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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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

CONDUCTED BY

ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.R.S.,
WILLIAM S. DALLAS, F.L.S.,
WILLIAM CARRUTHERS, F.R.S., F.L.S., F.G.S.,
AND
WILLIAM FRANCIS, Ph.D., F.L.S.

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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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WITH TWO PLATES.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"................. per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc 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. 55. JULY 1882.

I.—*On a* Cysticercus *from the Peritoneal Cavity of a Raccoon-like Dog* (Nyctereutes procyonides). By F. G. PENROSE.

[Plate II.]

IN the spring of 1878 the late Prof. Garrod, whilst dissecting "an adult male [of *Nyctereutes procyonides*] which died on the 2nd of February last, the father of a litter of six born on May 2nd, 1877," discovered an enormous number of some parasitic form of worm in the peritoneal cavity. He asked me to cut sections of one, and from those sections wrote the following paragraph when describing some anatomical peculiarities of the dog in the P. Z. S. 1878, p. 376:—

"In the peritoneal cavity of the adult male *Nyctereutes* (which, like the half-grown female, had excessive atheroma of all its larger arteries) I found an immense number of parasitic worms, collected especially about the abdominal surface of the liver and the stomach. These worms had 'heads' much like those of the *Bothriocephali*, but larger. My friend Mr. F. G. Penrose has most kindly made sections of them, and has demonstrated the existence of a most peculiar cavity in each. This cavity is coiled up within the ovate 'head;' its lumen is small; and its walls are plicated very extensively, the magnitude as well as the number of the folds being great.

It opens externally at its proximal extremity by one of its ends only. The ' body ' is tænioid in its proportions, and is not segmented. It is about 2½ inches in total length, the ' head ' being about the size of a hemp-seed or a little smaller."

I also showed the sections to Prof. Lankester, who gave me several references; but I failed to make any thing out, and nothing more was done until Prof. Lankester saw a monograph on *Cysticercus*-forms by Dr. Monier of Lille. He immediately recognized that the worm I had cut was a *Cysticercus*. He lent me the monograph, of which the title is 'Travaux de l'Institut Zoologique de Lille et de la station maritime de Wimereux,' tome iii. fascicule i., "Essai Monographique sur les Cysticerques par R. Monier," and persuaded me to cut some more sections, with the view of ascertaining if this particular form had been described.

Dr. Monier has fairly completely worked out the history of the *Cysticercus*-larva (*C. pisiformis*) of *Tœnia serrata*, and gives some beautiful figures.

He shows the early development in the liver of the rabbit, and describes a migration at the end of the first month into the peritoneal cavity. He then gives a description of a form soon after it has arrived in the peritoneal cavity. He shows how, at the time of leaving the liver, the young *Cysticerci* are at various stages of development, but that generally the cephalic rudiment of the future *Tœnia* is already differentiated, and even that it was distinctly indicated on the twenty-second day after infection.

He describes how the rudiment is at first a simple depression surrounded by a thick bed of granular cells, then how the invagination increases and how at the same time there is cell-proliferation, that at the bottom of the invagination a slight dilatation forms, and at the same time an elevation rises slightly to one side of the line of axis of the invagination from the floor of this invagination, which is the origin of the head of the future *Tœnia*.

He then describes the origin of the suckers and of the hooklets.

Embryos which he has just been describing have generally attained the length of more than a centimetre.

He then goes on to describe the histological details, and discusses the formation of the future vesicle.

The stage to which I have been referring is certainly less advanced than that of those I am going to discuss; and the next stage is also certainly more advanced. The two stages are illustrated at Pl. II. figs. 2 and 5.

He says that after arrival in the peritoneum the young animals soon become dropsical, and that it is then very difficult to tell their degree of development, and it is only to be done by sections.

I now propose to give a short account of my specimens, and to compare them with his two stages.

As will be seen from Prof. Garrod's description, they were present in immense numbers, lying loosely in the peritoneal cavity, although coiled and twisted amongst themselves, especially one heap in seemingly inextricable confusion lying between the liver and stomach.

Several were preserved for a few days in ordinary methylated spirit, and some of these were afterwards placed in absolute alcohol. Unfortunately no investigations were made whilst the animals were still alive and before reagents were applied. The method employed that gave the most satisfactory results was as follows:—Worm was imbedded in cacao-butter; a series of sections were cut; and these were stained on the slide with magenta; they were afterwards clarified by oil of cloves and mounted in Canada balsam.

Naked-eye characters.—If we divide them into an anterior swollen extremity and a posterior continuation or tail, then, with one exception (fig. 4), they all have the same general appearance about their anterior swollen extremity (*vide* figs. 1, 2, 3). This extremity is more or less ovoidal, covered by a smooth cuticle; and anteriorly there is a depression which is bounded by two prominent rounded lips; but there is no apparent difference of cuticle like that between mucous membrane and skin. This depression is the external orifice of a blind canal (*vide* fig. 5). Posteriorly this anterior swelling is continuous with the tail, there generally being some deep and well-marked furrows where the one passes into the other. The tail is extremely variable in all its dimensions.

In some the tail is very long: a total length of 4 inches was the longest I measured; but I do not know that that was the limit, as some of the specimens were so brittle that it was impossible to unravel the mass without breaking them. In others, on the other hand, the tail was reduced to a minimum, though not absent, the specimen being ·2 inch.

The diameter of this tail varied not only in different specimens, but also in the same specimen, being at one part contracted in length and thickened, at others greatly attenuated (*vide* fig. 4)—this being solely due to the effect of the alcohol on the muscular fibres, though the tail was normally much longer in some specimens than in others: the thinnest tails were not necessarily the longest, and *vice versâ.*

The cuticle of the tails and of the posterior part of the anterior extremities is thrown into a number of irregular transverse wrinkles. These have no relation with the segments of a *Tœnia*, though sometimes curiously simulating them and, as Dr. Monier has shown, are due to the following cause:—

The tail consists of a central core enclosed within the muscular zone, which contains both circular and longitudinal fibres, the latter greatly predominating; and between this layer and the cuticle there is a loose, subcuticular, very actively growing connective layer of cells.

As the central core increases but slowly relatively to this outer layer, and is of a firmer tissue, supported and enclosed by the muscles, it necessarily follows that the cuticle will be thrown into folds by the rapid increase of the subcuticular layer.

At the posterior extremity of the tail there is generally, though not always, a slight depression (*vide* figs. 1, 2, 3), looking something like the one at the anterior extremity. It seems to have nothing to do with any internal canal, as Monier says that both he and Leuckart have searched in vain for any canal that opened externally there; and although I made several series of sections expressly to try and find one, I did not succeed. Monier observed that whilst the larval *C. pisiformes* were still in the liver of their host, on the twenty-second day after infection, several specimens, though not all, became constricted somewhere near their middle, and two semiequal portions were formed, connected by a twisted cord, each end of which fitted into a depression, the one at the posterior extremity of the anterior part, the other at the anterior extremity of the posterior part (*loc. cit.* chap. ii. p. 26, and pl. i. fig. 3). The posterior extremity was thrown off, and the anterior part retained simply the depression into which the cord fitted; but occasionally there was a short remnant of the connecting cord left in the form of a short tag.

In the present form I have never seen the tag. Although the shortest specimens almost invariably show the depression, it is equally well marked in some of the longest, though depressionless ones have perhaps a greater average length than the average of the whole number; but those without a depression are decidedly exceptional. So I do not think that the great difference in length is due to some not becoming constricted and retaining their whole original length whilst others have lost their posterior halves, both from what has been said above and also because between the shortest and longest there is a perfect gradation in length.

In the exception (fig. 4) mentioned above, the anterior portion is much larger than in any other individual, is white and shiny, the others all being of a dull yellowish colour, and very irregularly swollen. It presents the usual anterior depression; but unfortunately this specimen was so brittle that, on cutting sections, the only point I succeeded in ascertaining was the presence of the regular canal. This swelling is most probably due to this individual specimen being more advanced in its development than the rest.

Monier has shown (*loc. cit.* p. 41) that soon after their emigration into the peritoneal cavity the *Cysticerci pisiformes* quickly become immensely swollen, owing to the collection of fluid; and he expressly states, with reference to pl. i. fig. 2 of his memoir, "Les cysticerques, à cet âge, sont généralement renflés à la partie où bourgeonne la tête."

On making a continuous series of longitudinal sections through the anterior extremity, one notices immediately that the depression mentioned above is the external orifice of a complicated canal terminating in a small blind extremity; and in those sections that pass through the middle of this cavity, almost at the extremity furthest from the orifice there is a small prominence histologically different from the plications of the wall of the canal. This is the rudiment of the future *Tænia*. It consists of a dense mass of deeply staining tissue, which appears to consist of fibres radiating from the apex, and which is continuous with the muscular tissue of the rest of the *Cysticercus* (fig. 5).

I have not been able to find any signs of hooklets; but there are four well-developed suckers (*vide* fig. 6) which lie out of the plane of a mesial section, but become visible in sections slightly away from that plane. They consist of a very dense striated tissue, are continuous with the cuticle lining the canal, and are often covered on both surfaces by black pigment-granules. They appear to have originated by a special modification of the cuticle. This cuticle lines the whole of the canal, and is continuous with the cuticle covering the animal externally.

The rest of the animal may be said to consist of three layers:—a central core composed of a cellulo-fibrous reticulum, many of the cells being strongly refracting, and known all through the Cestoids as calcareous corpuscles; this core is perforated in parts by vessels, which are particularly numerous in the tail, having a general longitudinal direction connected by transverse channels. The core is enclosed by a muscular zone, consisting for the most part of longitudinal fibres. This zone is very conspicuous in the tail, but becomes less important in the anterior extremity, though still readily traceable; it is not a perfect layer, but contains many interstices between the fibres, through which the subcuticular cells are continuous with those of the core.

The subcuticular layer is composed of histological elements similar to those of the core, but is less dense. It is penetrated here and there by vessels, contains calcareous corpuscles, is continuous internally with the core through the muscular interstices, and is attached by fine fibres to the *cuticle.*

This form presents the following points of interest:—

1. The extreme variability in the length of the different specimens and the great absolute length (4 inches) of some of the longest specimens.
2. The slight prominence of the head of the future *Tænia*, accompanied by the complete differentiation of the suckers.
3. The probable absence of hooklets.
4. The presence of a larval form of *Tænia* in a dog.

Some of these facts might, I think, be accounted for if we assume that these larvæ have undergone their development in an unusual host. Prof. Huxley, in his paper on the Canidæ (P. Z. S. 1880, p. 262), speaks of *Canis procyonides* as living largely upon fruits and roots, and never attacking large animals, and as therefore not a purely carnivorous animal in the physiological, though it is in the morphological meaning of the term.

But I have ascertained that the individual during the three years and eight months of his life in the gardens used to be fed on fowl's heads and raw horseflesh. From the length of his residence in the Society's gardens we may, I think, fairly assume that he took in the ova during his sojourn here, and that therefore these *Cysticerci* are probably the larvæ of some common *Tænia.* The presence of suckers and probable absence of hooklets would point to the adult being one with those characters.

One naturally turns to *Tænia saginata*, Goeze, more commonly known in this country as *T. mediocanellata*, Kuchenmeister, as being the common hookless form also possessing pigmented suckers; and its identification with this form is strongly supported (1) by the small relative prominence of the origin of the head of the future *Tænia*, (2) by the absence of hooklets, and (3) by the pigmented appearance of the suckers; whilst against this the *Cysticercus* of *T. saginata* is only known to occur in ruminants, especially calves. And Monier believes on indirect evidence that the *Cysticerci* are never very numerous in the same host. He says (p. 58, *loc. cit.*) that "although this *Tænia* is much more frequent at Lille than *T. solium*, we have not been able to come across its *Cysticercus*. It is true that we have not made a special search; but the veterinary surgeons and slaughterhouse-men have never observed it. One must conclude that this *Cysticercus* is never very abundant in the animals that it inhabits. One may, however, remark that the *Cysticercus* cannot be absolutely rare, since its *Tœnia* is frequent. . . . ."

He gives also, on pl. i. fig. 6, a drawing of this *Cysticercus* (of *T. saginata*), and refers to a fold, *pl′*, near the external opening of the canal, which he found constant in the six or seven specimens he examined.

In my specimens, although there were suggestions of this fold, it was never so well marked as in his drawings, and was not unfrequently altogether absent.

EXPLANATION OF PLATE II.

Figs. 1–4. Enlarged views of the whole *Cysticercus*.
Fig. 5. Longitudinal section through anterior extremity, passing through the canal and the prominence of head of future *Tœnia*.
Fig. 6. Prominence of head of future *Tœnia*, showing suckers and absence of hooklets.

c=calcareous corpuscles; *h*=prominence of head of future *Tœnia*; *m*=muscular fibres; *o*=opening at anterior extremity; *p*, posterior extremity, in most instances notched; *s*=sucker; *v*=vessels.

II.—*On the Fructification of* Eusphenopteris tenella, *Brongn.*, *and* Sphenopteris microcarpa, *Lesq.* By Robert Kidston*.

[Plate I.]

I. *Eusphenopteris* (*Sphenopteris*) *tenella*, Brongn. (Pl. I. figs. 1–6.)

Histoire des Végétaux fossiles, pl. 49. fig. 1; Illustrations of Fossil Plants, pl. xxxix.†

The barren and fertile fronds of this fern are dissimilar; and were it not for their occurring in unusually favourable circumstances, it would be impossible to ascertain that these two forms of fronds belong to the same species. I have found no fern associated with *Eusphenopteris tenella*, with the exception

* Communicated by the Author, having been read before the Royal Physical Society, Edinburgh, April 19, 1882.
† Edited by G. A. Lebour, 1877.

of a single specimen of *Sphenopteris delicatula*, Sternberg*, which appears, however, rather to be a small variety of *E. tenella* than a distinct species, as they are connected by intermediate forms. This circumstance appears to prove conclusively that the fructifying fronds can only belong to *E. tenella.*

All the fruiting fronds of this fern with which I have met were collected by myself at Furnace Bank, Sauchie, near Alloa, where it occurs very plentifully, but is limited to a single bed of arenaceous shale overlying the coal, which is at present being worked.

Figs. 1 and 2 show two of the most common types of this plant as met with at Sauchie. Brongniart's figure represents only a small portion of a frond; a much better specimen is shown in the 'Illustrations of Fossil Plants;' but it is there only designated "*Sphenopteris* sp."

Eusphenopteris tenella must have attained considerable size, as one of my specimens shows pinnæ 7 inches long, given off from an axis only the eighth of an inch thick. Of the barren fronds, some are lax and others much more compact; we have in the fertile fronds similar distinctions. This is shown in figs. 3 and 4. The capsules or urceolate indusiums are oval in form, and show a small depression at their apex, which probably indicates the position of an aperture (figs. 3 and 4). Their greatest length measures $\frac{1}{25}$ of an inch. They are arranged in two rows, one on each side of the rachis of the pinnule, the capsules being alternate, as shown in figs. 4 and 6; but they commonly appear as secund, the one row being bent over the other. This is well shown in fig. 3.

The different positions of the capsules are probably dependent upon their state of ripeness when fossilization took place. From the fine state in which the specimens are preserved, the outline of the cells composing the capsules is distinctly shown.

The affinities of this fern to recent genera are somewhat obscure. The capsules in form resemble those of *Hymenostachys* (Hymenophyllaceæ); but in the fossils there is no discernible trace of a column, which forms a constant character in that genus. They agree, however, in the dimorphic condition of the fronds. I fear that at present we can only presume that this fern is most probably referable to the Hymenophyllaceæ. Both fertile and barren fronds are plentiful in the Coal-measures, Sauchie, near Alloa; and a fine barren speci-

* 'Essai d'un Exposé Geognostico-Botanique,' Sternberg, pl. 26. fig. 5.

men is exhibited in the Museum of the Glasgow University, from the "Roof of the Kiltongue Coal, Bailieston."

I have placed this fern in Schimper's *Eusphenopteris* in preference to Brongniart's generic name of *Sphenopteris*, as those individuals with cuneate segments form a very distinct group of the Sphenopteroids, and their removal from *Sphenopteris* helps to simplify that complex genus*.

In some recent works on vegetable palæontology attempts have been made to found a classification of ferns on the basis of their fructification; but so few fossil ferns having been obtained in this state has necessitated the introduction of two sets of characters in the classification of one group of plants: viz. those found in fruit are classified according to the structure and arrangement of that organ; but those whose fruit is still unknown, are classified, as formerly, from characters possessed by the barren fronds.

If the system of classification according to fruit be adopted with *E. tenella*, I believe a new genus would be required for its reception; but for the foregoing reasons I prefer retaining it with the other Eusphenopteroids till more is known of their fruit. Even were there evidence for a complete classification founded on the fruit, it would prove of little value to the working palæontologist, who has, in the great majority of cases, to deal with barren specimens.

II. *Sphenopteris microcarpa*, Lesq. (Pl. I. figs. 7–14.)

Atlas of Coal Flora of Pennsylvania, pl. xlvii. fig. 2; Coal Flora of Pennsylvania, p. 281.

About two years ago Mr. J. Bennie handed to me for examination a small specimen of this fern, beautifully fruited, but which at the time I was unable to identify. Shortly after I saw a copy of the 'Atlas to the Coal Flora of Pennsylvania and the United States,' by Lesquereux, which was published in 1879. On plate xlvii. fig. 2 of this work a small Sphenopteroid is illustrated under the name of *Sph. microcarpa*; but from the figure given I could not definitely determine that the plant collected by Mr. Bennie belonged to the same species, and at that time no description of it had appeared. This lack, however, was supplied in 1880, when the same author published the 'Description of the Coal Flora of the Carboniferous Formation,' &c. He gives here a very good description of the barren fronds; and in regard to the fertile it is stated that "each of the small obtuse teeth or indentations on the borders of the lobes has, at the top of one

* Schimper und Zittel, 'Handbuch der Paläontologie,' p. 107.

or two of the veinlets, small round elevated dots, which, when seen with a glass, appear like sori. I consider them as fructifications, comparable, by their position at least, to the fruit-dots of some *Duvalliæ* of our time—*Leucostegia* for example"*.

In the present specimen the fruit is exceptionally well preserved, showing the outline of the cells which form the walls of the sporangia (figs. 12, 13, and 14).

The sporangia appear to be usually developed in groups of three, situated at the upper extremity of the veins, so that they become marginal in position (fig. 10). Sometimes, however, they are produced singly, as in fig. 11; but such cases are rare. I have not observed any sporangia situated in the sinuses; they are placed in the little lobes or teeth of the pinnules. The imperfect manner in which Lesquereux's specimen appears to be preserved may have led to this slight mistake in his description. The sporangia are oval in outline, and about $\frac{1}{75}$ of an inch wide in their greatest diameter. Most of them show a marginal border; and in one individual (fig. 14) the cells composing it appear to lie at an oblique angle to those forming the large central part; but whether this border is a true annulus or only a mechanically-produced simulation of that structure I am unable to decide.

Grand'Eury † describes the fruit of *Sphenopteris chærophylloides*, the sporangia of which appear to be very similar to those under consideration. In reference to his specimen, however, he states that the sporangia were not provided with an annulus. He seems inclined to regard *Sph. chærophylloides* as a transitional form between *Schizæa* and *Marattia*.

As regards *Sphenopteris microcarpa*, I think the character of the fruit points to affinities with the Osmundaceæ, and it is probably most closely related to the genus *Todea*. This species is widely distributed in the Coal-measures of Scotland.

I am indebted to Mr. James Bennie for the pleasure of examining the fruited specimen, which was collected by him near Dysart, Fife. Mr. Thomas Naismith has also kindly shown me the same plant from Mount Vernon, Lanarkshire; and I have met with it at Sauchie, near Alloa, Clackmannanshire, and near Dollar, on the borders of Perthshire.

None of the Carboniferous ferns which from time to time have been obtained in fruit appear to be referable to existing genera. Though in many cases they approach very closely,

* *Loc. cit.* p. 280.

† 'Flore Carbonifère du Département de la Loire:' Paris, 1877.

yet they have hitherto always shown some character which has necessitated their being kept separate *.

EXPLANATION OF PLATE I.

Eusphenopteris tenella, Brong.

Fig. 1. Portion of barren frond from Sauchie, near Alloa.
Fig. 2. Portion of larger form from same locality.
Fig. 3. Fertile frond, lax form, from same locality.
Fig. 4. Fertile frond, compact form, from same locality.
Fig. 5. Sporangia or capsules, magnified, showing the small apical aperture.
Fig. 6. The same, viewed more obliquely.

Sphenopteris microcarpa, Lesq.

Fig. 7. Portion of barren frond, from near Dollar, collected by Mr. A. E. Grant.
Fig. 8. Pinnule, enlarged.
Fig. 9. Portion of fertile frond, from near Dysart.
Fig. 10. Pinnule of fig. 9, enlarged, showing sporangia arranged in groups of three.
Fig. 11. Another pinnule, enlarged, more sparsely fruited.
Fig. 12. Two sporangia, magnified, showing slight indication of a marginal border.
Fig. 13. Sporangium, magnified, showing a slight obliquity of the arrangement of cells forming the marginal border.
Fig. 14. Another sporangium, magnified.

Note.—In fig. 7 the engraver has missed the character of the plant. The ultimate pinnules are represented as merged together, but should be distinctly separate, as shown in the enlarged figure (8).

III.—*On certain Limpets and Chitons from the Deep Waters off the Eastern Coast of the United States.* By W. H. Dall†.

I have received from Prof. Verrill certain limpets or patelliform shells and chitons collected under his supervision off the south-east coast of New England, in deep water, by the United-States Fish-Commission parties in 1881, with his kind permission to describe them. Though without particular beauty and of small size, the hope that these specimens would prove of interest has not been disappointed.

Limpets are generally shore or shallow-water mollusks;

* Stur, in his 'Culm Flora,' describes a fossil fern (*Todea Lipoldi*), which appears to be similar to *Sphenopteris bifida*, L. & H. As its fruit is unknown, his reason for placing it in the genus *Todea* seems simply to rest on the segmentation of the frond being somewhat of the same nature as that seen in such species as *Todea superba*.

† From the 'Proceedings of the United-States National Museum,' April 24, 1882, p. 400.

the connexion of certain peculiarities of structure in them with their geographical distribution, and the progressive development indicated by the characters of different genera, have already been the subject of comment by me*.

The forms of lowest organization and least specialized characters among those already known are those which inhabit the deeper water; hence there was reason to suppose that features of much interest would be exhibited by the few specimens which had just been brought up from much greater depths than any from which limpets had hitherto been obtained.

The examination was rendered more complete by the possession of additional specimens, which are contained in the deep-sea collection from the Antilles, made by Prof. Alex. Agassiz and Lieut.-Commander Bartlett, U.S.N., on the United-States Coast-Survey steamer 'Blake.' These afforded valuable confirmation of impressions derived from the study of the material obtained from Prof. Verrill.

Some of the specimens obtained are of unusual interest, as showing a combination of characters which has heretofore been unknown in animals of the same order. While the shells present few salient features, the soft parts show extraordinary and unexpected characters. They are divided into representatives of the orders Riphidoglossa, Docoglossa, and Polyplacophora. The Docoglossa comprised representatives of both the suborders Abranchiata and Heterobranchiata, but all somewhat anomalous in their characters. It is in the first-mentioned order, however, that the richest results were obtained, since it appears necessary to separate the three species obtained into two genera, representing each a family, which differs by apparently sound characters from any hitherto known, and which it has therefore been necessary to describe as new.

Almost all the species appear to be blind.

Order RHIPHIDOGLOSSA.

Family **Cocculinidæ**, Dall.

Shell patelliform, not nacreous, symmetrical, with an entire non-sinuated margin, and a posteriorly inclined apex with a deciduous spiral nucleus. Muscular impression horseshoe-shaped, interrupted over the head.

Animal with a prominent head and muzzle, two tentacles, as in Lepetidæ; gill single, plumose, asymmetrical, resembling that of Acmæidæ, extending between the under surface

* Sci. Results of the Expl. of Alaska, i. art. ii. pp. 41–43 (1876).

of the mantle and the foot (from a point above and behind the head) backward on the right side, attached only at its base. Anus anterior, opening above and behind the head. Mantle-margin plain; sides and margin of the foot without papillæ or ornamental processes excepting two filaments, one on each side of the median line, between the mantle and the foot-disk behind. Radula with a small or moderate rhachidian tooth (in the known species), three inconspicuous laterals with denticulate cusps, and a fourth, dentate, larger outer lateral*; uncini numerous (50–150), similar, hooked at the tip, those of each lateral series springing from a common base.

Formula: $\frac{1}{m\,(1+3.3+1)\,m}$.

This family differs from its nearest described allies (the Fissurellidæ) in its single asymmetrical gill, in the absence of appendages to the sides of the foot or on the mantle-edge, and in its patelliform, unfissured, unsinuated, and wholly external shell.

From the succeeding family, Addisoniidæ, it is separated by its symmetry, the character of the gills, and by its dentition. By its dentition it is most nearly allied to *Parmophorus* or *Scutus* (if figures be taken as a criterion), and much resembles some species of *Helicina*; but it must be borne in mind that very few species of Fissurellidæ have been figured in proportion to the whole number known. The other characters, however, forbid its incorporation with the Fissurellidæ, as they conflict in nearly every important feature with the definition appropriate to that family.

At first it was thought that *Propilidium* might be incorporated in this family; but an examination of the available data relative to that genus indicates that it belongs rather to the Fissurellidæ, where it, apparently, represents an imperforate *Puncturella.*

Genus Cocculina, Dall.

Animal blind; shell colourless, with radiating and concentric sculpture. For other characters see diagnosis of family.

Cocculina Rathbuni, n. sp.

Shell depressed, white, thin, with sides nearly parallel, and their slopes lightly flattened, and with ends similarly broadly rounded; sculpture of faint closely (but irregularly) set grooves radiating from a smooth apex (which has originally a subspiral nucleus) and crossed by concentric growth-lines,

* Much as in *Scutus* as figured by Gray, 'Guide,' p. 163.

which are more or less irregular in different individuals; faint yellowish areas seem to indicate a thin, very closely adherent epidermis; apex prominent, more or less incurved and slightly laterally compressed, usually showing a scar where the embryonic nucleus was attached; inside polished or smooth; length 11·0, width 6·5, altitude 2·75 millim. Another dead specimen is three times as large.

Soft parts: Foot ovate, thin, not very high, somewhat pointed behind; mantle-margin moderately wide, with a thickened plain border; behind, on each side of the "tail," between the mantle and foot, is one cylindrical blunt filament; sinus above the head and neck quite deep; gill exactly as in *Acmæa*, small, hardly projecting out of the sinus; head large, end of muzzle semilunate, with a strongly-marked margin; in the midst of this flat lunate area is a rounded papillose space surrounding the mouth; this organ, if furnished with jaws at all, has them of such soft and cuticular consistency as to show neither under the knife nor under an ordinary dissecting microscope, but it appeared to be without jaws; tentacles moderate, subcylindrical; eyes none; course of the intestine much as in *Patella*, but shorter.

Dentition.—Rhachidian tooth squarish, rounded in front, nearly flat, about as long as the two inner laterals; inner three laterals slender, with small denticulate cusps, outer or third usually a little longer than the others, but the proportions slightly different in the less mature part of the radula; fourth or major lateral about twice as long as the others and slightly broader than the rhachidian tooth, rather strongly cusped, the cusp notched into five or six denticles, and the shaft somewhat curved, the shaft and cusp translucent; uncini numerous (100 or more), slender, slightly twisted and hooked, united on each side on a single continuous base, which is a little longer than the width of the radula between the uncini.

Hab. Station 937 of the United-States Fish Commission in 1881. This is 102 miles S. by E. ½ E., by compass, from Gay-Head Light, Martha's Vineyard, the bottom-temperature being 40°·5 F., and that of the surface 72°·0 F. The same species was obtained by the United-States Coast-Survey dredgers on the steamer 'Blake,' Lieut.-Commander J. R. Bartlett commanding, under the supervision of Prof. Alex. Agassiz, on hard bottom (temperature 44°·5 F.), at station 288, in 399 fathoms, off Barbadoes, and off Martinique, in 502½ fathoms sand and ooze, at station 195, bottom-temperature 41°·0 F., the surface in both cases being about 80°·0 F. I take pleasure in naming this species after Mr. R. Rathbun, of the United-States Fish Commission.

Cocculina Beanii, n. sp.

Shell elevated, white, thin, resembling in sculpture and general features the last species, except in the following particulars:—The form of the base is about as in *C. Rathbuni*; but the profile differs widely: the anterior and posterior slopes of the present species, instead of being subequal and nearly similar, are unequal, the anterior being considerably the longer, roundly and conspicuously arched; the posterior slope is about half as long as the other and deeply concavely excavated; this results from the fact that the apex, instead of being depressed and nearly central, is elevated, subposterior, and much incurved; like that of the previous species, it bears a scar where the (probably spiral) embryonic shell was attached. The sculpture resembles that of the preceding species, being stronger and more cancellated in some specimens and nearly obsolete in others. The very young show proportionally stronger sculpture, even slightly spinous at the intersections in some specimens. The surface is generally partly eroded, probably from the same action as that which so rapidly reduces dead shells and corals to a species of grey ooze in the deep sea. There seems to be no indication of epidermis in this species. Length 8·0, breadth 5·0, height 4·0 millim.

Soft parts in general as in the last species, except that the head and muzzle are much elongated, the sinus behind the head deep; gill longer and larger than in *C. Rathbuni*, projecting out on the right side of the head; tentacles longer and foot shorter proportionally than in *C. Rathbuni*; the mantle-margin is much puckered; but this is probably due to the alcohol; the margination, which forms a semilunar area at the end of the muzzle in the preceding species, in *C. Beanii* is interrupted before the papillose area which here distinctly forms the end of the muzzle, the effect of which is to produce two lappets, one on each side, extending from the end of the muzzle to the anterior edge of the foot. There appears to be no jaw.

Dentition.—In this species the bands of uncini are proportionally longer and wider, and the rhachidian tooth smaller, than in the preceding. The rhachidian tooth is small, with a tridentate cusp and bifurcate base; it is about half as long as and hardly wider than the first three laterals; the latter are elongate, slender, with denticulate cusps, the outer is rather the shorter in the mature part of the radula; the major lateral is longer, with a more slender shaft than in *C. Rathbuni*, and a proportionally larger, very concave cusp with seven or eight denticulations; the banded uncini are singly broader than in *C. Rathbuni*, and collectively about one half longer.

Hab. Station 871, U.S. Fish Commission, lat. 40° 02′ 54″ N., long. 70° 23′ 40″ W., in 115 fathoms muddy sand; station 894, U.S. Fish Commission, lat. 39° 53′ N., long. 70° 58′ 30″ W., 365 fathoms mud and gravel, both in 1880; station 947, 312 fathoms, sandy mud, bottom-temperature 44° F.; station 949, 79½ miles south of Martha's Vineyard, in 100 fathoms, yellow mud, bottom-temperature 52°, surface 66° F.; station 997, 335 fathoms, yellow mud, bottom-temperature 40° F.; these last in 1881 (Verrill); and from the same localities as *C. Rathbuni* in the West Indies (Agassiz), with the additional locality of station 264, 416 fathoms, grey ooze, off Grenada, bottom-temperature 42°·5 F. * It is named in honour of Dr. T. H. Bean, of the United-States Fish Commission.

Family **Addisoniidæ**, Dall.

Shell asymmetrical, porcellaneous, somewhat like *Capulacmæa*, Sars.

Soft parts much as in the last family, but strongly asymmetrical, with an enormously developed lateral series of separately inserted gill-laminæ, like those of Patellidæ, and without filamentary appendages of any kind. Radula with a large simple rhachidian tooth with, on each side, two large simple transverse laterals, followed by two minute ones, and a large outer lateral with a strong tridentate cusp, outside of which is a single scale-like flat uncinus, bearing an elongated thickened ridge, but no cusp.

Formula: $\frac{1}{1\,(\frac{1}{3}+2+2.2+2+\frac{1}{3})\,1}$.

This family might be incorporated with the last, were it not for the differences in the branchiæ and in its dentition. These latter are of great weight. The dentition of *Addisonia* is like nothing known in the whole group of Rhiphidoglossa, but, while it recalls the dentition of the Chitonidæ in some features, has a decidedly Docoglossate aspect. Perhaps the most rational hypothesis is that this group bears to the preceding family much such a relation as in Pulmonata is borne by the Cyclotacea of Troschel towards the Cyclostomacea. Indeed the resemblance of the radula of *Cocculina Rathbuni* to that

* This is, perhaps, the shell referred to under the name of "*Acmæa rubella*?, Fabr.," Verrill, Proc. U. S. Nat. Mus. iii. p. 391, dredged (dead) at station 894, United-States Fish Commission, 1880, off the S.E. coast of New England, in 39° 53′ N., 70° 58′ 30″ W., in 365 fathoms.

of some of the species of *Helicina* figured by Troschel is quite remarkable. This family contains, so far as known, but one genus.

Genus ADDISONIA*, Dall.

Shell ovate, subconical, strongly asymmetrical, porcellaneous, thin; with a blunt apex curved backward, downward, and to the left, without an epidermis; with an unthickened, simple, entire margin; pedal muscular impression horseshoe-shaped, interrupted in front. Soft parts: head provided with two tentacles, without eyes or eye-tubercles; muzzle plain, simple; foot thin, orbicular, without lateral or posterior tubercles, processes, or fringes; mantle-edge simple, thickened; gill composed of leaflets as in *Patella*, the series starting on the right behind the head and continued within the mantle-edge backward, the body of the animal being asymmetrically placed with regard to the aperture of the shell to afford room for the enormous series of branchial leaflets; anus opening behind and above the head slightly to the right of the median line, and indicated by a small papilla.

Radula: see description of the family.

Type and only species yet known,

Addisonia paradoxa, n. sp.

Shell ovate, thin, whitish; apex presenting an appearance as if an embryonic tip (perhaps spiral) had fallen and been replaced by a peculiarly blunt ovate apex, which in the young shell is nearly marginal, posterior, and to the left of the middle line, but in the adult is considerably within the margin, curved downward and backward, and much more asymmetrical; sculpture of faint grooves radiating from the (smooth) apex and reticulated by the stronger concentric lines of growth, besides which the extremely inflated arch of the back is somewhat obscurely concentrically waved; over the sculpture the shell has a polished appearance; margins thin, sharp; interior smooth, somewhat polished; the scar of the pedal muscle narrow, a considerable distance within the margin, the anterior ends of the scar enlarged, hooked backward on their inner edges; these ends connected by a line broadly arched forward and marking the attachment of the mantle to the shell over the head. Soft parts whitish, dotted with fine purple dots; mantle-edge thickened, smooth; muscular base of the

* In honour of Prof. Addison E. Verrill, of Yale College and the United-States Fish Commission, whose surname has already been applied to more than one group of invertebrates.

foot nearly orbicular, extremely thin and delicate, not high; muzzle short, plain, without any strongly defined margination, with the end finely papillose and a little puckered; mouth small, furnished with two lateral pads covered with a cartilaginous thin coat, which completely dissolves in liquor potassæ, and hence can hardly be termed a jaw, though it occupies the place of the buccal plates in other genera; head moderate, not much produced, broader than long, extended laterally into a single, rather short and stout tentacle on each side; tentacles showing slight transverse ridges (due to contraction?), destitute of any basal elbow or tubercle, such as bears the eye in allied groups, and with no appearance of any organ of vision or bulbus whatever. Behind the head a thickened ridge, containing a large vessel, takes origin and passes backward around the right mantle-edge, reaching nearly to the posterior median line; from this ridge depend fifty or sixty branchial leaflets resembling those of *Patella*, and not like those of *Acmæa* or the Fissurellidæ; these leaflets are very large in proportion to the size of the animal, and gradually diminish posteriorly; they are slightly inclined outward; the anal papilla is very inconspicuous, opening between the line of the branchia and the head, a little to the right of the head; the intestine is much shorter than in the Patellidæ, and coiled in much the same way through the very large greenish hepatic mass; this surrounds the ovary, which rises to the surface of the back in about its centre, and in this individual was crowded with eggs already in various stages of segmentation, and of about the size and general appearance of those of *Acmæa patina*. The ovary appeared to be a single, simple, sac-like body of irregular contour as in *Acmæa*; no crop was noticed; and the stomach seemed of very moderate size.

Since but one specimen was available the observations were more or less imperfect, especially since the internal parts were somewhat softened. To obviate the extreme contraction caused by alcohol, the specimen was placed in water, with the result that it almost immediately swelled and became covered with an immense quantity of very slimy mucus, which rendered it almost impossible to handle, being so slippery; and it had to be replaced in alcohol again to harden before the examination could proceed. The edge of the mantle is marginated with a rather broad thickened band, apparently without papillæ or other appendages of any kind. The space occupied by the branchiæ is so large that the remainder of the animal is forced a good deal to the left in the aperture of the shell.

The radula has a large, flat, ovate central tooth, with a thickened anterior edge, but no marked cusp; on each side of this two rhomboidal flat laterals with a similarly thickened anterior margin; the inner is the larger, and the outer somewhat more rounded in form; close to this are two minute narrow laterals with small cusps, hidden partly under the cusps of the next or major lateral, for which reason they cannot well be made out until the radula is partly torn apart or broken up; these two little laterals are the most anterior of the transverse series, which has a form like a very transverse M; the major lateral has strong Docoglossate features, being set on a flat plate whose posterior inner and anterior outer corners are thickened and raised into the likeness of a pseudocusp, the true shaft of the tooth being very short and terminating in a strong tridentate pellucid cusp; the outer tooth is a squarish, plate-like uncinus, exactly as in some Chitons, with a thickened longitudinal ridge near the inner margin.

Length of shell about 10·0, width 7·5, and altitude 4·0 millim.

Dredged by the United-States Fish Commission in 1881 at stations 923, 940, and 950, in 96, 130, and 69 fathoms, sandy bottom, about 75 miles S. and W. from Martha's Vineyard. Bottom-temperature 52°, which belongs to the warmer bottom area. This very remarkable form would have been called a "synthetic type" by Prof. Louis Agassiz. The shell at once recalls *Capulacmæa* (=*Pilidium*, Midd.), which, however, is distinctively Tænioglossate in dentition. The details of the branchial leaves resemble those in *Patella*, the position of the branchiæ and the form of the head resemble *Acmæa*, the smooth, thick, mantle-margin and absence of eyes are characters found in Lepetidæ. Some features in the dentition recall Chitonidæ, and others Cocculinidæ. The position of the animal in its shell is as in the Rhiphidoglossa universally.

Nothing of the kind has been recognized in the collection made by Messrs. Sigsbee and Bartlett, of the U.S. Navy, in the Gulf of Mexico and Antilles, under the supervision of Prof. Alex. Agassiz, on the United-States Coast-Survey steamer 'Blake,' leading to the supposition that this may be a rather more northern form, though found in the warm area.

Order DOCOGLOSSA.

Suborder **ABRANCHIATA.**

Animal destitute of external branchiæ. Embryonic shell spiral.

Family **Lepetidæ**, Gray.

Lepetidæ (Gray), Dall, Ann. & Mag. Nat. Hist. 1871, vii. pp. 286–291.

Subfamily *Lepetinæ*.

Animal without eyes, without lateral teeth, with a rhachidian tooth, and erect uncini; muzzle with an entire margin, which is extended backward into a tentacle-like filament on each side; shell patelliform, with a subspiral nucleus, which is generally lost in early life, the permanent tip being erect or anteriorly directed. Typical genus *Lepeta*, Gray.

Subfamily *Lepetellinæ*, n.

Shell and soft parts as in Lepetinæ, except that it has distinct eyes and is provided with true lateral teeth, and also with scale-shaped uncini. Typical genus *Lepetella*, Verrill.

Genus Lepetella, Verrill.

Lepetella, Verrill, Am. Journ. Sci. xx. p. 396 (Nov. 1880).

Type *Lepetella tubicola*, Verrill, *l. c.*, also Proc. U.S. Nat. Mus. iii. p. 375 (1881).

Habitat. In two to four hundred fathoms off the S.E. coast of New England (stations 869 and 894, U.S. Fish Commission, 1880) in old tubes of *Hyalinœcia artifex*, V. (Coast of Norway, in deep water, Sars?)

Professor Verrill has well described this little shell in the articles referred to, as well as its dentition, which he calls Tænioglossate. It is indeed so in one sense, though not in the technical sense of belonging to the order Tænioglossa, which has a formula $\frac{1}{3.3}$, while the formula of *Lepetella* is $\frac{1}{1\,(2.2)\,1}$, the essential difference being that all Tænioglossa have on each side of the rhachidian tooth three laterals and no uncini, while *Lepetella* has two laterals and an uncinus.

The specimens examined by me were dry, or from deterioration of the alcohol had become quite soft; and, for this reason perhaps, I could not detect the eyes seen by Professor Verrill so distinctly in the fresh and living animal*. So far as the external features could be determined, there was no difference between them and those exhibited by *Lepeta* or *Cryptobranchia*. The dentition is remarkable, both in relative number of teeth and in presenting the only instance of a well-developed distinct scale-like (chitinoid) uncinus yet known in the order. In fact, the radula has throughout dis-

* I have, however, no doubt of their existence. A letter from Dr. J. Gwyn Jeffreys states that a small limpet like *Lepeta*, but with eyes, has been dredged off the coast of Norway by Prof. G. O. Sars, which may probably prove to be *Lepetella*.

tinctly *Chiton-like* features, and bears additional testimony, if such were needed, to the acuteness of Troschel in combining (dental characters only being considered) both Chitons and Limpets in one dental order. The external form is of course partly due to its peculiar habitat; other specimens will no doubt eventually be found clinging to some flat surface and of normal shape. It seems to be a northern form, and does not occur in the Blake collections.

Suborder **PROTEOBRANCHIATA.**

Animal with external branchiæ. Embryonic shell conical.

Family **Acmæidæ.**

Gill plumose, cervical.

Genus SCUTELLINA, Gray.

Scutellina, Gray, P. Z. S. 1847, p. 168, = *Scutella*, Broderip (not Lamarck). Type *S. crenulata*, Broderip.

The animal of the typical species of *Scutellina* is unknown; according to Arthur Adams, that of a closely allied species (*S. ferruginea*) resembles *Acmæa* in its externals, except that the shell is pure white, with prominently reticulated sculpture, and the apex is prominent, pointed, and very anteriorly situated. Mr. Adams distinctly states that the animal has eyes; and it is quite probable that the genus will eventually prove to be a good one.

A specimen was recently obtained, with the dried animal (from some West-Indian corals), of a species which is also represented in the Blake collection, and which would probably be referred, from the shell-characters alone, to *Scutellina*, though it differs from the received diagnosis of that genus in having a blunt subcentral erect apex, much like ordinary *Acmææ*. An examination of the soft parts showed, however, wide differences from any described genus, necessitating the establishment of a new one for its reception :—

Genus PECTINODONTA, Dall.

Shell resembling *Scutellina*, with a blunt subcentral apex. Soft parts resembling *Acmæa*, except in the following details :—Animal blind, with the front part of the head between the tentacles and above the muzzle much produced upward and forward, extending considerably further forward than the end of the muzzle. Muzzle marginated, with lappets at the outer corners. Jaw thin, translucent. Gill exactly as in *Acmæa*; sides of foot and mantle-edge simple, nearly smooth. Dentition $\frac{0}{0\,(1.1)\,0}$; teeth large, with transverse pectinated or denticulate cusps, like those of the large lateral teeth of some Tectibranchs or Nudibranchs.

Pectinodonta arcuata, n. sp.

Shell white, elongate-ovate, moderately elevated, with a blunt polished apex, on which in young specimens remain traces of the disk-like chalky embryonic shell; the slopes from the apex to the ends both convexly arched, margin simple or slightly denticulated by the radiating sculpture; within polished; scars as in *Acmæa*; epidermis none; sculpture externally of fine, uniform, rounded, closely-set threads, radiating from near the apex to the margin, and reticulated by the fine, rather prominent, regular, concentric ridges of growth, both ridges and threads averaging near the margin about three and a half to the millimetre. Long. from end to end 14·5 millim., from apex to anterior end 5·5 millim.; lat. 10·0 millim.; alt. 5·5 millim.

Habitat. West Indies; St. Thomas, in coral; Santa Lucia, station 215, in 226 fathoms, Blake expedition.

The examination of a well-preserved specimen showed that the end of the muzzle formed a semilunar area with a distinctly-marked margin and lappets at the posterior corners. In the middle of this flat and nearly smooth area is the mouth, surrounded by a small circular papillose area. The jaw is thin and translucent, but sufficiently strong to resist contraction on the drying up of the soft parts. The radula contains about 175 series of teeth, which are large, with strong cusps, which are turned toward the middle line of the radula and strongly denticulate. The denticulate part, as in most Docoglossa, is nearly black; the anterior denticles are larger, the posterior nine subequal in size; the whole number of denticles is twelve; the whole tooth has somewhat the appearance of a coarse curry-comb, and suggests that it is due to a consolidation of the normal three Docoglossal laterals rather than the suppression of all but one and the modification of that one.

The protrusion of the anterior arch of the head is very peculiar and remarkable; the foot is rather short for the size of the shell; otherwise the features are those of *Acmæa* in general. The gill is rather large and exactly as in *Acmæa*.

The number of teeth is the smallest known in any limpet; and none of the same shape have been recorded in the order.

It is likely, however, that *Scutellina*, when investigated, will prove to have very similar dentition *.

Chitonidæ.

Genus CHÆTOPLEURA (Shuttleworth), Cpr.

Chætopleura apiculata, Say.

Habitat. Station 938, United-States Fish Commission, 1881, being 100 miles S.E. by E. ½ E. (magnetic) from Gay-Head Light, Martha's Vineyard. The depth was 210 fathoms, green sand and mud, the bottom-temperature 40°·5, the surface 72°·0 F.

In these researches only two specimens of Chitonidæ were obtained; and these are not of a genus characteristic of the deeps. These specimens were young, but did not differ from young ones of the same species from shallow water. There have been found in depths of 100 fathoms or less along the north-eastern coast of New England, and northward, two other tolerably common Chitons, one of them, *Trachydermon albus*, Linné, which does not go to great depths, as far as known, either in the Atlantic or Pacific. In Alaska it is abundant from low-water to 100 fathoms. The other, *Leptochiton cancellatus*, Sowerby, occurs off the British possessions, and may reach a depth of 300 fathoms. Rarer species, which may be found in deep water are:—*Leptochiton alveolus*, Sars (150 fathoms, Gulf of Maine); *Hanleyia mendicaria*, Mighels and Adams; *H. debilis*, Gray (to 300 fathoms); and *H. tropicalis*, Dall, from southern waters (Sand Key, 128 fathoms).

The greatest depth from which Chitons have been reported is 1006 fathoms, at which the *Leptochiton Belknapi*, Dall, was obtained in the North Pacific. It has since turned up from Kerguelen in the 'Challenger' collections, and, perhaps, may eventually be found in the North Atlantic.

Notes on the Genera.

The slender side teeth of *Lepeta* are distinguished from true laterals by not being situated on the central longitudinal area of the radula. By their form alone it would be impossible to distinguish them from teeth which are truly laterals, like the inner laterals of *Lepetella*.

Since 1869 (when I revised the classification of the Lepetidæ, and, somewhat later, of the order to which they belong)

* I should be most thankful for a dried or alcoholic specimen of soft parts of the typical species of *Scutellina* (*S. crenulata*, Broderip).

little by little information has been coming in which fills the gap then known to exist in our knowledge of the order. It is now possible to review more understandingly the relations of the dentition of the different groups. It would seem at first sight as if the dentition of *Lepeta* and *Lepetella* differed very widely; but more reflection diminishes the apparent divergences.

It may be suggested that in *Lepeta cæca* the large rhachidian tooth really represents a consolidation of the six laterals characteristic of *Acmæa*, which is supported by the fact that G. O. Sars * figures the lateral cusps of the rhachidian tooth in *Pilidium fulvum* as accessory rather than inherent parts of that tooth, a view (I find on reference to them) supported in part by my own original drawings, and a condition which, though not universal or necessary, may yet be characteristic of some stages of the development of the individual or of the radula, or perhaps of some individuals merely, while in others the consolidation goes so far that the sutures (as in the bony structures of higher animals) are obliterated. In that case the rhachidian tooth of *Lepetella* would represent the consolidation of the two inner laterals merely, if the number six be taken as typical, which, from its universality elsewhere in the order, we may reasonably assume to be the case. This is the typical number in the Tænioglossa, to which (as Professor Verrill indicates in his description) the radula of *Lepetella* is in some respects analogous, though the Tænioglossa have no uncini. In the same way, as has before been pointed out, the single large dentate laterals of *Pectinodonta* may represent, in the other division of the order, each a consolidation of the three typical laterals of *Acmæa*.

The name Onychoglossa has been used by G. O. Sars (1878) to denominate the same group and as indicative of the same characters as those possessed by the Docoglossa (Troschel, 1861), as revised by me eight years previously. I do not see any especial gain which might result to science from substituting the newer for the older name.

The relations of the groups may be expressed somewhat as follows:—

Order DOCOGLOSSA.

Shell wholly external, dish-shaped, with apex anteriorly directed; animal with two short tentacles, a non-extensible muzzle; branchiæ external or none; renal and anal apertures situated above the neck, between body and mantle-

* Moll. Reg. Arct. Norveg. tab. ii. fig. 12.

edge; no copulatory or external genital organs; mouth provided with a horny jaw and long radula with peculiar teeth; dental formula not exceeding $\frac{1}{3\,(3.3)\,3}$; metamorphosis of the embryo taking place in the egg, which is fertilized in the ovary.

Suborder **ABRANCHIATA.**

Animal without external branchiæ. Embryonic shell spiral.

Family **Lepetidæ.**

Subfamily *Lepetinæ.* Without eyes; with a marginated muzzle extended (on each side) into a tentacular process. Uncini erect. Dental formula $\frac{1}{2\,(0.0)\,2}$ $(?=\frac{0}{2\,(3+3)\,2})$.

Lepeta, Gray $\begin{cases} \textit{Lepeta}, \text{ s. s. } (+\textit{Pilidium}, \text{ Forbes non Middendorff}). \\ \textit{Cryptobranchia}, \text{ Middendorff.} \end{cases}$

Subfamily *Lepetellinæ.* With eyes; other soft parts as in *Lepeta.* Uncinus scale-like. Dental formula $\frac{1}{1\,(2.2)\,1}$ $(?=\frac{0}{1\,(3+3)\,1})$.

Lepetella, Verrill.

Suborder **PROTEOBRANCHIATA.**

Animal with external branchiæ. Embryonic shell conical.

Family **Acmæidæ.**

With a plumose cervical branchia; with or without a branchial cordon; muzzle frilled; no rhachidian tooth.

A. Without a cordon.

A. Muzzle with lappets.

a. Blind.

Pectinodonta, Dall. $\frac{0}{0\,(1.1)\,0}$ $(?=\frac{0}{0\,(3.3)\,0})$.

b. With eyes.

Scutellina, Gray. Typical species not yet examined.

Acmæa, Esch. $\frac{0}{0\,(3.3)\,0}$.

B. Without muzzle-lappets.

Collisella $\begin{cases} \textit{Collisella}, \text{ Dall, s. s.} \quad \frac{0}{1\,(2-1.1-2)\,1} \\ \textit{Collisellina}, \text{ Dall.} \quad \frac{0}{2\,(2-1.1-2)\,2}. \end{cases}$

B. With an interrupted cordon; no lappets.

Lottia (Gray), Cpr. $\frac{0}{1\,(2-1.1-2)\,1}$.

C. With complete cordon; no lappets.

Scurria, Gray (not Cpr.). $\frac{0}{1\,(2-1.1-2)\,1}$.

Family Patellidæ.

Without a cervical branchia, but with a more or less complete cordon; muzzle papillose, not frilled, marginated, or with lappets.

A. Branchial cordon complete.

a. With rhachidian tooth; branchial lamellæ arborescent, produced; sides of foot smooth. *Ancistromesus.*

Ancistromesus, Dall. $\frac{1}{3\,(1-2.2-1)\,3}$.

b. Without rhachidian tooth; branchial lamellæ short, linguiform. *Patella.*

Patella, Linné. Foot smooth, branchial lamellæ subequal all around. $\frac{0}{3\,(1-2.2-1)\,3}$.

Patinella, Dall. Foot with a scalloped frill, interrupted only in front; gills as in *Patella*. $\frac{0}{3\,(2-1.1-2)\,3}$.

Nacella, Schumacher. Foot frilled; gills very small in front; shell peculiar; lateral teeth all bidentate. $\frac{0}{3\,(2-1.1-2)\,3}$.

B. Branchial cordon interrupted in front.

a. Sides of foot smooth. *Helcion.*

Helcion, Montfort. Third laterals posterior, bidentate. $\frac{0}{3\,(1-2.2-1)\,3}$.

Helcioniscus, Dall. First laterals anterior. $\frac{0}{3\,(2-1.1-2)\,3}$.

Patina, Gray. Third laterals posterior, denticulate; shell peculiar. $\frac{0}{3\,(1-2.2-1)\,3}$.

*   *   *   *   *   *

Metoptoma, Phillips. Posterior edge emarginate or waved. Fossil in Carboniferous of Great Britain.

January 22, 1882.

IV.—*Notes on the Mollusca procured by the Italian Exploration of the Mediterranean in* 1881. By J. Gwyn Jeffreys, LL.D., F.R.S.

Having been lately at Florence, Professor Giglioli kindly offered me an opportunity of examining the Mollusca which were obtained in the Italian Expedition to the Mediterranean in 1881; and he requested me to publish a notice of the principal results in that department of zoology. His preliminary Report of the Expedition was published at the close of last year in the 'Atti del III. Congresso Geografico Internazionale,' and is highly interesting to all naturalists. It conclusively showed that the great abysses of the Mediterranean are not (as the lamented Professor Edward Forbes supposed) azoic, but that they abound in life of all kinds. This fact has been corroborated by the French exploration in the 'Travailleur' of another part of the Mediterranean, made in the same year, an account of which appeared in the 'Comptes Rendus' from the pen of Professor Alphonse Milne-Edwards. Fishes, Mollusca, Crustacea, Annelids, Echinoderms, Zoantharia, Corals, Foraminifera, and Sponges were amply represented in both of those expeditions from depths of from 500 to nearly 2000 fms.

Forbes's dredgings in the Mediterranean did not exceed in depth 230 fms.; Admiral Spratt dredged there living Mollusca in 310 fms.; and in the 'Porcupine' expedition of 1870 productive dredgings were made off the north coast of Africa at depths of 1415 and 1456 fms. These were the only deep-water researches by dredging in the Mediterranean previously to last year. It was therefore clear that the bottom of this famous sea or marine lake had never been properly investigated for zoological purposes.

The Italian surveying-ship 'Washington,' under the command of Captain Magnaghi, commenced operations on the 1st of August, and returned to Genoa on the 6th of September, 1881. The commander is an experienced hydrographer and a thorough man of science. Professor Giglioli, of Florence, who is well known as an eminent and accomplished zoologist, had the scientific charge of the expedition as naturalist. The course of exploration was from Maddalena, round Sardinia to Naples, and thence to the western coast of Sicily. There were thirty-three stations and thirty-eight dredgings; and the depths at which dredgings were made ranged from 60 to 3630 metres, or from about 32½ to 1970 fms.

As regards the Mollusca, the number of specimens procured was not great; but many of the species were extremely interesting. I will now proceed to mention some of them. All the depths having been recorded in metres, I will render them in fathoms by adding a twelfth part to each metre, so as to correspond nearly with the English yard measure, of which two make a fathom*.

BRACHIOPODA.

†*Terebratula vitrea*, Born.

Very fine specimens occurred in 214 fms.; one of them is $1\frac{6}{10}$ inch long. An oblong variety came from 841 fms., and the variety *sphenoïdea* from 217 fms. The inside ribs of the upper or deeper valve are sometimes visible on the outside, owing to the semitransparency of the shell. As to the distribution of this and other species in space and time, I would refer to my papers on the Mollusca of the 'Lightning' and 'Porcupine' expeditions in the 'Proceedings of the Zoological Society of London' for 1878, 1879, 1880, and 1881.

CONCHIFERA.

†*Amussium Hoskynsi*, Forbes.

From 214 to 609 fms.

†*Arca obliqua*, Philippi.

From 123 to 544 fms. Described by the author of the species as a Tertiary fossil.

†*Arca pectunculoïdes*, Scacchi, var. *septentrionalis*.

From 337–464 fms.

†*Leda messanensis*, Seguenza.

From 217 to 544 fms.

†*Nucula ægeensis*, Forb.

From 1521–1536 fms.

†*Nucula corbuloïdes*, Seg.

From 1521–1536 fms.

†*Limopsis minuta*, Ph.

From 217 fms.

* The species having a † prefixed to their names are Upper Tertiary fossils of Italy.

†*Limopsis pygmœa*, Ph.

Pectunculus pygmæus, Moll. Sic. i. p. 63, t. v. f. 5.

From 217 fms. A single but fresh valve. A Pliocene fossil of Italy and the English Crags; hitherto unknown as recent or living. The specimen mentioned in the supplement to 'British Conchology' (vol. v. p. 175) as from Corsica is *L. minuta*.

Malletia obtusa, M. Sars.

From 337–464 fms.

Malletia cuneata, Jeffreys.

From 337 to 1536 fms.

Axinus planatus *, Jeffr.

SHELL triangular, expanded, and somewhat flattened, thin, lustreless, and opaque: *sculpture*, an angular ridge running down the middle, with a shallow furrow on the anterior side, besides regular slight concentric riblets in the line of growth, and numerous intermediate minute striæ: *colour* whitish: *epidermis* filmy and scarcely perceptible: *margins* rounded in front, sinuous (as in *A. flexuosus*) on the anterior side, obliquely and abruptly truncated on the other side, deeply excavated or concave below the beak: *beaks* prominent, pointed, and incurved: *lunule* semicordate, with a thickened edge: *ligament* enclosed in a short, narrow, and curved groove: *hinge-line* triangular, occupying only a small portion of the entire circumference: *hinge-plate* thick: *teeth* none: *inside* glossy, exhibiting the obverse of the riblets but no longitudinal striæ: *muscular scars* indistinct. L. 0·55, B. 0·5.

From 432–544 fms.; a single valve only and the fragments of another.

With this species was dredged an unusually large and rather flattened valve of what I should consider *A. flexuosus*, var. *polygona*, which shows the same longitudinal striæ on the inside that, according to the Abbé Brugnone, distinguish *Ptychina biplicata* of Philippi from *A. flexuosus*.

A. transversus (*Lucina transversa*), Bronn, has a different shape, texture, and sculpture.

†*Axinus orbiculatus*, Seg.

From 214 fms.

†*Pecchiolia granulata*, Seg.

From 127 to 301 fms.; of large size.

* Flattened.

†*Pholadomya Loveni*, Jeffr.

From 85 to 1217 fms. Perfect and large specimens at the last-mentioned depth, measuring upwards of an inch in length.

†?*Neæra obesa*, Lov.

From 337 to 1536 fms.

†*Neæra costellata*, Deshayes.

From 817 fms.

Solenoconchia.

†*Dentalium agile*, M. Sars.

From 86 to 1963 fms.; widely distributed. One specimen from between 1500 and 1600 fms. is more than 2 inches long. I now find that, compared with *D. striolatum* or *abyssorum*, the present species is more slender and not so strongly ribbed, and that the curve is more gradual and not abrupt towards the point or base. Perfect specimens of both species have a short terminal pipe within the slit and occasionally issuing from a truncated and thickened base, as in *D. dentalis* and *D. tarentinum*. Philippi was the first to describe *D. agile* from the Italian Tertiaries as *D. incertum* of Deshayes; but it is not the last-named species. It was dredged in the 'Porcupine' and 'Travailleur' expeditions off the Lusitanian coasts.

†*Dentalium striolatum*, Stimpson.

From 200–277 fms. *D. brevifissum*, Brugnone.

Gastropoda.

Emarginula multistriata *, Jeffr.

Shell helmet-shaped, somewhat compressed at the sides, rather thin, lustreless, and opaque: *sculpture*, numerous slight ribs, which radiate from the beak or apex to the front margin on every side; usually, but not regularly, a smaller alternates with a larger rib; the crests are studded with rather distant tubercles, giving a prickly appearance; the intervals between the ribs are filled with minute and close-set transverse striæ: *colour* whitish: *margins* slightly notched by the termination of the ribs: *beak* small, incurved, placed perpendicularly to the front margin: *slit* short, but broadish: the fissural furrow is filled up with crowded arched septa or plates: *inside*

* Much striated.

glossy, showing the impression of the external sculpture. L. 0·5, B. 0·3.

From 217 fms.; a single specimen. Also from the 'Porcupine' expedition of 1870, off the western coasts of Spain, in from 292 to 374 fms.

This differs from *E. cancellata*, Ph., in being proportionally higher, narrower or compressed at the sides, and thinner; the beak overhangs the front margin; the ribs are slighter and more numerous, and the intermediate striæ twice as many. It is also distinct from *E. tuberculosa*, Libassi, and *E. confusa*, Seg., in sculpture and other respects.

†*Trochus Ottoi*, Ph.

Moll. Sic. ii. p. 227, t. xxviii. f. 9.

From 214 to 970 fms. Also dredged in 'Porcupine' and 'Travailleur' expeditions, as well as in the 'Blake' or United-States expedition. This and the next two species were originally described as fossils of the South-Italian tertiaries.

†*Trochus Wiseri*, Calcara.

Giorn. Maur. 1841, p. 31, t. iv. f. 14.

From 244 to 544 fms. *T. gemmulatus*, Ph., 1844, and other synonyms. Off the Gulf of Bona, in 1456 fms. ('Porcupine' expedition); Bay of Biscay ('Travailleur' expedition).

†*Turbo filosus*, Ph., var. *glabrata.*

Moll. Sic. ii. p. 155, t. xxv. f. 4 (as *Trochus filosus*); var., ii. p. 226, t. xxviii. f. 1 (as *Trochus glabratus*).

From 217 fms. North-Atlantic expeditions of 'Porcupine' in 1870, and 'Travailleur' in 1881. The operculum shows that this species belongs undoubtedly to *Turbo*, and not to *Trochus*.

†*Hela tenella*, Jeffr.

Lacuna tenella, Brit. Conch. v. p. 204, pl. ci. f. 7.

From 807 to 1536 fms. Also throughout the North Atlantic.

Odostomia speciosa, H. Adams.

Turbonilla speciosa, Proc. Zool. Soc. 1869, p. 274, pl. xix. f. 11.

From 214 fms. Also from 'Porcupine' expedition, off the Atlantic coast of Spain. Query *Turbo plicatilis* of Brocchi ?

†*Trophon multilamellosus*, Ph.

Murex multilamellosus, Moll. Sic. ii. p. 182, t. xxvii. f. 8.

From 200–277 fms. Also from the Atlantic cruise of the 'Porcupine' in 1870. Originally described as a Calabrian fossil.

†*Columbella costulata*, Cantraine.

Fusus costulatus, Diagn. Moll. (1837), p. 20.
Buccinum acutecostatum, Ph. Moll. Sic. ii. (1844) p. 192, t. xxvii. f. 14.
Buccinum testæ, Aradas, Descr. Conch. foss. Gravitelli (1847), p. 28.
Columbella haliæeti, Jeffr. B. C. iv. (1867) p. 356; v. (1869) p. 219, pl. cxviii. f. 3.

From 85 to 544 fms. Has an extensive distribution in the North Atlantic. A Sicilian and Calabrian fossil; first described by me as recent or living.

†*Defrancia torquata*, Ph.

Pleurotoma torquatum, Moll. Sic. ii. p. 171, t. xxvi. f. 14.

From 217 fms. Also from 'Porcupine' expedition of 1870, in the Atlantic. Originally described as a Calabrian fossil.

*Defrancia nodulosa**, Jeffr.

SHELL spindle-shaped, slender, rather solid, glossy, and semitransparent: *sculpture*, sharp and oblique longitudinal ribs, of which there are twenty on the body-whorl, besides numerous intermediate concentric striæ, those on the lower half of the last or body-whorl being thread-like, uninterrupted, and oblique; each whorl has also below the fissural band a sharp keel or ridge, which is somewhat knotty or jagged at intervals, owing to the junction of the ribs and striæ; the fissural band is crossed by arched striæ corresponding with the ribs, of which they appear to form a continuation; the top whorls have the same kind of arched striæ disposed lengthwise: *epidermis* none: *colour* white, with a faint tinge of yellowish-brown on the apex: *spire* long, graceful, bluntly pointed: *whorls* 8, moderately convex; the last is not quite equal in length to the rest of the spire; apical whorls rounded: *suture* deep: *mouth* oblong, flexuous: *canal* rather long and wide: *outer lip* curved, sharp-edged: *fissure* wide and deep, regularly curved: *inner lip* smooth: *pillar* long, slightly flexuous. L. 0·35, B. 0·15.

From 611 to 1216 fms.

* Somewhat knotty.

Three specimens. Also from the 'Porcupine' expedition of 1870, off the coast of Portugal in 795–994 fms., and in the Mediterranean in 1415–1456 fms.

*Defrancia tenella**, Jeffr.

SHELL oval, tapering at first towards the apex, but becoming disproportionately broad towards the base, very thin and fragile, of a dull hue, and semitransparent: *sculpture* none, except a few slight and indistinct spiral striæ and occasional lines of growth; the top whorls are minutely and closely reticulated by curved striæ, as in other species of the present genus: *epidermis* not perceptible: *colour*, for the most part whitish, the first four whorls being reddish-brown: *spire* short, sharply pointed: *whorls* 7, convex; the last is twice the size of all the other whorls put together; apex conical: *suture* deep, not concave or sunken: *mouth* oval, flexuous: *canal* short and wide: *outer lip* curved and having a sharp edge: *fissure* remarkably wide and deep, forming an oblique curve: *inner lip* glazed: *pillar* long, and sloping towards the canal. L. 0·2, B. 0·15.

From 1963 fms.

A single and perfect specimen of this beautiful little shell. It is allied to a species which I have named *exquisita*, dredged in the 'Porcupine' and 'Travailleur' expeditions off the western coast of Lusitania, in about 1000 fms.; but the last-named species is distinctly cancellated, and has a much narrower and longer fissure.

Defrancia convexa†, Jeffr.

SHELL spindle-shaped, rather thin, lustreless, and opaque: *sculpture* numerous, slight, thread-like and regular spiral striæ, which are alternately larger and smaller; those on the base are more close-set and finer; there are no longitudinal ribs; but the upper whorls have a few knob-like prominences in the middle, which may be the remains or traces of ribs, and they give a bluntly angular appearance to those whorls; the lines of growth are flexuous; the fissural groove, which lies immediately below the suture, is somewhat excavated, and is marked by numerous and regular curved striæ: *colour* whitish: *whorls* 8–10, convex: *suture* deep: *mouth* oblong: *canal* of moderate length: *pillar-lip* smooth and enamelled. L. 0·85, B. 0·35.

From 217 fms.

* Delicate. † Rounded.

An imperfect but characteristic specimen. It differs from *D. Leufroyi* in having a longer spire, regular and fine transverse striæ, no ribs, and merely a few nodulous markings on the upper whorls; the groove is more distinct, and the canal is not so short and abrupt. *Pleurotoma inflata* of Cristofori and Jan has the same longitudinal ribs as *D. Leufroyi* (which is not given in their catalogue); and I consider it a variety of the last-named species.

†*Pleurotoma modiolus*, Cristofori & Jan.

Fusus modiolus, Cat. (1832), p. 10.
Pleurotoma carinatum, Ph. Moll. Sic. ii. (1844) p. 176, t. xxvi. f. 19.

From 217 fms. Also North Atlantic. First described and known as an Italian fossil.

†*Cylichna ovata*, Jeffr.

Cylichna umbilicata; var. *conulus*, B. C. iv. p. 414.

From 337–464 fms. Throughout the North Atlantic, and fossil in the South-Italian Tertiaries. Not *Bulla conulus* of Deshayes, nor *C. striatula* of Forbes with several synonyms.

Cylindrobulla fragilis, Jeffr.

Cylichna fragilis, Ann. & Mag. Nat. Hist. 1856, xvii. p. 188, pl. ii. ff. 16, 17.

From 1521–1536 fms. Spezzia, and dredged by Mr. McAndrew on the Atlantic coast of Spain. The 'Washington' specimens are adult; the largest is $\frac{6}{10}$ inch long. They are microscopically and regularly striated in a transverse or spiral direction. I cannot agree with the Messrs. Adams that Fischer's genus *Cylindrobulla* is the same as *Lophocercus*, nor with Monterosato in considering it a section of *Acera*; although the generic characters require some amendment.

†*Actæon pusillus*, Forb.

Tornatella pusilla, Rep. Æg. Invert. p. 191.

From 217 fms. Also North Atlantic and a Sicilian fossil. Scarcely distinguishable from *A. Noæ* of the English and Belgian Crags, and of the Icelandic Tertiary or Post-tertiary deposits, except in respect of size.

†*Scaphander punctostriatus*, Mighels & Adams.

Bulla punctostriata, Boston Journ. Nat Hist. vol. iv. (1842) p. 43, pl. iv. f. 10.

Scaphander librarius, Lovén (1846).

From 85 to 1536 fms. Also throughout the North Atlantic, and a Sicilian fossil.

I am delighted to find that science will be further benefited by another Italian exploration of the Mediterranean in the course of this summer.

V.—*Description of a new Genus and Species of Frogs of the Family* Ranidæ. By G. A. Boulenger.

Nyctixalus, g. n.

Pupil vertical. Tongue free and deeply notched behind. Vomerine teeth none. Tympanum distinct. Fingers free, toes with a rudiment of web; tips of fingers and toes dilated into regular disks. Outer metatarsals united. Omosternum and sternum with a bony style. Terminal phalanges obtuse.

Closely allied to *Megalixalus*, but distinguished by having the toes nearly free.

Nyctixalus margaritifer, sp. n.

Head rather large, broader than the body; snout prominent, the tip obliquely truncate backwards and downwards; nostrils close to the tip of the snout; canthus rostralis angular; loreal region concave; interorbital space concave, broader than the upper eyelid; eye large; tympanum very distinct, nearly as large as the eye. Limbs slender; fingers rather long, first shorter than second; toes short, with a slight web at the base, extending as a narrow fringe along the sides; subarticular tubercles moderately developed; a very indistinct inner metatarsal tubercle. If the hind limb is carried forwards along the body, the tibio-tarsal articulation reaches the tip of the snout. Upper surface with very small pearl-like scattered tubercles; upper eyelid strongly tubercular; belly and lower surface of thighs granulate. Dark brown above and beneath; a yellow spot on each scapula; other, smaller, yellow spots on the limbs, fingers, and toes; belly marbled with yellow. Male without vocal sac. From snout to vent 35 millim.

One male specimen in the Royal Museum, Brussels. Purchased as being from the East Indies.

VI.—*Descriptions of new Species of Lepidoptera, chiefly from Duke-of-York Island and New Britain.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The following species have recently been received from the Godeffroy Museum, along with other species already described.

Rhopalocera.

This consignment is unusually rich in Euplœinæ, most of which appear to be specifically distinct from any thing hitherto named: one or two of these however, are, identical with species previously received by Messrs. Salvin and Godman, and included in their lists as doubtfully recognized forms. The latter, I now think, may be safely regarded as distinct from their allies in other islands; and therefore I have named them.

Both sexes of *Salpinx erimas* have been received, the female much resembling that sex of *S. Treitschkii*, but with all the white spots of the upper surface much enlarged; on the under surface it scarcely differs from the male excepting in the usual sexual characters.

Until the publication of Mr. Moore's revision of the subfamily I shall not attempt to separate generically the greenish species heretofore placed under *Danais*, but, to save confusion, shall describe them provisionally as members of that genus.

1. *Danais claribella*, sp. n.

♀. Semitransparent greenish white with black nervures; all the wings with a broad black-brown external border, upon which are two irregular series of greenish-white spots, the inner series large and oval, excepting towards the apex of primaries, where the series is inangled (the five uppermost spots being small, the second and third nearly round); the sixth to ninth spots on these wings are almost confluent with the ground-colour, from which they are merely separated by a squamose blackish transverse streak; the outer series consists of small spots in pairs and is submarginal; the costal and inner margins of the wings are black-brown; the body above black, marked as usual with white. The wings below chiefly differ in that the external area is paler, especially on the secondaries, with the exception of its inner border, which, both above and below, is deeply dentate, and which below shows this dentation to be produced by large hastate blackish spots extending from the inner series of whitish spots beyond the internal margin of the external area. Pectus black, spotted with white; venter testaceous, with a central white stripe. Expanse of wings 82 millim.

Viti.

Most like *D. albata*, but very distinct in pattern from anything hitherto described.

2. *Danais sobrinoides*, sp. n.

Danais sobrina, Salvin & Godman, P. Z. S. 1877, p. 141.

Differs from *D. sobrina* in the larger size and paler green tint of all the spots, in the absence of the basidiscoidal streak on the primaries, and the dusky character of the costal markings of the secondaries. Expanse of wings, ♂ 80 millim., ♀ 74 millim.

New Britain.

3. *Salatura decipiens*, sp. n.

♂. Nearly allied to *S. mytilene* of Felder from New Guinea, the primaries differing only in the absence of any spots on the costal border, and in the presence of a rather broad internomedian ferruginous streak; the secondaries, however, are considerably more like *S. fulgurata*, but differ in the smaller white discoidal patch and in having two imperfect submarginal series of white dots. Expanse of wings 83 millim.

Solomon Islands.

4. *Salatura biseriata*, sp. n.

Allied to *S. mytilene*, but smaller and rather greyer in tint; the white spots beyond the cell of primaries absent in the male; all the wings with two imperfect submarginal series of white spots, better defined in the female than in the male; the inner series of the secondaries decidedly larger than the others: the white spots on the under surface of secondaries towards the middle five in number. Expanse of wings 77 millim.

Duke-of-York Island.

5. *Salpinx biformis*, sp. n.

Allied to *S. Treitschkii*, but decidedly bluer and darker in both sexes; the male with more oblique outer margin, the spots on the primaries smaller, the fusiform interno-median spot of the male single and shorter; the spots on the primaries of the female less distinct, and placed upon pale bluish squamose streaks; those of the secondaries, however, sharply defined.

On the under surface all the spots on both sexes are decidedly smaller than in *S. Treitschkii*. Expanse of wings, ♂ 88 millim., ♀ 84 millim.

Duke-of-York Island.

Doubtless a geographical representative of *S. Treitschkii*.

6. *Salpinx œnea*, sp. n.

Also allied to *S. Treitschkii*; slightly larger, the wings more produced, the female more bronzy in colour; the whitish spots above smaller. Primaries below with a greenish-white spot in the cell, and an increasing series of five spots in the transverse series beyond it (two or three additional spots in the female), the fifth spot large and oval, with a bluish or pink tint; female with a pinky-white internal streak and a broad whitish internal border: secondaries with a basal white spot; a spot within the cell, the male with six, and the female with seven whitish dashes in an angular series beyond the cell; two similar dashes (the outer one small) upon the radial interspaces and in an oblique line with the angle of the postmedian series. Pectus more distinctly white-spotted than in *S. Treitschkii*. Expanse of wings, ♂ 88 millim., ♀ 95 millim.

Solomon Islands.

A male, apparently referable to typical *S. Treitschkii*, was also in the collection, marked as coming from the Solomon Islands; as the only difference between it and males from New Ireland consists in the interno-median streak or spot being single instead of double, I do not hesitate to regard it as that species. *S. œnea*, however, is probably only a race of the same butterfly.

In the Museum we have a female of this group more nearly allied to *S. lorenzo*, which it may be as well to describe here.

7. *Salpinx viridis*, sp. n.

♀. Dark bronze-green; primaries with a rather large spot within the cell, and a larger fusiform spot on the interno-median area, shorter than in the preceding species, pinky white: secondaries with the costal area broadly greyish; a dot near the base of the subcostal interspace, and an increasing series of seven conspicuous spots in a slightly bent series beyond the cell, the first and last very small, the second and third fusiform, the fourth and fifth cordate, the fifth largest, the sixth narrower than the fifth, but similarly notched in front: body above blackish, spotted in front with white. Primaries below with the spots much larger, three additional spots in an angular series beyond and below the cell: secondaries with only six of the upper-surface spots beyond the cell smaller than above, but a large spot in the cell, and three (instead of one) white spots placed obliquely between the cell and the discal series; pectus white-spotted; venter grey-spotted. Expanse of wings 96 millim.

Thursday Island, south of New Guinea.

8. *Salpinx perdita*, sp. n.

Nearest to *S. pasithea* of Felder and *S. nemertes* of Hübner *, but decidedly smaller, all the pale spots on primaries smaller, sometimes wholly wanting in the female; the discal series of white spots (when present) six in number; the interno-median lilac spot of the male sharply defined, small and oval: secondaries of the male with the pale discoidal patch of a more sandy-brown colour than in *S. nemertes*: secondaries of the female with three subapical decreasing white spots, as in that species. On the underside the differences are much more marked; primaries of male with no blue dashes beyond the cell, the subcostal spot smaller, the spot on first median interspace smaller and rounder; the discal series of seven white spots nearer to outer margin; the marginal white spots wholly absent: secondaries with the angulated disco-submarginal series of spots white in both sexes, but blue-edged in the male. Expanse of wings, ♂ 80 millim., ♀ 86 millim.

Duke-of-York Island.

Messrs. Salvin and Godman have also received examples from New Britain, and kindly presented a pair to the Museum collection.

9. *Crastia honesta*, sp. n.

♀. Allied to *C. melina*, rather larger and slightly more smoky in colour, especially on the secondaries; the primaries showing all the lilacine-white spots and the double interno-median lilacine-white streak of the under surface, *i. e.* a broad crescent-shaped lilacine spot near the end of the cell, a semicircular series of six unequal spots beyond the cell, the fourth elongated into a narrow dash, and the interno-median streak (10 millim. in length) before mentioned; the slightly paler arched submarginal belt is nearly as well defined as in *C. Batesii*: secondaries with two indistinct rosy-whitish dashes placed obliquely above the two subcostal branches, and a barely perceptible pale brown spot near the end of the cell; in other respects the secondaries are much like those of *C. oc-*

* These are mere local races of one species at most.

culta ♀, of New Guinea, in pattern, though paler in colour, being of a rather dark pitch-brown, with greyish costal area and diffused slightly bronzy-brown submarginal belt a little paler than the ground-colour: body blacker than in *C. melina*. Under surface nearly as in that species, but darker, the spots as a rule decidedly larger, excepting that on the first median interspace of primaries, which is small and oval; there is also no break in the arched postmedian series on these wings. Expanse of wings 94 millim.

Solomon Islands.

10. *Crastia cerberus*, sp. n.

Rufous-brown, with a slight bronze reflection: wings paler towards the external margins; male above with five scarcely visible whitish spots towards the outer margin of primaries: secondaries with greyish costal area; female with a whitish dot near the base of second median interspace, and an angulated series of seven rather larger spots towards outer margin of primaries: secondaries with pale costal area; three decreasing subapical white spots. Under surface a little paler than the upper; primaries with a small spot at base of first subcostal interspace, another near the end of the cell, and a transverse series of four increasing spots beyond the cell lilacine; an externo-discal angulated series of eight white spots and an imperfect series of submarginal white dots; all these spots are reduced to mere dots in the male; the female has an additional elongated interno-median white streak: secondaries with a spot in the cell and an arched series of five to seven spots beyond it lilacine; three subapical spots and a submarginal series of dots (imperfect in the male) white; all these spots are larger in the female than in the male; two white basal dots: body spotted with white. Expanse of wings, ♂ 78 millim., ♀ 82 millim.

New Britain.

Seems to be more like a species standing in M. Oberthür's collection under the name of "*Euplœa L'Orzæ*, Boisd.," than any thing else that I have seen; we have a female from New Ireland presented by Messrs. Salvin and Godman.

C. cerberus may easily be confounded with the following, the pattern on both surfaces being very similar.

11. *Euplœa illudens*, sp. n.

Smaller and much redder and darker in both sexes than *Crastia cerberus*, readily distinguished by having only four or five spots towards apex in the externo-discal series, and *by* *the well-defined sericeous brand* (8 *millim. in length*) *on the middle of the interno-median area of the male*: below, the externo-discal series consists of six spots instead of eight (as in *C. cerberus*), and there is no submarginal series of white dots on the primaries; the secondaries differ in having not more than five apical submarginal dots instead of twelve; in other respects the pattern agrees; the outer margin of the primaries, however, is distinctly less convex. Expanse of wings, ♂ 79 millim., ♀ 74 millim.

♀, Duke-of-York Island.

The male, from New Ireland, was presented by Messrs. Salvin and Godman; I have found it necessary to include it in the above description.

E. illudens belongs to the same group as *E. Hübneri.*

12. *Euplœa decipiens*, sp. n.

Allied to the preceding species, but the primaries of the male much narrower and more produced at apex, with a decidedly longer sericeous brand (10 millim. in length), its outer extremity much more nearly approaching the outer margin; externo-discal spots of primaries very small, lilacine, four in number, subapical, almost wholly obliterated in the male; submarginal white dots on the under surface of the secondaries wanting in the male. Expanse of wings, ♂ 70 millim., ♀ 73 millim.

Duke-of-York Island.

Though this species has almost the same pattern and coloration as the preceding, it differs considerably in the shape of the male primaries, the apical area being more contracted than in any species known to me; the form and position of the sericeous brand, as well as the shape of its wings, would locate it nearer to *E. Paykullii* and *E. torvina* than to the *E. Hübneri* group, to which its pattern allies it.

13. *Euplœa fraudulenta*, sp. n.

Allied to *E. zonata* from Borneo. Male of the same colours above, but with the sericeous brand upon the primaries very large and extending almost to the external angle, as in *E. torvina* of the New Hebrides, with a less prominent oblique and somewhat sericeous streak above the ordinary one in the centre of the first median interspace, and answering to one of the white markings of the under surface, and with no pale marginal spots on the secondaries. Primaries below rich pitchy brown, with a slightly paler diffused arched submarginal band; a triangular bluish-white spot close to the end of the cell, two smaller spots of the same colour beyond the cell, and a conspicuous oblique snow-white streak on the first median interspace; internal area bronze-brown, shading into greyish white towards the margin: secondaries pitchy brown, with diffused sandy-brown borders (widest at anal angle); a pale blue spot in the cell, and an arched series of seven blue spots beyond it; three decreasing subapical spots and five submarginal dots, all white; two white dots at base; pectus black, spotted with white; venter olivaceous brown. The female is larger and paler than the male, and (in addition to the usual sexual differences) may be distinguished by having a white spot near the end of the cell and two white dots beyond the cell on the upper surface of primaries; an angular discal series of six subapical white spots on the under surface of the same wings, as well as a very broad and long interno-median white patch: the secondaries only differ in the greater size of all the spots. Expanse of wings, ♂ 85 millim., ♀ 94 millim.

Solomon Islands.

14. *Dyctis holofernes*, sp. n.

Black-brown, shading into bronze-brown towards the external borders and tinted with purple on the margin: primaries with an arched subapical series of four small white spots. Primaries below paler than above, dark rufous-brown with paler internal area; base of costal margin dotted with white; a white spot close to the end of the cell, and an externo-discal series of six oval blue-edged white spots: secondaries dark piceous brown, spotted with white at the base; a small greenish-white spot in the cell; an arched almost submarginal series of seven blue-edged white spots; external border irregularly flecked with little grey dashes; inner margin of eyes white: body dark brown. Expanse of wings 72 millim.

Duke-of-York Island.

The collection contained an example of *Hipio Crameri* from New Britain; of the single specimen previously recorded I was unable to give the locality. Both specimens are males; and it now remains to be seen whether *H. amabilis* is or is not the female of the same species.

15. *Neptis ampliata*, sp. n.

Allied to *N. latifasciata*, from which it differs in the greater size of the white spots of the primaries and the much greater width and more oval form of the central white belt of the secondaries; the outer edge of this belt is strongly undulated. Expanse of wings 72 millim.

New Britain.

As *N. latifasciata* is a common representative of the *N. heliodora* group occurring at Cape York, it is hardly necessary to give a detailed description of the above species.

16. *Neptis fissizonata*, sp. n.

Near to *N. heliodora*; like it, black, with cream-coloured spots, but differing in the greater size of the discoidal spots of primaries, in the presence of a basal streak on these wings, in the narrower and more perfectly macular central band of secondaries, and in the presence of a well-defined series of eight discal cream-coloured spots on the secondaries. Expanse of wings 60 millim.

Solomon Islands.

17. *Neptis eblis*, sp. n.

Probably most nearly allied to *N. heliopolis*; black above, the outer half of the disk of all the wings occupied by three series of oval pale brown spots, the central series with large white pupils. Wings below paler; the three series of spots lilacine, the central series being, more strictly speaking, white, with lilacine edges: primaries with an additional large white spot in the cell; internal area pale brown: secondaries with a large white spot at base of cell: anterior legs white in front; venter with two central creamy-whitish lines. Expanse of wings 69 millim.

New Britain.

This is the darkest *Neptis* known to me.

The collection also contains two species of *Charaxes* new to the Museum series, viz. *C. demonax*, from New Britain, and *C. jupiter*, from Duke-of-York Island.

[To be continued.]

VII.—*Descriptions of new Coleoptera from Madagascar* (Anthribidæ *and* Longicornia). By Charles O. Waterhouse.

The species here described were (with one exception) collected by the Rev. W. Deans Cowan, and are from the neighbourhood of Fianarantsoa.

Anthribidæ.

Diastotropis crassicornis, n. sp.

Niger, supra squamis olivaceis æneis et cupreis dense tectus; elytris breviter oblongis, parallelis, ad apicem obtuse rotundatis, sutura impressa; antennis crassis, pedibus obscure piceis hic et illic violaceo tinctis. ♀.

Long. (rostro excl.) 6 lin.

In the 'Transactions of the Entomological Society' for 1877, p. 11, I described a species under the name of *D. olivaceus* from two examples which I believed to be sexes. The species now described is founded on what I then considered to be the female. I have now before me from Fianarantsoa a small female, which only differs from the male in having the antennæ much shorter, the general form and colour of the male and female being very similar. The female example, therefore, originally described must be considered a distinct species, differing in having the rostrum relatively longer, the length from the front of the eye to the base of the mandible being equal to the greatest width of the head, whereas in *D. olivaceus* (♀) this part of the rostrum is much less than the width of the head. The antennæ in *D. olivaceus* are very slender to the sixth joint; in *D. crassicornis* they are thick and gradually become a little more so towards the club. The fore part of the prosternum is densely transversely strigose and punctured; in *D. olivaceus* this is scarcely observable.

Diastotropis planifrons, n. sp.

Olivaceo-niger, opacus, squamis minutissimis dense tectus; fronte et rostro planatis, creberrime punctatis; thorace elongato, antice et postice paulo angustato, confertim subtilissime punctato, postice linea vix elevata arcuata instructo; elytris thorace duplo longioribus, convexis, ad apicem arcuatim angustatis; antennis (apice excepto) pedibusque obscure piceis. ♀.

Long. 7 lin.

Rostrum one quarter broader than long, flat, without any ridges. Space between the eyes very wide. Thorax a little longer than its greatest width, which is rather behind the middle, evenly convex, gently narrowed in front and behind; the sides not distinctly angular at the widest part. Elytra at the base straight, much broader than the base of the thorax; very convex, gradually declivous at the apex, with a black velvety stripe on the suture from the middle to the apex; in some positions lines of distant punctures may be seen. Antennæ the length of the thorax, the second to sixth joints slender; the seventh and eighth a little wider at their apex; club black. Legs shining; tibiæ with delicate pubescence.

This species is narrower than *D. olivaceus*, which it resembles somewhat in colour. The absence of any ridges on the rostrum separates it from all its allies.

Diastotropis nitidipennis, n. sp.

Elongatus, sat angustus, nigro-violaceus; capite thoraceque opacis, confertim punctulatis; elytris æneis, nitidissimis, subtiliter striato-punctulatis, sutura postice nigro-velutina.
Long. $7\frac{1}{2}$ lines.

This species has the form of *D. planifrons*, but is at once distinguished by its highly polished brassy elytra. The rostrum is very similar, but has a distinct shallow median impression. The thorax is evenly convex, densely and extremely finely punctured, very gently arcuate at the sides. The elytra have a slight impression at the base within the shoulder, the suture is also impressed below the scutellum. Besides the lines of fine rather distant punctures, some extremely minute ones may be traced here and there on the interstices. The antennæ (with the exception of the club) are pitchy, slender, in the male a trifle longer than the length of the thorax, in the female scarcely shorter. The legs are pitchy bronze, shining. The male has a well-marked round impression on the division between the first and second segments of the abdomen, and a slight one on the margin of the second and third segments.

This and the preceding species might perhaps be separated as a distinct genus from *Diastotropis*, on account of the non-carinate rostrum, more cylindrical thorax, &c.; but I prefer at present including them.

Cerambycidæ.

Logisticus modestus, n. sp.

Brunneus, subtiliter griseo-sericeus, capite thoraceque nigrescentibus.
Long. 6–$7\frac{3}{4}$ lin.

General colour very light brown, the underside of the insect more pitchy. Head brownish black, rather broad; muzzle rather short, the space between the front of the eye and the base of the mandible (viewed laterally) about half the diameter of the eye. Eyes large and prominent, moderately widely separated above; where they are most approximate, they are distant about $\frac{3}{4}$ millim. in the smaller examples, and nearly 1 millim. apart in the larger. Thorax obliquely narrowed in front of the lateral tubercle, subparallel behind; the lateral tubercle angularly prominent; on the disk are four slight small round swellings, two a little in front of the middle and two near the base. Elytra very straight at the base, with scarcely any impression within the shoulders, somewhat flattened on the back, with a fine sutural stria; the apex of each elytron with a very slight truncature.

The sexes are extremely alike. The male, however, is rather less robust in build; the apical joint of the antennæ is distinctly longer than the preceding; the apical segment of the abdomen has a very slight indication of a notch at the apex, with a slight impression; and the claw-joint of the tarsi is very slightly dilated at the apex.

This species is very close to *L. simplex*, Waterh. (Ann. & Mag. Nat. Hist. 1880, v. p. 417). It differs in having the head distinctly broader, the eyes more prominent, standing out more away from the head posteriorly; the lateral tubercle of the thorax is more prominent, and the legs are pale brown.

Lamiidæ.

Dioristus, n. gen.

Head gently concave between the antennal tubercles, which are only very slightly elevated. Antennæ as long as the whole insect in the male, a little shorter in the female; densely pubescent, with a few longer hairs beneath the third, fourth, and fifth joints; the first joint short, thick, and subovate; the third a trifle longer than the first and second together; the fourth a little longer; the fifth to tenth distinctly shorter, subequal; the eleventh in the male rather longer than the tenth. Eyes strongly granular, almost divided. Thorax subquadrate; the disk flattened, and with a well-marked elevation on each side; the sides with a small tubercle rather in front of the middle. Scutellum a curvilinear triangle, transverse. Elytra moderately elongate, not very convex, perpendicularly deflexed at the sides, scarcely declivous at the apex; at the base much broader than the thorax, gently narrowed a little distance below the shoulders, and thence to near the apex nearly parallel in the female, slightly narrowed in the male; the apex broad and obtuse, but scarcely truncate, ciliate. At the base of each elytron (a little nearer the scutellum than the shoulder) is a well-marked longitudinal elevation. Intermediate tibiæ not sulcate; posterior tibiæ as long as the tarsi. Claws divergent. Prosternal process with a well-marked obtuse tubercle. Mesosternal process nearly perpendicular in front.

The species upon which I propose to establish this genus calls to mind the group of *Xylorhiza*; but all its general characters are those of *Niphona*, from which it differs much in appearance, in the elevation on each side of the disk of the thorax, the crest at the base of each elytron, the tubercle on the prosternal process, and the rather longer posterior tibiæ, &c.

