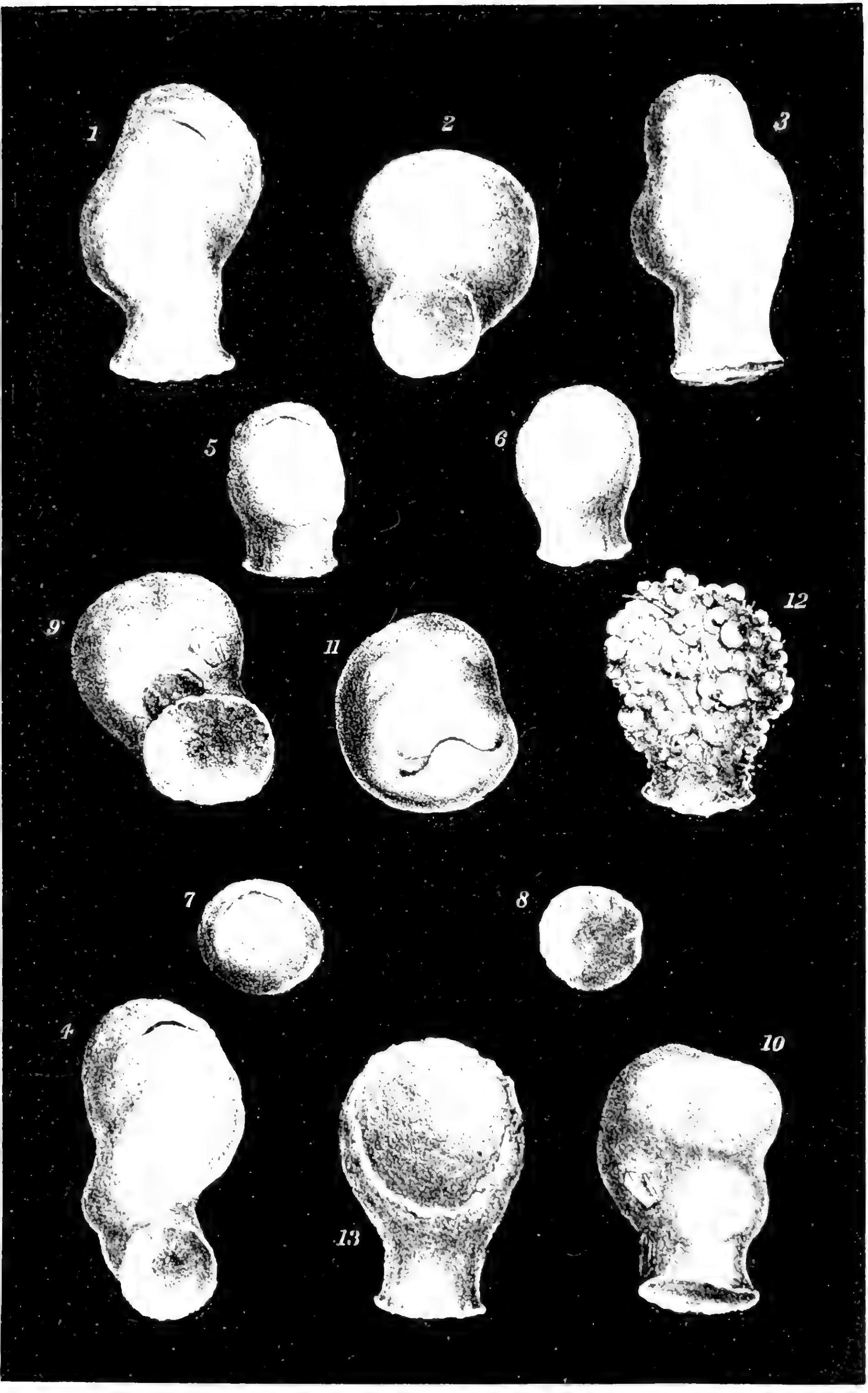


H. A. Nicholson del. R. Mintern lith.

Mintern Bros. imp.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