Dioristus albolateralis, n. sp.

Elongatus, subparallelus, fuscus, dense brevissime ochreo-fusco pilosus; capite, thorace elytrorumque basi rugosis; elytris parce punctatis, guttis plurimis in fasciis tribus ordinatis plagaque laterali niveis.
Long. 11–15 lin.

Clothed with dense light-brown pubescence, with a slight ochreous shade in some lights. The colour is uniform above, speckled with brown below. The head is very deeply punctured, and the surface is uneven. The antennæ are brown, with the base of each of the joints (and nearly the whole of the underside) grey. The thorax is subquadrate (a little shorter than broad), subparallel, with a slight projection behind each anterior angle, and with a small lateral tubercle; very coarsely and rather closely punctured; the disk flattened, with a rugose elevation on each side, and a very small elevation a little behind the middle. The base of the elytra is rather coarsely asperate-punctate; the rest of the surface is even, with darker punctures here and there. There are numerous pure white marks, which range themselves in three interrupted arcuate bands; and the greater part of the sides is taken up with an elongate white patch.

VIII.—*On the correct Generic and Specific Name of the Indian Shámá.* By R. Bowdler Sharpe, F.L.S., F.Z.S., &c., Department of Zoology, British Museum.

If we consult the writings of Indian ornithologists at the present day, we find this bird always spoken of as *Cercotrichas macrura* (Gm.). A few years ago it was called by Jerdon and other writers *Kittocincla* or *Cittocincla macrura*, while *Cercotrichas* was employed for the generic name of the Red-winged Chat-Thrush of Africa (*C. erythroptera*).

The genus *Cercotrichas* was proposed by Boie in the 'Isis' for 1831 (p. 542); and the following species were included in it:—

Turdus phœnicopterus, Temm.
—— *erythropterus*.
—— *macrurus*, Lath.
—— *tricolor*, Vieill.
Saxicola leucocampter, Mus. Berol.

Of these birds *Turdus tricolor* and *T. macrurus* are both Shámás, and have been spoken of as one and the same species. *Turdus phœnicopterus* is not a Thrush, but a Cuckoo-Shrike, *Campophaga phœnicea* (Lath.). It appears never to have been made the type of any absolute genus. *Turdus macrurus*, Lath., was taken by Gould (P. Z. S. 1836, p. 7) as the type of his genus *Kittacincla*; and *T. tricolor*, V., has always been considered to be a synonym.

What *Saxicola leucocampter* of the Berlin Museum is I have not yet been able to find out.

It appears to me to be certain that, Gould having taken *Turdus macrurus* out of Boie's composite genus *Cercotrichas*, and having made it in due form the type of his genus *Kittacincla*, it is quite wrong to employ *Cercotrichas* for the Shámá.

With varying fortunes the generic name of *Cercotrichas* was employed until 1870, when its fate appears to me to have been definitely settled by Drs. Finsch and Hartlaub, who made Gmelin's *Turdus erythropterus* the type of their genus *Cercotrichas*, of which they gave full characters, founding, indeed, the genus *de novo*, and adopting Boie's name; so that the synonymy of the genus would stand

Cercotrichas, F. & H.

Cercotrichas, pt., Boie, Isis, 1831, p. 542 (typo haud indicato).
Cercotrichas, Finsch & Hartl. Vög. Ost-Afr. p. 249 (1870). Type *C. erythropterus* (Gm.).

Saxicola leucocampter is probably *Thamnolæa albiscapulata* or *Th. cinnamomeiventris*, in which case it would be absorbed in 1850 into Cabanis's genus *Thamnolæa*, while no one since Boie's time has associated *Turdus phœnicopterus*, Temm., with the Chat-Thrushes.

The synonymy of the genus *Cittocincla* will be as follows:—

Cittocincla, Gould.

Cercotrichas, pt., Boie, Isis, 1831, p. 542 (typo haud indicato).
Kittacincla, Gould, P. Z. S. 1836, p. 7. Type *C. tricolor*.
Cittocincla, Sclater, Ibis, 1866, p. 109 (nom. emend.).

I do not think that the name *macrura* can be upheld for the Indian species of this genus. There are two closely allied birds, one of which is found in Southern and Central India and Ceylon, the sub-Himalayan region eastwards from the Ganges, ranging through the Burmese countries to Siam, Cochin China, and Hainan, and down the Malayan peninsula to Java. In Sumatra the Shámá differs in having much less black at the base of the outer tail-feather, while in Borneo there is usually no black at all at the base of these feathers, the outer tail-feather being entirely white. In some examples, however, there is a little black at the base of this outer tail-feather; and hence I can only look upon the Bornean bird as a race of the Indian one. It has been named *C. suavis* by Dr. Sclater.

Now the name *Turdus macrurus* of Gmelin (S. N. i. p. 820) is founded on the "Long-tailed Thrush" of Latham (Gen. Syn. ii. part i. p. 72, pl. xxxix.), which is said to have come from the Island of Pulo-Condore, off the coast of Siam. The species from this island will doubtless prove to be the same as the Siamese and Burmese birds; but, as figured and described by Latham, it agrees with *C. suavis* of Borneo. If, therefore, it turns out to be specifically identical with the latter, the name of *macrura* must take precedence of Dr. Sclater's name *suavis*. At all events, in the face of the uncertainty that exists it seems better to speak of the ordinary Indian bird as *Cittocincla tricolor* (Vieill.), founded on Levaillant's plate cxviii. in the 'Oiseaux d'Afrique,' where a very fair figure of the species is given; and considering that there is a bird in existence which has a white outer tail-feather, as figured by Latham, his "Long-tailed Thrush" ought not to be referred, in any case, to the common Shámá of India and Burmah.

IX.—*Notes on the* Trochamminæ *of the Lower Malm of the Canton Aargau* (*Switzerland*). By Dr. Rudolf Haeusler, F.G.S. &c.

[Plates III. & IV.]

The zone of *Ammonites transversarius* (=Birmenstorfer Schichten=Etage Argovien I.) is represented in the Jura of the Canton Aargau by alternating layers of greyish more or less compact limestones and softer marls of the same colour, which overlie the ferruginous marls of the Upper Dogger (Callovian), and are covered by the clayey marls of the Middle Argovian étage (zone of *Terebratula impressa*). Their lithological character is nearly the same throughout the canton; but their fauna and flora change considerably towards the upper limit; and though it is quite impossible to subdivide this complex of strata into distinct subzones, yet, chiefly for microscopical researches, it is convenient to adopt three different horizons, which in the course of this paper I shall call A, B, C.

A comprises the oldest sediments of the zone, covering the *Ornatus*-beds of the Callovian, with predominant limestones and a richly developed fauna of Cephalopoda.

B, the beds with lithologically analogous character, and numerous Brachiopoda and Crinoidea.

C comprises the youngest marly beds with Nulliporites and few animal remains.

According to these artificial subdivisions the microscopical fauna is different: the arenaceous Foraminifera, chiefly the *Trochamminæ*, reach their maximum development in the lowest beds A, where they are associated with *Lituola* (*Haplophragmium*, *Haplostiche*, *Placopsilina*), *Endothyra*, *Plecanium*, and other arenaceous and hyaline species (*Nodosaria*, *Dentalina*, *Cristellaria*, &c.). In many cases the unfavourable condition of the minute shells, caused through pseudomorphoses, incrustration with iron-pyrites, or atmospheric influences, makes the determination of the species impossible.

The Foraminifera mentioned in this paper were obtained from materials collected during a twelve-years' stay in the Canton Aargau, from all the different localities where the zone is exposed, but principally from the following:—Staffelegg (near Aarau), Densbüren, Auenstein, Kreisacker, Büren, Hottwyl, Hornussen, Bözen, Mandach, Villigen, Birmenstorf, Schambelen, &c.

The oldest known arenaceous Foraminifera of the Swiss Jurassic formation are some rare placopsiline *Lituolæ* attached to the shells of *Gryphæa*, *Pecten*, and *Ammonites* of the Lower Sinemurian beds, where they occur with numerous varieties of *Nodosaria*, *Dentalina*, *Marginulina*, *Cristellaria*, &c.

Trochammina appears for the first time in the Bajocian, and ranges from here through the whole Upper Dogger, but only in two species (*T. incerta* and *T. filum*). With the Lower Malm the arenaceous and some other Foraminifera become more abundant, so that these beds have yielded up to the present time almost as many species and varieties as the rest of the Swiss Jurassic formation together.

In these sediments all the principal types of the genus *Trochammina* are well represented; most of them disappear suddenly towards the Middle Sequanian beds. Some of them are only known from the beds A of the *transversarius*-zone; *T. incerta* and *T. gordialis* are occasionally met with in the beds C and the zone of *Terebratula impressa*. The Upper Argovian limestones, with a more littoral fauna of numerous *Myæ* (*Pholadomya*, *Goniomya*, &c.), contain several of the *Trochamminæ* of the Lower Argovian (*T. incerta*, *T. gordialis*, *T. filum, T. jurassica*), which mount into the beds of the Lower Sequanian (zone of *Am. bimammatus* and *Hemicidaris crenularis*), where chiefly one small layer with numerous spines of *Rhabdocidaris caprimontana* is noticeable for the small but well-preserved microscopic shells.

It is very probable that these compact limestone sediments, formed under somewhat similar conditions as those of the lower Birmenstorf Schichten (chiefly the beds crowded with Hexactinellid sponges), may contain all the species of the latter, which, owing to the difficulty of collecting them, have not yet been found. The higher beds of the Malm have not yet been carefully examined; but from the few microscopic specimens from the Middle and Upper Sequanian and the Kimmeridge group, it seems that *T. incerta* and *T. gordialis* are the only representatives of the genus. These were also found in the Sequanian of Olten, Solothurn, and Ste. Ursanne, and in the Kimmeridge beds of the neighbourhood of Pruntrut.

The few pieces of Alpine Upper Jurassic rocks which I examined, and which offer the least favourable condition for microscopical researches, did not yield any traces of Foraminifera.

Trochammina incerta, O.

This species is, as a rule, not common in the Swiss Jurassic formation; but it is the most remarkable from its wide geographical and geological distribution. It is present in every étage from the Bajocian up to the Kimmeridgian. It always presents very much the same appearance and the same typical varieties, not considering alterations of the shell through atmospheric action; while probably all the other species of *Trochammina* differ considerably when found in beds with entirely different constituents and organic remains.

According to the composition of the shell and the mode of growth, this species can be divided into two distinct varieties.

In the one, which, for convenience, we may call *Tr. incerta* reg., the test is thin, more or less transparent, built up of a generally siliceous cement and a minimum quantity of foreign sandy matter.

In the second (*T. incerta* irreg.) the test is thicker, not transparent, and built up of numerous small particles of quartz-sand imbedded in a whitish or ferruginous cement.

T. incerta reg. comprises almost invariably the more regularly convoluted larger specimens, with from six to eight convolutions lying in one plane, similar to *Spirillina arenacea*, Will.*; *T. incerta* irreg. the smaller irregular forms with few

* Williamson, Rec. Foram. Brit. p. 93, pl. vii. fig. 203.

convolutions (four or five) passing into the conical and *Quinqueloculina*-like species and *T. filum.*

Both varieties run into each other through numerous intermediate forms with regard to the mode of growth and the composition of the shell. The division is therefore entirely artificial, but so far quite justifiable as it prevents us from uniting the most heterogeneous forms under one name, and from making thus a clear description quite impossible.

T. incerta irreg. may be divided into several subvarieties, as the forms resembling *T. incerta* reg., or those differing from *T. gordialis* merely by the discoidal obvolution of the tube, corresponding to *Cornuspira variabilis*, K. & Z., or as those identical with *C. crassa*, K. & Z. It is, however, impossible to draw lines of separation—the more so as hardly two specimens are alike, the great number of these one-chambered *Trochamminæ* forming an unbroken chain of nearly-related individuals, passing from *T. incerta* typ. into the conical and even polythalamous species. As a rule, it may be said that the more the shell differs in its external appearance from the typical *T. incerta* reg. of this zone, the greater becomes the mass of sandy constituents compared with that of the siliceous or calcareous cement. Most of the specimens of this species answer the description of *Orbis*, *Involutina*, and *Ammodiscus* given by Strickland, Terquem, Reuss, and Bornemann; but many of the conical specimens consisting of a similarly built-up test, and the compact limestones of the Upper Argovian étage containing undoubtedly shells with calcareous cement, all these and some similar forms known as *Spirillinæ*, *Operculinæ*, *Cornuspiræ*, must be united to the genus *Trochammina*, as, indeed, was done long ago by English geologists.

A. *Trochammina incerta* reg.* (Pl. III. figs. 1–4.)

Test free, regularly convoluted or partly involuted, discoidal, formed of a simple non-constricted imperforate tube, regularly increasing in width.

Convolutions six to eight in one plane, sometimes embracing; aperture large, at the non-constricted end of the tube; test thin, transparent, built up of almost hyaline siliceous shell-matter and a few very minute grains of sand. Surface smooth, sometimes brilliant, and with small more or less regularly distributed depressions, which, when examined with a low power, take the appearance of perforations, and give the shell a resemblance to *Spirillina*.

* The descriptions given only refer to the Foraminifera of the *transversarius*-zone of the Aargau, if not stated otherwise.

The rounded impressions on the outer surface, which are only present in the almost homogeneous glass-like specimens, are not visible in transmitted light when the object is mounted in balsam. On the contrary, the sandy grains (which when the shells are viewed as opaque seem to be absent) become thus plainly visible with the aid of a high power and the polariscope.

In none of the sections from the Upper Argovian limestones of the Geissberg, where the cement is calcareous, are any traces of this peculiar condition of the surface visible.

When found in material much changed through the action of atmospheric agencies, it becomes difficult to distinguish the shells from *Spirillina* without the use of a high power.

The condition of the siliceous tests differs widely from those changed by pseudomorphoses; so that it is evident that they represent their natural state. It can easily be accounted for by the great amount of silica, as may be judged from the immense accumulations of siliceous sponges in the same beds, whilst these are absent in the beds with calcareous *Trochamminæ*, although siliceous tubes are also met with in strata with hardly any siliceous substances, except grains of quartz-sand and argillaceous compounds, as some Liassic *Involutinæ* and the *Trochamminæ* of the Bathonian limestones of the Frickthal.

As typical specimens of this variety may be considered those resembling in the mode of growth the regularly convoluted recent variety, described as *Spirillina arenacea*, Will., but with a test resembling somewhat in its microscopical structure *Involutina silicea*, Terq.* A similar form was described by Gümbel† from the same zone at Streitberg as *Spirillina tenuissima*, and from the Eickberg by Kübler and Zwingli‡ (also from the Bathonian and Argovian II.). Similar regularly convoluted discoidal forms are known from many other formations; but the composition of the test is generally somewhat different, as in *Cornuspira Hœrnesi*, Karrer §, from the Vienna basin, in *Serpula Rœssleri* Schmid ||, from the German Zechstein, and in *T. incerta* from the English Permian rocks ¶.

* Terquem, Second Mém. For. Lias, p. 450, pl. vi. fig. 11.

† Gümbel, Die Streitberger Schwammlager &c. p. 214, pl. iv. fig. 12.

‡ Kübler & Zwingli, Die Foraminiferen des Schweizer Jura, p. 19, pl. iii. fig. 2.

§ Karrer, "Ueber das Auftreten &c." (Sitzungsb. k. Akad. Wiss. Wien, vol. lii. p. 495, pl. i. fig. 10).

|| Schmid, Neues Jahrb. Min. 1867, p. 582, pl. vi. figs. 46, 47.

¶ Jones, Parker, & Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 388, pl. xiii. fig. 1.

The same regular form is figured in Carpenter's Introd. Foram. (pl. x. fig. 2). Although the Carboniferous specimens are generally less regular, Brady* mentions a discoidal variety, the test of which, however, is much more sandy and calcareous than in those from the Lower Malm.

The usual diameter of the Argovian specimens is 0·35 millim.

Kübler and Zwingli† describe a constant elliptical variety (*Cornuspira elliptica*) from the Lower Bathonian, and a similar compressed variety‡ from the Lower Argovian (*C. concava*), and Karrer a corresponding form from the Vienna basin§.

In the beds A of the Frickthal I found several specimens with a somewhat similar mode of growth; but the first part of the shell is discoidal, as in the normally developed variety; the elliptical arrangement begins only with the third or fourth convolution. The microscopical structure is the same as in the typical *T. incerta* reg., as well as the total length and diameter of the tube (Pl. III. figs. 6, 7). In one specimen, length = 0·42 millim., diameter of tube (last convolution) = 0·04 millim., number of convolutions 6–7.

In another specimen the oldest part of the shell is elliptical and becomes gradually discoidal.

These deformed shells pass possibly into *T. pusilla.* Often the youngest part of the last convolution becomes embracing and leaves the plane, as in Pl. III. figs. 4, 5.

Distribution. In the beds A, B, and C of the Aargau, but also of the Cantons Schaffhausen and Solothurn, and the upper zones of the Malm (Argovian II. and III., Sequanian I., &c.). Not common.

B. *Trochammina incerta* irreg.

Test free, irregularly convoluted, composed of a non-septate cylindrical tube of almost invariable diameter. Convolutions few, in one plane; aperture small circular, or large crescentic.

Test finely arenaceous, built up of numerous minute grains of quartz-sand, imbedded in a whitish or sometimes ferruginous cement.

This variety comprises a great number of forms, passing from *T. incerta* reg. *to T. gordialis* and *T. filum.* From the first they differ chiefly in their thick, more arenaceous, opaque or but slightly transparent test, and the small number of

* Brady, Monogr. Carb. & Perm. Foram. p 71, pl. ii. fig. 13.
† Kübler & Zwingli, *l. c.* p. 17, pl. ii. fig. 3.
‡ *Loc. cit.* p. 24, pl. iii. fig. 3.
§ Karrer, *l. c.* p. 494, pl. i. fig. 10.

irregularly arranged convolutions, and in being almost invariably filled up with a black ferruginous compound, which is often found also in *T. gordialis* (Pl. III. fig. 18), while the shells of *T. incerta* reg., in spite of the wider aperture, are, as a rule, empty. The presence of this substance seems to be characteristic, as specimens from the Randen (Canton Schaffhausen), and even from older formations, contain it. It is perhaps due to a different chemical composition of the sarcode.

In a few instances the convolutions are partly embracing; but in others they hardly touch each other. According to the different mode of growth, the aperture is rounded, sometimes margined or crescentic. Forms resembling those figured pl. ii. figs. 10–14 in Brady's monograph of Carboniferous and Permian Foraminifera may be considered typical.

Distribution. In the lower and middle beds of the *transversarius*-zone with *T. incerta* reg., but also in the upper strata of the Argovian and in the Sequanian.

Trochammina gordialis, J. & P.*
(Pls. III. & IV. figs. 8–20.)

This species comprises a large number of different forms, consisting of a free, irregularly convoluted test, forming in its earlier stage a regular elevated conical spiral, to which the younger part, chiefly the last convolution, is attached in various manners. Width of the tube almost invariable; convolutions few, occasionally partly embracing; aperture large, sometimes margined, in other cases small, at the constricted end of the chamber.

Shell composed of numerous minute grains of sand imbedded in a colourless or brownish cement.

Specimens with septate tubes, as described by Jones and Parker, from the Indian and Arctic seas, appear to be wanting in the Upper Jurassic formation. As a rule this variety differs little from the *T. gordialis* of other formations; for instance, the *T. proteus*, Karrer†, fig. 3, from the Vienna basin, or those from the Permian‡.

Kübler and Zwingli§ describe as *Cornuspira variabilis* specimens from the Argovian II. (zone of *Terebratula impressa*),

* Jones & Parker, Quart. Journ. Geol. Soc. vol. xvi. p. 304; Carpenter, Introd. Foram. p. 141, pl. xi. fig. 4.

† Karrer, "Ueber das Auftreten &c.," Sitzungsber. k. Akad. Wien, vol. lii. p. 494, fig. 4.

‡ Jones, Parker, & Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 390, pl. xiii.

§ Kübler & Zwingli, *l. c.* p. 33, pl. iv. fig. 4.

which may be considered passage forms from *T. incerta* to the typical *T. gordialis* *.

Analogous specimens to those figured by Brady † are occasionally met with.

Similar specimens to *Trochammina proteus* (fig. 8) ‡, with a regularly divided tube, which, according to Jones, Parker, and Kirkby §, are varieties of *T. gordialis*, occur also in the lower beds A of the Aargau.

Distribution. Almost everywhere with *T. incerta*, but chiefly in the beds A and B of Büren, Mönthal, Bözen (where, in the lowest banks cut by the road to the station, they are more common than anywhere else), and Hottwyl; also in the limestones of the Upper Argovian of the Kammerfels (Geissberg) and Remigen, and of the Sequanian I. of Lanffohr and Auenstein. Several specimens I obtained also from the same zones of the neighbourhood of Olten and Solothurn, &c.

Trochammina charoides, J. & P. (Pl. IV. fig. 21.)

The few microscopic shells belonging to this species agree fully with the descriptions given by Parker and Jones ||, Kirkby, Carpenter, Brady, Karrer, &c. ¶, although typical specimens are very rare. They are, as a rule, very small, never exceeding 0·3 millim., composed of a simple tube of invariable diameter coiled up in a conical spiral. Test finely arenaceous, resembling *T. incerta* irreg. and *T. gordialis*, from which they differ but very little.

Distribution. In the lowest beds A of Büren; very rare.

Trochammina pusilla, Gein.** (Pl. IV. figs. 27–30.)

In the beds A of the Frickthal I found several *Trochamminæ* which show, perhaps, the greatest resemblance to *T. pusilla*.

Shell free, irregularly convoluted, formed of a non-septate

* Jones on Swiss Jurassic Foraminifera, Geol. Mag. vol. x. no. 5, p. 211.

† Brady, *l. c.* p. 77, pl. iii. figs. 1–3.

‡ Karrer, *l. c.* p. 494, pl. i. fig. 8.

§ "Nomenclature of Foraminifera," Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 388.

|| Jones & Parker, Quart. Journ. Geol. Soc. vol. xvi. p. 304.

¶ Carpenter, Introd. Foram. p. 141, pl. xi. fig. 3; Karrer, Sitzungsber. Akad. Wiss. Wien, vol. lii. p. 494, pl. i. fig. 4; Parker, Jones, & Brady, Monogr. Foram. Crag, p. 26; Jones, Parker, & Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 390; Brady, Monog. Carb. Perm. Foram. p. 77.

** Geinitz, Verst. deutsch. Zechstein, p. 6, pl. iii. figs. 3–6; Dyas, p. 39, pl. x. figs. 15–21.

cylindrical tube, convoluted nearly in one plane. Convolutions few, partly embracing. Aperture large, sometimes margined, at the non-constricted end of the tube.

Test finely arenaceous, the minute particles of sand imbedded in a colourless or ferruginous cement, which generally hides the older part of the shell or forms a narrow fringe. Diam. 0·2–0·5 millim.

The Swiss specimens approach the nearest to the subdiscoidal variety from the English Permian *, and resemble in the mode of growth of the last convolutions *T. incerta* (figs. 6 and 7).

A specimen with a fringe of shell-matter is also figured from the Carboniferous strata †.

Most of the specimens from the *transversarius*-beds may be considered transitional forms between *T. incerta* and *T. pusilla* typ.‡

Distribution. In the lower beds A overlying the Callovian marls at Bözen and Büren. Very rare.

Trochammina filum, Schmid.§ (Pl. III. fig. 22.)

In the *varians*-beds of the Bathonian stage, and chiefly in the Lower and Upper Argovian group, there occur simple arenaceous tubes, sometimes partly coiled up, of a somewhat doubtful nature, but which may possibly be assigned to *T. filum*. They consist of a cylindrical, thin, irregularly bent, partly convoluted, often slightly constricted tube, with a large rounded aperture, differing but little from similarly-formed siliceous tubes of different origin, with which they are associated in the sponge-beds of the lower *transversarius*-zone.

Distribution. In the beds A of the Frickthal, the Upper Argovian rocks of the Geissberg, and the Upper Bathonian beds of Birmenstorf. Rare.

Trochammina constricta, sp. nov. (Pl. IV. figs. 23–26.)

Test free, oblong, formed of a thin, regularly septate, and constricted tube of nearly uniform width. Convolutions few, sometimes slightly embracing, coiled up nearly in one plane. Aperture small, circular or crescentic, at the constricted end of the last chamber.

Shell-structure finely arenaceous, the numerous minute

* Jones, Parker, and Kirkby, Ann. & Mag. Nat. Hist. ser. 4, vol. iv. p. 386, pl. xiii. figs. 2–6.

† Brady, Monogr. Carb. Perm. Foram. pl. iii. fig. 4.

‡ Brady, *loc. cit.* p. 79.

§ Schmid, Neues Jahrb. Min. 1867, p. 582, tab. vi. fig. 48; Jones, Parker, & Kirkby, *loc. cit.* p. 389; Brady, *loc. cit.* p. 81.

grains of sand imbedded in a whitish or ferruginous subtransparent cement.

In the structure of the delicate shell this variety resembles *T. incerta* irreg., sometimes even *T. incerta* reg. The last chamber is sometimes straight.

As this variety is the most constant of all *Trochamminæ* of the zone, and so far found only in the lower *transversarius*-Schichten, it is a characteristic fossil for this division of the Upper Jurassic formation.

Distribution. In the Cephalopod-beds of Büren, Hottwyl, Bözen. Rare.

Trochammina jurassica, sp. nov. (Pl. IV. figs. 31–40.)

Test free, thin, composed of a regularly-constricted tube, with Agathistegian mode of growth. Convolutions few, embracing; sutural lines hardly visible. Aperture small, at the often projected end of the tube.

Test delicate, built up of coarse particles of sand and minute spicules of siliceous sponges imbedded in a constantly ferruginous dark brown cement.

Diameter variable. Length 0·4 millim., breadth 0·25 millim.

Through the coarsely arenaceous texture and the dark rusty cement this species forms an exception from all Jurassic *Trochamminæ*. In its general outlines it is very variable, sometimes compressed, the convolutions lying nearly in one plane, sometimes almost triangular. The last chamber is often straight, and bears the simple rounded aperture.

Its nearest relations are undoubtedly the *Miliola*-like *T. milioloides*, J., P. & Kirkby *, and *T. Robertsoni*, Br. †

In the relative position of the last convolutions the variable shells of *T. jurassica* imitate some *Quinqueloculinæ*, as *Miliola seminulum*, L., *Q. Chemnitziana*, O., *Q. Buchiana*, O.

True *Miliolæ* are very rare in the beds in which *T. jurassica* is most abundant, except an elongated variety of *Spiroloculina* which occurs in many other horizons, chiefly in the hard limestones with *Rhynchonella varians* of the Bathonian series. It is possibly the same form which Kübler and Zwingli described as *Ophthalmidium birmenstorfense* from the same beds. Near Mönthal I collected casts and fragments of another species of *Spiroloculina* in the same beds with *T. jurassica*.

Rotaline *Trochamminæ* with helicoid septate shells are

* Jones, Parker, & Kirkby, *loc. cit.* p. 390, pl. xiii. figs. 9–14; Brady, *loc. cit.* p. 79, pl. iii. figs. 11–15.

† Brady, *loc. cit.* p. 80, pl. iii. figs. 6, 7.

generally found with the ammodiscoidal forms, but, unfortunately, only in fragments not sufficient to determine the species. Some shells described as *Rotalia* and *Endothyra* may be associated with the polythalamous *Trochamminæ*. The tests are very variable in general shape, forming more or less elevated conical spirals, composed of numerous regularly-increasing chambers, finely arenaceous, the small particles of quartz or calcareous materials imbedded in a pure white, sometimes siliceous and transparent, but generally calcareous ochreous cement. These fossils belong probably to some already described species (*T. inflata*, *T. squamata*, *T. coronata*, *T. vesiculata*, *T. Reussi*). From the Bathonian rocks, where they appear for the first time in greater number, they range through the Upper Dogger and the Lower and Middle Malm.

Figs. 41 and 42 (Pl. III.) represent an interesting variety uniting the typical *T. constricta* with the regularly convoluted conical types and the polythalamous discoidal *Trochamminæ*, like a form figured by Karrer from the Vienna basin *.

Comparing the rhizopodal fauna of the Argovian Lower Malm with that of other countries, it surprises one to see that several of the most common Foraminifera of the Aargau have as yet not been discovered anywhere else, while *T. incerta* seems to be present everywhere.

The only species with almost equally wide distribution is a *Textilaria* or *Plecanium*, first described by Gümbel from the Streitberg sponge-beds as *Textilaria jurassica*, varieties of which (known as *T. franconica*, Güm., *T. Triggeri*, Schw., *T. flexa*, K. & Z., *T. helveto-jurassica*, K. & Z., *T. scyphiphila*, Uhl., *T. argoviensis*, Haeus., &c.) are met with in almost every zone of the Malm. The broader varieties unite the lanceolate *T. jurassica* with some from the Cretaceous formation.

Before concluding, a few remarks on the different families of Jurassic Foraminifera may be of interest.

As stated before, the rhizopodal fauna of the Swiss *transversarius*-beds is very rich in species and varieties compared with older zones of Liassic or Middle Jurassic age. Many of the widely-distributed types of *Lagena*, *Nodosaria*, *Dentalina*, and *Cristellaria* can be traced throughout the whole Jurassic series, beginning with the lowest Sinemurian limestones of the valley of the Reuss; while the oldest Liassic beds, the celebrated insect-marls of the Hettangian étage, were extremely poor, and yielded only a few fragments of Cristellarians and spiroloculine *Miliolæ*.

* *Loc. cit.* pl. i. fig. 8.

With the exception of small serpuloid bodies attached to a valve of *Lima* from the Muschelkalk of the Rhine valley, which are possibly remains of *Webbinæ*, no traces of Foraminifera have been detected in the Trias of the Canton Aargau. In the Sinemurian limestones with *Amm. Bucklandi* and *Gryphæa arcuata*, numerous genera (*Lagena, Nodosaria, Dentalina, Vaginulina, Marginulina, Cristellaria, Frondicularia*) are represented by many, *Cornuspira, Textilaria, Placopsilina*, and a small *Trochammina* or *Endothyra* by one very rare species.

Throughout the whole Lias this fauna remains almost unchanged, except that *Textilaria* and *Cornuspira* disappear towards the upper strata.

With the Dogger, *Trochammina, Valvulina, Endothyra, Plecanium*, and *Spirillina* appear. *Miliola* reaches its greatest development in the Jurassic formation, and several other genera, as *Lituola, Textilaria*, and some types of *Nodosaria*, become more abundant than in the Lias.

At the end of the Callovian period a great change in the general lithological and palæontological character of the sediments takes place, which is particularly remarkable from the sudden appearance of a rich fauna of siliceous sponges.

Here the Foraminifera with sandy or partly sandy shells form the greater part of the microscopic fauna. Only a few of the Liassic types of *Lagena, Nodosaria, Dentalina*, &c. are still traceable. The Textilarians are the most conspicuous through the great number of closely-allied varieties of the *Sagittula* group. Towards the younger zones several genera (*Frondicularia, Globigerina*, &c.) disappear, and others (*Nodosaria, Dentalina, Vaginulina, Marginulina*) become gradually scarcer; but the imperfect knowledge of the upper Sequanian and the Kimmeridgian sediments does not allow of giving a satisfactory list of the Upper Jurassic Rhizopods.

It is interesting to observe several widely distinct macroscopical faunas in the Malm, differently developed according to considerable changes in the nature of the sea-bottom; whilst the Foraminifera seem to have adapted themselves much more easily to the new conditions of life, thus giving birth to many interesting varieties, which, without numerous intermediate forms, it would be absolutely impossible to recognize as mere descendants of the typically-formed species of the Lower Malm.

The greatest impediment to Swiss geologists arises from the want of many of the most important works on Foraminifera, which makes a careful study of the many important microscopical species almost impossible, and which accounts for the great faults occurring in the few papers on this part of Swiss palæontology.

The results of long researches on the Foraminifera of the Lower Malm shall be published in a short time. For the present I hope that these few remarks on the Jurassic *Trochamminæ* may be sufficient to furnish further proofs of the wide range and great variability of this interesting genus.

EXPLANATION OF PLATES III. & IV.

Figs. 1–3. *Trochammina incerta* reg.
Figs. 4, 5. *T. incerta* reg., passing into *T. incerta* irreg.
Figs. 6, 7. *T. incerta*, elliptical variety, showing the discoidal arrangement of the older convolutions.
Figs. 8–20. *T. gordialis.*
Fig. 10 *a–d.* Apertures of same.
Fig. 21. *T. charoides.*
Figs. 22, 22 *a*, *b*. *T. filum.*
Figs. 23, 24. *T. constricta.*
Fig. 25. Aperture of same.
Fig. 26. *T. constricta*, coiled up in the opposite manner, showing the last straight chamber with the small circular aperture.
Fig. 27. *T. pusilla.*
Figs. 28, 29. The same, the interior convolution hidden by finely arenaceous shell-matter.
Fig. 30. Ditto, aperture.
Fig. 30 *a*. Ditto, showing the fringe of hyaline cement.
Figs. 31–34. *T. jurassica.*
Figs. 35, 36. Ditto, with different development of the last chamber.
Figs. 37–39. Ditto.
Fig. 40. Ditto: portion of shell, with grains of sand and spicules. *a*= crystal of pyrites.
Figs. 41, 42. *Trochammina*, intermediate form between *T. constricta* and the rotaline varieties.

BIBLIOGRAPHICAL NOTICES.

A Monograph of the British Fossil Cephalopoda. Part I. *Introduction and Silurian Species.* By J. F. Blake, M.A., F.G.S., Professor of Natural Science in University College, Nottingham. 4to. London: J. Van Voorst, 1882.

This work, uniform in size and style with the Memoirs of the Palæontographical Society, will comprise a complete history of the British Palæozoic Cephalopoda, a group of Mollusca important to the geologist, which, from their distribution and varied forms, constitute a characteristic portion of the early fauna of the globe. By grants from the Government fund in aid of scientific research, the author has been able to collect materials from various museums and private collections, and thus examine about 2000 well-characterized specimens during the progress of the work. The first part, now issued, consisting of 248 quarto pages of text and 31 plates, treats only of the Silurian species.

Commencing with the general position of the Cephalopoda in the animal kingdom, Prof. Blake treats of the chief points in which, as a class, they differ from the rest of the Glossophora, as the rudimentary condition of the foot, the partial segmentation of the ovum, and the inflexion of the intestine towards the ventral side of the body, in which latter character they agree with the Pteropoda. Although the two orders into which the Cephalopoda are divided, the Dibranchiata and Tetrabranchiata, are numerically very unequal in a living state, yet when the fossil forms are included the proportion is reversed, the greater number of the latter belonging to the second order.

As the whole of the Silurian Cephalopods, and nearly all the rest of the Palæozoic ones, are considered to be tetrabranchiate, their description is prefaced by a detailed account of the anatomy of the *Nautilus* (pp. 5–17), followed by a description (under nine heads) of the structure of the shell and the organs immediately related to it, as essentially connected with the better interpretation of the fossil forms (pp. 17–41). Of these, the septa and siphuncle are fully considered. The size and position of the siphuncle are very variable, and constitute important characters in the definition of many of the Palæozoic types, it being either simple or complex, and either ventral, median, or dorsal in position. Although there are families with non-central siphuncles, still that position is the preponderant one; for Barrande remarks that out of 1500 known forms 500 have central and 418 subcentral siphuncles.

With regard to the classification of the Cephalopoda, after discussing the views of other authors, and the position of *Bellerophon* and *Clymenia*, with which latter genus and *Goniatites* Barrande formed a third group, Prof. Blake divides the Tetrabranchiata into two suborders, Ammonitoidea and Nautiloidea.

As the former suborder is doubtfully represented in the British Silurian rocks, he proceeds to discuss the grouping of the genera of the Nautiloids, which, according to him, has not hitherto been satisfactorily accomplished. "The object is not to make a mere analytical table, without reference to the history of the group, but to show the connexion between the relations in structure and the relations in time."

The earliest and most important group is that of the Orthocerata of extreme simplicity:—(1) with a straight shell, including *Orthoceras*, *Gonioceras*, *Tretoceras*, *Endoceras*, *Actinoceras*, *Bathmoceras*, *Bactrites*; (2) with a curved shell, *Cyrtoceras* and the subgenera *Trigonoceras* and *Piloceras*. These form a natural group, and are characterized as the "Conici." The second group, more restricted in time, with slight or no curvature, more or less inflated or irregular in form, and with variously shaped apertures, is constituted by the "Inflati," and contains *Phragmoceras*, *Gomphoceras*, *Poterioceras*, and *Ascoceras*. Thirdly we have the "Spirales," of simple form, but with great curvature, and the whorls generally in contact, except *Gyroceras*, containing *Nautilus*, *Trocholites*, *Clymenia*, &c. The members of the fourth group, having less symmetry and a more variable curvature, are associated together as the "Irregulares," including *Trochoceras*, *Lituites*, *Ophidioceras*.

Suborder Nautililoidea (having a variable siphuncle).

Group I. *Conici.*—Curvature slight or none; form conical and regular	Shell straight.	*Orthoceras.* *Endoceras.* *Actinoceras.* *Tretoceras.* *Gonioceras.* *Conoceras.*
	Shell curved.	*Cyrtoceras.* *Piloceras.* *Trigonoceras.*
Group II. *Inflati.*—Curvature slight or none; form inflated, and irregular		*Poterioceras.* *Gomphoceras.* *Phragmoceras.* *Ascoceras.*
Group III. *Spirales.*—Curvature considerable, form simple.		*Trocholites.* *Clymenia.* *Nautilus.* *Nothoceras.* *Gyroceras.*
Group IV. *Irregulares.*—Curvature considerable, but variable; form irregular or unsymmetrical		*Trochoceras.* *Lituites.* *Ophidioceras.* *Cryptoceras.*

The genera belonging to the above groups are successively noticed, with their synonyms, history, description, and subdivisions as adopted by other authors or as followed in this work, and, lastly, their range in time and geographical distribution (pp. 48–68). In the same systematic manner are the species of the 17 genera and subgenera described and carefully figured, so that the student of the Palæozoic Cephalopoda may readily determine any one of the 143 species (of which 55 are new or renamed) recorded in this work (pp. 79–232). Throughout the descriptions the author has adopted a somewhat novel but excellent plan in describing actually not a species but a single type specimen (except in those referred to Bohemian forms), round which the other specimens designated by the same name are grouped as closely as they can be.

Following the type is a general description of other specimens referred to the same species, and its relation to other known British or foreign forms, and a notice of its geological and geographical distribution.

Commencing with the Conici, the species of *Orthoceras*, about 70 in number, are arranged under two groups, of which 3 belong to the Brevicones and the remainder to the Longicones; the latter are again divided, according to external ornamentation, into *Annu-*

lati 20, *Angulati* 6, *Lineati* 13, *Imbricati* 7, and *Læves* 22, the external surface of the latter not being fully known; then follow the subgenera, *Actinoceras* 1, *Endoceras* 3, *Tretoceras* 1, *Conoceras* 1. *Orthoceras* has its earliest representative in the Upper Tremadoc, attained its maximum in the Upper Silurian, and is well represented in subsequent periods to the Trias. The 23 species of *Cyrtoceras* are divided, according to the position of the siphuncle, into Endogastric and Exogastric (adopted from Barrande); and Prof. Blake proposes a third division, Mediogastric (Mesogastric?), with the siphuncle near the centre.

Cyrtoceras commences in the Lower Tremadoc, and is represented in the Silurian, Devonian, and Carboniferous; the subgenus *Piloceras* is of Lower Silurian and *Trigonoceras* of Carboniferous age.

Of the Inflati, *Gomphoceras* has 11 and *Phragmoceras* 7 species, all of which are chiefly Upper Silurian; the 3 species of the singular genus *Ascoceras* from the Ludlow rocks are fully described.

The Spirales are represented by 3 species of *Nautilus* from the Upper Silurian, and 3 of the subgenus *Trocholites*, of Lower Silurian (Bala) age.

The last group, Irregulares, includes *Trochoceras*, 12 species, of which 8 are Upper and 4 Lower Silurian forms; *Lituites* has 2 species from the Lower Ludlow. *Lituites articulatus*, Sow., and a new species are placed by Mr. Blake under *Ophidioceras* of Barrande, which differs from *Lituites* in having the walls in contact; the genus is only known in the Upper Silurian of England and Bohemia.

The Silurian Cephalopoda range in time from the Tremadoc beds to the Upper Ludlow tilestones, as shown in the table, pp. 233–236. Of the 143 species the greatest number (65) occur in the Lower Ludlow, 43 in the Wenlock shale; and an equal number (39) in the Bala beds and Upper Ludlow, while the Wenlock Limestone contains 35 species. In the second (condensed) table, p. 237, showing the growth, culmination, and, in some cases, the decay of the various genera or groups, and thus giving some insight into the laws which govern the appearance and disappearance of forms of life, it will be observed that the larger number belong to the Conici group, which first appear in the Lower Silurian and contain the bulk of Lower Silurian forms; but, in relation to the maxima of species, the Bala beds of the Lower and the Wenlock shale and Lower Ludlow of the Upper Silurian contain the greatest number, while, from the fact that the species in the Wenlock Limestone are fewer than in the shales either above or below, Prof. Blake infers "that the Cephalopods of those days were not commonly frequenters of clear and shallow waters, but were partly pelagic, and not uncommonly gregarious in more or less turbid waters." The Conici and Spirales continue to flourish in later periods, the *Nautilus* of the latter being now the only living representative.

The two other more or less abnormal groups, Inflati and Irregulares, although represented in the Bala beds, attained their maximum in the Ludlow period, when the whole class was most flourishing, and then rapidly died away. From these facts Prof Blake considers that we obtain independent confirmation of laws which appear to widely govern the development of life, and may be thus stated:—"The simpler forms of a class are the first to be introduced, and the more complex appear later. It is only when the class is in its most flourishing condition, and not long before the close of a period, that it throws out the more remarkable and abnormal forms. The group which somewhat represents the mean of the whole, and never attains an extraordinary abundance, as the SPIRALES, is the longest to last." The different forms of shells in the Nautiloidea of the Palæozoic rocks and their apparent successive development from the straight to the curved form, the *reverse* of which succession takes place in the Mesozoic Ammonitidæ (viz. from the curved to the straight form), more than thirty years ago arrested the attention of Von Buch, who made some ingenious suggestions as to the causes which brought about the reversed conditions in the two groups (Ann. & Mag. Nat. Hist. ser. 2, vol. v. 1850, p. 382). After alluding to the various modifications which take place in the Ammonitidæ until their final disappearance in the Cretaceous strata with the Baculites, Von Buch remarks "that in the same manner as the Ammonitidæ vanish from the world, in the same manner exactly do the Nautilidæ make their appearance in the oldest. The Ammonite vanishes through a series of forms between it and the outstretched Baculite; the Nautilus, on the other hand, rises through a similar series of forms from the long-extended Orthoceratite."

It must not, however, be forgotten that, just as the straight *Orthoceras* continues contemporary with the successive appearance of the other forms in the Palæozoic rocks, so the curved Ammonite continues throughout with all the other modifications of the Ammonitidæ.

With regard to the geographical distribution of the British species as given in the table above referred to, 6 of the 143 species are found in America, and 32 are common to Europe; of these, 24 occur in the Lower Ludlow, and 18 in that and other strata.

Prof. Blake next considers the character of some genera and their appearance in time as at present known. *Cyrtoceras* first appears in the Lower Tremadoc, followed in the Upper by the *Orthoceras*, the less simple form preceding the straight one; but, says the author, the history of discovery shows that we can place but little trust in such an isolated fact, which is liable any day to be reversed. "Nevertheless, on any theory of evolution, this is just what we might expect; for the lower groups from which the Cephalopoda might be derived are not straight, like an *Orthoceras*, but curved, like a *Cyrtoceras*. Moreover we should expect, from the frequent curvature exhibited near the apex in the *Orthocerata*, that their ancestors were curved."

Another fact, in relation to the position of the siphuncle, is noticed, that the endogastric group antedates the exogastric in *Cyrtoceras*, as does the endogastric *Phragmoceras* that of the usually exogastric

Gomphoceras, and the subgenus *Trocholites*, with internal siphuncle, appears before *Nautilus*.

Prof. Blake continues some further general observations and carefully expressed views bearing on the origin and fixity of species and the theory of evolution, derived from the study of the Silurian forms, which afford a fair succession of the same class; and therefore, so long as the surrounding circumstances remain the same, the process of evolution by indefinite variation should either be uniform, or should cease when the best adaptation to these conditions had been acquired. He considers that the present study of Silurian Cephalopoda offers no contradiction or difficulty, but rather affords aid, if not as great as could be desired, yet as much as could be expected, to the general theory of evolution.

Hitherto the species of Silurian Cephalopoda were to be sought for in the different works of Murchison, M'Coy, Salter, and others; we have now, however, a monograph of the British forms, systematically arranged, carefully described, well illustrated, and replete with important observations on the structure, affinities, and modifications of the group, indicating throughout not only a great amount of labour, but of critical acumen and care displayed in the determination of the typical and varietal forms, thus supplying a much-wanted treatise on the early history of this group of Mollusca, and adding a valuable contribution to palæontological literature.

Catalogue of the Fossil Foraminifera in the British Museum (Natural History). By Prof. T. Rupert Jones, F.R.S., F.G.S., &c. 8vo. Pp. i–xxiv and pp. 1–100. London: Printed by order of the Trustees, 1882.

Following the work of Dr. H. Woodward on the British Fossil Crustacea, we have a similar Catalogue of the fossil Foraminifera in the British Museum, printed also by order of the Trustees.

This Catalogue having been prepared by Prof. T. R. Jones, one of our best authorities on this group of organisms, is a guarantee that it will form a useful work of reference to those interested in the Foraminifera, or assist them in consulting the specimens contained in the national collection. In the introduction a general sketch is given of the nature and mode of growth of the Foraminifera, including the differential character of the structure of their shells, upon which they are primarily divided into Imperforata or Porcellanea, and Perforata or Hyalina, and the former further subdivided into Calcarea and Arenacea, while some may have had limp, tough tests, consisting of material analogous to chitine, as *Ceratestina*. For so little is known of any real differentiation of the sarcode that there remain but few features of essential value for the classification of this infinitely variable order: "there are only the tissue, form, and structural peculiarities of the shell for determination; and these present many gradational phases, not only among individuals of any related group, but between the great groups themselves."

A classification of the Foraminifera adapted from Mr. H. B. Brady's "Notes on Reticularian Rhizopoda" is given (p. ix), and a table (p. xiv) showing their range in time, thus affording a general view of the occurrence and succession of the most important genera from the Silurian epoch to the present time.

A combined geologico-geographical arrangement is adopted in this Catalogue, with the view of aiding both a special and comprehensive study of the fossil Foraminifera and allied Rhizopods preserved in the British Museum, in which arrangement certain geographical lines are followed, beginning with the British Islands, and going eastward, under the several geological headings, and then returning to the west for a new line, the successive stages of each geological system being noted in upward order.

In the supplementary notes are some valuable remarks on the more important groups mentioned in the preceding part of the Catalogue, as *Eozoon*, *Receptaculites*, *Fusulina*, *Orbitolina*, *Nummulites*, and on the Foraminifera of the Chalk of England, of that of the north of Ireland, and also of the London Clay at Hampstead.

A geographical index and an index of the genera and species are also given; so that it is hoped this Catalogue may be the means of increasing the usefulness of this portion of the national collection.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

April 26, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On Fossil Chilostomatous Bryozoa from Mount Gambier, South Australia." By Arthur W. Waters, Esq., F.L.S., F.G.S.

The author gave a descriptive list of 66 species of Bryozoa, belonging to the suborder Chilostomata, from the collection of the Geological Society and of Mr. Etheridge, Jun.; of these, 15 were considered to be new, 28 are now found living, of which 23 in Australian seas, 25 were found in the material previously described from S.W. Victoria, 2 were considered identical with European chalk forms, 11 with Miocene, 12 with Pliocene, and 21 have been found in a collection from Bairnsdale, Gippsland.

Mr. Waters states that the collections in his hand from S.W. Victoria, Mount Gambier, and Bairnsdale will together yield about 200 species of Chilostomata and Cyclostomata.

2. "*Thamniscus*: Permian, Carboniferous, and Silurian." By George W. Shrubsole, Esq., F.G.S.

After a sketch of the genus, represented by one Permian, possibly two Carboniferous, and one Silurian species, the author discussed certain peculiarities claimed for the Permian form by the founder of the genus, Prof. King, viz. certain "denticles, vesicles, and hemispheric bodies, similar to those observed in *Cellaria salicornea*." These the author failed to find, but observed on the cell-face of this form a strong defensive spine, hollow at the base, which, when worn, gave an appearance which resembled the above structures. A denticle-like process also seems only to be the unequal wearing down of the cell-mouth. The author redescribed the genus, as well as a new Silurian species, for which he proposed the name of *Thamniscus antiquus*. It is from the Dudley limestone, and is in the Woodwardian Collection at Cambridge. It is not rare, but is generally too fragmentary for description.

3. "On the Occurrence of a New Species of *Phyllopora* in the Permian Limestones." By George W. Shrubsole, Esq., F.G.S.

The specimen on which this species is founded is mentioned in an early paper by Prof. Sedgwick on the Magnesian Limestone. It was afterwards named *Fenestella ramosa* by Prof. Phillips, and considered by Prof. King identical with *Thamniscus dubius*. But with neither of these genera has it any relationship, as it really belongs to King's genus *Phyllopora*, founded to include certain Polyzoa formerly referred to *Retepora*, a modern genus whose characteristics cannot be detected among the remains of the Palæozoic Polyzoa. The author described the characters of the species, and traced the history of the genus, which, in its range from Lower Silurian to Permian times, is characterized by two distinct types of species.

May 10, 1882.—J. W. Hulke, Esq., F.R.S.,
President, in the Chair.

The following communications were read:—

1. "On the Relations of *Hybocrinus*, *Baerocrinus*, and *Hybocystites*." By P. Herbert Carpenter, Esq., M.A. Communicated by Prof. P. Martin Duncan, M.B., F.R.S., V.P.G.S.

The author discussed the relations of *Apiocrinus dipentas*, Leucht., and of *Baerocrinus Ungerni*, Volborth, both from the Lower Silurian of Russia, to *Hybocrinus*, Billings, of the American Trenton limestone.

Ap. dipentas was regarded as a true *Hybocrinus*, as it was by Volborth and Schmidt; but the author followed Volborth and Grewingk in considering *Baerocrinus* a distinct generic type. The calyx consists of five basals supporting five radials, of which only three bear arms, while there is no indication of any anal system, unless it be the so-called Volborth's organ. *Baerocrinus* is probably to be regarded as a permanent larval form, which has only developed arms on three of its radials.

Hybocystites problematicus, from the Lower Silurian of Kentucky, which is supposed by Wetherby to be an intermediate form between the Crinoids and the Cystids, is believed by the author to be more closely allied to the Blastoids than to the Cystids. The three so-called arms are merely upward prolongations of the radials, which are segmented in the same way as the downward extending radials are in *Pentacrinus briareus*. They are not arms like those of *Hybocrinus* and other Crinoids. Of the five ambulacra that diverge from the peristome, the right and left anterior ones pass directly downwards from the summit onto the corresponding radials, and thence onto the basals. The other three ascend the inner faces of the short radial extensions, pass over their tops and down their outer faces, where they have been described as "more or less obscure furrows, of which nothing further is known." In some cases they reach the basals, and in others not, exhibiting a considerable amount of variation both in this and in other respects. There are therefore five recurrent and appressed ambulacra, and not two only, together with three arms, like those of Crinoids.

2. "On the Madreporaria of the Inferior Oolite of the Neighbourhood of Cheltenham and Gloucester." By R. F. Tomes, Esq., F.G.S.

The author called attention to the observations of Milaschewitsch on "Rejuvenescence" in corals, published in vol. xxi. of the Palæontographica, and explained its nature as opposed to "gemmation." He suggested that, in describing corals, the following classification of the costæ should be adopted:—

1. *Mural costæ*=those which appear on the wall, whether of simple or compound species.
2. *Septal costæ*=those which are a prolongation of the septa.
3. *Intercalicular costæ*=those which cover the cœnenchyma between the calices.

He adopted in general Dr. Wright's views as to the stratigraphical position of the coralligenous deposits in the Gloucestershire Inferior Oolite, and gave a tabular statement of the distribution of the species in the several coral-beds, pointing out that each of these has its own species, which do not pass much from one to the other. He recorded about sixty species, many of which were described as new, and proposed two new genera (*Phyllogyra* and *Phylloseris*), besides introducing five or six genera previously characterized on the continent, but not recognized in England—namely *Donacosmilia*, *Confusastræa*, *Chorisastræa*, *Oroseris*, and *Dimorpharæa*.

The author referred especially to some so-called *Thecosmiliæ*, such as *T. gregaria*, and insisted that they should be removed to the genus *Chorisastræa*, as they increase by gemmation at the base only of the corallum, and never by fissiparity as in the type of *Thecosmilia* (namely *T. trichotoma* from the Corallian of Nattheim). He remarked upon the characters of the genus *Heterogyra*, Reuss, and its allies, including his new genus *Phyllogyra*; and further indicated that *Thamnastræa* and allied genera have been removed by Milaschewitsch from the Fungidæ and placed among the Poritidæ, in consequence of their perforated septa, an alteration in which he agreed.

3. "On the Exploration of two Caves in the Neighbourhood of Tenby." By Ernest L. Jones, Esq. Communicated by Prof. W. Boyd Dawkins, F.R.S., F.G.S.

The caves noticed in this paper were that of Coygan, near Laugharne, partially described by Dr. Hicks in the 'Geological Magazine' in 1867, and a cave known as Hoyle's Mouth, reported on to the British Association in 1860 by the Rev. Gilbert N. Smith. Both caves were rock-fissures. The Coygan cave had been a Hyæna-den, as was shown by the deposits of crushed bones and coprolites trodden down into a solid mass by the passing of the animals. Besides remains of Hyæna, it furnished those of Horse, Mammoth, Tichorhine Rhinoceros, Elk, Red Deer, Roe Deer, Reindeer, Cave Bear, Cave Lion, *Bos primigenius*, Wolf, and Fox. The presence of Hippopotamus was doubtful. Besides these animals, the presence of Palæolithic man in the cave was indicated by some cut bones and by two flint-flakes evidently chipped by man. In the second cave, Hoyle's Mouth, the Hyæna, the Cave Bear, &c. were wanting, the place of the latter being taken by the common Brown Bear. In one part remains of an old hearth were found; and the whole contents of the fissure pointed to a Neolithic date. At one time the cave appears to have been used as a place of sepulture.

May 24, 1882.—J. W. Hulke, Esq., F.R.S.,
President, in the Chair.

The following communication was read:—

1. "On a remarkable Dinosaurian Coracoid from the Wealden of Brook, in the Isle of Wight, preserved in the Woodwardian Museum of the University of Cambridge, probably referable to *Ornithopsis*." By Prof. H. G. Seeley, F.R.S., F.L.S., F.G.S., &c.

The specimen described was obtained in 1866 by Mr. Henry Keeping, midway between the fossil forest at Brook Point and Brook Chine, about 10 feet above high-water mark. The author stated that it was the largest Dinosaurian coracoid known to him, that it differed in important characters from that of *Iguanodon*, and that, of described genera, it most probably belonged to *Ornithopsis*. The bone is from the right side, and nearly perfect; its length is about $16\frac{1}{3}$ inches, and its greatest breadth about 14 inches; the humeral articular surface is nearly 8 inches, and the suture for the scapula about $10\frac{1}{2}$ inches long. The bone is moderately thick, slightly convex externally and concave within, thickened at the humeral articulation. The nearest approach to this coracoid is made by that of the skeleton referred to *Hylæosaurus*, from the Wealden of Tilgate; but in it the distal portion of the bone is more prolonged, the median portion is less thickened, and the foramen is placed behind the middle of the humeral border, far away from the scapular margin, near which it is situated in the present bone. From the coracoid of *Iguanodon* it differs by the absence of the notch between the humeral and scapular surfaces, which there represents the foramen in this bone. In some respects it resembles certain American types, such as *Morosaurus*, and especially *Camptonotus*.

MISCELLANEOUS.

On the Unpaired Eye of the Crustacea. By M. Hartog.

It is well known that in most Crustacea, besides the two compound eyes (which are fused together in the Cladocera), there exists an unpaired median eye. It exists alone in most of the Copepoda and in the naupliiform larvæ of all orders; it is even seen in the phyllosomatous larvæ of the Loricate Decapods. Wherever the two kinds of eyes coexist in the adult but not in the newly-hatched larva, the unpaired eye is the first formed. It must therefore be regarded as the primitive eye of the Crustacea.

The structure of this organ has not been sufficiently studied. Claus has demonstrated that it is formed in all cases of a central pigmented mass, in which are half immersed three lenticular bodies or "crystalline spheres"—two lateral, and one central. By investigating the anatomy of *Cyclops* and *Diaptomus* by the method of thin sections, I have ascertained that this organ is of a much more complicated composition than had been supposed. The pigmented mass is, so to speak, structureless; the colouring-granules in it are especially placed at the surface contiguous to the "crystalline spheres." Each sphere is composed of radiating elements or optical bacilli, the inner ends of which are applied against the pigmented mass, while the peripheral segments contain a nucleus. The eye thus described is situated upon the terminal process of the brain, from which the optic nerves originate, one for each sphere; the nerve, instead of penetrating into the pigmented mass, *skirts the outer surface of the crystalline sphere, and penetrates it directly* not far from its hinder margin.

Claus figured an analogous structure in the unpaired eye in the Phyllopoda (see his memoir on the development of *Apus cancriformis* and *Branchipus stagnalis*); but he did not indicate its true significance. I have recently bred these same species, and have discovered in them a perfect analogy of structure with that just described in the Copepoda.

We may therefore conclude that the unpaired eye in all the Crustacea that possess it is composed of three simple eyes, placed anterior to the brain, *with reversed optical bacilli, receiving conductive fibres of the optic nerve upon their outer margin*, and brought so close together that their pigmented or choroid layers are combined into a single mass.

We may detect a nearly identical structure of the visual organ in two other groups:—

1. The Chætognatha, according to M. Hertwig, have absolutely the triple eye of the Crustacea; but, instead of being median and unpaired, it is repeated on the two sides of the head.

2. Certain Planarians, *Dendrocœlum lacteum* for example, have two paired eyes, which, according to Justus Carrière, have the structure which I adopt for one of the simple eyes united in the median eye of the Crustacea.

It is probable that the eye of the Chætognatha and Crustacea is to be referred back to the type of the Planarians, but that the two former groups have no direct relationship between them.

The method of thin sections has revealed to me some other interesting peculiarities, which I hope soon to publish in a more extended memoir upon *Cyclops*.

The eye which most nearly approaches that of the Crustacea and Chætognatha seems to be that of the *Planariæ*. M. Justus Carrière has just published (Arch. für mikr. Anat. xx. p. 160) a memoir on the eyes of these very primitive animals; and, according to his text and figures, it must be assumed that each eye of the *Planaria* or *Dendrocœlum* represents one of the components of the eye of the Crustacea. It is therefore more rational to refer back the eyes of the Crustacea and Chætognatha to such a primitive ancestral group as the Turbellaria than to seek direct approximations between the two former groups.—*Comptes Rendus*, May 22, 1882, p. 1430.

Sponges from the Neighbourhood of Boston, U.S.

Mr. E. Potts exhibited some fragments of freshwater sponges collected in the Cochituate Aqueduct and sent to him by the Superintendent of the Boston Waterworks. Alluding to the deleterious effects recently attributed to this sponge, as the cause of the pollution of the Boston water-supply, he said he was not prepared either to affirm or deny it. While he was well aware that a decaying freshwater sponge was one of the foulest things in nature, in his own experience he had never met with it in sufficient quantities, locally, to suppose it capable of tainting, in its decay, millions of gallons of water, as now represented.

An examination of the sponge as to its specific relations revealed some peculiar facts. Primarily it was evident that the sponge was much "mixed," the presence of two or more species being very apparent.

One of these, with long branching finger-like processes, smooth skeleton-spicula, no appearance of dermal or flesh-spicula, while the abundant *smooth* statospheres retained few if any acerate spicules, bore a sufficiently close resemblance to the description of *Spongilla paupercula*, as given by Dr. Bowerbank from specimens collected in the same or a neighbouring locality before 1863.

With this form was found another, probably altogether sessile, consisting of an intertexture of stout fusiform acerate skeleton-spicules, abruptly pointed, coarsely spined, except near the extremities; spines subconical, acute; dermal spicules absent or undiscovered; statospheres without granular coating, some of them exhibiting a few misplaced, irregular or malformed birotulate spicules, the distinguishing feature of which is the prolongation of the familiar boss upon the outer surface of each rotule into a long acuminate spine, in line with and a continuation of the shaft. He suggested for this species, provisionally, the name *Meyenia acuminata*.

The exceptional features referred to above, as marking this collection of sponges, were, first, the fact that all the statospheres, whether belonging to the genus *Spongilla* or *Meyenia*, were *smooth* —that is, without a granular or cellular "crust;" second, the apparent absence of dermal spicules in both, and the abnormal character of those belonging to the statospheres. The appearance is not infrequent, but has, so far as known, heretofore been limited to the genus *Spongilla*. The recurrence of the same feature in the associated genus *Meyenia*, coupled with the fact that many of the birotulates upon its statospheres were imperfect, the rays being more or less aborted, approximating their shape to that of the spined fusiform acerates of *Spongilla*, gave rise to the suggestion that here, possibly, had been, not merely a mechanical mixture by inter- or superposition of species, but an organic hybridization produced by the flowing together of the amœboid particles of which the sponges are composed, or even by a fertilization of the ova of one by the spermatozoids of the other.

Several facts indicative of the probability that such hybridization may take place were adduced, and the further discussion of the subject deferred until an examination of the living sponge in its native locality, or experiments upon those germinated in confinement, could be made.

It is important to notice that the specimens received were collected in February, when the sarcode matter had nearly all been washed away, with, probably, accompanying changes in the presence or numbers of the smaller spicula.—*Proc. Acad. Nat. Sci. Philad.*, Feb. 14, 1882, p. 69.

On the Priority of Euplœa Castelnaui *of Felder over* Euplœa phœbus. By Arthur G. Butler, F.L.S., F.Z.S., &c.

In the first part of his 'Rhopalocera Malayana,' p. 24, Mr. Distant gives priority to *E. Castelnaui*; he remarks as follows:—"As Mr. Butler has himself admitted the identity of his *E. phœbus* and *E.*

Castelnaui, Feld., of which there can be no doubt, it becomes necessary to use the earlier and Felderian name to this insect, though Butler still retains his own designation." Here Mr. Distant inserts a footnote to this effect:—" This author has (Trans. Ent. Soc. ser. 3, vol. v. p. 471) argued that Felder's work was antedated."

It is an exceedingly unfortunate fact that, although I have been assured positively on two different occasions (by men who knew the truth) that Felder's second volume *was* antedated, I have never been able to use their declarations as positive evidence—the first witness (an Austrian, though not an entomologist) having stated facts of which he did not know the importance, unaware that in so doing he was giving evidence against a personal friend; to give the name of this innocent informer would have been inexcusable.

The second case is a harder one, since we have here to do with a well-known German lepidopterist, who, though also a friend of the Felders, ought to have set aside his personal feelings in the interest of truth and justice. This gentleman showed me the actual date of publication written by himself upon the cover of the part when received, and he assured me that it had been forwarded to him (according to instructions given to the publisher) *as soon as it was ready*.

I have elsewhere pointed out that Hewitson gave instructions * that the part should be sent to him as soon as ready, but that he also never received it until the end of January 1867; nay, he was informed in the early part of that month that it was not ready. The explanation offered by the Felders was, I believe, that the coloured copies were not ready, but that the work could be obtained uncoloured.

It is a singular fact that early in 1867, when I was commencing my 'Catalogue of Satyrinæ in the British Museum,' I had seen neither the second nor the third parts of the 'Reise der Novara;' and not knowing in which volume the Satyrinæ would be published, I wrote to the Felders informing them that unless I could see proofs or advance sheets it would be impossible for me to include their species in my Catalogue; and that, in answer to this intimation, they forwarded to me proof-sheets with plates on thin paper of the second and third parts. One would have supposed, had the second part been ready in an uncoloured condition, that the Felders would have wished to prove the fact by sending it in its bound form with thick plates.

Now my reason for again calling attention to this vexed question is from a feeling that Mr. Distant (to whom I had asserted my knowledge of the antedating of Felder's second part upon authority, to which, nevertheless, I was unwilling to refer) has hardly done me justice in allowing it to be supposed that I retained my own name, knowing that Felder's had priority. As for what he says about my quoting Felder's date subsequently, he must be aware that in so doing I had taken the date from the titlepage, either failing for the time

* I see, however, that I did not mention his name, although he never asked me not to do so.

being to recall the fact of its inaccuracy, or inserting it between inverted commas to show my disbelief in it.

Mr. Distant is too old a friend not to be sure that I should at once prefer the name proved to be of earlier date whether it displaced my own or not: to retain one's own name for a species when priority has been proved for that of another author, is a childish form of egotism of which, as he well knows, I was never guilty.

On the Fecundation and Development of Hermella alveolata, *M.-E.* By Dr. R. Horst.

In his 'Mémoire sur l'embryogénie des Annélides" (Ann. Sci. Nat. sér. 3, Zool. tome x. p. 153), Quatrefages described the various stages in the evolution of *Hermella alveolata*; and two years afterwards (ibid. tome xiii. p. 126) he published his researches upon the fecundation and conditions of development of this annelid. The author has had the opportunity of making a fresh investigation into the subject at Prof. Giard's laboratory at Wimereux, near Boulogne.

He finds that the ova of *Hermella alveolata* have a strongly granular vitellus, a large germinal vesicle, and a very distinct germinal spot. At first the vitellus is in contact with the vitelline membrane; but as soon as the spermatozoids come into contact with the ovum, the vitellus separates a little from the wall of the latter, and at the same time a concentration of the granules of the deutoplasm takes place, so that a transparent layer of protoplasm forms at the periphery (the enveloping layer of Fol *). It is very probable that the separation between the membrane and the vitellus is not due solely to the contraction of the latter, but also to the penetration of water by osmosis, as was supposed by Quatrefages, and as Calberla † has shown to be the case in the ova of *Petromyzon*. This peripheral space does not entirely separate the vitellus from the vitelline membrane, the relation being maintained by numerous scarcely visible filaments surrounding the vitellus like a halo. Calberla observed the same phenomenon in the ova of *Petromyzon* ‡.

When a spermatozoid is occupied in penetrating the vitelline membrane, *a broader filament than the rest, like the pseudopodium of an* Amœba, *advances from the periphery of the vitellus to meet the spermatozoid*, until the latter has perforated the vitelline membrane. In about twenty minutes the spermatozoid makes its way into this vitellic filament and becomes confounded with it; the process of the vitellus then gradually contracts; and in this way the spermatozoid penetrates into the vitelline mass.

Spermatozoids do not penetrate into all the filaments, one of which will often disappear while another originates at the periphery of the vitellus. The author believes, however, that more spermatozoids than one penetrate the ovum. About an hour after

* 'Recherches sur la fécondation,' &c.

† Zeitschr. für wiss. Zool. vol. xxx. p. 437.

‡ *Loc. cit.* p. 458, pl. xxxvii. figs. 7, 8, pl. xxxix. figs. A, B.

the penetration of the spermatozoid, the vitellus loses its spherical form and becomes much flattened at one of its poles. At this pole a small layer of clear protoplasm collects, in the midst of which the first polar globule appears, soon followed by a second; the vitellus resumes its original form; and soon afterwards the segmentation of the ovum begins. Quatrefages says that the first segmentation-groove, which divides the ovum into two unequal spheres, makes its appearance upon any part of the surface; but the author thinks that this is not the case, as he has always seen the first groove or plane of segmentation occur in the direction of the point where the polar globules had made their appearance, as observed by Halley and others in *Leptoplax tremellaris*. He thinks that the property of the polar globules of determining the direction of the first segmentation-groove is the only part of the function of those remarkable bodies of which we know with certainty, and that consequently they are well entitled to their old name of *directive bodies*.

Quatrefages's description of the segmentation of the ovum in *Hermella* is said by the author to be quite erroneous; but the only details he gives are that the segmentation seems to have much analogy with that of the ovum of the Naiades (Flemming)* and of the common mussel (Théodore Barrois)†. The animal spheres finally surround the vegetative part of the ovum, and thus form an *amphiblastula*.

Twelve hours after impregnation the embryo has the form of a mesotrochal larva with a group of long cilia at its cephalic pole, besides its vibratile belt. The larva, when four days old, has a dome-like form, owing to the preoral part being strongly developed. The mouth opens into a long œsophagus lined with vibratile cilia, and separated by an annular constriction [from the intestine ?]. The latter opens by a terminal anus. On the ventral side a ciliary furrow is directed towards the mouth. To the right and left of the intestine there is a bundle of four provisional setæ. The dorsal surface of the preoral part has two small brown ocular patches. The larva differs in several respects from those of other sedentary annelids; the larva of *Terebellides Strœmii* alone presents some points of analogy, according to the description of Willemoes-Suhm‡.—*Bulletin Scientifique du Département du Nord*, 4e année, 1881, pp. 1–4.

On the Condylarthra.

Professor Cope made some observations on the characters of the newly-discovered group of Perissodactyle Ungulates which he had called the Condylarthra. He defined it as follows, comparing it with the typical Perissodactyla, which he referred to a suborder under the name Diplarthra.

Astragalus with one uniformly convex distal articular
face; humerus with epicondylar foramen .... *Condylarthra.*

* Sitzungsb. d. Wien. Akad. Bd. lxxi.
† Bull. Sci. du dép. du Nord, 1879.
‡ Versl. en Meded. Kon. Akad. Amsterdam.

Astragalus with two truncate or concave distal articular facets for the cuboid and navicular bones; no epicondylar foramen of humerus .... *Diplarthra.*

The Condylarthra have as yet been only found in the lowest horizon of the Eocene period, the Puerco and Wasatch, and only on the North-American continent. Appropriately to this position in time, its structure indicates that it is the most primitive type of the order of the Perissodactyla. A number of genera and species belong to it; and these fall into two families, which are defined as below. They conform to the definition of the order in possessing an alternating arrangement of the carpal bones and a third trochanter of the femur. The approximation to the Hyracoidea is greater than that of any group of the Perissodactyla. That order agrees with the Condylarthra in the simple articular extremity of the astragalus, which, however, is less convex; but it has a very peculiar articulation with the anterior face of the distal extremity of the fibula, seen in no other group of Ungulates. In the manus the lunar bone is very peculiar, not being divided below into two facets as in other Ungulates, and articulating with the carpals of the trapezoides series (the intercalare) as well as with the unciform. In these points the Condylarthra agree with other Perissodactyla. In *Hyrax* there is also no epicondylar foramen. The two families are defined as follows:—

Dentition bunodont; toes 5—5; premolar teeth different from the molars above and below .. *Phenacodontidæ.*

Dentition lophodont, with crescents and deep valleys; premolars partly like molars below; toes? .... *Meniscotheriidæ.*

The bunodont dentition and five toes on all the feet give the Phenacodontidæ the lowest place in the suborder and order as the most generalized type known. The Meniscotheriidæ have a quite specialized dentition; and until I learned its condylarthrous character I was at a loss to account for the presence of such perfection in so old a type. The number of the toes is yet unknown; but I suspect, from the large size of those I have seen, that they are less numerous than in the Phenacodontidæ. It appears to have had no descendants, and is a good illustration of Dr. Kowalewsky's views as to the persistence of the "adaptive" over the "non-adaptive" types of articulation. Kowalewsky observed that the types of Ungulata which have the carpo-metacarpal and tarso-metatarsal articulations simple, and not alternating, have become extinct. In those which persisted the metapodials articulate with two bones of the carpal or tarsal series. The same rule has generally applied in the Ungulates to the distal astragalar articulation. The Diplarthra and Amblypoda with the double articulation have left descendants, while the Condylarthra with the single articulation have disappeared without leaving a trace. The Proboscidea, which have the same simple distal articulation, still remain, however, to show an exception to this generalization.

The Condylarthra are distributed as follows :—

PHENACODONTIDÆ.

	Puerco.	Wasatch.
Anacodon		1
Phenacodus	2	8
Protogonia	1	
Pantolambda	1	
Catathlæus	3	
Anisonchus	1	
Haploconus	3	
Periptychus	1	
MENISCOTHERIIDÆ.		
Meniscotherium	3	
	15	9

The genera of Phenacodontidæ are distinguished as follows :—

I. Fourth superior and inferior premolars with an internal cusp.

Last superior premolars with two external cusps; inferior molars with well-developed cusps .. *Phenacodus.*

Inferior molars with flat grinding faces; no cusps. *Anacodon.*

Last superior premolar with but one external cusp; inferior molars with V's.................. *Protogonia.*

Inferior premolars consisting of an anterior V and a posterior longitudinal crest.............. *Pantolambda.*

II. Fourth superior premolar with a high internal cingulum concentric with the single external cusp.

a. Superior molars with intermediate tubercles; fourth premolars with internal cusps.

Posterior inner tubercles of the superior molars not cut off; several superior premolars with internal cingulum .... *Catathlæus.*

aa. Superior molars with intermediate tubercles forming branches of a V with the anterior inner; posterior inner distinct and cut off by a groove; inferior premolars without inner cusps; first inferior true molar tubercular.

Third superior premolar with elevated internal crest .... *Anisonchus.*

Third superior premolar a cone without inner crest .... *Haploconus.*

aaa. Superior molars unknown; inferior true molars with anterior lobe; the first with a transverse heel instead of opposite tubercles.

Anterior external lobe of inferior molars forming a cutting-edge .... *Periptychus.*

The only genus of the above in which the structure of the feet is well known is *Phenacodus*. It is partially known in *Catathlæus*.

The only genus of Meniscotheriidæ is distinguished as follows:—

Inferior premolars consisting of two V's .... *Meniscotherium.*

Proc. Acad. Nat. Sci. Philad., March 21, 1882, p. 95.

Domestication of Wild Ducks.

In a paper "On the Domestication of some of our Wild Ducks," Mr. Charles Linden, the author, states, after efforts to domesticate several of the species, capturing them young or raising them from eggs, that none of those transferred to the barn-yard "adapted themselves thoroughly to this state excepting the mallard, dusky duck, and Canada goose, the progeny of which prospered well and attained a greater weight and size than the ordinary domesticated stock. Some of them are still living, and betray, in many instances, a tendency to revert in point of plumage to their original condition, while the majority have become completely metamorphosed into ordinary barn-yard fowl. No hybrids from any two different wild species, which bred only within the enclosure, were ever obtained, excepting from crosses between the mallard and dusky duck." The crossing was readily accomplished "without any need of resorting to special inducements." He says, "it is evident that the dusky duck is fully as domesticable as the mallard, which has been thus far supposed to be the originator of our common tamed ducks."—*Amer. Journ. Sci.*, May 1882, p. 421.

On Balanoglossus, *&c.*

Prof. Leidy stated that in a recent trip to Atlantic City, he had observed the singular worm, *Balanoglossus aurantiacus.* It occurs in moderate number along the shore of a pond between the beach and the lighthouse. In the same position he had collected *Solen ensis*, specimens of which were presented this evening. As this occurred in considerable number, he had procured a sufficient quantity to try it as an article of food, and had found it to make excellent soup. In the vicinity he had picked up a number of specimens of *Actinia rapiformis*, which had recently been thrown upon the beach. On a former occasion, at Atlantic City, he had observed another *Actinia*, the *Bicidium parasiticum*, which is parasitic on the large jellyfish, *Cyanea arctica*, so frequently thrown on shore during the summer.—*Proc. Acad. Nat. Sci. Philad.* Mar. 7, 1882, p. 93.

On a new Species of Sagitta.

Prof. Leidy stated that in a recent trip to Atlantic City, N. J., he for the first time met with the singular worm *Sagitta.* It occurred in large number in the same pond in which he had previously noticed *Balanoglossus.* Whether it was there at the time of his former visit he was unable to say, as the animal is as transparent as the water in which it lives, and may easily escape observation. His attention was accidentally directed to its discovery. Along the edge of the pond there were numerous linear white bodies, flaccid and motionless, which he at first took for fragments of a bleached alga. From the uniformity of their size he stooped to examine them more closely, when he noticed others in the water, more transparent, lying on the sand and occasionally moving suddenly and so actively as to send a little spray above the surface. On transferring some of these bodies to a vial he detected their nature. Subsequently the water was seen to swarm with the little creatures. They are exceedingly sensitive, and quickly die after removal. In life they are perfectly transparent and colourless, and move actively at intervals with a sort of spasmodic jerk, bending the tail downwards and darting forward. After death they become flaccid, dull, and white; and hence the appearance of the multitude of dead ones on shore.

The *Sagitta* is interesting as being one of those peculiar animals which have puzzled naturalists as to its exact relative position. It is now usually regarded as the representative of an order of worms with the name of Chætognatha.

A species, *Sagitta elegans*, has been described by Prof. Verrill as occurring at Wood's Holl, Vineyard Sound, and Gay Head, on the New England coast; and he refers to a second, undetermined species occurring in Vineyard Sound.

The *Sagitta* of Atlantic City appears to differ from the former, and also from all other described species found elsewhere, and may be readily distinguished from them by its greater number of mandibular hooks. It may be characterized as follows:—

Sagitta falcidens.

Animal transparent, colourless; body compressed, elongated fusiform, with two pairs of lateral hemielliptical fins, separated by intervals from each other and the broad obcordate caudal fin, which is truncated posteriorly. Head obcordate, about as broad as it is long. Preoral series of spines, 6 or 7 in each, minute; postoral series 18 in each, successively decreasing. Mandibular hooks, from 11 to 14 in each series, usually 12, besides an immature one, scythe-shaped, yellowish brown in colour. Length about three fourths of an inch, width $1\frac{1}{2}$ to 2 millim. Head 1 millim.; caudal fin 1·5 to 1·75 millim. wide. Mandibular hooks 0·75 millim. long.

At the same time, as previously, numerous mounds of the *Balanoglossa aurantiacus* were observed. There were also noticed in the same pond many projecting tubes of sand, which were found to contain *Clymena torquata.* Further, several specimens of *Glycera americana* were collected. On the shore of the pond in one place *Donax fossor* appeared to have its residence; and among *Solen ensis*, a single living *Solecurtus gibbus* was found.—*Proc. Acad. Nat. Sci. Philad.* April 4, 1882, p. 102.

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X.—*The* Entoniscidæ. By Dr. R. Kossman *.

[Plate IX.]

The literature of the Entoniscidæ is at present confined to a few memoirs by only three naturalists. These are as follows:—

1. Fritz Müller. "*Entoniscus porcellanæ*, eine neue Schmarotzerassel," Arch. f. Naturg. Band xxviii. p. 10 (1862). See Ann. & Mag. Nat. Hist. ser. 3, vol. x. p. 87.
2. Fritz Müller. "Bruchstücke zur Naturgeschichte der Bopyriden, 1. Binnenasseln," Jen. Zeitschr. f. Med. u. Naturw. Band vi. p. 63 (1871).
3. Giard. "Sur les Isopodes parasites du genre *Entoniscus*," Comptes Rendus, August 12, 1878.
4. Fraisse. "*Entoniscus Cavolinii*, n. sp., nebst Bemerkungen über die Umwandlung und Systematik der Bopyriden," in the Arb. a. d. zool.-zoot. Inst. d. Univ. Würzburg, Band iv. (1878).
5. Giard. "Notes pour servir à l'histoire du genre *Entoniscus*," Journ. Anat. et Physiol. 1878, p. 675.

Some treatises in which *Entoniscus* is mentioned cursorily will be found cited in the bibliography of the last-named memoir.

When, on the occasion of my finding an *Entoniscus*, I read

* Translated by W. S. Dallas, F.L.S., from the 'Mittheilungen aus der zoologischen Station zu Neapel,' Band iii. p. 148 (1882).

and compared these memoirs, it struck me that those of Fraisse and Giard sought to establish certain differences between the forms investigated by them and those described by Fritz Müller, differences which, while in themselves of the greatest significance, were coupled in a very remarkable way with a close agreement in many secondary things. In fact, it could not but greatly startle one to learn that, with the greatest similarity in the form of the head and of the abdominal part, complete resemblance in the conditions of life, &c., our European Entoniscidæ were *hermaphrodites*, while the Brazilian ones are *diœcious*, and that, of the former, one species certainly, like the rest of the Isopoda, possessed paired separated brood-leaves, while the rest all possessed one or more closed *brood-sacs*, which, moreover, were on a quite unaccustomed part of the body.

This surprise induced me to make an after-investigation, which has proved both statements to be erroneous. The Entoniscidæ examined by Fraisse and Giard have separate sexes, and, just like the rest of the Isopoda, carry their ova until they hatch, between paired separate brood-leaves inserted ventrally on the pereion. But, although this correction brings about a very considerable approximation between the Brazilian and European Entoniscidæ, I have nevertheless arrived at the opinion that the distinction of two genera is indicated. This view is founded only in the second line upon the differences of the female forms: for me the difference of the males is far more decisive; and, indeed, this compels us to retain the old generic name *Entoniscus* exclusively for *E. porcellanæ*, but under the new one (I propose *Entione*) to unite *E. cancrorum* with *E. Cavolinii* and *E. Moniezii*.

People will be astonished to hear me speak of the males of the last-mentioned forms after such distinguished naturalists as Fraisse and Giard have declared that they sought for males with great care upon many specimens, and always in vain. I must own that I have found it easy to detect the males, and that I am in possession of a great number of them. Two circumstances probably have prevented the above two gentlemen from being so fortunate:—in the first place the comparatively smaller size of the males, always supposing that the relative size of the two sexes of *Entoniscus porcellanæ*, as represented by Fritz Müller, was in the minds of the seekers; but also (and this must be the principal reason) the circumstance that both *savants* regarded the peculiar sac which encloses the parasite as an integral constituent of the latter, and did not remove it. To distinguish the transparent little animal, which is scarcely 1 millim. in length, through the tissues of this is certainly very difficult, whilst after even only an imperfect peeling of the parasite it is quite easily discovered.

Fritz Müller (1) has described in detail and figured the male of *Entoniscus porcellanæ*; but of that of *Entoniscus* (*Entione*, nob.) *cancrorum* he has only figured the abdomen ('Für Darwin,' fig. 16), and devoted a few words to it in his 'Bruchstücke' (2, p. 55). Nevertheless his statements, as compared with my own results, enable us to establish those peculiarities of the male which *distinguish the Entoniscidæ in general from the Bopyridæ*, as well as to discriminate these from the mere generic characters.

In the first place the males of all Entoniscidæ in common have only six pairs of pereiopods, and therefore remain in this respect in a larval stage which is passed by the Bopyridæ by the development of the seventh pair.

Then the males of all Entoniscidæ seem to differ from those of the Bopyridæ by the retrograde condition of the antennæ. Fritz Müller (2, p. 55), indeed, says that in respect of the structure of the antennæ the male of *Entione cancrorum* resembles the males of the Bopyridæ; but as he enters into no details upon this point, and gives no figure, and as, on the other hand, there is very much in favour of the generic identity of *E. cancrorum* with *E. Cavolinii* and *E. Moniezii*, I cannot help thinking that he must have overestimated the really existent differences in the antennal region of the two forms. At any rate *E. porcellanæ*, *Cavolinii*, and *Moniezii* agree in this, that in the frontal region, instead of distinct antennæ, there is only *one* pair of lobe-like one-jointed projections, which bear a group of setæ at their obtuse extremity; but which pair of antennæ these processes represent it is impossible to decide.

The males of the Entoniscidæ have the mouth-structure (see fig. 5) in common with those of the Bopyridæ, as the curved, unjointed, and unpalpiferous mandibles have their simple apices projecting close together between the labrum and labium. But there are no rudiments of maxillæ and maxillipeds. As regards the pleon, the males of the Entoniscidæ agree closely with many Bopyridæ; it is distinctly six-jointed, and at least the first five segments are destitute of paired appendages. The internal organization agrees perfectly with that of the male Bopyridæ, as Fritz Müller (1) has already demonstrated.

The differences between the males of the two genera Entoniscus (*E. porcellanæ*) *and* Entione (*E. cancrorum*, *Cavolinii*, and *Moniezii*) are as follows :—

In *Entoniscus* the pereiopods are "reduced to nearly sessile inarticulate roundish lumps."

In *Entione* they are jointed and furnished with terminal claws.

In *Entoniscus* the pleon is destitute of all appendages; the last segment bears only some minute spinules.

In *Entione* there are, on the anterior segments of the pleon, unpaired, ventral, horn-like processes bent backward (see fig. 4), of which the foremost is the most considerably developed; but the apical segment bears two spiniform appendages exceeding it in length, and curved ventrally, which, by curvature of the pleon, can be moved towards the above-mentioned unpaired processes, and with these, like the arms of a forceps, assist in the fixation of the animal.

In *Entoniscus*, lastly, the head is narrow, and the antennal lobes, which are quadrangular, project laterally far beyond the margin of the head. In *Entione*, on the contrary, the head is broad, and the rounded antennal lobes scarcely project laterally beyond its margin.

No distinctions appear to exist between the males of the different species of *Entione*, at any rate not between the European species.

I come now to refer to the *females*, and first of all to their external form. Here also I commence with those peculiarities which *are proper to the Entoniscidæ in general, but wanting in the Bopyridæ*.

In the first place the trunk is entirely or almost entirely unsegmented (see fig. 2), and it is destitute of the dorso-ventral depression. The head is considerably broader than the trunk, and distinctly notched by a longitudinal furrow (fig. 3). Jointed antennæ are deficient, as also, apparently, piercing mandibles, and also pereiopods.

On the other hand, *all the Entoniscidæ share with the Bopyridæ* the possession of separated paired brood-leaves on the ventral surface of the pereion. As regards *E. porcellanæ* this is distinctly shown by F. Müller's figure (1, Taf. ii. fig. 1; see 'Annals,' ser. 3, vol. ix. pl. ii. fig. 8); but he also says expressly, "The brood-plates, on the other hand, are developed into enormous, much-folded, lobate, and slit membranous lobes. When I could count them distinctly . . . I found six pairs." With regard to *E. cancrorum* (*Entione*), on the contrary, the same author says (2, p. 55), "In *Entoniscus cancrorum* there is present a closed brood-chamber, formed by a single pair of brood-leaves originating close behind the head. The brood-chamber forms a sac, of very variable form and size, directed obliquely forward, applied by its upper surface to the underside of the head, which it passes to a greater or less extent." Giard (5, p. 685) in a similar manner, with respect to *E. Cavolinii* and *E. Moniezii*, speaks of "chambres incubatrices" of peculiar arrangement, very different from that occurring in *E. cancrorum*. Lastly, Fraisse also shares in this view. He speaks of (4, p. 11) "the much-folded thin membrane, which, likewise originating from two edges of the great chitinous stem, forms the true closed brood-chamber." And further on (p. 12), when he speaks of the lateral brood-chambers, which, like Giard, he ascribes to *E. Cavolinii*, he represents them as leaf-like in the young state, and says, "In transverse sections it appears that the interior is occupied by a loose connective tissue, the interspaces of which are frequently filled with coagulum. In fully developed specimens a lumen has been formed, which is occupied only by ova or larvæ."

Whoever compares with these statements and the figures accompanying them my figure (Pl. IX. fig. 1), drawn from life, will at once perceive upon what the errors of these three naturalists are founded. Fritz Müller, evidently accustomed, from the example of *E. porcellanæ*, to find the parasite imbedded in a very delicate tissue, could not make up his mind to regard the tougher sac in which *E. cancrorum* lay also as a constituent of the host, and to remove it in preparation; and when he had once taken the grave step of interpreting this sac, when it coats the brood-chamber, as the wall of the latter belonging to the parasite itself, it was easy for Giard and Fraisse to follow him in so doing. Fraisse indeed cut open the sac in front, and found in it the anterior pair of brood-leaves, which he describes clearly enough (p. 11); but as the wall of the sac in which the parasite lay was adherent to the outer surface (which happens when the living animal is injured, by the secretion of a quickly coagulating fluid, probably the cement serving for the attachment of the ova when laid), Fraisse seems to have separated, together with the wall of the sac, the more delicate parts of the brood-leaves from the ramified chitinous ribs which traverse the latter like the veins of a leaf. What was thus set free might well be compared, as it is by him, to a biserial plume; and it appears explicable that he should regard these plume-like artificial products not as brood-leaves, but as "metamorphosed limbs." His error regarding the posterior brood-leaves seems to have been produced somewhat differently. In young specimens he appears to have prepared them freely, without knowing that he had done so, and consequently he describes them quite correctly. In older specimens, however, he did not prepare them freely, and supposed that the ova were introduced into a subsequently-produced lumen of these leaves, which, for an Isopod, or, indeed, for any Crustacean, would be truly astounding.

If one kills the *Entoniscus* very quickly, the sac in which it lies can be easily removed after some time; if the *Entoniscus* be kept living for some days in sea-water, this sac, not being a part of the parasite, begins to macerate and separate in rags. In this way we easily ascertain that the animal has two pairs of greatly-developed brood-leaves, both of which are inserted on the ventral surface close behind the head, and of which the anterior pair is bent far forward and upwards beneath the head, whilst the hinder pair extends backwards as far as the pleon. These brood-leaves are constituted exactly like those of the Bopyridæ &c.; *i. e.* they are thinly membranous, with a venation of chitinous thickenings. The anterior margin of the anterior leaf, which, by curvature, becomes dorsal (in the figure the right leaf is omitted for the sake of clearness), curls a little inwards. These anterior brood-leaves receive the eggs more especially between themselves; the posterior ones, which show a faint venation, receive the ova rather between them and the wall of the body. Of course the wall of the sac in which the parasite lies assists in completing the closure of the brood-chamber, just as in *Bopyrus* &c. the same thing is done by the gill-cover of the host; but there is absolutely no trace of any amalgamation or other union of the right and left brood-leaves, and the brood-chamber of the parasite is therefore not in itself closed.

The differences between the females of the two genera Entoniscus *and* Entione *are not inconsiderable.* I shall dwell here also first of all upon the external characters.

The chief distinction relates to the pleon. This in *Entoniscus* is distinctly segmented, six-jointed; the first five segments bear each a pair of inarticulate sabre-shaped unsetigerous feet, which are in fact considerably longer than the segments to which they belong. In *Entione*, on the contrary, the pleon is unsegmented, and, instead of sabre-shaped, it bears leaf-shaped appendages, of which the anterior are the largest and have a strongly frilled margin; the last pair, marked L in Fraisse's figure (4, pl. ii. fig. 7), is quite smooth.

While in *Entoniscus* the pereion is furnished with six pairs of large much laciniated brood-leaves, the posterior ones in *Entione*, especially in the fully developed stage, are rudimentary. In younger females, as Fraisse and Giard repeatedly indicate, traces of them may be found. On the other hand, the two anterior pairs (Fritz Müller probably only overlooked the second pair in *E. cancrorum*) are very strongly developed, and the anterior pair curves forward and upward beneath the head, while the hinder pair extends posteriorly.

With regard to the structure of the head also a difference may perhaps exist; at least I do not see that Fritz Müller figures or describes in *E. porcellanæ* the sucker-like cushions which Fraisse (4, pl. ii. fig. 6) and Giard (5, pl. xlvi. fig. 5) represent, and which are also to be seen in my figure (Pl. IX. fig. 3).

As to the specific distinctions within the genus Entione it is difficult to speak with absolute certainty. *E. cancrorum* is very cursorily described, and we have only a sketchy figure of an animal not full-grown. But *E. Moniezii* and *E. Cavolinii*, notwithstanding the details given, are also, even leaving out of consideration the errors already mentioned, very unsatisfactorily described; so that it is essentially only on the ground of the identity or, at any rate, near relationship of the hosts that I can assert with more or less certainty the identity of my specimens with the two species above mentioned. The dorsal and ventral regions are repeatedly confounded in Fraisse's and Giard's memoirs; in explanation of this I can only suppose that the specimens that those two naturalists had before them died in the most unnatural contortions, and remained in the same after death—to which, perhaps, the circumstance that the sac in which the parasite is enclosed is killed by the action of spirit earlier than the parasite itself, and rendered rigid, may have contributed. The position and form that the animal, after being freed from this sac, infallibly assumes when in sea-water, and in which it remains when killed with alcohol or any thing of the kind, is shown in my figure (Pl. IX. fig. 1).

It will be seen from it that *Entione Moniezii*, as also *E. Cavolinii*, has on the thorax, which otherwise is cylindrical, four strong excrescences, which, however, are wanting in younger females. Of these excrescences two, forming a pair, are placed close together not far behind the cephalic enlargement *on the back* of the animal. In Giard's scarcely intelligible figure (5, pl. xlvi. fig. 1) they are marked λ λ', and still covered by the two posterior brood-leaves, which, however, are apparently for the most part cut away. In Fraisse's description and figure I can find no indication of these protuberances, which, moreover, cannot be visible in his fig. 5 (pl. ii.), as they are upon the surface which is turned away.

Two other protuberances lie, unpaired, one behind the other, *in the middle line of the ventral surface.* They are figured by both observers. Fraisse indicates them in his fig. 5 (pl. ii.) by the letter O; but explains them quite wrongly, as follows:—"Ova which are deposited in strings in the interior of the body and then project into the brood-chamber at various spots, in swellings of this kind." In the text a similar conception is somewhat indistinctly recognizable. On page 13 we find:—"The brood-chambers situated at the sides of the parasite have been produced by arching of the skin, which contracts on the sides of the body, and so forms irregular cavities, which are partially supported by firm chitinous ribs. These cavities communicate with the interior of the body, and in the middle stage of the life of the animal are separated from the body-cavity only by spongy connective tissue. *Subsequently the ova, deposited in long connected blind sacs, penetrate through the loose tissue and also occupy these brood-chambers.*" And at p. 20:—"The older ova are deposited in long cæcal tubes, which now occupy not only the body-cavity, previously containing only the middle intestine, but also for the most part displace the spongy connective tissue which forms the body-parenchyma. The skin of the body is forced into multifarious diverticula, of which, however, only the two figured* appear to be constant."

I hope the friendly naturalist, who even in this very memoir has furnished such meritorious results, will forgive me if I suggest that in these statements his imagination has carried him too far. The ova of a Crustacean, an Isopod, deposited in cæcal tubes in the interior of the body-cavity, are said to make their way through its loose connective tissue into brood-chambers formed by the lifting up of the skin of the body! But would not all this be much, very much, more surprising than that dorsal brood-chamber in *Phryxus* for the adoption of which Fraisse so heavily reproaches M. Hesse? And how simple is the truth in this case. Fraisse's cæcal sacs, in which the ova are supposed to be deposited, are in reality the branches of the ovary, which also completely fills these two protuberances; and they get out of this ovary, not through gaps in the connective tissue, but through a pair of quite normally placed female sexual apertures, not under the lifted integument, but entirely external, *i. e.* under the protection of the brood-leaves, and of course within the sac in which the entire parasite is enclosed.

These two protuberances are also figured by Giard (5, pl. xlvi. figs. 1 and 2 β & γ). But while even by Fraisse, in consequence of spiral twisting of the specimen figured, the

* These are the ventral protuberances now under discussion.

protuberances are brought to lie opposite to the insertion of the brood-leaves, and therefore dorsally, Giard, in his figure, even expressly indicates the side on which they are placed as dorsal by means of the letter D. In the text he says, "At the dorsal part we observe two long median protuberances slightly curved from behind forwards." In his first article (3, p. 2) he actually thinks that these excrescences "recall morphologically certain features of the zoëa-form." In the second memoir he reverts to this, but remarks more cautiously:—"I do not venture to pronounce in so affirmative a manner upon their true morphological value." Independently of the boldness of even hinting a comparison in the order Isopoda (in which not the smallest trace of the zoëa has been ascertained) between a protuberance produced by enormous growths of the ovary only in the last stage of existence and a zoëal spine, —independently of this, I say, M. Giard himself, when he has ascertained that we have to do here, not with *dorsal*, but with *ventral* protuberances, will probably recognize the erroneousness of this idea.

In the figure and description of *E. cancrorum*, we see nothing of these processes; but the animal, as is shown by the small size of the anterior brood-leaves, was not full-grown. In the two species investigated by me they were regularly present in the adult animals, and so far showed a specific difference that in *E. Cavolinii* the size of the two ventral protuberances was always about equal, while in the *Entione* of *Portunus arcuatus* the posterior of these two protuberances, as shown in our figure (Pl. IX. fig. 1), was very much longer and stronger. In the case of the *Entione* of *Portunus puber*, which Giard has described as *E. Moniezii*, he does not call attention to this difference, but does notice a difference in the colour and size of the first appendage on the pleon. This double difference, again, has not occurred to me on the parasite of *P. arcuatus*; and I therefore at first indicated the latter as a new species, *E. salvatoris*. Probably, however, this cannot be maintained. That Giard attempts to judge of the frequency of his *E. Moniezii*, and even sets up a definite proportion (1 : 100) between the animals affected and those not affected by it (3, p. 3, for *E. Cavolinii*, 1 : 30), is the less admissible, because, in another place (5, p. 698), he himself states that he had found only two specimens, and these, moreover, upon the same host. The truth here again is, that the animal occurs epidemically in particular localities, and is there common, but elsewhere not to be met with.

Fritz Müller and Giard, I may take this occasion of remarking, have made similar statistical statements with regard to the combination of *Sacculina* and *Entoniscus*, as also with regard to the *sex* of the host of the latter. I find both to be inadmissible. In opposition to the supposed frequency of the association of the two parasites, we have the fact that, of my very numerous examples of *Entoniscus*, *only one* was associated with a *Sacculina*; probably the above-mentioned naturalists have accidentally fished in a spot where both epidemics prevailed at the same time. But if Fraisse actually supposes that at Naples *Entoniscus* occurs solely, or almost solely, upon females, this is plainly controverted by the fact that among the first 198 *Pachygrapsi* that I had opened, and of which 75, or two fifths, were females, I found eight males and only two females attacked by *Entoniscus*. I can confirm the sterility of the females.

I now pass to the discussion of the *internal anatomy*. With regard to this a good deal has been done before me; but in this also several considerable mistakes have been made. On the internal structure of the male, Fraisse and Giard, as they have never met with it, could say nothing; but what Fritz Müller (1, p. 14) states about it is correct and almost exhaustive; it is sufficient to add that the nervous system and the histological structure of the organs agree with the characters of the male Bopyridæ as completely as all the rest. I have not thought it necessary to give figures, as I can refer to those which I have published of the male of *Gyge* ("Studien über Bopyriden, II.," Zeitschr. für wiss. Zool. Bd. xxxvi. pl. xxxv. figs. 3 & 5).

As to the internal structure of the *female* of *Entoniscus* Fritz Müller has less to say, as above cited. He speaks of "conical cæca" which are to be found in the head, meaning thereby the papillæ, subsequently quite correctly represented by Fraisse and Giard, which are attached, not, as he seems to suppose, to the outer, but to the inner surface of the stomach; otherwise he has nothing to say about the earlier portion of the intestine. Of the liver he correctly states that it consists of two tubes placed close together on the ventral surface, and extending from the head as far as the neighbourhood of the abdomen. On the connexion of the liver with the intestine and the further course of the latter he says nothing. He also states that the ovaries are situated in the back and commence a little behind the head, and, further, that they cause several protuberances on the back; but he did not detect their orifices. He demonstrates the position of the heart in the pleon.

The position of the mouth is shown in my figure; and I have also represented its form (Pl. IX. fig. 7) reconstructed from longitudinal sections, and therefore perhaps a little distorted;

to a certain extent my results agree with the figure given of it by Fritz Müller (1, pl. ii. fig. 5). According to this a very rudimentary labrum, a somewhat more distinct medianly emarginate labium, and a pair of rudimentary limbs furnished with a denticle seem to be present; the latter certainly correspond to the stilettiform mandibles of the Bopyridæ, but are much stouter and not covered by the labium. Between these mandibles the mouth-aperture appears vertical at the surface; a little further down it becomes triangular, with the apex directed downwards; the latter disappears, and the triangular cleft becomes first a crescent-shaped one (with the concavity turned upwards, *a*), then a simpler transverse fissure (*b*), and lastly a transverse cleft which divides at its extremities (*c* and *d*). This transverse cleft finally breaks through into the stomach, which is filled with the long papillæ. The stomach, as Fraisse has already correctly stated, and as, indeed, is distinctly expressed even in the external form of the body, is divided by a deep furrow, running round it in a plane perpendicular to the longitudinal axis, into two nearly globular communicating halves. I have already mentioned in my "Studien über Bopyriden," that an indication of this division exists also in the Bopyridæ; and I have there also referred to the finer structure and the function of this organ; to this I may refer, so far as a completion of Fraisse's statements seems necessary.

The name *cephalogaster*, which Giard proposes for the head of the Entoniscidæ because it contains this stomach ("cette tête mériterait plutôt le nom de cephalogaster"), is, in the first place, not properly formed, for such a name would indicate a particular kind of *stomach*, but not a particular kind of *head*; and, secondly, it is unnecessary, because in all Crustacea the stomach, if present, is situated in the head, and therefore we should have to say *cephalogaster* instead of *cephalon*.

An intestine issues from the papillose stomach; and its special constitution is noticed only by Fraisse. In his figure 6 he shows quite correctly how in this region of the intestine a great swelling projects from the dorsal surface into the lumen; and both in his figure and in the text he indicates peculiar minute chitinous hairs, which still further obstruct the remaining narrow fissure. This arrangement evidently serves for the establishment of a separation between the liver and the papillose stomach, and proves that here the former does not receive nutritive matter into its cavity. In the Bopyridæ only an indication of this swelling is present, and, indeed, in the partition projecting into the stomach; this, although exactly similar in form and histological structure, does not push itself into the intestine, and is destitute of the chitinous hairs. The mass of the swelling consists of a parenchymatous connective tissue with nuclei, which is coarsely vesicular, especially in the centre. This swelling gradually diminishes; and the narrow lumen, which was previously crescentiform, becomes in transverse section stellate. The folding of the intestinal wall causing this is almost exclusively formed by the greatly thickened cuticula. Fraisse's fig. 7 reproduces this correctly; only the body-cavity (*Kh*) and the trabecula of connective tissue or mesenteries (*B*) that he represents seem to me to be artificial productions. Neither of them exists in my sections. I have also observed a slight displacement of the dorsal vessel at this spot; but it is not so strong as Fraisse represents it, and ceases again further back.

Very soon after the intestine has acquired the above form, it enters into communication with the liver. Of this two anterior lobes, each of which again itself forms considerable diverticula, have previously made their appearance; but at this point they are united into a common cavity, which is situated ventrally to the intestine. Giard says (5, p. 689) that the intestine terminates cæcally, and that the "supposed" hepatic cæca open into its anterior part. This is so far incorrect, that the intestine is decidedly not continued beyond the spot where it communicates with the liver. On the other hand, of course he is the more undoubtedly in the right in saying that no true rectum (*Enddarm*) exists. Fraisse, throughout his memoir, gives this name to the hepatic sacs themselves; but this is certainly to be rejected. In my 'Studien über Bopyriden' I have endeavoured so far to excuse this interpretation, which, however, is certainly morphologically erroneous, by demonstrating that in the Bopyridæ the liver probably takes over partially the function of the intestine, and applying this also to the Entoniscidæ: but I now find that this application was precipitate; for both the above-mentioned peculiar closing apparatus of the middle intestine and the constitution of the epithelium of the liver render it here very improbable that the hepatic tubes have any other than a purely secretory function. Even in the parts nearest to the opening into the intestine the cells of the epithelium have a peculiar form, inflated towards the end; and it is in accordance with this that at this point, immediately beneath the free surface, a drop of secretion is almost regularly accumulated in the protoplasm of the cell (Pl. IX. fig. 8). Immediately beneath the epithelium there is a tunic of connective tissue (perhaps also containing some muscular fibres?), which is considerably thicker than in the Bopyridæ. Close behind the orifice of the intestine the liver divides into two parallel sacs, which again bear strong diverticula. Giard (5, p. 690) asserts that the ramification of these hepatic sacs is less than in *Bopyrus*; but I must contradict this decidedly, and in doing so can appeal to transverse sections, copied by means of the camera. All that we can affirm is, that the ramifications of the liver of *Bopyrus*, in accordance with the depressed form of the body of the animal, spread out more laterally, and consequently are perhaps more striking in the surface view. At any rate, Giard has allowed himself to be deceived by sectionizing a young animal (his section represented in fig. 7 is evidently derived from such a specimen). But even in the Bopyridæ the liver in young animals is simply tubular.

With regard to the apparatus of circulation I have little to add to what has been ascertained by F. Müller, Fraisse, and Giard. That the dorsal vessel in an animal with such soft integuments and such a colossal temporary growth of particular organs, especially the ovary, does not invariably lie in the median line need not surprise us. Nevertheless the transverse sections drawn by me show that the deviation is not very considerable, but confined within narrow limits. A little before the vessel reaches the head it divides; and even previously it emits a number of lateral branches, which it does not appear to me to be necessary to trace. A blood-sinus occurs around the ventral nervous cord; this dilates perceptibly behind. Histologically the blood-vessels of the Entoniscidæ are distinguished from those of the Bopyridæ by their much stronger walls.

Upon the nervous system Fritz Müller has said nothing. Giard thinks that there exist only a supra- and an infra-œsophageal ganglion; but he admits that his investigations upon this point were too imperfect to disprove the existence of a ventral cord. Fraisse, in his transverse sections, repeatedly figures the central nervous system in the right spot; but gives an explanation of them (p. 19) which, from the many vacuoles said to be visible in this organ, must excite some doubts. In point of fact, no such things are to be seen in the nerve-cells; but the nervous system rather exactly fulfils histologically one's just expectations. I trace it as far as a little behind the anterior ventral protuberance nearly to the female sexual orifice; it has therefore the same extent as in the Bopyridæ. That it possesses a segmental division is shown by the transverse sections, in which it appears sometimes larger, sometimes smaller. But as the enlargements in the transverse sections appear to me to be irregular in distance and magnitude, I cannot ascertain the number of the ganglia. The preparation of longitudinal sections which would show them is very difficult, in consequence of the curved form in which the animal dies.

I come now to the ovaries, about which the most erroneous opinions have been put forth. What Fritz Müller says about them, namely that they occupy the dorsal surface, is very little, especially as, in point of fact, they also penetrate to the ventral surface, and, indeed, so far that they meet there in some places.

Fraisse has unfortunately fallen into an unlucky mistake with regard to this organ; he has taken the adipose body for the ovary. This tissue has given rise to unspeakable confusion in the literature of the parasitic Isopoda: Rathke took it for an upper division of the liver; and in *Gyge* Cornalia and Panceri regarded it as salivary glands. In all these cases it is evident that the glandular aspect of the tissue is to blame for the mistakes; and especially the error of taking it for the ovary is easily explained by the enormous size which some of its cells attain, as I have already stated with regard to the Bopyridæ ("Studien über Bopyriden," II.). What Fraisse has regarded as the clear germinal vesicles, and figured in his pl. xxi. fig. 14, are the fat-drops which gradually collect in the protoplasm, but not around the nucleus. This nucleus is very large, especially before the accumulation of fat, and contains numerous nucleoles; the contents of the younger cells is strongly granular, and, as Fraisse has correctly observed, become more intensely coloured or appear of a darker colour than the older, less granular and therefore more translucent cells. It is certainly very probable that in very young animals the connexion of this fatty body with the interstitial connective tissue is as distinct as I have found it to be in the Bopyridæ; but in the Entoniscidæ sectionized by me the demarcation had already become very decided, by which the error of supposing that we have to do with a distinct organ is rendered all the more intelligible. However, there is nothing to be found in it of a special envelope. As my figures * show, the fatty body lies chiefly towards the back. It is only about the œsophagus and the commencement of the middle intestine that it becomes more extensive and pushes its way to the ventral surface; and this seems to explain Fraisse's figures 3, 4, and 5, which, however, do not, as he supposes, represent transverse sections, but somewhat oblique longitudinal sections. In general the fatty body follows the course of the aorta, often separating into several groups, which may then unite some-

* [This refers to coloured figures of successive transverse sections which we have not reproduced.—Eds. *Ann. Nat. Hist.*]

times dorsad, sometimes ventrad of the aorta. It has its greatest extent at the middle intestine, where the cessation of the stomach and the absence of the liver and ovaries leave room for its greater extension. I find it to be least developed in the region of the two large ventral protuberances. In the pleon it again becomes larger.

As Fraisse found the ovaries in the fatty body, it is a matter of course that he regarded the true ovaries as something else. This is the case; and, indeed, it would appear that in doing so he has fallen into *two* errors. In the *adult* animal he described the true ovarial tubes as "long cæca" in which the older ova are deposited; and in this way he explains his remarkable notion of the process of oviposition, to which I have already adverted (p. 88). In my figure 9 (Pl. IX.) I give a representation of these ovarial tubes, in which we can clearly distinguish the still very immature and nucleated younger ova (which are comparatively rich in plasma, and therefore strongly tinted) from the more mature ones (in which the nucleus is invisible and the coloured plasma is displaced, with the exception of a few drops, by the colourless nutritive vitellus). These tubes are not so much strongly branched as rather (as is seen especially in young animals, and is also the case in the Bopyridæ) brought together in a zigzag form. The older the animal, the riper the ova and consequently the longer and thicker the sacs become, the more closely do they appear to be packed together, so that an insight into their arrangement is no longer to be obtained. Anteriorly they extend nearly to the union of the liver and intestine, posteriorly to, or even into, the pleon, in both directions therefore by no means so far as is stated by Fraisse, in consequence of his confounding them with the fatty body.

The two oviducts open laterally in the region between the two ventral protuberances, in young animals more ventrally, in older ones, when the ovaries have occupied and strongly inflated the ventral surface in the protuberances and their neighbourhood, more dorsally. The oviduct is lined with a very thick epithelium of tall cylindrical cells, of which the nuclei are placed at about half the height of their axis; this epithelium probably here also secretes a cementing substance for the deposited ova.

Here we have a fresh mistake of Fraisse's to refer to. It is evidently the oviduct with the just-produced ovary of a *young female* that he has taken for the testis and its orifice. My reasons for this assertion are as follows:—

In the first place, except the oviducts, I have found no glands opening laterally to the exterior, while, on the other hand, Fraisse did not find the orifices of the oviducts, unless these were his testes.

But then his figure 2 (pl. xxi.) evidently represents a transverse section through a young animal, and, indeed, one carried through the spot where the ovaries open. The spot is sufficiently determined by his statement upon fig. 3. That it is a young animal appears with certainty from the fact that no developed ovary is to be seen in this section; for what he indicates as such is also in this case undoubtedly the fatty body. In my fig. 11 I give a section through this part of an immature female; and I think no one will fail to see its agreement with Fraisse's fig. 2. What opens to the right in my figure is undoubtedly the oviduct; it is sufficiently characterized by cylinder-epithelium; and to the left there is a zigzag tube, which certainly represents the immature ovary. This, with its very small cells, is indeed scarcely distinguishable from an immature testis; but a section carried through a mature animal at the same spot leaves no doubt upon the matter. Fraisse's elucidatory figures 16 and 17, indeed, apparently reproduce the appearance of a very moderately preserved animal, and are therefore very indistinct; but I think I can recognize in fig. 17 the cylinder-epithelium of the oviduct, and in fig. 16 the zigzag-shaped immature ovarial tube filled with very small cells. The supposed spermatozoids represented in fig. 18 are enigmatical to me; but, whatever they may be, they do not look like spermatozoids, and they will never prove to us that we have here really to do with a testis.

Giard tells us as good as nothing about the ovary: he says only (p. 687) that it shows four lateral prolongations, two anterior and two posterior, directed from above downwards towards the ventral surface of the *Entoniscus*, and, further (p. 691), that he had already given the description of the ovary. His fig. 7, however, evidently corresponds to Fraisse's fig. 2 and my fig. 11; and his "glandes collétériques" are therefore the immature ovaries. He says indeed that they open "not far from the ovarial orifices," in the neighbourhood of the small ventral process. All this, however, is not very positive. In the transverse section he shows these orifices as actually ventral; but those processes which he calls ventral are, as I have already shown, and as a glance at his figures will remind us, really dorsal. Even in this therefore there is a contradiction. Then it is very singular that he asserts he has seen the ovarial orifices, and yet indicates them in none of his figures. Moreover I am in doubt in what he saw them. Was it in the adult animal *in toto*? Here they are very difficult to find; and if in it he saw two small punctiform holes instead of one, a hundred causes of error may have existed. Or in a transverse section? Then how is it possible that in the transverse section in which his "glandes collétériques" open, there is nothing indicated of the ovary, which is said to open not far from them? I say that, supposing a *developed* ovarium to be in question, there is actually no room for it between the liver and the integument. This latter circumstance would seem to show that the section figured by him was made through an animal such as he represents in figs. 4 and 5, and therefore an immature one; then the position of the "glandes collétériques" exactly corresponds to that of the immature ovary; and to this must be added that the existence of a shell-gland which in early youth is already as large as the still undeveloped ovary itself cannot but appear very doubtful.

In short, I believe that Giard's "glandes collétériques" are identical with the ovaries, although that estimable naturalist is convinced that they undoubtedly secrete the egg-shell.

I have still to refer to two supposed glands, which are indicated by Fraisse in his figures by the letters D and K, one of which he calls a "skin-gland," the other a "cement-gland." He reproduces no histological details in the drawing. As he says of the "cement-gland" that it consists of a great number of much contorted tubes, which are all lined with rather large epithelial cells, it is probably identical with the organ which is shown on the ventral side in my sections 1 and 2. It is very improbable that a gland situated in such a position really secretes a cement for the ova; there is no analogy for any thing of the kind in the class of the Crustacea. To regard it on account of its position as a salivary gland, which Fraisse offers us as another possibility, is likewise not very acceptable. The analogy indicated by him with the salivary glands of *Gyge* and *Ione* (in the latter Fraisse says that he has himself found such glands) would also be wanting, as these have only been erroneously taken for salivary glands, and are in reality parts of the fatty body. I regard these supposed glands as merely the strong folding and frizzling of the brood-leaves finding expression in the transverse section in such forms, and the supposed epithelium as its external epidermis.

As regards the "skin-gland," Fraisse gives neither an explanation nor any evidence of its existence. I have not found it at all.

I have arrived at the conclusion of my description of the internal organization. I would willingly have communicated something of importance on the developmental history. But what Fritz Müller (1, p. 12) says of *Entoniscus*, namely that it "accumulates a whole series of consecutive broods about it simultaneously, so that the material for the whole developmental history might be obtained from the brood-leaves of the same animal," is incorrect, either everywhere or, at any rate, for the European Entoniscidæ. Rearing experiments of all kinds that I have instituted have, however, always miscarried, so that I have never obtained any stages which had not already been observed by my predecessors. I must therefore confine myself to one or two corrections with regard to the newly hatched larva. The pleopoda of the larva do not resemble those given by Fraisse and Giard, but, even in the case of our species, exactly those given by Fritz Müller (1, pl. ii. figs. 11, 12) for *E. porcellanæ.* The outer antenna figured by Fraisse is imperfect. See my figure 6 (Pl. IX.).

In opposition to the differences between the embryos of *E. porcellanæ* and *E. cancrorum*, which Fritz Müller found and arranged in a table, which was afterwards completed by Giard (5, p. 697) for *E. Cavolinii*, I have also something to say. I believe that these are not specific differences, but differences of age, both of which, however, are passed through within the host. Even *à priori* such important differences in embryos of such similar animals are very remarkable and doubtful, and it is interesting to see what strenuous efforts Fraisse has made (4, p. 28 *et seqq.*) to bring these statements into accordance with the Darwinian theory.

As a matter of fact, however, Giard finds the larvæ of *E. Cavolinii* very similar to those of *E. cancrorum*, and different from those of *E. porcellanæ*, especially as regards the development of the last pair of pereiopoda; whilst, on the contrary, Fraisse and I find the larvæ of *E. Cavolinii* rather to agree with Fritz Müller's description of the larvæ of *E. porcellanæ*; and Fraisse asks directly "why the larva of *E. Cavolinii* has not also undergone a similar metamorphosis of the sixth pair of legs"—to which, indeed, he finds only a very hypothetical answer.

Both larval forms, therefore, appear to exist in *E. Cavolinii.* If we remember further that the seventh segment of the pereion is wanting in the larva of *E. porcellanæ*, but present in that of *E. cancrorum*, that the pencil of olfactory threads characteristic of *older* Bopyrid larvæ is wanting in the former (see 1, pl. ii. fig. 4) and present in the latter (2, pl. iii. fig. 3), that the pleopoda in the former are less and in the latter more richly setigerous, and, finally, that the former is considerably smaller (the trunk at least one fourth, and the limbs still more strikingly), we can hardly feel any doubt that we have to do with different stages of age, which are passed through within the host. And in this way also it is explained why the younger larvæ, still adapted for this residence, which Fraisse and I have met with, possessed so much less vitality than those found by Fritz Müller and Giard; under normal conditions they would only have quitted the host after a considerable further development. This is effected, as Fraisse and I suppose, by their tearing open the sac in which their mother is enclosed, by the aid of the more strongly developed last pereiopoda. In numerous attempts to inject this sac I have never been able to drive out the fluid through any previously existing aperture. Consequently it does not seem to me very probable that this sac is one of the internal organs of the host; and I therefore incline towards Fritz Müller's opinion, that it is actually an invulsion of the integument, in which the aperture of invulsion may have closed up.

That the Entoniscidæ undertake a change of hosts, as Fraisse believes, seems to me not very probable. In the first place, such a change appears to be unnecessary to bring the animal to its definitive locality; even if no invulsion occurred, the same organs which aid the larva in escaping from the closed sac would be able to assist it again into a new host. Secondly, however, the larva figured by Fritz Müller (2, pl. ii. fig. 3), as regards the stage of its development, completely reminds us of the Bopyrid larva figured by me ("Studien über Bopyriden, II.," pl. 34. figs. 9, 10) as it actually attaches itself to the *definitive* host. This has still only a small secondary branch developed on the pleopoda and the seventh pereipoda, which must probably have taken place, not on an intermediate host, but during free existence.

EXPLANATION OF PLATE IX.

Fig. 1. *Entione Moniezii*, Giard, mature female, seen from the side.
Fig. 2. The same species, immature female, from the side.
Fig. 3. Head of the latter in front.
Fig. 4. *Entione Cavolinii*, male, from the side.
Fig. 5. Head of the same, seen from the ventral side.
Fig. 6. Larva immediately after exclusion.
Fig. 7. Region of the mouth of *E. Cavolinii*. *a, b, c, d*, successive sections through the œsophagus.
Fig. 8. Epithelium of the liver.
Fig. 9. Ovarian sac.
Fig. 10. Somewhat oblique section across the oviduct.
Fig. 11. Section through an immature female. *a*, liver; *b*, fatty body; *c*, nervous system; *d*, vessel; *e*, ovary.

XI.—*On some new Species of Spiders of the Genus* Cœrostris *from Madagascar*. By Arthur G. Butler, F.L.S., F.Z.S., &c., Assistant-Keeper, Zoological Department, British Museum.

[Plate VI.]

In a large collection of Spiders recently obtained by the Rev. Deans Cowan in Madagascar I detected an unusual number of forms of this interesting genus of Gasteracanthidæ. In addition to female specimens of *C. mitralis*, *avernalis*, and *stygianus**, of which figures have been published, I found females of a species allied to *C. tuberculosa* of Vinson and *sexcuspidata* of Fabricius; also the female of a fine species apparently allied to *C. Keyserlingii* of Caffraria, a species near to *C. Wahlbergii* in both sexes, with one or two others of less interest.

1. *Cœrostris extrusa*, sp. nov. (Pl. VI. figs. 3, 3 *a*, 3 *b*.)

♀. Cephalothorax dark piceous, rather longer than broad, laterally constricted and dorsally depressed behind the caput; the latter twice as broad as long, with six tubercles, two on each side and two at the back; central oculiferous tubercle rather prominent, the eyes upon it larger than those of the lateral tubercles, the anterior pair decidedly nearer together than the posterior, the four eyes together forming a trapezium; lateral eyes placed obliquely, the anterior ones being larger than the posterior. Abdomen chocolate-brown above, with a broad, central, longitudinal, creamy yellowish band, divided in its basal half by a more or less defined longitudinal brown stripe, having parallel decreasing pinnate processes on both sides, the anterior and ventral surfaces yellowish testaceous; the anterior and lateral surfaces are also impressed with regular parallel lines on which are black dots; in form the abdomen is elongate scutiform, subcaudate and deeply bifid behind; the anterior margin is bounded by eight regular conical mammoid tubercles, the last of which on each side forms the anterior of three equidistant tubercles placed upon a slight projecting process rising from the dorsal surface; the lateral margin, instead of curving gracefully inwards towards the caudal process, is slightly interrupted in the middle by a small tubercle or pustule, which gives it a decided angularity of outline; two other pustules are placed towards the side and at

* It is possible that *C. mitralis*, var. *turrigera*, of Thorell may represent highly developed examples of this species; the abdominal processes, however, are shorter in adult examples seen by me.

about the middle of the dorsal surface; the usual six impressed dots are present. Legs piceous, flattened and grooved above, cylindrical below, setose, relative length 1, 2, 4, 3; palpi piceous, flattened, setose; falces blackish, very large, with double series of five teeth, of which the fourth in each series (placed at the inner angle) is decidedly the largest; maxillæ and labium piceous, with testaceous anterior borders, of the normal shape; pectoral shield heptagonal, sinuated in front; epigyne black. Length (including cephalothorax) 21 millim., of abdomen alone 18, of cephalothorax (including falces) from base $6\frac{1}{2}$, of falces 4, first pair of legs 26, second 23, third 16, fourth 21 millim.

Betsileo Country, Madagascar.

In the form of its legs this species seems to agree with Walckenaer's *Epeira imperialis*, which, unless it be taken from a dried and much distorted example, can hardly be the *E. sexcuspidata* of Fabricius.

The black dots on the borders of the abdomen probably represent the absent ocelli.

2. *Cœrostris retorta*, sp. nov. (Pl. VI. figs. 6, 6 *a*, 6 *b*.)

♀. Cephalothorax mahogany-red, nearly square, laterally arched and dorsally shelving behind the caput; the latter more than twice as broad as long, clothed with whitish and yellowish pilosity; oculiferous tubercles very prominent, the central one rather higher behind than in front; the eyes small, forming a short trapezium; lateral tubercles slightly oblique, less so than in some of the species; the four tubercles of the hinder series very long, especially the lateral ones, which are like obtuse spines. Abdomen testaceous, with the anterior protuberances buff-coloured; anterior surface buff-coloured, crossed by four longitudinal brown lines, two from the bases of the protuberances and two central; sides and posterior border whitish; anterior margin with six tubercles in pairs, two others placed behind the first and last upon the base of the protuberances, the latter very long, reflexed, flattened in front, tapering, bifid at apex, and with two internal lateral acute tubercles, one near the base and the other beyond the middle; the anterior surface of the abdomen is regularly triplicate, and the lateral and posterior surfaces less regularly plicate; ventral surface, as usual, flattened; blackish piceous, with testaceous margins. Legs whitish, banded with brown; the tarsi and metatarsi flattened above and longitudinally grooved, otherwise cylindrical, setose, tapering; relative length 1, 2, 4, 3; palpi castaneous, clothed with yellowish bristles, flattened; falces castaneous, with blackish culm and movable claw, with two series of four teeth along the anterior margins, the fourth at the angle slightly largest; maxillæ and labium blackish, with yellowish anterior borders; pectoral shield obtusely pentagonal, castaneous; coxæ and femora below castaneous. Length (including cephalothorax) 16 millim., of reflexed abdominal protuberances 7 millim.

East coast of Madagascar.

This singular species seems to me to approach *C. Keyserlingii* in structure; it is also somewhat allied to *C. avernalis.*

3. *Cœrostris ecclesiigera*, sp. n.
(Pl. VI. figs. 1–1 *c* & 2–2 *c*.)

♂. Cephalothorax nearly square, castaneous, slightly expanded and obliquely depressed behind the caput; the latter twice as broad as long, densely clothed with appressed sericeous whitish pilosity; oculiferous tubercles very prominent, the central one forming a short trapezium a little broader than long; eyes rather small, black; lateral tubercles less prominent than the central one, slightly oblique, the eyes smaller; two prominent tubercles on the posterior margin of the caput, separated from each other by the central sutural impression and a little wider apart at their apices than the posterior central pair of eyes. Abdomen testaceous, pyriform, with longitudinally and transversely plicate anterior and concentrically plicate lateral and posterior surfaces; ascending towards the front, where it is crowned by a broad central conical tubercle, preceded on the anterior margin by two short tubercles; a rather short conical tubercle (considerably shorter than the central one) on each side and a little behind the central one; ventral surface nearly flat, greyish, with a brown spot in the region of the spinnerets. Legs castaneous, barred with whitish above, but the tarsi yellowish below, the upper surface flattened, longitudinally grooved, clothed with short whitish pilosity, below cylindrical, relative length 1, 2, 4, 3; palpi yellow, rather short, cylindrical, with enormous pyriform bulb, slightly convex and setose on the upper surface, inarched, but with an obtuse convex keel on the under surface; a small bead-like blackish pustule at the apex of the inferior margin, which is the true termination of the bulb; falces pale castaneous, the movable claw reddish with blackish base, the teeth I cannot determine; maxillæ, labium, and coxæ pale olivaceous; pectoral shield pentagonal, with a central patch of white hairs, but otherwise dark castaneous. Length (including cephalothorax) $5\frac{1}{2}$ millim.

♀. Cephalothorax nearly square, castaneous, slightly expanded and arched at the sides, and obliquely depressed on the dorsal surface behind the caput, the latter twice as broad as long, clothed with short golden yellowish pilosity; oculiferous tubercles very prominent, the central one forming a short trapezium, a little broader than long, the eyes upon it rather small and about equal in size, black; lateral tubercles, as in the male, scarcely oblique, with the anterior eye decidedly larger than the posterior; one tubercle on each side and two mammoid tubercles, as in the male, upon the posterior margin, all black-tipped. Abdomen testaceous, pyriform, but enormously developed forwards, so as to conceal the anterior margin when looked at from above; anterior surface ornamented from the lateral margins of the central protuberance by a longitudinal whitish stripe, and in front of the protuberance by a Y-shaped marking of the same colour; the anterior margin runs over the front of this protuberance (which is very long and pyramidal), and which thus bears three out of eight small conical tubercles which bound the margin; on each side of, and a little behind, the central protuberance is a shorter and incurved one bearing on its outer edge two short but ill-defined tubercles, which widen its base; lateral and posterior surfaces concentrically plicate; ventral surface nearly flat, dark brown, with the margins and a pentagonal scutiform patch behind the epigyne (and dotted with six black dots in converging series of three each) ochreous. Legs castaneous with paler bands, flattened and clothed with fulvous bristles above, cylindrical, with more or less yellow tarsi below, relative length 1, 2, 4, 3; palpi castaneous, densely clothed with fulvous bristles, flattened, terminating in a short fine spine-like point; falces reddish castaneous, with the culm and movable claw blackish; teeth very small, four on each side; maxillæ and labium olivaceous, with yellowish anterior borders; coxæ olivaceous; pectoral shield pentagonal, piceous. Length (including cephalothorax) 9½ millim., height of anterior central abdominal protuberance from posterior margin of caput 7 millim., from its anterior base 3 millim.

Central Madagascar.

A second male differs somewhat in form and very much in coloration, so that at present I hesitate to regard it as a variety of this species. *C. ecclesiigera* is evidently allied to *C. Wahlbergii* from Caffraria, yet exhibits too many discrepancies from Dr. Thorell's description to permit its identification with that species. It is also allied to *C. Petersii* of Karsch, though by no means so specialized a form as the latter.

4. *Cœrostris Cowani*, sp. n. (Pl. VI. figs. 4, 4 *a*.)

♀. Cephalothorax dark mahogany-red, but with the caput when dry silvery white, nearly square, but expanded laterally and depressed dorsally behind the caput; central oculiferous tubercle very prominent; eyes black, forming a short trapezium, the posterior pair being slightly larger than the anterior, a little wider apart than the latter, the two pairs separated from one another by an interval about equal to that between the two eyes of the anterior pair; lateral tubercle transverse, the eyes small, especially the posterior ones; a small lateral tubercle behind the eyes on each side, and two mammoid tubercles near the back of the caput. Abdomen elongate, pentagonal, conically excised at the back, golden brown, with a broad sericeous white belt spotted with brown occupying the anterior surface, extending into the anterior lateral processes, between which it is crossed by a streak of golden brown, behind which it contracts, is again crossed by a brown spot, and then terminates abruptly at about the centre of the dorsal surface; six conical tubercles, in pairs, arranged across the anterior surface, and a little behind them two long lateral, slightly compressed and obliquely ascending subcylindrical processes, one on each side, their apices feebly bituberculate; a small, very acute, central tubercle between and a little more forward than these two; two conical tubercles placed laterally halfway between the lateral processes and the extremity of the abdomen, their anterior half golden brown, and their posterior half white, and between and beyond these in the dorsal region a pale irregular band in continuation of the central longitudinal belt; ventral surface whity brown, with a broad blackish central belt behind the black epigyne, bounded on each side by three conspicuous white spots; falces piceous, with a few silvery white hairs towards their bases; movable claw tipped with castaneous; six teeth on each side, of which the first and fourth pairs are much the largest. Legs and palpi above setose, somewhat flattened, but less so than in most species, castaneous red, marbled with stramineous; tarsi banded in the centre with white and tipped with blackish, below smooth shining reddish castaneous, cylindrical; relative length, as usual, 1, 2, 4, 3; maxillæ and labium blackish, with pale golden-brown fringes and pale olivaceous anterior borders; pectoral shield scutiform, truncated in front, imperfectly heptagonal. Length (including cephalothorax) 11 millim., of lateral anterior abdominal processes 2 millim.

East coast of Madagascar.

Of this beautiful though not very large species we have three female examples, all of which, when dry, exhibit precisely the same pattern and coloration. Another species having the same general form, though differing wholly in pattern and in the number of mammoid tubercles across the front of the abdomen, was received with *C. Cowani*.

5. *Cœrostris excellens*, sp. nov. (Pl. VI. figs. 5, 5 *a*.)

♀. Cephalothorax almost square, a little longer than broad, expanded and arched behind the caput, where it is abruptly and deeply excavated, its centre yellowish, shading into castaneous red in front and at the sides; caput nearly twice as broad as long, snow-white, yellowish in front, and with a black, longitudinal, impressed central dash behind the central oculiferous tubercle, the latter very prominent, forming a short trapezium, black in the centre and with the eyes almost wholly black, rather small, especially the anterior pair, between which and the posterior pair there is a shorter interval than in the preceding species; lateral tubercles prominent, slightly shorter behind than in front*, the eyes very small; two obtusely conical lateral brown tubercles (one on each side) behind the latter, and two widely separated similar tubercles near the back of the caput. Abdomen formed nearly as in the preceding species, but decidedly longer, sericeous whity brown, crossed in front by parallel series of minute black sigilla, the last series being placed behind the anterior arched series of tubercles; the latter, which form the anterior margin, are eight in number, the third and sixth small and slightly behind the line of the others, conical; behind the first and last there is on either side a deeply bifid obliquely ascending process; a little in front of and in the central line between the two lateral processes is a rather large conical tubercle; nearly halfway between the lateral processes and the base of the bifurcation of the posterior margin there is on each side a similar conical tubercle, and immediately in front of the bifurcate terminal process are two very obtuse tubercles; a black band runs down each side of the abdomen, across the two outside anterior tubercles and the lateral processes, to beyond the middle of the lateral surface; there is also a brown central longitudinal ovoid spot between the four ordinary black dots; behind this and including the posterior lateral tubercles are two transverse black dashes, behind which, again, are two slightly convergent black longitudinal bands, terminating in the bifid process, which is also black; ventral surface olivaceous, with a broad central black band, bounded on each side by three white spots. Legs with the femora bright reddish castaneous, the tibiæ and tarsi black banded with white, flat-

* The reverse is the case in most species.

tened and setose above, cylindrical below; palpi castaneous, with the terminal article black banded with white, flattened and setose; falces piceous, castaneous at the base and above, with the basal half densely covered with white pilosity; movable claw tipped with reddish castaneous; teeth apparently as in the preceding species; maxillæ and labium olivaceous, with whitish anterior borders; pectoral shield black, with a few appressed white hairs, heptagonal. Length (including cephalothorax) 11 millim., of lateral anterior abdominal processes 1½ millim.

East coast of Madagascar.

EXPLANATION OF PLATE VI.

Fig. 1. *Cærostris ecclesiigera* ♂, natural size.
Fig. 1*a*. Abdomen (from behind), of twice the natural size.
Fig. 1*b*. Palpus.
Fig. 1*c*. Tarsal claws of first pair of legs.
Fig. 2. *Cærostris ecclesiigera* ♀, natural size.
Fig. 2*a*. Abdomen (from behind), natural size; 2 *b*, profile.
Fig. 2*c*. Tarsal claws of first pair of legs.
Fig. 3. *Cærostris extrusa* ♀, natural size.
Fig. 3*a*. Caput, showing eyes and tubercles.
Fig. 3*b*. Tarsal claws of first pair of legs.
Fig. 4. *Cærostris Cowani* ♀, natural size.
Fig. 4*a*. Tarsal claws of first pair of legs.
Fig. 5. *Cærostris excellens* ♀, natural size.
Fig. 5*a*. Tarsal claws of first pair of legs.
Fig. 6. *Cærostris retorta* ♀, natural size.
Fig. 6*a*. Profile view.
Fig. 6*b*. Tarsal claws of first pair of legs.

XII.—*New Sponges, Observations on old ones, and a proposed New Group.* By H. J. Carter, F.R.S. &c.

Order III. PSAMMONEMATA.

Fam. 1. **Bibulida.**

Group 1. Euspongiosa.

Euspongia compacta, n. sp.

Thin, horizontal or vertical, extending concentrically from a pedunculated or contracted irregular base, terminating at the circumference in an irregularly-fissured round margin. Consistence that of very compact felt. Colour dark fawn when fresh, light fawn or grey after exposure when dry; dermal sarcode colourless. Surface uniformly plane on both sides, interrupted only by the pedunculated attachment; minutely reticulated in relief from the subsidence of the dermal sarcode upon the subjacent fibrous structure, which terminates in little tags, each of which bears a sand-thread. Vents numerous, small, circular, each provided with an annular diaphragm of the dermal sarcode; disposed singly or in scattered groups on one side, more plentiful and more or less in juxtaposition on the other; when single and isolated, presenting a stelliform arrangement of the superficial branches of the excretory canal-system, but when on the margin running in straight lines towards the latter. Pores in the interstices of a soft fibrous reticulation *in* the dermal sarcode which tympanizes the interstices of the subdermal fibrous reticulation. Internal structure composed of fine keratine fibre, densely reticulated, whose interstices are tympanized by the internal sarcode, here and there presenting a sand-thread, which terminates in the "tags" on the surface; traversed plentifully by the branches of the excretory canal-systems that finally end in the vents. Size of specimen about 8 by 5 inches in its longest diameter, and $\frac{3}{4}$ inch thick.

Hab. Marine.

Loc. South Australia, "off Darien Island;" Woolongong and Port Fairy.

Obs. This sponge, from its composition and structure, is evidently a very compact form of the officinal kind, too compact, indeed, if not thin, to be of any use for domestic purposes. Although I am at present in possession of several specimens, my description is chiefly taken from one belonging to the British Museum, which has been preserved in spirit and bears a label with "J. B. Jukes. Off Darien Island" on it, together with "J. 121." in the corner; from which I infer that it was obtained at least from the south coast of Australia, as two of the other but dried specimens bear labels respectively on which "Woolongong" and "Port Fairy" are written. In the absence of any register-number, I make this inference because a great number of both wet and dry specimens of sponges from these localities in the British Museum bear the well-known name of the late Mr. J. B. Jukes; and I cannot find out where "Darien Island" is or if there be such a place. My running-number on the label is 619.

I have already alluded to the world-wide occurrence of the group Euspongiosa under different forms ('Annals,' 1882, vol. ix. p. 273), which has been made the first in my order Psammonemata because it contains the *least* quantity of sand-thread (fibre axiated with foreign bodies), while the second, viz.

Paraspongia, only differs from the first group in presenting a larger and more evident quantity, which, of course, deteriorates the quality of the sponge. So scanty is the sand-thread in the officinal sponges that, in preparing them for the market, the little tags on the surface containing it are frequently washed off, when it becomes difficult to find their continuation internally; and thus its existence may be doubted. However, it is always present in the *fresh* specimen, which has been preserved in spirit from the commencement. The dermal sarcode on *Euspongia compacta* is colourless, not black or purple, as it is on the officinal sponges, which accounts for Aristotle's observation, made on the latter *circa* 330 B.C.! viz.:—"When alive, before they are washed, they are black" (Hist. of Animals, B. v. chap. xiv. p. 119, Engl. transl. Richard Cresswell, M.A., Bohn, 1862).

Fam. 2. **Hircinida.**

Group 4. CALLHISTIA.

Taonura * *flabelliformis*, n. sp.

Fan-shaped, thick, stipitate, more convex on one side than the other (such as a cast of the interior of a clam-shell would be), thinning out to the circumference, which is circular, with an obtuse margin. Consistence soft, resilient. Colour yellow-amber. Stem short, thick, hard, gnarly, sometimes branched and naked for a short distance before the flabellate expansion begins. Surface rendered more or less smooth, probably by the dermal sarcode, when fresh; now largely irregular by a succession of depressions, becoming smaller and more numerous towards the circumference, presenting the appearance of imbrication, probably caused by the once projection of the feathered ends of the subdivided branches. Vents large, arranged linearly along the margin, Pandean-pipe-like. General structure radiating, so that when held up to the light the lines may be observed to extend from the stem to the circumference, where they are found to mark the intervals between the main canals of the excretory system, which take the same direction and end in the vents there. Minute structure fibrous, reticulated, forming a soft fine keratine tissue, in which the vertical fibre is axiated with foreign bodies and the lateral branches simple. Size of specimen about 1 foot broad by 6 inches high and 1½ inch thick near the base; sometimes longer than broad.

* ταῶς, peacock, οὐρά, tail.

Hab. Marine.

Loc. South Australia, Illawarra, &c.

Obs. This sponge is described from the washed-out skeleton, of which there appear to have been a great number of specimens on the south coast of Australia, most of which, I suppose, have now been picked up for preservation. I have placed them in the fourth group of the Psammonemata, viz. the Callhistia, on account of their beautiful texture; but, like most of the groups in the family of Hircinida, they all have the same kind of psammonematous fibre, differing only in its amount, the rigidity of the fibre itself, its peculiar structure, and the general form of the specimen; how many of which may be varied forms of the same species I am unable to state, as almost the whole family have been grouped together from the *skeletons alone*, which form a great part of the collection in the British Museum, and appear to have been chiefly obtained from the south coast of Australia. Thus, much here being empiric, much will have to be supplied hereafter before the Hircinida can be satisfactorily distinguished and classified. Meanwhile this form furnishes a typical example of the group Callhistia, promised in the third part of my "Notes," &c. There are several specimens of *Taonura* in the British Museum which bear my running number 66, registered 44. 9. 13. 3, 6, 7, 4, and 13, which apparently were collected by Mr. J. B. Jukes.

Order IV. RHAPHIDONEMATA.

Fam. 1. **Chalinida.**

Group 2. Palmata.

Chalina palmata, Crtr.
(=*Halichondria palmata*, Johnst.,=*Isodictya palmata*, Bk.)

The palmate form of this sponge, being often like a hand (whence the name "Mermaid's Glove" in Shetland at the present day), has caused it to be recognized for nearly a century, commencing with Ellis and Solander's illustration in 1786 (Nat. Hist. of Zoophytes, p. 189, tab. lviii. fig. 6), designated *Spongia palmata.* Finally, after having received many different names, Dr. Bowerbank, in 1866, placed it in his genus *Isodictya* (Mon. Brit. Spong. vol. ii. p. 311), and in 1874 gave a figure of it under the form of the "Mermaid's Glove" and the name *Isodictya palmata* (ib. vol. iii. pl. lii.), having made the following observation in his earlier description (*l. c.*), viz:— "This sponge is, I believe, the Mermaid's Glove of the

Orkney fishermen;" but if we are to be influenced by the form only, since he does not add, as in many instances, that it has been identified with the type specimen, then it is necessary to look at Johnston's illustration (Brit. Spong. pl. ii. fig. 1), where we shall find nothing but a common branched sponge, without any likeness whatever to a hand or glove. I myself also have a straight branch about 6 inches long and 1 inch in diameter at the base, which is somewhat contracted, wherein the vents are confined to a line on both sides in the way noticed by Fleming (Brit. Animals, p. 523), and the specimen so little compressed that it is almost identical in form with a similar growth of *Chalina rubens*; but feeling almost certain that it was a genuine specimen of *Chalina palmata*, since, although of a grey colour from being a washed-out portion, traces of the peculiar anchorate first described and illustrated by Dr. Bowerbank (*l. c.*) still exist in it, I sought the comparison which Bowerbank seems not to have done, viz. microscopic examination of the type specimen labelled *Halichondria palmata*, no. 2, registered 47. 9. 7. 1, now in the Johnstonian collection at the British Museum, and found that this also is not only a washed-out one and grey in colour, like my own, but also now contains only towards the axis of the branch, some of the characteristic anchorates (not like that in the Bowerbank collection, which is the aforesaid "Mermaid's Glove" form, with the sarcode on, and of a brown colour, charged abundantly with the anchorate). Thus Dr. Bowerbank's specimen becomes identified with the type specimen in the Johnstonian collection. It requires some time, however, to find out the anchorate in the latter, even with the aid of soaking in liq. potassæ, wherefore, perhaps, it is not figured in my first and rather hurried examination made several years ago; and it is just possible too that this accounts for Dr. Bowerbank's silence on the point.

As regards change of nomenclature, it might be observed that, when we find Johnston placing this sponge next before his *Halichondria oculata* and *H. cervicornis* (op. cit.), which were rightly designated by Dr. Bowerbank "Chalinæ" (B. S. vol. ii. pp. 361 and 364), and that Dr. Bowerbank's diagnosis of *Isodictya* (ibid. p. 9) begins thus:—"Skeleton without fibre, composed of a symmetrical network of spicula," &c., type specimen "*Isodictya palmata*," while that of his "Chalina" (ibid. p. 13) commences with "Skeleton fibrous. Fibres keratose, solid, cylindrical, and interspiculate" [? introspiculate], type specimen "*Chalina oculata*," it will not be considered unreasonable, as the specimens in the Johnstonian collection and my own also would, in their "washed-out" state, have had no existence but for their keratose chalinoid fibre (see Bowerbank's illustration, *l. c.* fig. 2), that I also should propose the generic term "*Chalina*" instead of "*Halichondria*" for this sponge.

Let us now turn our attention for a few moments to the anchorate (woodcut, fig. 1, *a*, *b*), whose peculiarities demand special consideration, for it differs considerably from any that have hitherto come under my observation.

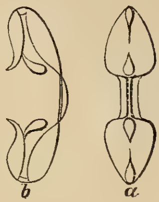

Fig. 1.—Anchorate of *Chalina palmata*, greatly magnified. *a*, front view; *b*, lateral view.

Thus it is equiended ("equianchorate"), as stated by Dr. Bowerbank in 1866 (*l. c.*); moreover, when viewed in front, it presents the canoe-shape of this spicule, to which I have applied the generic term of "naviculiform" (fig. 1, *a*); but when viewed laterally (fig. 1, *b*) the crumpled appearance which *is* represented in Dr. Bowerbank's illustrations (*l. c.* figs. 3, 4, and 5), but not the "bifurcate terminations" of the anterior arms, although rightly mentioned in both his earlier and later descriptions, which are *not* illustrated. Examining it more particularly we find that the term "siliceo-membranous," used by Dr. Bowerbank, well applies to the whole spicule, and hence its "crumpled appearance;" while others of the same kind in other sponges which are stiffer do not yield in this way, but maintain their straight navicular shape when viewed in *all* directions. In *Chalina palmata*, however, the shaft of the anchorate is much thinner towards the ends ("siliceo-membranous") than in the middle, which may account for its bending up there; it is also alate on both sides throughout, the aliform portion being narrow in the middle third, and then expanded circularly on each side, after the manner of the wing-like appendages of these spicules generally; while the anterior arm or appendage, being obovate, leaf-like, or petaloid (fig. 1, *a*), and supported in the centre by a process like a midrib extended from each end of the shaft, appears, when viewed laterally (fig. 1, *b*), to be bifurcated, which seems to arise from the extension inwards of a process from the midrib, and outwards by an eversion of the free border of this petaloid arm (as is often the case), termed by Dr. Bowerbank "exflected." This gives the anchorate of *Chalina palmata* its peculiar appearance, which I have never noticed before except in *Microciona affinis* (from the Gulf of Manaar), where the free extremity of the anterior arm presents a "fish-hook"-like form, that I have endeavoured to illustrate ('Annals,' 1880, vol. vi. p. 41, pl. iv. fig. 15), but, from the minuteness of the object, could not explain.

Returning to the description of this sponge generally, it seems to me that Schmidt has wrongly identified his *Reniera palmata* with the *Spongia palmata* of Ellis and Solander (Spong. Adriatisch. Meeres, p. 74); for if we look at their representation (*op. et loc. cit.*) we shall find that it is a branched form with prominent pustular vents on the *surface*, which would not have been the case had they been at the ends of the branches, as stated in Schmidt's diagnosis of his *Reniera palmata*, viz. "in extremitate plerumque observatur osculum;" for both do not occur together. Besides, the type specimen of the latter in the British Museum (no. 75) is soft, fragile, and isodictyal, while that of *Chalina palmata* is tough and fibrous, to say nothing of the absence of any flesh-spicule.

Among Dr. Bowerbank's general collection of sponges now in the British Museum there are several specimens of one which, in its structure, spiculation, and colour, although not in general form, very much resembles *Chalina palmata*; but they are so worn down by having been washed about in the sandy beach from which they were probably picked up for preservation, that, although their general form and structure remain, it is difficult to say positively if they originally possessed those fringe-like growths around the vents which would conclusively identify them with other specimens of the like kind that have been known for many years past. Thus Esper represents one, under the name of *Spongia compressa* (tab. lv.), which, but for the "fringes," seems to be identical with that in question; while Ehlers, who in 1870 examined Esper's specimens in the museum at Erlangen with the view of identifying them with Schmidt's nomenclature, calls it "*Desmacidon compressa*," whereby we learn that it has the characters assigned by Schmidt to this genus in 1868, viz. a network formed of spiculo-fibre, the skeleton-spicule an acerate, and the flesh-spicule an *equianchorate* (Spong. Küste Algier, p. 11), which are just those of the sponge to which I have alluded, and which, but for the *un*crumpled form of the naviculiform anchorate, would be those of *Chalina palmata*; hence I shall now describe it, as far as the specimens will permit, under Esper's specific and my own generic appellation, thus:—

Chalina compressa, Esper.

Battledore-shaped, compressed, for the most part broader than long, subelliptical transversely, thick, sometimes subpyriform by proliferous growth; round on the free edge, becoming contracted and stipitate on the other. Consistence firm, resilient. Colour now light yellowish grey. Surface on both sides even for the most part, but sometimes proliferously lobed, as above stated. Vents large, confined to the margin, arranged irregularly in one or two lines, Pandean-pipe-like, or on the prominent parts of the lobes when there are any; raised round the orifice, and presenting the remains apparently of a fringe. Structure fibro-reticulate; fibre kerato-spiculiferous, with the vertical lines most pronounced, traversed by the excretory canals, which, radiating from the stem upwards, end in the large vents on the margin. Spicules of two kinds, viz.:—1, skeletal, acerate, fusiform, curved, gradually sharp-pointed at each end, smooth, 89 by $5\frac{1}{2}$-6000ths inch in its greatest dimensions; 2, flesh-spicule, equianchorate naviculiform, about 6-6000ths inch long; the former chiefly confined to the fibre, and the latter plentifully distributed throughout the sarcode. Size variable according to the specimen, say 6 inches broad and 4 inches high without the stem; $\frac{1}{2}$ to 1 inch in thickness; stem thick, compact, and stout.

Hab. Marine.

Loc. ?Algoa Bay.

Obs. While the other structures and spiculation are the same as in *Chalina palmata*, the equianchorate differs in not being bent upon itself and in the absence of the peculiar bifurcation at the end of the anterior or petaloid arm. Again, while the anchorate in *Chalina compressa* represents, as it were, a canoe cut entirely down to the keel in its middle third, which would thus represent the shaft only, that of *Chalina palmata* is, as it were, alate on each side of the keel (fig. 1, *a*). One of the specimens (for there are several) evidently presents the remains of a raised and apparently fringed border round the vents, which tends to identify it with Esper's *Spongia compressa*, if not also with the *Spongia tubulosa* of Pallas (Elench. Zoophytorum, no. 229, p. 383), although the other specimens are so rounded by attrition that, if there was any thing of this kind, it is all washed off. The raised pustular margin round the vents is also a feature of *Chalina palmata* (see Johnston, p. 93, pl. ii. figs. 1 and 4, also Ellis and Solander, p. 189, tab. lviii. fig. 6). As to colour, it might have originally been brown or amber, instead of grey (as the specimens now are); but this is the case with those of *Chalina palmata* under similar circumstances, viz. after having been exposed to the action of the surf, as the amber-colour of the "Mermaid's Glove" in the Bowerbank collection indicates. Thus, too, there is a specimen in the British Museum, no. 39, registered 71. 6. 5. 1, from Port Elizabeth (that is, also in Algoa Bay), South Africa, which in general form, structure, and spiculation is almost identical with *Chalina compressa*, but, not having been exposed to the action of the surf, still retains the fringes round the vents, and presents an amber-brown colour. No. 205 *bis*, registered 50. 2. 5. 4, from the Falkland Islands, and no. 42, registered 71. 6. 5. 1, also from Port Elizabeth, appear to belong to the same category.

Order V. ECHINONEMATA.

Fam. 1. **Ectyonida.**

Group 1. Pluriformia.

Echinonema vasiplicata, n. sp.

Vasiform, plicate, stipitate; wall stout, continuous, meandriniform; margin round. Consistence compact, firm. Colour light grey now, ? originally purple. Surface even throughout, both outside and in. Vents not obvious. Pores probably as usual, in the dermal sarcode tympanizing the interstices of the reticulated subdermal tissue. Structure fibro-reticulated; fibre kerato-spiculiferous, echinated, finer on the surface than internally. Spicules of three forms, viz.:—1, skeletal, acerate, curved, fusiform, pointed at each end, smooth, varying much in size, the largest being 62 by 2-6000ths inch in its greatest dimensions; 2, echinating, straight, clavate, round at the ends, spined throughout, spines recurved, longer over the middle than at the ends, 21 by 2-6000ths inch in its greatest dimensions, not including the spines; 3, thin, setaceous, acuate, about the same length as the skeletal spicule, scanty. Size of specimen 4½ inches high, 3¾ inches across the brim; cavity 3½ inches deep.

Hab. Marine.

Loc. Swan-River district; Freemantle, S.W. Australia.

Obs. There is a specimen of this kind in the British-Museum collection, viz. no. 594, registered 72. 5. 21. 46, also labelled "Swan River." That above described belongs to the Bowerbank general collection.

Trikentrion lœve, Crtr.

This name was proposed for a little digitate branched specimen in the British Museum, described and illustrated, so far as the spiculation goes, in the 'Annals' for 1879 (vol. iii. p. 294, pl. xxvii. figs. 9–12), which up to this time had appeared only from the "west coast of Africa;" but the one which I am now about to notice was found without label among a set of sponges in the Bowerbank collection from the coast of S.W. Australia, whereby I am inclined to infer that it also came from this locality. Although totally different in form, it possesses the same kind of spiculation, and is infested apparently by the same kind of parasitic polyp; but, being much waterworn and correspondingly mutilated, I can only give the following description of it, viz.:—

Irregularly fan-shaped, very thin, stipitate. Consistence firm. Colour now cinnamon-brown. Infested with a parasitic polyp (*Bergia*), whose anastomosing stoloniferous growth forms a branched reticulation of a white colour that contrasts strongly with that of the sponge, over both sides of which it has spread itself. Size of specimen about 4½ inches square and ⅛ of an inch thick.

Although the stem is nearly worn off and the edge generally appears to have equally suffered in the surf, yet the general thickness cannot have been much reduced, or the branches of the parasitic polyp would not be still existing almost in their entirety over the plane surfaces. The structure and spiculation need not be described, as they would hardly be different from those of the little digitating branched specimen above mentioned.

Order VI. HOLORHAPHIDOTA.

Fam. 1. Renierida.

Group 4. Carnosa.

Reniera crateriformis, n. sp.

Globular, thick, excavated, sessile; excavation cup-like, conical; vertically ridged externally, smooth within. Consistence friable. Colour now whitish grey outside, light brown internally. Surface covered with a fine dermal spiculo-fibrous reticulation, rendered irregular on the outside by the presence of the vertical ridges, which, becoming shorter and more multiplied upwards by subdivision and addition, finally end in the thin and even margin of the excavation. Vents chiefly on the inner surface and towards the bottom of the excavation; the rest, which are few in number and smaller, external on the ridges. Pores in the fresh state probably in the sarcode tympanizing the interstices of the fine dermal fibro-reticulation. Structure internally fibro-reticulate, fibre almost entirely composed of the spicules of the species, glistening, asbestus-like; traversed by the branches of the excretory canal-system, which are very large and chiefly end in the vents opening into the bottom of the excavation. Spicule of one form only, viz. acerate, large, curved, fusiform, sharp-pointed at each end, smooth, about 90 by 6-6000ths inch in its greatest dimensions; chiefly confined to the formation of the spiculo-fibre. Size of specimen about 7½ inches in diameter; excavation 4½ inches across the brim, and 3½ inches deep.

Hab. Marine.

Loc. ? Australia (so said by the dealer).

Obs. This sponge belongs to the first family of my order Holorhaphidota, viz. the Renierida, originally made up of the genera "*Rayneria*" and "*Esperia*" of Nardo, not Schmidt ('Isis,' 1833, Spongiarum Classificatio, order ii. p. 519 *et seq.*), under the characters of "Spongiaria fulcimentis naturæ siliceæ aculeiformibus, &c." Influenced by this, Schmidt placed both under the genus to which he has given the name of "*Reniera*, Nardo," restricting the spiculation to that of an acerate form, viz. "simplicissima et uniformia, nunquam nodosa" (Spong. Adriatisch. Meeres, 1862, p. 72 &c.), and using the name "*Esperia*" generically for a totally different kind of sponges (*ib.* p. 53).

I have divided *my* family of Renierida into four groups, of which typical examples have been given in the key to my classification ("Notes" &c., 'Annals,' 1875, vol. xvi. p. 196); and it is to the last of these, viz. the "Crassa," that I would relegate the species above described, viz. *Reniera crateriformis*, chiefly on account of its spicule being the largest in the family and connected with the largest specimens. Thus, in the British Museum, no. 492, registered 61. 5. 11. 8, is all together 18 inches in diameter and 12 inches high, of which the excavation is 13 inches across the brim and 12 inches deep, surrounded by a number of minor crateriform cones, each of which is as large as a small sponge of this kind; so that probably it is one of the largest on record. There are two other specimens bearing ridges externally, like that above described, viz. one numbered 288, registered 41. 1. 13. 45, with "8332" in the corner of the label, and the other 492, without any register number; but these with others of the like kind, although still large specimens, are not near so large as that first mentioned.

Schmidt's "*Reniera? calyx*" (Spong. Adriatisch. Meeres, 1862, p. 76, Taf. vii. fig. 12), of which there is a type specimen in the British Museum no. 81, registered 67. 7. 26. 71, although of considerable size, being 9 inches high, including the stem, and 5 inches broad, has a spicule not more than half the size, although of the same shape as that of *Reniera crateriformis*; besides, it has a smooth homogeneous cuticle, underneath which is a fibrous layer like the bark of a tree, to which I shall more particularly allude presently; and this it was probably which induced Schmidt to place the note of interrogation after "*Reniera*" above quoted.

Proposed new group :—

PHLŒODICTYINA *.

Under the above name and with the following characters, provisionally given, I propose to group the few sponges to be hereafter mentioned, whose peculiar structure seems to me to make it desirable that they should be thus separated from all others of the kind.

Characters. Form variable, chiefly globular, accompanied by tubular expansions both above and below, or above only, which are closed at the extremities, simple, or branched; or globular in form, growing round the root of an aquatic plant?, without tubular extensions; or vasiform, with pustular eminences only inside. Structure essentially laminated and concentric; laminæ of two distinct kinds, which may alternate with each other in variable plurality, commencing dermally with an apparently homogeneous, fine, isodictyal layer, densely spiculous; followed by a coarse open spiculo-fibrous reticulated one, whose lamination is parallel to the surface, and contrasts strongly in structure (and bass-relief internally where not followed by another layer) with the isodictyal homogeneous one outside; also strongly with the tissue of sponges generally, whose reticulated structure is *continuous* with the deepest portion, and not laminar, like the bark of a tree, as in this instance. Internally hollow or more or less filled with a pulpy isodictyal tissue like the outer lamina, *i. e.* composed of sarcode densely charged with the spicule of the species. No evident oscula. Pores in the dermal layer. Spicule of one kind only, viz. acerate, sometimes accompanied by a bihamate flesh-spicule (*fibula*).

The first mention of such a sponge as this was made by Dr. Bowerbank in 1866 under the name of *Isodictya robusta* (Mon. Brit. Spong. vol. ii. p. 304), from a specimen obtained by the Rev. A. M. Norman in 1861, who found it in abundance about 30 miles east of the Outer Skerries, Shetland. The specimen was "cup-shaped," had "apparently" been

* φλοιός, bark, bass; δίκτυον, net.

furnished with a "short pedicel," and was "$1\frac{1}{2}$ inch high by $\frac{3}{4}$ inch broad;" the skeletal spicule "acerate," accompanied by a "bihamate" flesh-spicule; and that the above name was given provisionally, may be learnt from the following passage, viz. "These peculiarities of structure strongly induce me to believe that the sponge should form the type of a new genus."

A few pages on, the same species (as we shall see by and by) obtained in 1864 by Mr. J. G. Jeffreys at Shetland, is structurally described under the name of "*Desmacidon Jeffreysii*" (*ib. ib.* p. 347); but *here* no mention is made of the flesh-spicule, nor is the entire form of the sponge given, as it was "cut into numerous pieces by the dredge;" but a basal fragment is stated to have presented "numerous tubular cloacæ, varying from $\frac{1}{2}$ an inch in height and 2 lines in diameter to 4 inches in height and $\frac{3}{4}$ inch in diameter at the base, usually decreasing gradually in size to the distal extremity, and terminating in a contracted apparently permanent orifice" (p. 348); the word "apparently" of course implies doubt. It is evident from Dr. Bowerbank's description here that he was influenced by the presence of the spiculo-fibrous layer in placing this sponge under his genus *Desmacidon* (*ib. ib.* p. 10).

Thus we find it repeated by Dr. Bowerbank again, with a very good illustration, ten years afterwards, viz. in 1870, and again from a specimen supplied by Mr. Norman, who dredged it at Shetland in 1868 (Mon. B. S. vol. iii. pl. lxii.); meanwhile, however, Mr. Norman himself had described it, and had given it a new *generic* name, i. e. "*Oceanapia*," having, as he states, become "convinced" that Dr. Bowerbank had mistaken it "for something very different from what he had imagined." Hence the following synonymy:—

"*Oceanapia Jeffreysii* (Bow.) = *Desmacidon Jeffreysii*, Bow. Brit. Spongiadæ, vol. ii. p. 347, = *Isodictya robusta*, ibid. p. 304." (Report of Brit. Association for 1868, p. 334.)

As Mr. Norman's description of this sponge is far more satisfactory than any that had preceded it, we, of course, find it quoted by Dr. Bowerbank (B. S. vol. iii. p. 158) with other observations of his own, among which, as Mr. Norman's name for it is taken from the sponge being in form like a "Swede turnip," Dr. Bowerbank rightly observes that the choosing of "*Oceanapia*," as a generic term, is "unfortunate," because "there are numerous other sponges of a similar form, both British and exotic, which vary so greatly in their anatomical structures as to render it quite out of the question that they should be grouped together in the same genus" (p. 161). But it is equally "unfortunate" that Dr. Bowerbank should have called it "*Desmacidon*;" for who with his diagnosis of the genus *Desmacidon* (*l. c.* before quoted) could find out *Oceanapia* by it? or why has Dr. Bowerbank used the term "*Rhaphiodesma*" for "British" sponges (viz. our Esperina) in which, if any thing, the presence of spiculose fibre is even more characteristic than in his type specimen, *Desmacidon fruticosa*? That he knew both possessed such fibre is evident; for the terms *Desmacidon* and *Rhaphiodesma* etymologically mean the same thing.

If, then, neither Dr. Bowerbank's nor Mr. Norman's names are satisfactory, and we look for another, viz. one which is but a "mere fortuitous combination of letters" indicating nothing, such as "*Biemna*," given by the late Dr. J. E. Gray to *Desmacidon Jeffreysii* in 1867 ("Notes on the Arrangement of Sponges," Proc. Zool. Soc. Lond. 1867, pp. 538, 539), it will be observed that, in point of priority, it precedes Mr. Norman's; but it includes a number of other species which have nothing to do with *Oceanapia*; and as for the description of this sponge, first given by Dr. Bowerbank under the name of "*Isodictya robusta*," this will be seen to just precede "*Biemna*" under the generic name of "*Gellius*" (!). Under such circumstances I can see no other course to follow but to accept Mr. Norman's generic appellation, viz. "*Oceanapia*." It may not be desirable to call sponges generically after their *form*, as before stated; but this has the merit of being graphically expressive externally, and almost equally applies to the fibrous often mixed up with the pulpy isodictyal structure internally, so that on the whole the term "*Oceanapia*" is not only most appropriate, but most acceptable to *me* generally, as I know of no other sponge with which its characteristics could be confounded.

Hitherto, with the exception of Dr. Bowerbank's conjectured (*i. e.* "apparently) permanent orifice" in the termination of the tubular extensions of *Oceanapia*, already mentioned, no vents have been noticed; while in a fragment of some pieces which Mr. Norman kindly sent me in 1876 there is an entire branch whose termination neither has nor ever had any; it is simply rounded like the finger of a glove; and in one subsequently found by Dr. Bowerbank, which was "well preserved" and "three and a half inches in height, the distal termination was in the form of a blunt cone, very thin, and rather coarsely reticulated" (B. S. vol. iii. p. 159). My own observations on a species that will be mentioned hereafter accord with Dr. Bowerbank's statement; so that it may fairly be inferred that the "coarsely reticulated" structure at the ends of the tubular appendages serves the purpose of a distinct vent, especially as no others have been observed; but how Dr. Bowerbank could ally this to the open cloacal vents at the ends of the lobes in *Desmacidon fruticosa*, I am unable to conceive (B. S. vol. iii. p. 160).

It was hardly to be expected that the hitherto best of all spongologists, viz. Dr. Oscar Schmidt, should, during his great experience, have failed to meet with some of the Phlœodictyina; and thus we find them described and illustrated in his introduction to the Atlantic sponge-fauna, under the name of "*Rhizochalina*" (Spongf. Atlantisch. Gebiet. p. 35, Taf. iv. figs. 1, 2). *He* also likens their form to that of an "onion or turnip," with a firm layer on the outside and concentric fibrous ones within, together with one form of spicule, viz. acerate; and considers the upper tubular appendages to be for the introduction of water and nourishment, while the under ones are for excretionary and root purposes. Yet it is strange, after this, that Schmidt should identify Dr. Bowerbank's *Desmacidon Jeffreysii* with his own "*Esperia*" (*op. cit.* p. 77), and, in his footnote, assume that the anchorates had escaped observation ("entgangen"); while he fails to notice Mr. Norman's *Oceanapia* in connexion with his *Rhizochalina*, which he himself, as before stated, likens to an onion or turnip ("zwiebel- oder rübenartige Körper").

With reference to the classification of these sponges, I should, now that I have had to examine most of them more particularly, be inclined to put the group in my first family of the order Holorhaphidota, viz. the Renierida, next to Crassa. Schmidt has placed his *Rhizochalina* in that of the Chalineæ (*op. cit.* p. 79); and so I at first "felt inclined" to place them in the second family of the Rhaphidonemata, viz. the Cavochalinida ('Annals,' 1880, vol. vi. p. 37); but since I have had to study them more seriously my views have changed, and now I find that, the outer layer being isodictyal and the inner one *spiculo*-fibrous, it is impossible to place them among the Chalineæ, where, if any thing, the keratine preponderates over the spiculous part of the fibre; albeit the Chalineæ and Isodictyosa run into each other, as already stated ('Annals,' 1882, vol. ix. p. 277). Again, the isodictyal character of the outer layer and the form of the spicule allying them to the first four groups of my Renierida, it seems to me desirable that the Phlœodictyina should come next to these, as above suggested, *Desmacidon fruticosa* belonging to my Halichondrina.

There is a resemblance between the appendiculate Polymastina (ex. gr. *P. spinula*, Bk. B. S. vol. iii. pl. xi. figs. 10–13) and those Phlœodictyina, especially in the structure of their tubular appendages, whose wall is composed of a layer of fine spicules externally resting on a reticulated spiculo-fibrous one within; but the body of the *Polymastia* is solid, sessile, and filled with a tough structure consisting of bundles of stout long spicules radiating in bundles from a central point, like that of *Donatia*, while the spiculation, being acuate or pinlike, is totally different from that of the Phlœodictyina. Balsamo-Crevelli's *Suberites appendiculatus*, illustrated and described in the 'Atti della Soc. Ital. de' Scienze' for 1863, vol. v. tav. vi. figs. 10–17, is no doubt an appendiculate *Polymastia*.

Having thus introduced the subject, I will now briefly enumerate the species of Phlœodictyina that have come to my notice, beginning with the British one first mentioned:—

1. *Desmacidon Jeffreysii*, Bowerbank.
(= *Oceanapia Jeffreysii*, Norman.)

Well described by the latter in 1868 (Report Brit. Association, p. 334); well illustrated by the former in 1874 (Mon. Brit. Spong. vol. iii. pl. lxii.), but the flesh-spicule (bihamate) is omitted, although mentioned in the description. Skeletal spicule acerate; flesh-spicule bihamate.

Loc. Shetland.

Type specimen in the British Museum.

2. *Rhizochalina oleracea* and *R. carotta*, Schmidt.

Described and illustrated in 1870 (Spongf. Atlantisch. Gebiet. pp. 35, 36, Taf. iv. figs. 1, 2). Spicule of one kind only, viz. acerate, curved, sharp-pointed at each end, smooth,

Loc. Antilles.

3. *Desmacidon fistulosa*, Bowerbank.

Well illustrated in 1873 (Proc. Zool. Soc. Lond. p. 19, pl. iv. figs. 7, 8). Tubular appendages "*above only*." Dermal layer smooth, yellowish, glassy, like a varnish in its dried state ("coriaceous," Bk.), ? from the abundance of dried sarcode. Spicule of one kind only, viz. acerate, curved, fusiform, sharp-pointed at both ends, smooth.

Loc. Freemantle, S.W. Australia; Gulf of Manaar.

Type specimen in the British Museum, Bowerbank general collection. There is also a specimen in the general collection of the British Museum, No. 513, but with no other label.

4. *Desmacidon fistulosa*, var. *fuliginosa*, Crtr., n. var.

In the Bowerbank general collection, now in the British

Museum. Dermal layer even, but not glassy, varnish-like. Colour throughout soot-black. Spicule of one kind only, like the foregoing.

Loc. Freemantle, S.W. Australia.

5. *Phlœodictyon isodictyiforme*, Crtr., n. sp.

Massive, sessile, incrusting, spreading, irregular in form; more or less composed of erect cylindrical appendages rising from a subbasal lamina. Consistence fragile. Colour fawn. Surface even; appendages hollow, tubular, closed at the free end, which is often expanded and bifurcate; walls composed of two layers, viz. an external and an internal one,—the former isodictyal and homogeneous in appearance, densely spiculous; and the latter spiculo-fibrous, consisting of a coarse, open reticulation, whose longitudinal lines are most pronounced, projecting in relief from the inner surface. Tubular appendage rougher over its free extremity than elsewhere, but presenting no defined osculum there, nor on any other part of the sponge that I can see. Pores probably in the soft dermal layer. Body of the sponge almost obsolete, consisting of that small portion of the lamina which exists between the erect appendages, with which it is confounded both in structure and continuation. Spicule of one kind only, viz. acerate, curved, fusiform, sharp-pointed at each end, smooth, 30 by $\frac{1}{3}$-6000th inch in its greatest dimensions. Size of specimen about 2 inches square; tubular appendages about 9-12ths inch high and 2-12ths inch in diameter.

Hab. Marine. Growing over shell-detritus at the sea-bottom, old mussel-shells &c., amidst Polyzoa, especially *Crisia eburnea.*

Loc. Vigo Bay; west coast of Spain.

Obs. This sponge is in the Kent collection at the British Museum, No. 15, registered 72. 5. 4. 1, dredged on board the 'Norna' in 1870. At first sight it looks very much like an *Isodictya*, but, on dissection, is found to be similar in structure to *Desmacidon Jeffreysii*—which distinguishes it from an appendiculate *Polymastia*, to which it also bears some resemblance externally.

6. *Phlœodictyon hondurasensis*, Crtr., n. sp.

This name is proposed for a tubular fragment, about $2\frac{1}{2}$ inches long, which consists of the bifurcation of one 5-8ths of an inch in diameter, of which the wall is composed of two laminæ, as in the foregoing species, viz. an outer or homogeneous isodictyal tissue of spicules, and an inner one of coarse reticulated spiculo-fibre. The latter, however, although laminar, does not present any prominence of its fibre parallel with the surface, as in the foregoing species, but a uniformly reticulated structure in which the interstices of different sizes are circular, like those of a similarly constructed sieve; it is also more or less repeated inwards, accompanied finally by a tissue like that of the dermal layer, which appears to have filled the central portion, supported on a loose straggling reticulated fibre. Spicule of one kind only, viz. acerate, curved, fusiform, sharp-pointed at each end, smooth; 40 by 2-6000ths inch in its greatest demensions.

Loc. Honduras.

The specimen, which bears a label on which is written "Honduras, D.," is in the Bowerbank general collection, now in the British Museum. As Dr. Dyson supplied Dr. Bowerbank with specimens from Honduras, the "D" probably stands for his name.

7. *Phlœodictyon niduliformis*, Crtr., n. sp.

This name is proposed for a species which has grown around the root or the stem of an aquatic plant in a conical form, with the largest end upwards, looking like a bird's nest in its present state. Its vertical diameter is about 4 inches, and the same across the base of the cone or upper part; composed of concentric reticulated layers or coarse spiculofibre; faced externally by the same kind of isodictyal tissue noticed in the other species. Spicule of one kind only, viz. acerate, curved, cylindrical, abruptly pointed at each end, smooth; about 37 by 1-6000th inch in its greatest dimensions.

Loc. ?

The specimens, of which there are two in the British Museum, numbered 206 *bis*, and registered 43. 4. 10. 27 and 28 respectively, are much mutilated, but, bearing bits of *Polytrema miniaceum*, may have come from some tropical climate, ? West Indies.

8. *Phlœodictyon vasiformis*, Crtr., n. sp.

This name, again, is proposed for a mutilated fragment of a vase-like form, now compressed, about 5½ inches high, 5 inches across the brim, and 1½ inch thick in the wall. The latter is composed of two kinds of structures, viz. a dermal layer, which is homogeneous and isodictyal, continued over the inner as well as the outer surface, with a coarse spiculofibrous reticulated structure between, in which the vertical fibres predominate, and the interstices are oblique or elongated in the same direction. But while the isodictyal layer on the outer side is even and uniform in its structure, that on the *inner* side is covered with little pustuliform eminences, through which the excretory contents may have been eliminated, as there is no appearance of oscula in any other part. Spicule of one kind only, viz. acerate, curved, fusiform, sharp-pointed at each end, smooth; about 60 by 3-6000ths of an inch in its greatest dimensions.

Loc. ? Australia.

The specimen is in the British Museum, general collection, numbered 557, and registered 59. 10. 7. 40.

9. *Reniera? calyx*, Schmidt.
(Spong. Adriatisch. Meeres, p. 76, Taf. vii. fig. 12.)

I have already alluded to this species, of which the British Museum possesses a type specimen, No. 81, registered 67. 7. 26. 71. It is large and goblet-shaped, 9 inches high, with a cup-shaped excavation 3 inches across the brim and 4 inches deep; covered with a smooth, thin, dark, dermal layer, under which is a coarse fibrous structure arranged, according to Schmidt's examination of Esper's specimen (see *l. c.*), in concentric layers, with a " simple vent " at the bottom of the cup. The spicule, which is comparatively small for the size of the sponge, and of one kind only, is acerate, curved, fusiform, sharp-pointed at both ends, and smooth, about 60 by 2-6000ths inch in its greatest dimensions.

Loc. Adriatic Sea.

Although Schmidt considered this sponge a Renierid, he doubted, as may be seen by the note of interrogation after the generic name, as well as in his following description, whether it should be classed with the sponges that he was then describing. Its position, as I have not the opportunity of more closely reexamining the type specimen in the British Museum, is here placed among the Phlœodictyina provisionally.

Fam. **Suberitida.**

Group 12. Laxa.

Suberites stelligerus, Crtr., n. sp.

Massive, conoidal, lobate, erect, sessile, somewhat compressed, contracted towards the base, expanded towards the centre, which, from the presence of vacuities below, appears to have been formed by the union of lobes or branches originally separate, finally terminating by subdivision of the mass into little conical processes over the upper third. Consistence fragile, tender. Colour now, in its apparently washed-out state, light grey. Surface villous, soft, uniformly covered with a pile formed of pinlike spicules arranged vertically, with their points outwards. Vents numerous, irregularly scattered over the surface. Texture soft, reticular, without fibre, more or less cellular, traversed by the branches of the excretory canal-system, which terminate in the vents mentioned. Spicules of two kinds, viz. :—1, skeletal, pinlike, with terminal or ante-terminal more or less capitate inflation, curved, slightly fusiform, gradually sharp-pointed, 265 by 5-6000ths inch in its greatest dimensions (fig. 2, *a*); 2, flesh-spicule, stelliform,

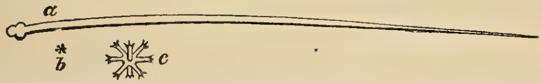

Fig. 2.—Spiculation of *Suberites stelligerus*. *a*, skeletal spicule; *b*, flesh-spicules: scale 1-96th to 1-6000th inch. *c*, flesh-spicule, much more magnified, to show general form and spinous ends of rays.

more or less nucleated, in which originate 8–10 straight rays, each of which terminates abruptly in four or more short everted spines about 4-6000ths inch in diameter (fig. 2, *b*, *c*). Pinlike spicules and stellates equally plentiful. Size of specimen 6 inches high, 4½ inches broad, and 2 inches thick.

Hab. Marine.

Loc. Honduras.

Obs. This sponge, from its loose, apparently compressed, fibreless structure, pinlike form of the skeletal spicule, and presence of shell detritus imbedded in its surface, has all the characters of a Suberite belonging to my group Laxa; but the presence of the *stellate* flesh-spicule is new to me, although not in allied forms, ex. gr. *Axos Cliftoni*, *A. flabelliformis* ('Annals,' 1879, vol. iii. pl. xxvi. figs. 3 and 6), and the small stellate in *Donatia lyncurium*. From the old appearance and mutilated condition of the specimen, which belongs to the Bowerbank general collection, it appears to have been picked out of a sandy beach, where it might have been for years, and now bears a label on which is written "Honduras, Dyson;" hence the locality is known.

XIII.—*Contributions to the Knowledge of the Alcyonaria. Part* II., *including Descriptions of new Species from Mauritius.* By Stuart O. Ridley, M.A., F.L.S., &c.

[Plate V.]

Like the first paper of this series (this Journal, ser. 5, vol. ix. p. 184), the present communication will be found to owe its chief importance to specimens collected by Mr. V. de Robillard at Mauritius, all those given below as from this locality having been obtained from that collector. But while the former were chiefly remarkable for size and beauty, and only secondarily for their novelty in some cases, those now to be described include some of the greatest interest from the rarity and high systematic importance of the types to which they belong, and will be seen to throw important light on the distribution of the genera of Alcyonaria in our present seas. I have added notes on two species not from Mauritius, the reasons for which will be seen by reference to the remarks on *Echinomuricea coccinea* and *Eunicella pergamentacea*.

Fam. **Primnoidæ.**

Acis.

Acis, Duchassaing de Fonbressin & Michelotti, Mém. Cor. Ant. p. 19.

This genus has hitherto been known only from the West Indies, whence the above-named authors described the only known species, *A. guadalupensis* (*l. c.* p. 20, Guadelupe) and *nutans* (Suppl. Mém. Cor. Ant. p. 109, Santa Cruz): the one has a prominent verruca, covered with numerous squamous spicules, while that of the latter is barely raised above the general surface; the one appears to connect the genus with *Primnoa*, the other with *Muricea*. The occurrence, as will now be shown, of this otherwise West-Indian genus in the Indian Ocean, and in its western portion in particular, has a peculiar significance for the student of geology, as showing that a communication probably existed between these two areas at a period later than that at which the genus was differentiated from the main stem of the family; the distribution of *Villogorgia* (see Ann. & Mag. Nat. Hist. ser. 5, vol. ix. p. 187) and *Melitodes* (*Melithœa*, Lamarck &c.), in both which cases a single species of an exclusively or almost exclusively Indo-Pacific genus represents it in the West-Indian area, appears to show the same fact. This group, from the wide range of its species, is especially fitted to illustrate a truth of this kind.

Acis orientalis, sp. n.

Corallum branching approximately in one plane; branching dichotomous, with the addition of alternating pinnæ at different points; branches given off at short intervals. Common stem very short. Stem and branches cylindrical, hardly diminishing appreciably in thickness from the base upwards; ends of branches slightly clavate; diameter at base 2 millim., just before apex of branches 1·5 millim., at apex 2 millim. Verrucæ low, broad at summit, about ·5 millim. high and ·9 millim. across, alternate, 1 to 3 millim. apart, almost entirely confined to the anterior and lateral aspects of the branches. Colour of general cortex dirty white (the spicules white, outlined with an umber pigment), of verrucæ umber-brown, their centres white when closed. Axis flexible, thin; pale brown at ends of branches. Spicules of general cortex:—(i.) Large, modified fusiform, consisting of a body tapering more or less towards the ends and of several (about ten) large monticular prominences arranged on the outer side of the spicule; the whole spicule and the prominences densely covered with low broad tubercles, themselves very elaborately tuberculate; size of spicule very various—average maximum about 1·8 millim., shortest diameter about ·28 millim., largest diameter (that which includes the monticular processes) about ·45 millim.; height of these prominences ·07 to ·14 millim. These large forms pass by gradation into smaller ones of about ·62 by ·14 millim., with the monticular processes often very small. (ii.) Squamous, with monticular process in the centre of the outer side; the margin cut into lobes of different forms and sizes, sometimes divided into secondary lobules; average maximum size about ·7 by ·52 millim. (iii.) Spicules of verrucæ, horizontal series surrounding the base of the verrucæ, and forming a ring by the apposition of their ends, fusiform, bent at the middle, tapering gradually to slender pointed ends, covered closely with small simple tubercles, largest at the middle; size about ·45 by ·07 millim. (iv.) A modified form of (ii.), consisting of flattened tuberculate basal portion fixed at the outer margin of the verruca, and an elongate projecting part, which rises up from and (with its companions) forms a crown upon the margin of the verruca; it is much roughened by tubercles, chiefly ridge-like, serrate, and directed forwards; the apex of the spicule is irregular; size about ·47 by ·14 millim. (v.) Fusiform, radiating from the interior of the wall of the verruca (meeting in its middle in the contracted state of the polype); they taper to sharp points, and are covered with thin, ridge-like, mostly forwardly-projecting tubercles; size about ·28 to ·42 millim. by ·053 to ·07 millim.

Hab. Mauritius, 80 fathoms.

Obs. The species is represented by three specimens growing on a mass of sponges and other forms, including *Cirripathes* and another Primnoid Alcyonarian.

The larger specimen is 90 millim. ($3\frac{3}{5}$ inches) high and 70 millim. ($2\frac{4}{5}$ inches) broad.

The species differs from both the West-Indian forms in the possession of flat squamiform in addition to the fusiform cortical spicules, and in the guarding of the mouth by the projecting points of the modified squamiform spicules. I find no trace of the "very fugitive" surface-layer of "squamules" stated by Duchassaing de Fonbressin and Michelotti (Suppl. Mém. Cor. Ant. p. 108) to overlie the larger fusiforms, although the specimens are as fresh and perfect as dried specimens can be.

Muricella perramosa, sp. n.

Corallum branching abundantly, commencing at or near the common spreading base; branches decreasing gradually in diameter towards apex. Branching primarily dichotomous; but most of the branches are pinnate alternately with terminal or branched twigs set about 4 millim. apart; the larger branches given off at angles of about 45°, the smaller ones and the terminal twigs at about 80°. Most branches subcylindrical, the lateral diameter being slightly the largest (some terminal twigs appear decidedly flattened out laterally, owing to the lateral position of their verrucæ). All the branches are more or less curved; owing to this and to the profuseness of the branching, the frond has a broad fan-like outline. Branching takes place, as a rule, in one plane; but the frond is curved in and out of this plane, and secondary fronds more or less parallel to the axis of the main frond are not uncommon.

Greatest diameter of main branches about ·18 millim., of terminal twigs (excluding verrucæ) ·018 millim., length of latter about 7 millim.

Cortex compact, thin, rendered slightly uneven by the thickness of the largest spicules below described. Verrucæ hemispherical (sometimes extended in the direction of the long axis of the branches), rising sharply from the cortex; height and basal diameter both about ·5 millim.; frequent on all parts of the corallum, and only 1 millim. apart on the terminal twigs (occasionally absent on one side of the branches for considerable distances, and almost confined to the lateral margins of many of the terminal twigs). Colour of entire corallum dull crimson-red, inclining to brick-red. Spicules of general cortex:—(i.) fusiform elongated, lying parallel to the axis of the corallum, tapering to moderately sharp points from the middle, straight or slightly flexuous, densely covered with prominent tubercles, which are simple and more or less pointed towards the ends of the spicule, but towards the middle become terminally swollen and roughened (these median tubercles measure ·2 to ·3 millim. in height by ·017 to ·025 in maximum diameter at apex). Two sizes are distinguishable, though approximately connected by intermediate sizes; they are (1) about 1 by ·18 millim., and (2) about ·42 by ·053 millim., and ·017 to ·025 in apical diameter. No. 1 occurs scattered singly among the far more numerous no. 2, and may be seen on the surface of the cœnenchyma with a lens. (ii.) Smaller irregular linear spicules, with approximately pointed ends and two more or less distinct whorls of coarse, rough, and often divided tubercles, about ·035 millim. high; length of spicule ·12 to ·14 by ·07 millim. Proper spicules of verrucæ subfusiform, with rounded ends, and covered with low tubercles; length ·28, breadth ·038 millim.

Hab. Mauritius, 90 fathoms.

Obs. Very fine specimens of this graceful species have been obtained from Mr. de Robillard; the largest measures 20 inches (500 millim.) in height by 19 inches (475 millim.) in extreme breadth. It seems to be the abundance and slender proportions of the branches and the number of curved lines which they present that give this form so light and elegant an appearance.

It differs in slenderness of habit from *M. humosa* and *M. tuberculata*, Esper, and in its uniform red colour from all the other known species.

Echinomuricea coccinea.

In my former paper (ser. 5, vol. ix. p. 184) I included *Nephthya coccinea*, Stimpson, among the species to be distinguished in the genus *Nephthya*, overlooking the fact that Verrill had re-examined Stimpson's specimens, and found it necessary to place the species in the genus *Acanthogorgia*, and subsequently (Amer. Journ. Sci. xlvii. p. 285) formed the genus *Echinomuricea* (Proc. Ess. Inst. iv. pp. 152, 188) to contain it. As an examination of specimens in the British Museum shows the propriety of Verrill's proceeding, I shall in future allude to the species as *Echinomuricea coccinea.*

Fam. **Gorgoniidæ.**

Eunicella pergamentacea, sp. n.

Gorgonia viminalis, var., Esper, Pflanzenth. ii. p. 51, pl. xi. A.

This species appears to be distinct from *G. viminalis* of Esper; the few and long terminal branches, the distance which separates the verrucæ, and the loose character and whitish colour of the cortex (causing it to wrinkle when dried) appear points of sufficient importance to separate it from that species.

At the same time the spiculation is essentially that of *Eunicella*, the genus to which Verrill refers *Gorgonia verrucosa* and numerous other Atlantic species.

Hab. Mediterranean (*Esper*).

It is from the leathery or parchment-like appearance of the cortex when dried that the specific name *pergamentacea* has been taken. It seems to me important to distinguish a species which, though not uncommon, has hitherto been confounded with another form.

Fam. **Gorgonellidæ.**

Nicella dichotoma.

Scirpearia dichotoma, Gray, P. Z. S. 1859, p. 481.
Nicella mauritiana, id. Cat. Lithophytes Brit. Mus. p. 40, fig. 12.

Some good-sized specimens have been received from Mr. de Robillard; the largest measures 340 millim. ($13\frac{1}{2}$ inches) in height from the (dead) base, and 240 millim. ($9\frac{1}{2}$ inches) in maximum diameter. Studer (M.B. Ak. Berlin, 1878, p. 660, pl. v. fig. 31) seems by his figure to have wrongly identified the species. The original specimens have for their spiculation a dense cortical layer of small double heads, and a subjacent layer of longer densely tuberculate cylindricals or fusiforms, having a median bare space more or less strongly indicated. The colour is variable; that of one specimen varies from ochreous yellow to dull flesh-colour; that of another is dirty white. The shape of the verrucæ varies considerably, according as they are open or closed: in the former condition they are rectangular at the apex, as seen from the anterior or posterior sides of the frond, while in the latter they usually appear conical, with rounded apices, when viewed in the same way. Their basal diameter may vary from 1·25 to 2·25 millim. in the closed condition. The axis is strongly penetrated with carbonate of lime.

It appears to me that the earlier specific name should be maintained.

Hab. Mauritius, 80 fathoms.

Fam. **Trinellidæ**, Gray.

Parisis.

This genus is allied to *Trinella*, Gray; but the latter has no true spicular verrucæ; while in *Parisis* the spicules, the subjacent ones of which have the same general character as in *Trinella*, ascend into and support the verruca.

The genus has not been hitherto recorded as occurring out of the Chinese seas, the type species, *P. fruticosa*, having been taken in the Sooloo Sea, and the only other species, *P. laxa*, at Hong Kong and in Formosa Channel.

Parisis mauritiensis, sp. n.

Corallum flabellate, branching in one or more parallel planes. Branching frequent, approximately dichotomous for the first three or four divisions, the smaller branches alternately pinnate; branches given off at an angle of 45° (occasionally about 60° in small branches). Stem and main branches cylindrical, the subterminal branches with their terminal pinnæ flattened out laterally. The larger branches marked in some places by longitudinal striæ (the reflex of the longitudinal canals) in the dry state. Hard and soft joints of same length, viz. about 3 millim. In the main branches the soft joints are somewhat narrower than the hard ones in the dry state (possibly owing to shrinkage), producing a somewhat annulated appearance in the branch. Cortex compact, smooth, about

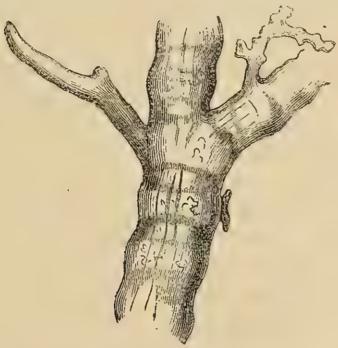

Fig. 1.—*Parisis mauritiensis*: the second bifurcation from base, nat. size.

·25 millim. in thickness, pure white in dry state. Diameter of largest main branch 10 to 11 millim., greatest diameter of terminal (flattened) twigs ·7 millim. Verrucæ confined (with rare exceptions) to lateral aspects of terminal and subterminal branches (occasionally a few on branches of the third degree), uniserial, alternate, 1 to 2 millim. apart; truncato-conical in shape, projecting somewhat upwards as well as outwards; height about ·8 millim., apical diameter ·5 millim.; of same colour as cortex. Superficial spicules of cortex and verrucæ very various in shape, viz. subglobular, limaciform, or elongated, with median constriction (Germ. "bisquitförmig"); beset with small pointed low tubercles; maximum diameter varying from ·038 to ·0633, smallest diameter ·022 to ·032 millim. Subjacent spicules of cortex subcylindrical, with irregular ends, and more or less constricted at one or two points; beset with few scattered rough boss-like tubercles; size about ·1 by ·053 millim.

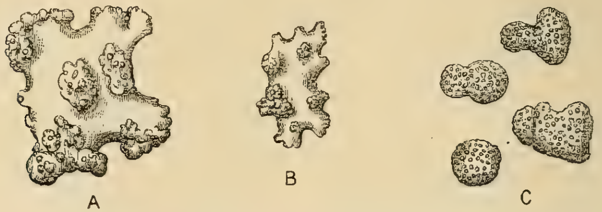

Fig. 2.—*Parisis mauritiensis.* A, superficial spicule, × 190 diam.; B and C, subjacent spicule of cortex, × 190 diam.

Hab. Mauritius, 80 fathoms.

Obs. The specimen upon which this species is based is in the dry state, and measures 19 inches (480 millim.) by $12\frac{1}{2}$ inches (315 millim.) in maximum height and diameter respectively. It very closely resembles in character *Parisis fruticosa* (judging chiefly from a specimen in the Museum from Formosa, which appears to belong to that species); but in it the verrucæ appear to be somewhat more distinct from the branches, and not directed forwards, and are not confined to the lateral aspects of the branches. In *Parisis laxa* the verrucæ are said to be crowded, the cœnenchyma rough, and the branches occasionally coalescent, characters which do not apply to *P. mauritiensis.* The extension so far to the west of the Indian Ocean of a genus hitherto known only from Chinese seas is a fact of considerable interest.

Subfam. *Sclerogorgiaceæ.*

Suberogorgia suberosa.

An immense dry specimen 3 feet 5 inches high and 18 inches in maximum lateral diameter. The colour is pale wainscoat to pale rufous brown; the branches are given off mostly at angles of 30°. The colour, very different from the deep brick-red usual in this species, may perhaps be due to the manner of drying. The spiculation presents no points by which to distinguish this form from typical specimens of the species, although the very stout main stem and larger branches, and the relatively small lateral expansion of the branches, give it a somewhat unusual appearance.

Hab. Mauritius, 90 fathoms.

EXPLANATION OF PLATE V.

Fig. 1. *Acis orientalis*: part of largest specimen, from front, natural size.
Fig. 2. The same: apex of branch, from front, × 8 diam.
Fig. 3. The same: apex of branch, from behind, × 8 diam.
Figs. 4 & 5. The same: cortical fusiform spicules No. 1, × 43 diam.
Fig. 6. The same: cortical squamous spicule No. 2, × 43 diam.
Fig. 7. *Parisis mauritiensis*: lateral branch, nat. size.
Fig. 8. *Muricella perramosa*: terminal branch, nat. size.
Fig. 9. The same: cortical spicule No. 1, × 43 diam.
Fig. 10. The same: cortical spicule No. 2, × 43 diam.

XIV.—*Carcinological Investigation on the Genera* Pemphix, Glyphea, *and* Aræosternus. By T. C. Winkler*.

I. *Introduction* †.

A few months ago Dr. J. G. De Man, Curator at the Museum of Natural History at Leyden, informed me that he

* Translated by W. S. Dallas, F.L.S, from the 'Archives du Musée Teyler,' ser. ii. deuxième partie (1881), pp. 73–124.

† *Literature.*

1822. Brongniart et Desmarest. Histoire Naturelle des Crustacés fossiles.
1822. Schlotheim. Nachträge zur Petrefaktenkunde.
1827. Mantell. Geology of Sussex.
1829. Phillips. Geology of Yorkshire.
1833. H. von Meyer, in Nova Acta Naturæ-Curiosorum, tom. xvi. pars ii.
1834. Milne-Edwards. Histoire Naturelle des Crustacés.
1839. Von Münster. Beiträge zur Petrefaktenkunde.
1839. F. A. Römer. Versteinerungen des norddeutschen Oolithgebirges.
1839. Geinitz. Characteristik des sächsischen Kreidegebirges.
1840. Von Meyer. Neuer Gattungen fossiler Krebse.
1841. F. A. Römer. Versteinerungen des norddeutschen Kreidegebirges.
1842. Deslongchamps, in the Mémoires de la Société Linnéenne de Normandie.
1849. Robineau-Desvoidy, in the Annales de la Société Entomologique de France, 2e serie, tome vii.
1849. M'Coy, in the Annals and Magazine of Natural History, vol. iv.
1850. Dixon. Geology and Fossils of Sussex.
1850. Von Meyer, in the Palæontographica, Band i.
1851. Bronn. Lethæa geognostica.
1852. Milne-Edwards, in the Annales des Sciences Naturelles, 3e série, tome xvii.
1854. Bell, in the Annals and Magazine of Natural History, ser. 2, vol. xiv.
1854. Pictet. Traité de Paléontologie.
1858. Quenstedt. Der Jura.

was engaged in describing a new species of Macrurous Decapod Crustacea, which not only represented a new genus, but at the same time would form, side by side with the Palinuridæ and the Scyllaridæ, a new subfamily of the family Loricata. As he did not know whether there were any genera of fossil Crustacea analogous to or identical with the new genus, M. de Man begged me to compare the latter with the remains of fossil Macrurous Crustacea contained in the palæontological collection of the Musée Teyler. I immediately set to work. I compared with the diagnosis of the new species and the figure of the specimen which were given to me by the above-mentioned naturalist all the examples of fossil Macrurous Crustacea which existed in the museum confided to my care. This comparison, however, did not entirely satisfy me; the Musée Teyler, rich as it may be in fine remains of fossil Crustacea, does not possess all the known species described by those palæontologists who have devoted themselves to carcinological researches. Fortunately the magnificent Teylerian library is at my command. I had to read all that has been written on the Macrurous Crustacea in the works of which a list will be found in the footnote, pp. 133, 134.

This investigation has convinced me that there is certainly no identity between the genus *Aræosternus*, De Man, and any of the genera of Crustacea that lived in the past geological ages. But, although it is different, there is at the same time a very great analogy between this recent genus and the fossil

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1858. Etallon, in the Bulletin de la Société Géologique de France, 2e série, tome xvi.
1859. Oppel. Der mittlere Lias Schwabens.
1860. Oppel, in the Jahreshefte des Vereins für vaterländischer Naturkunde in Württemberg, Band xvii.
1861. Etallon. Notes sur les Crustacés jurassiques.
1862. Oppel. Palæontologische Mittheilungen.
1864. F. von Alberti. Ueberblick über die Trias.
1867. Quenstedt. Handbuch der Petrefaktenkunde.
1874. Schlüter, in the Verhandlungen des naturhistorischen Vereins des Rheinlands und Westfalens, Band xxxi.
1881. De Man, in Notes from the Leyden Museum.
1881. De Man, in the Tijdschrift voor Entomologie.
1881. Winkler, in the Archives du Musée Teyler, 2e série, tome i.

Besides the works mentioned, the following may be studied:—
Bell. Fossil Malac. Crust. of Great Britain.
Edinburgh Journal, vol. xix.
Dictionnaire des Sciences Naturelles, tom. xxxvii.
Koch und Dunker. Beiträge zur Palæontologie.
F. von Alberti. Gebirge Württembergs.
Neues Jahrbuch (Leonhard und Bronn), 1835, 1836, 1837, 1842, 1849, 1851, 1852, 1853, 1854, 1855, 1857, 1861, 1870, 1874.

genus *Glyphea*. By means of the description of *Aræosternus Wieneckei* and the diagnoses and descriptions of the species of fossil *Glypheæ* which occur in the different palæontological works, I hope to be able to prove what I advance. But, what is more, my investigations have proved to me that the genus *Aræosternus*, De Man, is very probably the existing representative of a very long series of extinct genera—that we may follow the traces of its ancestors through the Tertiary, Cretaceous, and Jurassic periods back to the epoch of the Lower Lias—that there is a series, an uninterrupted succession, which commences with a liassic genus, and terminates in the recent genus—that probably the ancestry of these successive genera, which commence with the liassic *Glypheæ*, must be sought in a geological period anterior to that of the Lias, in the Triassic period, and that this origin of the long series of the *Glypheæ* is to be found in the species described under the name of *Pemphix* (*Palinurus*) *Sueuri*.

In order to demonstrate that my hypothesis is well founded, it is necessary, in the first place, to glance at the genus *Pemphix*, then to give a short historical sketch of the genus *Glyphea*, adding thereto a description of the specimens of that genus contained in the Musée Teyler. After this statement I shall make known the specific characters of *Aræosternus Wieneckei*, De Man. I shall demonstrate that perhaps the *Glypheæ* descend from the genus *Pemphix*; then I shall compare *Aræosternus* with the genus *Glyphea*, pointing out the analogies which unite and the differences which separate these two genera; and, finally, I shall discuss the arguments and considerations which lead me to see in *Aræosternus Wieneckei*, De Man, the last representative of a series of lost forms, the last existing genus of a succession which is probably in course of becoming extinct.

II. *Glance at* Pemphix Sueuri, *von Meyer*.

In 1822 Desmarest gave a description of the carapace of a Macrurous Decapod Crustacean under the name of "Langouste de Lesueur" (*Palinurus Sueuri*). He says that this carapace, which is petrified in calcareous material, is nearly of the size of that of a common crayfish and granular all over; it has a very small triangular rostrum hollowed into a groove, and no spines in front; the rest of the anterior margin is too imperfect to be described. Its surface is divided into three distinct parts by transverse impressed lines, the first of which is not very sinuous, and the second wider, V-shaped and bordered. The first two parts separated by these lines are tuberculous; one of them, the anterior, is the stomachal region, and the second the genital region. The third part, which corresponds to the position of the branchiæ on each side, is simply granulate; and it is probable that the region of the heart is confounded with it towards the posterior margin, which is sinuous, rounded, and marked with a double projecting line which follows all its contour. The author says that he does not know from what place this fossil comes *.

In 1832 Hermann von Meyer published the description of *Pemphix Sueuri* under the name of *Palinurus Sueuri*, Meyer.

After speaking of the description given by Desmarest and cited above, this author says, "With this species of fossil Crustacean we must unite *Macrourites gibbosus* of Schübler, the remains of which have been found in the upper beds of the Muschelkalk. The specimen described presents some segments of the abdomen and the entire carapace. This carapace is granulate; the tubercles are of the size of a pin's head; most of them occur upon the middle of the cordiform cephalothorax. Upon the middle of the back up to the head is seen a regular impressed line. The surface of the cephalo-thorax is covered with small tubercles" †.

In 1840 the same author gives a detailed description of *Pemphix Sueuri*, and especially of the furrows and tubercles of the carapace of that Crustacean. The abdomen consists of six segments and of a caudal fin, the median plate of which forms the seventh segment, and two of its lateral plates are divided longitudinally by a median line, while the two outer plates consist of two transverse parts. The outer antennæ are simple, filiform, multiarticulate, and of a length equal to that of the whole body; their peduncle is covered by a finely-striated protective scale. The inner antennæ consist of two terminal filaments, placed upon a peduncle of moderate length. The anterior limbs are much longer and stronger than the others, and bear a pincer, the body of which is stouter than the fingers; the latter are of equal length, conical, and not much curved. The second pair of limbs are smaller and bear chelæ; the third pair are also provided with chelæ. The fifth pair has no chelæ; and the fourth is unknown ‡.

Pictet, in 1854, says :—"The species of *Pemphix* were formerly confounded with the *Palinuri*, from which, however, they differ in many respects. The carapace, instead of being divided only into two parts, is divided into three, of which the anterior corresponds to the stomachal region, the middle one to the greatly developed cardiac and genital regions, and the posterior to the branchial regions. The anterior legs,

* Brongn. et Desm. Hist. Nat. des Crust. foss. p. 132.

† Nova Acta Nat. Cur. tom. xvi. pars ii.

‡ H. von Meyer, Neue Gattungen fossiler Krebse, p. 1.

which are still imperfectly known, differ more from the following legs than in the *Palinuri*. The anterior margin of the carapace is prolonged into a point, and, in particular, into an elongated, lancet-shaped ray *.

Quenstedt, in his 'Handbuch der Petrefaktenkunde,' associates *Pemphix Sueuri* with the Locustina, and describes it under the old name of *Palinurus Sueuri*. He places it therefore among the Macrurous Crustacea of which the first pair of limbs has no pincers. After describing the carapace with its furrows and tubercles, the caudal fin, and the antennæ, the author goes on to say, "The examination of the legs is more difficult. For a long time we knew nothing of them with certainty; but at length, in 1842, Hermann von Meyer gave us some light upon them. According to him the anterior legs are stronger than the others, and terminate in a pincer. Although on examining the figure one is not convinced of the fact, it is nevertheless certain that the following legs bear pincers. In the Muschelkalk of Wiesen, in Switzerland, I found a specimen in which the last joint of the first pair, which, according to von Meyer, should be a pincer, is perfectly preserved; it *terminates only with a claw*, as in the Locustæ "†.

For the purpose which I propose to attain it is not necessary to speak more in detail of *Pemphix Sueuri*; we shall revert to this Crustacean after having studied the genus *Glyphea* and the genus *Aræosternus*.

III. *Historical Sketch of the Genus* Glyphea‡.

In 1822 Desmarest published the description of a fossil Crustacean forming part of the collection in the Paris Museum. He described this specimen under the name of *Palinurus*, and gave the following diagnosis of the genus:—

"Carapace elongate cylindroid, having various regions, especially the stomachal and the branchial, very clearly marked, and presenting anfractuosities and impressed lines in greater number than those of the rest of the other Macrurous Crustacea; lateral antennæ very long and very stout.

"Legs terminated by pointed joints" §.

The specimen was from the limestone of Monte Bolca.

Pictet, in speaking of this specimen, calls it *Palinurus quadricornis*, Desm., although Desmarest gives this name to the common recent *Palinurus* ||.

* Pictet, Traité de Paléontologie, tome ii. p. 444.

† Quenstedt, Handb. der Petref. p. 324.

‡ This "Historical Sketch" has been considerably abridged in the translation.

§ Brongn. et Desm. Hist. Nat. des Crust. foss. p. 131.

|| Pictet, *loc. cit.* p. 443.

In the same year (1822) Desmarest described the "Langouste de Regley," *Palinurus Regleyanus*, Desm. He examined two individuals of this species, both of which are contained in a fragment of rose-coloured limestone of rather coarse grain, forming a sort of rolled pebble as big as one's fist. They were found at the village of Ru, near Vésoul. The author gives the following description of them:—

"In this species the carapace is elongated, compressed, margined at its contours, and covered throughout with rather distant granular points. The stomachal region is slightly angular, and marked above, in its middle, with a line projecting a little in front, but which changes posteriorly into a straight furrow, produced as far as the region of the heart; we see a projecting, granular, longitudinal line on each side of that region; and near its posterior margin we remark a small transverse furrow also on each side. The great transverse furrow of the carapace, placed behind the region of the stomach, is very strongly marked. The genital region is very wide, and divided into two parts by the impressed longitudinal line which comes from the middle of the stomachal region. Each of these parts has laterally a small transverse impression. The cardiac region is of moderate extent, and of a pentagonal form, marked in the middle with a small raised keel, which is the continuation of the median furrow of the genital and stomachal regions. On each side there is a small, elongate, triangular appendage. The branchial regions, which are very distinct, are separated from each other by a median impressed line, and also from the cardiac and genital regions by another oblique line, which runs to the sides of the carapace at the point where its great transverse furrow terminates"*.

I have thought it desirable to reproduce this description here, because it will be of service to us hereafter in speaking of the genus *Arcæosternus*.

Pictet says that *Palinurus Regleyanus*, Desm., is a *Glyphea*†; and on another page of the work quoted the same author says, "*Glyphea Regleyana*, H. von Meyer, *G. vulgaris*, id., *Palinurus Regleyanus*, occurs in the 'terrain à chailles' of the department of the Haute-Saône"‡.

Milne-Edwards (Hist. Nat. des Crust. ii. p. 302) says that Desmarest refers to *Palinurus* two species of fossil Crustacea, but that he does not accept this view of their affinities. *P. Regleyanus* appears to him to be most nearly related to *Nephrops*.

* Brongn. et Desm. *loc. cit.* p. 132.
† Pictet, Traité de Paléont. tome ii. p. 443.
‡ Pictet, *ibid.* p. 451.

In 1822 also Schlotheim described another fossil Crustacean of his collection under the name of *Macrourites pseudoscyllarus* (Petrefactenkunde, Nachtr. pt. i. p. 36). The specimen was too imperfect for detailed description; but he regarded it as nearly allied to *Scyllarus*, and remarks that although its claws are of a different form, it would appear that it should take its place in that family, seeing that its claws are toothed, at least on one side. The specimen was from Solenhofen.

Twelve years afterwards (1834) Voltz noticed a species of *Palinurus* (*P. Münsteri*) which he saw in the museum of Besançon and in the collection of Count Dressier (Neues Jahrb. 1835, p. 62); and a few months later Hermann von Meyer (Neues Jahrb. 1835, p. 328) stated that he had described and figured the Crustacea from the "terrain à chailles" of Fertignay and elsewhere, previously identified with *Palinurus Regleyanus*. He regarded them as forming three species of a distinct genus, *Glyphea*, viz. *G. vulgaris* (=*Palinurus Regleyanus*, Desm.), *G. speciosa*, and *G. ventrosa*.

In another twelvemonth von Meyer (Neues Jahrb. 1836, p. 56) says that his genus *Glyphea* included five species, namely *G. ventrosa*, *G. Regleyanus*, *G. Münsteri* (previously *G. speciosa*), *G. Dressieri*, and *G. pustulosa*. The first three occur in the "terrain à chailles" of the Haute-Saône, the fourth in the same formation near Besançon, and the fifth in the Bradfordian of Bouxweiler, Bas-Rhin. He adds that it is very remarkable that the Bradfordian form differs less from the most recent of the species of the "terrain à chailles" than some of the latter do from each other.

In 1837 von Meyer records (Neues Jahrb. 1837, p. 314) that Count Münster possessed *Glyphea pustulosa* from the Corallian of Dernebourg and of Wendhausen, near Hildesheim, and also fragments of what seemed to be *G. Dressieri*. The collection at Bayreuth contained a cephalothorax exactly like that of his *G. Mandelslohi* from the Oxfordian of Rabenstein and Thurnau, and from the same formation a fragment belonging to *G. ventrosa* or an allied species. The largest species then known to him was in the possession of M. von Alberti, from the Lower Lias of Frittlingen, near Rothweil; he named it *G. grandis*.

F. A. Römer in 1839 (Verstein. nordd. Ool. p. 51) described two species, namely *G. speciosa* and a new species which he named *G. Bronni*, from the Lower Corallian of Hersum. In the same year (1839) Count Münster described the fossil Crustacea of his collection (Beitr. zur Petref. ii. p. 39), and referred nine species to the genus *Glyphea*, namely:—*G. fusiformis*, Münst.; *G. crassula*, Münst.; *G.*

intermedia, Münst.; *G. elongata*, Münst.; *G. modestiformis*, Münst.; *G. lævigata*, Münst.; *G. minuta*, Münst.; *G. verrucosa*, Münst.; and *G. Veltheimii*, Münst. In his diagnosis of the genus he says that the lateral antennæ are as long as the rest of the body, filiform, multiarticulate, and situated on a peduncle of three joints; the legs of the first pair are long and bear large pincers, generally unequal; the legs of the second and third pairs are slender, long, and terminated by weak didactyle hands, with the outer finger movable; the legs of the fourth and fifth pairs are still more slender, and terminate in a hooked claw, &c. It would appear therefore that the species just named are not *Glypheæ*, as all the limbs in this genus are monodactyle. They were afterwards referred to *Eryma* by H. von Meyer.

On the other hand, true *Glypheæ* were described by Münster as forming his genus *Orphnea*, characterized by having the outer antennæ very long, longer than the rest of the body; the legs of the first pair long and very broad, with a single curved and pointed claw, which meets only a short tubercle; the other pairs of legs also monodactyle; the claws of the fifth pair very long; the carapace shorter than the abdomen, which terminates in five rounded caudal plates. Münster described six species, namely *O. pseudoscyllarus*, *striata*, *lævigata*, and *pygmæa* (all afterwards placed in *Glyphea* under the name of *G. pseudoscyllarus*), *O. squamosa* (now *Glyphea squamosa*), and *O. longimana* (a doubtful species). Pictet (Traité de Pal. ii. p. 447) refers to these species and to Quenstedt's opinion upon them.

In the same work (ii. p. 45) Münster described another genus of Macrurous Crustacea under the name of *Brisa*, allied to *Orphnea*, but having the natatory appendages larger and more rounded, and situated on the sides of the abdomen. The two species *B. lucida* and *B. dubia* were from the lithographic limestone of Bavaria. These forms have since been referred to *Glyphea*.

In 1849 H. von Meyer (Neues Jahrb. 1849, p. 548) met with another species, *G. Hauensteini*, from the freshwater Molasse of Oberbuchsiten, in Switzerland.

In the same year (1849) Robineau-Desvoidy published (Ann. Soc. Ent. Fr. 2e sér. vii. p. 131) a memoir on the Crustacea of the Neocomian of Saint Sauveur-en-Puisaye (Yonne), in which he described thirty species, twenty-seven belonging to the Macrura. A single specimen of *Glyphea* occurred; and the author named it *G. neocomiensis*. It showed only four segments of the abdomen (second to fourth), of which the first two present five deep furrows traversing the whole of the back, separated by elevated lines covered with sharp tubercles directed forward. The second line is interrupted in the middle. The third and fourth segments have neither the furrows nor the lines.

In 1850 Dixon (Geol. & Foss. of Sussex, p. xv, pl. xxxviii.* fig. 8) published a figure of part of the cephalothorax of a Crustacean, which appears to belong to a *Glyphea.* It is from the Cretaceous beds of Sussex. In the same year H. von Meyer (Palæont. i. p. 141) described, under the name of *Selenisca gratiosa*, a fossil Crustacean from a deposit of the age of the Solenhofen Limestone at Wurmlingen, near Tuttlingen, in Württemberg. He regarded it as allied to *Glyphea.*

In 1851, in his 'Lethæa geognostica' (iv. p. 423), Bronn described the *Glypheæ* as having the anterior limbs terminated by pincers. This is an error, probably due to Phillips (see Jameson's Edinb. Journ. xix. p. 372); but he adds that we must not confound the genus *Glyphea*, Meyer, 1835, with the synonymous genus of Münster, 1839, for the latter of which Meyer, in 1840, proposed the name of *Eryma.* Pictet (Traité de Pal. ii. p. 450), in 1854, seems to have copied Bronn's error.

In 1858 Quenstedt mentions *Glyphea grandis* from the Lower Lias of Frittlingen as probably identical with *Mecochirus grandis* (Der Jura, p. 88). He also (p. 200) mentions a *G. Amalthei*, known only from portions of the pincers (which may belong to *G. liasina*, Meyer), and a *G. numismalis*, Oppel, which is larger and came from the Numismalis marls of Hinterweiler, south of Tübingen (p. 349). Afterwards (p. 391) he describes a pincer found in an iron-mine at Aalen, under the name of *G. aalensis*, and adds that he adopted the name *Glyphea* because it was then in vogue, forgetting apparently that the *Glypheæ* are monodactyle. Elsewhere (p. 549) he refers to the Astacine Crustacea, of which the cephalothorax has two transverse grooves instead of one as in the existing genera; and for this reason, he says, von Meyer gave them the name of *Glyphea* and afterwards that of *Klytia.* He figures *Glyphea bedella* (pl. liii. fig. 5) from Balingen, which he regards as having most analogy with *Klytia ventrosa* of the White Jura. In his description of the Brown Jura (p. 807), Quenstedt refers to some Crustacea from this formation, which he names *Glyphea ornati*, *G. Mandelslohi*, and *Orphnea ornata.* The first two have didactyle pincers, and are not *Glypheæ.* With regard to his *Orphnea ornata* he says, "In the 'Handbuch der Petrefactenkunde,' p. 269, it is shown that von Münster's genus has as its type *Palinurus Regleyanus*, Desm., from the 'terrain à chailles,' and *Macrourites pseudoscyllarus*, Schloth.

Von Meyer, who, in 1835, formed his genus *Glyphea* of these species, afterwards, in the 'Palæontographica,' i. p. 141, figured, under the name of *Seleniscа speciosa*, a specimen from the White Jura of Tuttlingen, which seems to approach our *Orphnea ornata*." *Glyphea ventrosa β*, Quenst., according to von Meyer, is a *Klytia*; and *G. Veltheimii*, Quenst., cannot be a *Glyphea*, as he speaks of slender pincers and a long finger.

Also in 1858, Etallon published (Bull. Soc. Géol. Fr. sér. 2, xvi. p. 182) descriptions of the fossil Crustacea of the Haute-Saône and Haut-Jura. The species described by him are for the most part from the "terrain à chailles." He characterized, among others, the genus *Glyphea*, and remarked that, notwithstanding the characters in which it approaches *Pemphix* and *Palinurus*, the external lamina of the antennæ and the mobility of the last segment of the thorax must cause them to be kept with the Astacians. The genus was too much enlarged by Münster, who included in it species now referred to *Clytia* and *Eryma*. Taking as types the species found in the "chailles" of the Haute-Saône, the characteristic forms occur from the Lias to the Kimmeridgian; some species have a wide distribution; and many occur in several stages. Etallon describes *Glyphea Regleyana*, Meyer, *G. Münsteri*, Meyer, *G. rostrata*, M'Coy, and *G. Udressieri*, Meyer—the last identical with *Palinurus squammifer*, E. Desl.

In 1860 Hermann von Meyer* wrote on the subject of Etallon's researches, and discussed some of his results. In the same year appeared Oppel's note on the species of the genera *Glyphea* and *Pseudoglyphea* †, in which he points out that the *Glypheæ* of Münster belong to *Eryma*, Meyer, along with *Aura*, Münst., *Klytia*, Meyer, and *Pustulina*, Quenst., while *Glyphea*, Meyer, includes *Orphnea* and *Brisa*, Münst., and *Seleniscа*, Meyer.

This paper was preliminary to a great memoir on the Jurassic Crustacea, published by Oppel in his 'Paläontologische Mittheilungen,' in 1862, in which he fully characterized the genus *Glyphea*, to which he referred the following twenty-four species:—

1. *G. Heeri*, Opp., from the Lias of Schambelen.
2. *G. major*, Opp., with the preceding.
3. *G. alpina*, Opp. Lias of the Alps.
4. *G. liasina*, Meyer.
5. *G. Terquemi*, Opp. Middle Lias, Moselle.

* Neues Jahrb. 1861, p. 73.
† Jahresh. Ver. vaterl. Naturk. Württ. xvii. p. 108.

6. *G. solitaria*, Opp. Inferior Oolite, Württemberg.
7. *G. pustulosa*, Meyer. Inferior Oolite, Württemberg.
8. *G. crassa*, Opp. Inferior Oolite, Moselle.
9. *G. Martini*, Etall. Callovian.
10. *G. ornata*, Quenst. (*Orphnea*). Callovian, Württemberg.
11. *G. Udressieri*, Meyer (incl. *G. Dressieri*, Mey., *Palin. squammifer*, Desm., and *G. Udressieri*, Etall.). Oxfordian.
12. *G. Münsteri*, Voltz (incl. *Palin. Münsteri*, Voltz, *G. speciosa* and *Münsteri*, Mey., *G. speciosa*, Röm., and *G. Münsteri*, Etall.). Oxfordian.
13. *G. Regleyana*, Opp. (incl. *Palin. Regleyanus*, Desm., *G. Regleyana* and *vulgaris*, Mey., *Palin. longebrachiatus*, Desm., and *G. Regleyana*, Etall.). Oxfordian.
14. *G. Bronni*, Röm. Corallian.
15. *G. rostrata*, Phill.
16. *G. Etalloni*, Opp., = *G. rostrata*, Etall.
17. *G. Perroni*, Etall. Corallian.
18. *G. gratiosa*, Meyer (*Selenisca*). Kimmeridge.
19. *G. pseudoscyllarus*, Schl. (incl. *Ast. fluviatilis*, Bajer, *Macrourites pseudoscyllarus*, Schl., *Scyllarus dubius*, Holl, *Orphnea pseudoscyllarus*, *striata*, *lævigata*, and *pygmæa*, and *Brisa dubia* and *lucida*, Münst., *Orphnea pseudoscyllarus* and *striata*, Frischm. Lithographic stone of Solenhofen and Eichstadt.
20. *G. squamosa*, Münster (*Orphnea*). Solenhofen.
21. *G. tenuis*, Opp. Eichstadt.
22. *G. Sœmanni*, Opp. Lithographic stone of Cirin.
23. *G. jurensis*, Opp. Kimmeridge.
24. *G. Meyeri*, Römer.

In 1870 C. Schlüter (Neues Jahrb. 1870, p. 962) noticed *Glyphea Lundgreni* from the Lower Cretaceous of Sweden. Other Cretaceous species are *G. neocomiensis*, R.-Desv., *G. cretacea*, M'Coy, and *G. Carteri*, Bell. Four years later the same author (Verh. naturh. Ver. Rheinl. und Westf. 1874, p. 48) fully described *G. Lundgreni* from Saltholm, in Sweden, which may be identical with a Crustacean figured by Dixon.

IV. *The* Glypheæ *of the Teyler Museum.*

The Teyler Museum possesses ten slabs of the lithographic limestone of Bavaria, seven from Solenhofen, and three from Schernfeld, near Eichstadt, which present more or less complete remains of Macrurous Crustacea. No doubt these fossil

Crustaceans must be ranged in the genus *Glyphea*, and belong to the species named *G. pseudoscyllarus*, Schloth. Among these slabs of stone there are some which show only very mutilated and nearly undecipherable organic remains; but in some of them the animal is preserved in a manner so perfect that it is not difficult to recognize the different parts of the body and to discern the characteristic marks of the species. This fortunate circumstance enables me to make a very complete description of this remarkable species of *Glyphea*; for the parts of the body which are deficient in one slab are frequently admirably preserved upon another.

The cephalothorax is longer than broad; it is covered with tubercles which, on the anterior part, are arranged upon parallel lines, so as to form beaded salient lines, and behind the great transverse furrow are irregularly disseminated. Most of the specimens still present traces of depressions, elevations, and grooves which adorned the carapace during the life of the animal; but in general these characters have been more or less effaced during the fossilization of the body. However, the great deep transverse groove which, on each side of the cephalothorax, is directed towards the median line, and thus forms a semilunar line upon the carapace, separating the stomachal region from the posterior regions, is almost always met with.

The segments of the abdomen appear smooth in most of the specimens; but in some they sometimes present isolated tubercles, and the most perfect specimen in our collection even bears some small tubercles on the seventh segment of the abdomen and on the lateral plates, which, with that segment, form a caudal fin of five lamellæ arranged in a fan. This seventh segment is of a more or less triangular form, being not very wide and narrower behind than in front, while the lateral natatory lamellæ are nearly circular. These external lamellæ are divided transversely; and this division leads one to suppose that these lamellæ were soft and flexible for the posterior third of their length. The first six segments of the abdomen present on each side a triangular lamellar process. It would appear that all these segments, or, at any rate, some of them, bore appendages in the form of small oval lamellæ, which, no doubt, were natatory false feet; one of the specimens in the Teyler Museum presents one of these false feet isolated. The size of this appendage compared with that of the animal would lead one to suppose that this specimen was a female, as we know that in general the appendages of the abdominal segments are much more developed in the females than in the males of existing Crustacea.

The inner antennæ, placed upon a jointed peduncle, are composed of two slender multiarticulate and elongated flagella; the peduncle seems to me to be composed of three joints of a cylindrical form.

The outer antennæ are much stouter and much longer than the inner ones. Their peduncle is composed of two joints, of which the posterior is adorned with several longitudinal series of small tubercles, which, according to M. Oppel, are slender spines. This basal portion of the antenna bears a very long multiarticulate filament. . . . Above the base of the external antennæ there is a pointed movable lamina or protective scale shorter than the peduncle of the antennæ. It appears to me that the surface of this movable scale is perfectly smooth.

The ocular peduncles are very long and broad; they do not seem to be cylindrical as usual, but have the appearance of being almost lamellar. According to M. Oppel the extremity of these peduncles is almost always lost; but the greater part generally exists in its original position and form, although flattened in a certain direction.

None of the specimens at my disposal present any traces of the jaw-feet; consequently I cannot give a description of them; but M. Oppel says that these organs consist of several segments, and that they are digitiform and of a moderate length, equal to that of the movable scale of the outer antennæ.

The legs of the first pair are large and broad and garnished with tubercles and teeth, which are generally situated upon longitudinal lines; their penultimate joint especially is toothed below; the series is composed of about ten sharp teeth, one of which is much larger than the others. These anterior legs terminate in a single pointed and slightly curved finger. This finger also presents some small tubercles, arranged in rows, which give it the aspect of being adorned with prominent beaded lines. It may be, however, that these tubercles are not truly tubercles, but teeth or spines depressed by the pressure undergone by the animal in the beds of limestone which have preserved these remains for us.

The succeeding legs are more slender; and their surface is smooth or presents only a few isolated tubercles. They terminate in a slender and pointed claw; all the five pairs of legs are consequently monodactyle.

In general the size of these Crustaceans is small; they rarely attain a length of more than 1½ to 2 inches.

On comparing our description with the diagnosis of the species established by M. Oppel, it is not difficult to recognize in the specimens described representatives of the species named *Glyphea pseudoscyllarus*, Schl., Oppel.

Most of the examples are adult animals; but among them are two which are undoubtedly young individuals. It is, according to M. Oppel, upon such non-adult individuals of *Glyphea pseudoscyllarus* that von Münster established his genus *Dubima.*

V. *On* Aræosternus Wieneckei, *De Man.*

In order to be able to compare the fossil genus *Glyphea* with the recent genus *Aræosternus*, it is necessary in the first place to give a short summary of the peculiarities of the latter. We must run through the description of the single species of this genus, inserted by Dr. J. G. De Man in the periodical work entitled 'Notes from the Leyden Museum,' vol. iii. M. De Man says:—

This new and very interesting form, to which I propose to give the name of *Aræosternus*, in consequence of its narrow sternum, belongs without any doubt to the family Loricata (Scyllarides, Palinurides). By its generic characters it is a very near ally of the genus *Palinurus*, Fab., the "*Palinuri communes*" of Milne-Edwards; but it differs therefrom so remarkably by the structure of the cephalothorax and the form of the front and the sternum, that it must represent a new subfamily, equal in value to the Scyllarides and the Palinurides. The family Loricata must therefore be divided into three subfamilies, the Scyllarides, Palinurides, and Aræosternides, the last being characterized by the rectangular and narrow sternum and by the structure of the carapace, which is elongated, subcylindrical, and covered with hairs, without spines.

The single specimen, a male, was given to Dr. Wienecke when he visited the Isle of Rats, near Bencoolen, in Sumatra. The person who presented it to the above-mentioned traveller said that he had found the animal in the sea.

The specific characters of *Aræosternus Wieneckei* are as follows:—The cephalothorax is of an elongate rectangular form; its greatest breadth, a little behind the cervical furrow is, in proportion to its length, as 5 to 8; the cervical groove is situated a little behind the middle; the lateral portions of this groove are directed downward and forward towards the anterior part of the antennary sternum; the branchial grooves are very shallow; in front of and parallel to the semilunar posterior margin of the upper surface of the cephalothorax there is a very deep groove.

The front is separated from the outer angles of the carapace by two deep triangular incisions, in which the eyes are situated. The anterior margin of the front and the outer angles of the orbits are faintly toothed; and on the median line of the anterior part of the front there is a series of a few pointed teeth. The broad and triangular front entirely covers the ophthalmic and antennary segments.

The carapace does not, like that of the *Palinuri*, bear spines; but the whole surface is covered with a multitude of tufts of small hairs, with a few scattered long hairs.

The outer antennæ are formed as in the *Palinuri*, their peduncle uniting with the epistoma. There is no movable scale or protective lamella.

The basal joint of the peduncle is armed with a small spine at the external angle; the upper surface is concave posteriorly and convex anteriorly; the lower surface is convex and a little rough; the inner surface is concave and smooth; the anterior margin of the upper surface is adorned with some yellow hairs. Long hairs cover the second joint of the peduncle, as well as the terminal filament, which is multiarticulate and almost as long as the carapace.

The inner antennæ are situated a little below the outer ones and formed exactly as in the *Palinuri*; their basal joint, the longest of all, extends as far as the middle of the carpocerite of the outer antenna; the second and third joints are of equal length, and are together as long as the first joint; the two terminal filaments are very short; the inner one, which is the longer, is multiarticulate and furnished with hairs on the two margins.

The epistoma is of a transverse rectangular form; its anterior margin is concave, with a median process in the form of a small knob; the concave part is toothed; the other lateral parts of the margin are crenulated; and the outer surface of the epistoma is covered with small tufts of fine hairs.

The outer jaw-feet extend as far as the middle of the carpocerite of the outer antennæ, and are formed as in the *Palinuri*. The third joint of these limbs is of a trapezoidal form, longer than broad; the inner margin of the inner surface is narrow, armed with nine or ten pointed teeth, of which the anterior are the largest; the inner surfaces of all the joints are furnished with a multitude of long yellow hairs.

The sternum is of an elongate and rectangular form. This piece is composed of five segments, of which the first, or anterior, is a little narrower than the second; the second, third, and fourth segments are nearly of equal breadth; while the fifth segment is very narrow, not so wide as the first.

The ambulatory legs are all monodactyle; the first pair is much stronger than the others. The other pairs diminish in length and breadth in proportion to their distance from the first pair. All the legs are formed like those of the *Palinuri.* The outer surfaces of all the legs are furnished with small tufts of hairs, and the upper and lower margins with very long yellow hairs.

The abdomen resembles that of *Palinurus*; it is a little longer than the carapace. The sixth segment of the abdomen likewise perfectly resembles that of the *Palinuri*; and its lateral appendages form, with the seventh segment, the caudal fin.

The above is a brief summary of the peculiarities of this remarkable Crustacean; for more ample information I refer the reader to M. De Man's memoir. This naturalist, having had the politeness to send me a fine figure of his specimen of *Aræosternus Wieneckei*, accompanied by some remarks, I find myself in a position to add some further particulars to the description inserted in the 'Notes from the Leyden Museum.'

The author writes to me as follows:—"My *Aræosternus* cannot be associated with any existing genus of Macrurous Crustaceans known to me, and this for the following reasons:—It differs from the Carides by the absence of a protective lamella on the peduncle of the outer antennæ, from the Astacides (*Homarus*, *Astacoides*, *Astacus*, *Nephrops*, *Paranephrops*, *Enoplometopus*, &c.) for the same reasons and because all the legs are monodactyle, from the fossil Eryonides for the same reasons; from the Palinurides (*Palinurus*) on account of its non-triangular sternum not widened in the posterior part, and on account of the different structure of the cephalothorax; from the Scyllarides for the reasons mentioned under the Palinurides, and, further, because the outer antennæ are not lamellar; from the anomobranchial Thalassinides (*Callianides* &c.) by the monodactyle feet; from the *Thalassinæ* by the broad and not linear lateral lamellæ of the penultimate segment of the abdomen; from the Callianassides (*Callianassa*, *Trypæa*), because the outer jaw-feet are not lamelliform, and by the monodactyle feet &c.; from the genera *Glaucothoe*, *Laomedia*, *Calocaris*, and *Anius*, which belong to the subbranchial Thalassinides, by the monodactyle feet and several other differences; from the genus *Gebia* by an entirely different habit, by the form of the front, by the eyes being lodged in a sort of orbit, but especially by the structure of the antennæ: in *Gebia* the peduncle of the outer antennæ is composed of several joints, while the flagellum of the inner antennæ is much longer than the peduncle; in *Aræosternus* this part is much stouter than the peduncle.

"Our form must be associated with the family Loricata (Palinurides, Scyllarides) because it presents the characters which distinguish this family from the other group of Macrurous Decapod Crustacea, *i. e.* the absence of a protective lamella, or scale, to the external antennæ, the monodactyle feet, and the structure of the peduncle of the outer antennæ, which is composed of three joints, of which the first two are intimately united with the epistoma, a peculiarity which is met with only in the Loricata. Nevertheless it departs from the Palinurides and the Scyllarides by the non-triangular sternum and by a different habit. It must therefore form a new genus and a new subfamily in the group of the Loricata."

[To be continued.]

XV.—*Descriptions of new Species of Lepidoptera, chiefly from Duke-of-York Island and New Britain.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

[Continued from p. 43.]

18. *Libythea pulchra*, sp. n.

Allied to *L. Geoffroyi* and *L. antipoda.* Wings above bright lilac, the whole disk of the secondaries bright fulvous orange, borders of all the wings narrowly dark brown; veins brown: thorax blue-green, tips of palpi and shoulders brown; abdomen brown, bluish at base, greyish brown spotted with black at the sides. Primaries below ochraceous, apical area brown crossed by a vague band of greyish lilac; borders brown, the costa traversed by darker striations: secondaries rosy lilacine, alternating with four bands of bronze-brown and striated with the same colour: body ashy whitish, the pectus bluish at the sides. Expanse of wings 57 millim.

New Britain.

19. *Curetis solita*, sp. n.

♂. Primaries above dark chocolate-brown, with the lower half of the discoidal cell and a large oval patch confluent with it upon the median interspaces, bright orange: secondaries slightly paler than the primaries, with slight purplish and bronze reflections; an elongate subapical orange spot and a few scales of the same colour beyond the cell: body as usual. Under surface snow-white, with slightly sordid margins and brown fringes to the wings; a few scarcely perceptible slender grey dashes across the disk, and a submarginal series of black dots. Expanse of wings 41 millim.

New Britain.

Allied to *C. celebensis*.

20. *Holochila regina*, sp. n.

Near to *H. intensa*: the male of the same brilliant cobalt-blue, but with the external black border of primaries of only two thirds the width at apex; the female also very similar to that sex of *H. intensa*, but with the white spot more completely concealed by a bright silvery blue shot, so that in some lights it is quite confluent with the interno-median patch of silvery blue. Expanse of wings, ♂ 30 millim., ♀ 29 millim.

Duke-of-York Island.

We have males of this species from New Guinea.

21. *Miletus scintillans*, sp. n.

♂. Allied to *M. anacletus*, but the wings above of a shining greenish cobalt-blue (instead of ultramarine), and with the black apical area of primaries slightly narrower; on the under surface the submarginal metallic spots are slightly pink, like tarnished silver, instead of golden green; all the other metallic markings are more golden than in *M. anacletus*; there is a small pale blue spot at the end of the cell of primaries, and below and beyond it are reddish-orange spots, the oblique subapical band is reddish orange instead of ochre-yellow; the red bands of secondaries are darker, the first being preceded by a short orange dash, the second decidedly straighter than in *M. anacletus*, the third entirely different in shape, nearly straight from the second subcostal to the first median branch, where it is interrupted and V-shaped to the abdominal margin; the submarginal band inside the metallic spots orange instead of ochre-yellow; external border buff. Expanse of wings 36 millim.

New Britain.

The blue colouring of this beautiful species is more like that of *M. epicletus* than *M. anacletus*; but the pattern of the under surface more nearly approaches that of the latter species. In both the colouring above and some of the under-surface characters it approaches the Fabrician type of *M. narcissus*, which leads off from it in the direction of *M. pythias*.

22. *Lampides astarte*, sp. n.

♀. Above grey. The wings with vivid sky-blue reflections; markings much like those of *Lycænesthes larydas*, Hew. (nec Cramer)*; the primaries with rather a broad ex-

* Cramer's figure is not at all like Hewitson's insect on either surface. I am somewhat doubtful as to whether it is even a *Lycænesthes*.

ternal blackish border, upon which a submarginal paler lunated line is dimly visible; the inner edge of this border is bounded by a diffused white line: secondaries with an oblong blackish spot just beyond the cell; a rather broad blackish external border with undulated white inner edge, and enclosing a marginal series of dull black spots with lunate white inner borders; tail short, black, tipped with white: abdomen brownish. Wings below with the basal half pale brownish grey; the secondaries crossed by irregularly placed oblong darker patches edged with blackish and white; the primaries with only one such patch at the end of the cell, external half snow-white, an irregular blackish-bordered grey-brown band crossing the disk immediately beyond the basal area; a submarginal undulated blackish stripe, followed by a marginal series of blackish spots, the last two on the secondaries intense black sprinkled with metallic blue scales, the last but one being large, the blue scaling confined to its outer margin, and its inner edge bounded by a pale stramineous lunule; a black marginal line; fringes spotted with blackish at the extremities of the veins; tail as above: body below white, the legs greyish. Expanse of wings 29 millim.

New Britain.

23. *Lampides complicata*, sp. n.

♀. Allied to *L. argentina*. Wings above pale blue-grey; primaries with a broad apical area and external border dark grey-brown; a small black spot at the end of the cell; a slender abbreviated white submarginal line near external angle: secondaries with a marginal series of white-edged conical grey-brown spots, bounded internally by an undulated line of the same colour, the sixth spot blackish and surmounted by a small orange spot. Under surface pale stone-brown, with white-bordered darker brown markings as follows:—two irregular oblong spots closing the discoidal cells and enclosed by two continuous irregular bands connected with the extremities (that is to say, on the costal border of primaries and the abdominal border of secondaries); a continuous undulated (or almost zigzag) submarginal white-bordered brown stripe, limiting the marginal conical spots, which are continued to the apex of primaries, the last two on secondaries being partly black and surmounted by orange; a slender brown marginal line; fringe white; tail blackish, with whiter outer margin and tip. Expanse of wings 24 millim.

"New Britain" (in accompanying list of specimens).

A ticket on the specimen indicates that it is from Duke-of-York Island.

24. *Amblypodia minnetta*, sp. n.

♂. Nearly allied to *A. helius*, from which it differs in its smaller size and the narrower black external border to its wings above, and below in the considerably smaller size of all the white-edged black-brown spots, none of which consequently are confluent, so that the discal bands consist of chain-like series of white-edged spots. Expanse of wings 41 millim.

Duke-of-York Island.

There is a pair of what appears to be this species in the Hewitson collection, from New Guinea. The specimens are arranged under *A. helius*.

25. *Hypolycæna periphorbas*, sp. n.

♀. Allied to *H. phorbas* and *H. tmolus*. Upper surface much like the same sex of the latter species, but the white patch on the primaries smaller, not bluish; the secondaries shorter, not so grey, with four well-defined whitish-edged blackish submarginal spots above the tails. Under surface brassy instead of pure white, excepting a patch on the primaries corresponding with the white patch of the upper surface; the short bars closing the discoidal cells and the discal band ochreous instead of pale stone-colour; the discal band widely interrupted in the centre on the primaries, and much more irregular on the secondaries; the ocelloid marginal band much more defined, the spots enclosed within it distinctly conical on the secondaries. Expanse of wings 36 millim.

New Britain.

26. *Delias Salvini*, sp. n.

♂. Near to *D. bagoë* (=*eurygania*); but the primaries on both surfaces with a small curved oblique subapical white band in place of the large sulphur-yellow patch of *D. bagoë*; the secondaries below with the crimson tapering submarginal band much more arched, so that its outer edge is almost parallel to the outer margin. Expanse of wings 65 millim.

New Britain.

27. *Elodina primularis*, sp. n.

Sulphur-yellow; primaries with dark bronze-brown costal and external borders formed as in *E. therasia* (=*bouruensis*?), but decidedly wider: secondaries with three squamose brown spots at the extremities of the second subcostal, radial, and third median branches; abdominal border white: body greenish grey. Primaries below sulphur-yellow, very bright towards the base; an arched brown band from the costal border beyond the cell to the outer margin near external angle; apical area cream-colour; fringe dark brown: secondaries cream-colour. Expanse of wings 45 millim.

Duke-of-York Island.

28. *Appias delicata*, sp. n.

♂. Allied to *A. celestina*. Pale chalky blue, with the veins on external area of primaries and a tapering external border black: secondaries with the second subcostal, radial, and third median veins terminating in diffused black spots; abdominal border whitish: body blue-grey. Under surface bluish white; primaries with a blackish squamose streak from the fifth subcostal or upper radial branch to the external angle, uniting upon the veins with a tapering internally sinuated marginal grey band: secondaries with the basal half of costal area bright sulphur-yellow; discoidal cell and disk creamy yellowish, shading off externally into a submarginal diffused greyish band united on the veins to a grey border, so as to leave four or five large spots of the ground-colour; base of abdominal border and pectus pale sulphur-yellow. Expanse of wings 73 millim.

New Britain.

29. *Belenois picata*, sp. n.

♂ ♀. Allied to *B. teutonia* of Australia, but differing on both surfaces in the much larger submarginal white spots, and on the under surface in the total absence of all the orange patches and spots. Expanse of wings 64 millim.

New Britain.

As Donovan gives perfectly recognizable figures of *B. teutonia* (omitting only the small black discocellular line on the male) it is unnecessary to describe *B. picata* in full.

30. *Zetides seminigra*, sp. n.

Differs from *Z. agamemnon* above in the greater size of the subcostal spots beyond the cell of primaries, in the more emerald-green colour of the spots of the oblique postmedian series, in the continuation of this series to the inner margin by the introduction of two large spots placed transversely instead of the three small obliquely placed spots of *Z. agamemnon*, thus leaving a clear space throughout between the postmedian and submarginal series, in the more uniform size of the spots of the latter series (which terminates in two small unequal spots in place of the large double one of *Z. agamem-*

non), in the almost total absence of the green and white markings on the secondaries, in the much less prominence of the pink coloration on the under surface and of the green spots on the secondaries, in the paler colour of such spots as remain, in the presence of a red-bordered black spot towards the base of the costal border, immediately above the ordinary lunule of these colours, in the presence of two conspicuous scarlet spots in place of the two other ordinary red-edged black spots, and in the greater size of the black patch beyond the middle of the subcostal area. Expanse of wings 100 millim.

New Britain.

31. *Plesioneura insulata*, sp. n.

♂. Allied to *P. alysos* of Ceylon. Dark chocolate-brown; primaries with an oblique trifid semihyaline white patch from the subcostal vein near the end of the discoidal cell to the first median branch; a small transverse bilobed spot separate from the above, but of the same colour, across the internomedian area near the external angle. Expanse of wings 43 millim.

New Britain.

32. *Tagiades clericus*, sp. n.

Nearly allied to *T. atticus*: primaries dark purplish brown, with two conspicuous hyaline white spots near the end of the cell and two placed obliquely near the base of the median interspaces; an oblique and slightly angulated subapical series of four hyaline white points: secondaries dark brown, with the anal fourth snow-white; the apex, three large marginal spots, and two unequal obliquely placed subapical spots black: body dark brown. Primaries below nearly as above: secondaries snow-white, bluish in the centre, and with the base and costal area broadly purplish brown; a subconfluent marginal series of unequal black spots; three small subapical black spots, the second and third close together, on the radial interspaces: pectus bluish white; venter white. Expanse of wings 52 millim.

Duke-of-York Island.

33. *Tagiades presbyter*, sp. n.

Allied to *T. atticus* and *T. menaka*: primaries above black-brown; a subcostal dot and two unequal dots near the end of the cell, forming an oblique series beyond the middle; two dots placed obliquely on the median interspaces, the usual five subapical dots, a squamose dash at the end of the cell, and another near the external angle hyaline white: secondaries with the basal half and apical area black-brown; remainder of wing, with the exception of a large submarginal black spot and a black border confluent with the apical area, snow-white: body dark brown. Primaries below with the squamose spots replaced by well-defined snow-white spots, that near the external angle large and bifid; otherwise nearly as above: secondaries snow-white, pale blue towards the base; costal area, a subapical spot near the outer margin, and a narrow external border black: body below white; pectus and legs slightly bluish. Expanse of wings 46 millim.

Duke-of-York Island.

34. *Pamphila repetita*, sp. n.

♂. Extremely like *P. ancillaris* of the Amazons. Dark bronze-brown: primaries with a chocolate-coloured patch below the cell, bounded externally by a slender oblique hyaline white line from first median branch to submedian vein; two hyaline white dots placed obliquely in the median interspaces. Under surface paler, with golden reflections: primaries with hyaline markings as above. Expanse of wings 31 millim.

Duke-of-York Island.

35. *Pamphila albiclavata*, sp. n.

♂. Chocolate-brown; basal half of wings above clothed with ochraceous scales: primaries with three or four bright ochreous spots in an oblique series from the third median branch to the submedian vein: secondaries with two or three ill-defined ochreous spots on the median and radial interspaces, thus extending the ochraceous-tinted area of the wings: head flecked with ochreous; front of thorax greenish. Wings below chocolate-brown, irrorated with ochreous: primaries with three increasing ochreous spots from third median branch to submedian vein: pectus ochraceous; venter brown, barred with cream-colour; club of antennæ broadly banded with cream-colour. Expanse of wings 35 millim.

Duke-of-York Island.

P. albiclavata much resembles the female of the American *P. Wingina.*

Heterocera.

36. *Macroglossa fulvicaudata*, sp. n.

Allied to *M. alcedo*. Primaries above dark pitchy brown, crossed by two inconspicuous sericeous greyish bands, the first just before the middle, transverse, slightly wider in front than behind; the second discal, its inner edge extending from the inner margin close to external angle to the apical third of costa; these bands are limited internally by nearly straight blackish lines; the first is also bounded externally by an irregularly-undulated line, but the second band has a diffused outer margin *: secondaries with the submedian vein, the median vein with its branches, and a very broad external border occupying half the wing black; the rest of the wing bright orange-ochreous, paler upon the costal border: head and thorax greyish olivaceous, with chocolate-brown patches on each side behind; abdomen dark purplish brown, with the three basal segments orange at the sides, and the remaining segments with orange lateral tufts; anal tuft deep orange. Wings below chocolate-brown: primaries with a small basal ochreous patch: secondaries with the basiabdominal third bright ochreous, but with brown anal margin; three parallel dark-brown lines from costa to submedian vein, across the centre of the wing: palpi and front of pectus white, remainder of pectus pale ochreous; venter ochreous, with triangular ferruginous patches on each side; anal tuft bright ochreous. Expanse of wings 56 millim.

New Britain.

The example in our collection from New Ireland is larger, measuring 64 millim. in expanse.

37. *Macroglossa calescens*, sp. n.

Primaries above dark purplish brown, mottled with sericeous grey; a rather ill-defined black band forking above the median vein before the middle, and two parallel trisinuate dark-brown lines across the disk: secondaries bright saffron-yellow, with two basal patches below the median vein, and a very broad external border, abruptly tapering at anal angle, but occupying about half the wing, dark purplish brown: head and thorax greyish olivaceous, with a sprinkling of ash-grey scales, dark reddish brown behind; abdomen dark laky brown, with metallic-green scales along the posterior margins of the segments, the three basal segments with deep-orange lateral patches; lateral margins of segments blood-red. Primaries below dark purplish brown, gradually shading into blood-red towards the external border, which is irregularly black-brown; extreme base ochreous: secondaries deep

* A specimen in the collection from New Ireland, presented by Messrs. Salvin and Godman, shows no trace of the blackish lines; but it is somewhat worn, and may have lost them.

sienna-red, shading into blood-red towards the external border, which is black-brown; abdominal area bright ochreous; three dark-brown stripes a little wider apart than in the preceding species: palpi and pectus ashy white; legs grey-brown; venter blood-red, irrorated with orange, with steel-blue scales along the posterior margins of the scales; anus brown. Expanse of wings 53 millim.

New Britain.

Although a broader-winged insect, the style of coloration in this species on both surfaces is very like that of *M. catapyrrha.*

38. *Rhamphoschisma Godeffroyi*, sp. n.

Primaries above pale silvery brown, slightly clouded with olivaceous, crossed in the middle by a broad X-shaped dark olivaceous double belt, beyond which the disk, with the exception of the apical area and a small patch at external angle, is of a still darker olivaceous colour; an apical costal patch reddish olivaceous, only separated by a zigzag silvery line from a large irregular black-brown patch on the external border: secondaries dark purplish brown, paler at base, crossed in the middle by a rather narrow bright ochreous band, its outer edge deeply incised below the first median branch; costal border greyish brown: body greyish brown; tegulæ reddish brown, with black margins and whitish fringe: abdomen black at the sides, the three basal segments with ochreous spots, increasing in size and intensity from the base backwards; posterior segments with reddish-orange lateral tufts; terminal segment with a white spot on each side along its anterior margin. Wings below brownish grey, the primaries shading into deep brick-red towards apex and upon the disk; a nearly straight central red-brown stripe and two parallel arched discal stripes of the same colour; external border olivaceous, the inner edge of it sprinkled with pale scales; extreme base cream-coloured: secondaries with a black spot before the middle of costa, from which runs the first of three equidistant dark-brown lines extending from the costal margin to the submedian vein; a fourth irregular submarginal line, terminating in a blackish anal border; a broad ochreous patch on the abdominal area: body below deep flesh-coloured; palpi dull white; inner surface of legs very broadly fringed with long straw-coloured hairs; centre of venter greyish. Expanse of wings 60 millim.

Duke-of-York Island.

In my ‘Revision of the Sphingidæ’ I regarded *Rhamphoschisma* as congeneric with *Macroglossa*; and if *M. trochilus* be accepted as type I must still hold the same opinion. This species, however, will have to stand as type of *Psithyros*, Hübn.; and therefore in any case Wallengren's genus falls; but if we accept Felder's extension of the genus, it may stand for all such species as have broadly-fringed and pilose legs, and (so far as I can judge from figures alone) would contain *M. Mitchelii*, *M. imperator*, *R. rectifascia*, *R. scottiarum*, and possibly *M. tinnunculus*. At any rate the hairy-legged species will have to be separated generically from *Macroglossa*.

39. *Protoparce Schmeltzii*, sp. n.

♂. Primaries above much like those of *P. cingulata*, excepting that the black markings are all replaced by dark velvety grey-brown, the two elongated median stripes being only partly visible in certain lights; discocellular spot white: secondaries ash-grey, crossed at basal fourth by a very oblique brown band, in the centre by two brown stripes, which unite and are continued as a single line from below the first median branch; external border broadly brown, especially at apex; all these brown bands, as well as the costal border, which is whitish, are slightly shot with gold; fringe white, broadly spotted with brown: thorax grey, with several longitudinal black lines; an arched line at the back of the collar on each side: abdomen dark grey in the dorsal region, but with the sides alternately banded with black and white; a bright ochreous spot on each side at the base. Wings below sericeous brownish grey, with feebly indicated darker stripes somewhat as above: body below greyish white; venter with snow-white posterior borders to the segments. Expanse of wings 108 millim.

Australian region.

No reference is given to this species in the list received with the collection; and therefore I am unable to record the exact locality. It is an exceedingly distinct species, intermediate between the *P. carolina* and *P. cingulata* groups.

40. *Spilarctia turbida*, sp. n.

♀. Allied to *S. rosacea* and *S. basilimbata* of Japan. Primaries cream-coloured, clouded all over the central area with brown, upon which the veins and a spot at the inferior angle of the cell show creamy white; two large black spots crossed by the median vein, the first near the base and the second at origin of first median branch; two abbreviated oblique black bands divided by the nervures, the first from apex to third median branch, the second from the lower radial at the end of the cell to the first median branch; several small black spots and dots are also scattered over the surface near to the costal, external, and internal borders: secondaries rose-pink, cream-coloured at external border; a large black spot at the end of the cell, a smaller oval submarginal spot on the radial interspace, and two unequal spots placed obliquely near the anal angle: thorax sordid cream-colour; margins of collar slightly rosy; two black spots on the collar, a black dash on the tegulæ, and a longitudinal black central stripe on the thorax: abdomen bright rose-pink, with dorsal and lateral series of black spots. Wings below pinky white, the primaries with the basal two thirds washed with vermilion; the black markings nearly as above: secondaries with the discocellular black spot extended as an oblique streak to costa; pectus smoky-brown, sparsely clothed with bright rose-red hairs; venter cream-coloured. Expanse of wings 45 millim.

Duke-of-York Island.

The *Chelonia costata* of Boisduval, both sexes of which are in the collection from Duke-of-York Island, is apparently a species of *Phissama*. M. Boisduval says, "L'abdomen avec trois rangées de points noirs en dessus et deux en dessous, ce qui la distingue de *Fulvia*, laquelle Donovan a représentée avec l'abdomen entièrement jaune." But the Museum copy of Donovan shows three dorsal spots on the abdomen, and were they entirely omitted it would probably only be due to the rubbed condition of Donovan's type. I fear therefore that we shall have to adopt the name of *Phissama fulvia* for this species.

On the same plate with the latter, Donovan gives a poor figure of the *Hypsa eusemioides* of Felder as "*Noctua versicolor*" of Fabricius, whereas the latter is evidently a species with a white *costal* * stripe, and said to have come from the West Indies, or, as Fabricius says, the islands of America.

41. *Areas hyporhoda*, sp. n.

♂. Primaries above ochreous, with a black spot at the end of the cell, and two on the basal half of the internal border: secondaries rose-colour, with a black spot at the end of the cell: thorax ochreous; abdomen rose-red, with dorsal and lateral series of small black spots. Wings below rose-coloured towards the base, ochreous towards the external borders; a black spot at the end of each discoidal cell: body below rose-red, the centre of the venter ochraceous. Expanse of wings 44 millim.

* "Fascia abbreviata alba ad marginem crassiorem."

♀. Much larger and broader than the male, the primaries above without any black spots, and all the wings below of a deeper rose-colour almost to the borders. Expanse of wings 53 millim.

New Britain and Duke-of-York Island.

We have a still larger female (58 millim. in expanse) in the Museum collection, presented by Messrs. Salvin and Godman: it was received from New Ireland; and hitherto I have regarded it as probably the female of the more narrow-winged, paler, and somewhat differently spotted *Aloa bifrons* of Walker. The receipt of the true male, however, puts this quite out of the question; indeed I am of opinion that *A. bifrons*, with its elongated narrow wings, is congeneric with Cramer's *Phalæna amasis*, and I would suggest its being placed with it under Hübner's generic name *Rhodogastria*; the first two species placed under the latter group by Hübner fall into other genera.

42. *Damalis tigrina*, sp. n.

♂. Bright ochreous; primaries deeper-coloured at the base; with the exception of a large patch at the end of the cell, the apical half of the costal border, and the base, all the interspaces enclose longitudinal broad blackish stripes: abdomen with dorsal and lateral series of black spots. Under surface ochreous, the wings with a decreasing border of internervular black stripes; primaries with black costal margin; collar, prothorax, and front of pectus orange-ochreous. Expanse of wings 56 millim.

New Britain.

Nearest to *D. nebulosa* from Borneo, Malacca, and the Andaman Islands.

[To be continued.]

XVI.—*Contributions towards a General History of the Marine Polyzoa*. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. ix. p. 127.]

[Plates VII. & VIII.]

X. FOREIGN CHEILOSTOMATA (Miscellaneous).

Family **Eucratiidæ**.

RHABDOZOUM, nov. gen.

Der. ῥάβδος, a rod, and ζῶον, an animal.

Gen. char.—*Zoarium* erect, phytoid, composed of numerous celliferous shoots, held together by a ramified stem made up of bundles of radical fibres given off from the inferior portion of the shoots; celliferous shoots consisting of a cylindrical bi- or trifurcate stem, which gives origin to the radical fibres and also to erect chitinous rods, on the summit of which are borne two or three similar stems, more or less dichotomously divided. *Zoœcia* pyriform, ranged in linear series round an imaginary axis, so as to form cylindrical stems; aperture moderately large, subterminal, oblique. *Avicularia* not capitate.

I am indebted for specimens of this singular and beautiful form to Mr. J. Bracebridge Wilson, of Geelong, an able investigator of the Victorian Polyzoa, and an enthusiastic and experienced dredger. He has kindly supplied me with a quantity of his dredgings, and requested me to undertake the pleasant office of reporting upon any thing new which they may yield. As a first instalment three species, which seem to be undescribed, are dealt with in this paper, of which the present is by far the most remarkable.

A question may arise *in limine*, as to the systematic position of *Rhabdozoum*; and possibly it may prove to be entitled to rank as the type of a distinct family; but, for the present, I prefer to place it among the Eucratiidæ, with which it has undoubted affinity. The zoœcia bear a close resemblance, in many respects, to those of *Eucratea chelata*, Linnæus; and they are disposed (as in that species) in linear series, each cell rising from behind the top of the aperture of the one below it; on the other hand, the redundant spinous armature and the extraordinary development of the radical appendages are eminently Bicellarian. Avicularia are of the rarest occurrence amongst the Eucratiidæ. The cylindrical arrangement of the cells and the rod-like pedicels on which a large portion of the celliferous stems are elevated, are distinctive characters and have no parallel in either of the two families referred to.

The chitinous rods, which constitute the chief peculiarity of the present form, are probably a modification of the (so-called) radical fibres. Both these structures originate on the surface of the cells which compose the basal portion of the shoots; the fibres tend downwards and constitute first the compound stem or trunk of the colony, and ultimately the rootlets, by which the whole composite structure is held to its place; the rods ascend and support the principal celliferous segments. At its upper extremity the rod expands into a kind of cup, the rim of which (in the only known species) is set round with long spines; and from this rises a short celliferous stem, which soon bifurcates.

Rhabdozoum Wilsoni, n. sp. (Pl. VIII. fig. 4.)

Zoarium composed of a number of shoots, held together by a rather thick compound stem made up of the radical fibres emitted from the base of each shoot, and forming a much ramified, spreading, arborescent structure; each shoot composed of two parts—(i) a short bi- or trifurcate cylindrical stem, bearing cells, from which the radical fibres originate, and (ii) a number of erect, slender, chitinous rods rising from this stem, supporting on their summit other celliferous stems of similar structure, dichotomously branched, the branches widening upwards; rods transparent, terminating above in a cup-like expansion, the edge of which is closely set round with spines, distinctly annulated immediately below the cup. *Zoœcia* subpyriform, disposed in longitudinal series, and so that the orifices range in oblique transverse lines across the stem, translucent, surface smooth and glossy; aperture oval, occupying about one third of the length of the cell, with a thin margin, somewhat contracted below, the lower extremity turned slightly inwards, inferior portion of the cell narrowing downwards; immediately below the aperture two or three extremely long curved spines, articulated to a short tubular base, replaced in many of the cells by a small *avicularium* on a mound-like elevation, with a pointed mandible directed forward. *Oœcium* terminal, rounded, smooth. Height of the largest specimen about 1½ inch.

Loc. Off Port Phillip Heads, Victoria (*Mr. J. Bracebridge Wilson*).

The appearance of this very curious species is quite unique. At first sight, a well-developed composite specimen is not unlike a mass of one of the larger Australian *Bicellariæ*; but the resemblance is merely superficial. The tall and slender pedicels, crowned by the delicate feathery tufts, are unlike any thing which I have hitherto met with among the Polyzoa, unless they may be compared with the stem of such a form as *Kinetoskias* (*Naresia*) *cyathus*, Wyville Thomson, which Busk regards as representing a radical tube, or rather "a coalesced bundle of tubes" *.

The basal or primary portion of the shoots in *R. Wilsoni* is usually composed of a triplet of short stems, which converge below, and are borne on a kind of peduncle made up of numerous radical fibres compactly bound together, which ultimately unite with other peduncles, all of them, towards the base of the specimen, forming a thick trunk. The fibrous peduncle

* "On a peculiar Form of Polyzoa closely allied to *Bugula* (*Kinetoskias*, Kor. & Dan.)," Micr. Journ. vol. xxi. n. s.

on which each individual shoot is supported may certainly be regarded as the representative of such a structure as the stem of *Kinetoskias*. The rods originate from the side of a zoœcium, and rise to a height (including the terminal stems above) of about half an inch; they are much thicker than the ordinary radical fibres. There are sometimes one or two twists or imperfect annulations at the base, and (as I have mentioned) immediately below the cup they are distinctly and very prettily ringed. As many as seven (or perhaps more) may rise from one of the basal triplets. The portion of the celliferous stem immediately *above* the cup, from which the dichotomous branches originate, differs somewhat from the rest. The cells composing it are furnished with a much larger number of spines than is usual (as many as six), and they almost form a continuous whorl round the stem (Pl. VIII. fig. 4 *b**). The cup at the summit of the rod must be regarded as made up of partially aborted cells placed closely side by side, the spines of which constitute a perfect ring.

The zoœcia which carry avicularia are destitute of spines, the avicularian swelling occupying the position in which they are usually developed. The spines are a very characteristic and conspicuous feature of the species. They are of very great length, tubular and transparent, rising in twos or threes immediately below the aperture from a tubular base (to which they are jointed); they continue almost straight or slightly curved for a short distance, and then bend abruptly upwards, overarching the zoœcia and completely enveloping and embowering the stems. The zoarium is composed of delicate, glossy, translucent material.

I have not had the opportunity of making an examination of the genus *Kinetoskias*; but in *Rhabdozoum* we seem to have a somewhat parallel form belonging to the Eucratean group.

Family **Membraniporidæ.**

Group *a* (*Flustridæ*).

Zoarium corneous and flexible, foliaceous, erect (in the adult state). *Zoœcia* with raised margins; front wall membranaceous or membrano-calcareous.

Flustra, Linnæus.

Flustra reticulum, n. sp. (Pl. VII. fig. 4.)

Zoarium branched dichotomously, of a dark colour when

* This is a rough *camera lucida* sketch; but it gives a fair idea of the general appearance of this region of the zoarium.

dried; segments short, stout, the extremities somewhat obliquely truncate. *Zoœcia* quincuncial, on one surface only, rounded above, widest in the middle, contracted below, subtruncate at the base; margins rather prominent, smooth, destitute of spines; *avicularia* scattered amongst the zoœcia and on the same plane with them; area smaller than that of the cell, not expanded in the middle, running off to a point below, the inferior portion closed in by membrane, the upper occupied by the mandible, which is elongate (more than half the length of the area), rounded at the apex, and of a dark-brown colour. *Oœcium* large (about half the length of the cell), prominent, rounded above, inclosed by the membranous front wall of the cell above it, the oral margin forming a shallow arch, and terminating on each side in a triangular callosity.

Height of specimen about $1\frac{1}{4}$ inch.

Loc. Off Port Phillip Heads, Victoria (*Mr. J. B. Wilson*).

The zoarium in this species has a characteristic aspect, due to the very short and broad and truncate terminal segments. The surface appears rather coarsely reticulate, owing to the elevation and distinctness of the cell-margins. The oœcium is a marked feature; though overspread by the membranous wall, it is less deeply immersed than is usual, and the oral arch, with its callosities, stands out prominently.

EUTHYRIS, nov. gen.

Der. εὖ, well *, and θυρίς (dim. of θύρα), a small door.

Gen. char.—*Zoarium* corneous, erect, and foliaceous. *Zoœcia* with raised margins; aperture closed in by a membranaceous (or membrano-calcareous) wall; orifice surrounded by a chitinous border; oral valve furnished with a distinct hinge.

In this form the simple semicircular opening in the front wall of the cell, with the membranous lid characteristic of the normal *Flustra* (and *Membranipora*), is replaced by a much more highly organized orifice, which is bounded and, as it were, isolated by a distinct border, and furnished with a solid operculum working upon a hinge. We must, I think, recognize here the characters of a generic group, in which *Carbasea episcopalis*, Busk, and *C. bombycina*, Ellis and Solander, will rank, as well as the species which I am about to describe.

MacGillivray has recently constituted a genus under the name *Thairopora* for a parallel group amongst the *Membraniporæ* †.

* To suggest the idea of higher structure.

† "Descriptions of new or little-known Polyzoa," Trans. Roy. Soc.

Euthyris obtecta, n. sp. (Pl. VII. fig. 3.)

Zoarium much branched dichotomously; habit rather straggling, the segments tall, narrow, not expanded upwards, somewhat rounded at the extremities, with a smooth border along the edge. *Zoœcia* on one surface only, quincuncial, subrectangular, margins not conspicuous; front wall smooth and shining, depressed below, rising towards the orifice, overspread by a membranous covering, which forms a flat uniform roofing over the zoarium; orifice of the ordinary cells suborbicular, with the lower margin flattened, surrounded by a chitinous rim and closed by a solid operculum; distributed amongst the ordinary zoœcia are occasional cells which are broader and have a larger orifice, elongated transversely, narrow between the upper and lower margins, and slightly curved inwards below. *Avicularia* none. *Oœcium* (?).

Height of specimen about $3\frac{1}{4}$ inches.

Loc. North Australia (*Miss Jelly*).

Two points are worthy of notice in this species—the continuous membrane which overspreads the surface of the zoarium, concealing the true cell-wall, and the larger zoœcia, with modified orifice, which occur in some number amongst the ordinary cells. The latter may be subservient in some way to the function of reproduction, though we have no direct evidence on the point; similarly modified cells have been noticed in other cases. The epitheca also occurs in many species belonging to very different families.

Family **Myriozoidæ** (part.), Smitt.

Schizoporella, Hincks.

Schizoporella conservata, Waters. (Pl. VII. fig. 2.)

This species, which has been described by Waters from Tertiary beds in South-west Victoria, occurs in Mr. Wilson's dredgings from Port Phillip Heads. As the recent specimen differs a good deal in superficial character from the fossil form, I have given a figure of a few of the cells. Mr. Waters describes the surface of the zoœcium as smooth; in Mr. Wilson's specimen it is strongly areolated round the margin and reticulate in the centre. The avicularia, which are numerous, are of the lanceolate type; the mandible is long and slender

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Victoria, December 1881. I have already ('Annals' for July 1880) directed attention to the structural peculiarities of this group as probably supplying the basis of a new genus, and am glad to find that this view is supported by Mr. MacGillivray's authority.

and bent at the extremity; they are almost universally raised. A shallow arched groove crosses the operculum a short distance above the sinus, and is a rather conspicuous character.

The only specimen which I have examined may probably have been Hemescharine in habit, as the dorsal surface of the crust is overgrown with other Polyzoa.

Loc. Mount Gambier (*Waters*); off Port Phillip Heads (*Mr. J. B. Wilson*).

Schizoporella latisinuata, n. sp. (Pl. VII. fig. 5.)

Zoœcia quincuncial, hexagonal, bordered by conspicuous raised lines, usually terminating above on each side of the orifice in a nodulous projection; front surface dense, flattish (sutures very shallow), thickly punctured, overspread with a shining membranous epitheca; orifice arched above, a very wide sinus occupying about two thirds of the lower margin, straight below, the opening not at all contracted; peristome elevated and somewhat thickened round the top and sides, broad and flattened out below. *Avicularia* none. *Oœcium* (?). *Zoarium* forming a glossy patch of a brownish colour.

Loc. Off Port Phillip Heads (*Mr. J. B. Wilson*).

The form of the sinus in this species is remarkable; it is neither rounded below nor contracted at the opening. Its lower boundary-line is straight; and it is of about the same width throughout, occupying a large proportion of the inferior margin of the orifice.

Family **Escharidæ** (part.), Smitt.

Lepralia, Johnston (part.).

Lepralia striatula, n. sp. (Pl. VIII. fig. 1.)

Zoœcia ovate, quincuncial, rising considerably towards the centre; surface smooth, areolated round the margin, and traversed by radiating grooves, which pass from the areolæ upwards; orifice horseshoe-shaped, arched above, straight below, contracted by two opposite denticles a short distance above the lower margin; about as broad as high; peristome raised, carrying four spines above; on each side of the orifice (or on one side only) near the top a small *avicularium*, raised, with an elongate subspatulate mandible directed downwards; immediately under the inferior margin a swelling, which is carried up into a blunt point, and bears on its inner aspect a rounded *avicularium*. *Oœcium* rounded above, broad (sub-crescentic), compressed in front, where it is thickly covered with small punctures; the rest of the surface smooth, usually an umbo on the summit.

Loc. Zanzibar (*Miss Jelly*).

MUCRONELLA, Hincks.

Mucronella diaphana, MacGillivray, form *armata*.
(Pl. VIII. fig. 3.)

A form of this species occurs in New Zealand which differs in some respects from that described by MacGillivray, and most notably in being furnished with avicularia. It may be characterized as follows:—

Zoœcia quincuncial, rather broadly ovate, distinct, the front wall somewhat flat and depressed below, rising towards the oral region; surface smooth, of a delicate greyish colour; orifice arched above, straight below, three denticles within the lower margin, the central one the largest, and at the top four long jointed spines, composed of calcareous segments, with chitinous joints between, articulated to a tubular base; in the centre of the lower margin a rather broad blunt mucro; at each side a little below the orifice (or sometimes on one side only) a raised avicularium, with pointed mandible directed outwards. *Oœcium* rounded, smooth, umbonate.

Loc. Queenscliff and Warrnambool (*Mr. Watts*): form *armata*, New Zealand (*Miss Jelly*).

Frequently there rises immediately above the orifice a kind of calcareous screen, pointed above and slightly hollowed out in front, which is not noticed by MacGillivray. The spines, which are all jointed and articulated to a tubular base, are usually four (occasionally five) in number on the New-Zealand specimens; the full complement is only met with on the margin of the colony; on the inner cells seldom more than a single spine survives.

Mucronella vultur, n. sp. (Pl. VIII. fig. 2.)

Zoœcia very large, quincuncial, sometimes much elongated, usually ovate, convex, separated by deep sutures; front wall highly calcified, vitreous, surface silvery, uniformly covered with small circular foramina; orifice ample, suborbicular; peristome slightly raised, bearing on its upper margin six spines, articulated to a tubular base; within the lower margin in the centre a hammer-shaped tooth and two small lateral denticles; immediately behind the central tooth a massive mucro, bearing on one side a large *avicularium*; mandible running out to a very finely-pointed extremity, which is bent abruptly inwards, directed upwards. *Oœcium* (?).

Loc. Australia (*Miss Jelly*).

Mucronella præstans, n. sp. (Pl. VII. fig. 1.)

Zoœcia ovate, quincuncial, often much expanded below, front wall rather depressed, strongly areolated round the margin, the central portion smooth or traversed by the prolonged radiating furrows of the areolæ; surface very bright and shining; orifice suborbicular; peristome carried up in front into a neck-like prolongation of considerable length, which often rises into a point in the centre (occasionally bimucronate), the lip somewhat everted and frequently much thickened, at the sides sloping off towards the upper margin, which is not elevated and bears four spines; on one side of the cell, attached to the neck-like elevation of the peristome, and directed outwards, or sometimes placed lower on the cell and sloping obliquely downwards, a large spatulate *avicularium*, raised on a kind of bracket, the walls of which are perforated. *Oœcium* rounded, rising rather steeply towards the centre, somewhat prolonged and contracted towards the orifice, strongly areolated round the base; central portion smooth and shining, more or less traversed by the areolæ, mucronate.

Loc. New Zealand, recent, and from later Tertiary beds (*Miss Jelly*).

This is without question one of the most attractive of its tribe, its remarkable beauty being due to the exquisite border formed by the areolation round the cells and the brilliancy of the vitreous surface. The oral operculum seems to be composed of a thin almost membranous material. The raised peristome projects very considerably, and is commonly carried out to an acute point; frequently, however, it is broader in front; and the margin is often much thickened. There is some variability in the position of the avicularium; but it is usually placed against the neck of the cell or at the base of it.

Mucronella rotundata, n. sp. (Pl. VIII. fig. 5.)

Zoœcia quincuncially arranged, with a more or less rounded outline, short, tumid, suberect, separated by deep sutures; surface smooth or slightly pitted over; orifice of (proportionally) large size, arched above, straight below, a central bifid tooth and two minute lateral denticles placed very close to it within the lower margin; peristome elevated round the sides and in front, where it is carried up into a central mucro of moderate size; on the upper margin four slender spines. *Avicularia* none. *Oœcium* (?).

Loc. Singapore or Philippines (*Miss Jelly*).

This has much the appearance of a distinct form, though in some respects very nearly allied to *M. ventricosa*, Hassall. As only a small colony of young cells has been examined, I cannot speak with confidence as to some of the superficial characters; but the short subrotund and tumid cells, not contracted above as in *M. ventricosa*, the large orifice, not raised and suberect and closed in by the rather massive peristome and spines as in the latter, the three small denticles set closely together, the rather slender mucro, and the complete absence of striation and marginal punctures are all distinctive points. The cells are much smaller than those of *M. ventricosa* and of delicate texture; but this may be due to the immature condition of the colony.

In the absence of more fully developed specimens, I merely name it provisionally. It may rank as *M. ventricosa*, form *rotundata*, if further evidence should show that it is referable to this species.

Family **Membraniporidæ.**

Membranipora, De Blainville.

Membranipora pilosa, Linnæus, form *foliacea*.

I have received through Miss Jelly, from New Zealand, a specimen of an interesting form of this common and cosmopolitan species. It grows as an erect foliaceous frond, with the cells disposed on both surfaces and closely united back to back. Pallas mentions such a form in his 'Elenchus' as occurring in the North Sea*; but amidst all the varieties of this protean species, from various parts of the world, which I have examined, it has never occurred to me before. We hardly require any fresh evidence to show that such varieties of habit are of very small systematic significance.

EXPLANATION OF THE PLATES.

Plate VII.

Fig. 1. *Mucronella præstans*, n. sp. 1 *a*. Zoœcium with avicularium; 1 *b*. Zoœcium, showing the membranous (?) operculum as it appears when thrown back.

Fig. 2. *Mucronella conservata*, Waters, from a recent Australian specimen.

Fig. 3. *Euthyris obtecta*, n. gen. & sp. Group of zoœcia, showing one of the large cells with modified orifice. 3 *a*. The same, natural size.

Fig. 4. *Flustra reticulum*, n. sp. 4 *a*. Zoœcium with avicularium. 4 *b*. Natural size.

Fig. 5. *Schizoporella latisinuata*, n. sp.

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* "In frondes lubenter assurgit, utrinque cellulosas, crassiusculas, spongiosas; primo simplices . . . . deinde ramosas, imo pinnato-multifidas."—*Elenchus*, p. 50.

PLATE VIII.

Fig. 1. *Lepralia striatula*, n. sp. 1 *a.* Oœcium.
Fig. 2. *Mucronella vultur*, n. sp.
Fig. 3. *Mucronella diaphana*, MacGillivray, form *armata*. 3 *a.* Oœcium.
Fig. 4. *Rhabdozoum Wilsoni*, n. gen. & sp. A shoot, of the natural size. 4*a.* The same. Portion of a celliferous stem, magnified, showing the arrangement of the zoœcia, avicularia, and spines. 4 *b.* Summit of one of the chitinous rods, showing the annulation, the cup-like expansion, and the basal portion of the upper celliferous stems. This figure is less highly magnified than the rest. 4 *c.* Zoœcia, with oœcia.
Fig. 5. *Mucronella rotundata*, n. sp.

BIBLIOGRAPHICAL NOTICES.

The Student's List of British Coleoptera, with Synoptic Tables of the Families and Genera. Compiled by FRANCIS P. PASCOE. Small 8vo. London: Taylor and Francis, 1882.

IN this little volume Mr. Pascoe has gone back to his old love, and, after instructing us all in general zoology, contents himself with the more modest task of cataloguing the British Beetles. But, just as his little treatise on 'Zoological Classification' was one of the most useful manuals that we possess, so the 'Student's List of British Coleoptera' offers its readers a good deal more than is promised in its title. As regards the list itself, indeed, our author makes but little claim to originality. "Lists," he says, "are necessarily compilations; and in this one I have almost entirely depended on the authority of previous compilers;" but there is a certain amount of criticism that must be exercised even in the preparation of a catalogue of the names of British Beetles, hackneyed as the task is, and we know enough of Mr. Pascoe's work to feel sure that this part of his labour has been conscientiously performed.

As to the principles on which he has acted in connexion with vexed questions of priority, Mr. Pascoe has some remarks in his preface which merit attention. He complains, and with much justice, of the confusion introduced by the disturbance of old-established names of species and genera to make room for others of longer standing, the precise significance of which must often be uncertain from the imperfect manner in which species were generally characterized in the early days of descriptive entomology. To a very considerable extent we are prepared to go with him, and to join in any protest that he may make against superseding well-known names upon light grounds, even in cases where it can be demonstrated that the name to be revived undoubtedly applies to the same species that has for years borne another name of later date. But we are not prepared to go the whole length that he seems inclined to do, and to set up a sort of statute of limitations in matters of nomenclature. There is one absolute rule that may certainly be adopted, namely that no generic names should be regarded as valid unless proposed by an author who makes use of the binominal method; and this would get rid of many of those changes of old-established names to which Mr. Pascoe so strongly objects; but it seems to us that the law of priority is the only one to which we can appeal in general, and that, while it should be applied with judgment, it must nevertheless be observed as strictly as possible. When Mr. Pascoe speaks of the common practice of the "scamping of descriptions, *pour prendre date*," in terms of reprobation, we cordially agree with him. This sort of thing is a growing vice and a growing evil.

Besides his list of British Beetles, which appears to have been compiled with great care, Mr. Pascoe has furnished the students of his little book with a most important help in the investigation of the native species of this order, in the form of a series of tables of families and genera. Of course, it is always a very difficult matter to make out the genera of any group of insects or other animals from the best-prepared tables alone; there are shades of character that cannot be conveyed by the short phrases necessarily used in a table; but no worker in the present day can overlook the value of such guides through the labyrinth of classification. As the author himself says, the characters selected as most convenient for the purposes of these tables are not always the most important: but we have glanced through many of them and examined some carefully; and, so far as we can see, they are eminently practical, and convey a great amount of useful information in a condensed form. There is one good thing that we may fairly wish to British entomologists; and that is, that Mr. Pascoe may be able to follow up this book with similar manuals of the other orders of the class.

Rhopalocera Malayana: a Description of the Butterflies of the Malay Peninsula. By W. L. Distant. Part I. London (West, Newman, & Co., Hatton Garden) & Penang.

Lepidopterists, and especially the students of the Rhopalocera section, ought to esteem themselves very fortunate in the liberal way in which they are catered for by the authors of Butterfly faunas, a class of books which ought to facilitate very considerably the determination of species, and give more copious information regarding distribution and local variation than can be found elsewhere. The number of works of this description recently finished or in course of publication is quite large; and most of them form handsome volumes in quarto size, richly illustrated with coloured figures. Some of these publications, we regret to observe, seem scarcely calculated to advance the department of biology to which they are devoted, the authors seeming to have no other object than the bare description or enumeration of the species as an aid in the naming of collections; they invite students to a mere Barmecide feast, from which all details longed for by the scientific entomologist, regarding the natural affinities of genera, facts of local variation, and so forth, are eliminated. In these respects the present work strikes us as a superior one of its class. The author enters fully into the structure and metamorphoses of the different groups, discusses their natural relationships, and under each species gives full details regarding geographical distribution and variation.

In dealing with these generalities he is, at the same time, never unnecessarily diffuse; and his remarks and conclusions are those of a writer evidently well acquainted with his subject. The figures, in chromolithography by West, Newman, and Co., are excellent, and indicate a distinct advance in this department of art. Full descriptive characters are given of all species and genera, as well as of groups superior to genera. Such a work is deserving of all encouragement, and we trust that its success will answer the expectations of its promoters, the chief of whom, we are informed in the prospectus, is Mr. D. Logan of Penang.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

June 7, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Notes on the Annelida Tubicola of the Wenlock Shales, from the Washings of Mr. George Maw, F.G.S." By George Robert Vine, Esq. Communicated by Prof. P. Martin Duncan, M.B., F.R.S., V.P.G.S.

The author commenced with a sketch of the bibliography of the subject and of the known Silurian genera of tubicolar Annelids. This was followed by a description of the following genera and their contained species:—*Cornulites*, *Conchicolites*, *Ortonia*, *Spirorbis*. Of the last there is one species (*S. minutus*) from the Buildwas Shale; this differs only in the slightest degree from *S. arkonensis*, described by Prof. Nicholson from the American Devonians. The new genus *Arenatubulites* is in many respects a peculiar and interesting form, having the tube composed of minute grains of sand, like *Sabellaria* and *Terebella*. The author describes two species, *A. elongata* and *A. amplexa*; they occur in the Pickwood beds. A description follows of the genus *Tentaculites*, which the author referred to the Tubicolar Annelids: and several species of it were described.

2. "Description of Part of the Femur of *Nototherium Mitchelli*." By Prof. Owen, C.B., F.R.S., F.G.S., &c.

The specimen described consisted of the distal portion, probably about one half, of a femur obtained from Darling Downs, Queensland, and received by the author from Dr. George Bennett. Its principal differences from *Diprotodon* are that it has no depression above the outer condyle, but in its place a rough longitudinal rising for the attachment of the same or of a homologous muscle; and the hinder surface of the outer condyle is transversely convex. The relative width of the post-condylar fossa resembles that in *Phascolomys*; and a further resemblance to the Wombats consists in the more equal prominence of the lateral boundaries of the rotular surface than in *Diprotodon* and *Macropus*. The bone differs from the corresponding part in the Wombats by several subordinate characters; and the animal to which it belonged would seem to have been intermediate between *Phascolomys* and *Macropus*. From the size and characters of the bone the author referred it to *Nototherium Mitchelli*; its breadth across the condyles is $5\frac{3}{4}$ in.

3. "On *Helicopora latispiralis*, a new spiral Fenestellid from the Upper Silurian beds of Ohio, U. S." By E. W. Claypole, Esq., B.A., B.Sc. (Lond.), F.G.S.

The author referred to the genus *Archimedes*, recognized by Lesueur, D. D. Owen, and James Hall, as a spiral form of Fenestellid, the remains of several species of which occur in Lower Carboniferous Limestone rocks in the United States. In *Archimedes* there is always a strong central shaft. The species here described by the author under the name of *Helicopora latispiralis* occurs in the Upper beds of the Niagara group of the Upper Silurian at Cedarville, Ohio; and the new genus is distinguished from *Archimedes* by the absence of the solid stony axis above mentioned. Its character as given by the author is as follows:—"Polyzoary expanded, fenestrate, and spiral, formed of slender bifurcating branches poriferous on one face, connected by non-poriferous bars, forming an open network; cells arranged in two rows along the branches, one row on each side of a median keel. Axis very thin, or consisting only of the thickened central border of the spiral polyzoary." The species described grows to as much as eight inches in diameter. The author has seen a second species of the genus.

June 21, 1882.—J. W. Hulke, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "On *Thecospondylus Horneri*, a new Dinosaur from the Hastings Sand, indicated by the Sacrum and the Neural Canal of the Sacral Region." By Prof. H. G. Seeley, F.R.S., F.G.S.

The author described a mould of the neural canal of the sacral region of a Dinosaur, obtained by Dr. A. C. Horner, of Tonbridge, from a quarry in the Hastings Sand at Southborough. The specimen is about 2 feet long, slightly imperfect at both ends, but showing indications of five complete vertebræ, with traces of others at the two extremities, making at least seven vertebræ in all. The general form of the neural chamber is compressed from side to side, and dilated from below upwards, especially in the region of the second, third, and fourth vertebræ, its depth over the third foramen being nearly 3½ inches. Indications of bone preserved on the surface seem to show that the neural canal was enclosed in a mere bony film. The indications of transverse processes show that they were directed forward in front, outward in the middle, and backward behind. The first process on the right side, which is preserved, expands somewhat conically outwards and forwards, and terminates in a large flattened facet for the ilium. For the animal indicated by this specimen the author proposed to found a new genus, *Thecospondylus*, and named the species *T. Horneri*.

2. "On the Dorsal Region of the Vertebral Column of a new Dinosaur, indicating a new genus, *Sphenospondylus*, from the Wealden of Brook in the Isle of Wight, preserved in the Woodwardian Museum of the University of Cambridge." By Prof. H. G. Seeley, F.R.S., F.G.S.

In this paper the author described a series of six vertebræ, remarkable for the great lateral compression of the centrum, which is so narrowed inferiorly as to terminate in a sharp longitudinal ridge. The centra average about 3½ inches in length. The neural arches are depressed; the transverse processes are at first directed backward, but soon become directed outward, retaining their upward direction; the facet for the head of the rib is at first large, placed at the base of the transverse process, and bounded behind by a sharp ridge which runs to the hinder margin of the neural arch; but afterwards the rib-head rises higher, so as to be chiefly above the zygapophysial facets; and then it becomes smaller, the ridge behind it disappears more or less, and the transverse process becomes vertically compressed and thin. The author referred to other vertebræ showing similar characters contained in the Fox Collection in the British Museum, but stated he had seen neither cervical nor caudal vertebræ of this type. The animal indicated by these remains was regarded by the author as constituting a new genus most nearly allied to *Iguanodon*, for which he proposed the name of *Sphenospondylus*; but he abstained from giving the type a specific name "in view of the likelihood of these vertebræ pertaining to the *Iguanodon Seeleyi*."

3. "On Organic Remains from the Upper Permian Strata of Kargalinsk in Eastern Russia." By W. H. Twelvetrees, Esq., F.G.S.

In this paper the author described the Kargalinsk steppe, north of Orenburg, as consisting of a grassy, treeless, undulating steppe, with sluggish, winding streams, in the banks of which, and in ravines, the exposures of subsoil show only red marl or sandstone devoid of fossils. Mine-borings and shafts go down through red, yellow, and grey sandstones and red and white marls, which are fossiliferous wherever the beds of copper-ore exist. On the eastern border of the steppe there are two protrusions of limestone, with *Terebratula elongata*, *Loxonema*, &c., on outcrops running nearly N.W. and S.E., which throw off the cupriferous sands east and west. The western of these outcrops in its southern continuation near Sakmarsk is charged with Permian fossils, including the above. The same limestone, regarded by the author as belonging to the Zechstein, crops up in other places, and apparently underlies the whole basin of the steppe, the upper sandstones resting conformably upon it. From the latter the author gave the following list of fossils:—*Cardiopteris Kutorgæ* (=*Aroides crassispatha*), *Walchia biarmica* and *piniformis*, *Lepidodendron*, *Schizodendron tuberculatum*, *Anomorrhœa Fischeri*, *Caulopteris* ——?; *Calamites infractus*, *Suckowi*, *gigas*, and *leioderma*; *Unio umbonatus*, *Platyops Richardi* (a Labyrinthodont), *Rhopalodon Wangenhäuseri*, *Cliorhizodon orenburgensis*, *Deuterosaurus*, and various Labyrinthodont and Reptilian remains. Upon these the author remarked that the list of plants has a Palæozoic aspect, while the Reptilian remains seem to be more of a Secondary character. After consideration of all the facts, the author came to the conclusion that possibly some of the beds in the central part of what is known as the Permian basin may be passage-beds between the Permian and Trias, but that the Kargalinsk series includes the uppermost beds of the Permian.

4. "On Chilostomatous Bryozoa from Bairnsdale (Gippsland)." By A. W. Waters, Esq., F.G.S.

This paper continues the author's papers on South-Australian Bryozoa, already communicated to the Society. It describes a collection made by Mr. J. R. Y. Goldstein, containing 40 forms, of which 12 were not previously known to have existed in Australia. Several species, however, known in other places as incrusting, here occur in the *Eschara* habit; and all together the number of incrusting species from this locality is small. The author calls attention to the frequency with which the Australian Bryozoa exhibit different modes of growth, showing the importance of preferring for classification zoœcial to zoarial characters. The three localities in Australia have furnished 126 species of Chilostomata, of which 51 are known living and 41 fossil; 14 are considered identical with European Miocene species, 17 with Pliocene, and 4 are thought to be identical with Cretaceous species. The author gives a detailed description of the various species in his Bairnsdale collection.

5. "The Silurian Species of *Glauconome*, and a suggested Classification of the Palæozoic Polyzoa." By G. W. Shrubsole, Esq. F.G.S., and G. R. Vine, Esq.

The authors discussed the history of our knowledge of the genus *Glauconome*, and especially of the Silurian species. They then characterized the genus, to which they refer only the Bala species formerly regarded as identical with *G. disticha*, Goldf., but which they describe as *G. Sedgwickii*, Shrubs. *Glauconome disticha*, Goldf., from the Wenlock of Dudley, is taken as the type of a new genus *Arcanopora*.

The authors then remarked upon the characters on which the classification of the Polyzoa is founded, drawn from the study of the recent forms, and stated that throughout the Cainozoic and Mesozoic series no Polyzoa are known which cannot be referred to the recognized groups. Many Palæozoic forms are in a different case. The orifices seen on the surface are not, in many instances, the mouths of the cells, but those of what the authors call *vestibules*, beneath which the true cell-mouth is concealed. For these types they propose to found a new suborder under the name of CRYPTOSTOMATA, and characterized by having the zoœcia subtubular, or, in section, slightly angular, and the orifice surrounded by a vestibule or otherwise concealed. The families referred to this group are the Ceramoporidæ, Ptilodictyidæ, and Arcanoporidæ.

MISCELLANEOUS.

Notes on the Luminosity of the Sea, taken on the West Coast of Norway from September 1881 *to April* 1882. By W. E. KOCH, B.A., F.G.S.

I TRUST the following notes may be of interest to naturalists, although I fear there is nothing new about them.

During my travels I was much struck by the almost constant luminosity of the waters: but I also noticed great variations in its intensity; sometimes it was quite as brilliant as I have ever seen it in southern climes, at others much fainter. It struck me that some of the flashes of light emitted by certain forms resembled the steel-blue spark of an electric machine; hence I was led to try certain experiments with magnetized needles in buckets of water. The results obtained were decidedly disappointing; but nevertheless I feel sure that a great deal of the so-called phosphorescence is due to animal electricity, and I hope some one more competent and better fitted out than myself may undertake this line of research. Another fact which seems to fall in with this idea is that during thundery weather and displays of the aurora borealis the luminosity was most intense.

The highest temperature registered at night at the surface-water was 45° F., the lowest 32° F.; and on both occasions the luminosity was equally brilliant.

The small light-emitting animals were of the usual types (*Hydromedusæ*, *Medusæ*, *Ctenophora*, &c.); but many were embryonic forms quite unknown to me.

To quote from my diary:—

"September 14, 1881. Weather cold and windy (west wind). Waters crowded with medusoid forms; and all the way from Stavanger to the Lysefjord (15 English miles) the luminosity was most marked.

"September 29, 1881. East wind, fine and cold. Waters extraordinarily clear, so that forms of life could be easily distinguished in twelve fathoms of water. Luminosity was great, but not so intense as when a grey cloudiness, due to myriads of tiny creatures, tinges the fjord waters. This cloudiness is probably due to migration, and always precedes the arrival of herring-shoals; it is most marked in spring and autumn, and usually occurs with a westerly wind.

"All through November the luminosity was great, but especially so on the 23rd, when we had hail and lightning during the day and the aurora at night. The average temperature of surface-water during this month was 42° F.

"On December 16 a violent east gale was blowing. Temperature of air about freezing-point, and surface-water 38° to 40° F. The whole fjord was streaked with fire; and the shore-line seemed a seething mass of flame. Some forms emitted disks of light which appeared to be 3 inches across.

"December 23, 1881. Thermometer 26° F. in air, and 37° F. in water. Splendid display of aurora, and sea gloriously luminous."

On December 27 I left Stavanger for Bergen; and at 5 A.M. the luminosity of the sea was wonderful, pillars of flame, disks and stars of fire tumbling one over another in the wake of the vessel; some emitted a yellow and others a white phosphorescent lingering light; but many gave forth steel-blue flashes exactly like electric sparks.

After spending a week examining the fine natural-history museum in Bergen, I returned to Stavanger on January 3rd, 1882, and the sea was luminous as usual. Constant luminosity during January and February.

In March I went to Haugesund to see the herring-fishery, and I found the waters grey with life and very luminous. I then went on into the Hardangerfjord; and as we crashed through the ice at Norheimsund, I noticed that it seemed to emit light on fracture. I had read somewhere that this was supposed to be due to electricity; so I got up some buckets of ice and water: eliminating the ice, I found the remaining water perfectly luminous, and I noticed that the steel-blue flash seemed to predominate. Here, then, was the explanation; but as I had not a microscope of sufficient power with me, I could not carry out my researches. As these creatures live quite well in water at freezing-point, possibly they may be even included in ice, and make long journeys without injury.

At Odde I noticed the same phenomenon, the ice being 3 inches thick.

I left Stavanger for Hull in April, and it was worthy of remark that the waters along the Norwegian coast were luminous; yet as we steamed westward the luminosity gradually diminished; hence I think that certain currents carry these animals northward along the coast and into the fjords.

In conclusion, I may sum up as follows:—

(α) That the luminosity of sea-water occurs all the year round, even when ice is present.

(β) That it is greater during electrical atmospheric disturbances, and is partly caused by electricity.

(γ) That it is also well marked during the migrations of fishes, and may have an important bearing on their food and migrations.

(δ) It appears to be at its maximum in spring and autumn, when the waters swarm with embryonic forms.

On the Priority of Euplœa Castelnaui *of Felder over* Euplœa phœbus. By W. L. Distant.

Under the above heading, in the last issue of this magazine (*antè*, p. 73), Mr. Butler has expressed himself dissatisfied that in my 'Rhopalocera Malayana' I have used Felder's name for a species of *Euplœa* in preference to one proposed by himself.

My reason for this arrangement was simply that Felder's publication bore date 1865, whilst Butler's description was published in 1866.

I was aware that Mr. Butler had preferred and published a charge that Felder's publication was antedated, and also that an explanation had been given by the Felders that the work could be obtained with uncoloured plates at their date of publication, though the coloured copies were not ready at that time. This statement I at least felt bound to accept; and I was under the impression that, from Mr. Butler having since published 1865 as the date of Felder's descriptions of *Euplœa*, he had seen his way to withdraw from so serious a charge.

That accusation amounts, in the first instance, to one of literary mendacity, and, secondly, of publishing a designedly false statement in support of the same. This I cannot credit; and therefore I could not write my 'Rhopalocera Malayana' as though I did. It is only natural for Mr. Butler to regret the loss of some of his specific names; but he must pardon me for saying that I think he is ill-advised in again making so serious a charge against the reputation of a lepidopterist who, though no longer here to reply, has still left a memory among friends and colleagues which, so far as I can learn, leaves no room for stain.

If, however, I write with pleasure that I accept both Felder's original date and subsequent explanation, it is with regret that I find an inclination on the part of my friend Mr. Butler to think that in so doing I have in some way accused him of "a childish form of egotism." I am also sorry to have to notice the statement (probably in haste) made by Mr. Butler that, when I wrote that he had subsequently used Felder's date, I was "well aware" that in so doing he "had taken the date from the titlepage, either failing for the time being to recall the fact of its inaccuracy, or inserting it between inverted commas" to show his disbelief in it. I was aware of nothing of the kind when I wrote my first part, which was in proof when I mentioned my views to him. I was then told that the dates were either in inverted commas or had been altered by the Secretary of the Linnean Society. I found on reference that the inverted commas were non-existent; and I could not, when writing my part, first make a charge against the Felders on the authority of Butler, and then explain away his apparent withdrawal of the same by a somewhat invidious reference to the Secretary of the Linnean Society.

I can only, then, again assure my friend Mr. Butler that, because I do not support his charge against the Felders, I do not necessarily bring one against him; and he will probably agree with me that the whole of this unsavoury discussion is detrimental to the cause of even descriptive entomology, and affords further proof of the injury done to the same by personal competition.

On some Experiments in Hybridization between different Species of Echinoidea. By M. R. Köhler.

Experiments on the hybridization of Echinoderms have been hitherto but few in number. In 1873 M. Marion published ('Comptes Rendus,' April 14) an account of fecundations effected between *Strongylocentrotus lividus* and *Sphærechinus granularis*, which resulted in the production of perfectly developed Plutei. A year later Agassiz announced, in the 'Archives de Zoologie Expérimentale,' a case of hybridization between two species of the genus *Asteracanthion*, in which the larvæ attained the stage of Bipinnaria. At the suggestion of M. Marion I have resumed these experiments in the laboratory of marine zoology at Marseilles; and their results possess some importance in connexion with the physiology of the species, which was, indeed, indicated by M. Marion in his note presented to the Academy. These new experiments in hybridization have been extended to several species of regular and irregular sea-urchins. I cannot here give a complete analysis of these fecundations, which will be studied in detail in my memoir on the Echinoidea of the shores of Provence. I shall therefore content myself with indicating the definitive results at which I have arrived.

In March and April the products of the genital glands in most of the species of Marseilles have generally arrived at maturity; nevertheless it is not unusual to meet with individuals of which the ovules or spermatozoids, still immature, are unfit for any attempt at fecundation. It is therefore indispensable to precede each experiment by a microscopic observation. It is equally important to make, in parallelism with each crossed fecundation, a direct fecundation under the same conditions, and with products belonging to the same individuals, for the purpose of arriving at comparable results, both as to the state of the larva and the time it takes to arrive at a definite stage in both cases.

The following is a list of the experiments made, with the results obtained in the most successful fecundations:—

Strongylocentrotus lividus ♀ and *Sphærechinus granularis* ♂.—Pluteus regularly and perfectly developed.

Id. and *Psammechinus pulchellus* ♂.—Pluteus always well developed.

Id. and *Dorocidaris papillata* ♂.—The ova, of which a very small number were fecundated, did not pass the blastula stage. (It is true the only living *Dorocidaris* I had at my disposal had been captured some time, and its spermatozoids were not very active.)

Strongylocentrotus ♀ and *Spatangus purpureus* ♂.—Many negative experiments; fecundation, however, is possible, but the fecundated eggs are always few in number. Nevertheless they arrive at the blastula stage, or sometimes the gastrula with a shallow invagination.

Strongylocentrotus ♂ and *Sphærechinus* ♀.—The larvæ do not pass the blastula stage.

Id. and *Psammechinus* ♀.—Plutei normally and perfectly developed.

Id. and *Spatangus* ♀.—All the ova become regularly segmented. I have never seen them attain the Pluteus stage; they do not pass the stage of perfect gastrula, with a gastric cavity and calcareous spicules on each side of the mouth.

Psammechinus ♀ and *Sphærechinus* ♂.—The larvæ always stopped at the gastrula stage, with the gastric invagination not deep.

Id. and *Dorocidaris* ♂.—No appearance of segmentation. (The same observation applies to both *Dorocidaris* and *Strongylocentrotus.*)

Id. and *Spatangus* ♂.—A few ova were segmented and attained the blastula stage.

Psammechinus ♂ and *Spatangus* ♀.—In all the experiments all the ova attained the stage of Plutei, and these lived for several days. The development takes place comparatively very slowly; thus, the hybrid larvæ are still in the gastrula state when the larvæ, obtained by direct fecundation under the same conditions, have attained the Pluteus stage a day or two. Moreover the form of the Pluteus presents some peculiarities; the arms are shorter and stouter, and the contours are less regular than in the normal Plutei of *Spatangus*; the calcareous skeleton also presents differences. Even in the gastrula we observe peculiar characters, the pigmentation being much less abundant in the gastrulæ produced by crossed fecundations.

Psammechinus ♂ and *Sphærechinus* ♀.—A small number of ova become segmented, but do not pass the blastula stage.

Crossed fecundations therefore are possible between different species of Echinoidea, and that between very wide limits. There is certainly at least as much difference between a *Spatangus* and a *Psammechinus* as between two mammals belonging to two allied orders. And if the Plutei obtained by crossing between regular Echinoids do not appear to differ much from the legitimate Plutei of the type functioning as female in the experiments, there are certainly well marked differences between a legitimate Pluteus of *Spatangus* and a hybrid Pluteus of *Spatangus* and *Psammechinus.*

I must, in conclusion, call attention to one fact:—Because the ova of a species when fecundated by the spermatozoids of another species arrive at the state of Pluteus, it does not follow that the converse is true. Thus the ovules of *Spatangus* are perfectly fecundated by the spermatozoids of *Psammechinus*; but the ovules of the latter, subjected to the influence of the semen of *Spatangus*, remain for the most part intact, while the rest scarcely reach the blastula stage.—*Comptes Rendus,* April 24, 1882, p. 1203.

On Variation in the Nest-forms of the Furrow-Spider (Epeira strix). By the Rev. Dr. H. C. McCook.

The author had observed that some of the orb-weaving spiders have a marked tendency to vary the forms of their nests. The spinning-work of spiders may be classified as (1) the *snare*, spun for the capture of prey; (2) the *enswathment*, by which insects are disarmed and prepared for food; (3) the *gossamer*, used for purposes of aqueous or aerial locomotion; (4) the *cocoon*, spun for the propagation and protection of the species; and (5) the *nest*, which is a domicile more or less elaborate and permanent, within or under which the aranead dwells for protection against enemies and weather-changes. As a rule the great groups of Orb-weavers differ from each other and agree within themselves in the characteristic form of nest. The form prevailing in each family is substantially the same; each species appears to adhere quite steadily to one characteristic form; but there are some marked variations in the habit of certain species, the most decided of which have been observed in the case of *Epeira strix*. Some examples of this were given.

1. The ordinary nest of *E. strix* when domiciled in the open field or wood is a rolled leaf. A single leaf is taken, the edge pulled up, drawn under, and fastened by adhesive threads into a rude cylinder, within which the spider hides during the daytime. A thread-connexion with the foundation-lines of the snare is maintained; but rarely with the centre of the orb by a taut trap-line, as is the habit of the insular spider, *Epeira insularis*.

2. A second form of nest varies from the rolled-leaf nest in having the edges of two adjacent leaves bent towards each other and lashed together on the exterior at the juncture by silken cords and on the interior by adhesive-tissue web. An oval opening is left at the united points of the leaves, through which the connecting-line passes to the snare. The spider domiciles within the leafy cavern thus formed.

3. Again, the spider avails herself of small holes in wood or stone, openings in fences, the interspace between curled bark on the trunk of old trees, or some like cavity, which she appropriates as a nesting-place. A slight lining will generally be found upon the concave surface. Dr. McCook had noticed that in such cases the snare is sometimes diverted from its normal shape in order to give a convenient approach thereto from the den. One such example was found spun between a side of the Peace Fountain in Fairmount Park (Philadelphia) and the stone wall adjoining. In order to pitch her tent within a hole in the rock, the spider diverted one of the radii from the plane of the orb, and extended it backward to the hole. The spirals which passed over this radius thus made an elbow or angle, which was indeed nearly a right angle, and gave the orb an odd broken appearance. The radius of course served as the bridge-line by which the spider passed from her den to her snare.

4. Another variation was due to an accident in the environment of the web. A half-grown *E. strix* had woven a snare in the hollow of a decayed tree (at New Lisbon, Ohio), within two feet of the ground. A colony of the Pennsylvania carpenter-ant (*Camponotus pennsylvanicus*) had quarters in the tree; and a squad of black workers were busy excavating their wooden galleries. These dropped their chippings from openings just above the spider's orb, whose viscid spirals retained goodly quantities of the brown sawdust. In course of time a ball of chippings as big as a walnut had accumulated, or,

perhaps, had been purposely massed by the spider. However that may be, the ball was utilized as a nest; its centre had been pierced, a spherical cavity formed by silk-lining the interior, which was entered by a circular door bound around the edge by spinning-work. This quaint domicile was pendent from one of the strong upper foundation-lines; and herein the spider rested, while the emmet carpenters worked away above her, and continually dropped chips upon the roof of her den, and the orb beneath, until one side of the snare was quite covered with them. In this case the position of the nest, as well as its form, was exceptional, as the nest-site of *E. strix* is well nigh invariably beyond the limits of the web, sometimes, indeed, several feet. In these points the spider was evidently led to an intelligent variation of her nest-building by circumstances.

5. Another variation, or rather a series of variations, was noted upon the side of Brush Mountain, at Bellwood, Pennsylvania. Several young pine trees had been cut away and tossed from the mountain to the banks of the Juniata river below. The foliage had withered and fallen from the boughs, whose branches stretched out dry and bare; and among them a colony of young furrow-spiders had pitched their tents and spread their snares. One specimen happened to spin her web near the axil of several goodly sized branches, which were formed into a natural shelter by the inverted position of the bough. The spider had recognized this vantage, and made her nest at the point of junction, or rather took shelter there, for there was very little artificial nesting beyond a faint tissue spread over the bark at the point where she sat.

A second specimen had lodged at a point near the tip of a small branch whose delicate dry twigs gave no sufficient shelter, and, besides, were directed upward. Accordingly a silken tube, funnel-shaped, was spun between the twigs, within which the young spider nested.

A third spider, lodged in a similar site, had made a silken sack for a tent, whose mouth had apparently originally opened directly towards the snare. But a saltigrade spider had fastened a parasitic tubular nest upon one side of this sack; and accordingly the mouth was found closed and the door shifted to the opposite side, as though to avoid interference with a troublesome neighbour.

A fourth individual had woven a simple silken cover or screen, behind which she lodged. A fifth had pitched her tent upon a stray leaf, beneath which a similar cover, a small rectangular piece of silk canvas (suggestive of the military bivouac or "dog tent") was stretched by lines attached to the sides and corners, and fastened to the leaf-surfaces and surroundings. Between this sheet and the leaf the spider was ensconced, having the usual bridge-line connexion with the orb.

6. Two of the above colony had established nests in tufts of a parasitic moss fastened upon the dead limbs. One of these was very pretty and ingenious. The moss grew in a bunch about the size of a hickory-nut; this was pierced at the top, and the filaments pushed aside sufficiently to allow an interior cavity large enough to house a spider. An oval door or opening was formed near the top by bending and binding back the fibres of the plant. A secure and

tasteful retreat was thus obtained at the only really available spot in the vicinity of the snare.

7. When the furrow-spider weaves her orb upon the exposed surfaces of human habitations, as the cornices of porches, outhouses, &c., her nest takes a form quite different from any of the above. A tube of stiff silken fibre) is spun against the surface, to which it is lashed at all sides. This cylinder is about an inch long and half an inch thick, and, at the end towards the orb, has a circular opening about a quarter of an inch in diameter. The stiff texture of the nest appears to be necessary to make the walls self-supporting, inasmuch as there are no supporters like the twigs and leaves found at hand in arboreal sites. Moreover the open position of the domicile exposes the spider very freely to the assaults of the mud-daubers who frequent such localities, to birds, and other enemies; so that a canvas is needed of tougher texture than that required in sheltered sites. It may be remarked that in old buildings, which present cracks and crannies convenient for nesting, woven nests of this sort will rarely be found.

It is thus seen that while there is a general regard to protection of the spider's person, there is a modification over a quite wide degree of variation in the form of the protective nest; further, that this modification appears to be regulated, more or less, by the accidental environment of the domicile, and in such wise as to show no small degree of intelligence in adapting the ordinary spinning habit to various circumstances, and to economizing labour and material.—*Proc. Acad. Nat. Sci. Philad.* March 21, 1882, p. 97.

On Segmentation in the Mites. By P. Kramer.

After referring to some previous publications of his own and of other writers on this subject, the author describes, as follows, the segmentation of a minute mite found by him on the ground in a fir-plantation in the Thüringer Wald, and which he identifies with *Alycus roseus* of Koch. He says:—

"The dorsal aspect shows a very distinct segmental line between thorax and abdomen. The shoulders of the latter project rather convexly; and between them the segmental line is slightly sinuated posteriorly. The abdomen shows nine distinct segments, which follow one another exactly as we see them in the little *Podurœ*. The segmental grooves between the first three abdominal segments are broad, and present, to a certain extent, the appearance of double lines, of which the anterior cut off the preceding segment, and the posterior commence the succeeding one. The lateral margin of the abdomen shows distinctly the convexities and constrictions which correspond to the middles and the boundaries of the segments. The setation throughout follows the segmental conditions; there are rows of setæ upon the surfaces of the segments, only running parallel to the boundary-lines of the segments. The hindmost segment bears the perfectly terminal anal aperture, half of which is seen in the dorsal view, while the other half is seen in the ventral aspect.

"On the thorax there is a distinct pair of eyes, furnished with very convex lenses, just as in *Rhyncholophus.* It further bears several long setæ, of which the pair situated between the eyes is distinctly fringed. This special pair of setæ on the thorax when seen under a low power, especially as it is placed near the black eye-spots, leads one to suppose that we have here a respiratory organ, similar to the stigma of the Oribatidæ; but a higher magnifying-power shows distinctly that this pair of setæ is nothing but a perfectly ordinary capillary structure. On the thorax there are also three longitudinal lines, branched in a tree-like fashion behind, and two transverse lines; and these divide its whole dorsal surface into several areas, three of which occupy the entire central space. The small setæ on the segments of the abdomen are short and feathered on both sides, as is known to be the case in some species of *Trombidium.* In the living animal they have a bright white lustre, and so give the whole back a white glimmer. The colour of the skin, however, is a faint violet with a reddish tinge.

"On the lower surface we again see the thoracic segmental lines distinctly running between the coxal plates of the second and third pairs of legs; but besides these the segmental lines of the back likewise pass onto the lower surface, not, however, as simple circularly environing lines, but (and this is particularly distinct in the posterior ones) they bend forward in the middle of the abdomen, and run round the sexual aperture, occupying this laterally, so that, by this means, the anus and sexual aperture appear as if placed in the same last segment. The course of the segmental lines of the more anteriorly situated abdominal segments could not be distinctly traced on the lower surface. The sexual aperture is of considerable size, and is closed by two larger convex valves, which are hollowed within, and each furnished with three somewhat oval sucking-disks. The outer surface of these valves, like the surface of the coxal plates, is covered with a reticulated system of lines; at the margin of each valve there is a close-set series of short feathered setæ, by which the fissure between the plates is partially closed.

"As regards the limbs, all four pairs of legs are quite similarly formed. The number of joints in the anterior legs is five; in the posterior legs there are six free joints. All the feet are armed with three claws. The palpi are five-jointed; and the apex of the fifth joint is closely covered with a number of shortly-plumose setæ. The mandibles are cheliform, short, and rather convex.

"Unfortunately, in the single specimen available for examination it could not be discovered where the tracheal aperture was, or, indeed, whether any tracheæ existed, so that the systematic position of this remarkable animal must remain undetermined. The presence of well-developed eyes, however, renders it probable that this mite is to be placed near the *Trombidia.*

"Its significance in the abdominal question, however, is the most important point in the observation of our mite. It is evident that in examining it we find three natural divisions—the capitulum (mouth-segment), thorax, and abdomen, and this last again divided into distinct segments. In accordance with this we also observe buccal limbs, thoracic limbs (in two pairs), and abdominal limbs (also in two pairs).—*Archiv für Naturg.* 1882, p. 178.

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THE ANNALS

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XVII.—*Notes on Fossil Calcispongiæ, with Descriptions of new Species.* By George Jennings Hinde, Ph.D., F.G.S.

[Plates X., XI., & XII.]

In the course of a recent examination of the fossil sponges in the British (Natural-History) Museum at South Kensington, I devoted particular attention to those forms which have been grouped together by Prof. Zittel as a new family of calcareous sponges under the term "Pharetrones," with the view of discovering, if possible, some fresh evidence which would serve to determine the validity or otherwise of this classification, which has been contested, more particularly in this country, by two eminent authorities on recent and fossil sponges—Messrs. Carter and Sollas. To my good fortune, I succeeded beyond my anticipations in ascertaining some fresh facts respecting the spicular structure of several sponges of this family, which appear in my estimation to be of importance in deciding the question of their true character; and my purpose in this communication is to describe these new facts and discuss their bearing on the subject.

The family of the Pharetrones, described by Zittel in his 'Studien über fossile Spongien' (of which a translation by Mr. W. S. Dallas, F.L.S., is contained in the third and fourth volumes of the 'Annals' for 1879), embraces a very numerous group of fossil sponges which occur in strata from the Devonian to the Cretaceous inclusive. In regard to outer form, these sponges possess the same variety which is met with in fossil siliceous sponges; but as a rule they are individually of much smaller dimensions. Their main characteristic feature is the possession of a fibrous skeleton, composed of carbonate of lime, and, unlike many other fossil sponges sometimes associated with them in the same strata, whose skeletons are also calcareous, this material forms the original skeleton, and is not the result of subsequent replacement. The fact, now generally recognized by those who have studied fossil sponges, that the present calcareous or siliceous condition of these bodies affords of itself no certain indications of their original composition, has caused a great amount of confusion. It is only within a comparatively recent period that the instability of the organic silica in sponge-spicules and its replacement by calcite in many fossil sponges has been demonstrated. Before this fact became known all fossil sponges with calcareous skeletons were regarded as possessing this mineral constitution originally; for calcite was generally thought to be much less stable than silica, and it was believed impossible that it could replace this latter material. At the present time, with many authorities, the belief is in the opposite direction, and, instead of regarding all sponges with calcareous skeletons as formed originally of this material, it is asserted that no known fossil sponges were originally calcareous, and that all those with calcareous skeletons have become so by dissolution and removal of the original silica and its replacement by calcite. It becomes therefore a matter for the exercise of judgment to determine the original composition of any fossil sponge. In the case of sponges, for example, whose skeletons are built up of lithistid or hexactinellid spicules we are enabled at once to determine that their composition, though now frequently calcareous, was originally siliceous; for we know that in all existing sponges with this type of spicular structure the composition is invariably siliceous; and, further, the fossil examples occur frequently both in a calcareous and siliceous condition, and those which are siliceous exhibit the outer form and interior canal-structure of the component spicules in a comparatively perfect state, whilst the opposite occurs with those which are calcareous; and from this we may conclude that this latter material is not the original constituent of the skeleton of these sponges.

The fibrous character of the skeleton of the Pharetrones, however, is so unlike that of any existing calcareous sponge that we are unable to apply the comparison which enables us to determine its original composition, as in the case of the siliceous sponges just mentioned. In all existing Calcisponges the spicules forming the skeleton are imbedded in the exoderm or syncytium of the sponge, and never form, as in the case of the Pharetrones, anastomosing solid fibres. Thus loosely imbedded in the sarcodic material of the syncytium, it would be impossible that they should be able to retain their arrangement after the death of the animal and the consequent destruction and decay of the syncytium. This perhaps led Häckel to state in his magnificent monograph that up to the present (1872) not a single fossil calcisponge is known (vol. i. p. 241). He further adds, "One might expect to find the microscopic calcareous spicules of these sponges as fossils in different strata; and probably with more complete micro-geological investigations these will be abundantly found; but up to the present none have ever been described and figured."

If, however, it can be shown that the skeleton of the fossil Pharetrones, though disposed in the form of solid anastomosing fibres, is yet built up of calcareous spicules which show the closest agreement in form with those of existing calcisponges, the objection raised against their alliance with the existent examples of the order would be deprived of most of its importance; for it is on the character of the individual spicules of the skeleton rather than on their arrangement that the classification of both siliceous and calcareous sponges, recent as well as fossil, depends. The following observations of Häckel with respect to the spicules of the existing Calcispongiæ will equally apply to the fossil examples of the order. He says that, notwithstanding there is much less variety in their form, arrangement, and combination than in those of siliceous sponges, yet they are of the highest morphological value, and afford the only sure foundation for a natural classification and a genealogical system of the calcareous sponges.

In studying the characters of the fossil Calcisponges we encounter a difficulty arising from the frequent obliteration of all traces of spicules in the fibres through the changes which have taken place in the process of fossilization. In many instances the fibres only show a structure of finely radiate calcitic crystals; in others but faint traces of spicules here and there can be detected; and even where the spicular structure is fairly preserved the only method available for examination is by means of thin microscopic sections, which, except in the cases of the simplest forms of spicules, and then only when the plane of the section corresponds with that of the spicule, do not allow a satisfactory investigation of the entire spicule. When only thus partially seen, some of these calcareous spicules have been, by some authorities, compared to the spicules of siliceous monactinellid and tetractinellid sponges whose original constitution is now replaced by calcite. Hitherto the spicules of fossil calcisponges have never been noticed in the free state, and our knowledge of the minute structure of the Pharetrones has been solely derived from the study of thin microscopic sections.

Leaving aside for the present the consideration of the true characters and affinities of the spicules of the Pharetrones, it is worth while to inquire if the character of the strata in which these fossils occur, and the condition of other fossils associated with them, will give any subsidiary help towards solving the question of their original structure. As nearly all the Pharetrones which are met with in this country are derived from the Lower Greensand, the Upper Greensand, and the Upper Chalk, we need not in making our inquiries go beyond these three horizons. Beginning with the lowest, it is somewhat remarkable that a very large proportion of the Pharetrones in England has been yielded by the Lower-Greensand strata of Faringdon, in Berkshire. So abundant are these organisms that the bed containing them is known as the "Sponge-gravel." It is a conglomerate of siliceous sand and gravel, hardened by a ferruginous cement. The sponges form a large part of the bed; the material surrounding and enveloping them, if we except the remains of other organisms, is entirely siliceous, while the sponges themselves are entirely calcareous and are acknowledged to have grown in the same beds in which they are now found. It is therefore altogether improbable that the sponges in this gravel-bed should have had their skeletons, if originally siliceous, so completely replaced by calcite, a material which is now not present in these beds save in the remains of these and other calcareous organisms. On the other hand, the unaltered appearance of these sponges and the resemblance of the calcite of their skeletons to that of the shells and other organisms associated with them favour strongly the opinion that they still possess their original calcitic structure. No undoubted siliceous sponges have, so far as I am aware, been discovered with the Pharetrones in this sponge-gravel. Prof. Sollas admits the difficulty of explaining, on his hypothesis of the original siliceous composition of these sponges, their present calcareous condition in this bed, on account of not finding the silica resulting from the solution of their original structure; but he supposes that it has been carried away by current-action of the seas and subsequent drainage of percolating waters *. He makes no reference to what appears to

* Ann. & Mag. Nat. Hist. 1878, vol. ii. p. 362.

me the far greater difficulty of accounting for the complete substitution of silica by calcite in a stratum where free calcareous material does not exist.

Passing now to the Upper Greensand, Pharetrones occur, though not very abundantly, in beds of this age at Warminster; and in the same locality and in beds of similar lithological characters there are numerous examples of siliceous lithistid sponges. The comparison of examples of these different groups thus preserved under similar conditions is very instructive, and shows, one may say almost at a glance, such great differences, that no one could suppose that both these groups were originally siliceous in composition. The matrix is of quartzitic and green grains, hardened by a siliceous cement, without any trace of calcareous material. The Pharetrones in this Warminster Greensand are entirely calcareous; their outer form is perfectly preserved; and the fibre, both at the surface and in the interior of the sponge, is alike of a comparatively soft white earthy material, whilst the interspaces are filled by the transparent quartzitic and green grains of the matrix. Altogether different are the appearances presented by the siliceous lithistid sponges in these same beds. The sponges themselves are siliceous; the outer form is preserved; but the exterior surface in the majority of the specimens exhibits only the cemented grains of the matrix, with here and there partially obliterated spicular structure. In the interior the spicular skeleton is either imbedded in glassy silica, or it not unusually happens that the siliceous spicules have been dissolved and their empty moulds remain. In no single instance have I found these moulds refilled with calcite. On the hypothesis of the siliceous origin of the Pharetrones it appears inexplicable that they should now be exclusively and completely calcareous, whilst the undoubtedly siliceous Lithistids should yet retain their siliceous structure. The present differences can only be understood by admitting the calcareous origin of the Pharetrones.

It is, however, on the Pharetrones in the Cambridge Greensand, and more particularly on the structure of *Pharetrospongia Strahani*, Sollas, that Prof. Sollas bases his arguments in favour of the siliceous character of these fibrous sponges. The matrix enclosing the sponges is a dark bituminous material; the brown and greenish grains of which it is composed appear to be cemented, in part at least, by calcite; for after treatment with acid they are disintegrated. The sponge-fibres are mainly composed of calcite which readily dissolves in acid; but very frequently there remains here and there a thin delicate film, forming, as it were, a sheathing on the exterior surface of the fibre, chiefly consisting of the minute spicules, now siliceous and cemented together by siliceous material. Now at first sight it might be said that in this sponge at least the original structure was siliceous; for some, though only a very small portion, of the fibre yet retains a siliceous composition. A comparison, however, with the present condition of siliceous hexactinellid sponges occurring in the same beds throws great doubt on such a conclusion. So far as my experience extends, none of the hexactinellid sponges in this Cambridge Greensand retain their original siliceous structure; their spicular skeletons for the most part are now represented by hollow moulds: and on the hypothesis of the siliceous origin of *Pharetrospongia*, one would have expected to find the fibres dissolved away in a similar manner, and the empty moulds remaining; but this condition never occurs. It is true that occasionally the moulds of the hexactinellid spicules have been infiltrated with calcite; but this replaced material is of quite different character from that of the fibre of *Pharetrospongia*. There is another fact which tends to prove that the siliceous spicular film occasionally present in the fibres of *Pharetrospongia* is of secondary origin, which is that it is invariably restricted to the *exterior* of the fibre, whilst the interior remains calcareous. If the fibre had been originally siliceous throughout, it would naturally have been expected that the *interior* portions, those least exposed to the influences of change, would have retained the original structure the longest, whereas the interior is invariably calcareous. On the hypothesis of the original siliceous structure, it seems to me inexplicable that the fibre should have remained siliceous on the exterior, and that the interior should have been replaced by calcite. If, however, we suppose the original constitution of the fibre to have been calcareous, and a subsequent silicification of the exterior surface to have taken place, the explanation is at once simple and easy to be understood. This explanation receives confirmation from the phenomena presented by examples of this same sponge (*Pharetrospongia Strahani*) which are abundantly met with in the Upper Chalk of Kent and Sussex. In these specimens the fibre is smooth, white, and purely calcareous in its composition. The form and outline are perfectly preserved, in striking contrast to the condition of the siliceous hexactinellids in the same strata, of which the originally siliceous spicular mesh has been completely dissolved away, leaving either hollow moulds or a secondary replacement of a loose powdery oxide of iron. Some specimens, however, of the calcareous *Pharetrospongia* have been enveloped by flints; and I have discovered that these examples have suffered a similar change to that which has happened with the Cambridge-Greensand specimens; namely, the interior portion of the fibre remains calcareous and can be removed by acid, whilst the exterior, in immediate contact with the flinty matrix, has become silicified. This fact very clearly shows the secondary origin of the siliceous envelope of the fibres of *Pharetrospongia.*

It seems to me therefore that the originally calcareous structure of the Pharetrones is strongly supported by the present condition of these fossils and the contrast between them and the remains of siliceous hexactinellid and lithistid sponges which are present in the Lower and Upper Greensand and the Chalk.

The new facts which I have to bring forward respecting the spicular structure of the Pharetrones mainly rest upon the discovery that, in certain sponges of this group from the Upper Greensand of Warminster, the fibre is in such a loose semi-friable condition that the spicules composing it may be obtained, in some instances quite, in others partially, free from the matrix, thus enabling their true forms and proportions to be ascertained with a degree of accuracy which it has been impossible to arrive at by a study of thin microscopic sections. These Warminster sponges not only presented this peculiarity of the fibre, but they also exhibited on the outer or dermal surface a layer of spicules differing in form and size from those composing the inner fibre, and sufficiently large in some instances to be visible with a strong simple lens. This discovery led me to make a special search for these surface-spicules, and resulted in proving their occurrence on the exterior of several different genera of Pharetrones both from Cretaceous and Jurassic strata. The significance of this discovery will be understood from the fact that in their character and position these surface-spicules, as will be hereafter shown, strikingly resemble those of existing Calcisponges.

The Warminster sponges above referred to belong to two genera (*Verticillites*, Def., and *Corynella*, Zittel); but they appear to me to constitute new species. In common with the other calcareous sponges from these beds, these retain their outer form well preserved and mostly free from the matrix, which consists of a somewhat coarse-grained quartzitic sand with green particles, probably of glauconite. The fibres of the skeleton have a dull white aspect, alike in the interior and on the exterior surface; and, as already mentioned, they are in places partially disintegrated, and break up into a soft powdery material, in which many of the spicules remain, though for the most part fragmentary. Subjoined are detailed descriptions of the Warminster Pharetrones and of two species from the Cretaceous strata of Vaches Noires, near Havre, in which the spicular structure of the fibre presents important differences from that of the Warminster specimens.

Verticillites D'Orbignyi, n. sp.
(Pl. X. figs. 1, 2, 7, 8; Pl. XI. figs. 1–24.)

The examples of *Verticillites* which I propose naming *V. D'Orbignyi* are small club-shaped sponges from 16 to 23 millim. in height, growing either singly or in small groups from a common base. Not infrequently new individuals spring from the sides or near the summits of others, as if by a process of budding. In some examples the base is contracted to a minute blunted stem; in others it expands to form a surface of attachment. Above the base is the first chamber, which is small and inconspicuous, and succeeded above by other subspherical chambers, arranged in single series, usually four to six in number. Each chamber is larger than the one beneath; and the summit-chamber is conspicuously the largest. The chambers, excluding the summit, are each from 2 to 4·5 millim. in height and from 4 to 6·5 millim. in width; the summit-chamber is from 6 to 9 millim. in height and from 9 to 14 millim. in width. The roof of each chamber in the series forms the floor of the one above it; and the different chambers are connected together by an interior tube passing through them. I have only been able to examine this tube in a single specimen, in which it appears to be imperforate. The summit of each chamber is depressed, dome-shaped, with a circular aperture in the centre, which in the summit-chamber is 2·25 millim. in width, and is bordered with a slightly elevated collar with smooth even margins. The walls of the sponge are only ·16 millim. in thickness, and appear to be formed of a single thin layer of fibre. The outer surface is smooth, and perforated with numerous minute circular or oval apertures, about ·25 millim. in width and about their own diameters apart. These apertures open directly into the interior chambers.

The fibres forming the wall of the sponge are entirely composed of spicules, apparently disposed in two layers—an outer or dermal layer, and beneath this the inner layer, forming the main portion of the fibre. I have obtained spicules from both these layers and mounted them in Canada balsam. Seen by transmitted light they are translucent, with occasionally a yellowish tint. Their outer surfaces have generally a rough eroded aspect, as if covered with a powdery coating of minute earthy particles, though probably this appearance is really due to a partial decomposition of the spicule itself. Some of the rays of the larger spicules exhibit a smooth surface and even outlines, though in no instance comparable to the exquisite smoothness of the spicules of existing sponges. Under polarized light the fossil spicules occasionally exhibit faint prismatic tints of the same character, but less distinct than those shown by recent calcareous spicules. I have not discovered any traces of an interior canal in these spicules.

The spicules forming the outer layer of the sponge are either three- or four-rayed, and vary considerably in size. Three rays of the spicule are horizontally extended in the same plane, radiating from a common centre; in section each ray is circular, thick-set at the centre, where it connects with the others, and gradually tapering to the extremity, which is bluntly pointed. Two of the three rays of the spicule are equal or very nearly equal in length, such as are termed by Häckel "lateral" or paired-rayed, whilst the opposing ray, the "basal" ray of Häckel, is either longer or shorter than the lateral rays. Where a fourth ray is present (the "apical" ray of Häckel), it springs from the central point of the three rays and at right angles to them. In this species the lateral or paired rays of the relatively large dermal spicules are either straight or nearly so, as in Pl. XI. figs. 3, 4, or possess a slight curve, which may be either towards the basal ray, as in figs. 5–8, or away from it, as in figs. 1, 2. The angle formed by the lateral rays varies from 160° to 180°, whilst that on either side of the basal ray correspondingly varies between 90° and 100°. The paired rays are usually both longer and stouter than the basals. The apical ray, where present, appears to be shorter than any of the facial rays. There are great variations in the dimensions of these surface tri- and quadriradiate spicules. The length of *ray* in the largest which I have been able to measure is ·24 millim. by ·054 millim. in thickness, whilst in a small specimen the ray is only ·05 millim. in length by ·015 millim. in thickness.

The spicules of this surface or dermal layer are disposed with their facial planes parallel with the wall, so that the rays rest on the surface without spreading over the circular apertures. In some portions the basal ray of the triradiates is directed towards the base of the sponge; but in general no regular disposition of the spicules is apparent. The apical ray of the quadriradiate spicules appears to penetrate the wall at right angles to its surface. The majority of the dermal spicules seem to be quadriradiate; but in some no trace of a fourth ray can be detected. The largest of these spicules are disposed on the surface with their rays nearly touching; the smaller forms appear to be disposed beneath and between the rays of the larger.

Beneath this surface-layer of tri- and quadriradiates the wall-fibre of this sponge is composed of spicules of a very different form. These latter are in reality triradiates also, though at first sight scarcely to be recognized as such. They are mostly elongated, curved, filiform bodies, with a small projecting knob in the middle (Pl. XI. figs. 18–23); many are nearly straight or geniculate (figs. 14, 15), also provided with a similar central projection, which represents the basal ray of a triradiate spicule, on either side of which are the lateral or paired rays. The rays are nearly of an even thickness throughout their length; in some they slightly diminish towards the extremities. The minute basal ray is in the same plane with the lateral rays, and, in the case of the curved forms, always springs from the outer or convex side of the curve. From their extreme delicacy it is rare to obtain these filiform spicules entire; the rays are usually fractured, and the broken portions might be mistaken for uniaxal spicules; but I have not detected simple uniaxal spicules anywhere in this sponge. The largest which I have been able to measure is ·3 millim. from end to end, or ·15 millim. of a single lateral ray, whilst the thickness is ·006 millim. The knob or basal ray is only ·009 millim. in length, and is, I believe, complete. The fibre of the sponge is built up of these filiform spicules (figs. 18–23) disposed close together, though not absolutely parallel with each other; for many rest across the others, though generally in the same direction. The curved spicules are mostly disposed round the margins of the canals which penetrate the wall. The geniculate spicules (figs. 14, 15) are rare forms; so also is the spicule represented in fig. 16, which appears in form to be intermediate between the spicules of the dermal layer and those of the interior fibre. The triradiate (fig. 24) with all the rays unequal is also a rare form. I have carefully searched all the fragments of the fibre without discovering other than these filiform spicules in it. The inner or cloacal surface of the fibre, which faces the interior cavity of the sponge, appears to be unprovided with any special layer of spicules similar to those of the dermal surface.

The spicules met with in this sponge are in form so distinctly typical of calcareous sponges, that it would seem hardly necessary, but for the great doubt which has been manifested respecting the affinities of the Pharetrones, to point out in detail their close resemblance to those of existing Calcisponges. We have only to turn to the beautiful figures in Häckel's monograph to find a resemblance in form, and, as regards the dermal spicules, a correspondence in position which conclusively shows a relationship between these fossils and the recent examples of the order. Beginning with the large quadriradiate spicules of the dermal surface with the lateral rays curved away from the basal, as in figs. 1, 2, Pl. XI., we find closely corresponding forms in the dermal spicules of *Leucandra Johnstonii*, Carter, sp., = *Leuconia nivea*, Bowerb., Häckel, Monogr. Bd. ii. p. 216, T. 34. f. 1 *a*. In conjunction with the large quadriradiates in this recent sponge, there are, according to Häckel, numerous triradiates very variable in size and form; the majority are subregular or sagittal, many irregular, and few completely regular (T. 34. f. 1 *a*, *b*). These correspond in form, though larger in size than those which I have represented in figs. 9–13, 16, 17, Pl. XI. In this recent species Häckel states that the three facial rays of the large quadriradiates lie on the dermal surface, while the apical ray bores through the wall into the cloacal cavity, thus corresponding in position to the dermal spicules of the fossil form.

The pickaxe form of dermal spicule with the lateral rays turned towards the basal ray occurs in the surface-layer of *Leucaltis clathria*, Häckel, Monogr. Bd. ii. p. 159, T. 28. f. 36, and *Leucandra cucumis*, Häck. Mon. p. 205, T. 33. f. 1 *f*; but the recent forms are two or three times as large as the fossil. The spicule represented in fig. 4, Pl. XI., with the lateral rays in a straight line, also occurs in the recent *Leucandra stilifera*, O. Schmidt, sp., Häck. Mon. T. 33. f. 4 *d*. Coming now to the smaller spicules, the sagittal triradiates, represented in figs. 14, 15, are similar to the medium small triradiates of the cloacal surface of *Leucaltis solida*, O. Schmidt, sp., Häck. Mon. T. 27. f. 3 *f*; but the basal ray is not so reduced in these as in the fossil forms. In this recent sponge there are also small triradiates similar to those of my figures 9–13, 24, Pl. XI. I have not been able to discover any spicules of recent Calcisponges which closely resemble the slender filiform spicules which mainly compose the fibre in this fossil species, figs. 18–23. The form which approaches the nearest is one figured by Bowerbank from *Leuconia fistulosa*, Mon. Brit. Sp. vol. iii. pl. v. f. 16; but in this the basal ray, though small, is by no means reduced to the insignificant proportions of that of the fossil.

Whilst the various forms of spicules present in this fossil thus closely resemble the spicules in recent Calcisponges, they do not correspond to the spicules of any known siliceous sponge, whether fossil or recent. The skeleton of some siliceous tetractinellid sponges is built up of three- and four-rayed spicules; but in the large majority of these, the rays are equal in length, they radiate from the centre at equal angles, and are but seldom in the same plane, but usually elevated in the form of a three-sided pyramid, with the fourth ray at the apex. No one at all acquainted with sponge-spicules would confound these with the spicules of calcareous sponges.

A dermal surface-layer of large quadriradiate spicules similar to those present in this fossil appears to be a common feature in several existing Calcisponges, amongst others in *Leucaltis clathria*, Häck. Mon. Bd. ii. p. 159, T. 28. f. 3, and *Leucaltis crustacea*, Häck., Mon. Bd. iii. Taf. 28. f. 1; but in no existing sponge is there the same disposition of the spicules of the interior to form anastomosing solid fibres as in this and other allied fossil forms; and this character forms the distinctive feature of the Pharetrones, sharply marking them off from the families of existing Calcisponges.

The main differences between this species and *Verticillites anastomans*, Mantell, sp., 'Wonders of Geology,' p. 636, f. 3, consist in its mode of growth, the chambers being spherical instead of cylindrical, and the upper much larger than those beneath. I am unable to determine if there are any differences in the spicular structure of the two species; for though the examples of *V. anastomans* are very abundant in the Faringdon gravels, in none are dermal spicules visible. D'Orbigny has mentioned a species of *Verticillites* under the name of *V. incrassata*, Prodr. de Pal. vol. ii. p. 186; but as the only reference to it, contained in the following paragraph, "Espèce dont les tiges grossissent de la base au sommet au lieu d'être cylindriques," is obviously insufficient for satisfactory recognition, I have preferred to give a new designation to this species.

Horizon and Locality. Upper Greensand, Warminster, Wiltshire.

Coll. British Museum of Natural History (Cunnington coll.); Museum of Practical Geology, Jermyn Street.

Corynella rugosa, n. sp. (Pl. X. fig. 4; Pl. XI. fig. 25.)

The examples of this species are all simple, and in form cylindrical, straight or curved. The base is contracted to a minute blunted stem; and the summit is truncate. The outer surface has concentric ridges, which are either continuous or broken up into tubercular elevations. An average specimen is 48 millim. in height and 18 millim. in thickness. The cloaca is in the form of a cylindrical tube; the aperture at the summit is 4 millim. in width. The walls vary in thickness between 4 and 7 millim.

The sponge-walls are formed of anastomosing fibres, of the same character as those of *V. D'Orbignyi*; but instead of a single layer one sixth of a millim. in thickness, there is a continuous network 5 to 7 millim. in thickness, extending from the exterior to the surface of the central cloacal tube. The exterior is smooth, and exhibits closely arranged, approximately circular apertures, which are in fact merely the interspaces between the network of the fibres. The examples do not show the interior surface of the cloaca.

A dermal layer of relatively large spicules can be detected here and there on the surface; but I have not been able to obtain these detached; so far, however, as they can be observed by the aid of a simple lens, they appear to correspond in form, size, and position with the quadriradiate spicules of the exterior of *V. D'Orbignyi*. I have succeeded, however, in obtaining spicules of the interior fibre free from the matrix, and find them similar in all essential features to the filiform spicules of the preceding species. In some the basal ray is slightly longer and terminates acutely. The arrangement of the spicules in the fibre is also precisely similar to that already described in *V. D'Orbignyi*. This similarity in the spicular structure is of great interest when one considers the diversity in the form, size, and thickness of the wall in these two sponges.

Horizon and Locality. Upper Greensand, Warminster, Wiltshire.

Collection. British Museum of Natural History (Cunnington coll.).

Corynella socialis, n. sp. (Pl. X. fig. 3.)

Sponge compound, consisting of three or more individuals springing from a common cylindrical stem, or else growing by lateral buds. The base either widely expanded or contracted to a blunted point. The summits flat, wide, and obliquely truncate. The outer surface uneven, with short blunted projections. The typical example is 49 millim. in height and 43 millim. in its greatest width. The individual sponges are from 17 to 21 millim. in thickness. The walls vary from 5 to 10 millim. in thickness; and the aperture of the cloacal tube is 5 millim. in diameter.

The outer surface exhibits apertures of irregular form, bounded by the interlacing fibres. In one small part of the surface, spicules, apparently quadriradiate, could be detected. The fibre in one specimen was sufficiently firm to allow a thin microscopic section to be prepared from it. Examined by transmitted light the fibre presented the appearance of well-defined anastomosing bands from ·12 to ·17 millim. in width, of a dark tint, in which are seen numerous delicate, closely arranged, and for the most part parallel thread-like bodies, distinguished by their lighter outlines. These spicules appear, at first sight, to be simple uniaxal forms; but on close inspection, in places where they are less closely packed together, one or two can be seen to be geniculated and to possess a minute projection in the centre, representing the atrophied basal ray of triaxal spicules, similar to the spicules of the fibre of the preceding species. The difficulty of observing the minute basal ray of these spicules in thin sections might easily give rise to error respecting the character of the spicules, as they would be mistaken for uniaxal forms.

In external form this species is allied to *Corynella* (*Distheles*) *excavata*, Roemer (Pal. Bd. xiii. T. 1. f. 19), and *C.* (*Distheles*) *depressa* (Fromentel, Introd. T. ii. f. 7); but its walls are considerably thicker, and both the individuals and the compound form are notably larger.

Horizon and Locality. Upper Greensand, Warminster, Wiltshire.

Collection. British Natural-History Museum (Baker coll.).

Sestrostomella rugosa, n. sp.
(Pl. X. fig. 6; Pl. XII. figs. 1–15.)

Sponge compound, growing in upright bushy masses, consisting of several individuals, from conical to cylindrical in form; united at their bases, and occasionally laterally, but with free summits. The typical specimen is 68 millim. in height, and 76 millim. in greatest breadth. The individuals are about 12 millim. in thickness. The lower portion of the specimen figured appears to have been enveloped in a compact rugose external membrane. The summits of the individual sponges are either rounded or truncate. The external surface, save in the lower portion of the specimen, where the compact membrane is present, is extremely rough, and exhibits an irregular open network of coarse fibres. From the summits of some of the individual sponges, well-defined deep open canals extend downwards. The cloacal aperture, where present, is about 2 millim. in width; but in some individuals it seems absent, and the summit only shows the interstitial apertures between the fibres; but the open canals are present, just the same as in the individuals with a distinct cloacal aperture.

I have not detected any dermal spicules in this species, and, considering the rough character of the exterior, one could hardly expect to meet with them. But though unsuitable in this respect, the condition of the sponge is very favourable for the preparation of thin sections. In a transverse section, taken from the basal portion of a specimen, examined by transmitted light, the fibres appear as bright translucent bands from ·2 to ·41 millim. wide, in a brownish calcareous matrix. The outlines of the spicules appear as very fine lines. Where the plane of the section intersects the fibre in the direction of its length, it appears as a broad band with well-defined margins; when the fibre is cut transversely, the section is circular. The fibre exhibits an altogether different character in the form and arrangement of the component spicules from that which prevails in the examples of *Verticillites* and *Corynella*, already described. Instead of a regular disposition of parallel filiform spicules, nearly uniform in thickness and length, the fibre of this species is composed of spicules very variable in form, and ranging in size between very large and very small forms. A fragment of the fibre and different forms of the spicules are represented in Pl. XII. figs. 1–15. As these figures are drawn with the camera lucida on the same scale of 200 diameters, an idea may readily be formed of the variation in size of these spicules. The central portion of the fibre generally appears to be occupied by a large tri- or quadriradiate spicule, one ray of which extends along the central axis of the fibre, as shown in fig. 1 *a* and in section fig. 2 *a*. Sometimes but a single ray of this central spicule is visible in the plane of the section; in other instances portions of three rays are visible, as in fig. 3. The largest ray of these central spicules which I have met with is ·5 millim. in length and ·05 millim. in thickness. Beyond this centrally-placed large spicule the remaining portion of the fibre appears to be composed of several different forms of triradiate spicules, whose rays are so compactly and intricately interlaced together that it is extremely difficult to ascertain their complete forms with any degree of precision. Of those recognizable, some appear to be sagittal tri- and quadriradiates, figs. 1 *b*, 5, 9–11, with rays from ·03 to ·06 millim. in length; others pickaxe in form (fig. 8), or rudely fork-shaped with wide irregularly curved prongs (fig. 6); whilst others are regularly fork-shaped (figs. 12–15), with short, slightly-curved lateral rays and a slender, straight, tapering basal ray, varying in total length between ·07 and ·19 millim. These spicules appear to be distributed in the fibre without any definite order; in a few instances, however, I have noticed the small regular fork-shaped spicules, with their prongs or lateral rays directed towards the margin of the fibre and the basal ray penetrating inwards; but this disposition does not appear to be constant.

It is only by careful search that the small spicules just mentioned can be singled out in the confusedly mingled mass of spicular forms present in the fibre; the general appearance of the fibre is that of numerous very fine, sinuous, interrupted lines, which run parallel with the direction of the fibre, and are closest arranged near the margins. I have been unable to determine satisfactorily the character of these minute wavy lines. In part they appear to be formed by the closely interlacing rays of irregularly fork-shaped spicules similar to that represented in fig. 6; but they may also indicate the bisected outlines of very minute spicules which are so interwoven and dovetailed into each other that the separate forms cannot be distinguished. In the recent sponges *Leucandra Johnstonii*, Carter, sp. (Ann. & Mag. Nat. Hist. 1871, vol. viii. p. 3, t. 1. figs. 5–12), and *Leucandra stilifera*, O. Schmidt, sp. (Atlan. Spong. p. 73, t. 2. fig. 24), and some other forms as well, the skeleton is in part composed of relatively very large quadriradiate and very minute uniaxal and quadriradiate spicules. Häckel states (Mon. Bd. ii. p. 225) that in the last-named species, *L. stilifera*, the minute uniaxal spicules are mixed up together in masses which may be compared to stucco or mortar, which covers the smooth dermal and gastral surfaces, and envelops and connects together the large and colossal quadriradiates which form the scaffolding of the skeleton. It seems to me probable that in this fossil species the large quadriradiate spicules of the centre of the fibre are similarly enveloped by minute spicules, and that the minute wavy lines seen in the thin microscopic section may be the outlines of a compact felted mass of these diminutive bodies.

The tri- and quadriradiates of this fossil are precisely similar in form to spicules met with in several species of Häckel's recent genus *Leucandra*; but in respect of their dimensions, the largest fall short of the size of some of the spicules of the recent sponges. The pickaxe spicule (fig. 8) and fork-shaped spicules (figs. 6, 12–15) are more specialized and restricted forms, consequently of greater value for comparison; for if these very peculiar types occur in recent Calcisponges, but little doubt can be entertained of the calcareous origin of the fossil sponges. It is therefore satisfactory to find that spicules of similar form are present in the skeleton of two recent species of calcareous sponges, *Leucetta pandora*, Häck. (Mon. Bd. ii. p. 127, Taf. xxii. f. 3 *a–c*, Taf. xxiii.), and *Leucortis pulvinar* (Häck. p. 166). Similar spicules were first figured by Bowerbank (Mon. Brit. Spong. vol. i. p. 268, pl. x. f. 237) from a calcareous sponge from Freemantle, Australia. On these, Gray founded a new genus and species, *Lelapia australis* (Proc. Zool. Soc. 1867, p. 557). It is interesting to note that the two species with this spicule described by Häckel are also found on the south coast of Australia and in the Indian Ocean. If we turn to Häckel's figures of the different forms of spicules of *Leucetta pandora*, on Taf. xxiii., which are magnified to the same scale of 200 diameters as those on my Plate XII. we find that the forms which he terms "anchor-shaped triradiates," with recurved sagittate rays (*i*), correspond with the pickaxe spicule of my fig. 8; the fork-shaped spicules with open prongs (fig. 6) resemble those which Häckel terms completely irregular triradiates (*p*); whilst the small fork-shaped fossil spicules (figs. 13–15) may be compared with those of Häckel's fig. *h*; the fossil spicules, however, are much smaller and slenderer forms than the recent, and the basal ray gradually tapers instead of being swollen at its extremity. The variability of the spicules in this fossil seems to be almost as great as in the recent sponge, of which Häckel states that its skeleton may be considered a complete armoury for all possible forms of triradiate spicules.

Judging from the form and canal-system this fossil species appears to belong to Zittel's genus *Sestrostomella*. Up to the present, however, the spicular characters of the type species of this genus have not been ascertained; and until these are known the generic position of this species must be regarded as merely provisional.

Horizon and Locality. Cretaceous, Vaches Noires, near Havre.

Collection. British Natural-History Museum.

Sestrostomella clavata, n. sp.
(Pl. X. fig. 5; Pl. XII. figs. 16–25.)

Sponge compound, depressed, spherical in outline, consisting of numerous cylindrical individuals, mostly free at their summits, but partially united laterally, which grow from a central mass. There are no signs of any stem or expanded surface of attachment; but on the underside there are two smooth small patches on which the sponge seems to have rested during its growth. The individuals are from 8 to 10 millim. in diameter, with rounded summits. The cloacal aperture is about 2·5 millim. in width; in some examples it appears to be replaced by a few oscules or canal-openings. Straight open canals extend from the summit down the sides of some individuals. The outer surface exhibits only the irregular interspaces between the fibres.

A thin transverse section presents under the microscope substantially the same spicular structures of the fibre as in the preceding species, and therefore it will not be necessary to repeat the description of them in detail. Some representations of the spicules of the fibre are given on Pl. XII. figs. 16–24. In fig. 16 are represented portions of the sagittal and basal rays, and the truncated base of the apical ray, of a large quadriradiate spicule. The lateral rays of this spicule appear to have been curved in a similar manner to those of a large triradiate in *Leucetta pandora*, Häck. (Mon. Taf. xxiii. f. *m*, *e*). Portions of smaller tri- and quadriradiates are shown in figs. 17, 18. The fork-shaped spicules (figs. 20, 22–24) closely resemble those of *S. rugosa*. There is also a small irregular triradiate (fig. 21) which is precisely similar to one figured by Häckel in *L. pandora*.

In addition, however, to this spicular structure of the fibre, the type specimen of this sponge exhibits spicules on a small smooth oblong space on the under surface, which I have already mentioned as indicating the part on which the sponge rested during its growth. This spot, 10 millim. long, by 5 wide, is smooth and non-perforate, and is thickly covered by a layer of triradiate spicules, irregularly disposed, with the rays crossing each other (fig. 25). These spicules are sufficiently large to be seen with a simple lens; they vary in size; a fairly large specimen has the rays ·2 millim. long. It is very probable these spicules possess an apical ray penetrating into the interior and are thus really quadriradiates; but I am unable to determine this point. In form they are either sagittate or subregular, *i. e.* having the arms nearly of an equal length and the angles subequal. These spicules, thus apparently restricted to this small part of the exterior surface, closely correspond to the dermal spicules which in *Verticillites* and *Corynella* form a layer over the entire outer surface of the sponge. Notwithstanding the similarity in the spicular structure of the fibre to *S. rugosa*, the form and proportions of the mass and of the component individuals differ sufficiently, in my opinion, to permit this form to be regarded as a distinct species.

Horizon and Locality. Cretaceous, Vaches Noires, near Havre.

Collection. British Natural-History Museum.

From the close similarity which has been shown to exist between the minute spicular characters of the five species above described and those of existing Calcisponges, it seems to me that the originally calcareous composition of the fossil forms can no longer be disputed, and that Prof. Zittel was fully justified in placing together as a distinct family of Calci-sponges the numerous sponges with structures similar to the above species.

An examination of some of the calcareous sponges from Farringdon and Upware convinces me that they possess essentially similar minute structures to the sponges from Warminster and Vaches Noires, though, as a rule, their condition of preservation is unfavourable, and in no instance have dermal surface-spicules been detected; but thin sections of the fibres display similar features. For example, *Corynella* (*Scyphia*) *foraminosa*, Goldf., sp. (Petref. p. 86, t. 21. f. 4), from Farringdon, has the fibre made up of minute filiform spicules, apparently similar to those of *C. rugosa*. The fibre also of the common *Pharetrospongia* (*Manon*) *farringdonensis*, Sharpe, sp. (Quart. Journ. Geol. Soc. vol. x. p. 196, t. 5. figs. 5, 6), is similarly of filiform spicules; but whether these are really uniaxal or triradiates with the minute basal ray like those of *Corynella rugosa*, I have not yet been able to determine. The fibre of *Elasmostoma* (*Manon*) *macropora*, Sharpe (Quart. Journ. Gol. Soc. vol. x. p. 195, t. 5. figs. 3, 4), has a spicular structure of tri- and quadriradiates of the same character and arrangement as in *Sestrostomella rugosa*. Prof. Sollas has made this form the type of a new family and genus of *siliceous* sponges (Ann. & Mag. Nat. Hist. 1878, vol. ii. p. 336, fig. 1), on the supposed resemblance of the spicules to those of siliceous monactinellid and tetractinellid sponges, without apparently taking into account, amongst other things, the very great difference of size between the calcareous and siliceous forms, which of itself is sufficient to throw great doubt on their probable affinities. I have not been able to obtain a microscopic section of *Verticillites anastomans*, Mantell, sp. 'Medals of Creation,' vol. i. p. 227, fig. 4), but entertain no doubt that its minute structure will be found to correspond with the closely allied *V. D'Orbignyi*.

Not only in Cretaceous Calcisponges, but also in Jurassic examples, I am able to affirm the presence of a dermal layer of quadriradiate (?) spicules similar to those of the species above described. Thus in *Eudea perforata*, Quenst., sp. (Der Jura, p. 698, t. 84. figs. 26, 27), from the Upper Jura of Nattheim, the summit of the sponge has a layer of these spicules, though they are not to be detected in the compact membrane ("Dermalschicht" of Zittel) which invests the sides of this species; they are also present on the summit of *Eusiphonella Bronni*, Goldf. (Petref. p. 91, t. 33. fig. 9), from the same locality; and it seems very probable that the majority of the Pharetrones possessed a similar dermal layer, which, on account of the minute size of the spicules and the unfavourable condition of preservation, has not been hitherto noticed.

EXPLANATION OF THE PLATES.

Plate X.

Fig. 1. *Verticillites D'Orbignyi*, n. sp., natural size.
Fig. 2. The same, natural size.
Fig. 3. *Corynella socialis*, n. sp., natural size.
Fig. 4. *Corynella rugosa*, n. sp., natural size.
Fig. 4*a*. The same, showing the summit, with the cloacal aperture.
Fig. 5. *Sestrostomella clavata*, n. sp., natural size.
Fig. 6. *Sestrostomella rugosa*, n. sp., natural size.
Fig. 7. Fragment of the outer surface of *Verticillites D'Orbignyi*, showing the apertures in the wall, and the disposition of the large dermal spicules. × 56.
Fig. 8. Fragment of the interior surface of the wall of *Verticillites d'Orbignyi*, showing the arrangement of the minute triradiate spicules composing the fibre. × 56.

Plate XI.

(Figs. 1–24. Detached spicules of *Verticillites D'Orbignyi.*)

Fig. 1. Dermal spicule. Sagittal quadriradiate, with the lateral or paired rays curved away from the basal ray.
Fig. 2. The same. The lateral rays of this specimen are unequal in length, probably owing to the erosion of the shorter ray by fossilization.
Fig. 3. Dermal spicule. Sagittal quadriradiate, with straight lateral rays.
Fig. 4. Dermal spicule. Sagittal quadriradiate, with the lateral rays straight and in a straight line with each other.
Fig. 5. Dermal spicule. Sagittal quadriradiate, with the lateral rays curved towards the basal ray.
Fig. 6. The same. The basal ray more elongated than in the preceding.
Fig. 7. The same. Quadriradiate, with the three facial rays nearly equal in length; the lateral rays are slightly curved towards the basal ray.
Fig. 8. The same. Sagittal quadriradiate, showing the apical ray.
Figs. 9–13. Small forms of dermal spicules; all triradiates, with the rays unequal in length.
Fig. 14. Spicule of the fibre. Sagittal triradiate, with straight lateral rays and diminutive basal ray. This form most frequently occurs on the interior surface of the sponge-wall.
Fig. 15. The same. Triradiate, with unequal lateral rays, and the basal rays reduced to a small knob-like projection.
Figs. 16, 17. Dermal spicules. Sagittal triradiates, showing transitional forms between the dermal spicules and those of the fibre.
Figs. 18–23. Spicules of the fibre. Sagittal triradiates of various dimensions; the lateral rays mostly curved, so as to conform to the curvature of the fibre; the basal ray reduced to a diminutive knob.
Fig. 24. Dermal spicule. Triradiate with all the rays unequal.

Fig. 25. *Corynella rugosa.* Spicule of the fibre. Sagittal triradiate, with straight lateral rays.

All the above figures are drawn by means of the camera lucida, and magnified to the same scale of 200 diameters.

Plate XII.

Fig. 1. Longitudinal microscopical section of a portion of the fibre of *Sestrostomella rugosa*, as seen by transmitted light, showing one ray of a relatively large tri- or quadriradiate spicule in the centre (*a*), and the bisected outlines of sagittal and irregular triradiate spicules (*b*), which are confusedly intermingled together to form the fibre.

Fig. 2. Transverse section of the same, showing a cross section of one ray of a large central spicule (*a*), and the cut edges of the smaller triradiates surrounding it. The finer lines near the margin of the fibre in this and the preceding figure are probably outlines of minute spicules, so compactly wedged together in the fibre that the individual forms cannot be distinguished.

Fig. 3. *Sestrostomella rugosa.* Fragment of a large triradiate spicule, showing portions of the three rays, from the interior of the fibre, as seen in a microscopic section.

Fig. 4. The same. Fragment of triradiate spicule with unequal arms.

Fig. 5. The same. Fragment of quadriradiate spicule.

Fig. 6. The same. Triradiate (fork-shaped) spicule with irregular and unequal arms.

Fig. 7. The same. Irregular quadriradiate spicule.

Fig. 8. The same. Sagittal triradiate (pickaxe) spicule, with the lateral rays (imperfect) curved towards the basal ray.

Figs. 9–11. The same. Triradiate spicules, the rays incomplete.

Figs. 12–15. The same. Triradiate (fork-shaped) spicules from the fibre, showing the elongate basal ray and the lateral rays, often slightly unequal in length, and curved backwards, so as to become nearly parallel with each other.

Fig. 16. *Sestrostomella clavata.* Portion of large quadriradiate spicule, showing the imperfect sinuous facial rays and the truncated base of the apical ray, from a microscopic section of the fibre. The irregular lines within the spicule are apparently fractures in its substance.

Fig. 17. The same. Quadriradiate spicule (imperfect) similar to but smaller than the preceding.

Fig. 18. The same. Triradiate spicule.

Fig. 19. The same. Portion of a minute quadriradiate spicule.

Figs. 20, 21. The same. Fragments of irregular triradiate (fork-shaped) spicules.

Figs. 22–24. The same. Triradiate (fork-shaped) spicules, showing slight variations in size and form.

Fig. 25. The same. Triradiate (?) spicules, subregular in form, from a small smooth portion of the exterior surface of the sponge, probably the part from which the growth of the sponge commenced. × 150.

With the exception of fig. 25, all the above are drawn from microscopic sections by means of the camera lucida, and magnified to the same scale of 200 diameters.

XVIII.—*Diagnoses of new Species of* Pleurotomidæ *in the British Museum.* By EDGAR A. SMITH.

THE following descriptions have been written some time; and it was hoped that when published they would be accompanied by figures. This is very necessary considering the extent of the family, but not at present practicable. Nearly thirteen hundred recent species have been described; but many of these have already proved identical with others, and a good many more will no doubt, on further investigation, fall into the same category of bad species.

The object of having these diagnoses printed now is to prevent the distribution of manuscript names, which frequently occasions a great waste of time and labour.

Pleurotoma (*Clavus*) *alboangulata.*

Testa ovato-fusiformis, saturate fusca, strigis conspicuis albis 7 ab apice supra costas radiantibus ornata; anfract. 9, planiusculi, superne leviter constricti, costis obtusis albis 7 supra spiram continuis instructi; anfr. ultimus costis ad peripheriam evanidis dimidio infero omnino saturate fusco; apertura parva, longitudinis totius $\frac{2}{5}$ æquans, intus purpureo-fusca; columella callo crassiusculo purpurascente ad suturam tuberculato induta; sinus mediocris; canalis perbrevis, subangustus.

Long. 20 mill., diam. 7.

Hab. ——?

This species is very remarkably coloured. The seven white stripes radiating from the apex down the continuous ribs as far as the middle of the body-whorl contrast very markedly with the deep-brown ground-colour of the shell.

Pleurotoma (*Clavus*) *spinosa.*

Testa acuminato-ovata, saturate fusca, supra costarum medium albo tincta; anfract. 9, superne concavi, in medio acute angulati, costis medio aliquanto spinose acuminatis, superne versus suturam obsoletis (in anfr. ult. 8 paululum ante basim evanidis) instructi; anfr. ultimus aliquanto infra medium punctorum alborum seriebus duabus supra costas ornatus, circa caudam spiraliter striatus; apertura purpureo-fusca, longitudinis testæ $\frac{2}{5}$ vix æquans; columella superne valde tuberculata; sinus latus; canalis brevissimus.

Long. 15 mill., diam. $5\frac{1}{2}$.

Hab. ——?

The nearest ally of this species is *P. læta*, Hinds. The acute spine-like projections of the ribs are white; and the rest of the ribs also are of a paler colour than the interstices, the lower halves of which are darker than the upper.

Pleurotoma (Clavus) interpunctata.

Testa oblonga, subturrita, nitens, dilute rosea, zona angusta circa medium anfractuum et supra zonam illam inter costas punctorum saturate roseorum serie succincta; anfract. 9, superne excavati, inferne convexi, costis nodulosis circa medium (in anfr. ultimo 9 ad peripheriam obsoletis, ultima validissima roseo tincta, aliquanto pone labrum sita) instructi, lineis spiralibus incrementique lineis exilissime striati; anfr. ultimus zona secunda alba circa medium ornatus; apertura lata, longitudinis totius circa $\frac{3}{8}$ æquans; sinus parvus; canalis brevissimus; labrum tenue, effusum.
Long. 16 mill., diam. $5\frac{1}{3}$.

Hab. St. Thomas, West Indies. Coll. Cuming.

This species is remarkable for the pretty disposition of coloration.

Pleurotoma (Clavus) diversa.

Testa crassa, ovata, flavo-aurantiaca, inter costas rufo tincta; anfract. 8, convexiusculi, superne simplices, inferne costis crassis (in anfr. ultimo 10–11 prope medium evanidis) instructi, ubique spiraliter exiliter striati; apertura longit. totius $\frac{3}{7}$ adæquans; columella callosa ad suturam valde tuberculata; sinus mediocris, infra tuberculum situs; canalis brevis.
Long. 14 mill., diam. $5\frac{1}{2}$.

Hab. ——?

The ribs only occupy the lower two thirds of the whorl, the remainder being simple. The spiral striation is fine; that towards the base of the body-whorl is a trifle coarser.

Pleurotoma (Clavus) amanda.

Testa ovato-turrita, alba, zona fuscescente infra medium anfractuum ornata; anfract. 10, convexi, superne leviter excavati, et subangulati, costis plicosis, undulatis, obliquis (in anfr. penultimo 8, in ult. 7 basi fere continuis, ultima longe pone labrum sita validissima) instructi, transversim tenuiter confertim lirati, liris supra et inter costas continuis, longitudinaliter inter liras minute striati; apertura basi lata, longitudinis totius $\frac{1}{3}$ paulo superans; columella rectiuscula, callo mediocri superne incrassato labroque juncto induta; canalis latissimus, perbrevis.
Long. 17 mill., diam. $6\frac{1}{3}$.

Hab. ——?

A slight pit or excavation exists between the ribs at the upper part of the whorls. The spiral lirations are very distinct and regular, and appear to be separated by punctured striæ, which appearance is produced by the numerous longitudinal lirations in the interstices between them.

Pleurotoma (*Clavus*) *quadrilirata.*

Testa fusiformi-ovata, alba, inferne ad suturam et in anfr. ultimo circa medium linea saturate roseo-fusca cincta; anfract. 9, supra concavi, infra convexiusculi, costis subrectis superne versus suturam undulatam evanidis (in anfr. ultimo 7 vix ad basim continuis, ultima maxima) instructi, et circa dimidium inferius liris spiralibus 4 supra costas præcipue prominentibus cincti; anfr. ultimus infra liras spiraliter crebre striatus, infra lineam fuscam dilute roseo late zonatus; apertura parva, sordide albida, longitudinis testæ $\frac{3}{8}$ æquans; columella recta, callosa, ad suturam tuberculata; sinus mediocris; canalis brevissimus, levissime recurvus.

Long. 16 mill., diam. $5\frac{1}{2}$.

Hab. ——?

The deep pinkish-brown line above the suture is most apparent between the ribs. The four lirations on the ribs are rather acute and prominent, and are only on the lower half of the whorls.

Pleurotoma (*Clavus*) *interstrigata.*

Testa acuminato-pyramidalis, flavida, inter costas roseo-fusco strigata; anfract. $7\frac{1}{2}$, primi $1\frac{1}{2}$ læves, cæteri superne leviter constricti, inferne convexiusculi, costis crassis superne ante suturam evanidis (in anfr. ultimo 10 basi desinentibus) instructi, liris spiralibus supra costas subtubercularibus, in interstitiis fere obsoletis, cincti (liris in anfr. penult. 4, in ultimo circa 12), undique minutissime spiraliter striati, sutura undulata sejuncti; apertura intus flavescens, longitudinaliter fusco-roseo strigata, long. totius $\frac{4}{11}$ adæquans; columella callo prope suturam tuberculato induta; sinus parvus; canalis brevissimus.

Long. 11 mill., diam. $4\frac{1}{2}$.

Hab. St. Thomas and St. Vincent, West Indies.

Each of the longitudinal ribs may be said to be composed of four transverse nodules, and those on the body-whorl are bifurcate from the middle downwards. The liræ on the body-whorl below the four principal ones are only slightly interrupted in the interstices between the ribs.

Pleurotoma (*Clavus*) *hottentota.*

Testa oblonga, subturrita, fuscescens, zonis duabus albis (in anfr. ultimo 3) in interstitiis inter costas interruptis ornata; anfract. 8, superne leviter excavati, inferne convexiusculi, costis obliquis, superne versus suturas evanidis (in anfr. ultimo 12 infra medium obsoletis) instructi; anfr. ultimus striis paucis spiralibus circa caudam ornatus; apertura longit. totius $\frac{5}{13}$ adæquans; columella callo tenui superne tuberculato labroque juncto induta; canalis latus, apertus; sinus magnus.

Long. 13 mill., diam. $4\frac{1}{2}$.

Hab. Port Elizabeth, South Africa.

The upper interrupted white band is situated around the top of the ribs; just above each rib there is a faint brown spot, and the exterior of the labrum is whitish.

Pleurotoma (*Clavus*) *caffra.*

Testa subquadrato-ovata, subturrita, luteo-fuscescens, costis superne albis, punctulis numerosis albis rubrisque aliquanto fasciatim irrorata; anfract. 9? (apice fracto), superne læves concave excavati, deinde planiusculi, costis contiguis (in anfr. ultimo circiter 16 versus basim evanidis, sed supra caudam reproductis) instructi; apertura longit. totius $\frac{2}{5}$ æquans; columella valde callosa, superne tuberculata; canalis perbrevis, latus: sinus parvus.

Long. 16 mill., diam. $5\frac{1}{2}$.

Hab. South Africa.

The upper half of each whorl is concave and smooth and slightly thickened at the suture; the lower half is closely ribbed. The thickening below the suture is whitish, closely dotted with red.

Pleurotoma (*Clavus*) *coffea.*

Testa ovata, ad apicem acuminata, fusca, costis in medio albis ornata; anfract. 9, paululum infra suturam leviter constricti, deinde convexiusculi, costis superne versus suturam evanidis (in anfr. ultimo 10, infra medium desinentibus) instructi, incrementi lineis striati; anfr. ultimus zona secunda alba infra medium in interstitiis inter costas obsolete ornatus, circa basim striis paucis cinctus; apertura longitudinis totius ad $\frac{7}{17}$ æquans; columella callosa, ad suturam valde tuberculosa; sinus parvus, infra tuberculum situs; labrum extra validissime incrassatum alboque bimaculatum; canalis brevissimus.

Long. $8\frac{1}{2}$ mill., diam. $3\frac{1}{2}$.

Hab. Philippine Islands. Coll. Cuming.

The depression in the last whorl is broad and smooth; the fine apical whorls are small and produced suddenly into a cone.

Pleurotoma (*Clavus*) *bellula.*

Testa acuminato-ovata, flava, circa medium anfractuum albo fasciata; anfract. 8, primi 2 læves aurantiaci, cæteri superne leviter excavati, inferne convexi, costis obsoletis 10 instructi, liris spiralibus 5–6 (3–4 supra costas incrassatis) cincti; anfr. ultimus liris ad 15 ornatus; apertura longitudinis totius $\frac{1}{3}$ paulo superans; sinus mediocris; canalis brevissimus, leviter recurvus.

Long. $8\frac{1}{2}$ mill., diam. 3.

Hab. St. Vincent, West Indies.

The white band encircling the whorls includes three of the spiral lirations which are thickened upon the obsolete ribs; in fact, each rib might be said to be composed of the thickening of the liræ.

Pleurotoma (——?) *albata.*

Testa elongata, fusiformi-pyramidalis, alba; anfractus 9, primus lævis convexus, sequentes duo læves medio carinati, cæteri convexi, costis distantibus crassiusculis 6 supra spiram continuis (in anfr. ultimo paululum infra medium evanidis) instructi, sutura filo-carinata discreti, et liris tenuibus spiralibus prominentibus 4 (suprema quam cæteris valde tenuiore) cincti; anfr. ultimus liris circiter 15 ornatus; apertura longitudinis totius $\frac{1}{3}$ adæquans; labrum tenue, superne subprofunde sinuatum, intus liris 4–5 intrantibus munitum; columella lævis, callo tenuissimo induta; canalis brevis, leviter recurvus, angustus.

Long. 8 mill., diam. $2\frac{1}{2}$.

Hab. Persian Gulf (*Pelly*).

This species, when viewed with the apex towards the eye, appears hexagonal, as the six ribs are continuous up the spire. The spiral lirations, although fine, are conspicuously prominent. The form of this species approaches that of *P. pyramidula*, Reeve; but the sculpture is totally distinct.

Pleurotoma (*Crassispira*) *microstoma.*

Testa solida, elongata, subturrita, flavida; anfract. 9–10, primi 2 longitudinaliter exiliter crebre costati, liris spiralibus subcancellati, cæteri superne ad suturam carina undulata cincti, infra carinam sulco angusto tenuiter striato excavati, infra sulcum costis crassis contiguis, liris spiralibus nodulosis (in anfr. superioribus 3, in ultimo circiter 12) transitis (in anfr. ult. costis 12 fere ad basim continuis, una maxima crassissima pone labrum sita) instructi; apertura parva, longitudinis totius haud $\frac{1}{3}$ æquans; canalis brevissimus, recurvus; columella callosa, ad suturam tuberculata; sinus parvus.

Long. 16 mill., diam. 5.

Hab. Ceylon (*E. L. Layard*).

This species is remarkable for having the first two whorls large, and not smooth and glassy as in most other species, but finely ribbed and lirated. The aperture is very small.

Pleurotoma (Crassispira) atramentosa.

Testa turrita, nigro-fusca, fere nigra; anfract. 12, superne juxta suturam unicarinati, infra carinam concavi, ad basim nodulorum 14 serie unica (in anfr. ultimo in costas deorsum producta) ornati, et liris spiralibus duabus nodulos connectentibus cincti; anfr. ultimus infra nodulos liris 5 validis distantibus supra costas subnodosis, et infra eas circa caudam aliis minoribus circiter 10 succinctus, atque inter liras spiraliter sparsim striatus; apertura purpureo-nigra, longit. totius $\frac{1}{3}$ paulo excedens; columella callosa; labrum paululum pone marginem costa ultima incrassatum, superne infra carinam subprofunde sinuatum; canalis perbrevis, vix recurvus.

Long. 21 mill., diam. 7.

Hab. Panama. Coll. Cuming.

Care must be taken not to confound this species with *P. discors*, Sowerby, from which it mainly differs in having the row of nodules at the base of the whorl connected by two spiral lirations. The nodules in *P. discors* are much smaller and not joined together by liræ; and the keel at the upper part of the whorls is much more prominent than in the present species.

Pleurotoma (Crassispira) cubensis.

Pleurotoma luctuosa, d'Orbigny, Sagra's Hist. Nat. Cuba, vol. ii. p. 172, pl. xxiii. figs. 29–31.

Hab. Cuba (*d'Orbigny*); St. Thomas. Coll. Cuming.

The specific name *luctuosa* having been used by Hinds before d'Orbigny for a Californian species belonging to the same group of Pleurotomidæ, I have deemed it advisable to propose *cubensis* as a trivial name for the West-Indian shell.

Pleurotoma (Crassispira) albopustulata.

Pleurotoma albomaculata, d'Orbigny, Sagra's Hist. de Cuba, vol. ii. p. 176, pl. xxiv. figs. 16–18.

Hab. Cuba (*d'Orbigny*).

C. B. Adams described an allied species from Jamaica in the Proc. Boston Soc. Nat. Hist. 1845, vol. ii. p. 3, under the name *P. albo-maculata*. Such being the case, I propose the above name for the Cuban species, the description of which dates, according to the author, about 1846. *P. jayana*, C. B. Adams, is also a closely allied form.

Pleurotoma (Crassispira) caribbæa.

Testa elongate fusiformi-ovata, nigro-fusca, costis crassis flavidis ornata; anfract. 8, convexiusculi, superne prope suturam leviter pallide carinati vel incrassati, infra carinam leviter constricti, inferne costis crassis nodosis 10 superne in excavatione obsoletis instructi, ubique minute spiraliter striati; anfract. ultimus costis versus basim bifurcatis, ultima pone labrum maxima, liris spiralibus circiter 6 supra costas nodosis (nodulis flavidis) cinctus; apertura longit. totius $\frac{1}{3}$ æquans; columella callo tenui superne tuberculato induta; canalis brevissimus; sinus parvus.

Long. 12 mill., diam. $4\frac{1}{2}$.

Hab. Cuba. Coll. d'Orbigny in British Museum.

The bifurcation of the ribs on the body-whorl is very remarkable. The ribs are broader at the upper ends than inferiorly. Three or four of the spiral lirations are coarser than the rest, and are thickened on crossing the ribs. The palish keel beneath the suture is a little undulating and spotted with brown.

Pleurotoma (*Crassispira*) *flavocarinata.*

Testa ovata, saturate fusca, infra suturam carina validissima flava ornata; anfract. 9, superne valde carinati, infra carinam sulco angusto arati, infra sulcum costis parvis 18–20 (in anfr. ultimo fere ad basim continuis) instructi, inter costas spiraliter striati; anfr. ultimus liris ad 12, quarum superiores sex supra costas nodulosæ sunt, succinctus, striis paucis spiralibus inter liras ornatus; apertura parva, longitudinis totius $\frac{2}{5}$ adæquans; labrum infra carinam sinu parvo subamentiformi fissum; columella rectiuscula, callo tenui amicta; canalis perbrevis, vix recurvus.

Long. 12 mill., diam. 5.

Hab. Panama.

This species is very easily recognizable. The uniform deep brown or chestnut colour, the very stout yellow keel around the upper part of the whorls, and the little numerous ribs on the lower are the principal characteristics. The keel is edged above, or, in other words, is not quite contiguous with the suture. The sculpture is very like that of *P. discors*, Sowerby.

Pleurotoma (*Crassispira*) *latizonata.*

Testa solida, acuminato-ovata, dilute rubra, albo late fasciata; anfract. 8, planiusculi, costis exilibus circa 24 et liris spiralibus 4 (in anfr. ultimo 14) granulate cancellati, parte superiore tertia haud spiraliter lirati, ubique spiraliter minute striati; apertura parva, longitudinis totius $\frac{7}{18}$ adæquans; columella juxta suturam valde tuberculata; labrum crassissimum; sinus parvus, minime profundus; canalis brevissimus.

Long. 9 mill., diam. $3\frac{1}{2}$.

Hab. ——?

The general aspect of the surface of this shell is granulous;

but on closer examination the upper third part of each whorl is found to exhibit only the longitudinal ribs, which are suddenly directed obliquely to the left. The white band occupies about half the whorl, and includes the four upper series of granules. The transverse striation is fine and most easily seen on the upper part of the whorls.

Pleurotoma (*Crassispira*) *melanacme.*

Testa elongato-ovata, spira subacuminata, fusco-cinerea, costis lirisque albidis ornata; anfract. $7\frac{1}{2}$, primi $2\frac{1}{2}$ læves, politi, nigri, cæteri superne excavati, inferne costis parvis 12, liris spiralibus 3 supra costas incrassatis clathrati, striis spiralibus incrementique lineis insculpti; anfr. ultimus liris spiralibus ad 15, superioribus tribus supra costa subnodosis, succinctus; apertura parva, fusca, longitud. totius $\frac{1}{3}$ paulo superans; sinus parvus, paululum infra suturam situs; canalis brevissimus.

Long. $7\frac{2}{3}$ mill., diam. 3.

Hab. St. Vincent, West Indies.

The upper half of each whorl is concave, and not crossed by the ribs, which are situated below. Of the three spiral lirations which connect the ribs, the upper one is rather more slender than the others. There is a slight thickening just below the suture.

Pleurotoma (*Mangilia*) *modica.*

Testa ovato-fusiformis, sordide albida, ad apicem pallide rosacea; anfractus 6, supremi duo læves convexi, cæteri convexi, medio rotunde angulati, costis crassiusculis 10 supra spiram continuis instructi; costæ anfr. ultimi paululum ante basim liris spiralibus circiter 6 circa caudam interruptæ; apertura parva, longitudinis totius $\frac{5}{12}$ adæquans; labrum extra valde incrassatum, superne levissime sinuatum, intus læve; columella callo pertenui amicta; canalis latus, brevis.

Long. 6 mill., diam. $2\frac{1}{2}$.

Hab. Japan?

The nearest ally of this species is *P. septangularis*, var. *secalina*, Philippi; but the ribs are more acute, and there is no spiral sculpture except the few lirations around the base of the body-whorl, which are rather coarse.

Pleurotoma (*Mangilia*) *minutistriata.*

Testa ovata, sordide albida; anfract. $7\frac{1}{2}$, primi $1\frac{1}{2}$ læves nitentes, cæteri costis obliquis 13–14 (in anfr. ultimo paululum ante basim obsoletis) instructi, ubique exiliter (præsertim inter costas) spiraliter incrementique lineis striati; apertura ovata, longit. totius fere $\frac{2}{5}$ æquans; labrum costa ultima incrassatum, vix sinu-

atum; columella callo tenui amicta; canalis latus, brevissimus.
Long. $10\frac{1}{2}$ mill., diam. $3\frac{1}{2}$.
Var. Testa albida, hic illic prope suturam fusco maculata; anfr. $6\frac{1}{2}$, costis 12 instructi.

Hab. —— ?

The shell which I place as a variety differs from the type chiefly in having the ribs stouter and one less on each whorl. In both specimens, which have a semitransparent aspect, the nuclear half-whorl is brown.

Pleurotoma (*Mangilia*) *platycheila.*

Testa ovata, sordide albida, infra suturam hic illic fusco maculata, et circa anfr. ultimi medium rubro-fusco unizonata; anfract. $6\frac{1}{2}$, supremi $2\frac{1}{2}$ læves, cæteri costis crassis flexuosis 10–11 superne versus suturam sensim attenuatis (in anfr. ultimo ad basim desinentibus) instructi, passim spiraliter perspicue striati; apertura longit. totius fere $\frac{1}{2}$ æquans; labrum insigniter tenue, valde lateraliter dilatum, superne obsolete sinuatum; columella callo tenuissimo amicta; canalis apertus, brevissimus.
Long. $6\frac{1}{2}$ mill., diam. $2\frac{2}{3}$.

Hab. —— ?

The single reddish-brown band around the last whorl and the broadly expanded lip at once mark the distinctness of this species. The maculations near the suture are about three on a whorl.

Pleurotoma (*Mangilia*) *flexuosa.*

Testa ovata, fuscescenti-albida, linea rubro-fusca circa medium anfractuum et lineis duabus circa anfr. ultimum ornata; anfract. $6\frac{1}{2}$, primi $1\frac{1}{2}$ rotundi læves, cæteri perconvexi, costis flexuosis, confertis 15–16 (in anfr. ultimo ante basim evanidis) instructi; anfr. ultimus striis paucis spiralibus inferne insculptus; apertura ovata, longit. totius $\frac{2}{5}$ æquans; labrum extra costam ultimam maximam valde incrassatum, intus album, superne paululum infra suturam levissime sinuatum; columella callo tenui suturæ juncto induta; canalis brevissimus, latus.
Long. $8\frac{1}{2}$ mill., diam. 3.

Hab. —— ?

In this species the ribs are flexuous, turning obliquely to the left above, and to the right at the base of the body-whorl; and they are placed near together, being broader than the interstices between them. The spiral reddish-brown lines are only apparent on the ribs.

Pleurotoma (Mangilia) decora.

Pleurotoma costata (Gray), Reeve, Conch. Icon. f. 298.

Hab. St. Vincent, West Indies.

The name *costata* was used by Pennant many years ago for a species belonging to the section *Mangilia*, long before the publication of Reeve's description in the 'Conchologia Iconica.'

Pleurotoma (Mangilia) opalina.

Testa ovato-fusiformis, pallide purpurascenti-alba; anfractus 8, primi 2 læves, convexi, vitrei, tertius tenuiter costatus, cæteri superne leviter concavi, medio subangulati, infra angulum convexiusculi, costis circiter 12 (in anfr. ultimo fere basi productis) instructi, liris spiralibus 6–7 (quarum duæ circa medium cæteris paulo crassiores sunt) cincti; anfractus ultimus liris circiter 24 ornatus; apertura angusta, longit. totius $\frac{1}{2}$ adæquans; labrum extra valde incrassatum, medio macula parva fusca notatum, superne leviter sinuatum, intus superne obsolete unidentatum; columella callo tenui superne labro juncto induta; canalis brevis, angustus.

Long. 8 mill., diam. 3.

Hab. ——?

The entire surface is finely reticulated by the wavy lines of growth and spiral striations; but these are not visible under an ordinary lens.

Pleurotoma (Mangilia) trizonata.

Testa ovata, alba, dilute fusco zonata (in anfr. superioribus zonis duabus, altera superne prope suturam, altera ad basim, in anfr. ultimo tribus); anfr. 8, primi 2 læves vitrei, cæteri convexiusculi, superne aliquanto constricti, costis rotundis superne ante suturam evanidis (in anfr. ultimo 9 basi continuis) instructi, striis minutis spiralibus incrementique lineis pulcherrime insculpti; apertura linearis, angusta, longit. totius $\frac{1}{2}$ æquans; labrum intus incrassatum, superne obsolete unidentatum; columella callo minute granuloso induta; sinus parvus, minime profundus.

Long. $8\frac{1}{2}$ mill., diam. $3\frac{1}{2}$.

Hab. Sibonga, Zebu Island, 30 fms. (*H. Cuming*).

The sculpture of the third and fourth whorls from the apex is of a different character from that of the four succeeding. The ribs are thinner and more numerous; and spiral lirations take the place of the fine striation of the latter.

Pleurotoma (Mangilia) rufocincta.

Testa ovato-fusiformis, turrita, pallide flava, circa medium anfr. ultimi zona rufo-purpurea, superne prope suturam rufo tincta, et cauda purpureo-nigra ornata; anfract. 7, primi 2 læves politi, tertius longitudinaliter tenuiter costatus, cæteri superne decliviter planulati, medio acute angulati, infra angulum plani, costis crassis margine acutis ad bases contiguis (in anfr. ultimo ad 13 fere basi continuis) instructi, ubique transversim tenuiter striati; apertura longit. testæ totius $\frac{1}{2}$ æquans; columella obliqua, simplex, levissime torta; labrum costa ultima incrassatum, supra angulum obsolete sinuatum; canalis brevis, obliquus.

Long. 8 mill., diam. 3.

Hab. Porto Cavalho, S. America.

This species must not be mistaken for *Mangilia semiassa*, Gould, from which it differs in having more ribs or plications and also in the style of painting. The size and shape are similar.

Pleurotoma (*Mangilia*) *filicincta.*

Testa fusiformi-turrita, nitens, sordide albida, lineis spiralibus filiformibus (in anfr. ultimo ad 12 in penult. 4–5) cincta; anfract. $6\frac{1}{2}$, primi $1\frac{1}{2}$ vitrei globosi, cæteri superne declives, deinde rotunde angulati basique ad suturam contracti, costis longitudinalibus obliquis flexuosis (in anfr. penultimo ad 13, in ultimo versus labrum lævi haud costato circiter 10–11), inferne sensim evanescentibus; anfr. ultimus infra medium contractus, cum columella caudam brevem transversim striatam effingens; apertura pyriformi-ovata, longitudine spiram æquans; labrum superne leviter sinuatum, margine acutum, extra varicosum; canalis brevis, levissime recurvus.

Long. 13 mill., diam. 5.

Hab. Japan (*A. Adams*).

The chief marks of distinction in this form are the large apex, the third part of the body-whorl near the labrum lacking the costæ, and the very fine reddish spiral lines, the last character existing in *costulata*, Dunker, from which it differs in size, the absence of all spiral sculpture, and the character of the ribbing.

Pleurotoma (*Mangilia*) *ordinaria.*

Testa oblonga, subturrita, fusco-lutea; anfract. 7, primi 2 læves, cæteri ad latera parum convexi, costis subacutis 10–11 (in anfr. ultimo ad basim productis) instructi, spiraliter crasse striati, vel tenuiter lirati, liris paucis hic illic quam cæteræ majoribus; apertura angusta, longit. totius $\frac{2}{5}$ æquans; columella simplex; labrum incrassatum, superne parum sinuatum; canalis brevissimus.

Long. $7\frac{1}{2}$ mill., diam. $2\frac{1}{2}$.

Hab. Chile and Peru.

This species appears to be allied to *P. lutescens*, Reeve.

Pleurotoma (Mangilia) inepta.

Testa ovato-fusiformis, turrita, tenuis, alba; anfractus 7, superne breviter declives, deinde convexiusculi, costis 16–17 (in anfr. ultimo versus basim attenuatis) instructi, ubique transversim tenuiter conferte striati; apertura anguste ovata, longit. totius $\frac{6}{11}$ paulo superans; columella tenui-callosa; labrum extra incrassatum, intus læve, superne modice sinuatum; canalis brevis.
Long. 11 mill., diam. $4\frac{1}{2}$.

Hab. Honduras (*Dyson*).

This species has no very remarkable characteristic. It is simply rather closely ribbed, finely spirally striated, and has a little of the general aspect of the section *Cythara*.

Pleurotoma (Mangilia) millestriata.

Testa oblonga, turrita, alba, supra costas ad basim et circa anfr. ultimi medium prope basim supra costas rufo-punctata; anfractus 7–8? (apice abrupto), reliqui 5 convexiusculi, costis 7–8 (in anfr. ultimo ad basim supra caudam transversim flexis) instructi, ubique minute spiraliter striati; apertura elongato-ovata, longit. totius ad $\frac{3}{7}$ æquans, labrum costa ultima incrassatum, superne leviter sinuatum; canalis brevis, angustus, basi truncatus.
Long. 11 mill., diam. $3\frac{1}{2}$.

Hab. St. Thomas, West Indies. Coll. Cuming.

The manner in which some of the ribs on the body-whorl turn suddenly at right angles to the base of the columella is very remarkable. The penultimate and the three or four preceding ribs exhibit this character. At the upper ends, a little below the suture, the ribs are faintly angled; and the dots on the base in the upper whorls and on the middle and lower part in the body-whorl are so faint that they might be easily overlooked. There are also a few faint dots between the ribs, just below the suture.

Pleurotoma (Mangilia) caledonica.

Testa subquadrato-ovata, alba, epidermide fugaci, tenui, pallide lurida amicta; anfractus 8, convexi, costis 7 continuis (in anfr. ultimo basi productis) superne ad suturam undulatam productis instructi, ubique minutissime spiraliter striati; apertura longitudinis testæ $\frac{6}{11}$ æquans; columella lævis; labrum extra incrassatum, intus læve, prope suturam leviter sinuatum; canalis brevissimus, vix recurvus.
Long. 11 mill., diam. $4\frac{1}{2}$.

Hab. New Caledonia (*Brenchley*).

In form this species somewhat resembles *Cythara cithara*, Gould; but the penultimate whorl is larger, and the columella and labrum are not lirated. The suture is very prettily undulating, as the ribs are produced upward upon those above them, leaving little concavities between.

Pleurotoma (*Mangilia*) *Pellyi.*

Testa elongate ovato-fusiformis, alba, inter costas superne prope suturam et versus basim anfractus ultimi purpureo-fusco tincta; anfractus 8, primus parvus, convexus, sequentes 2 læves, medio carinati, cæteri leviter convexi, costis 7 continuis (in anfr. ultimo basi fere continuis) instructi, ubique spiraliter minute striati; apertura parva, ovata, longitudinis totius $\frac{5}{13}$ æquans; labrum costa ultima maxima extra valde incrassatum, vix sinuatum; columella callo crassiusculo labro juncto amicta; canalis brevissimus.

Long. $6\frac{1}{2}$ mill., diam. $2\frac{1}{3}$.

Hab. Persian Gulf (*Colonel Pelly*).

The seven strong ribs are continuous up the spire, thus making the shell heptagonal. The labrum has a purple-brown spot, which is the termination of the interrupted band around the base of the body-whorl, near the lower end of it.

Pleurotoma (*Mangilia?*) *acutangulus.*

Testa elongata, subfusiformis, alba, juxta suturam et ad caudam purpureo-rufo tincta, et circa medium anfr. ultimi zona angusta ejusdem coloris cincta; anfractus 8, supremi duo læves, tertius granose reticulatus, cæteri medio acute angulati, costis subacutis 7–8 supra spiram irregulariter continuis et versus basim anfr. ultimi evanidis instructi, circa angulum lira spirali tenui cincti, et ubique exiliter spiraliter striati; apertura albida, zona externa ornata, longit. totius $\frac{1}{3}$ paulo superans; labrum costa ultima incrassatum, vix sinuatum; canalis breviusculus, angustus.

Long. $7\frac{1}{2}$ mill., diam. $2\frac{1}{2}$.

Hab. ——?

This species is remarkable for the acute angulations of the whorls, the spiral liration at the angle, and the purplish-red bands at the suture and the middle of the last whorl, the latter being visible within the aperture. The number of ribs appears to vary from seven to eight; and they are not quite regularly continuous from the apex downwards.

[To be continued.]

XIX.—*Note on the Echinoderm-Fauna of the Island of Ceylon, together with some Observations on Heteractinism.* By Prof. F. Jeffrey Bell, M.A.

We know so little about the fauna of the seas around the island of Ceylon that, though there is no reason to suppose they will be found to teem with many new forms, it seems to be of interest and importance to give a brief statement as to what may be found by an active worker who will devote a short time to the occupation of collecting.

Dr. Ondaatje, Colonial Surgeon in Ceylon, has lately arrived in England, and has presented the Trustees of the British Museum with, *inter alia*, a collection of Echinoderms, of which the following is a list.

ECHINOIDEA.

1. *Diadema setosum.*

Well as the spines of this species are known to vary, I do not know whether a specimen with a number of its spines perfectly white, while others are more or less dark brown, has ever been put on record.

2. *Echinometra lucunter.*

It is well to have evidence that this widely distributed and very variable form is found off Ceylon.

3. *Salmacis bicolor.*

Since the time when I communicated to the Zoological Society some observations on the Temnopleuridæ*, and when the only specimens in the British Museum from a definite locality were those collected by H.M.S. 'Challenger' at Zamboanga, examples have been received from Port Molle (E. Australia) and from Mauritius. This species, then, is another of those which may be expected to be found throughout the whole area of the Indian Ocean.

Some years ago Dr. von Martens described a species which he called *Salmacis conica*; but this, in the opinion of Mr. Alexander Agassiz, is only a form of *S. sulcata.* The proportion of height to diameter in von Martens's species was 76·3 per cent.; the example now in our hands presents a proportion of 84 per cent.; and we have therefore the interesting case of the same kind of variation in shape presenting itself in two closely allied species in which, as a more ordinary rule, the longitudinal is never more than 65 per cent. of the transverse axis.

4. *Echinoneus cyclostomus.*

5. *Echinodiscus biforis.*

I adopt, provisionally, the specific name used by Agassiz in

* P. Z. S. 1880, p. 422.

his 'Revision of the Echini,' as the labours of nomenclature would become intolerable were one to make a critical review of synonymy on every occasion. I may point out, however, that by the arrangement of names in the 'Revision' Leske's clumsy term *bisperforatus*, which has some claims to priority, is not used for either of the species which he appears to have included under it.

ASTEROIDEA.

6. *Fromia milleporella.*

7. *Scytaster variolatus.*

Three small specimens are referred to this species; but intermediate forms, which should completely demonstrate the justice of their association with the mature examples, are still wanting to the national collection.

8. *Scytaster novæ-caledoniæ.*

This must be a most abundant species on the shores of Ceylon, and helps very much to point the moral of the danger of forming specific terms from localities with conspicuous names.

Several of the specimens present marks of injury; but only one has more than five rays, and Dr. Ondaatje tells me that, although he went to considerable trouble, he was unable to find a second example.

It is impossible to examine such a series as that now before me without being struck by the consideration that one factor in the production of abnormal forms among brachiate Echinoderms is the modification, or alteration, of the direction of vital activity due to the changes in an organism which must accompany so severe an injury as the loss of a large portion of one arm. It is not difficult to see that the result of such an injury might, of itself and by itself, be the production of two rays where one had previously existed, owing to increased activity, due to inflammatory action. A further result might well be a tendency, in a race of individuals of a certain species, to produce an irregular number of rays; occasionally, as in the case of *Asterias polaris*, this would be advantageous and would become a constant arrangement; as a rule, no advantage would be associated with it, and the phenomenon would partake only of the character of a sport.

This kind of variation may be called accidental, and may be presented by any species; some, however, constantly exhibit phenomena due to quite another cause (see under 15).

9. *Astropecten*, sp.

A small, not very well-preserved specimen, which seems to be more closely allied to *A. granulatus*, M. & Tr., than any form I have had the opportunity of examining.

OPHIUROIDEA.

10. *Ophiocoma erinaceus.*

11. *Ophiocoma scolopendrina.*

These two species appear to be both present in the collection; and it is interesting to note that what is ordinarily regarded as the general appearance of the one is to be found associated with the structural characters of the other—specimens with darker and lighter ring-marks on the spines presenting the swollen upper spines, while others in which the swelling of the upper spines is but faintly marked have the interbrachial spines on the lower surface of the disk almost, though not quite, bare of granules.

12. *Ophiocoma brevipes.*

13. *Ophiocoma pica.*

14. *Ophiothrix nereidina* (?).

Till the species of this genus have undergone some revision or been rearranged in smaller subgroups, there will often be considerable doubt as to the specific identity of a form not represented by several specimens.

15. *Ophiomastix annulosa.*

Although this species has been represented in the British Museum by specimens of considerable size, there has never yet been obtained one so large as that which we owe to the liberality and care of Dr. Ondaatje.

One specimen, which is nearly perfect, has its longest arm 300 millim. in length, while the disk is 28·5 millim. in *diameter*; another specimen, a good deal injured, has its disk 35 millim. in diameter. Here we can only guess at what the arms were or might have been: in the former specimen the arm, at a distance of 150 millim. from the disk, was 3 millim. wide, while it was 4·5 millim. wide at its base; in the latter specimen the arm, 5 millim. wide at the base, was 4 millim. wide at a distance out of 150 millim. It is quite possible that this example may have had arms 400 millim. long, and a total spread of 800 millim., or something like 32 inches.

The naturalist of an earlier school would have been content to admire the delicacy combined with solidity of such an Ophiurid's arm; today, when the current of speculation has set in a different direction, we are rather inclined to ask, what is the character of the struggle for existence of so large a creature, offering five distinct avenues for attack? The very condition of the injured specimen whose admeasurements have just been given answers the question; there must be a constant tendency to the loss of an arm or a part of one. Where vegetative repetition is so abundantly displayed, that loss can of itself hardly affect seriously the individual, certainly not the species; but, in some cases, the danger may react on the species in this way: rather than part with an arm there may be a choice, due to an inherited tendency, in favour of a loss of individuality. The disk divides under the influence of attacks from without.

The consideration of external influences is not, I think, to be neglected so completely as it has been by some writers. Simroth, for example, addressing himself to the "Cardinalfrage," "ob die Theilung der Seesterne überhaupt eine freiwillige sei, oder nur durch gewaltsame äussere Eingriffe bewirkt werde," decides in favour of the former*; and Prof. Häckel, who even uses the epithet "spontane," writes, "Bei gewissen Seesternen lösen sich die Arme freiwillig von der Scheibe ab" †. Of course, nothing more is meant by "voluntary" in this connexion than that the writer is unacquainted with the history of this tendency to fission, or with the character of the external stimulus that brings it into play.

The well-known observations of Kowalevsky and others afford sufficient evidence of the phenomenon of what may, in a sense, be spoken of as voluntary fission; but it is obvious that in so saying we are not at the bottom of the matter, and that it is unphilosophical to seek for no explanation beyond that of the dictates of a free will.

A capacity for self-injury appears to have been a dominant character in the primæval Echinoderm; the Holothurian of today can be easily roused to such a state of physiological excitement that he will eject his viscera; so, it seems, under another form did the Astrophiurid stock retain this tendency.

Under the influence of pain, fear, or anger, a starfish throws off an arm, or an Ophiurid divides its disk, fission of the disk

* Zeitschr. f. wiss. Zool. xxviii. p. 421.
† *Op. cit.* xxx. (Suppl.-Bd.) p. 435.

being the only possibility when centralization has extended so far. In the next place, it is to be noted that when the divided disk heals and buds afresh it may give signs of the loss of the quinary principle, and more than two arms may take the place of the two that are gone. The tendency to fission, the child of external irritation, became the parent of a habit of fission or simple reproduction. Carried on under certain conditions this habit led to yet another change; the permanently or characteristically sexradiate form, both in the north and in the south (*Ophiacantha anomala* and *O. vivipara*) ceased to have free-swimming embryos, and became viviparous. Here is cenogeny indeed! not only no trace of the bilateral symmetry of the embryo, but loss of quinary proportion in the adult!

Results so remarkable as these must not be dismissed as "freiwillig;" it seems that the tendency of an Echinoderm to break up under external irritation must be taken to be a proved fact. Passing from it forwards we recognize as an expression of this tendency, now crystallized into a habit, the fission of the Ophiurid disk; in some of the Asteroidea the tendency has become economized or concentrated, and only a single arm separates from the disk.

If, however, instead of passing forwards and coming within the range of heteractinic phenomena, we pass backwards into an earlier condition, and try to work out the cause of this tendency to division, we find ourselves brought face to face with polyactinism, a stage which must certainly be regarded as earlier than a fixed pentactinic condition. Here we find (*Brisinga*, *Labidiaster*) that the separate arms appear to break off for the purpose of setting free the genital products—a condition not inexactly paralleled by that zoological paradox *Palolo viridis*, and bearing a significant analogy to what obtains in some Discophora, where the researches of Prof. Häckel and of Dr. Romanes (whose work would not seem to have been consulted by Prof. Häckel) have shown that in some cases, at any rate (*Aurelia aurita*), the phenomenon of strobilation is associated with very great variability; or, to put the matter more generally, reproductive fission in low forms (or early stages?) is more or less indefinite in direction.

The origin, then, of the habit of self-mutilation in the Echinodermata is to be sought for in the imperative necessity of reproducing the species; as concentration and consolidation went on this habit disappeared, to be again roused into activity by the attacks of enemies. Thus roused, it has, in some groups, become definite in direction, and has again become a factor in reproduction. But the difference is a real one: at first it was merely for the evacuation of the genital products; today it is true asexual reproduction; and, wide as is the physiological, just as wide if not wider is the historical gulf. Between the two there stand the phenomena of adaptation to environment; in some cases this has been so complete (development of spines, marginal plates, odours) that the starfish fears no foe; in others, as in *Ophiomastix*, vegetative repetition is capable of atoning for all or much that is lost; in others, lastly, neither strength of spine nor length of arm suffices; and then the dangers to the species are atoned for by a modern recurrence to the ancient habit of fission.

The account given by Prof. Häckel of the different methods of reproduction may perhaps be conveniently modified, and put to stand thus:—

A. Sexual reproduction.
- (*a*) With metamorphosis ("metagenesis and internal gemmation").
- (*β*) Without metamorphosis (viviparous Echinodermata).

B. Asexual reproduction.
- (*a*) Fission, with repair.
- (*β*) External gemmation from a single arm.

A tabular arrangement of the stages of reproduction and fission may be useful:—

I. General break-up of the organism. Compare *Palolo*.
II. Gradual or regularized loss of the arm. Compare the Discophora.
III. Normal and combined evacuation of genital products through special pores.
IV. Injury to arm by external enemy. Compare tail of lizard.
V. Loss of arm (or division of disk) on irritation.
VI. Arm (or disk) gives off buds.

16, 17. *Ophiactis Savignii*.

In addition to a sexradiate example of this very widely distributed species, there are three specimens, two of which are sexradiate, of a species, not now to be exactly determined, which would appear to belong to the genus *Ophiacantha*. Here the sexradiate condition may possibly be an accidental variety. The specimens are all small and perhaps immature; at any rate, they present no evidence of that viviparous condition which, as is well known, is seen in some, at any rate, of the sexradiate species of that genus.

18. *Astrophyton clavatum*.

Broken pieces indicate the presence at Ceylon of a species which has as yet been only recorded from Zanzibar, though the British Museum has also specimens from Mauritius.

Crinoidea.

19. *Antedon*, sp.

Indications, the first within my knowledge, of a Comatulid from Ceylon are presented by a specimen with thirty-nine arms, only a few cirri, with about thirteen joints, the penultimate spine obsolete; with syzygies on the axillary distichal, axillary palmar, and third brachial; the next syzygy is on the eleventh brachial. The absence of a terminal comb from the proximal cirri induces me to suppose that the species belongs to the genus *Antedon*; and it would appear to be still undescribed; the dried condition of the specimen and the possession of only a single example forbid my describing it fully, or giving it a fresh specific name. I have urged on Dr. Ondaatje the advisability of preserving Crinoids in spirits; and I have little doubt that when he next brings or sends us a collection from Ceylon there will be some very interesting representatives of this ancient order.

It will be seen that Dr. Ondaatje has succeeded in obtaining an example from every group of the Echinodermata, with the exception of the Holothuroidea; and of these he hopes to make a collection on another occasion.

It will next be seen that a collection from Point de Galle, ranging thus over four classes, presents us with nothing new, except probably a Crinoid; the conditions of existence of a Crinoid with a *fixed larva* are so different from those of such other Echinodermata as have free-swimming embryos that nothing common to the two can justly be said.

Confining ourselves, then, to the other three classes, we observe that, as indeed we might have expected, the forms represented in this collection have all an exceedingly wide range; if we limit ourselves to the consideration of the single fact that Mauritius, Zanzibar, or the Mosambique are known stations in the area of distribution of all or nearly all the species, we shall see the point which is most forcibly urged by this collection. In the examination of the problems of geographical distribution, the homely fact of the presence of a powerful current must not be overlooked; and the recognition of its existence may sometimes save those who make a scientific use of their imagination from the necessity for feats of intellectual activity which, however remarkable when exhibited within the narrow arena of the students of a single group, are not always found to be acceptable to a wider audience.

XX.—*Descriptions of new Species of Lepidoptera, chiefly from Duke-of-York Island and New Britain.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 160.]

HOMOPSYCHE, gen. nov.

Aspect of the Homopterous genus *Flata*, but most nearly allied to *Barsinella*. Wings when closed taking much the same position as in *Cacoecia*: primaries broad, with arched costal margin, woolly, semitransparent, with strongly defined widely separated veins; discoidal cell long and narrow; costal vein short, not extending to the middle of the margin; subcostal with four branches, the first given off some distance before the end of the cell, the others beyond it; one radial emitted from the discocellulars (which are very oblique), so that it seems to be a fourth median branch; the three median branches emitted widely apart: secondaries elongate, almost triangular, but with the angles rounded off, coarsely scaled, semitransparent, strongly veined; the cell rather long, but not particularly narrow, the subcostal forking beyond it; discocellulars angulated; no radial vein. Body woolly, but the thorax, which is broad and short, almost naked above, so as to show its sutures *; anal tuft divided, very full, with the male harpagones very long, though slender; antennæ with an extremely long woolly basal joint, the remainder being slender, naked, and with an inner series of fine very short setæ; palpi very small and slender; proboscis rather large; legs thick, but rather long, the tibiæ with short, rather slender, terminal spurs.

43. *Homopsyche nudarioides*, sp. n.

White; the basal half of primaries with three equidistant pale-brown spots on both the costal and internal borders; a small darker-brown spot at the end of the cell; veins tipped with brown. Expanse of wings 20 millim.

New Britain.

44. *Pallene? metalligera*, sp. n.

Primaries above ochreous; the base and a large oblique spot before the middle of the internal border purplish opaline; an ill-defined arched discal opaline silvery line expanding below the radial vein into a broad silver patch, which fills the ex-

* This adds greatly to its likeness to a Homopteron.

ternal angle: secondaries cream-coloured: thorax ochreous; abdomen and under surface cream-coloured. Expanse of wings 10 millim.

New Britain.

45. *Artaxa fulva*, sp. n.

♂. Bright deep cadmium-yellow; primaries darker than secondaries, and crossed at about the basal third by a slightly arched whitish stripe; fringes of all the wings pale creamy yellow; abdomen pale along the dorsal region. Wings below ochreous, paler than above, with creamy borders; body ochreous. Expanse of wings 23 millim.

Duke-of-York Island.

Allied to *A. lutea*.

46. *Aroa immaculata*, sp. n.

♂. Cream-coloured, with the exception of the upper surface of the primaries, which is ochreous, and the pectinations of the antennæ, which are testaceous. Expanse of wings 21 millim.

Duke-of-York Island.

The large deeply-pectinated antennæ at once distinguish this from all species of *Artaxa*.

47. *Syntherata Godeffroyii*, sp. n.

♂. Ochreous; primaries above with the costal border and subapical area irrorated with brownish scales, giving them a sordid appearance; basicostal border lilacine greyish; lilacine greyish stripes as follows *:—a deeply dentate zigzag stripe from below the first median branch to the internal margin, a short irregularly dentate-sinuate stripe from costa across the external third of the cell, and two parallel undulated stripes enclosing a band of colour slightly paler than the ground-tint across the disk; a small ocellus with blackish-edged hyaline white centre, and a white iris encircled by a lilacine-greyish line, at the end of the cell; costal area at apex broadly lilacine greyish, crossed by a blackish spot; a sub-marginal series of squamose blackish dashes: secondaries with a small triangular blackish spot with pale flesh-coloured border at the end of the cell, and immediately followed by an arched series of about nine large unequal diamond-shaped spots, outlined in lilacine greyish; a dentate-sinuate flesh-coloured stripe, spotted with blackish between the veins, running

* This coloration is produced by a combination of reddish-chocolate and white scales.

parallel to the outer margin across the disk; a submarginal series of pale grey dashes: antennæ ferruginous; collar lilacine grey, a little more chocolate-tinted than the markings on the wings, and with whitish posterior margin. Wings below blotched and banded with chocolate-colour, the most prominent markings being two central bands, a large apical blotch on the primaries, a subapical blotch and a discal series of spots on the secondaries, a submarginal series of dashes, and the small ocelli; the basicostal areas are washed with clouded flesh-colour: venter with a series of brown dots on each side. Expanse of wings 147 millim.

New Britain.

Allied to *S. disjuncta* (*Antheræa disjuncta*, Walk.); the genus is really much closer to *Copaxa* than to *Antheræa*. *A. læpoides* from Borneo is also a *Syntherata*.

48. *Eumeta maxima*, sp. n.

♂. Primaries pale red-brown, with the subcostal area, including the discoidal cell and a broad longitudinal internomedian band, beginning at the base and tapering to a point upon the first median branch before reaching the outer margin, semihyaline whitish grey, with black margins; veins black: secondaries smoky brown, with reddish outer margin and hyaline greyish costal area: body pale sericeous cupreous brown, almost golden; abdomen with dorsal tufts of smoky-brown, tipped with white towards the base, the anal half clothed with woolly fuliginous hair; genitalia shining mahogany-brown; antennæ black. Wings below smoky greyish brown, with pale costal borders and a marginal series of pale reddish spots: primaries with pale sericeous brown internal border: body pale brown, the legs fringed with blackish hair. Expanse of wings 53 millim.

Duke-of-York Island.

Nearest to *E. Layardii* of Moore, and the largest species of the Psychidæ that I have seen.

49. *Zenzera bubo*, sp. n.

♀. Allied to *Z. strix*; pinky white, clouded with pale purplish brown, reticulated and spotted with black; the primaries with the base, a broad costal patch at about the basal third, a series of costal spots beyond the latter, a large patch immediately beyond the cell, and a discal series of large spots broken into three parts, each division placed further from the outer margin than the preceding one, so as to form an interrupted zigzag series, black: secondaries with the costal area broadly sericeous brassy brown, grey in certain lights; abdominal area broadly purplish brown, a discal series of black spots tapering towards the apex; all the wings with large black marginal spots; sides of thorax blotched with black: abdomen with two longitudinal series of black blotches. Under surface altogether browner than the upper; the markings less defined, excepting upon the costal border of primaries, which is white; with the black markings of the upper surface: body fuliginous brown; tarsi indistinctly barred with white. Expanse of wings 158 millim.

New Britain.

50. *Phanaca? cossoides*, sp. n.

Aspect of a *Cryptophasa* (see *C. albicosta*), but differing entirely in structure, which is that of a Notodont: primaries silvery white, the basal two fifths more or less clouded with red-brown, the outer margin of the red-brown area inarched; an indistinct curved stripe of the same colour crossing the wing immediately beyond the cell; costal margin and external border also red-brown: secondaries smoky grey, with white-tipped fringe; head and collar smoky grey; thorax whitish; abdomen bronze-brown. Wings below brownish, with bronze reflections; body sericeous white. Expanse of wings 29–31 millim.

Duke-of-York Island and New Britain.

As the type of *Phanaca* is too much broken for me to decide its sex, and as it possesses simple antennæ, whereas both specimens of *P.? cossoides* are males with tapering pectinated antennæ, the generic identification of this species must for the present remain doubtful. In neuration it agrees fairly well with *Phanaca*, though, in this respect, one of the specimens exhibits a singular aberration, the upper radial of the left primary being forked.

51. *Acontia inconcisa*, sp. n.

Allied to *A. signifera*. Above sordid silvery white: primaries crossed from the middle to the apex by a forked Y-shaped bronze-brown band, the lower half ill-defined; a brown spot at base of costal border; external border irregularly speckled with brown; a marginal series of brown dots; fringe cream-coloured, flecked with brown and black and tipped with white: secondaries with greyish external border; fringe cream-coloured, tipped with white and traversed by a grey line. Primaries below shining grey, costal border cream-coloured, grey-speckled, spotted with black above the end of the cell and at the apex; fringe cream-coloured, flecked with blackish: secondaries with the costal half cream-coloured, grey-speckled; a blackish discocellular spot and abbreviated discal line; a marginal series of linear black dots: body creamy white. Expanse of wings 18 millim.

Duke-of-York Island.

52. *Callopistria insularis*, sp. n.

Primaries above cream-coloured, silvery in certain lights, irregularly spotted and striped with sandy yellow; the blackish markings squamose, ill-defined, similar to those of *C. exotica*, excepting that the spot at the end of the cell and the marginal spot on the second median interspace are pupilled with silvery white; the other marginal spots are also depressed, olivaceous, and extend to apex; the two slender black lines converge in the same manner upon the interno-median area: secondaries shining greyish brown; fringe sandy buff, traversed by an imperfect grey line: head white; collar testaceous, thorax opaline white, abdomen opaline greyish. Wings below almost exactly as in *C. exotica*: body creamy whitish; femora, especially of the hind pair of legs, fringed with dark greenish-grey hair; a bifid blackish tuft on the posterior tibiæ. Expanse of wings 28 millim.

Duke-of-York Island.

Nearest to *C. chloriza* of Java.

53. *Anophia sericea*, sp. n.

Nearly allied to *A. olivescens*, but differing from it in the greater prominence of the black markings and the absence of any white markings on the upper surface, in which respects it more nearly approaches *A. Ramburii* of Europe. From the latter it may be at once distinguished by its glossy primaries, the absence of white marginal markings on the under surface of these wings, and the brown costal border of the secondaries on the under surface. Expanse of wings 36 millim.

Duke-of-York Island.

54. *Purbia muscigera*, sp. n.

Closely allied to *P. discrepans* (*Ophideres discrepans*, Walk.), but differing in the pinker tint of the primaries, on which the green spots are more vivid, the much more strongly angulated dusky stripes across these wings, the total absence of the two white spots on the median interspaces and of the blackish nebula beyond them, the absence of the whitish costal border of secondaries, and the smaller black lunate spot on the disk of these wings. Expanse of wings 89 millim.

New Britain.

As Mr. Moore has figured *P. discrepans* in his revision of the Ophideridæ, there will be no difficulty in identifying the species described above.

55. *Ctypansa bocanidia*, sp. n.

Lilacine grey; the wings traversed by two more or less diffused chocolate-brown stripes, the first at about the basal third oblique and regular, the second irregularly angulated, bounded externally by a series of white points, and crossing the centre of the disk; fringes, especially of the male, bluish grey and spotted with chocolate; primaries with a black spot at the end of the cell. Under surface dark smoky grey, the wings crossed by three equidistant dusky stripes, the outermost of which is bounded externally by a series of creamy-white spots. Expanse of wings 41 millim.

Duke-of-York Island.

The female is a little darker and more purplish than the male, and the stripes on the upper surface of its wings are darker and more diffused.

56. *Heleona tyrianthina*, sp. n.

♂. Allied to *H. mars* of Boisduval (?=*fenestrata*, Swains.), shining blue-black; primaries with a trifid bluish-white hyaline band before the middle, a small spot at the end of the cell; three spots in a subapical series and an oblong spot near the external angle upon the first median interspace: secondaries with a broad belt of semitransparent creamy white before the middle; basal half of costal area lilacine grey; an irregular discal series of bright orange spots: palpi, borders of collar, and posterior margins of abdominal segments bright orange; abdomen more purplish, and the thorax more greenish than the wings; anterior half of pectus and posterior half of venter bright cadmium-yellow: legs below greyish, above dark purplish; posterior tibiæ with large sandy-brown tufts; base of abdomen pale purplish brown, with a whitish posterior border. Expanse of wings 92 millim.

Duke-of-York Island.

A pair of this beautiful species, from New Ireland, was presented to the collection by Messrs. Salvin and Godman. They both have paler bodies (ash-grey with yellow bands) than the example before me; but as they are somewhat worn, this may be due to fading. The female also has the entire basal half of the secondaries hyaline white streaked with yellow, thus more nearly approaching *H. flavata* of Walker, from Timor.

57. *Boarmia repetita*, sp. n.

♂. Pale brown, black-speckled; wings with a lunule outlined in black at the end of the cells, almost filled in with black on the primaries, followed by two irregularly dentate-sinuate black lines upon the disk, the outer one almost submarginal and with a white external border; primaries with two closely approximated irregular black lines across the basal fourth; basal two thirds of antennæ broadly ramose-ciliate. Under surface greyish; the wings with blackish spots at the end of the cells; external area rather broadly dusky, with a white marginal spot on the second median interspace on all the wings; primaries with the apex white; secondaries with a white spot near the anal angle. Expanse of wings 41 millim.

Duke-of-York Island.

58. *Hypochroma sublimbata*, sp. n.

Above snow-white, densely irrorated with greyish olivaceous and brick-red scales: wings crossed by the two usual slender blackish dentate-sinuate lines, followed by a broad greyish belt traversed by a zigzag or crinkled white stripe, ill-defined, and followed by conical marginal white spots on the secondaries; a slender interrupted black marginal line; fringe touched with pale buff at the base: primaries with a slender transverse black discocellular line; costal border slightly brownish. Under surface snow-white: wings with creamy costal borders; a broad external black belt; fringe, several conical marginal spots, and the apex of the primaries snow-white; the latter wings with a well-defined black discocellular litura: antennæ with reddish-testaceous pectinations; proboscis ochreous; legs slightly yellowish, the anterior pair streaked with black. Expanse of wings 44 millim.

Duke-of-York Island.

Nearly allied to *H. crenaria*.

59. *Comibæna nivisparsa*, sp. n.

♀. Emerald-green; wings semitransparent, with a series of silvery-white lunules parallel to the outer margin, followed by a submarginal series of white dots and a marginal series of white spots; primaries with a dark green dot at the end of the cell, preceded by a silvery white spot, another spot before the middle of the inner margin ; costal border, excepting at base and a spot at the base of all the wings, silvery white: face sap-green, vertex of head silvery white; antennæ white above, yellowish below; abdomen with a dorsal series of white spots. Wings below sericeous greenish white, with creamy costal borders: body white; the legs and venter creamy. Expanse of wings 32 millim.

Duke-of-York Island.

Allied to *C. insperata.*

60. *Lycauges? angulata*, sp. n.

Sordid white; wings crossed in the middle by a brown stripe, which limits the slightly greyish basal area and encloses the discocellular spot of the primaries, whilst just avoiding that of the secondaries; these spots are black, conspicuous, and with pale borders; external half crossed by two undulated lines and two stripes placed alternately, the outer stripe forming the external border, but separated from the margin by a slender sordid white line ; the inner stripe of the primaries marked with an oblique blackish dash upon the upper radial interspace; a marginal series of black dots. Under surface bone-white, the markings somewhat confused, brown ; the discocellular spots even more conspicuous than above. Expanse of wings 14 millim.

New Britain.

Notwithstanding its great resemblance to the other species of *Lycauges*, I hesitate to pronounce *L. angulata* finally a member of that genus, on account of the decided angle at the extremity of the third median branch of its primaries.

61. *Hypena comes*, sp. n.

Primaries above lilacine grey, transversely striated and speckled with darker grey, and crossed beyond the middle by an oblique slender ferruginous line; a black dot at the end of the cell; the commencement of a second ferruginous line at the basal fourth of the internal area: secondaries ash-grey, with a slender brown marginal line and white fringe: body lilacine grey; eyes blackish. Primaries below brownish grey; secondaries and body whitish. Expanse of wings 24 millim.

New Britain.

Near to *H. ferriscriptalis.*

62. *Pharambara aurata*, sp. n.

Golden ochraceous, mottled with sienna-red, and reticulated with lilac-grey; four lines of dark grey dividing the wings into five nearly equal parts, the first two straight, the third and fourth angulated, and when seen through a lens apparently confused with the reticulations before mentioned; under surface with all the markings much less distinct than above. Expanse of wings 28 millim.

New Britain.

63. *Microsca cuprea*, sp. n.

Pale shining copper-brown; wings crossed by four or five irregular dull orange bands, with blackish margins, two near the centre of the primaries only edged externally with blackish; fringe golden at base, with a cupreous-brown central line and silvery white external edge; the wings in certain lights have a slightly lilacine gloss: secondaries with cream-coloured costal border. Wings below rather paler than above, but with similar markings: body sericeous, the pectus and legs cream-coloured. Expanse of wings 23 millim.

New Britain.

64. *Pyrausta viola*, sp. n.

Black with violet reflections; basal half of wings sordid white, blotched and spotted with violet-black; external half crossed in all the wings, from costa to outer margin, by a narrow sordid white stripe. Wings below paler, the discoidal and other blotches on the basal area much paler, the reniform spot enclosing a white >-shaped marking: body below white. Expanse of wings 17 millim.

Duke-of-York Island.

Most nearly allied to *P. absistalis*.

65. *Desmia perfecta*, sp. n.

Velvety black: primaries with a round spot at the inferior angle of the cell pearly hyaline white; three minute spots (the upper two sometimes confluent) placed transversely near the apex, and a fourth on the second median interspace, white: secondaries crossed near the base by a broad pearly hyaline white band; costal border brown: abdomen somewhat greyish sericeous. Primaries below as above; secondaries with a white marginal spot on the radial interspaces; pectus white, tibiæ and tarsi black; venter dark grey, sericeous with white transverse spots towards the base. Expanse of wings 27 millim.

New Britain and Duke-of-York Island.

66. *Asopia angusta*, sp. n.

♂. Wings golden stramineous, with white-tipped black fringe; primaries with two minute dashes at the base of the costa, a small spot near the base, and a costal spot at apical fourth, violet-grey; a small spot in the cell and an oblique dash on the discocellulars blackish violet. Body silvery, the collar testaceous; legs yellowish above. Expanse of wings 20 millim.

Duke-of-York Island.

67. *Hydrocampa stenioides*, sp. n.

Pearly white, with blackish-edged, pale sandy yellowish markings; primaries above with almost the same pattern as *Stenia bruguieralis*, but much more defined, owing to the white background: secondaries with a slender oblique subbasal interno-median blackish line; a quadrate spot at the end of the cell, from which a slender blackish line runs to the abdominal margin; a slender blackish discal line from the first subcostal to the second median branch; an oblong dark brown anal spot; an irregular pale sandy yellowish submarginal streak, blackish at the extremities, and a blackish marginal line; fringe traversed by a slender blackish line; head and basal segment of abdomen crossed by a brown line, and the anal segments by black lines: markings below indistinct. Expanse of wings 16 millim.

Duke-of-York Island.

68. *Stegothyris picata*, sp. n.

Wings above semihyaline creamy white; a discal band and the external border bronze-brown; primaries with the veins of the discoidal cell, an irregular streak on the discocellulars and the costal border bronze-brown: body banded throughout with pale bronze-brown. Wings below with the markings paler than above, the body wholly white; proboscis ochreous. Expanse of wings 18 millim.

New Britain.

69. *Glyphodes lachesis*, sp. n.

Allied to *G. Doleschalii* of Lederer (Tafel xiv. fig. 1), but differing in the absence of discoidal spots on the primaries, in the presence of an arched opaline-white internal spot, in the circular form of the discal spot (which in *G. Doleschalii* forms a subapical abbreviated band), and in the presence of a broad pearly white central belt in place of the central patch on the secondaries. Expanse of wings 40 millim.

Duke-of-York Island.

70. *Morocosma polybapta*, sp. n.

Allied to *M. margaritaria* of Cramer (Lederer, Tafel xiv. fig. 7), but with the hyaline tapering bands of the primaries reduced to much smaller triangular costal patches; the secondaries also with a submarginal triangular silver spot beyond the amethyst-centred orange discal band of the secondaries: the longitudinal thoracic stripes pale metallic bronze-brown. Expanse of wings 34 millim.

Duke-of-York Island.

71. *Margaronia plumifera*, sp. n.

Wings rather narrow and elongated; snow-white, opaline and semihyaline; the veins testaceous: primaries with testaceous costal border; costal vein, a small spot at the end of the cell, and a marginal series black: secondaries with two marginal black spots at apex: body silky pearly white; head metallic golden with the vertex white; antennæ white above, testaceous below; palpi with the upper half glistening metallic silver, the lower half white; proboscis silvery white at the base, otherwise testaceous; tibiæ and tarsi of anterior legs dusky above: at the base of the primaries is a small pouch containing a very long plumose pencil of testaceous hairs, which, when fully exserted, curl upwards and forwards in front of the costal margin to the middle of the wing. Expanse of wings 38 millim.

New Britain.

Nearest to *M. conchylalis*, but almost sufficiently peculiar to form the type of a distinct genus.

The collection contains a *Hoterodes* from Duke-of-York Island which seems to be the same as *H. ausonialis* of Tropical America.

72. *Hoterodes regalis*, sp. n.

Dark grey, the primaries shot with emerald-green to the middle and with purple from the middle to the outer margin, an opaline-white ovoid spot a little beyond the end of the cell; secondaries greenish at base, otherwise shot with purple; fringes of all the wings greenish bronze-colour: body shining bronzy grey. Under surface pale bronzy greenish grey; wings shot with purple towards the centre; white spot of primaries less oval than above; lower half of palpi, collar, tibiæ, and tarsi pearly white. Expanse of wings 36 millim.

♂ ♀, New Britain.

73. *Botys amplipennis*, sp. n.

Greyish brown, with bronze reflections, and in certain lights with a slight tint of lilac: primaries with an indistinct oblique arched dusky line across the basal fourth, a slender discocellular dusky litura, a widely arched discal line, retracted and zigzag below the first median branch, and an arched greyish submarginal streak divided by paler nervures: secondaries with a small black spot at the end of the cell, immediately followed by a white spot; an irregularly angulated and crenulated dusky discal line; a marginal series of blackish spots; fringes of all the wings smoky brown, with whity brown basal line and spots: body paler than the wings and somewhat pearly. Wings below whitish, with small black discocellular spots; a discal series of blackish dots on the veins, immediately followed by an indistinct dusky crenulated line: pectus snow-white; anterior femora brownish above; anterior tibiæ with black distal half; venter whitish. Expanse of wings 39 millim.

♂ ♀, New Britain.

74. *Botys perfenestrata*, sp. n.

Dull rose-colour; the wings spotted with gamboge-yellow spots, many of which have hyaline whitish centres, and arranged much as in *Pygospira tyres*, though less numerous; they consist in all the wings of two large discoidal spots, a very irregular discal series duplicated in the middle, and a marginal series; body spotted with gamboge-yellow. Wings below greyish, with pink reflections; all the spots white, with a slight bluish reflection: body sericeous bone-white, the legs streaked with dull pink or flesh-colour. Expanse of wings 32 millim.

New Britain.

A variety occurs in which all the wing-spots are much smaller than in the type.

Ægeriidæ.

PHLOGOTHAUMA, gen. nov.

Allied to *Paranthrene*, with which it agrees in the structure of its body and secondaries: the primaries, however, are slightly broader and quite different in neuration; the subcostal emits its first branch before the end of the cell, the second at the end, and its two others from a long footstalk; the discocellulars are very long and strongly angulated, the radials being emitted on each side of the angle; the first and second median branches also lie close together for almost their entire length, the third being further apart from them.

75. *Phlogothauma scintillans*, sp. n.

Primaries above golden cupreous, with fiery-pink reflections; a tapering hyaline marginal band from the inner margin to above the upper radial vein, slightly tinted with yellow; costal and external borders, inner margin, subcostal and median veins, and the outer two thirds of the radials purplish black: secondaries with the basal half from costa to submedian vein golden cupreous, with fiery reflections; abdominal and external areas hyaline, slightly yellowish, and traversed by black veins; fringe purplish black, with a few cupreous scales along the internal edge (as also in the primaries): body blue black; front of head and collar pearly white; palpi, coxæ, and under surface of femora brassy yellow; the broad tibial fringe of anterior legs purplish black, golden cupreous at the base. Expanse of wings 34 millim.

New Britain.

Hyponomeutidæ.

76. *Corinea aurata*, sp. n.

Primaries shining metallic golden: secondaries with the interno-basal half reddish golden (or golden ochreous), the apical half dark grey, shot with emerald-green: body golden. Primaries below and apical half of secondaries smoky grey, with slight purplish (or plum-coloured) reflections; the base of primaries and interno-basal half of secondaries golden ochreous; pectus dark brown, with large lateral silvery-white patches: the legs bronze-brown, with one or two white bars, the tarsi pale; venter golden ochreous, banded with white. Expanse of wings 25 millim.

Duke-of-York Island.

XXI.—*On the Structure and Functions of the Elytra of the Aphroditacean Annelids.* By William A. Haswell, M.A., B.Sc.

The possession of elytra, or scales, is one of the most characteristic peculiarities in the structure of the Aphroditacea. These elytra are thin squames of varying shape, but always more or less rounded, sometimes delicate and membranaceous, at other times stiff and horny, which cover the back of the annelid in a double row. Each elytron is attached to a peduncle or "scale-tubercle," the surface of attachment, of circular or oval form, being situated about the centre of the elytron, and the attachment being effected through the intermediation of a series of muscular fibres, by whose contractions the various movements of the scales are brought about. The elytra are usually attached to every alternate segment, the intermediate segments having as their equivalents the cylindrical dorsal cirri. In structure and mode of development the elytra and the cirri may be said to be essentially identical. Each consists of an infolding of the integument enclosing a nerve, the infolding in the one case taking a cylindrical form, while in the other it becomes compressed and scale-like. Such a cutaneous fold ought to contain representatives of the cuticular, the subcuticular, and the muscular layers of the integument; and such we find to be actually the case. Each scale contains three principal tissues, viz. (1) an investing cuticle, (2) a double layer of cells or cell-equivalents, and (3) a fibrous layer.

(1) The cuticle varies considerably as regards its degree of development. Sometimes, as in *Aphrodita* and *Hermione*, it is exceedingly delicate, and develops no appendages; in other cases, as in *Iphione* and many species of *Lepidonotus* and allied genera, its upper layer attains a considerable thickness and density, and may be variously sculptured on the upper surface; where appendages are present, such as fimbriæ or bristles, it forms an investment for them when it does not constitute their entire substance.

(2) The cell-elements, representing the subcuticular layer of the general integument, take the form of a complete layer of polygonal squames lying immediately beneath the cuticle. This layer is sometimes transparent, the outlines of the cells being only discernible with difficulty; at other times the cells are charged wiith pigment-granules, a lighter space in the centre being apparently the expression of a nucleus. This double layer of cells was first pointed out by Ehlers* in *Polynoë pellucida*. I have found it in most of the species which I have examined, though in some cases it does not appear to be distinct, and sometimes (*Iphione*) the upper layer becomes chitinized.

(3) In focusing deeper than the upper layer of cells, Ehlers states that he could distinguish a series of dots, which he represents as arranged in radiating lines, and which he regards as indicating the existence of some tissue between the two layers in the "cavity" of the scale.

* Die Borstenwürmer, p. 109 (1864).

It has been generally assumed by Quatrefages*, among others, that the scale is a flattened sac, between the two walls of which is a narrow cavity communicating through the scale-tubercle with the cavity of the body. Evidence in favour of this supposition is afforded by the fact that, in the case of certain species, specimens have been observed with all the scales distended and globular, as if blown up by the pressure of fluid from within. I have never seen this phenomenon, which seems to be very rare; it is probably due to a forcible contraction, similar to that which causes the throwing-off of the scales, forcing the perivisceral fluid through the scale-tubercle into the space between the two layers, and causing a rupture of the intermediate tissue.

That this is the true explanation of the phenomenon in question will be evident if we examine the structure of the scales in *Aphrodita* †. Here we find that the two membranes of which the scales are composed are firmly united together by fibrous tissue, and require some little force to separate them. This fibrous layer is visible in the undissected scale by focusing through the external membrane, and is seen still more distinctly when the two membranes are separated, when the torn fibres will be seen curled up on the inner surface. This central tissue consists of exceedingly fine fibres, which are sometimes arranged in definite interlacing bundles, while in other instances they cross one another irregularly in all directions. Morphologically this layer may be taken to represent the muscular layer of the integument.

In his account of the structure of the nervous system in *Aphrodita aculeata* ‡, M. de Quatrefages makes no mention of the existence of nerves in the elytra. Ehlers § seems to have been the first to observe their presence in the elytra of *Polynoë*. In *Polynoë pellucida* he found a nerve entering the scale through the scale-tubercle, and branching throughout the scale. A similar arrangement is very well seen in the scales of *Aphrodita* and some species of *Lepidonotus* and *Polynoë* after they have been strongly stained with hæmatoxylin or cochineal. The nerve divides near the point of entrance into numerous branches, which radiate towards the periphery and become divided again and again, giving off numerous minute twigs. The termination of many of the ultimate twigs in relation to the processes on the surface of the

* Histoire Naturelle de Annélés, t. i.

† *A. australis*, Baird, the Australian sea-mouse.

‡ "Sur le système nerveux des Annelides," Ann. des Sci. Nat. 3e série, t. xiv. p. 362.

§ Die Borstenwürmer, p. 110.

scale may be well seen in successfully-stained elytra of species of *Polynoë*; and there can be little room for doubt that these processes or papillæ are, in many instances at least, the end-organs of this elytral nerve.

The functions with which the elytra may be supposed to be connected are (1) protection, (2) the production of phosphorescent light, (3) sensation, and (4) incubation.

(1) The protective function of the scales is in some cases the predominating one. Thus in *Iphione* the scales are of extreme density, and cover the entire dorsal surface with a complete armour, which the animal is incapable of throwing off, and which gives it a remarkable resemblance to a Chiton. In others the scales, though tough, are more readily detached, and in many instances do not completely cover the dorsal surface; in many species of *Polynoë* again, they are so delicate, and are so readily parted with when the animal is irritated, that their direct protective action must be very slight; while in genera such as *Aphrodita*, in which the dorsal surface is covered with matted hairs, the presence of elytra from this point of view seems unnecessary.

(2) When certain species of *Polynoë* are irritated in the dark a flash of phosphorescent light runs along the scales, each being illuminated with a vividness which makes it shine out like a shield of light, a dark spot near the centre representing the surface of attachment where the light-producing tissue would appear to be absent. The irritation communicates itself from segment to segment; and if the stimulus be sufficiently powerful, flashes of phosphorescence may run along the whole series of the elytra, one or more of which then become detached, the animal meanwhile moving away rapidly and leaving behind it the scale or scales still glowing with phosphorescent light. The species in which the phenomenon of phosphorescence occurs are species characterized also by the rapidity of their movements, and also by the readiness with which the scales are parted with; and it seems not at all unlikely that the phosphorescence may have a protective action, the illuminated scales which are thrown off distracting the attention of an assailant in the dark recesses which the Polynoidæ usually frequent.

(3) That the elytra act, like the dorsal cirri, as organs of some special sense seems probable from their abundant innervation, as well as from the presence, in many instances, of fimbriæ and other appendages, some of which at least act as end-organs for the nerve-branches. These appendages, the form of which varies greatly, are processes of the upper wall of the scale, and probably consist of the cuticular, subcuti-

cular, and fibrous layers of the latter. The subcuticular layer is in most instances difficult to be distinguished; but in one species of *Polynoë* I find that certain vesicular appendages scattered over the surface of the elytra show distinctly beneath the delicate cuticle a layer of polygonal squames, and in the interior a series of fibres which radiate from the base of the vesicle to its outer wall, and may represent the fibrous layer of the wall of the scale, or may be special nerve-endings.

(4) The sexual products reach the exterior through apertures in the bases of the parapodia; and the ova are carried by ciliary action to the under surface of the scales, where they remain, adhering by means of a viscid matter, till the embryos are well advanced. Impregnation probably takes place while the eggs are in this situation; and I have found still crowding in great masses under the scale embryos which had reached the advanced cephalotrochous stage first described by Sars * in *Polynoë cirrata.*

Sydney, July 1, 1882.

XXII.—*Note on* Keramosphæra, *a new Type of Porcellanous Foraminifera.* By HENRY B. BRADY, F.R.S.

[Plate XIII.]

TOWARDS the end of last year I received from the 'Challenger' office a little white spherical Foraminifer, accompanied by a request that I would identify the species. I was then far from home, and without any better means of examining the specimen than that afforded by a simple magnifying-glass, viewed by which it appeared to be nothing more than a rather fine example of the globular variety of *Tinoporus* (*Gypsina*)—somewhat larger than usual for a recent specimen of that genus, but inferior in size to some of those found in the fossil condition, and scarcely so regular in contour. Owing to absence from England, I had no immediate opportunity of reverting to the subject, and had scarcely thought again about it, until a few weeks ago, when, in conversation with Mr. Murray, I learnt that the specimen had been sent to me because it appeared to differ in important particulars from *Gypsina*, and also because it was found at much greater depth than usually affected by that type. At the same time he placed in my hands another similar shell, which had been obtained by further search in the

* "Zur Entwickelung der Anneliden," Archiv für Naturg. 1845, pp. 11–19.

same batch of material. The result of the examination of these two specimens I propose to give in few words; and it is only necessary to state at the outset that they have been found to illustrate a type of foraminiferal structure not previously described, though closely related to certain well-known porcellanous forms.

The two organisms to which allusion has been made are, or rather were, spherical tests of $\frac{1}{10}$ and $\frac{1}{11}$ inch (2·5 and 2·3 millim.) diameter respectively, of milky-white colour and porcellanous texture; the entire surface was areolated or "blistered," the areolæ somewhat irregular in outline, each apparently corresponding to a single chamberlet. The general appearance of the larger of the two, as seen under a magnifying-power of 25 diameters, is excellently given in Pl. XIII. fig. 1, *b*. A transparent section, as nearly central as possible, was subsequently made of the same shell, portions of which, more highly magnified, are shown in figures 3 and 4. The smaller specimen, laid open by a particularly happy fracture, is accurately portrayed in figures 2, *a* and *b*.

The general arrangement of the test is easily understood by a comparison of these various drawings. They show that it is composed of chamberlets arranged in more or less regular concentric layers, that the chamberlets are convex on their outer surface, and that they vary somewhat in size and shape, but not to such an extent as to interfere with a tolerably symmetrical plan of growth.

To determine the minute structure with any degree of completeness, and especially the nature of the communication that subsists between the chamberlets, would require a number of sections made on different planes, which cannot be obtained without a larger supply of specimens; nevertheless, with the help of allied organisms, the anatomy of which is well known, the available material is sufficient for the elucidation of all the more important and characteristic features.

A preliminary examination brings one fact into prominence, namely the close analogy that exists between the arrangement of the chamberlets in the sectional view and that found in the genus *Orbitolites*; indeed there is scarcely any portion of the section to which a counterpart may not be found amongst the figures which accompany Dr. Carpenter's memoir on the latter type*. It must, of course, be borne in mind that the section of a spherical test does not, like the horizontal view of an Orbitolite, present a series of chamberlets grouped on one level, the whole of which, together with their means of intercommunication, can be seen at one time, but is rather the view

* Phil. Trans. 1856.

of a plane projected through a mass of chamberlets so arranged that they are necessarily intersected at different angles.

It may be noticed that although the section (fig. 3) passes through nearly the centre of the shell, it does not show any distinct primordial chamber. It is probable, therefore, that the initial chamber is of small size, perhaps scarcely distinguishable from the chamberlets, as is often the case in Orbitolites of the simple type. The early layers are comparatively thin and the constituent chamberlets small; and either for this reason or because the central portion of the section happens to be thicker than the rest, the structure appears somewhat confused.

Referring to fig. 4, which represents a portion of the section near the periphery, much more highly magnified, it will be seen that the communication between the successive layers is maintained by tubular orifices, *a*, *a*, *a*, *a*, one at the margin of each chamberlet, and that these orifices are set obliquely close to the line of union with the contiguous chamberlets. In the external layer they serve collectively as the general aperture of the test, and correspond to the peripheral pores of the Orbitolite; but they are not so conspicuous on the exterior, owing to their peculiar position and oblique setting. The chamberlets of the successive layers are neither regularly alternating, as in the simple Orbitolite, nor directly superimposed; and although there is a certain degree of uniformity in their relative positions, they are too variable in size and shape to conform to any rule in this particular.

The communication between the chamberlets of the *same* layer is maintained by short lateral stoloniferous tubes, which are less easy to identify than those uniting the *successive* layers already described. They are shown, in section, in fig. 4, *b*, *b*, *b*, *b*. Under favourable conditions one such opening is found near each end of the chamberlet; and as a section only shows one side of the chamberlet, there is probably a lateral orifice communicating with *each* contiguous chamberlet.

Notwithstanding a certain analogy to the genus *Orbitolites*, it is manifest that the organism described in the foregoing paragraphs represents a very distinct and independent type of Foraminifera. I propose to constitute a new genus for its reception, with the name *Keramosphæra* (κέραμος, porcelain, and σφαῖρα, a globe); and I am gratified to be able to associate with the species the name of Mr. John Murray, F.R.S.E., the present editor of the 'Challenger' Reports, by whom my attention was first directed to it, and by whose leave this preliminary notice is published. The following characters will serve for its distinction, pending the discovery of additional species.

Keramosphæra Murrayi, nov. gen. et sp.

Test free, porcellanous, spherical; formed of concentric layers, each consisting of a large number of chamberlets arranged more or less regularly in single series. Chamberlets of the same layer communicating with each other by short lateral stolons; those of the successive layers by the pores which formed the superficial apertures of the previous layer. Aperture consisting of numerous pores, one at the margin of each chamberlet. Colour white; surface areolated by the outlines of the somewhat convex chamberlets of the peripheral layer. Diameter about $\frac{1}{10}$ inch (2·5 millim.).

The specimens were found in material dredged during the 'Challenger' expedition at "Station 157, March 3, 1874; lat. 53° 55′ S., long. 108° 35′ E.; depth 1950 fathoms,"—a locality, roughly speaking, about five and twenty degrees south of the south-western corner of Australia. The material brought up was a nearly white, feathery-looking, diatom-ooze, composed chiefly of Diatomaceæ, Radiolaria, sponge-spicula, and other siliceous organisms; and the first point to be determined with reference to the specimens under consideration was that they were really calcareous. Foraminifera were not very numerous, about seventeen species in all; and the general aspect of the Rhizopod-fauna was distinctly arctic, except that the calcareous forms were, as a rule, somewhat thin-shelled.

EXPLANATION OF PLATE XIII.

Fig. 1. *Keramosphæra Murrayi*, nov. *a*, natural size; *b*, magnified 25 diameters.

Fig. 2, *a*, *b*. Another specimen laid open by fracture, showing the general internal structure. Magnified 20 diameters.

Fig. 3. Portion of a nearly central section of the specimen shown in fig. 1. Magnified 50 diameters.

Fig. 4. A smaller portion of the same, magnified 100 diameters, showing *a*, *a*, *a*, *a*, the orifices communicating between the chamberlets of the successive layers; *b*, *b*, *b*, *b*, lateral orifices communicating between the chamberlets of the same layer.

XXIII.—*Undescribed Rhopalocera from the Malay Peninsula.* By W. L. Distant.

Lycænidæ.

Polyommatus (*Cyaniris*) *Lambi*, n. sp.

Male. Wings above somewhat dark lavender-blue; anterior wings with the costal area and outer margin somewhat broadly fuscous, widest at base and apex; posterior wings with the costal, posterior, and abdominal margins somewhat broadly fuscous. Wings beneath greyish white; anterior wings with the costal area and outer margins slightly infuscated, and with the following pale fuscous spots:—a transverse linear one at the end of cell, one between third and fourth subcostal nervules, one above upper discoidal nervule, three in linear series and nearer outer margin, divided by the lower discoidal and first median nervules, and two larger, and placed more inwardly, divided by the third median nervule; obscure, waved and broken submarginal and marginal pale fuscous fasciæ. Posterior wings with seven large and prominent black discal spots—one, small, between bases of costal and subcostal nervures, followed by two which are more rounded and much larger, one in cell, at about base of third median nervule, near which is a smaller spot, contiguous, but outside cell, and two situate on abdominal margin; these are followed by a discal series of six pale fuscous spots, the first and innermost of which is situate between the subcostal nervules near their base, second and third on each side of discoidal nervule, and fourth, fifth, and sixth in irregular series, separated by the second and third median nervules; a transverse pale fuscous fascia at end of cell, and a much waved pale fuscous submarginal fascia, between which and outer margin are nine marginal spots, the upper four of which are pale fuscous, and the remaining five almost black. Body and legs more or less concolorous with wings.

Expanse of wings 30 millim.

Province Wellesley.

Allied to *P.* (*Cyaniris*) *lavendularis*, Moore.

Sithon Moorei, n. sp.

Male. Anterior wings above very dark and glossy fuliginous brown, with an irregular reddish spot or suffusion situate at end of cell and bases of the median nervules: posterior wings bright and somewhat pale bluish, the posterior margin black, inwardly bordered with white near anal angle, the fringe white; tails blackish with marginal white fringe; costal area pale hyaline, darker near base, upper portion of cell and basal area between subcostal nervules talc-like, and pale transparent, stramineous, above, beneath, and beyond which the colour is fuscous. The anterior wings beneath reddish ochraceous, a broad basal and a transverse central fuscous streak in cell, a pale fuscous line at end of cell, and two transverse, narrow, waved fuscous fasciæ between end of cell and outer margin. Posterior wings greyish white, the costal margin more or less suffused with reddish ochraceous, and with ten large fuscous discal spots, the upper six of which are subquadrate but irregular in size, and the posterior four are more irregular in shape, and have their centres more or less greyish; a submarginal and marginal fuscous line, the first of which is broken and irregular, and between which and margin is a narrow fuscous streak, leading to a long, pale bluish, metallic patch near anal angle, near each end of which is a fuscous spot; beneath the submarginal line near abdominal margin are two narrow ochraceous fasciæ, which amalgamate inwardly, and between which the colour is pale metallic bluish. Body above fuliginous brown, beneath greyish white; legs greyish white, annulated and streaked with fuscous.

Female. Wings above much paler than in male, and the posterior wings pale fuliginous brown, excepting near anal angle, where there is an obscure bluish patch with a few obscure fuscous marginal spots. Wings beneath as in male, but with anterior wings paler in hue.

Expanse of wings 35 to 38 millim.

Hab. Province Wellesley; Malacca. Sumatra (coll. Moore).

Allied to *S. ravindra*, Horsf.

Hesperiidæ.

Ismene (*Choaspes*) *Crawfurdi*, n. sp.

Wings above obscure olivaceous green, becoming tinged with fuscous towards outer margins. Posterior wings with a large anal-angular patch bright yellow, inwardly and broadly margined with black, apical portion of abdominal margin also bright yellow. Wings beneath paler and more metallic green, the nervures and nervules distinctly darker; posterior wings with a very large bright yellow anal-angular patch, which extends from about middle of abdominal margin to between second and third median nervules, and which possesses a long black irregular streak on inner side of internal nervure, two parallel transverse black streaks between submedian nervure and third median nervule, and two similarly parallel black spots, between second and third median nervules, on outer edge of yellow patch. Body above more or less concolorous with wings; body beneath and legs paler.

Expanse of wings 58 millim.

Province Wellesley.

Allied to *I.* (*Choaspes*) *Benjamini*, Guér.

Plesioneura Cameroni, n. sp.

Wings above dark chocolate-brown; anterior wings crossed near end of cell by a broad transverse yellow fascia, almost straight inwardly, and outwardly deeply and acutely notched above the first median nervule, and with a small subapical and sublunate yellow spot situate on the ultimate subcostal nervule. Wings beneath as above, but the brown colour slightly paler. Body and legs concolorous with wings.

Expanse of wings 38 millim.

Province Wellesley; Penang.

Allied to *P. aurivittata*, Moore.

The above species will be figured in my 'Rhopalocera Malayana,' and are contained in the collection made by myself and Mr. Sauer in Province Wellesley.

XXIV.—*Polyzoa of the Queen Charlotte Islands: Preliminary Notice of new Species.* By the Rev. Thomas Hincks, B.A., F.R.S.

In this paper I propose to give a diagnosis of a number of Polyzoa from the Queen Charlotte Islands, entrusted to me by Dr. G. M. Dawson on behalf of the Geological Survey of Canada.

These forms will be more fully described and figured in a special report on the Polyzoa of these islands, which I hope to publish hereafter. As the preparation of the plates may occupy some time, it seems better to record the new species at once, and so avoid the risk of being anticipated after much labour has been expended on the work.

All critical notes on the species will be reserved for the Report.

Family **Membraniporidæ**.

Membranipora, De Blainville.

Membranipora nigrans, n. sp.

Zoœcia ovate (variable, sometimes arched above and narrowing downwards, sometimes broad-ovate, sometimes oval), irregularly disposed, margins much elevated, crenate, the whole front of the cell covered by a rather coarse stout membrane of a black colour; oral valve large; on each side at the top a pointed *avicularium*, placed on the margin, depressed at the base, the beak sloping upwards, mandible directed obliquely downwards; very large *avicularia*, slightly raised in front, with a broad triangular mandible, which is bent abruptly in the middle, scattered amongst the zoœcia. *Oœcium* very shallow, just covering the extremity of the cell, smooth, with a raised rib across it a little above the oral margin.

Zoarium of a deep black colour, forming a large irregularly spreading crust.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Membranipora exilis, n. sp.

Zoœcia oblong, quincuncial, subtruncate above and below, set closely together, of considerable size and delicate material, margin thin, a good deal raised, the front wall wholly membranous; at the top of the cell 2 spines, and 3 or 4 on each side (or sometimes a smaller number), situated on the upper half of the cell, slender, pointed, suberect, jointed to a tubular base; a sessile *avicularium* on the margin at one side (often absent), just below the top, beak sloping upwards, scarcely bent at the extremity, mandible blunt, directed obliquely outwards. *Oœcia* (?).

Loc. Houston-Stewart Channel, Queen Charlotte Islands, enveloping *Cellaria borealis*, Busk, with a very thin crust (*Dr. G. M. Dawson*).

Membranipora conferta, n. sp.

Zoœcia oval, quincuncial, set closely together, front wall wholly membranous, margin thin, smooth; on each side about 4 sharply pointed spines, and (often) a central one below, which bend rather abruptly over the area and meet in the middle; an *avicularium* at each side on the margin, just below the upper end, slightly raised, pointed, the mandible directed upwards, a small erect spine below the *avicularia*; at the bottom of the cell a single pointed *avicularium* with triangular mandible, variously turned. *Oœcium* rounded, smooth, with a variously shaped depressed area (or fossa) in front, composed of thinner material than the rest of the surface, and appearing dark-coloured as compared with the surrounding dense white crust.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Membranipora levata, n. sp.

Zoœcia small, oval, distinct, quincuncial, margin very slightly raised, thin, smooth, the whole front closed in by a smooth, light-coloured, and rather glossy membrane, which lies very much on a level with the edge of the cell; above each zooecium, on a somewhat quadrate area, a small nodule, with a pointed *avicularium* on one side of it, the mandible directed transversely upwards. *Oœcium* rounded, smooth, umbonate.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Membranipora echinus, n. sp.

Zoœcia quincuncial, oval, distinct, separated by rather deep interspaces, 2 spines at the top and 7–8 slender, pointed, and rather tall spines down each side, which slant inwards but do not meet in the centre; on each side, springing from below the second spine from the top, a pedicellate *avicularium*, the upper part large and much swollen (closely resembling a "bird's head"), very slightly hooked at the extremity, apparently jointed to an extremely thin pedicle, mandible slender, pointed. *Oœcium* (?).

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Family **Cribrilinidæ.**

CRIBRILINA, Gray.

Cribrilina furcata, n. sp.

Zoœcia ovate, quincuncial, very regularly disposed, moderately convex; surface smooth and lustrous, often of a reddish-brown colour, on each side four to six shallow grooves, radiating to a median line, and a central one below, which are occupied by a row of roundish pores set very closely together, the ridges between them slightly raised, usually bearing several elliptical pores; orifice arched above, straight below, much broader than high, on each side a stout bifid spine (occasionally simple); peristome much thickened in front and rising into a central mucro. *Avicularia* none. *Oœcium* large (covering about half the cell above it), rounded, taller than broad, depressed in front, with a shallow oral arch; surface smooth, rather thickly punctured.

Loc. Off Cumshewa Harbour &c., Queen Charlotte Islands (*Dr. G. M. Dawson*).

Cribrilina hippocrepis, n. sp.

Zoœcia ovate, quincuncial; surface lustrous, flattish (sutures very shallow), traversed by radiating ridges (three to five on each side), which pass from the sides to the centre (no median keel), the grooves between them occupied by a line of rather large oblong pores; at the origin of each ridge an elliptical foramen, covered in by a delicate membrane;

orifice large, well arched above, constricted a little above the lower margin, which is straight; operculum of a rich reddish brown; peristome not elevated, lower margin much thickened, usually terminating on each side in a knob; large, elongate, depressed spatulate avicularia scattered amongst the cells. *Oœcium* (?).

Surface of *zoarium* flat; colour brown, with a tinge of red, in old states white and highly calcified.

Loc. Cumshewa Harbour and Houston-Stewart Channel, Queen Charlotte Islands, on shell (*Dr. G. M. Dawson*).

Family **Myriozoidæ** (part.), Smitt.

SCHIZOPORELLA, Hincks.

Schizoporella crassilabris, n. sp.

Zoœcia large, elongate, ovate, quincuncial, very distinct, convex, sutures not very deep; surface dense, punctured (the punctures often obliterated by the calcification); orifice suberect, suborbicular, with a broad rounded sinus occupying nearly the whole of the lower margin; peristome raised and thickened, forming a wall round the orifice, often massive in front, where it is carried out into a broad projection, which is notched or sinuated in the centre. *Avicularia* none. *Oœcium* large, rounded, broader than high, with rather large punctures.

Loc. Houston-Stewart Channel, Queen Charlotte Islands, 15–20 fms. (*Dr. G. M. Dawson*).

Schizoporella longirostrata, n. sp.

Zoœcia ovate, disposed in lines, moderately convex (sutures shallow); surface roughened or minutely granulated, covered with an epitheca; orifice arched above, lower margin extended into a wide rounded sinus; peristome thin, elevated at each side; on one side, generally a little below the orifice, an elongate, slender, pointed, dependent *avicularium*, the mandible (which is broad at the base and tapering above) directed obliquely downwards, usually turned slightly outwards. *Oœcium* rounded, flattened in front, thickly punctured, with a shallow oral arch.

Loc. Off Cumshewa Harbour, on shell (*Dr. G. M. Dawson*).

Schizoporella insculpta, n. sp.

Zoarium foliaceous and bilaminate or incrusting. *Zoœcia* large, ovate, quincuncial, depressed, separated by raised lines, sutures shallow; surface vitreous, glossy, thickly covered over its whole extent with punctures; orifice arched above, the lower margin almost entirely occupied by a wide very shallow sinus; peristome thin, moderately raised, extended in front (beyond the sinus) so as to form a small chamber, in which is a rounded orifice (? *avicularium*). *Oœcia* profusely developed, very large (covering about two thirds of the cell above), elongate, rounded above, with a tall oral arch, thickly covered with slight granulated ridges, which radiate from the opening to the base.

Loc. Queen Charlotte Islands, under 30 fms., attached to a stem, and on shell (*Dr. G. M. Dawson*).

Schizoporella maculosa, n. sp.

Zoœcia quincuncial, rather small, moderately convex, sutures shallow; surface shining, covered with small puncta, which are closed in by a brownish membrane, and give a spotted appearance to the front wall; orifice arched above, with a shallow bluntly-pointed sinus below, not contracted at the opening; peristome slightly thickened, on one side just below the orifice (or occasionally on both sides) a small rounded *avicularium* on a prominent boss. *Oœcium* (?).

Loc. Queen Charlotte Islands, on shell (*Dr. G. M. Dawson*).

Schizoporella tumulosa, n. sp.

Zoœcia quincuncial, very regularly arranged, very convex, ovate, much elevated centrally below the mouth, the wall sloping steeply down to the margin of the cell; surface dense, smooth, rather glossy, areolated round the edge, ridges radiating towards the centre; orifice orbicular, with a small central sinus, not contracted at the opening, peristome not elevated; immediately below the orifice, at one side of the sinus a rostrum, bearing on one side a pointed *avicularium*, the beak very slightly bent at the extremity, mandible directed upwards, the rostrum rising into a short mucronate point behind the avicularium; very commonly on the front of the cell near the bottom a much raised *avicularium* (mounted on a prominent elevation), with a pointed mandible directed straight outwards. *Oœcium* rounded, smooth, much broader than high, with a tall oral arch, filled in by a calcareous plate.

Loc. Off Cumshewa Harbour, Queen Charlotte Islands, in 20 fms., forming a brownish spreading crust (*Dr. G. M. Dawson*).

Schizoporella Dawsoni, n. sp.

Zoœcia ovate, quincuncial, very moderately convex, separated by raised lines, highly calcified, vitreous; surface reticulato-punctate (punctures appearing as deep shafts in the vitreous crust); orifice arched above, much broader than high (narrow between the upper and inferior margins); a shallow rounded sinus in the centre of the lower margin, not contracted at the opening; peristome perfectly simple, not raised. *Avicularia* none. *Oœcium* rounded, closely united to the cell above, somewhat depressed in front, glossy, covered with rather large punctures; a prominent, thickened border round the opening.

Loc. Virago Sound, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Schizoporella fissurella, n. sp.

Zoœcia small, quincuncially disposed, ovate, the lower portion flattish; oral region raised, tubular, suberect; surface smooth, porcellaneous, shining, sutures extremely shallow; orifice immersed, arched above, straight below, with a narrow slit-like sinus; peristome thickened and elevated round the mouth, so as to form a kind of neck, carried out in front into a mucronate process, which is sometimes notched in the centre. *Oœcium* rounded, smooth, with a small longitudinal fissure above the opening, and a central tooth-like process just within the oral arch.

Loc. Dolomite Narrows, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Family **Escharidæ** (part.), Smitt.

LEPRALIA (part.), Johnston.

Lepralia bilabiata, n. sp.

Zoœcia quincuncially arranged, short, very slightly convex (the sutures little more than incised lines), rounded above, widening out at each side and narrowing off towards the base, which is subtruncate; surface dense, smooth, of a somewhat waxy appearance; orifice large, occupying nearly half of the front surface, rounded above, very slightly contracted immediately above the lower margin, which is somewhat arched; peristome not elevated; operculum smooth, of a deep black colour, distinctly bilabiate. *Avicularia* none. *Oœcium* a subtriangular extension of the cell above the orifice, very little raised, a great part of its front surface occupied by a large foramen, closed in by membrano-chitinous material.

Zoarium of a very dark brown colour (almost black).

Loc. Houston-Stewart Channel, Queen Charlotte Islands, on shells (*Dr. G. M. Dawson*).

When the zoœcium is open, the orifice is occupied in great part by the entrance to a tubular passage (through which the polypide issues), which is formed *below* by the thickened border of the operculum, and *above* by a distinct chitinous rim. These two lips are brought together so as to close the entrance when the operculum is shut.

Lepralia nitescens, n. sp.

Zoœcia quincuncial, short-ovate, very ventricose; surface dense, vitreous, highly polished and glistening, smooth, with obscure radiating ridges, punctured, sometimes areolated round the margin; orifice much higher than broad, immersed in the older cells, arched above, slightly contracted a short way above the lower margin, which is a little curved outward; peristome not raised, the inner edge of the oral aperture finely denticulate; 3 or 4 spines above; on each side, in a line with the lower margin, a strong nodulous process; about the centre of the margin an *avicularium*, with rounded mandible, placed on a swelling, which extends some way below the mouth, and facing sideways, mandible directed upwards; often on the front of the cell near the bottom (towards one side) a bracket-like projection, bearing a rounded *avicularium*. *Oœcium* (?).

Zoarium forming a brownish patch on shell.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Lepralia claviculata, n. sp.

Zoœcia ovate or lozenge-shaped (sometimes irregular in shape and size), quincuncial, depressed; surface glossy, thickly covered with minute circular punctures, which give it a pretty speckled appearance; orifice arched and expanded above, slightly narrowed below, contracted by a small projection on each side a short distance above the lower margin, which curves slightly outward. *Avicularia* keyhole-shaped, placed on a distinct area very much smaller than that of the cell, and commonly immediately above a zoœcium, mandible directed upward. *Oœcium* very large, elongate (much higher than broad), depressed towards the opening, rising above into a kind of knob, white, glossy, thickly punctured; the surface for some distance above the oral arch frequently traversed by longitudinal furrows.

Zoarium a large, spreading crust.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Mucronella, Hincks.

Mucronella prælucida, n. sp.

Zoœcia ovate, quincuncial, slightly convex, separated by raised lines, surface thickly covered with roundish punctures, lustrous; orifice arched above, lower margin straight (no denticles); peristome raised, especially at the back and in front, where it rises in the centre into a blunt mucronate projection, which bends slightly inwards, the surface of the peristome smooth, entire, and very glossy. *Avicularia* none. *Oœcium* (?).

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

Mucronella prælonga, n. sp.

Zoœcia very long, quincuncially arranged, wider above than at the base (elongate-ovate, sometimes appearing almost subtubular), convex, depressed below, rising towards the orifice; surface thickly covered with punctures, shining (the glistening appearance due to the presence of an epitheca); orifice suborbicular, peristome elevated round it, carried out in front into a very prominent process, often much thrown back and elongated, sometimes simply pointed, sometimes bi- or trimucronate, on the inner side of it a single, small, sharply-pointed denticle; the upper margin produced in the centre into a sharp spinous process. *Avicularia* none. *Oœcium* (?)

Zoarium forming a whitish, subcircular patch on shell.

Loc. Queen Charlotte Islands (*Dr. G. M. Dawson*).

Smittia, Hincks.

Smittia spathulifera, n. sp.

Zoœcia large, ovate, quincuncial, moderately convex, separated by raised lines, surface reticulato-punctate; orifice arched above, lower margin straight and within it a large bifid tooth; peristome raised and thickened, and produced below into a spout-like sinus, within which is a short spatulate *avicularium*, mandible directed downwards. *Oœcium* large, immersed, closely united to the cell above; surface roughened, punctured round the edge.

Zoarium a brownish crust on shell.

Loc. Houston-Stewart Channel, Queen Charlotte Islands (*Dr. G. M. Dawson*).

[Additional.]

Membranipora, De Blainville.

Membranipora protecta, n. sp.

Zoœcia contracted above, expanded below, disposed rather irregularly in lines, set closely together, front wall wholly membranous, margin smooth; 2 erect spines (sometimes bifid) at the top, below them on each side a single bifid spine, and below these 2 large, branched, antler-like spines, which meet over the aperture; numerous *avicularia* interspersed amongst the cells, placed on a distinct area; beak elongate, slanting upwards, mandible with a triangular base, the upper portion long, slender, setiform. *Oœcium* (?).

Loc. Virago Sound, Queen Charlotte Islands (*Dr. G. M. Dawson*).

BIBLIOGRAPHICAL NOTICE.

Manual of British Botany. By Charles Cardale Babington, M.A., F.R.S., F.L.S., &c., Professor of Botany in the University of Cambridge. Eighth Edition. Corrected throughout. London: Van Voorst, 1881.

The veteran Professor of Botany at Cambridge may certainly be congratulated, not only on the fact that he is alive and well at the seventh revision of his *magnum opus*, which first saw the light thirty-nine years ago, but also that he has, during that period, virtually educated his critics and his public. The achievement of Professor Babington's life has been the removal of the reproach of insularity from British botany. Sir J. E. Smith was unrivalled in his day in his skilful tracing of synonyms in our earlier writers; Sir Joseph Hooker, in our own time, has brought the vast experience of the geographical botanist to gauge the relative value of our British forms; but it is to Professor Babington we owe that minute examination of fresh specimens, and that careful comparison with foreign herbaria and foreign critical writings, that has made the study of our flora a part of continental botany. His 'Manual' has become essentially the companion of working botanists, and its successive editions have most ably reflected the stages of progress made by them between 1843 and 1881.

To the general public it may seem a small matter whether a plant is to bear one of two conflicting names, whether it is to rank as a species or a variety, or whether the name originated with this or with that authority. The theory of evolution does indeed make us attach less importance to the second of these questions; but any one who has attempted original botanical work will have felt the immense advantage of a most precise system of nomenclature. If continental botanists are to know of what plants we may happen to be writing, or *vice versâ*, it is absolutely necessary that synonymy be most carefully studied. It is therefore with extreme regret that we read the note (very true, however, as it is) which the Professor feels compelled to add to his account of our British Rubi and Roses, after his years of study (p. 106), that "when the continental plants are better known it is feared that considerable changes of nomenclature will be necessary."

Though the present writer certainly considers Professor Babington's 'Manual' the most useful from many points of view that we have, yet, bearing in mind the odiousness of comparisons and the author's remark in the preface, that "the portability of this volume is perhaps its most valuable quality," there are points where it comes short of an ideal flora. "Facts relating to geographical distribution are usually omitted," but sometimes inserted in a most tantalizing manner, so that one is inclined to regret the ranges in altitude and in other countries which form so instructive a feature in Sir Joseph Hooker's 'Student's Flora.' We should often also have been glad of more synonyms, and think the name of the recorder of new plants might well be uniformly given as well as the reference to the first publication. Again, the descriptions of a considerable and multifarious number of plants are enclosed in brackets, whilst others are marked by asterisks or other signs; but there seems to be some want of a rigid uniform system upon which these signs are to be employed, as there is also less of exactitude in the principle of exclusion and inclusion than in the works of the late Mr. Watson. For instance, such casuals as *Malva verticillata* and *Staphylea pinnata* are perhaps rightly excluded, whilst *Narcissus lobularis*, *N. incomparabilis*, *Crocus argenteus*, and *Datura Stramonium* are included. It would be useful for field botanists to have all casuals described; but in forming an estimate of our indigenous flora we require more rigid excision. Professor Babington seems to have erred on one side or the other. As a counterpoise to the various additions many would like to see in the 'Manual,' most of those who use the book might well dispense with the Glossary which occupies pp. ix–xxv, and with the table of classes, divisions, and orders, on pp. xxxv–xlv, thus adding twenty-eight pages to the available space.

It will shorten our task of examining the "carefully revised" body of the work to notice the various additions, changes, merits, and oversights in botanical order, *i. e.* as they come; and it may be a question whether in future editions it may not be possible, for the benefit of those who own earlier editions, to indicate the chief alterations in the Preface, as did the late Sir Charles Lyell in the various editions of his 'Principles of Geology.' Many of the points we notice are no doubt trifling, as, for instance, that *Clematis*, though it occurs mostly on calcareous soil, is not absolutely confined to it.

In the difficult genus *Thalictrum* the species *T. saxatile* (Bab.), a well-marked form, is well placed as a smaller form of *T. collinum* (Wallr.), which is itself a variety of *T. majus* (Sm.).

The appearance of the new Guernsey species *Ranunculus triphyllos* (Wallr.) renews one's regret at the necessity British botanists consider themselves under of including the plants of these essentially French islands in their accounts of our Flora. Professor Babington's excellent method of condensation is shown, however, in his account of the variations of *R. acris.* "The variations *R. vulgatus* (Jord.) and *R. tomophyllus* (Jord.) have been found. *J. of B.* viii. 257, x. 238. The former has usually an oblique or horizontal rhizome, the latter a præmorse rootstock."

The apparently indigenous character of the pæony on the Steep Holmes in the Severn suggests to the geographical botanist the curious problem of our midland flora of isolated rarities, including *Thlaspi perfoliatum, Salvia pratensis, Euphorbia stricta, E. pilosa, Cephalanthera rubra, Lycopodium complanatum*, and such plants. What is its origin?

One cannot but read with admiration the account of *Nasturtium officinale*, in which *N. microphyllum* and *N. siifolium* of Reichenbach are treated merely as forms of the common watercress, as also that of *Sagina maritima*, where Jordan's species *S. debilis* and *S. densa* are similarly reduced; but after this it is remarkable that none of the variations of *Draba verna* are considered worthy of distinct notice, whilst four forms of so plastic a species as *Stellaria media* are dignified with varietal names.

The present writer (Journ. Linn. Soc. vol. xvi. p. 185) traced *Thlaspi perfoliatum* into Wiltshire; and *Polygala calcarea* has been found in more than one locality on the oolite hills of Gloucestershire, there being no chalk in that county. It is a question whether *Helianthemum ledifolium* had not better be altogether omitted from our floras, and also whether *Polygala grandiflora* is not better entitled to specific rank than many that receive it at Professor Babington's hands.

The prostrate variety of *Sagina apetala* now first receives the name *prostrata*: *Malva Alcea* is inserted apparently solely on the ground that it "should be found in England;" and *Lavatera sylvestris*, described by Mr. Trimen (Journ. of Bot. xv.) from specimens discovered by Mr. Curnow, appears for the first time.

The genus *Ononis* has been revised, *O. arvensis* (L.) appearing as "stoloniferous . . . pods . . . falling short of the calyx . . . α. glandular, fl.-l. equalling or surpassing cal., pod shorter than calyx. —β. *maritima*; glandular-villose, fl.-l. falling short of cal., pod as long or longer than calyx," and *O. campestris* (Koch) as "not stoloniferous . . . pods . . . exceeding the calyx."

Medicago lappacea, Lamk., recorded from Bedfordshire by the late Mr. Pryor (Journ. of Bot. xiv. 22) should have been inserted on page 84.

The lilac-purple variety of *Trifolium repens* appears as *T. Townsendii*, and *Lathyrus sphæricus* (Retz.), recorded by Mr. Pryor (Journ. of Bot. xii. p. 205) from Hertfordshire, also appears; but *L. hirsutus* should be recorded for Kent as well as for Essex and Surrey.

Among the Brambles, *Rubus Leesii* is reduced to the position of a variety of *R. Idæus*; *R. fusco-ater*, var. *Briggsii*, appears as *R. emersistylus* (Müll.); *R. pygmæus* (Bab. not Weihe) becomes *R. præruptorum* (Boul.); and *R. hemistemon* (Müll.), *R. discolor* β.

pubigerus, *R. hirtifolius* (Müll.), *R. Kœhleri* δ. *cavatifolius* (Müll.), *R. mutabilis* (Genev.), and *R. foliosus* β. *adornatus* (Müll.) appear for the first time, *R. mutabilis* and *R. hirtifolius* being due to Mr. T. A. Briggs's 'Flora of Plymouth.'

Rosa bibracteata (Bast.) replaces *R. stylosa* of the last edition.

Whatever they may be as living trees, it is very doubtful whether Dr. Boswell-Syme's four species of *Pyrus* can, in the herbarium, be looked upon as any thing but variations of *P. Aria*.

The appearance of a second species of the American genus *Claytonia*, *C. alsinoides*, as naturalized with us, is one more of the few instances of eastern, as opposed to the abundant western, migration of weeds, which suggest some important problems (*vide* Claypole, Pharmaceut. Journ. 1879).

Do *Saxifraga granulata* and *S. tridactylites* frequent sloping ground to such an extent as to call for the word "banks" in the habitat? and, considering its occurrence in Somerset, Hants, and Hertfordshire, is it explicit to speak of *Parnassia* as occurring "towards the north"?

The variety of *Apium nodiflorum* with roundish ovate leaflets and very short peduncles (E. B. 1431) now appears as *ocreatum*; and that of *Artemisia vulgaris* with dense racemes as β. *A. coarctata* (Forcell.).

Senecio spathulifolius (DC.) is an addition, the Holyhead plant having before been grouped under *S. campestris*. *Crepis hieracioides* (W. & K.) replaces *C. succisæfolia*; and *Hieracium pratense* (Fr.) replaces *H. dubium*, L. (Fr. of the last edition), and *H. collinum*. *H. Dewari* (Sy.) is new, as also is *Campanula rotundifolia*, var. γ. *arctica* (Lange), described by Mr. A. G. More under the varietal name *speciosa*, from Inish Boffin, in the 'Journal of Botany' for 1876 (p. 373).

Is there not a specimen of *Fraxinus heterophyllus* (Vahl) in Christ-Church meadows, Oxford, represented by specimens from Professor Dyer in the British Museum, in which all the leaves are simple? They are here described as "simple and pinnate," and an initial *E.* has dropped in by mistake.

Two important additions, due to Mr. Townsend, appear under the genus *Erythræa*, viz.:—*E. tenuiflora* (Link), recorded in the 'Journal of Botany' for 1879 (p. 329), which Professor Babington ranks as a variety of *E. pulchella*, whilst Mr. Townsend suggested it might be a hybrid of that species with *E. Centaurium*; and *E. capitata* (W.), var. *sphærocephala*, Townsend, in the case of which the author has disregarded the discoverer's varietal name, besides omitting his Newhaven locality, thus treating it as Willdenow's type, which it is not.

The genus *Euphrasia* so well displays the author's judicious spirit of revision that we cannot refrain from quoting his account of the varieties *in extenso*.

"α; glandular-pubescent above and on the calyx, *caps. oblong-obovate*, seeds ovoid greyish. L. usually large and broad, sometimes densely imbricate (*E. ericetorum*, Jord. ?).—β. *E. nemorosa* (Pers.) pubescent not glandular, caps. linear-oblong, *seeds fusiform* yellowish. L. usually narrow, sometimes (*E. Salisburgensis*, Funk.?) with very long teeth.—Some authors divide this into many species; but even the above are scarcely distinguishable at all times."

This important opinion should be taken in connexion with Hermann Müller's interesting researches on fertilization and latitude-variation, as it is probable that this species affords some remarkably puzzling instances of correlated change.

An examination of specimens has led the present writer to look upon *Veronica spicata*, L. (E. B. 2), from the chalk of Cambridgeshire and Suffolk, as very distinct from *V. hybrida*, L. (E. B. 673), of the carboniferous limestone in the West of England; but Professor Babington continues to unite them. Cultivation might settle the question.

Utricularia Bremii of Heer, the authority for the name not being cited, which was recorded by Mr. Webb in the 'Journal of Botany' for 1876 (p. 146); *Plantago intermedia* (Lilib.) put under *P. major*; the varietal name *salina* for the maritime form of *Atriplex deltoidea*; and *Rumex rupestris*, Le Gall, recorded by Mr. Briggs in 1875, are additions.

From personal investigation the present writer can fully indorse all that Professor Babington says of the Elms, though he would have liked to see the variety *nitida* of Syme included. Dr. Boswell-Syme's *Salix Sadleri* of 1875 is an addition; but, of course, the name *Orchis incarnata* (L.) appears in connexion with the plant to which Mr. C. B. Clarke has, since the publication of this edition, shown that it does not belong.

Epipactis violacea (Bor.) takes the place of *E. media* var. *purpurata*; *Romulea*, Mar., that of *Trichonema*, and *Crocus argenteus* (Sal.) that of *C. biflorus* (Müll.). Whilst on these changes of nomenclature, we must protest against the supersession of such a name as *Liparis*, on the ground of preoccupation in the animal kingdom. Zoologists find a far laxer rule without serious disadvantages.

Potamogeton Zizii, Mert. & Koch, discovered by Mr. Brotherston in 1878, and described by Mr. Trimen, here appears as of "Roth."

The genus *Zannichellia* has been revised, being now grouped under two species, *Z. palustris* and *Z. polycarpa*, the former being subdivided into three varieties, *brachistemon* and *macrostemon* of Gay and *pedicellata* of Fries.

Three new Sedges, viz. *Carex ornithopoda* (W.), *C. pilulifera*, L., var. *Leesii* (Ridley), and *C. frigida* (All.); *Agrostis alba*, var. *β. stolonifera*, in lieu of *subrepens*; *Nitella prolifera* (Kütz.), and six new Charas, *C. stelligera* (Bauer), *C. contraria* (A. Br.), *C. polyacantha* (Braun), *C. baltica* (Fr.), *C. connivens* (Braun), and *C. fragifera* (Dur.), the working out of which is mainly due to the acumen of the Messrs. Groves, complete the list of additions.

These few notes will be sufficient to show both the progress made in British botany since the publication of the last edition and the remarkable manner in which Professor Babington has digested it for our use. May the advance in the future be yet greater, and may he long live to record it!

MISCELLANEOUS.

Note on the Brisingæ. By M. Edm. Perrier.

In August 1853 Asbjörnssen, when dredging in the Hardanger-fjörd, brought up, from a depth of 100 or 200 fathoms, a large star-fish, to which he gave the name of *Brisinga endecacnemos*. The *Brisingæ* have since then been met with several times; but they have always remained precious rarities. The two expeditions of the 'Travailleur' have placed in our hands a magnificent, nearly perfect example, sixteen well-preserved disks, two very young individuals, and a great number of separate but entire arms.

The number of species of *Brisinga* at present described is three, namely *B. endecacnemos*, Asb., *B. coronata*, O. Sars, and *B. americana*, Verr. Our *Hymenodiscus Agassizii* is also an animal very nearly allied to the true *Brisingæ*. Most of the specimens collected by the 'Travailleur' in the Atlantic closely approached *B. coronata*, without, however, being completely identical with the types described by Sars. On the other hand, our large specimen resembles *B. endecacnemos*, although itself not departing widely from our other specimens. This comes in support of the opinion sometimes expressed that *B. coronata* and *B. endecacnemos* are only two different forms of the same species. Contrary to all expectation, the *Brisingæ* have been found in the Mediterranean; and there again the specimens collected have all the essential characters of *B. coronata*. It is further evident that *B. coronata*, in passing into the Mediterranean, has undergone important modifications in its proportions, which are more slender, and which might justify the creation of a new species, which might be called *B. mediterranea*. But it is more probable that the two species described in the Atlantic and the Mediterranean one are all one and the same species.

On the other hand, another form collected in the Atlantic in 1880, and which we shall call *B. Edwardsii*, is certainly distinct. The arms in this species are covered with imbricated contiguous plates, without spines, forming series of arches, the extremities of which rest against each adambulacral piece; and these pieces themselves are more abbreviated than in the other species, and bear spines with the apex widened.

The comparison of the species of *Hymenodiscus* and *Brisinga* leads to important conclusions with regard to the relative morphological value of the different parts of the skeleton of the Starfishes.

In *Hymenodiscus*, at the age at which we have seen it, all the skeleton is reduced to the ambulacral and adambulacral pieces. These pieces are therefore the only ones that we can regard as truly typical in the Asteriadæ. In the other species of *Brisinga* the pieces of the dorsal skeleton are superadded, arranged in arches more or less separated from each other; but these arches appear only in the inflated region of the arms containing the genital glands. Moreover, in the *Hymenodiscus*, while still destitute of genital glands, although already of considerable size, this dorsal skeleton of the arms is entirely wanting. It is also wanting in the very young *Brisingæ*, or is scarcely indicated in them, so long as the genital glands are still rudimentary. From this we must conclude that it represents simply an apparatus of protection for the genital glands; and this conclusion of course applies also to the other Asteriæ, of which the dorsal skeleton, which is, moreover, so variable, thus loses all typical significance.

The arms in the *Brisingæ* do not complete themselves until the appearance of the genital glands. The disk, on the contrary, is produced early, and forms around the digestive sac, the prolongations of which towards the arms do not appear until later. These various facts are absolutely in conformity with the theory of the Echinodermata that we proposed in our memoir on "Animal Colonies,"—a theory which leads us to see in these creatures, as in the Medusæ and Coralliaria, the result of the amalgamation of reproductive individuals, usually to the number of five, around a central nutritive individual. But with age the disk itself undergoes considerable changes.

In one of the young individuals that we have been able to study it is formed by a central piece and nine large, contiguous, triangular pieces, nearly coming into contact with the central piece, and with it covering the whole surface of the disk, or even extending beyond it, and projecting in the intervals of the arms, with which they alternate. All these plates, and especially the interbrachial ones, bear large movable spines; some smaller plates, alternating with them, and evidently of new formation, already exist between them and the central piece.

This constitution of the disk, resembling that of the calyx of a Crinoid which possessed nine arms, contrasts singularly with the structure of the disk of the adult *Brisingæ*, reduced to an integument supported by a ring of calcareous pieces.

This is how the passage takes place from the one form to the other. The growth of the disk is effected by the separation and dissociation of the pieces which constituted its central part; the interbrachial pieces are thus constantly pushed towards the margin of the disk; at the same time they become reduced more and more, place themselves exactly in the angles of the arms, and thus by degrees cease to form part of the skeleton of the disk, and finally constitute the odontophores.

Thus the odontophores are the remains of the pieces of the first order in the original disk of the *Brisinga*. The evident identity of the plan of organization of the *Brisingæ* and the true Asteriæ renders the same conclusion probable for the other starfishes. Upon one of these plates of the disk of the first order, the madreporic plate is always formed; this leads to an unexpected comparison. In the *Brisingæ* the displacement of the pieces forming the primitive disk stops when these pieces arrive at the outer margin of the buccal ring; but if the phenomena of growth have been sufficiently active to displace all these pieces to the ventral surface, the madreporic plate will pass with them, and we shall have an Asterias, of which the ventral surface of the disk will be identical with that presented by all the Ophiuri. The development of the *Brisingæ*, which, on the one hand, borders on that of the Crinoids, on the other hand, therefore, establishes a singular approximation between two other great classes of Echinodermata, the Ophiuridæ and the Stelleridæ.—*Comptes Rendus*, July 10, 1882, p. 61.

A Word respecting Mr. Distant's Notes on Euplœa Castelnaui. By A. G. Butler.

It was not my intention to take further notice of Mr. Distant's observations respecting this species; but his assertion that I charged the Secretary of the Linnean Society with cutting out inverted commas from my MS. compels me to make some reply, if only to state what I really did say.

I told Mr. Distant that, to the best of my belief, I had inserted inverted commas in some of my papers* in which the date of the second volume of the 'Novara' was quoted, and that, so far as I could recollect, such was the case in my paper published in the 'Linnean Transactions;' as to any mention of the Secretary of the Society, I can only say that Mr. Distant's memory must be misleading him.

Mr. Distant is surely aware that not a few entomological papers have been antedated, not in consequence of a tendency to mendacity on the part of those who have thus unfairly claimed priority, but simply from their maintaining that the distribution of a few proof-sheets is equivalent to publication; he forgets, moreover, that in his defence of one entomologist, he impugns the veracity of others.

Lastly, I must disclaim any dissatisfaction with Mr. Distant's preference of the name *E. Castelnaui* to that of *E. phœbus*; I only object to his stating that I used my name in preference to Felder's, knowing that the latter had priority. I regret that in a work, admirable in every other respect, the author has gone out of his way to make an assertion so unfounded.

On Crenothrix Kühniana (*Rabenhorst*), *the Cause of the Infection of the Waters at Lille.* By M. Alf. Giard.

The reddish colour, bad taste, and unpleasant odour presented at times by the water of the Emmerin springs which supply the town of Lille have long been noticed by the population of that town; but in the spring of this year the infection assumed alarming proportions. On the 22nd of April the water was absolutely unusable; and from that time every somewhat copious rainfall was followed by a longer or shorter period of more or less intense infection. During these periods the water carries on its surface a ferruginous red scum which can easily be collected by stretching cloths across the stream. Ferruginous deposits also form in the reservoirs and in certain parts of the distributing channels. These on certain days were so abundant that the horses refused to drink the water which was offered to them. A microscopic examination showed that the cause of the infection was a Schizomycete, *Crenothrix Kühniana*, Rabenh., the filaments of which become charged, in contact with the water exposed to the air, with a precipitate of sesquioxide of iron, then putrefy, and communicate a most disagreeable flavour to the water.

* In my paper on *Hestia* I used a note of interrogation with the date 1867.

This *Crenothrix* has been noticed in several localities, especially Halle, Breslau, and Berlin, and has been carefully studied by Professors F. Cohn, O. Brefeld, and W. Zopf. To the observations of those eminent botanists we have only to add that the microgonidia, formed in the swollen extremities of the tubes of *Crenothrix* by transverse division of the bacillar joints constituting those extremities, are animated during some time with an active motion, due to the existence of a flagellum. The latter is visible only with the highest magnifying power (Hartnack immersion objective no. 12).

The gonidia afterwards give birth to an irregular form (*Merismopœdia*), which is soon transformed into a mass of *Zooglœœ* similar to a *Palmella*, and finally into regularly cylindrical tubes of various lengths.

The causes which have brought about the exaggerated development of *Crenothrix* in the Emmerin waters are evidently manifold. The soil was prepared by industrial dejections, especially those from distilleries, which discharge nitrates in abundance into the water-bearing stratum, at certain places very near the surface. The sources are, moreover, in the vicinity of swamps and ponds, like those of Tegel in the environs of Berlin.

Last winter having been relatively dry, the water-level was lowered about 5 metres. The rains of the spring and the beginning of the summer suddenly raised it, and carried with them the vegetable productions or the animals which had been developed in the humid earth.

While at Lille the *Crenothrix* was thus brought in abundance into the Emmerin reservoirs and the water-pipes, several wells at Tourcoing furnished balls of a fine Oligochæte worm (*Phreoryctes Menkeanus*), till then unknown in France.

Lastly, a portion of the aqueduct is dug in the aquiferous chalk; and it was thought needless to arch over that part; moreover, inlets have been pierced in order to increase by drainage-water the supply furnished by the springs. Every time that the flow of the water is made more rapid, in that part of the aquiferous layer a veritable aspiration is produced, which carries into the aqueduct the spores and filaments of the *Crenothrix*, which a slower and more complete filtration would have retained in the soil.

To remedy this scourge, we at first advised to do away with the latter source of contamination, against which it is comparatively easy to guard. But we believe that this palliation would be insufficient while the channels are sown with the innumerable spores of the Schizomycete. We shall doubtless be obliged to have recourse to filters of sand, similar to those recommended at Berlin by Zopf and Brefeld.

Towns establishing new systems of canals of potable water will do well, in order to avoid the *Crenothrix*, to take the sources in the deep strata, to avoid waters containing salts of protoxide of iron (necessary to the vegetation of this Schizomycete), and to prefer to subterranean waters the more aerated waters of lakes remote from all industrial establishments.—*Comptes Rendus de l'Académie des Sciences*, July 31, 1882, t. xcv. pp. 247–249.

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No. 58. OCTOBER 1882.

XXV.—*Embryogeny of the Bryozoa ; an Attempt at a General Theory of their Development, founded upon the Study of their Metamorphoses.* By Dr. JULES BARROIS *.

[Plate XIV.]

THE present memoir is in continuation of my investigations upon the Escharina, already published †. All the great families of the Bryozoa have been in the same way subjected to observation from the point of view of the metamorphosis ; and it is the general conclusions of these investigations that I now publish, in anticipation of the detailed memoirs which must follow that on the Escharina, and which will appear hereafter upon each of the families.

1. The documents published upon the development of the group Bryozoa have hitherto been completely silent upon an essential point of their embryogeny. We know well how the various free larvæ to which the egg gives birth are formed and developed, and we also know how, from the very simple stage which follows the destruction of these first states, the definitive cell is gradually fashioned ; but all our knowledge proves

* Journal de l'Anatomie et de la Physiologie, 1882, pp. 1–34. Translated by W. S. Dallas, F.L.S., from a separate copy communicated by the author.

† Ann. Sci. Nat. 6e série, tome ix.

defective the moment we seek to approach the question of the relations of the larva to the adult form. In one word, we have precise documents upon the two extreme terms of the development; but between these two terms there exists a hiatus which no observer has succeeded in filling up.

From this it comes that, notwithstanding the minute investigations undertaken by many observers during the last few years, the embryogeny of the group Bryozoa has still remained in a comparatively backward state, at least as regards the conclusions. It is even still as impossible as at the beginning to apply our embryological knowledge to the appreciation of the adult organism. From not knowing the transition states which unite the two parts of the development, we still find it impossible to gather the fruit of the accomplished investigations.

Scarcely any of the observers of different periods but has been struck by the enormous importance of this particular point of embryogeny; and we find repeated attempts to get at a union of the two forms. As long ago as 1845 J. P. van Beneden tried to effect an approximation between the larva and the adult; next comes Smitt (1865), whose work is followed by a series of attempts made by Nitsche (1869), Metschnikoff (1869–71), Claparède (1871), Salensky (1874), and finally by Repiachoff and myself at the time of my memoir of 1877.

None of these various endeavours have been crowned with success; and we may even say that the most recent possess an entirely negative character: they assume that the larva becomes destroyed so as to be reduced to a sac in which we can detect nothing but a mass of globules in degenerescence—a stage entirely deprived of all trace of organs, and which would seem to render absolutely chimerical all hope of being able some day to follow the organs of the larva in their transformation into the definitive organs of the adult form.

2. It was at the laboratory of Concarneau, which is under the direction of MM. Robin and Pouchet, that, after many fruitless attempts, I for the first time succeeded in observing stages which have enabled me to fill up this gap, and to unite, organ by organ, a Bryozoan larva with its adult form. The first species with which I succeeded in attaining this result is *Lepralia unicornis*, which is abundant at Concarneau. The complete results of these first investigations have already been the subject of a special memoir published in the 'Annales des Sciences Naturelles' (sér. 6, tome ix.).

It is true that in the Chilostomata the larva in its transformations passes through stages in which the larval organs are so much reduced and so little recognizable that one can understand how they should have hitherto escaped notice; but nevertheless there never exists a stage representing a *complete destruction of the organism*, leaving only the skin of the larva filled with globules of degenerescence. Such a barrier as this, absolutely separating the larva and the adult from one another, does not really exist at all; and what has led to the belief in it is the extreme simplicity of one of the intermediate stages of the metamorphosis, combined with the extreme rapidity of the transformation in the first stages after fixation: these characters, common to most metamorphoses, are exaggerated in the Bryozoa to a degree of which we possess few examples. Notwithstanding this, the passage from the larva to the adult may be followed in detail in the Bryozoa as completely as in the clearest cases, such as the Brachiopoda and the *Serpulæ*.

3. The possibility of the detailed investigation of the passage of the larva to the adult form being once demonstrated for a single species, it will be easily understood that I could not but desire to apply the experience acquired in my first researches to the study of the same stages in the principal groups, so as to construct from these new data a complete theory of the development in the whole class of the Bryozoa; and it is these new investigations, followed out since 1877 in different localities, of which I now give a brief exposition.

My subject naturally divides itself into three parts, viz.:—

The detailed study of a type of Entoprocta;

The detailed study of the types of Ectoprocta:—Escharina, Cellularina, Ctenostomata, Cyclostomata, Lophopoda;

Summary.

I. Entoprocta.

An Entoproct larva consists of:—

1. The *ectoderm*, divided into the oral and aboral surfaces,—the former flattened, margined by the ciliary circlet, and capable of sinking in to form the *vestibule*; the second much inflated, forming of itself nearly the whole of the skin of the larva, and capable of closing over the first-named.

2. The *digestive tube produced from the endoderm.* It possesses here a structure identical with that of the digestive tube of the adult animal, divided into œsophagus, rectum, and stomach; it is derived directly, except as regards its two branches of entrance and exit, from the endoderm of the gastrula.

3. An *organ superposed upon the mesodermic bands.* This organ, formed of two opposite lobes, is placed at the centre

of the oral surface and between the two orifices of the intestine, at the place occupied in the adult form by the cloaca with the incubatory sac. It is behind this organ that the cells representing the mesoderm are situated. This layer exists in the Entoprocta under the form of a special and well-defined trace, representing, as in so many instances, two kinds of germinal bands (*Keimstreifen*).

Accessory organs.—To omit nothing, we may further indicate two small appendages attached to the skin—one at the extremity of the body of the larva (caudal appendage), the other beneath the mouth on the aboral surface (subbuccal appendage); they are derived by gemmation from the two primitive layers. Certain authors ascribe very great importance to them; but they have none from a morphological point of view, and, in my opinion, they represent organs of sense belonging exclusively to the larval organism.

Metamorphosis *.

The phenomena are as simple as instructive, and differ much from what has been supposed.

The larva attaches itself by the *oral* pole; then we see the whole posterior portion of the vestibule (formed by the invaginated oral surface) gradually sink into the interior of the embryo.

This phenomenon is continued until the bottom of the vestibule (the whole of the portion which bears the apertures of the intestine), carrying with it the digestive tube, has changed its originally horizontal position for a vertical position (form *Loxosoma*) or a horizontal position in the opposite direction (form *Pedicellina*). During this movement the bottom of the vestibule becomes isolated and detaches itself gradually from its edges; and these become degenerescent to form globules, which for a moment fill the inner cavity of the peduncle. The circlet of cilia which formed the limit of these margins gives origin to the pedal gland.

In other words the essential portion of the vestibule quits its connexions with the oral surface, to enter into relations with the opposite surface, carrying with it the digestive tube. In this movement the posterior surface of the larva becomes the anterior surface of the adult, and the orientation becomes interverted.

While these two great phenomena (degenerescence of the inferior part of the vestibule and displacement of the superior,

* See 'Comptes Rendus,' June 27, 1881, p. 1527; 'Annals,' August 1881, p. 163.

carrying with it the digestive tube) are being effected, a narrow depression with thick lips is seen to originate towards the top of the anterior surface of the ectoderm; this is what I call the *labial thickening*. This thickening advances to meet the polypide already formed in the interior, to constitute the aperture of the cell.

Thus these investigations confirm most of the broad homologies generally accepted between the two forms, the adult and the larva, in *Pedicellina*, which I reproduce in the following table:—

Digestive tube of the adult....	Digestive tube of the larva.
Intratentacular space	Vestibule.
Its median projection	Bilobed organ { Cloacal sac or pouch of the Ectoproct larvæ.
Ciliated canal opening into the cloaca (Hatschek)	Ciliated canal opening into the fissure.

On the other hand (and this is a most unexpected result) the *caudal appendage* does not at all correspond to the pedal gland of *Loxosoma*, and the different parts of the skin of the larva all have relations with the skin of the adult completely the reverse of what was supposed, since there has been in all a complete reversal, the top becoming the bottom and the anterior becoming the posterior surface.

Conclusion.—There is, in fact, a very complete passage of the organs of the larva to the organs of the adult; but this passage is not effected in a simple manner, and does not at all yield in complexity to the metamorphosis of the Ectoprocta; in this respect there is no ground for maintaining the essential distinction that has been made between the two groups.

II. Escharina.

Larva.

The development commences, as in the Entoprocta, by the formation of a more or less epibolic gastrula, followed by the formation of two embryonic bands, each composed of three or four cells, and soon breaking up into not very distinct elements situated towards the oral surface.

1. *Ectoderm.*—The whole group of the Escharina is distinguished from the Entoprocta by an important character:—*The oral surface has lost the faculty of retracting itself to form a vestibule.* Further, we find that the cells of the circlet have greatly increased in the direction of the length, a change which becomes the source of many others.

Towards the aboral pole the cells rise up, carrying with them a portion of the skin, so as to give origin to a circular fold formed by the cells of the circlet lined by a portion of the aboral surface. This fold forms a true *mantle*, which increases above the aboral surface, and finally covers it more or less completely.

This envelopment of the aboral surface by a *mantle* gives rise to the formation of a *pallial cavity*. In the Escharina the envelopment is never complete, and the extremity of the aboral surface, occupied by a special organ called the *hood*, always continues to project beyond this cavity. This hood, formed principally by a circle of radiating cells placed beneath the skin, is, in my opinion, by no means the homologue of the *caudal appendage* of the larvæ of the Entoprocta, but of the *labial thickening* which appears in the latter after fixation.

Towards the oral pole there is no elevation, and the sole effect of the elongation of the cells of the circlet is to reduce more and more the space at first occupied by the oral surface, which becomes depressed and becomes thinner in proportion. It is at first upon the anterior portion, furnished with the pyriform organ, that the whole reduction exclusively takes effect; it becomes slender, depressed, and thinner, and finally reduced to an elongated fissure edged on each side by the cells of the circlet.

Thus the oral surface is early divided into two distinct portions—a *free* portion of rounded form, and a *narrow portion enclosed in the circlet*. The former always coincides with the oral pole: it becomes reduced without interruption, to the profit of the second, in proportion as the encroachment of the circlet progresses; but in the Escharina it is still tolerably wide.

2. *Endoderm.*—The endoderm originating from the gastrula does not, as in the Entoprocta, give origin to a complete and well-formed digestive tube, but soon resolves itself into a compact mass of not very distinct elements—the *vitelline mass*, which for a long time occupies the interior of the embryo; in the larva we find it broken up into disseminated globules. We may regard the vitelline mass as representing the digestive tube, which is deficient in the larvæ of Entoprocta.

In a single species investigated by Repiachoff, the endoderm of the gastrula (formed, however, in the same manner as in the other larvæ of the group Ectoprocta) is seen to give origin to a complete digestive tube. This fact certainly possesses much interest, and places beyond dispute the homology that I have just indicated between the digestive tube of the larvæ of Entoprocta and the vitelline mass of the larvæ of Ectoprocta.

3. Lastly, the cloacal sac of the Entoproct larvæ is here replaced by a kind of sac with very thick walls, similarly produced by an invagination of the exoderm, and placed near the centre of the oral surface. Very often a part of the wall of the sac rises up into a more or less elongated languette, which may be compared to the small pointed lobe placed at the side of the œsophagus in the Entoproct larvæ. In an *Alcyonidium* allied to *A. mytili* this languette becomes so long as to project beyond the aperture of the sac. In this state it may be compared to the small lobe of the Entoprocta, while the sac in which it is lodged would represent the great semicircular lobe bearing the anus, which, in the Entoprocta, already surrounds the small one.

These analogies are further comfirmed by the fact that in the larva of *Tendra zostericola* this sac, as in the Entoprocta, occupies the space included between the two branches of the intestine.

Accessory Organs.—1. Here again I must mention an elongated comma-shaped organ (*pyriform organ*), which occupies the front of the oral surface, and is composed of a small mass of glandular nature opening into the fissure of the anterior oral surface and surmounted by a group of radiating cells (those which serve as a base to the vibratile tuft). It has been supposed that in this organ we have the homologue of the *subbuccal appendage* of the Entoprocta. Following the ideas put forward by Hatschek with respect to *Pedicellina*, it has been regarded as a rudimentary bud, which would convert the Bryozoan larva into a compound form.

Upon this subject it will suffice for me to remark that the pyriform organ by no means occupies the same position as the *subbuccal appendage* of the Entoprocta: the latter is placed upon the *aboral surface*, *beneath* the mouth; the former is situated upon the *oral surface*, and *in front of* the buccal orifice. It would be well to name it the *prebuccal appendage*, in opposition to the name of *subbuccal*, which I apply to that of the Entoprocta.

According to my investigations, the *prebuccal appendage* of the Ectoproct larvæ disappears completely during the metamorphosis; and the same is the case with the *subbuccal* and *caudal* accessory organs of the larvæ of the Entoprocta. Hence I can only regard these accessory organs as belonging exclusively to the larval organism. The observation of facts by no means confirms the hypothetical views adopted with regard to them by the authors cited.

2. On the other hand, there exists in the Escharina a less apparent organ of great importance. Situated directly beneath the pyriform organ, this organ consists of two small ridges formed by simple thickenings of the skin. In the larvæ it easily escapes observation; and this explains why it has not hitherto been indicated. After fixation it is seen to increase to form a part of the adult organism; and it then becomes more easy to distinguish.

Metamorphosis.

In my memoir upon the metamorphosis of the Escharina I have already given a complete description of this, to which I may refer. I shall confine myself here to repeating the principal features.

1. *Fixation by the oral pole.*—The first phenomena of the metamorphosis consist in the devagination of the internal sac; the sac comes forth and becomes converted into a square lamina, by means of which the fixation is effected. Are we to say that for this reason we must regard the sac as being only an adhesive organ belonging truly to the larval organism? It would certainly be very rash to assert this; the function of securing the fixation may very well be performed by an organ originally destined to other uses and temporarily adapted to the function of a sucking-disk. In my opinion, the fact that I have just indicated proves nothing against the homology previously pointed out between the internal sac of the Escharine larvæ, the bilobate organ of the Entoproct larvæ, and the cloacal sac of the adult form.

However this may be, the oral surface is seen to sink down upon itself after the issue of the sac, so as to form a small more or less shrivelled tube which unites the adhesive lamina to the edge of the circlet.

2. *Reversal of the mantle.*—This fixation by the oral pole is accompanied, as in the Entoprocta, by a retreat of the vestibule into the interior of the embryo, but with a variation which depends solely upon the difference in structure of the larvæ.

In the Entoprocta the vestibule is fully formed, and its sinking into the interior of the embryo consequently does not necessitate any further change; but in the Escharina this is not the case. Here the aboral surface has lost the faculty of closing over the oral surface, and, further, the circlet has increased behind so as to surround the aboral surface with a kind of mantle, forming in this way a special cavity, playing the part of antagonist to the vestibule, and which I have called the *pallial cavity*.

We see therefore that the sinking of the oral surface into the interior of the embryo must here be preceded by a very important phenomenon, the *reversal of the mantle.* The larva suddenly quits the special arrangement which it affected among the Escharina, to revert to a form nearer that of the Entoprocta, and in which the aboral surface may again close over all the rest.

When the reversal of the mantle is effected the pallial cavity has completely disappeared; the larva then consists only of a simple sac entirely formed by the aboral surface, which has contracted around the edges of the adhesive lamina; in the interior is the cavity of the vestibule, margined by the circlet and the oral surface, the latter returning upon itself towards the centre, to be continued into a small tube which traverses the cavity of the vestibule and unites with the adhesive lamina.

3. *Formation of the polypide and of the opaque globules.*—The entire wall of the vestibule (including the circlet), the oral surface (including the prebuccal organ), and the upper part of the adhesive lamina are destined to fall into degenerescence, to form the thick mass of opaque globules which afterwards lines the whole base of the cell. The two small thickenings in the form of ridges situated towards the top of the vestibule in this stage alone escape the process of degenerescence; they increase while all the rest begins to be atrophied, and finally unite *above the vestibule* to form a single mass of increasing volume, and which afterwards passes towards the *superior and anterior* part of the future cell. At this point it meets with a second rudiment, originating from the invagination of the hood, and becomes confounded with it to form the polypide. In *Lepralia ciliata* the invagination of the hood gives origin to the whole of the internal epithelial layer of the polypide; the rudiment originating from the wall of the vestibule furnishes all that belongs to the external muscular layer.

It seems to me legitimate to see, in the two parts of the vestibule of the larvæ of Escharina (the rudiment which is detached from the upper portion, and the remainder of the wall destined to fall into degenerescence), parts corresponding to the two great divisions, *upper and lower*, of the vestibule of the Entoprocta, of which the former likewise forms the polypide, while the second breaks up into globules exactly comparable to the mass of globules of the young cells of the Escharina.

As to the invagination of the hood, I regard that as homologous with the labial thickening of the Entoprocta. There is consequently a complete correspondence in all points.

Thus in the Entoprocta, as in the Ectoprocta, the polypide may be regarded as originating from the amalgamation of two distinct rudiments coming, one from the aboral surface of the larva, the other from the upper part of the vestibule of the larva, and which unite to form the polypide. In the Entoprocta the former (the labial thickening) is small, and gives origin only to the aperture of the cell, and the second, containing the entirely developed digestive tube, gives origin to nearly the whole of the polypide. In the Ectoprocta the reverse is the case: the former (the hood) is the more important, and it is this that forms nearly the whole of the polypide; the second is comparatively restricted, and gives origin only to the muscular connective parts of the future polypide. There is nothing very surprising in this variable intrusion of the two rudiments into one another; we have in the same way in the Tunicata an important portion, the *cloacal tubes*, placed at the boundary of the endoderm and ectoderm, and furnished sometimes by the one, sometimes by the other of those layers.

Lepralia Pallasiana.—In order to judge of the degree of constancy of the phenomena described in *Lepralia unicornis*, it will not be without interest to examine a second species of the same family before passing to other groups. The following are the results which I have obtained by the careful study of *Lepralia Pallasiana*, a species of the same family, but of a type very distinct from that of *L. unicornis.*

The sole differences that we could observe only commence at the close of the metamorphosis, at the moment when the skin removes from the internal organs to give rise to the square stage. We observe that in *Lepralia Pallasiana* the fatty mass, instead of retaining the horseshoe-shape more or less resembling that of the circlet, forms a square lamina, which surrounds the rudiment of the polypide. Moreover this rudiment, when once formed, does not separate again from the aggregation of globules with which it is in contact by its posterior part.

In *Lepralia unicornis* we have three stages:—

1. The two rudiments of the polypide unite so as to form a continuous cord from the aperture of the cell to the fatty mass.

2. They become concentrated into a small mass suspended from the skin.

3. The rudiment, definitively formed, has again become elongated as far as the fatty mass.

In *Lepralia Pallasiana* (and, I believe, in a good many other species) we pass directly from stage 1 to stage 3.

Such are the kinds of variations that we discover between the different types, when we do not go beyond the group Escharina. We will now pass to the more distant groups.

III. Cellularina (*Bugula avicularia*).

Larva.

The larvæ of the Cellularina belong to the same type as the larvæ of the Escharina; but in some species, such as *Bugula avicularia*, they differ therefrom by a greater elongation of the cells of the circlet. This elongation causes the *free portion* of the oral surface to be reduced to a degree of which we find no example among the Escharina; while the *enclosed* portion has acquired an extraordinary length, and occupies nearly the whole height of the young larva.

Moreover the skin of the larva, which in the Escharina may be regarded as composed half and half of each of the two surfaces (oral and aboral), is here formed chiefly by the circlet.

Metamorphosis.

Nevertheless the length of the cells of the circlet has not here any influence upon the metamorphosis, which takes place absolutely, as in the Escharina, by direct reversal of the mantle; it is necessary, however, to note particularly the peculiar form of the adhesive lamina and the aspect of the hood after fixation.

1. *Adhesive lamina.*—The adhesive lamina has no longer the same form that I have described in the Escharina. In the latter the internal sac of the larva contained two small symmetrical elevations, which, after fixation, only made more distinct the angles of the kind of lozenge formed at this period by the adhesive lamina; in the *Bugulæ* these two symmetrical elevations are replaced by a single more voluminous elevation, which fills nearly the whole cavity of the sac. After fixation this elevation forms a large mamilla at the bottom of the adhesive lamina, causing the latter to appear double, and formed of two superposed inflations, of which the inferior and smaller one originates from the interior projection of the sac, and the larger superior one from its wall.

2. *Hood.*—The hood, coloured by means of carmine, shows us, principally after fixation and very distinctly, its essential part composed of a circle of radiating cells situated beneath the skin of the aboral surface, and which I regard as the first

rudiment of the future polypide. It is here that I have seen most distinctly the superposition of the cells of the skin upon the circle formed by the radiating cells: the fact appears here so clearly as to cut short every doubt; and it is for this reason that I point it out.

3. *Of the second stage of the metamorphosis.*—The development appears to depart more from the type of the Escharina in the second stage of the metamorphosis at the period when the adhesive plate (composed of its two superposed inflations) becomes united with the skin of the aboral surface, to give origin to a *club-shaped stage.* We then see the whole of the hood sink into the interior in a very sudden fashion, and not gradually, as in the case of the Escharina; moreover it penetrates much more deeply than was seen in the preceding group. Before stopping, and even before reaching the opaque ring formed by the circlet, it traverses this ring, so that the rudiment of the polypide is soon situated beneath the ciliary circlet. Unfortunately I have not yet studied the changes which take place in the rudiment of the polypide during this passage across the ring formed by the cells of the circlet; it is probably at this moment that the phenomena take place which correspond to the meeting of the two rudiments which we have indicated in the Escharina.

It is not long after this club-shaped stage, in which the rudiment of the polypide is seen placed beneath the circlet and in the posterior part, that the cell begins to swell, to give origin to the stage described by authors. Here we fall in with known phenomena.

IV. Ctenostomata. (Pl. XIV. figs. 3 and 8.)

In the Ctenostomata, and especially in the species that I have taken as the type (*Serialaria lendigera*), the increase of the cells of the circlet is carried to the extreme point, and with it all the consequences which follow upon it. The cells of the circlet form ribs of great length, which occupy almost the whole surface of the larva; the oral surface is almost entirely *enclosed*; one of the two poles is occupied by an exceedingly reduced small hood, the other by a free portion of the oral surface reduced to quite rudimentary dimensions. Lastly, and this is especially the great fact characteristic of the larvæ of Ctenostomata, the internal sac is nearly atrophied; it no longer possesses an internal cavity, and is reduced to a small solid mass adherent to the inner surface of the residue of the oral surface.

Metamorphosis (fig. 8).

This latter character has a very great influence upon the metamorphosis of the larvæ of the Ctenostomata, inasmuch as the devagination of the sac observed in the Escharina and Cellularina is no longer met with, the whole being reduced to the reversal of the mantle.

Moreover the length of the cells of the circlet, which had no effect in the metamorphosis of the Cellularina, here has a great influence upon the course of the phenomena, and produces a kind of reversal of the mantle absolutely different from that we have seen, each of the large cells which constitute the circlet having to fold several times upon itself before penetrating to the interior of the embryo.

The phenomena in general occur as follows:—

The whole of the elongated band which, in the larva, forms the whole of the oral surface reduced by the circlet (that is to say, the free and rounded part which immediately surrounds the oral pole, together with the portion enclosed in the circlet), sinks into the interior of the embryo, producing a long fissure, over which the neighbouring parts close. These parts are here formed exclusively by the two symmetrical portions of the circlet which were included between the two free and enclosed divisions of the oral surface. When this last has buried itself in the interior, these two symmetrical prolongations of the circlet become inflated into two large lobes which bound the fissure and which are formed by the antero-inferior part of the cells of the circlet, the extremities of which are folded back upon themselves.

Here, in the absence of a special organ, it would seem that the rather sudden drawing back of the oral surface acts in the manner of a piston to produce fixation, which is effected by the projecting lobes which bound the median fissure above, and generally by their posterior part. The cavity V (fig. 8) to which this drawing back gives origin, and which is bounded by the two lobes in question, constitutes a first and important cavity concealed by the lobes L (fig. 8); it represents the vestibule here. A second cavity, peripheral to the lobes, is soon formed around the former one, and results from the reversal of the ciliary circlet which closes over the two lobes. This reversal does not take place at all in the same manner as in the larvæ of the Escharina and Cellularina: the cells of the circlet, instead of turning bodily, taking as their turning-point the line of junction with the oral surface, roll themselves up in their lower portion, in this way penetrating gradually into the embryo; while at the same time, at the upper part, all the aboral surface unfolds itself in proportion, issuing by degrees from the pallial cavity. In other words, there is a gradual inrolling of the circlet inwards, accompanied by an unrolling of the aboral surface outwards; it is a peculiar kind of reversal of the mantle, which will terminate in the same results as the more sudden reversal of the Escharina, but by passing through absolutely different stages.

We see further that, in the Ctenostomata, the portion destined to break up into globules and formed chiefly by the cells of the circlet, will not, as in the Escharina and Cellularina, have the form of a hollow ring, a torus surrounding the whole cavity of the vestibule, but that it consists of two distinct parts, an *enveloping* portion and a portion *enveloped*, the latter alone enclosing the cavity of the vestibule. At first the enveloped portion really consists only of the two great lobes which bound the fissure of the oral surface; but later on, and in proportion as the enveloping portion increases by the rolling inwards of the great cells of the circlet, we see the portion of these same cells which has already penetrated to the interior and forms the bottom of the peripheral cavity, rolled up again, but in the opposite direction, so as to join themselves to the lobes of the centre, which in this way receive a great increase. Finally, the long ribs which formed the circlet become divided into two nearly equal parts—an enveloped part which is joined to the lobes, and an enveloping part formed by the upper parts of the circlet.

Thus all the cells of the ciliary circlet become folded upon themselves two or three times, giving the mass formed by their union a very complex aspect, which it is difficult to unravel.

At the close of this period of the metamorphosis the mass constituted by the whole of the invaginated circlet is situated towards the bottom of the cell, of which it occupies the posterior and inferior parts (retaining the same orientation as in the case of the larva); the entire embryo has the aspect of a rounded sac, not at all flattened as in the Escharina, but exceedingly uniform and nearly spherical; we can, however, still distinguish the point of closure of the aboral surface below, and the point occupied by the extremity of the hood.

It is in the space left free by the mass of the invaginated circlet—that is to say, in the *anterior* and *superior* portion of the embryo (orientation of the larva)—that the polypide will be formed. Unfortunately I have been unable here to investigate the important question of the origin of the polypide in the same detailed manner as in the Escharina; nevertheless I can establish an important point, namely that there is no invagination comparable to the invagination of the hood of the Escharina and Cellularina. This is due, no doubt, to the very great reduction of this organ in the larva of the Ctenostomata—a reduction which continues during the first stage of the metamorphosis, so that at the moment when the circlet has penetrated into the interior we can scarcely indicate the position of the hood, which seems to have entirely disappeared.

Notwithstanding this, it has often seemed to me that, towards the superior posterior part of the mass of the circlet, at the place corresponding to the hood, there could be seen a cellular mass which I should be tempted to regard as proceeding from the cells which formed the central organ of the hood. This cellular mass seemed to me to form the essential part of the future rudiment of the polypide; nevertheless I have sometimes met with a second, smaller rudiment, forming, so to speak, a pendant to the former one, and situated at the inferior and anterior part of the aggregation of cells of the circlet. Perhaps we have here two parts comparable to the two rudiments described in the larvæ of Escharina. This part of my researches is still incomplete.

[To be continued.]

XXVI.—*Notice of a second Species of* Triprion. By Dr. A. Günther, F.R.S.

Hr. Forrer, who has just returned from a collecting expedition in Central America, has brought with him three living specimens of a *Triprion*, which he found near Presidio, in Mexico, and which evidently belong to a species different from, and larger than, *T. petasatus*.

This species may be called *Triprion spatulatus*, having a longer and broader snout than *T. petasatus*; the bony ridges, especially the supraorbital and supratympanic ridges, and the canthus rostralis project in a much less degree; and the interorbital space is much less concave. The coloration is a uniform light olive, without any spots, changing in intensity of shade only; the upperside of the head is sometimes of a yellowish-bronze colour.

Other distinguishing characters may be found when the specimens are dead and more accessible to examination. At present, I may add only that the pupil is transversely oval when expanded, and subquadrangular when more contracted, but never vertical. It can be shut entirely.

XXVII.—*On the Conario-hypophysial Cerebral Tract of Professor Owen.* By Robert Garner, F.R.C.S., F.L.S.

A remarkable paper on this subject was read by the veteran anatomist above named at the meeting of the British Association in 1881, and published in full in the Journal of the Linnean Society for January of this year, throwing light on those enigmatical parts of the brain, the hypophysis or pituitary gland, and the pineal gland, together with the intervening third ventricle. The Professor also draws other conclusions, to be alluded to further on in this paper.

He alludes to Dr. Sapolini's ideas respecting the glandular nature of the pituitary, which are, perhaps, but a version, further carried out, of views which have been held by many anatomists—that the parts in question are an essential to the secreting and serous system of the brain, indicated, in fact, by the old name of glands. But passing by other notions which have been, or might be, held on this subject—that the bodies and region in question have some topographical relations to the formation of the cerebral convolutions (Foville and Callender), that the so-called glands may indicate respectively the junction of the cerebral and spinal tracts, the pituitary being situated at the termination of the motor, and the pineal at the termination of the sensitive spinal tract, or that they act as sensitive nerves, indicative of the state of the brain or its bony case—the Professor enunciates his own theory, a deduction from certain not unknown facts, but especially from others more modern of an embryological nature, which theory appears to us to be made out and quite his own.

If we descend from fishes, as the skate, dogfish, or cod, to the cephalopodous mollusk, say the sepia, it will be evident that in the latter the nervous system is concentrated into what may be termed a brain (fig. 1, p. 284), corresponding, generally speaking, to the brain of the fish, but that it is threaded, as it were, by the œsophagus, this tube having a course which, in the fish, would be from the pituitary through the third ventricle and out at the pineal, or *vice versâ*.

Passing over, as already observed, all supposed uses or functions of the parts composing this tract in the vertebrates, they are considered to be the altered homologues of the œsophagus and mouth, as seen in the sepia. The reasoning from which these conclusions were drawn are, as just said, founded on certain embryological facts—*imprimis*, that though the intestinal canal of the invertebrates answers, upon the whole, to that of the vertebrates, the anterior inlets of the two do not correspond, the mouth of the invertebrate being a *deutostome* and temporary one in the embryo vertebrate (the entry of the umbilical vessels forming the primary *protostome*), whilst the mouth of the vertebrate is the final *tritostome*. We are not informed, however, in what vertebrate embryo such an anterior communication through the palate is actually found; but the inference is that way, and the presumption strong. In some reptiles the place of the pineal must be looked for immediately under the pericranium, at the so-called parietal foramen. An approach to such a course of the œsophagus is figured in the embryo lamprey, after W. B. Scott; and there is the close connexion of the pituitary with the gastro-branchial or gastro-pulmonary inlet (and he avails himself of Mr. Balfour's labours on this embryological point) in Elasmobranch fishes. Indeed such a connexion almost remains in some birds, as in the cuckoo or goose, in the last of which the pituitary descends backwards half an inch in the sphenoid, and the canal communicates by two small openings with the lower surface of the skull.

So far, then, the argument is, that the neural mouth in the invertebrate is a temporary one or embryonic in the vertebrate, and that the mouth and the œsophagus of the invertebrate become the conario-pituitary tract of the vertebrate. This theory seemingly makes plain the unity of organization and composition between the two great divisions of animals, and also seems to bridge over a hiatus which has always been perplexing to the naturalist.

The Professor, however, extends his conclusions further. We may see from his theory of the typical vertebra, from other views in the 'Comparative Anatomy of Vertebrates,' as well as from the present paper, that he by no means lags behind in many of the philosophical theories first proposed by Goethe and Oken, and especially advocated in France previous to 1830* by Geoffroy St.-Hilaire, Blainville, &c., but opposed strongly by Cuvier. Geoffroy took up certain views of two young anatomists, that there is perfect *unity of plan* between the highest mollusk (*Sepia*) and the vertebrate (a bird). All that is required to make the matter plain is, according to this, to bend the spinal column of the latter back upon itself, after the fashion of an acrobat, when a position is obtained apparently similar to the form of the sepia. Cuvier combats all this; and his paper was published in the 'Annales

* The writer attended Blainville's *leçons* in the year 1830 at the Jardin, and with an introduction also to Cuvier himself. Most would admit that the transcendental views alluded to ran somewhat wild at this time, though many of them have been adopted since.

des Sciences Naturelles,' with two diagrams, a little more comprehensive than those given by the English anatomist, and, we think, not quite pliable to the views assumed by Geoffroy. Cuvier's views are principally founded on the difference of the relations of the œsophagus to what he considers the brain (upper ganglion) in the sepia; but Prof. Owen's theory, in the main, certainly does away with Cuvier's principal objection.

Cuvier insists on the strict limitation of terms; there is much *similarity* but not *identity* of structure, and of composition by similar parts and organs; but as to the *unity of plan* there is little or none, any more than that a cottage is built on the same plan as a many-storied mansion. He seems averse to have recourse to type and uniformity, but brings forward adaptive variation or relation to the exterior under the name of *conditions of existence.*

The first and simple conclusion of Owen, so far made good we think, is a very remarkable homological deduction. The mouth and gullet of the invertebrate becomes a cerebral tract of the vertebrate, with uses as a component of the cerebral spinal system; or rather, if I may suggest, the invertebrate œsophagus with its attached glands alone becomes the tract in question; whilst the large buccal mass of the sepia, being dermal in its origin, is but transposed in the vertebrate. The peculiar loop-like character of the brains of some cartilaginous fishes is owing to the patency of the tract.

When we follow up the subject, though we think it may be said that there is much similarity in many respects between the sepia and the fish, we, with Cuvier, must doubt whether there is unity of plan. The sepia and all Mollusca are monosomous; no vertebrate is so, though some fishes, as *Lophius* (fig. 2) may approach to this. It is this want of sameness as to plan which is the essential difference; for the sepia has certainly more constituent parts which appear to answer to those of a vertebrate than is generally recognized—the principal nervous divisions and a cartilaginous cranium and traces of the maxillæ, with several scattered cartilaginous elements supporting the trunk, fins, breathing-parts, &c., though the shell continues to be the principal support, analogous to, but not the homologue of, the spinal column.

According to the Professor's ultimate deduction, the change from the invertebrate to the vertebrate is effected by the œsophagus of the latter leaving its lower or posterior cerebral exit and diverging under or behind the cerebral ganglia, and so opening on what must now be considered as the anterior hæmal aspect—that is, on the same side as the shell or *os* *sepiæ* is situated. This view answers well enough in making the two portions of the beak of *Sepia* to correspond with the avian beak; and no doubt the spiniferous lamina may equally well be considered as either the tongue or the palate. But it may be objected that, according to this view, the umbilical canal would enter the body on the neural or dorsal aspect, the aural sacs would be wrongly placed, also that the ventral or hæmal surface is more highly coloured, and that the young sepia, when progressing, prefers that surface to be upwards, like the vast majority of invertebrates: here also is lodged the *os sepiæ*, the analogue, though by no means the homologue, of a spine. The great nervous tracts of the mantle too, though they arise from the subœsophageal ganglia, are directed towards this aspect; and if any tracts must be considered as spinal, these, through all the Mollusca, seem to correspond, though the primitive annular disposition of a ring or loop remains.

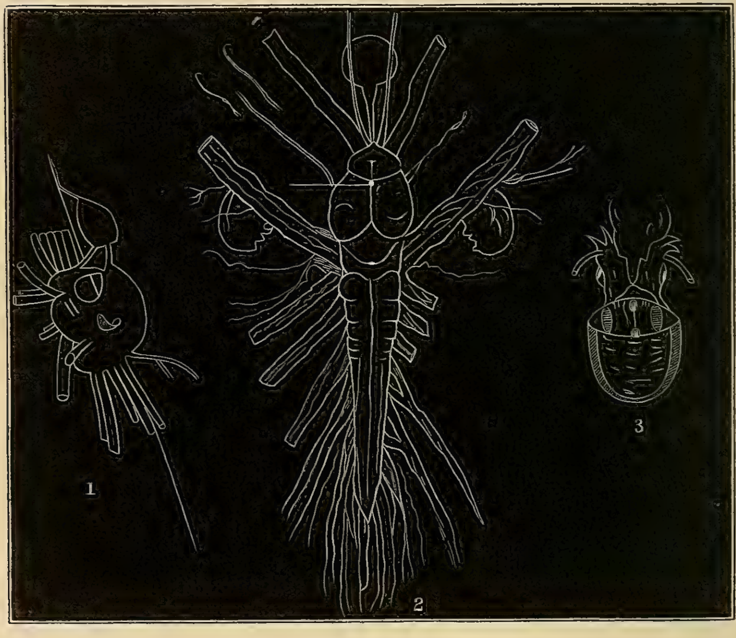
The situation of the ganglia in the invertebrate is determined by that of the locomotive, prehensile, and respiratory organs, the only type of formation recognizable. Thus the helix, with its foot homologous to that of the sepia, though entirely postoral and undivided, has its lower parts much as in *Sepia*; in *Aplysia*, having lateral processes of the body, the ganglia in question are lateral; and in *Doris*, with its strong mantle above and weak foot below, all the ganglia of the ring form one mass on its upper part, it being only completed by a commissure. Other objections to the theory that by *reversing surfaces and change of nomenclature* the sepia becomes tantamount to a bird, are that the relative position of the liver and alimentary canal do not seem to correspond, and the situation of the main artery would also be ventral, whilst the vein would be on the opposite aspect. Certainly the heart and the respiratory organs, which in the sepia may, according to the old nomenclature, be said to be ventral, are in many lower mollusks dorsal; but this has no relation to the question, but is due rather to what Cuvier terms the conditions of existence*.

Admitting the originality and truth of the Professor's main view, is it certain that the transfer of the oral opening has

* We have elsewhere (Ann. & Mag. Nat. Hist., May 1877) endeavoured to explain the different situations of the shell and its relative development in the sepia, nautilus, argonaut, and in Gastropods. In the first the cellular part (*vulgo* bone) is only partially present and is dorsal; in the second and third the expanded part is present on the ventral side; whilst in the snail or whelk its expansion (as well as the branchiæ) is dorsal; but this is from the torsion of this part of the body, and the ascension, as it were, of the branchiæ and the nerves, &c.

been in the direction and in the mode indicated? If so, certainly a very easy way is discovered of solving a difficulty; the morphology of a caterpillar agrees with that of the vertebrate; and we are compelled to admit that a snail or a worm in reality creeps on its back, that the convex part of a lobster is on the ventral aspect, with its limbs reversed in their direction to those of the vertebrates, &c.

But another explanation, which still requires the Professor's view of the conario-hypophysial tract and that the supra-œsophageal ganglion answers to the fore brain, yet implies the correctness of the old opinion as to the upper and lower surface in the sepia, appears to answer all requirements, embryological, anatomical, and otherwise. The accompanying sketch may be thought to be what the French call a *vue schématique*; but it is true to nature (fig. 1).



The subœsophageal ganglion in the invertebrate, *projected forwards* to correspond to the exterior or *condition of existence*, is composed of three constituents, marked out by the passage of the aorta:—the anterior one at the base of those prehensile and partly locomotive organs the feet or arms; in the middle the part supplying the external orifices of respiration (that is, the funnel and nuchal valves), which are in some species also connected with locomotion, from their effect when in action, also the organ of hearing; and most posterior another portion, from which are derived visceral, branchial, and those large compound nerves given to the mantle. We may very fairly point out olfactory, optic, and auditory nerves, in their proper situation, oculo-motor, the fifth or tentacular (the pes anserinus of Cuvier), the seventh or siphonic, the vagus or great visceral nerve, and the pair of nerves which go backwards to the mantle and its muscles, and have been considered analogous to the spinal cord. The view advocated only trenches upon that of our *Chef* in this, that the supposed *quondam* entry and exit of the œsophagus through the brain are reversed. Both views seem strange enough; one must be true; and we think this is less strange than the other. The new mouth appears to enter, in the vertebrate, on what corresponds to the siphonic or lower side—that is, apparently, where the yolk (in the sepia) is absorbed in the crop (protostome, see fig. 3); the mouth of the matured sepia has relation to the pituitary rather than to the pineal, and the exit of the œsophagus, *vice versâ*, to the pineal rather than to the pituitary. Perhaps the inferior hypoaria ganglia of fishes may be explained as remnants of the molluscan arrangement; but let that go.

We are inclined, then, to believe that *morphological fitness* or *conditions of existence* must be considered as well as *typical formation*, the former often overriding the latter; and whilst we concur in the terms *neural* and *hœmal* in anatomy, the common terms *dorsal* and *ventral*, or others more anatomically correct (say *upper* and *lower*), we think must be retained, though the two sets of terms are distinct.

Admitting the truth and originality of Prof. Owen's main proposition, it perhaps may still be held that less is required to believe, with Cuvier, that the subœsophageal nervous ganglia in the Mollusca, which appear homologous with the medulla oblongata of the vertebrate, and so of the ventral cords of Articulata, which may be the homologue of the medulla spinalis, really occupy the ventral aspect of the body, than to adopt a view which ignores many other conditions and morphological considerations, and leads to such strong conclusions.

XXVIII.—*The Affinities of* Palæocampa, *Meek and Worthen, as Evidence of the wide Diversity of Type in the earliest known Myriopods.* By SAMUEL H. SCUDDER*.

In an article on the structure of *Euphoberia* of the Mazon Creek nodules, published in this Journal a year ago †, the wide departure of modern myriopods from their ancient allies, in structure, general appearance, and habits, was clearly pointed out by detailed comparisons between the relics preserved in the Carboniferous rocks and the corresponding parts in modern types. A considerable number of specimens of Archipolypoda, as the ancient forms were termed, bearing out in every particular the points then brought forward, have since been examined, and have been fully represented in an illustrated memoir just published by the Boston Society of Natural History. Thanks to the local naturalists who have so well explored the beds of Mazon Creek, and who have furnished nearly all the material for the papers mentioned, I shall now attempt to show that *Palæocampa* is neither the caterpillar of a lepidopterous insect, nor a worm‡, but a myriopod of another new and strange type. Messrs. Carr and Bliss, of Morris, Ill., have sent me three specimens of *Palæocampa* in fine condition, better preserved and a little larger than the original, which has been lost by fire. Messrs. Meek and Worthen have also examined a second specimen; so that five in all have now been studied. Only one of these, that procured by Mr. Bliss, is preserved in such a way as to show the legs; and, until its discovery, the affinities of this animal would necessarily have remained very obscure.

But for my previous study of the Archipolypoda of Mazon Creek, and the revelation which these ancient types give of the divergence of structure between extinct and modern forms of Myriopoda, it would have been difficult to reach the full conviction that *Palæocampa* was a myriopod. It is a caterpillar-like segmented creature, 3 or 4 centim. long, composed of ten similar and equal segments besides a small head; each of the segments excepting the head bears a single pair of stout, clumsy, subfusiform, bluntly-pointed legs, as long as the width of the body, and apparently composed of several equal joints. Each segment also bears four cylindrical but

* Amer. Journ. Sci., Sept. 1882, pp. 161–170. Read before the National Academy of Sciences, in April 1882.

† Ann. & Mag. Nat. Hist. for June 1881, p. 437.

‡ *Cf.* Meek and Worthen, Proc. Acad. Nat. Sc. Philad. 1865, p. 52; *eosd.* Geol. Surv. Ill. vol. ii. p. 410, pl. xxxii. fig. 3, vol. iii. p. 565; Scudder, Geol. Mag. vol. v. p. 218.

spreading bunches of very densely packed, stiff, slender, bluntly tipped, rod-like spines, a little longer than the legs. The bunches are seated on mamillæ and arranged in dorso-pleural and lateral rows.

The individual rods have an intricate structure: instead of being striate, as supposed by Meek and Worthen in their last examination, they are furnished externally with about eighteen longitudinal equidistant ridges, about half as high as their distance apart; the edges of these ridges are broken into slight serrations at regular intervals about equal to the distance between neighbouring ridges, the highest point of each serration being towards the apex of the spine; the body of the ridge itself appears as if broken at each serration. The intervening space between neighbouring ridges is equally divided by two or three exactly similar but minute ridges, serrated at more frequent intervals. This serration of both larger and smaller ridges, with the apparent jointing or incision of the ridges to the base at the lowest point of each serration, gives the whole spine a jointed appearance; but a close inspection of the floor of the spine itself between the ridges shows no sign whatever of any break in its perfectly smooth surface. The diameter of the spines is only about one tenth of a millimetre; and yet it gives room for an exquisitely regular division of its periphery by seventy or more delicate ridges, every fourth one higher than the intervening, and all broken at minute intervals by uniform serrations. The preservation of these structures from Carboniferous times is only less remarkable than the occurrence, apparently so near the origin of the type to which it belongs, of ornamentation of such excessive delicacy, finish, complication, and regularity. I cannot discover that dermal appendages of such delicate and specialized organization occur anywhere today among arthropods, unless it be when developed as scales, as in Lepidoptera and occasionally in other groups of hexapods. Some chætopod worms have indeed hairs of curious asymmetrical structure, often very delicate and somewhat specialized, but never, so far as I can learn, to nearly so high a degree as here. The collection of these rods into fascicles is also not a little curious, and is again a feature known now in arthropods only in a few instances, such as some tufts of hairs in lepidopterous caterpillars like *Orgya*, or the pencils of hair-like scales in the males of some perfect Lepidoptera (*e. g.* at the tip of the abdomen in *Heliconia*, *Danais*, *Agrotis*, *Leucarctia*, &c.), or in the terminal fascicles of barbed hairs in the myriopodan genus *Polyxenus*.

There is no group of animals into which such a jointed creature as this could fall excepting worms, myriopods, or the larvæ of hexapod insects. The certainty that this animal possessed a single pair of well-developed legs of identical character on every segment of the body behind the first segment or head is of itself sufficient evidence to exclude it both from the worms and from the larvæ of hexapod insects. No such legs or leg-like structures occur today in worms; and it would be idle to look for them in their ancestors of Carboniferous times. The only approach to such an appearance in hexapod larvæ is in the young of tenthredinous Hymenoptera, where, however, a difference of great morphological significance is found between the true or thoracic legs and the prolegs or those attached to the abdomen—a difference based on one of the most essential underlying features of their structure as hexapods. No such difference occurs in *Palæocampa*; and it is therefore impossible to conceive of it as the larva of a hexapod insect of any sort.

In myriopods only do we find a repetition of legs of exactly similar structure on every or nearly every segment of the body*; by this test *Palæocampa* is a myriopod; and now that we have found ancient types of this group, like the Archipolypoda, bearing huge and bristling spines arranged in series along the sides of the body, we need not be at all disconcerted at discovering this new type with longitudinal series of fascicles of stiff rods, although we cannot restrain our surprise and admiration at their exquisite intricate structure.

Accepting *Palæocampa* then as a myriopod, we may next ask what relation it bore to the myriopods of the same period and found in the same waters, and also to myriopods of today. The differences between the stout, forked, and bristling spines of the Archipolypoda and the close-set but spreading bunches of highly organized stiff rods of *Palæocampa* appear upon the barest statement. Were it not, however, for the complicated ornamentation of the rods themselves, the distinction between the fascicles of *Palæocampa* and the spines of *Euphoberia* would be hardly greater than that between the latter and the long hairs of an undescribed genus of Archipolypoda which has recently fallen under notice; so that to this feature alone we cannot grant so high an importance as to another which has already been named—the presence in *Palæocampa* of a single pair of legs (and consequently, to judge by analogy, of a single ventral plate) to each segment; while there are two ventral plates and pairs of legs to each

* Some smaller groups formerly, and by some authors still, considered as belonging to the myriopods must be excepted from this statement; their relation to *Palæocampa* will be discussed further on.

segment in Archipolypoda. This is a difference of profound significance, which has separated the prevailing types of myriopods down to the present day, lying as it does at the base of the distinctions between the living chilopods and diplopods. The discovery of this type is of the greater importance because we have hitherto known nothing of any chilopodiform myriopods previous to Tertiary times, unless Münster's dubious *Geophilus proavus* from the Jura possibly be an exception.

In studying the Archipolypoda we necessarily confine our comparisons with modern types to the Diplopoda, because of their common possession of the fundamental feature just named: in the same way the comparisons between *Palæocampa* and recent forms must be reduced to the common features or the radical distinctions which appear in studying the Chilopoda. Now, although the structure of *Palæocampa* may be far less perfectly known than that of the equally ancient *Euphoberia* and its allies, enough can be seen to point conclusively to wide and important differences between it and modern Chilopoda.

In Chilopoda, of which the modern *Scolopendra* or centipede is the type, the body is always depressed, formed of many segments, rarely as few as sixteen behind the head, each of which is compound, being formed of two subsegments, one of them atrophied and carrying no appendages; both dorsal and ventral plates are coriaceous, of nearly equal width, and possess no armature whatever excepting the simplest hairs, which are occasionally scattered over the surface. The larger subsegment bears a single pair of legs, which are composed of five slender, cylindrical, subequal joints beyond the coxa, and armed with a single apical claw; they are attached to the interscutal membrane uniting the distinct dorsal and ventral plates of each segment, and are therefore separated by the entire width of the broad ventral plates. The hindmost legs are transformed to anal stylets, while the first two pair are more profoundly transformed to subsidiary mouth-parts, the first becoming palpi and the second stout nippers. The head, really composed of eight primitive segments, is apparently made up of two, each of which is generally of about the same size as the body-segments and as distinctly separated; the stout biting-jaws, composed of the second pair of legs, spring from this second segment of the head, and the palpi or first pair of legs from the hinder part of the first cephalic segment; the anterior part of the same bears the many-jointed simple antennæ.

Passing now to the comparative study of *Palæocampa*, we find that its body was, in all probability, cylindrical, composed of a limited number of segments behind the head, and the head itself, considerably smaller than the body-segments, is composed of only a single apparent segment. The legs of the segment immediately succeeding it are in every respect like those of the rest of the body, and have nothing whatever to do as auxiliary to the mouth. In this point alone we have a distinction as wide and incisive as any which separate the modern Diplopoda and Chilopoda. In the body-segments we discover no trace of any thing more than a simple ring without subdivision; but as the specimens indicate a coriaceous structure like that of modern Chilopoda, and no trace of the division between the dorsal and ventral plates can be seen in any of them, the separation of the segments into two subsegments, as in Chilopoda, one of them greatly atrophied, could hardly be apparent did it exist. But on the other hand, as we regard the second subsegment of Chilopoda as atrophied, we should expect to find it fully or partially developed in these creatures, which of all known ancient types are certainly the most closely related to them. Yet we find here no sign of any thing more than the simplest possible, uniform, leg-bearing segments, and of a very limited number. In one feature, however, they are not so simple as in Chilopoda; for, as stated, each is provided on each side with two pairs of mamillæ, supporting very large bunches of spreading rods, and the rods themselves sculptured in a very remarkable way. This distinction between the two types, though more striking and noticeable than any other, is in itself by no means so important as the others, but may be added to the catalogue; and it must have some weight, from the total absence of appendages of any sort (beyond scattered hairs) from the dorsal plates of Chilopoda. The position of these rows of fascicles and of the legs indicates that the ventral plates are only a little narrower than the dorsal, and probably of about the same extent as in the Archipolypoda; in this respect they do not differ to any important degree from modern Chilopoda. The legs were different in form; but their poor preservation in the only specimen in which they have been seen prevents any thing more than the mere statement of the following difference: while the legs of Chilopoda are invariably horny, slender, adapted to wide extension and rapid movement, those of *Palæocampa* are fleshy, or at best subcoriaceous, very stout and conical, certainly incapable of rapid movement, and serving rather as props.

These differences, which underlie every part of the body that is preserved in *Palæocampa*, show that while the general accordance of grand features compels us to look upon *Palæocampa* as the precursor of the Chilopoda, we must separate it from them in the same way as we separate the Archipolypoda from the Diplopoda. For such a group the name of Protosyngnatha is proposed, indicating its ancestral relations to the chilopods, or Syngnatha, as they were called by Latreille.

There are, however, two aberrant groups of living animals more or less closely related to myriopods, and placed with them by some authors, with which also we shall compare *Palæocampa.* The first of these is *Peripatus,* our knowledge of which has been so much increased of late years, and especially by the researches of Moseley.

In external appearance *Peripatus* resembles an annelid, but is furnished with a pair of long jointed antennæ, and with numerous fleshy tapering legs, each armed at tip by a pair of claws; the legs, set wide apart, are obscurely jointed, the joints being perceptible only at the extreme tip and on the apical half of the inner side, above which are the large elongated openings into the nephridia. The entire body is of a leathery texture with no external sign of segments, or of the separation of the head from the rest of the body, except the appendages—namely the legs, the nephridia opening on the legs, and the ordinary appendages of the head. The same is true when the internal structure of the body is examined; for neither in the disposition of the muscles nor of the tracheal apparatus does it appear that one could judge whether a pair of legs represented one or more segments of the body; even in the nervous system it is only indicated by a small ganglionic swelling next each pair of legs. The tracheæ are like extended cutaneous glands, independent of one another, and scattered over the body; and the longitudinal muscles show no regular segmental breaks. This weakness of segmental divisions is nowhere paralleled among hexapods, arachnids, or myriopods, and is an indication of very low organization among arthropods generally. The number of legs indicates from fifteen to thirty-five segments in the body, according to the species. The first pair, as they are developed in the adult, are functionless as legs, and are situated (in the specimens I have examined—a South-American species, probably *P. Edwardsii*) midway between the antennæ and second pair of legs, and not only outside of, but at some distance from the mouth-parts, so that the latter are not furnished with auxiliary appendages borrowed from a segment behind the first, as in chilopods; this is further proven by the development of these parts in the two groups. The body is profusely covered above with corrugated papillæ, without regular distribution.

From this it will appear that *Palæocampa* differs in many essential features from *Peripatus*, and in most at least of these shows a higher organization. The segments are well separated from one another; and the head is distinctly marked. The number of segments is much less; and each bears clusters of appendages of a highly specialized character. Although no spiracles are present in the remains we have of *Palæocampa*, it is clear that respiration must have been effected through linearly disposed openings, since the muscular or mechanical requirements for the movement of a completely segmented body (especially if, as in *Palæocampa*, the segments bear a heavy armature) forbid the miscellaneous distribution of tracheæ, and demand a well-developed system with the same linear arrangement which we find in the armature. The best that can be said of the respiratory apparatus in *Peripatus* is that the tracheal bundles show a tendency toward "a concentration along two sides of the body, ventral and lateral." The possession, however, in each type, of a single pair of legs to every segment behind the head indicates an affinity which cannot be overlooked, and which is the more interesting since one of the types is very ancient and the other is universally looked upon as the existing survivor of an ancient type. The form of the body and of the fleshy legs is also similar; but there are minor points, and, however close the agreement between these forms, we cannot look upon *Palæocampa*, with its undoubtedly well-developed tracheal development, as in any sense the genetic predecessor of *Peripatus*; for the generally distributed tracheal apertures of the latter could not have developed from a serial disposition without a degradation of type, which, as Moseley points out, many other features combine with this to disprove. It may also be added that while the legs of *Palæocampa* are poorly preserved in the only specimen which gives a side view, the presence of nephridial openings, of such an extent and in such a place as in *Peripatus*, could hardly fail of detection, and they are entirely absent. The presence of these in *Peripatus* is one of the marks of its inferior organization, or rather of its alliance to an inferior type, the annelids.

The other aberrant group which we must specially notice is *Scolopendrella*, placed at first among Chilopoda, but recently shown by Ryder and Packard to differ from them in very important features, in some at least of which it agrees with *Palæocampa*. The researches of these naturalists, as well as the earlier observations of Menge, clearly prove that it must be separated from the myriopods altogether, and that it is certainly provided with many points of affinity to the Thysanura. Ryder suggests for it an independent place between the Myriopoda and Thysanura, under the name Symphyla. Packard, with better reason, would place it within the Thysanura, under which head he would also include the Collembola and Thysanura proper, or Cinura, as he terms them.

Scolopendrella, as these authors point out, differs from the Chilopoda in that the appendages of the segment behind that furnishing the mouth-parts proper do not serve as auxiliary organs for manducation, but are developed, like those of the succeeding segments, as legs, while the mouth-parts resemble those of Thysanura, and differ from those of Chilopoda: indeed the whole head is decidedly thysanuriform, the legs are provided with a pair of claws, and the terminal segment bears a pair of caudal stylets with a special function. Besides these points, the possession of a collophore is distinctively thysanuran; and the position of the stigmata, between the legs, is different from the position they uniformly maintain in Chilopoda, while it only adds to the great irregularity of place seen in Thysanura. On the other hand, the identity of form in the thoracic and abdominal segments, the full development, upon the abdominal segments, of jointed legs like those of the thoracic segments, and the occasional alternation of leg-bearing and apodal segments in the abdomen, are striking marks of its real affinity to the chilopods. Abdominal appendages, homologous with legs, but unjointed, do, however, occur in Thysanura to a greater degree than in other hexapods, so that we can hardly refuse to admit these polypodous creatures as lowest members of the subclass of insects proper, although they are the only non-hexapodal type.

Now the separation of the head and its appendages from those of the next succeeding segment distinguishes *Palæocampa* from the Chilopods in the same way as it does *Scolopendrella*; so, too, the segments behind the head in *Palæocampa* and *Scolopendrella*, alone of all arthropods in which the head is thus clearly separated, agree in showing no distinction whatever between what may be looked upon as thoracic and what as abdominal, whether in the form of the segment itself or in the appendages of the segments. These are certainly fundamental points; but when we have mentioned them we have reached the end of all possible affinities or points of resemblance, unless we may consider the minute structure of the rods in the fascicles of *Palæocampa* paralleled by the well-known delicacy of organization of the scales in other Thysanura, though they do not exist in *Scolopendrella*. The limited number of abdominal segments might be looked upon as a further point, were it not that the number is even less than in *Scolopendrella* or in the Cinura, and that the Pauropida among diplopod myriopods have in some instances even a still smaller number. On the other hand, the character of the legs, the apparent absence of a double claw at their tip, the peculiar armature of the fascicled rods, which form so striking a feature in *Palæocampa*, the want of any caudal stylets, and the complete uniformity of the segments of the body unprovided with distinct dorsal scutes distinguish *Palæocampa* not only from *Scolopendrella*, but from all Thysanura whatever; the general form of the body, too, is altogether different from any thing occurring there, even its cylindricity being foreign to the Thysanura, excepting in their highest types among the Collembola. It seems therefore clear that the points of affinity between *Palæocampa* and *Scolopendrella*, with the single exception of the separation of the head and its appendages from the body, are precisely those in which *Scolopendrella* is chilopodan, and that the assemblage of features which our fossil presents are therefore chilopodan rather than thysanuran.

Regarding *Palæocampa*, then, as a myriopod, though of a type very distinct from any known, whether living or fossil, we are brought face to face with two remarkable and somewhat parallel facts:—First, that *in this ancient myriopod*, as old as any with which we are acquainted, carrying us back indeed as far as any traces of wingless tracheate arthropods have been found, and therefore presumably not far from the origin of this form of life upon the earth, *we find dermal appendages of an extraordinarily high organization*, more complicated, as we have pointed out, than any thing of the sort found in living arthropods, excepting the more varied but not more exquisite scales of several orders of hexapods—a form of appendage which it would seem, on any genetic theory of development, must have required a vast time to produce, but which we now seem to find at the very threshold of the apparition of this type of arthropod life.

Second, that *at this early period*, in marked contrast to what we find in other groups of articulated animals, *the divergences of structure among myriopods was as great as it is today*. This is the more surprising because we possess only imperfect remains of a few types; and yet from what we already know of the Archipolypoda, on the one hand, and of the Protosyngnatha on the other, they are found to differ quite as much as the Diplopoda and Chilopoda, and in points fully as important as those which separate so sharply these great modern groups. Whether they are to be looked upon, one as the ancestor of one, the other of the other, of these modern groups, is another question. It would certainly be reasonable to consider the Archipolypoda as the common ancestors of both the Chilopoda and Diplopoda—and possibly the Protosyngnatha as the descendants on one line of a primitive type which, on another line, has retained its integrity up to the present day in *Peripatus* (and on possibly a third line has reached *Scolopendrella*), while on that which produced *Palæocampa* it has not, so far as we know, survived the Carboniferous epoch. With the facts of structure of ancient and modern types now before us, we are compelled, on any genetic theory, either to presume a great acceleration of development in earlier times or to look for the first appearance of myriopods at a vastly remoter epoch than we have any reason to do from the slighter hints in the rocks themselves—a period so remote as to antedate that of winged insects, which are now known from rocks older than any which have yielded remains of myriopods. In a memoir on Devonian insects, the concluding portion of which was republished in this Journal *, I showed the probability, on developmental grounds, that some of the Carboniferous insects, "together with most of those of the Devonian, descended from a common stock in the Lower Devonian or Silurian period, and that the union of these with the Palæodictyoptera (of the Carboniferous) was even further removed from us in time." The structural relations of myriopods and hexapods render it probable that the former preceded the latter; and in complete accordance with this expectation, the structural relations of the oldest fossil myriopods indicate their apparition at a period earlier than that to which the winged insects are hypothetically assigned. This would compel us to consider the earlier type as aquatic, for which we have presumptive evidence in the structure of the Euphoberidæ, and renders it all the more surprising that the penetrating researches of the last thirty-seven years, since the first Carboniferous myriopod was discovered, have not yielded the slightest trace of fossil myriopods below the Coal-measures. This discrepancy between fact and hypothesis should never be lost sight of, and should stimulate to more searching investigations, particularly of those articulates of the older rocks whose affinities have not been satisfactorily settled.

* Am. Journ. Sci. vol. xxi. p. 117.

XXIX.—*Diagnoses of new Species of* Pleurotomidæ *in the British Museum.* By Edgar A. Smith.

[Continued from p. 218.]

Pleurotoma (*Defrancia**) *rubro-apicata.*

Testa ovata, alba, ad apicem rubra; anfract. 8, primi 2 minute granulosi, sequentes duo oblique exiliter reticulati, cæteri convexi, superne ad suturam canaliculati, costis tenuibus 12 (in anfr. ultimo haud ad basim attingentibus) et liris spiralibus 5–6 (in anfr. ultimo 16–19) supra costas subnodosis clathrati; apertura parva, longit. totius ad $\frac{5}{11}$ æquans; labrum incrassatum, intus denticulis 8–9 munitum, juxta suturam subprofunde sed anguste fissum; columella tortuosa, basi obliqua; canalis angustus, brevis.

Long. $5\frac{1}{2}$ mill., diam. $2\frac{1}{2}$.

Hab. Japan?

The four apical whorls are red, the rest of the shell is white. The upper part of each whorl is distinctly channelled.

Pleurotoma (*Defrancia*) *capensis.*

Testa abbreviato-fusiformis, pallide fusca, infra medium anfracti ultimi fusca, interdumque hic illic fusco ac prope suturas albo maculata; anfract. 9, primi 2–3 convexi, minute reticulati, cæteri superne angulati et tabulati, costis longitudinalibus gracilibus (in anfr. ultimo ad 12) et spiralibus fere æque validis (in anfr. superioribus 3, in ultimo circiter 6 præcipuis, atque aliis circa caudam subgranosis) fortiter cancellati, intersectionibus acute nodulosis; apertura ad $\frac{3}{7}$ longitudinis totius æquans, basi contracta; labrum incrassatum, intus denticulatum et ad suturam incisum, inferne cum columella rectiuscula canalem brevem leviter recurvum formans.

Long. $13\frac{1}{2}$ mill., diam. 5.

Hab. Port Elizabeth, South Africa.

This species is very closely related to the European *D. reticulata*, Bronn. It differs chiefly in the whorls being less rounded, more constricted at their base, and slopingly tabulated above; and the cancellation is rather coarser. The coloration is similar.

Pleurotoma (*Defrancia?*) *asperulata.*

Testa fusiformis, lutescens; anfract. $9\frac{1}{2}$, primi $2\frac{1}{2}$ læves, vitrei, politi, cæteri perconvexi, sutura canaliculata sejuncti, costis tenuibus 18 et liris spiralibus 8 supra costas leviter echinatis, concinne clathrati;

* This section is employed, in the sense as restricted by Dr. Gwyn Jeffreys, for such species as have a cancellated sculpture, minutely reticulated apical whorls, and the labral sinus *at* and *not below* the suture. Perhaps it would be advisable to employ the name *Clathurella*, proposed by Carpenter, as *Defrancia* was previously appropriated for another branch of the animal kingdom.

anfract. ultimus superne rotundatus, basi subelongate caudatus, liris spiralibus 18–20 (quarum inferiores 9–10 circa caudam simplices sunt) ornatus; apertura parva, longit. totius $\frac{1}{3}$ paulo superans; labrum tenue, ad suturam profunde angusteque incisum; columella tortuosa; canalis angustus obliquus, paululum recurvus.

Long. 10 mill., diam. 3.

Hab. Japan (*A. Adams*); Persian Gulf (*Col. Pelly*).

This species partakes of the general aspect of *P. reticulosa*, but is distinguishable from it by its longer spire, narrower form, closer reticulation, and smooth apical whorls.

Pleurotoma (*Defrancia?*) *reticulosa*.

Testa fusiformis, luteo-alba; anfract. 10, primi 4 convexi, oblique tenuiter crebreque costati, et obsolete transversim striati, cæteri superne juxta suturam anguste læviterque canaliculati, infra canalem perconvexi, et concinne reticulati, reticulo ex costis tenuibus circiter 18 (in anfr. ultimo ante caudam obsoletis) et liris spiralibus (in anfr. penultimo 6, supernis duabus quam cæteræ minoribus) supra costas subechinatis constructo; anfr. ultimus superne rotundatus, inferne in caudam subelongatam productus, liris spiralibus ad 18 (inferioribus 10–12 simplicibus) cinctus; apertura cum canali longit. totius $\frac{3}{7}$ adæquans; labrum juxta suturam anguste profundeque incisum; columella tortuosa, haud callosa; canalis angustus, subelongatus.

Long. $11\frac{1}{2}$ mill., diam. 4.

Hab. Japan (*A. Adams*); Persian Gulf (*Col. Pelly*).

At the base of the last whorl, around the cauda, a faint brown band is traceable. The smooth furrow at the top of the whorls, their reticulated surface, and the rather produced canal are characters at once indicating this species.

Pleurotoma (*Defrancia?*) *trifilosa*.

Testa ovato-turrita, nitens, albida, lineis tribus fusco-olivaceis circa medium anfractuum, et quatuor circa basim anfr. ultimi, ornata; anfractus 7, primus castaneus, sequentes duo læves convexi, cæteri convexiusculi, costis obliquis tenuibus circiter 13 (in anfr. ultimo paululum infra medium evanidis) instructi, liris spiralibus ad 7 supra costas subnodosis cincti; anfr. ultimus liris 19–20 ornatus; apertura longitudinis totius ad $\frac{4}{9}$ æquans; labrum leviter incrassatum et superne sinuatum, intus denticulatum? (vix adultum); canalis brevis, obliquus, aliquanto recurvus.

Long. $4\frac{1}{2}$ mill., diam. $1\frac{2}{3}$.

Hab. ——?

This very pretty shell is remarkable for its numerous ribs, which are about equal in width to the interstices between them; and the spiral lirations are arranged close together and are slightly granulous on crossing the ribs. Three of them around the middle of the whorls and four encircling the lower part of the body-whorl, and separated from the above by three white liræ, are of an olive-brown colour. Probably, in the adult shell, the labrum may be furnished with a few denticles within.

Pleurotoma (*Defrancia*?) *piperata.*

Testa acuminato-ovata, sordide albida, punctis rufo-nigris ornata; anfractus 9, primi tres convexi, primus luteus, cæteri convexiusculi, costis circiter 15 et liris spiralibus 4 supra costas granosis concinne cancellati; anfract. ultimus liris ad 14 succinctus; apertura parva, longitudinis totius $\frac{2}{5}$ adæquans; labrum incrassatum, intus denticulis 3–4 ornatum, superne leviter sinuatum; columella callo tenui induta; canalis brevis, obliquus, leviter recurvus.
Long. 5 mill., diam. $1\frac{2}{3}$.

Hab. Straits of Korea (*A. Adams*).

The reddish-brown dots are on the granules and are disposed somewhat regularly. They are frequently three in number on each alternate rib, near the suture; but around the middle of the body-whorl they do not occur. The West-Indian species *monilifera*, Sowerby, is the nearest ally of this species; it is, however, a little more slender, consists of two more whorls, of which the apical ones form a more acuminate apex, and the cancellation is finer.

Pleurotoma (*Defrancia*?) *alternans.*

Testa ovata, albida vel pallide cornea, costis alterne fuscis et albidis ornata, anfract. 7?, apice abrupto reliqui 5 leviter convexi, costis longitudinalibus 12 (in anfr. ultimo ad basim continuis) et liris spiralibus supra costas leviter nodosis (in anfr. penult. 4, in ultimus 10) valde cancellati; anfr. ultimus circa medium lira quarta tota albida cinctus, et infra illam costæ omnes fuscæ sunt; apertura aliquanto angusta, longitudinis totius ad $\frac{3}{7}$ æquans; labrum incrassatum, intus circiter 6-dentatum, superne leviter sinuatum; canalis angustus, brevis, basi truncatus.
Long. 6 mill., diam. $2\frac{1}{2}$.

Hab. ——?

The colouring of this species is very remarkable. In the upper whorls the ribs are alternately brown and white, and the lowest liration, which is in conjunction with the suture and encircles the middle of the body-whorl, is wholly white. The fifth and sixth lirations on the last, reckoning from the suture, are rather far apart, and the longitudinal ribs between them are uniformly brown.

Pleurotoma (Defrancia?) albicaudata.

Testa ovata, superne acuminata, fusca, ad apicem et basi anfracti ultimi alba; anfractus 7, superne 2–3 albi, minutissime reticulati, cæteri convexiusculi, sutura subprofunda discreti, costis circiter 12, et liris spiralibus 3–4, supra costas subnodulosis fenestrati; anfract. ultimus liris spiralibus 12, quarum inferiores 6 albæ granosæque sunt, ornatus; apertura longit. totius quam ½ paulo minor; labrum extra valde incrassatum, intus denticulis 4–5 munitum, prope suturam subprofunde sinuatum; canalis brevis.

Long. 4 mill., diam. 1½.

Hab. Persian Gulf (*Col. Pelly*).

The contrast of colour, the chief portion of the shell being a rich brown, with the apex and lower part of the body-whorl white, is very remarkable. This peculiarity, together with the strongly cancellated surface, at once distinguish this pretty species.

Pleurotoma (Defrancia?) moretonica.

Testa ovato-fusiformis, brunnea; anfr. 9, primi 2 læves, politi, tertius minute reticulatus, cæteri superne decliviter tabulati, inferne planiusculi, costis tenuibus 22–24 (in anfr. ultimo ad basim haud continuis) et liris spiralibus præcipuis 3 et aliis minoribus inter illas (in anfr. ultimo circiter 25) tenuiter reticulati; apertura angusta, longit. totius ½ æquans; labrum extra incrassatum, margine crenulatum, superne modice sinuatum; canalis brevis, angustus.

Long. 11 mill., diam. 3½.

Hab. Moreton Bay, Queensland (*Strange*).

The uniform brown colour and the fine reticulation are the chief characteristics. The spiral lirations are slightly nodulous on crossing the ribs.

Pleurotoma (Defrancia?) commoda.

Testa elongato-ovata, alba; anfract. 8, primus lævis, secundus minute oblique reticulatus, cæteri convexiusculi, costis tenuibus ad 14 (in anfr. ultimo basim vix attingentibus) et liris spiralibus gracilibus (in anfr. penult. 6–7, in ultimo circiter 16) concinne cancellati; apertura longit. totius ½ paulo minor; columella callo tenui induta; labrum extra incrassatum, intus liris tenuibus 9–10 ornatum, versus suturam rotunde sinuatum; canalis angustatus, brevis.

Long. 8 mill., diam. 2½.

Hab. California.

The spiral lirations are rather finer than the longitudinal ribs, and are slightly thickened on crossing them. In some specimens there is a slight tooth-like projection near the base of the columella.

In general form this species is rather like *P. producta*, Pease, from the Sandwich Islands; but the sculpture is different. In the former the cancellation is much more open, and the liræ are scarcely nodulous at the points of intersection with the longitudinal ribs, whereas in the latter the ribs are very close together.

Pleurotoma (*Defrancia*?) *subgranosa*.

Testa ovata, alba, infra suturas zona flavo-fusca, et infra medium anfr. ultimi altera, ornata; anfractus $6\frac{1}{2}$, primi $2\frac{1}{2}$ convexi, oblique tenuiter costati, cæteri convexuisculi, sutura canaliculata sejuncti, costis subcrassis 12 (in anfr. ultimo basi continuis) et liris spiralibus (in anfr. tertio quartoque 3, in penultimo 4, in ultimo 12) supra costas subgranosis cancellati; apertura angusta, longit. totius $\frac{5}{11}$ adæquans; columella medio incrassata; labrum incrassatum, intus denticulis 5 armatum; sinus subamentiformis, paululum infra suturam situs; canalis angustus, brevis, basi truncatus.

Long. $5\frac{1}{2}$ mill., diam. $2\frac{1}{3}$.

Hab. ——? A variety from Singapore. Coll. Cuming.

The brownish band below the suture includes the two upper lirations; that around the body-whorl colours the sixth and seventh (reckoning from the suture). The single specimen from Singapore is undoubtedly this species, but has a slightly distorted look and is of larger dimensions, being 7 millim. long and 3 broad.

Pleurotoma (*Defrancia*?) *associata*.

Testa fusiformi-ovata, turrita, rubro-fusca, circa medium anfr. ultimi zona angusta flava cincta; anfract. $6\frac{1}{2}$, primus $1\frac{1}{2}$ lævis, politus, cæteri convexiusculi, supra oblique tabulati, costis 12 (in anfr. ultimo basim vix attingentibus) et liris spiralibus 4 supra costas nodulosis instructi; anfr. ultimus liris circiter 15, inferioribus 6, vix nodulosis, succinctus; apertura longit. totius ad $\frac{3}{7}$ æquans; labrum incrassatum, intus denticulis 5–6 munitum; columella juxta suturam callosa; canalis angustus, brevis, truncatus.

Long. 7 mill., diam. $2\frac{1}{2}$.

Hab. ——?

P. zonulata, Angas, appears to be the nearest ally of this species.

Pleurotoma (*Daphnella*) *Souverbiei*.

Testa elongato-ovata, parum nitida, alba, lineis spiralibus paucis interruptis lacteis ornata; anfract. 9?, apicalibus 3 fractis supremi reliqui 3–4 longitudinaliter oblique costati, spiraliterque striati, cæteri læves, convexiusculi, tenuiter spiraliter incrementique lineis striati; anfr. ultimus magnus, cauda oblique sulcata terminatus; apertura latiuscula, longit. totius $\frac{9}{19}$ adæquans; labrum leviter incrassatum, ad marginem dentatum, juxta suturam sinuatum; canalis brevis, vix recurvus, paululum obliquus.

Long. 19 mill., diam. 7.

Hab. Swan River, West Australia (*G. B. Sowerby*).

Although this species has considerable likeness to *P. rissoides*, Reeve, it is very different in several respects. The proportion of the last whorl to the entire shell is much larger in the present species, occupying nearly two thirds of the entire length, whereas in *P. rissoides* it only extends to a little more than half of it. The spiral striation, the less convex whorls, and the absence of coloration at the apex are the characters by which this species may be known.

Pleurotoma (*Daphnella*) *tenuiclathrata.*

Testa ovata, tenuis, semitranslucida, albida, dilutissime luteo tincta, versus basim anfr. superiorum et circa medium anfr. ultimi zona irregulari lactea opaca cincta; anfract. 9?, apicalibus 3 abruptis superiores reliqui 3–4 costis longitudinalibus ad 8 et liris fortibus transversis 2–3 cancellati, cæteri convexi, liris longitudinalibus tenuissimis spiralibusque paululum crassioribus et pulcherrime granulatis (paucis hic illic quam cæteræ majoribus) exiliter cancellati; apertura longit. totius $\frac{1}{2}$ adæquans; labrum tenue, ad suturam aliquanto profunde sinuatum; columella sinuosa; canalis brevis.

Long. 14 mill., diam. 5.

Hab. ——?

The spiral lirations are very numerous and beautifully minutely beaded.

Pleurotoma (*Daphnella*) *supercostata.*

Testa ovato-fusiformis, tenuiuscula, luteo-albida, haud nitens; anfract. $6\frac{1}{2}$, convexi, quorum ultimi 4 prope suturam leviter concavo-depressi, primus $1\frac{1}{2}$ lævis, sequentes 3 plicis longitudinalibus (circiter 10) et striis numerosis transversis cincti, cæteri lineis spiralibus confertissimis et longitudinalibus innumeris minute reticulati; anfr. ultimus magnus, ventricosus, basim versus contractus, cum columella caudam brevem effingens; apertura paululum spira longior; columella fere recta; canalis brevis, paululum recurvus; labrum ad suturam distincte sinuatum, extra incrassatum.

Long. 13 mill., diam. $5\frac{1}{2}$. Apertura long. 7, diam. $2\frac{1}{2}$.

Hab. Japan (*A. Adams*).

The convex whorls slightly excavated near the suture, the upper ones only being longitudinally ribbed, and the minute striation, forming a very fine reticulation over the entire surface, are the chief characteristics of this very distinct species. It was named *D. striolata* in manuscript by A. Adams.

Pleurotoma (*Daphnella*) *Macandrewi.*

Testa ovato-fusiformis, sordide albida, zonis duabus pallide luteis ad suturas, et in anfr. ultimo tertia infra medium ornata; anfr. 11, convexi, superne leviter concave planulati, costis tenuibus obliquis (in anfr. antepenult. 10, in penult. 12, in ultimo circiter 17 basi attenuatis) instructi, liris spiralibus numerosis subgranosis cincti; anfract. ultimus circa caudam lutescentem liris subvalidis circiter 8 ornatus; apertura longitudinis totius $\frac{4}{9}$ adæquans; columella basi tortuosa; canalis angustus, pro *Daphnella* subelongatus.

Long. 18 mill., diam. 6.

Hab. Persian Gulf (*Pelly*).

The sinus is probably like that of other *Daphnellæ*; but as the labrum is broken away, I cannot describe it. The granulous character of the spiral lirations is produced by their being crossed by fine longitudinal striæ. I feel a sorrowful pleasure in associating with this species the name of the late and deeply-lamented Robert McAndrew, one of the most liberal of the many donors of shells to the national collection.

Pleurotoma (*Daphnella*) *tenella.*

Testa ovata, tenuis, alba, ad apicem pallide violacea, superne ad suturam pallide brunneo fasciata, in anfr. ultimo fasciis tribus (suprema ad suturam, mediana latissima, infima angusta circa caudam) ornata; anfract. 8?, apice abrupto reliqui 4 superne decliviter planulati, medio leviter angulati, infra angulum convexiusculi, costis tenuibus flexuosis obliquis (in anfr. ultimo ad 18 paululum ante basim evanidis) instructi, undique tenuiter spiraliter lirati; apertura elongato-ovata, longit. totius $\frac{1}{2}$ adæquans; columella callo tenui superne incrassato labroque juncto induta, inferne paululum infra medium tuberculo parvo munita; labrum extra incrassatum, intus dentatum; sinus semicircularis; canalis angustus brevis.

Long. 11 mill., diam. 4.

Hab. ——?

The two lower bands are only separated by a very narrow white one. The spiral lirations are fine, but rather distant, being about eight in number in the penultimate whorl and about forty-five in the last. Possibly the tubercle on the columella is not constant.

Pleurotoma (*Daphnella*) *Gealei.*

Testa ovato-turrita, alba, costis fusco-luteis (hic illic unica alba) ornata, circa anfr. ultimi medium linea alba cincta, pone labrum fusco maculata; anfract. 10? apice fracto primus reliquus minute spiraliter striatus, cæteri decliviter tabulati, inferne convexiusculi, costis subrectis 11 (in anfr. ultimo basi continuis) et liris spiralibus 8 (supremis 4 tenuibus confertis, supra tabulas sitis) supra costas leviter incrassatis cancellati; anfr. ultimus liris ad 17, infimis 5 circa caudam valde granosis, cinctus; apertura longit. totius $\frac{2}{5}$ paulo excedens; columella superne leviter callosa, planulata; labrum extra costa ultima incrassatum, intus 10-lirato-dentatum, prope suturam sinu parvo emarginatum; canalis angustatus, truncatus, brevis.

Long. 14 mill., diam. $5\frac{1}{3}$.

Hab. ——?

The granules on the cauda are large and are alternately white and pale brown.

Pleurotoma (*Daphnella*) *Butleri.*

Testa oblonga, leviter turrita, alba; anfractus 8? (apice abrupto), reliqui 5 fere plani, costis 13–14 subrectis, tenuibus (in anfr. ultimo basi productis) instructi, et liris spiralibus circiter 8 filiformibus inter et supra costas continuis (in anfr. ult. ad 24, quarum inferiores 5–6, supra costas nodulosæ sunt) cincti; apertura angustissima, quam longitudinis totius $\frac{1}{2}$ paulo minor; labrum paulo pone marginem costa ultima incrassatum, superne sinu subamentiformi ornatum, intus læve; columella rectiuscula, leviter callosa, lævis; canalis angustus, subbrevis.

Long. $9\frac{1}{2}$ mill., diam. 3.

Hab. Island of Capul, Philippines. Coll. Cuming.

This very pretty shell is remarkable for the numerous slender ribs, which incline a little to the left at the upper suture, and the delicate thread-like lirations, of which the two or three uppermost are situated nearer together than the rest, and about half a dozen which encircle the base of the body-whorl become developed on crossing the fine ribs into little nodules. The thin callus on the columella is united above to the labrum, and with it forms a loop-like sinus.

Pleurotoma (*Glyphostoma*) *soror.*

Testa breviter fusiformis, subturrita, albida, infra medium anfr. ultimi rufo-fusca; anfract. 10, primus convexus, vitreus, secundus lævis medio carinatus, cæteri superne concaviusculi, inferne leviter convexi, costis 12 (in anfr. ultimo vix ad basim attingentibus) instructi, liris spiralibus 3 (in anfr. ultimo 15) cincti; apertura longit. totius $\frac{1}{2}\frac{1}{6}$ adæquans; labrum extra incrassatum, margine dentatum, intus denticulis 6 munitum; sinus mediocris, subamentiformis; columella transversim lirata; canalis profundus, angustus, leviter recurvus.

Long. 13 mill., diam. $4\frac{1}{3}$.

Hab. Persian Gulf (*Col. Pelly*).

This shell has considerable affinity to *P. spurca*, Hinds, but differs in the upper part of the whorls lacking spiral striations, the canal being shorter, and the sinus not so produced outwardly to the right.

Pleurotoma (Glyphostoma) biseriata.

Testa breviter fusiformis, turrita, albida; anfr. 8, primi 2 læves, cæteri superne decliviter planulati, medio angulati, inferne plani, longitudinaliter costati (in anfr. ultimo costis 14 medio obsoletis), liris spiralibus 5 cincti, superioribus duabus tenuibus supra angulum sitis, sequentibus duabus magnis supra costas nodulosis, infima juxta suturam tenui; anfr. ultimus infra liras nodulosas liris aliis ad 10 ornatus; apertura parva, longit. totius ad $\frac{4}{13}$ æquans; columella callo tenui ad suturam incrassato induta, medio liris 3–4 (superne maxima) ornata; labrum intus extraque incrassatum, intus bidentatum; sinus magnus; canalis brevis, recurvus.

Long. 8 mill., diam. $2\frac{1}{2}$.

Hab. ——?

The lip of this shell is very peculiar, perhaps abnormal: it is thickened on the outside by the last longitudinal rib; and within there is a second rib, leaving a groove between it and the outer one; in fact the labrum may be said to have two margins. The two nodulous lirations are considerably larger than the others.

Pleurotoma (Glyphostoma) obtusicostata.

Testa anguste ovata, crassa, lutescens, infra medium anfr. ultimi castanea; anfract. 9, convexiusculi, superne prope suturam levissime constricti, costis 12 crassis, rotundatis, paululum obliquis instructi, liris confertis tenuibus supra ac infra costas continuis ubique ornati, paucis circa caudam quam cæteræ paulo majoribus; apertura parva, longit. totius $\frac{3}{8}$ æquans; labrum extra costa incrassatum, basi castaneo maculatum, intus liris tenuibus curtis circiter 10 (infima crassa) armatum, prope suturam sinu subamentiformi emarginatum; columella castanea, transversim obsolete tenuiter lirata; canalis angustus, brevissimus, leviter recurvus.

Long. 8 mill., diam. $2\frac{2}{3}$.

Hab. ——?, Japan probably. Variety from the Persian Gulf (*Pelly*).

In the specimen from the Persian Gulf the labrum has a second chestnut spot above, and the spiral lines are a little coarser than in the type.

Pleurotoma (*Glyphostoma*?) *exquisita*.

Pleurotoma vittata, Reeve (non Hinds), Conch. Icon. sp. 53, pl. vii. fig. 53.

Hab. Island of Luzon, Philippine Islands.

Pleurotoma (*Glyphostoma*?) *rubrocincta*.

Testa breviter fusiformis, turrita, rubescenti-alba, ad suturas rubro tincta et circa medium anfract. ultimi zona angusta rubra cincta; anfract. 7, primus lævis, secundus tenuiter crebre costatus, cæteri superne decliviter tabulati, deinde angulati, infra angulum plani, ad suturam constricti, costis subconfertis (in anfr. ultimo 12–13 fere ad basim continuis) instructi, liris spiralibus ad 6 supra costas leviter incrassatis (in anfr. ultimo circiter 18, quarum duæ supra angulum cæteris minores sunt) cancellati; apertura angusta, longit. totius $\frac{1}{2}$ paulo superans; columella obsolete dentata; labrum extra incrassatum, intus ad 8-dentatum; sinus vix apparens; canalis perangustus, brevis.

Long. $6\frac{2}{3}$ mill., diam. $2\frac{1}{2}$.

Hab. Ovalau, Fiji Islands, 12 fms.

The nearest ally to this species is *P. fasciata*, Gray.

Pleurotoma (*Glyphostoma*?) *bathyraphe*.

Testa ovato-fusiformis, roseo-alba; anfract. 7, primus lævis, secundus tenuiter arcuate costatus, cæteri leviter convexi, costis longitudinalibus 14 (in anfr. ultimo basi continuis) et liris validis 3 (in anfr. ultimo 15) supra costas nodosis cancellati, sutura profunda canaliculata sejuncti; apertura angusta, longit. totius $\frac{1}{2}$ paulo superans; labrum extra incrassatum, intus dentibus 7 (superioribus maximis) munitum, superne vix sinuatum; columella callosa, liris transversis circiter 6 ornata; canalis angustus, brevis.

Long. 6 mill., diam. $2\frac{1}{3}$.

Hab. San Nicolas, Zebu, Philippines, 10 fathoms (*Cuming*).

The cancellation of this species is very pretty, since the spiral lirations are thickened on crossing the ribs, and thus form transversely elongated tubercles. The suture is well marked and deep.

Pleurotoma (——?) *sexcostata*.

Testa angusta, fusiformis, fusca; anfractus 9, primi duo læves, convexi, sequens $1\text{–}1\frac{1}{2}$ crebre tenuiter costatus, cæteri fere plani, costis 6 leviter obliquis, prominentibus (supra spiram continuis, et in anfr. ultimo vix ad basim continuis) instructi, liris spiralibus 3 supra costas valde prominentibus, in interstitiis fere obsoletis, cincti; anfr. ultimus liris 13 ornatus, quarum tres infra medium cæteris minores et sex circa caudam interstitiis haud interruptæ; apertura parva, longitudinis totius $\frac{2}{5}$ adæquans; columella callo tenui sed satis distincto superneque labro juncto induta; labrum ad marginem tenue, extra costa ultima incrassatum, paululum infra suturam sinu subsemicirculari ornatum, intus liris parvis 6–7 armatum; canalis angustus, aliquanto elongatus.

Long. 6 mill., diam. fere 2.

Hab. Singapore, 7 fms. Coll. Cuming.

This uniformly rich-brown species is remarkable for the six ribs which are continuous up the spire, and the three lirations which traverse each whorl. They are very prominent on the ribs, standing out like little transverse nodules, and are almost obsolete in the interspaces.

Pleurotoma (*Taranis*?) *turritispira.*

Testa fusiformi-ovata, turrita, tenuis, sordide albida vel pallide straminea; anfractus 6. primi 2 pallide rubescentes, minute spiraliter granoso-lirati, convexi, cæteri superne decliviter tabulati et angulati, infra angulum fere plani, liris spiralibus præcipuis 4 (suprema ad angulum, cæteris infra eam sitis) et liris tenuioribus paucis supra angulum cincti, ubique incrementi lineis elevatis inter liras ornati; anfr. ultimus magnus, inter et infra liras 4 præcipuas liris aliis numerosis minoribus succinctus; apertura longitudinis totius ad $\frac{1}{2}$ æquans; labrum tenue, haud sinuatum; columella leviter contorta, callo tenuissimo amicta; canalis brevis, subangustus, leviter recurvus, ad sinistram flexus.

Long. 6 mill., diam. 2.

Hab. Japan.

Under a simple lens the two apical whorls appear almost smooth; but by the aid of a more powerful microscope they are seen to be covered with numerous close spiral series of minute granules.

XXX.—*Carcinological Investigation on the Genera* Pemphix, Glyphea, *and* Aræosternus. By T. C. Winkler.

[Concluded from p. 149.]

VI. *The Genus* Pemphix *compared with the Genus* Glyphea.

In the preceding pages we have glanced at the organization of *Pemphix Sueuri*, Meyer, we have given a short historical sketch of the genus *Glyphea*, followed by a description of the representatives of that genus which exist in the Musée Teyler, we have studied the organization of *Aræosternus Wieneckei*, De Man, according to the description published by the learned carcinologist of Leyden; and now let us examine into the differences which separate and the resemblances which unite the genus *Pemphix* and the *Glypheæ*, in order to learn whether it is permissible to regard the genus *Pemphix* as the direct ancestor, the original of the genus *Glyphea*.

Let us first see what are the differences.

The cephalothorax in *Pemphix* is distinguished from that of the *Glypheæ* by the principal grooves which divide it into three distinct parts, and by the form of the regions which are surrounded by these furrows. The cephalothorax of the *Glypheæ* is divided into two principal parts by a single groove, the nuchal or transverse groove. In general the surface of the cephalothorax in *Pemphix* is more ornate than that of the *Glypheæ*, the tubercles are more robust, the different regions are characterized by convex forms, depressions, &c. The front is more pointed, and the lateral incisions or sinuses of the anterior margin of the carapace are deeper than in the genus *Glyphea*.

There is one interesting question, namely to know whether the ambulatory legs of *Pemphix* differ or not from those of the *Glypheæ*. We know that von Meyer ('Neue Gattungen fossiler Krebse,' p. 6), in speaking of the anterior limbs, says, "The anterior limb is stouter and longer than the others; it would hardly seem that it was armed with a pincer, such as has been ascribed to it. One would rather think that its last joint was a slightly curved claw, and that the penultimate joint had no finger-like process. Pictet (Traité de Pal. ii. p. 444) says that the anterior limbs are not well known." Quenstedt places *Pemphix Sueuri* among the Locustinæ, *i. e.* among those Macrurous Crustacea of which the first pair of limbs possess no chelæ. This author, in speaking of the description given by Hermann von Meyer, says (Handb. der Petrefact. p. 324), "According to him the anterior limbs are stronger than the rest, and terminated in a pincer." Here the author places a? He proceeds, "Although in examining the figure one is not convinced of it, it is nevertheless certain that the succeeding legs bear pincers. In the Muschelkalk of Wiesen, in Switzerland, I have found a specimen in which the terminal joint of the first pair was perfectly preserved; it only terminates *in a claw*, as in the Locustæ."

It is therefore doubtful if we are to regard the feet of the first pair in *Pemphix* as a difference distinguishing that Crustacean from the *Glypheæ*, or whether we are justified in finding in them an analogy. Probably the ambulatory legs of *Pemphix* were monodactyle, like those of the *Glypheæ.*

Let us now examine the analogies:—

In *Pemphix Sueuri* we find the cylindroid form of the cephalothorax of the *Glypheæ.* Like that of the *Glypheæ*, it is covered with tubercles and divided by impressed lines or grooves. Von Meyer described the carapace of *Pemphix* as granulated and covered with tubercles.

The outer antennæ of *Pemphix* are long, multiarticulate, and situated upon jointed peduncles, exactly like the outer antennæ of the *Glypheæ.* On the first joint of the antennary peduncle we observe a protective scale or movable lamina, resembling the scale which protects the peduncle of the outer antennæ of the *Glypheæ.*

The inner antennæ of *Pemphix* are shorter than the outer, and terminate in two filaments, like the same organs in the *Glypheæ.*

The caudal fin of *Pemphix* exactly resembles that of the *Glypheæ*; we again meet with the same characteristic form of the seventh segment of the abdomen and the same form of the lateral plates of the sixth segment, of which the two outer are divided into two parts by a transverse line as by a hinge.

The abdomen in *Pemphix* is exactly analogous to that of the *Glypheæ*; and the same may be said as to the general habit of *Pemphix Sueuri.*

Considering the very great resemblance of the organization of *Pemphix* to that of the *Glypheæ*, and at the same time the comparatively unimportant differences which distinguish the latter from the former, is it not permissible to see in the genus *Pemphix* the Triassic ancestor of the genus *Glyphea?* No doubt in the geological ages which separate the formation of the beds of the Triassic epoch from the times in which lived the species of Crustacea whose petrified remains we find at present in the sediments and deposits of the Jurassic, Cretaceous, and Tertiary epochs, some anatomical characters may have been changed or modified: the arrangement of the grooves of the cephalothorax may have become different from what it was; the cephalothorax may have become more adorned with tubercles; the rostrum may have become less produced; and in this way the descendants of the genus *Pemphix* presented themselves under the form of the genus *Glyphea* in the period that immediately succeeded the Triassic epoch.

VII. *The Genus* Glyphea *compared with the Genus* Aræosternus.

We have just seen that very probably the genus *Pemphix* is the stock, the origin, of the genus *Glyphea*. Now we shall seek the existing representative of this genus; we wish to see whether a form of Macrurous Crustacean analogous to the fossil genus still exists in the present creation. For this purpose let us compare the genus *Glyphea* with the genus *Aræosternus*, De Man.

In the first place as regards the differences.

The surface of the cephalothorax of most *Glypheæ* is adorned with tubercles, in some species (*Glyphea Heeri*, Opp.) with hollow points or with small holes, sometimes with spines (*Glyphea Münsteri*), and in some species it is even almost entirely smooth (*Glyphea major*, Opp.). The tubercles are very often situated upon projecting lines, so as to form beaded rows, as may be seen in *Glyphea Regleyana*; among the specimens of *Glyphea Lundgreni* we also find some that are smooth.

The surface of the cephalothorax of *Aræosternus Wieneckei*, De Man, is adorned with a multitude of rugosities or very slightly elevated tubercles, broad and flat, which bear small tufts of hair of a yellow colour. M. De Man says the carapace does not bear spines, as in the *Palinuri*, but the entire surface is covered "with numerous small transverse tufts of very short yellow hairs, a few longer hairs being scattered among them." In this point, therefore, there is no very great difference between the *Glypheæ* and *Aræosternus Wieneckei*.

Another difference consists in the presence of a protective lamina or scale in the *Glypheæ* and the complete absence of this organ in *Aræosternus*. This scale is greatly developed in most *Glypheæ*. M. Oppel says (Paläont. Mittheil. p. 56), "Although this movable scale is not often met with, it appears nevertheless that it must have existed; for I have found it in several species of *Glyphea*, and especially in the well-preserved specimens. It is narrow and pointed, and does not attain the length of the peduncles of the outer antennæ." Although von Meyer says that *Glyphea gratiosa* (his *Selenisca gratiosa*) does not possess a movable scale, yet it may be that the specimen had been provided with such an organ and had lost it. *Aræosternus*, on the contrary, does not possess this protective plate; M. De Man says "an antennal scale is wanting."

Another difference is observable in the laminæ which form the caudal fin. The external laminæ of the *Glypheæ* are divided transversely, or separated by an oblique hinge; all the specimens which present the caudal fin intact offer this peculiarity. Etallon mentions this division of the outer plates of the caudal fin in speaking of the *Glypheæ* of the "terrain à chailles" which he has examined; von Meyer, Oppel, and other naturalists also speak of them. According to the figure of *Aræosternus Wieneckei*, all the laminæ of the caudal fin of this species are membranous in the inferior two thirds of their length, and calcified in the superior third. M. De Man says, "The seventh segment (the telson) is quadrangular, a little longer than broad; the anterior third is calcified, and furnished with several tufts of short hairs, as on the margins of the other segments; the other part is membranous, with many longitudinal series of very small tufts of short hairs. The lateral lamellæ of the sixth segment are broad, and form with the seventh segment the caudal fin; their upper surfaces are covered with several longitudinal series of tufts of hairs, resembling those of the upper surface of the seventh segment." Moreover the seventh segment of the abdomen of *Aræosternus* is of quadrangular form, while in the *Glypheæ* this organ is in general more or less triangular. There is therefore a considerable difference between the caudal fin of the *Glypheæ* and that of *Aræosternus Wieneckei*.

These are the differences which separate the *Glypheæ* from *Aræosternus*. Now let us examine the analogies.

On glancing at the figure of *Glyphea Sœmanni*, Opp., in pl. i. of the 'Paläontologische Mittheilungen,' and at the same time at the figure of the natural size of the unique specimen of *Aræosternus Wieneckei*, De Man, drawn by that naturalist himself, one is at once struck with the very great analogy or resemblance which exists between these two forms of Crustaceans. No doubt the habit of the one is also that of the other genus.

The cephalothorax of the *Glypheæ* is of an elongate cylindroid form. M. De Man says of the cephalothorax of his *Aræosternus* that it has an elongate subcylindrical form, and that its superior surface has an elongate rectangular form; its greatest width, which occurs a little behind the cervical groove, is in proportion to the length as 5 to 8. The front of the *Glypheæ* is not much pointed; and at its sides there are seen the two sinuses which lodge the ocular peduncles. In *Aræosternus*, according to M. De Man, we observe a broad triangular front, slightly curved downwards. It is separated from the external angles of the cephalothorax by two deep triangular incisions, in which the eyes appear. The posterior margin of the cephalothorax of *Glyphea* is semilunar; and M. De Man describes this part of the cephalothorax of *Arœosternus* as "the curved posterior margin of the upper surface of the cephalothorax." It appears therefore that the general form of the cephalothorax of *Glyphea* does not materially differ from that of *Arœosternus*.

A transverse furrow, the cervical groove, a little behind the middle of the cephalothorax, divides the carapace of all the *Glypheœ* into two principal parts. This groove, which is rather deep on the two sides of the back, is directed forwards and downwards. See the description of this groove in *Glyphea Lundgreni*, Schlüter (Verhandl. Rheinl. und Westfalens, 1874, p. 48). It is remarkable that M. De Man speaks nearly in the same terms of the cervical groove of *Arœosternus*:—"The cervical groove occurs a little behind the middle; its lateral parts are directed downwards and forwards towards the anterior part of the sternum." There is therefore no essential difference in this character.

The abdomen of several species of *Glypheœ* is perfectly smooth; there are only some of them in which that part of the body is adorned with a few scattered tubercles. That of *Arœosternus* is also smooth—that is to say, without tubercles or spines; only it is ornamented with a multitude of small tufts of hairs, except on the superior or dorsal surface. The lateral plates of the segments of the abdomen are also of the same form in both genera.

In both genera the ocular peduncles are cylindrical and lodged in sinuses of the anterior margin of the cephalothorax. M. De Man calls these sinuses in *Arœosternus* "deep triangular notches, into which the eyes project," which may almost be said of the genus *Glyphea*.

The jaw-feet of the *Glypheœ* consist of four joints, like those of *Arœosternus*.

The inner antennæ of the *Glypheœ* consist of a peduncle composed of three joints and of two multiarticulate terminal filaments. The inner antennæ of *Arœosternus*, according to M. De Man, are like those of the *Palinuri*; that is to say, the first joint is the longest and extends as far as the carpocerite of the outer antennæ; the second and third joints are of equal length, and together as long as the basal joint; and the terminal filaments are very short. It would therefore seem that these organs in the two genera only differ in the relative length of the filaments.

The outer antennæ of the two genera are exactly alike as regards the joints of their peduncle and the multiarticulate terminal filaments, which are a little shorter than the carapace. They differ only, as we have seen above, in the presence of a movable scale in the *Glypheæ* and the deficiency of that organ in *Aræosternus*. On the other hand, the basal joint of the outer antennæ of the latter is armed at the outer angle with a small spine. Is this spine a rudimentary protective lamina?

The legs of the first pair in the *Glypheæ* are much more robust than those of the succeeding pairs; they do not possess pincers, but are monodactyle. We may say precisely the same thing of the anterior legs of *Aræosternus*. On comparing an anterior limb of *Glyphea tenuis*, Opp., with a leg of the first pair of *Aræosternus*, one is struck with the incontestable resemblance which exists between these two organs. We recognize in these limbs the same structure, the same form of joints, the same three or four conical spines at the inferior margin of the propodite, and especially the same single small triangular finely pointed finger.

M. De Man says of the other ambulatory legs of his *Aræosternus* that they gradually become shorter and are formed like those of the *Palinuri*. One cannot judge otherwise of the last four pairs of ambulatory legs of the *Glypheæ*; the analogy is here incontestable.

Aræosternus is furnished with natatory false legs; they are of an ovoid pointed form and of foliaceous structure. I have observed a similar natatory leg in one of the specimens of *Glyphea pseudoscyllarus* in the Musée Teyler, as already stated. On comparing the enlarged figure of this organ with the false feet of *Aræosternus*, one is struck with the great resemblance of these parts.

From the enumeration of this multitude of analogies, compared with the very restricted number of differences between the fossil *Glypheæ* and the existing *Aræosternus*, it is easy to conceive the idea that the genus *Aræosternus* is derived from the genus *Glyphea*, that the same form of crustacean which already existed at the Triassic epoch, has maintained itself, with some modifications, during all the geological periods which have succeeded the Trias to the present day. I therefore see in the *Aræosternus Wieneckei*, De Man, the last representative of the *Glypheæ*, a genus of Crustacea which in its turn was a descendant of the genus *Pemphix*.

VIII. *Considerations and Observations.*

In the preceding I believe I have demonstrated the continuation or uninterrupted succession of a special form of Crustacean from the Trias to the present time—a form which presented itself first as *Pemphix*, afterwards became modified to give origin to the *Glypheæ*, and finally, after having undergone some further changes, is at present known as *Aræosternus.* The investigation of the existence of this long series of animal forms has made known to us a multitude of peculiarities with regard to the modifications and bodily changes undergone, the grade of generic development, &c. of this form of Crustacean.

Palæontological researches have shown that the most ancient Crustacea were Macrurous, that the Anomura made their appearance long before the Brachyura, and that the Brachyura did not show themselves until a comparatively recent geological period, namely in the Cretaceous. The most ancient Macrurous Decapods have been found in the Bunter Sandstone of Soultz-les-bains; these are forms analogous to the genera *Gebia* and *Galathea.* After the Bunter we find the Muschelkalk, which has preserved for us two forms of the genus *Pemphix.* In the Jurassic deposits, including the Lias, we meet with a great number of genera of Macrurous Decapoda, known at present under the names of *Eryon*, *Glyphea*, *Eryma*, *Pterochirus*, *Megachirus*, *Palinurina*, *Cancrinos*, and many others. In the Cretaceous again we find several Macrurous genera, side by side with the first Brachyura. In the present day the reverse is the case; in the existing fauna we count at least three species of Brachyurous Crustacea for one Macruran. The most recent palæontological investigations, the most complete treatises upon fossil Crustacea, prove that the close of the Cretaceous period and the whole of the Tertiary period are characterized by a predominance of Brachyurous Crustacea. It would appear, then, that in the Cretaceous period Nature prepared for the production of Brachyurous species—species which she scatters in the existing period with so much prodigality. The result of carcinological researches with regard to the predominance of certain forms of Decapod Crustaceans is, on the one hand, absolute predominance of Macrurous and almost complete absence of Brachyurous Crustacea in the older strata of our globe, and, on the other, a very great predominance of Brachyurous Crustacea, with continuation of the Macrurous Crustacea, in the more modern deposits.

The investigations of palæontologists have further taught us that each of the different formations of the globe contains only remains of Crustaceans of a form proper to it, or, to express myself more precisely, that no *species* of Crustacean of a given period has lived during another period, while the *genus* has been able to exist during several consecutive geological periods. For example, none of the *species* of Macrurous

Crustacea of the Lithographic Limestone has as yet been met with in the Cretaceous; it has sufficed for Nature to interpose the Kimmeridgian and the Portlandian to cause the disappearance of all similarity, all identity between the *species* of Crustacea of the Jurassic and Cretaceous deposits. But the *genus* has survived during the successive changes of the earth's crust; witness the *genus Glyphea*, which we have at present in hand, which has existed from the Lias, and perhaps even from the Trias, to the Tertiary beds of Monte Bolca, and even to the present day in the form of *Aræosternus*.

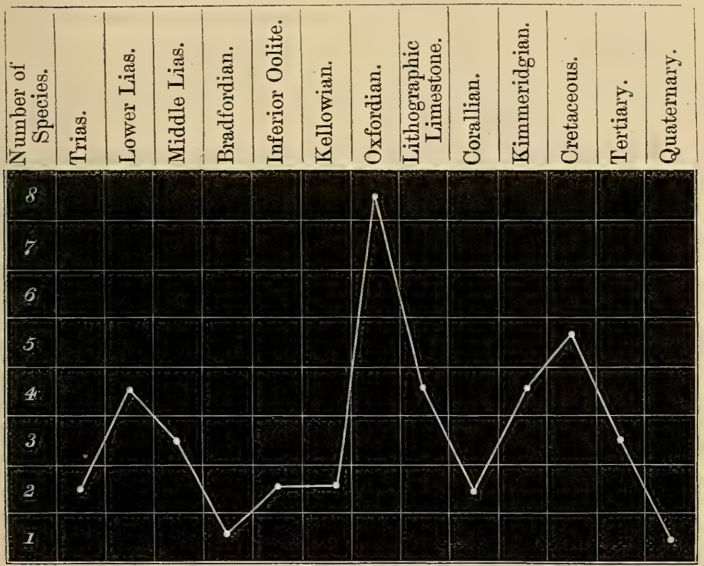
Let us now turn our attention to the alternate development and decrease of the genus *Glyphea* during the successive periods of its existence. In the Trias it presents itself for the first time in the form of the genus *Pemphix*, consisting of two species, *P. Sueuri* and *P. Alberti*, Meyer. In the Lower Lias the species have increased in number, as we already find in it four species—*Glyphea grandis*, Mey., and *G. Heeri*, *G. major*, and *G. alpina*, Opp. In the Middle Lias we only know three species, *G. liasina*, Mey., and *G. Terquemi* and *G. amalthea*, Opp. It would appear that in the Bradfordian external conditions were unfavourable to the genus; we only meet with a single species, *G. pustulosa*, Mey. In the Inferior Oolite there exist two species, *G. solitaria* and *G. crassa*; and the same number occur in the Kellowian, *G. Martini*, Etall., and *G. ornata*, Quenst. But in the Oxfordian the genus *Glyphea* attains its greatest development; it there presents as many as eight species—*G. Regleyana*, Mey.*, *G. Etalloni*, Opp.†, *G. vulgaris*, Mey.‡, *G. speciosa*, Mey., *G. Münsteri*, Mey.§, *G. ventrosa*, Mey., *G. Udressieri*, Mey.||, and *G. Mandelslohi*, Mey. In the period that follows the Oxfordian, in the deposits of the Lithographic Limestone, the number of species is considerably diminished; we only meet with four species, namely *G. pseudoscyllarus*, Mey.¶, *G. squamosa*, Mey.**, *G. tenuis*, Opp., and *G. Sæmanni*, Opp. In the Corallian only two species appear, *G. Bronni*, Röm., and *G. Perroni*, Etall. The Kimmeridgian, on the other hand, contains double the number of the preceding formation; we find in it *G. gratiosa*, Opp.††, *G. rostrata*, M'Coy‡‡, *G. jurensis*, Opp., and *G. Meyeri*, Opp. In the Cretaceous period the number

* *Palinurus Regleyanus*, Desm.
† *Glyphea rostrata*, Etall. non Phill.
‡ *Palinurus Regleyanus*, Desm.
§ *Palinurus Münsteri*, Voltz.
|| *Palinurus squammifer*, E. Desl.
¶ *Macrourites*, sp., Schl.
** *Orphnea*, sp., Münst.
†† *Selenisca gratiosa*, Mey.
‡‡ *Astacus rostratus*, M'Coy.

of species of *Glyphea* still further increases; we find here *G. neocomiensis*, Rob.-Desv., *G. cretacea*, M'Coy, *G. Carteri*, Bell, *G. Lundgreni*, Schlüt., and an undetermined species, *Glyphea*, sp., Dixon. In the Tertiary the genus diminishes in number of species; there are only three—*G. numismalis*, Opp., *G. Hauensteini*, Mey., and the species placed among the *Palinuri* by Desmarest. Finally, in the Quaternary or actual period the number of species decreases considerably; we know only a single species, *Arœosternus Wieneckei*, De Man.

The following graphic Table enables us to follow the alternate progressive and retrograde course of the genus *Glyphea* through the geological ages of the globe.

Graphic Table of the Genus Glyphea.



This Table teaches us that the genus *Glyphea* has existed during the innumerable ages which have succeeded one another from the Triassic epoch to the present time, that it first appeared in the form which has been named *Pemphix*, that it traversed the Jurassic, Cretaceous, and Tertiary periods, and that it seems now to be approaching extinction in the form to which the name of *Arœosternus* has been given. An existence so long and uninterrupted shows us that this form of Crustacean has had a very considerable vitality, a remarkable force of resistance, a tenacity which nothing could overcome. Although this form has certainly undergone some modifications (of which we shall speak presently), in general it has remained the same as it was during this long series of ages; it has not been able to change its monodactyle feet into pincers; it has not been able to conceal its long tail beneath its carapace. It is supposed that it is a progress in organization if the monodactyle foot becomes changed into a didactyle pincer; it is believed that in these pincers the didactyle Crustacean possesses a more effective means of seizing its prey than the monodactyle Crustacean has in its claws. It is also supposed that it is an advance in the organization of the Crustacean when the abdomen bends so as to remain concealed beneath the carapace; it is generally believed that the Brachyurous Decapod Crustacean is the highest type of the organization of the Crustacea. And yet the generic form of the *Glypheæ* has survived through geological ages; it has been victorious in the battle of life, in which its contemporaries, *Eryma*, *Megachirus*, *Eryon*, and several other genera, have succumbed*.

The surface of the body of the *Glypheæ* has not remained without alteration during the many ages of their existence; there is a considerable difference between the first representative, *Pemphix*, and the last, *Aræosternus*. But these changes of external characters do not merit the name of essential; they are only unimportant modifications with reference to the vital functions. In the first place, the tubercles, which are so highly developed in *Pemphix*, appear much less robust, and especially less numerous, in the carapace of the Jurassic *Glypheæ*: there are even some from the Kellowian, and especially a species from the Cretaceous, of which the carapace is nearly smooth; while the carapace of the last representative, *Aræosternus*, is adorned only with small and but slightly elevated plates, the almost imperceptible remains of the great tubercles of its Triassic ancestor, *Pemphix*.

The *Glypheæ* are not the only animals the existing representatives of which no longer present the ornamentation of the outer integuments of their ancestors. The fishes of our present waters do not possess the scales adorned with tubercles, hollow dots, beaded striæ, &c. of the *Gyrodontes*, the *Belonostomi*, the *Caturi*, &c. which lived in Jurassic waters. We are certainly justified in seeing in the slight elevations, the squamiform rugosities of the carapace of *Aræosternus*,

* The author here enters into a long digression upon the question whether the acquisition of additional parts constitutes an advance of organization, which we have not thought it desirable to reproduce.

indications or remains of the strongly marked tegumentary ornamentation of the more ancient *Pemphix* and *Glyphea.*

The entire body of *Aræosternus* is covered with little tufts of yellow hairs, with here and there isolated longer hairs scattered among the tufts. The fossil *Glypheæ* present no hairs. It might be supposed that the tubercles of the surface of the carapace of these latter Crustacea were peduncles which at one time bore tufts of hairs, and that these hairs were lost during fossilization. There are, however, Crustaceans which lived in the same ages and in the same waters, side by side with the *Glypheæ*, such as the *Megachiri*, the *Microchiri*, and others, the remains of which, preserved in the Lithographic Limestone of Bavaria, still allow us to perceive a multitude of hairs, which are very visible along the antennæ, the anterior limbs, &c. of these animals. Why, if the *Glypheæ* were ornamented with hairs, should not their fossil remains show us hairs, preserved as perfectly as those of their contemporaries the *Megachiri*? We may therefore suppose that the *Glypheæ* were not furnished with hairs like *Aræosternus*. But no one will assert that an animal the skin of which is covered with hairs, cannot descend from another of which the skin is naked, or that a hairy animal could not have had an ancestor with a skin unfurnished with hairs. The elephant of the present day is completely destitute of hairs, while its ancestor, the mammoth, was provided with them; but no one doubts as to the degree of relationship which unites these two forms. No one will see a generic difference in the more or less hairy state of the outer integument of animals.

The limits of our investigation do not allow us to dwell further upon these interesting subjects. What we have said will suffice, we believe, to demonstrate that the genus *Glyphea* existed as long ago as the Trias under the form of *Pemphix*, and that it will probably become extinct in the present epoch under the form of *Aræosternus*.

XXXI.—*List of Lepidoptera recently collected by Lieut. Alfred Carpenter at Yedo and Oö-Sima.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE following species, collected by Lieut. Carpenter, of H.M.S. 'Magpie,' were received in two consignments, the first of which (collected in Porpoise Strait, Oö-Sima or Harbour Island, Lu-chu group, off China, during the month of March) contained only five specimens of Lepidoptera, of which three had suffered so much in transit as to be barely recognizable; the second consignment (from Tateyama Bay, entrance to Gulf of Yedo, Japan, collected in May and June) contained thirty-four examples, for the most part in very fair condition.

As adding to our knowledge of the geographical distribution of the Lepidoptera, these two little series are interesting; and therefore I have thought it worth while to draw up a list of them.

As usual, the butterflies are greatly in excess of the moths; otherwise it is probable that more novelties would have been received.

List of Species.

Rhopalocera.

1. Lethe sicebis, *Hewits.*, Yedo.
2. Gareris perdiccas, *Hewits.*, Yedo.
3. Ypthima argus, *Butl.*, Yedo.
4. Vanessa angelica, *Cram.*, Yedo.
5. —— glauconia, *Motsch.*, Yedo.
6. Pyrameis indica, *Herbst*, Yedo.
7. Lycæna japonica, *Murr.*, Yedo.
8. Lampides hellotia, *Ménétr.*, Yedo.
9. Chrysophanus timæus, *Cram.*, Yedo.
10. Amblypodia asinarus, *Feld.*, Lu-chu *.
11. Terias mandarina, *De L'Orza*, Lu-chu.
12. Ganoris crucivora, *Boisd.*, Yedo.
13. Papilio xuthus, *Linn.*, Yedo.
14. —— asiaticus, *Ménétr.*, Yedo.
15. —— japonicus, *Butl.*, Yedo.
16. —— Carpenteri, *Butl.*, Yedo.
17. —— spathatus, *Butl.*, Yedo.

Heterocera.

18. Zonosoma interlectum, *Walk.*, Lu-chu.
19. Adris tyrannus, *Guénée*, Yedo.
20. Remigia virbia, *Cram.*, Yedo.
21. Hypena thermesialis, *Walk.*, Lu-chu.
22. Saraca trimantesalis, *Walk.*, Yedo.
23. Timandra comptaria, *Walk.*, Yedo.
24. Abraxas miranda, *Butl.*, Yedo.

New Species.

Papilio Carpenteri, sp. n.

♂. Allied to *P. demetrius*. Primaries above blackish grey, with the borders, veins, and internervular streaks black: secondaries greenish black; a large jet-black spot at anal angle, bordered above by an orange-red lunule enclosing a black dash, and sprinkled in front with a few pearly whitish scales, below by a triangular golden-orange spot; fringe

* Too much damaged for insertion in the collection.

white between the veins; the usual sulphur-yellow costal streak: body black; abdomen greenish. Primaries below ash-grey, the black streaks and veins narrower than above: secondaries greenish black; a decreasing submarginal series of four orange lunules from apex to lower radial interspace; a few scales in the second median interspace, a large crescent in the first median interspace, and a large irregular patch enclosing a black spot, sprinkled in front with white scales, and bordered with white on the margin at anal angle: body below black. Expanse of wings 118 millim.

♂. Tateyama Bay, entrance to Gulf of Yedo.

♀. Much larger than the male. Primaries above pale brown, the veins and streaks blackish brown, diffused: secondaries with the basal half smoky brown, with a central nebula of bluish scales; external half blackish brown; a few orange scales on the second median interspace, a crescent on the first median interspace, and a large patch enclosing a round black spot and sprinkled in front with white scales, at anal angle: body smoky brown; head, as usual, black, dotted with white. Primaries below whiter than in the male, the cell slightly tinted with sulphur-yellow: secondaries dark chocolate-brown, the cell dark green; a continuous submarginal series of orange crescents, the first, second, and sixth large, the first sprinkled with pearly scales; anal orange patch larger than in the male, its upper portion extending inwards to beyond the second median branch, and more distinctly sprinkled with pearly scales: body below smoky brown, a whitish line down each side of the venter. Expanse of wings 136 millim.

♂ ♀. Nagasaki (*Whitely*). B.M.

The male from Whitely's collection is a little smaller than that obtained by Lieut. Carpenter, and agrees with its female in having a complete submarginal series of orange lunules on the under surface. The species stands nearest to *P. demetrius*, from which it differs in its smaller size, not much exceeding that of *P. macilentus*, the paler and not greenish colour of the primaries, the narrower tails of the male and the shorter tails of the female, the larger reddish-orange borders to the anal spot on the male, and the more uniform blackish colour of the secondaries below; from *P. macilentus* it differs in its superior size, broader wings, and shorter tails, and from *P. tractipennis* in its shorter wings and tails.

In identifying this group of Papiliones it must always be borne in mind that the males have longer or narrower tails to the secondaries than the females, and consequently without due care the examples of the latter sex are likely to be confounded.

XXXII.—*The Pelagic Fauna of Freshwater Lakes.* By Prof. F. A. Forel*.

In the years 1860–1870 the Scandinavian naturalists discovered a peculiar fauna, consisting essentially of swimming Entomostraca, which inhabits the pelagic region of lakes. I will endeavour to give a brief summary of this chapter of general zoology, which has been of late years repeatedly investigated, and has led to some new and interesting results †.

This fauna is not very numerous in species; but the number of individuals of the different species is enormous. I give here an enumeration of the species that have been found:—

* Translated from the 'Biologisches Centralblatt,' Band ii. p. 299.

† Literature:—

W. Lilljeborg ("Beskrivning &c.," Œfversigt af K. Vetensk. Akad. Förh. 1860) described the genera *Bythotrephes* and *Leptodora*, which are peculiar to this fauna. (*Bythotrephes* was first discovered by Leydig in 1857, in the stomachs of *Coregoni* from the Lake of Constance; he erroneously placed its habitat in the depths of the lake.)

From 1861–1865 G. O. Sars described numerous pelagic Entomostraca in the Norwegian lakes. ("Om Crustacea Cladocera," Förh. i Vidensk. Selsk. Christiania, 1861; 'Om en i Sommeren 1862 foretagen zoologisk Reise,' Christiania, 1863; 'Norges Fervands Krebsdyr,' Christiania, 1865.)

In 1866 Schœdler ("Cladoceren des Frischen Haffs," Wiegmann's Archiv, 1866) described *Daphniæ* which he had captured in the Frischen Haff.

In 1867 P. E. Müller ('Dänmark's Cladocera,' 1867; "Cladocères des grands lacs Suisses," Arch. des Sci. Phys. et Nat. Genève, 1870) ascertained the presence of this fauna in the Danish lakes; in 1868 he also found it in the Swiss lakes.

In 1871 Frič investigated the distribution of these Entomostraca in the Bohemian lakes ("Fauna der Böhmerwaldseen," Gesellsch. der Wissensch. Prague, 1871).

From 1874 to 1879 I myself investigated them in the Swiss lakes ("Matériaux pour la faune profonde du lac Léman—Faune pélagique XXXII., Flore pélagique XXXIII., Transparence de l'eau VII. et XXXVIII.," Bull. Soc. Vaud. Sci. Nat. tomes xiii. & xiv. Lausanne, 1876; "Variations de la transparence de l'eau," Arch. des Sci. Phys. et Nat. lix., Genève, 1877).

From 1874 to 1879 A. Weismann published his fine memoirs upon the natural history of the Daphnidæ ("Beitr. zur Naturg. der Daphniden," Zeitschr. für wiss. Zool., 1874–79), founded upon his investigations in the Lake of Constance. In 1877 he gave, in a popular discourse, "Das Thierleben im Bodensee" (Lindau, 1877), an excellent general description of the different faunas that inhabit the lake, and especially of the pelagic fauna.

In 1877 Pavesi discovered the marine fauna in the Italian lakes (Bull. entom. 1879; Rendiconti R. Ist. Lomb. ser. 2, xii. f. 11, 12, 16).

In 1879 Brandt collected these forms in the Gotschaï lake, in the Caucasus (Bull. Acad. St. Pétersb. 1880).

S. T. Smith has detected them in Lake Superior, in North America.

G. Asper ('Gesellsch. kleiner Thiere der Schweizer. Seen,' Zurich, 1880) studied the pelagic and abyssal fauna of the different Swiss lakes.

OSTRACODA: *Cypris ovum.*

CLADOCERA: *Sida crystallina*; *Daphnella brachyura*; *Daphnia pulex*, *D. magna*, *D. longispina*, *D. hyalina*, *D. cristata*, *D. galeata*, *D. quadrangula*, *D. mucronata*; *Bosmina longirostris*, *B. longispina*, *B. longicornis*; *Bythotrephes longimanus*; *Leptodora hyalina.*

COPEPODA: *Cyclops coronatus*, *C. quadricornis*, *C. serrulatus*, *C. tenuicornis*, *C. brevicornis*, *C. minutus*; *Heterocope robusta*; *Diaptomus castor*, *D. gracilis.*

If we were to cite all the animals which are found in the pelagic region of the lakes we should have to add the insectivorous fishes which feed upon these little Entomostraca, especially the *Coregoni*, and, further, the predaceous fishes (trout, pike, &c.) which attack the *Coregoni*; we should also have to add the Infusoria (*Vorticella convallaria*) which live upon the pelagic Algæ; and, finally, we should have to cite the animals which dwell far from the shores or rise from the bottom, and are thus found occasionally in the pelagic region, such as *Atax crassipes* (Pavesi, Asper), larvæ of Diptera, and *Piscicola geometra* (Forel). All these animals, however, appear only occasionally and as accessories in the pelagic fauna, which in reality embraces only the above enumerated Entomostraca *; these alone show the peculiar characters of pelagic animals.

In its general features the pelagic fauna is similar in all the countries and lakes of Europe that have as yet been investigated, from the lakes of the plains to those of the Alps, and from the Scandinavian countries to Southern Italy and the Caucasus. It is, however, seldom represented in any one lake by all the animals of the fauna. Thus, for example, the pelagic fauna of the Lake of Geneva in the years 1874–78, during which I investigated it, only possessed the following species:—*Diaptomus castor*, *Daphnia hyalina*, *D. mucronata*, *Bosmina longispina*, *Sida crystallina*, *Bythotrephes longimanus*, and *Leptodora hyalina.* From this point of view Pavesi has very carefully examined the Italian lakes, and given for each of them a table of the species captured. In estimating these tables, however, Weismann's observations must be taken into account. This naturalist has shown that the different species of Cladocera present a yearly periodicity; that during many seasons they disappear more or less com-

* Perhaps *Atax crassipes*, which Pavesi sometimes observed in the pelagic region of the Italian lakes, and which Asper detected in the Lake of Zurich, must be regarded as a species belonging to the pelagic fauna. It is a swimming water-mite, and, according to these observers, the specimens captured were almost transparent.

pletely from the waters they inhabit, and can only be found in the state of resting-eggs; that this period during which the animals disappear varies according to the different species, occurring for one in the summer, for others in the winter, spring, or autumn. According to this a revision of the pelagic population of a lake, if it is to be complete, must be drawn up on the results of numerous observations made at different seasons of the year.

The characters common to the animals of the pelagic region are due to their mode of life. They must swim incessantly without ever being able to rest upon a solid body; and instead of any organ of adhesion they possess a highly developed natatory apparatus; their specific gravity, which is nearly the same as that of the water *, enables them to swim about in the water without any great muscular exertion. They are rather sluggish animals, and escape the enemies that pursue them rather by their transparency than by their activity; they are, indeed (and this is their characteristic peculiarity), perfectly transparent, like crystals; and only their strongly pigmented black, brown, or red eye appears distinctly. This nearly perfect transparency of the pelagic animals may be regarded as a mimicry acquired by natural selection; only the animals which are as transparent as the medium in which they live have held their own.

They feed upon vegetable or animal structures; some feed upon pelagic Algæ (*Anabæna circinalis*, *Pleurococcus angulosus*, *P. palustris*, *Tetraspora virescens*, *Palmella Ralfsii*); the rest upon animal prey, eating the smaller and weaker species which live in the same water.

The pelagic animals perform daily migrations, as was found independently by Weismann and myself in 1874: during the night they swim at the surface; during the day they descend into the depths. Frič thought that in the Bohemian lakes he found that the different species selected a particular depth at which they preferred to dwell; but neither Pavesi nor myself have been able to ascertain that there was any such constancy of habitat. The different species form groups or flocks, in which the net obtains an abundant booty; but, at least in the great Swiss lakes, these associations of animals of the same species maintain no definite and permanent position.

As regards the greatest depths at which they are met with, I have captured them in the Lake of Geneva as far down as

* They are a little heavier than the water; and when they die the dead bodies sink to the bottom of the lake and then form an important part of the food of the fauna of the depths.

100 and even 150 metres; at these great depths, however, I have only found *Diaptomus*.

On account of these migrations Weismann regards them as nocturnal animals which keep at the extreme limit of light; their optic nerve would suffer under the influence of too bright a light, and they therefore descend into the deep water so soon as the light of the sun or moon becomes too strong. Nevertheless they must still see in order to be able to pursue their prey; and they therefore only descend to the point where their generally well-developed eyes enable them to find their nourishment. Weismann justly remarks that in these migrations they traverse daily a colossal stratum of water, in which they may find sufficient nourishment, sparingly as this may be distributed in the comparatively clear water of the freshwater lakes.

But what is the limit of light in freshwater lakes? I demonstrated in 1877 that the transparency varies with the seasons of the year; in the Lake of Geneva a shining object immersed in the water disappears (when the conditions of illumination and transparency are most favourable) when it is in a stratum of water of a depth of 16–17 metres. Photographic investigations with paper sensitized with chloride of silver had proved to me in 1874 that the limit of absolute darkness in the Lake of Geneva lies at a depth of 45 metres in summer and of 100 metres in winter. Asper, using much more sensitive plates (with emulsion of bromide of silver), in August 1881, found that the rays are still efficacious at 90 metres and more in the Lake of Zurich. All this, however, tells us nothing as to the limit of absolute darkness for the retina and especially the visual nerves of the low animals.

What is the origin of this pelagic fauna? Does it depend upon a local differentiation? Have the palustrine or fluviatile Entomostraca, those of the littoral region of the lakes, become transformed in each lake into pelagic species or varieties? To this last question we can with certainty answer in the negative. The remarkably wide distribution of this fauna, the almost complete identity of the pelagic Entomostraca in all the European lakes, from the Scandinavian to the Swiss, Italian, and Armenian, speak in favour of a common origin and distribution.

But how has this distribution been effected? Active migration from one lake to another is not admissible, both on account of the difficulty of communication between the different lakes, and because of the slowness and inactivity of the pelagic Entomostraca. On the other hand, passive migration in the state of resting-eggs which may have attached themselves to the feathers of migratory birds (ducks, grebes, gulls, &c.) perfectly explains the transference from one lake to another (A. Humbert, Forel). Pavesi has urged against this common origin and mode of distribution the irregularity of the pelagic peopling of the different Italian lakes, as many species are deficient in certain lakes while they occur in neighbouring lakes; but this very irregularity seems to me to be in favour of the occasional and accidental mode of distribution that we have just indicated. If we accept this mode of distribution, the differentiation of the pelagic species is no longer necessarily limited to the lake in which we find the animals or to the present geological epoch. This fact is of great importance in the explanation of the pelagic fauna of certain lakes of comparatively recent origin; in the case of our Swiss lakes the glacial period forms an absolute limit, which entirely prevents our accepting a local differentiation of the old Tertiary species and their transformation into the existing species. The pelagic faunas of many Italian lakes of volcanic origin are of a much later date still. But as we are no longer confined to a local differentiation of the autochthonous species, we have more time and space at our disposal for this differentiation.

I believe we must find the cause of the differentiation of the pelagic fauna in the combination of two different phenomena—namely, the daily migrations of the Entomostraca, and the regular local winds of the great lakes. It is well known that on the borders of great masses of water two regular winds prevail, one of which blows at night from the land towards the water, the other by day from the water to the land. The nocturnal animals of the shore-region which swim at night at the surface are at this time driven towards the middle of the lake by the surface-current of the land-wind, sink during the day, being driven away by the light, into the deep water, and thus escape the surface-current of the lake-wind, which would otherwise have carried them again to the shore. Constantly driven further every night, they remain confined to the pelagic region, as they are not carried back again during the day. Thus a differentiation takes place by natural selection, until at last, after a certain number of generations, there remain only the wonderfully transparent and almost exclusively swimming animals which we know. When this differentiation has once taken place, the pelagic species is conveyed by the migratory water-birds from one country to another and from one lake into another, where it reproduces its kind if the conditions of existence of the medium are favourable. In this way we may find the pelagic Entomostraca in lakes which are too small to possess the alternation of winds, the animals having been differentiated by the action of the winds in other larger lakes.

In this way we can easily explain the differentiation of most pelagic species, with the exception of two; and these are the finest and most interesting of the pelagic Entomostraca—namely *Leptodora hyalina* and *Bythotrephes longimanus*. These two Cladocera are not related to the freshwater species which form the littoral faunas of the lakes, or the palustrine and fluviatile faunas*; and therefore we cannot explain their origin by differentiation of the littoral forms. For these two species we must therefore, like Pavesi, seek a *marine origin*. *Bythotrephes* would be derived from an ancestor which was common to it and to *Podon*, its nearest ally, as, indeed, Leydig has already indicated. *Leptodora*, on the contrary, according to Weismann's view, would have branched off from a primæval Daphnid, of whose direct descendants nothing further is known.

But how could the passage from salt into fresh water be effected? Pavesi supposes that this may have taken place by the closing of a fjord, and its gradual conversion into a freshwater lake, so soon as it was separated by a bank from the sea. This is possible; and we have examples of the same kind in certain marine forms which occur in the freshwater lakes of North Italy and Scandinavia. But how if this transition has not taken place by passive migration and transference into lagoons which were constantly becoming less salt? For the decision of this question we have still no reliable materials. But so soon as the adaptation to fresh water had been effected, the distribution of these forms of marine origin took place in the same way as with other pelagic freshwater forms, and thus these two forms would be introduced into lakes which were never in direct communication with the sea.

In conclusion, we might draw a parallel between the pelagic fauna of freshwater lakes and that of the sea. The analogies are numerous and of great interest; but they are so patent that it is superfluous to dwell upon them particularly. The general facts are the same or very similar; the distinction lies chiefly in size and number. In the sea all is large; in our lakes every thing is of small and restricted dimensions—not only the number and size of the individuals, but also the number of species, the extent of their migrations, and their range of distribution.

* G. Joseph has discovered, in two large caves of Carinthia, a second species of the genus *Leptodora*, *L. pellucida*, which differs essentially from the *L. hyalina* of the pelagic lake-fauna by the absence of eyes. It is the only Cladocere that occurs in the cave-fauna (Berl. entom. Zeitschr. xxvi. 3, 1882).

XXXIII.—*Description of a new Genus and Species of Frogs of the Family* Hylidæ. By G. A. Boulenger.

The new frog described in this paper was purchased of Mr. A. Forrer, who obtained it at Presidio, W. Mexico, and succeeded in bringing it alive to England. Notes are appended on the coloration and habits of two other living frogs, obtained at the same place by the same collector.

Pternohyla, g. n.

Distinguished from *Hyla* by the great development of the inner metatarsal tubercle, which is strongly compressed.

Pternohyla fodiens, sp. n.

Tongue circular, entire and slightly free behind. Vomerine teeth in two round groups close together between the choanæ. Head moderate, broader than long, entirely bony, rough; labial borders projecting and slightly raised; snout rounded, once and a half as long as the diameter of the orbit, the profile obliquely descending from the eyes; the distance from the nostril to the orbit equals the diameter of the latter; canthus rostralis raised, curved; loreal region very wide, concave; interorbital space much broader than the upper eyelid, deeply concave; tympanum very distinct, half the diameter of the orbit. Fingers slender, slightly webbed at the base; no projecting rudiment of pollex; toes slender, moderately elongate, one-third webbed; disks of fingers and toes very small, much smaller than the tympanum; subarticular tubercles small, prominent; inner metatarsal tubercle large, compressed; no fold along the tarsus. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the posterior corner of the eye. Skin of back closely granulate; belly and lower surface of thighs granulate. Light brown above, with large elongate insuliform dark brown black-edged spots on the back, avoiding the vertebral line; flanks marbled with dark brown; thighs and groin sulphur-yellow, marbled with dark brown; limbs with large dark brown transverse spots; lower surfaces white, the throat with dark vermiculations. Iris golden. From snout to vent 59 millim.

This most remarkable form approaches *Triprion* in the shape of the head; the large compressed metatarsal tubercle distinguishes it from any species of the family Hylidæ.

It is a timid creature, getting very frightened when handled, whilst all other Hylidæ I have seen alive are very indifferent under similar circumstances. It is slow in its movements, and not a good climber. Its habits are more burrowing than arboreal. It is not able to climb up a glass, but burrows itself deeply in the moss by means of its metatarsal shovels, the movements executed in this proceeding being exactly those of *Pelobates*. I believe this to be the first instance of an adaptation to both burrowing and arboreal life. Some species of *Callula*, which were formerly believed to present this combination, are truly burrowing and unable to climb to any extent; *Callula pulchra*, which I had the pleasure of seeing alive in the Jardin des Plantes a few months ago, lives exactly like *Pelobates*, to which it bears a strong resemblance in the shining skin and enormously inflated lungs.

Hyla venulosa (Laur.).

This species has not been hitherto recorded from Mexico. The coloration of my specimen is as follows:—Upper surfaces light brown, with large chestnut-brown spots; these occupy entirely the hinder part of the back and the hind limbs; upon the latter the lighter ground-colour appears in the form of transverse lines; on the flanks the spots are bordered with pure white; lower surfaces of a rather dirty white, the throat with brown vermiculations. The eye is very beautiful, the iris being golden with black reticulations, and a vertical and a horizontal black bar, forming a cross. The vocal bladders are black; they cannot be retracted, as in the *Ranæ* with external vocal sacs; and when empty they hang on each shoulder like a cutaneous lobe. As is well known, the bones of this frog are of a beautiful "vert de gris;" this colour is seen on the vomerine groups and on the border of the lower jaw when the mouth is open.

The attitudes and movements of *H. venulosa* are much the same as those of its European congener; but it is entirely nocturnal, remaining concealed the whole of the day. It is by no means shy, but, when handled, exudes a great quantity of poisonous fluid, more so than any Batrachian I have had before. Besides, this fluid, of a milky appearance, coagulates instantaneously, sticking to the fingers in a very disagreeable manner; it has a strong odour, resembling that of peaches, and affects very disagreeably the mucous membrane of the nostrils, causing a strong itching.

Phyllomedusa dacnicolor, Cope.

The size of this species was believed to be that of *Hyla arborea*. Several specimens, brought home by Mr. Forrer, show that it attains to a very large size, viz. 83 millim. from snout to vent. The habits are those of *Hyla cœrulea*, which this frog resembles in size, general porportions, and colour. The faculty of opposing the inner finger and toe is conspicuous, though less so than in the typical species of *Phyllomedusa*. The colour of the upper parts is normally bright green, but rapidly changes to olive or brown; white dots are scattered on the flanks; the lower parts are pure white; the two inner fingers, the three inner toes, the lower surface of the hands and feet, and the sides of the limbs are yellowish pink. The iris is black, vermiculated with gold; a golden line borders the vertical pupil. The nictitating lid is veined with gold, and the lower eyelid completely opaque, green.

MISCELLANEOUS.

On the Sexuality of the Common Oyster (Ostrea edulis) *and that of the Portuguese Oyster* (O. angulata). *Artificial Fecundation of the Portuguese Oyster*. By M. Bouchon-Brandely.

Twenty or twenty-five years ago the Portuguese oyster, which is indigenous to the Tagus, did not exist on the coasts of France. It has been acclimatized in our waters quite accidentally. A ship coming from Portugal, having suffered damage, had to discharge its cargo in order to undergo repair. The oysters which it carried were thrown into the Gironde, upon the old Banc de Richard. Meeting there with conditions favourable to their propagation, they multiplied at such a rate that from Pointe de Grave to Richard, over an extent of from 25 to 30 kilometres, they now form a vast bed, the breadth of which will soon be limited only by the banks of the river.

The sexuality of this oyster differs essentially from that of the other kinds of oysters common to our waters, of which the most wide-spread is *Ostrea edulis*: this is hermaphrodite, as Lacaze-Duthiers, Coste, Davaine, Möbius, Eyton, Hart, and many others have proved. Is it a self-sufficing hermaphrodite? With respect to this, nothing has yet been quite demonstrated. Considering that the genital gland rarely presents the two sexes at the same degree of maturity, it is probable that it does not fecundate itself.

The Portuguese oyster, on the contrary, is unisexual. That is incontestable. We have opened a great number of them, taken at all the phases of the reproductive period; and all were either exclusively males or exclusively females.

On the other hand, contrary to what takes place with the common oyster, in which fecundation is accomplished within the valves, the ova are expelled from the shell; it is in the bosom of the water that they meet with the fecundating element. In fact neither ova nor embryos are ever found in the mantle of *O. angulata.* This is moreover corroborated by the fact that the ova and embryos of the Portuguese oyster are developed in the pure sea-water, while those of the common oyster, at least during the whole period of the gestation of the ovum and till the moment when the embryo abandons the maternal shelter, cannot live out of the liquid contained in the shell, which liquid, according to an analysis made in M. Berthelot's laboratory, contains a notable proportion of albumen. In vain we tried to preserve, in sea-water aerated and renewed, any embryos of *O. edulis* to complete development, whether they were in the state of *white* or of *grey* spat: the white embryos succumbed after two or three days, the grey ones after twelve or fifteen, although they had within reach collectors to which they could attach themselves.

These facts constitute an essential difference between the two species, which excludes every hypothesis of crossing and must cause the rejection of the theory of hybridation advocated by some ostreiculturists. We have moreover made some direct experiments at hybridation, which issued in a negative result. Thus, at different times during last year and this, we placed ova from Portuguese oysters in contact with zoosperms taken from common oysters, and conversely; but never, under the conditions of our experiments, have the elements naturally and instinctively come together, never has there been any trace of fecundation or development.

The sexual elements of *O. angulata* being, as we have said, clearly separate, we had a glimpse of the possibility of accomplishing artificial fecundation. The example of Brooks, of Baltimore University, who made successful attempts at artificial fecundation with *Ostrea virginiana*, was also encouraging.

After much feeling our way, we adopted the following method. With a little practice, it is easy to distinguish the sexes with the naked eye. By means of a camel's-hair pencil we detach the ova from the ovary, and deposit them in a vessel filled with sea-water—a phial, for example. In order to disaggregate them and clear them from the foreign matters with which they may be encompassed, the phial is agitated for a few moments, and then the liquid allowed to settle. The ova which are fit for fecundation sink to the bottom of the vessel; what remains in suspension must be eliminated. The liquid is decanted, and fresh sea-water poured in; and it is sufficient to add a small portion of seminal liquor in order that the ova may be directly and closely surrounded by the zoosperms; the first phases of fecundation commence immediately.

The ova and spermatozoids can, without being placed in contact, preserve their vital properties in the water for several hours. Our best fecundations were obtained with elements which did not come together until two or three hours after their extraction from the genital glands.

We shall not describe the first phases of the development of the ova; but we think we must record a fact which, we believe, has not before been observed: the embryos of *O. angulata* begin to move from seven to twelve hours after fecundation, according to the temperature. At Verdon we obtained some in seven hours, the water having a temperature of 22°. Their mobility was exhibited in rotatory and gyratory movements. Sometimes they turn on the spot as on a pivot; at others they remove rapidly and shoot like a dart across the field of observation. The shell is formed at about the sixth or seventh day after the impregnation.

The artificial fecundation presents no difficulty of execution; it ends, four times out of five, in the formation of a mobile embryo, if the elements employed are good. With the Portuguese oyster the laying is effected gradually, and sometimes lasts several weeks. When a speck in the genital gland becomes transparent, it is because the elements are ripe; and it is then that they can be employed with advantage.

In consequence of the preceding, and seeing the fecundity of the oyster of the Tagus*, we tried some practical applications. For this purpose we prepared at Verdon a "clear" of 100 square metres surface, into which we poured the animated products of various artificial fecundations. The difficulty was to preserve the embryos while at the same time securing the renewal of the water. We attained that result by making the water enter and flow away through a bed of fine sand.

After a month of reiterated experiments our endeavours were crowned with success. We had the satisfaction of finding some brood fixed on each of the tiles placed in our experimental "clear." This is so much the more remarkable as, until last week, none had yet attached themselves to the numerous collectors immersed on the oyster-beds of the Gironde—that is to say in the very centre of the "clear."—*Comptes Rendus de l'Académie des Sciences*, July 31, 1882, t. xcv. pp. 256–259.

On a Synthetic Type of Annelid (Anoplonereis Herrmanni) *a Commensal of* Balanoglossus. By M. A. Giard.

The rich sandy beaches of the Iles Glénans, especially those of

* 1 cubic centim. of ovary contains

	Ova.
By dissociation	2500000
By sections	5200000
Mean	3850000

The volume of the ovary of an oyster of average size varies between 6 and 8 cubic centim.

Ile du Loch and of the Ile St. Nicolas, contain two fine species of the genus *Balanoglossus*, which differ at the first glance in the breadth and colour of the branchio-genital region. One of them is of an orange-yellow in the male sex, of a greyish yellow in the female, and of a light brown in the immature animal; this the author names *Balanoglossus Robinii*. The other species, which is rather more slender and much narrower in the thoracic region, is of a salmon-colour, brighter in the female, more delicate in the male, and of a dull rose-colour in the asexual animal; the author calls this *B. salmoneus*.

These two forms appear to be allied to *B. aurantiacus*, found by Leidy at Atlantic City associated with *Solen ensis*, *Donax fossor*, and various Annelids of the genera *Clymene* and *Glycera*; and the *Balanoglossi* of the Iles Glénans live in the midst of a similar fauna. They are very abundant; and although it is difficult to obtain them entire from their great length (a metre and more) and extreme fragility, their position is easily discovered by the coils of sand of peculiar form which they throw up. They are to be reached at all times of the tide, especially *B. salmoneus*, which comes nearest to the shore.

The posterior extremity, which is nearest to the sand-coil, is the most easily extracted; it exactly resembles the intestine of a *Spatangus* filled with fine sand. The anterior extremity is obtained with more difficulty; it is folded several times upon itself, and covered with a mucus of very peculiar odour. The lateral margins of the thoracic region are raised dorsally to form a sort of tube, at the bottom of which, chiefly in *B. Robinii*, is found the parasite now to be noticed.

This Annelid would at once be referred to the Nereid group; but it presents more of the essential characters of the family Lycoridea. The body is cylindrical, slightly flattened, and feebly attenuated at the hinder part. The central region is traversed by a median furrow, which widens towards the cephalic extremity. The length of the animal is from 40 to 60 millim., its breadth (with the feet) from 5 to 9 millim. Its colour is a fine orange-yellow, tinged with fulvous on the feet.

The cephalic lobe is rectangular, twice as broad as long, and slightly emarginate in front. The tentacles are equal in length to the cephalic lobe, and *three in number*; the palpi, a little shorter than the tentacles, are inserted in two little lateral notches. There are four eyes, the two anterior larger and crescentiform.

The proboscis is entirely unarmed; the buccal aperture is quadrangular; the buccal segment differs but little from the succeeding ones; the tentacular cirri are of moderate size, placed at some distance from the lateral margins of the cephalic lobe, and probably six (in two groups of three) on each side.

The feet are all similar; the parapodia composed of two distinct and nearly equal rami. The upper ramus is furnished with *a single ligula* (the lower one) and armed *with simple capillary setæ*. The lower ramus is furnished with two bundles of setæ arranged on the two sides of a hastiform process. These setæ are composite, falciform, heterogomphous. The terminal joint increases in size from the lowest to the highest. The dorsal cirrus is much longer than the ventral.

For this Annelid the author forms the genus *Anoplonereis*, and names the species *A. Herrmanni*, in honour of M. Herrmann, lately director of the laboratory at Concarneau, where these researches were made. The worm occurs about once upon ten *Balanoglossi*. There is no epitocous form; sexual maturity occurs in May. The males seemed to be rather more common than the females. The skin is delicate, and ruptures easily when the animal is immersed in absolute alcohol.

As to the place to be given to *Anoplonereis* among the Nereids, the author remarks that the presence of three antennæ, the form of the superior ramus of the parapodia, the existence of simple capillary setæ, and the absence of jaws are so many characters which separate this Annelid from all the other Lycoridea. The absence of the superior ligula of the superior ramus occurs also in *Ceratocephale* and *Dendronereis*; but in these genera the setæ are all compound, and in the second the dorsal cirrus is pinnate. The form of the parapodia approximates *Anoplonereis* to the Hesionea, and especially to *Pordake*, and also to certain Syllidea, such as *Pionosyllis*, which also present simple setæ in the superior and compound falciform setæ in the inferior ramus of the parapodia. The presence of a third median antenna is also a Syllidian character met with in the Hesionea and *Polynoë*, but not in the Nereids.

The complete absence of buccal armature is remarkable in a Lycoridian. In *Ceratonereis*, indeed, there are no paragnatha at the basal part of the proboscis, and in *Leptonereis* and some allied types the paragnatha even disappear entirely; but the absolutely unarmed proboscis of *Anoplonereis* is unique in the group Lycoridea, and no doubt connected with its parasitic mode of life.

Thus *Anoplonereis* is a most curious type, uniting the Lycoridea on the one hand to the Hesionea and *Polynoë*, and on the other to the Syllidea; the last-named are to be regarded as the ancestors of the whole group of the Nereids (*sensu latiori*) as understood by Ehlers. —*Comptes Rendus*, August 21, 1882, p. 389.

Orthocynodon, *an Animal related to the Rhinoceros, from the Bridger Eocene**. By Wm. B. Scott and Henry F. Osborn.

Orthocynodon is the name given to designate a new genus of the rhinoceros line from the Bridger Beds of Wyoming. It was discovered by the Princeton expedition of 1878, in the Bad Lands of Bitter Creek. It carries the rhinoceros line farther back than it has been supposed to exist. The oldest representative of this line known is *Amynodon*, a genus found by Prof. Marsh† in the Uintah beds which overlie the Bridger. *Orthocynodon* was at first referred to the latter genus, until important differences in the molar dentition were discovered.

* Description from specimens in the E. M. Museum of Geology, Princeton, N. J.

† Am. Journ. Sci. ser. 3, vol. xiv. p. 251.

Generic characters. The lower canines are erect and functional, giving the name to the genus. The lower incisors are two on each side and semiprocumbent. The lower premolars, with the exception of the first, are somewhat simpler than the molars, but have the rhinoceros pattern of two inward-opening crescents directed forwards. The upper premolars have distinct posterior crescents and small postero-internal cusps. The postglenoid and posttympanic processes apparently do not unite to surround the external auditory meatus. There is a sagittal crest separating the temporal fossæ.

This genus differs from *Amynodon* in the erect canines, in the possession of a posterior crest and distinct though small postero-internal cusp on the second and third upper premolars; finally, in the fact that the premolar pattern in both jaws is like that of the molars. In *Amynodon* the canines are nearly procumbent, and the premolars are all unlike the molars. It is singular that this genus, belonging to a more recent geological formation than *Achænodon*, should have less of the typical rhinoceros structure in its molars.

Orthocynodon antiquus, gen. et sp. nov.

Dental formula, $i\,\frac{2\text{–}2?}{2\text{–}2},\ c\,\frac{1\text{–}1}{1\text{–}1},\ pm\,\frac{3\text{–}3?}{4\text{–}4},\ m\,\frac{3\text{–}3}{3\text{–}3}.$

The specimens consist of the skull and lower jaw of one individual, and a portion of the skull containing the molar series of another. In each the upper canines and incisors are wanting. The lower incisors are close to the canines; they are semierect in position and placed in a quarter circle. They have slight fangs and sharp crowns, with low cingula posteriorly. The canines are almost trihedral in section, and curve upwards and slightly backwards, worn at the back of their pointed tips by the upper teeth. A diastema of 2 inches separates them from the premolars. The lower premolar-molar series differs only in size and minor details from that of a young specimen of *Rhinoceros indicus*. The first premolar has a simple crown rising to a single point and supported on two fangs. The inner face is irregularly concave, as in the rhinoceros. Each of the remaining teeth presents two forward-opening crescents of similar pattern. The third and fourth upper premolars are preserved in our specimens, and the upper molars are complete. The premolars present an external longitudinal ridge; from it arise a broad anterior and a narrow and somewhat low posterior crescent, opening backward; the postero-internal cusps are small. The molars are like those of the rhinoceros in the proportion and disposition of their crescents.

The *skull* is about 14 inches long and 5 inches deep. The occipital condyle resembles that of the Indian rhinoceros. There is a recurved *paroccipital* process having a long forward union with the posttympanic. The *posttympanic* and *postglenoid processes* do not unite as in the modern rhinoceros. In common with all the Eocene Ungulates, there is quite a high thin sagittal crest and somewhat deep temporal fossa, quite unlike the Indian rhinoceros. The skull, in fact, does not resemble that of its modern relative. The *parietals* are narrow and compressed; the *frontals* expand into a broad well-rounded snout. We cannot ascertain from our specimens whether the nasals bore protuberances for the support of horns. It seems probable that they did not.

This animal will be fully described and figured in a later publication. The above is intended merely as a preliminary notice. *Orthocynodon* may be briefly described as an Eocene perissodactyle Ungulate with the premolar-molar dentition of a rhinoceros, and somewhat resembling *Amynodon* in the possession of canines and loss of the median incisors. It has little of the rhinocerotic character in the skull; but the resemblances in the dentition point it out as related to *Amynodon*, with which it belongs, among the group of Eocene progenitors of the Rhinocerotidæ.

Measurements.

	m.
Total length of molar series of the lower jaw........	·192
Antero-posterior diameter of the first lower molar ..	·038
Transverse diameter of the first lower molar	·022
Vertical diameter of the crown of the canine........	·040
Transverse diameter of the first upper molar........	·035
Antero-posterior diameter of the first upper molar ..	·035
Total length of the upper molars, estimated	·165

Amer. Journ. Sci., Sept. 1882, p. 223.

On the Structure of the Head of Archæopteryx. By W. Dames.

In the examination of the *Archæopteryx* in the possession of the Berlin Royal Mineralogical Museum, the results of which will be published in detail with figures, the matrix previously concealing some parts of the skeleton has been removed; and this has given a clear insight into the structure of the head.

When the specimen was obtained for the Museum, two large apertures were seen on the exposed right side of the skull; the hinder one, situated beneath the roof of the skull, was easily recognized as the orbit, especially as it contained a well-preserved bony sclerotic ring, consisting of separate plates lying one over the other, as in so many living birds. The anterior margin of this orbit is formed by a narrow bone, which is turned a little backward and extends down to the base of the skull. This bone (the lacrymal) at the same time forms the posterior boundary of a second, large, rounded triangular aperture, in the middle of which there is a crushed piece of bone separated from its natural connexions with the other parts of the skull. This aperture has been interpreted as the nasal aperture by authors, as by C. Vogt* and O. C. Marsh†. It appears, however, that the anterior part of the skull was still concealed by matrix; and it was only by very careful removal of the latter that the contours of the skull were completely exposed. This gave the important result that in front of the supposed nasal aperture there is a third aperture, placed obliquely to the longitudinal

* Rev. Scient. 2e sér. xvii. 1879, p. 242.
† British Association Report, York Meeting, 1881.

axis of the skull, of an acutely elliptical form and 9 millim. long. Posteriorly it is separated from the middle aperture by a narrow bridge of bone; above and in front it is bounded by a very narrow bone (part of the intermaxillary), and it does not reach the apex of the skull; in front of it there lies an equilaterally triangular piece of bone about 4 millim. long, which forms the tip of the beak. This aperture is to be regarded as the nostril; it is entirely enclosed by the intermaxillary. Its discovery renders the resemblance to existing birds much closer than was previously supposed. As in the bird, there are three apertures on the side of the skull:—a posterior, the orbit; a middle one, enclosed by the lacrymal behind and by the maxillary and intermaxillary in front and below; and an anterior one, the nostril, entirely in the intermaxillary.

This analogy with the skull of existing birds also essentially facilitates the study of the other parts of the skull. Thus the bony piece in the middle aperture will have to be regarded as the inner ascending part of the maxillary, and a long bone running to the base of the skull and partially concealed by the sclerotic ring as part of the vomer. The quadrate bone is also distinctly visible, although its exact form is not recognizable; and close in front of it there is a small bone, not projecting much from the matrix, which from its position may be the pterygoid. Of the roof of the skull scarcely any thing more than fragments of the frontals is preserved; the brain-cavity is filled with calc-spar. The occiput is deficient.

Results relating to the dentition were also obtained by the removal of the matrix. Two small denticles, situated under the middle opening, were previously visible. Afterwards ten teeth became distinctly recognizable, standing in the margin of the jaw. The foremost of these is at about 2 millim. from the tip of the beak; but there are indications that one or two teeth existed in front of this, so that the dentition reached quite to the apex. The teeth are about 1 millim. long, sugarloaf-shaped, very acute, and apparently smooth and shining, without any vertical furrows or striæ. The individual teeth are separated by intervals of scarcely 1 millim. Marsh (*loc. cit.*) assumed that the teeth were only in the intermaxillary, as the last one was still below the nostril; but now that it is proved that the aperture hitherto regarded as the nostril is really the middle one of three apertures in the side of the skull, it seems rather that the dentition was not confined to the intermaxillary, but extended to the maxillary, at least its anterior part. Marsh has also expressed the opinion that the teeth stood in a groove; from the recent examination it would rather appear that each tooth stands in a separate alveolus.

The lower jaw is retained in its natural position, *i. e.* articulated with the quadrate bone, and with its upper margin closely applied to the skull. It shows a postarticular process directed backward, such as occurs, for example, in the genus *Anser*. From the position of the lower jaw it cannot be seen whether it contains any teeth; but this appears probable. Below the lower jaw there is a part of an acicular hyoid bone, similar to those of existing birds.

The clearing of the shoulder-girdle, which is not yet completed, shows nevertheless that the part interpreted by Vogt (*l. c.* p. 242, fig. 18) as a coracoid is really a portion of the matrix, so that the structure of the shoulder-girdle, so far as it is preserved, can only be ascertained after this has been removed. All the inferences drawn from this part as to the relations of *Archæopteryx* to Birds and Reptiles therefore fall to the ground.—*Sitzungsb. Akad. Wiss. Berlin*, July 27, 1882, p. 817.

On the Innervation of the Mantle of some Lamellibranchiate Mollusca. By M. L. Vialleton.

The author has investigated the distribution and termination of the nerves in the part of the mantle lining the interior of the shell within the pallial line and the adductor muscles in the genera *Unio* and *Anodonta*. The process adopted was as follows:—The mantle, detached from its adherences in the living animal, was placed for fifteen minutes in lemon-juice, then in a 1-per-cent. solution of chloride of gold, where it was left for at least twenty minutes. It was then put into water acidulated with acetic acid (one drop to 20 gr.), when the reduction is effected in from twenty-four to thirty-six hours. Fragments of the mantle carefully torn can then be examined; or transverse sections can be made of it after hardening.

The portion of the mantle within the pallial line is formed by a lamina of connective tissue, rich in vessels and nerves, and covered on both surfaces with an epithelium of one layer of cells. Transverse sections show that the nerves are not equally distributed in the connective lamina, but more especially in two planes near its two surfaces; some are even placed immediately below the line of implantation of the epithelial cells. In a fragment containing one of these planes examined flat, the fibres are seen sometimes to fork or anastomose in the form of the letter Y, sometimes to cross at the same point, and their elementary fibrillæ form a tangle in which more or less complicated chiasmata are distinguished.

The fibres thus constitute an irregular network, with nodal points of very variable form. The arrangement occurs on both surfaces of the mantle; but the two planes communicate by fibres situated in the thickness of the connective lamina, and really form only a single plexus.

Each superficial plexus gives off finer fibres, which either originate directly from the large nerves of the plexus or, after the exhaustion of the latter, by repeated ramifications. These fibres finally divide into unifibrillar elements, which unite and anastomose in a thousand ways to form a plexus with very close meshes. It is *subepithelial*, for it persists when the epithelium is removed, but is more superficial than the one from which it originates.

Thus in the mantle of *Unio* and *Anodonta* the nerves form a plexus perfectly analogous to that seated in the connective tissue of the cornea beneath Bowman's lamina. It forms a very delicate nervous apparatus, which, being closely applied to the interior of the shell, may receive any shocks communicated to the latter, and transmit the impression of them to the animal. This arrangement is probably general among the Lamellibranchiata.—*Comptes Rendus*, September 4, 1882, p. 461.

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No. 59. NOVEMBER 1882.

XXXIV.—*Preliminary Notice of* Cephalodiscus, *a new Type allied to Prof. Allman's* Rhabdopleura, *dredged in H.M.S. 'Challenger.'* By Prof. M'Intosh, F.R.S.*

[Published by permission of the Lords Commissioners of the Treasury.]

A short time ago Mr. Murray, Director of the 'Challenger'-Expedition Commission, drew my attention to an anomalous organism which had been relegated to the Annelida; and though on examination it proved to be an ally of *Rhabdopleura*, Prof. Allman and Prof. Busk (both of whom had arrived at the same conclusion in regard to its systematic position) most kindly and disinterestedly insisted on my describing it, especially as *Phoronis* had just been the subject of investigation.

This remarkable form was dredged at Station 311 (in the Strait of Magellan †), January 11, 1876, in lat. 52° 50′ S., long.

* Communicated by the Author, having been read (with accompanying drawings) at the Southampton meeting of the British Association, August 1882.

† The Strait of Magellan appears to harbour several molluscoid rarities. Thus the remarkable *Goodsiria coccinea* of Prof. R. O. Cunningham (Trans. Linn. Soc. vol. xxvii. p. 489, tab. 58. fig. 3) is a social Ascidian with an elongate (above 2 feet) lobed, rooted, fibro-gelatinous mass of a vivid scarlet colour, "reminding one in some measure of the fleshier Alcyonoid polyps," in which minute flask-shaped animals are imbedded in circumferential cells. The animals are about a line in length, and, so far as can be made out from the sketches, appear to be social Ascidians. From the same neighbourhood the curious *Pyura Molinæ* of Blainville also comes.

73° 53′ W. Depth 245 fathoms. Bottom-temperature 7°·7 C. Sea-bottom composed of mud, which seemed to be fairly rich in other groups.

At first sight the flexible structure may readily be mistaken for a seaweed, since it is composed of a much-branched fucoid tissue tinged of a pale brownish hue and semitranslucent. Moreover the whole surface of the thickish stems is hispid with long spinous processes of the same tough secretion, and perforated here and there by somewhat large apertures with smoothly rounded edges. A more minute inspection reveals various opaque bodies in groups in the interior of the branches; and the appearance of these suggested the relationship of the structure to the Polyzoa or Ascidians. Prof. Busk, however, pointed out its distinction from the ordinary Polyzoa, and Prof. Herdman had stated that it was not an Ascidian. The following description is drawn up from a few fragments and three excellent slides mounted by Prof. Busk. Other points will probably be made out on the arrival of the larger examples, which have not yet reached me.

The cœnœcium or polyparium of *Cephalodiscus dodecalophus** consists of thickish, irregularly rounded or flattened stems of the consistency of soft seaweed, and having a slight lustre like the semitransparent tubes of many annelids. The stems have a diameter varying from 4 or 5 millim. to double or treble that breadth in the flattened expansions; but the general size of many of the branches is nearly uniform. The main trunks seem to have arisen from submarine objects, such as stones or sponges; but instead of standing erect like soft Gorgonians, to which the inosculations of the branches give them some resemblance, they appear to have been more or less horizontal, since pillars of the tissue occasionally pass, like aerial roots, from the underside to the plane of attachment. The surface of the branches is everywhere studded with elevations and ridges, which terminate in long spines—simple, bifid, trifid, or multifid, and here and there bending downward to join the main stem, so as to form loops or arches, or inosculating with adjacent spines. Some of the spines are very large, and project far beyond the others, and occasionally they occur in groups. They generally taper a little towards the tip, which is often attenuate and of a deeper brownish hue than the rest of the cœnœcium. The tips of the branches often show longer spines variously divided. The irregularity in regard to the distribution of the spines recalls the processes on the curious *Chondrocladia*, though it is much more marked than in the latter. All the spines are hollow

* κεφαλή, head; δίσκος, disk; δώδεκα, twelve; λόφος, plume.

and in connexion with the canals and cavities of the cœnœcium.

The surface of the polyparium, moreover, is dotted, especially at the bases of the spines, with large rounded apertures, which lead into the interior of the stem, the latter being honeycombed from end to end by an irregular system of wide canals and cavities intersected by bridles and arches, which thus provide for the constant ingress and egress of sea-water throughout the entire system. The inner surface of these canals and chambers is as smooth and glistening as the outer, the secretion being perfectly homogeneous and evidently the product of the inhabitants. It cuts with great readiness and as cleanly as a soft *Fucus*. Microscopically it consists of numerous layers of a translucent and very fine membranous secretion, the sheen or lustre being doubtless due to this arrangement. The whole disposition of the tissue points it out as the secretion of the polypides, just as much as the tube of an annelid or *Phoronis*, the more regular and less bulky cœnœcium of *Rhabdopleura**, and, it may be, the shell of a mollusk. Like the annelidan tubes it most approaches, it is little affected at first either by nitric acid or caustic potash, though the former by and by somewhat softens and bleaches it. This secretion of *Cephalodiscus* is paralleled by the curious investment or "house" of *Appendicularia*, and is therefore probably, like it, the homologue of the Ascidian test. The "house" has two funnel-shaped apertures, supported by a fibrous trellis-work, leading into the cavity containing the body.

It is not a matter for surprise that creatures so minute should secrete so conspicuous a home for themselves, or that it should preserve the algoid or zoophytic outline, especially when the productions of sponges and other forms are remembered, or when we reflect that even a transparent structureless fluid inside a smooth capsule (as in the Nemertean stylet-pouch) can produce, in countless examples of each species, precisely the same form of solid crystalline stylet. The enlistment of numbers in the present case supplies any deficiency likely to arise from minute size. The peculiar shape of the cœnœcium, moreover, has probably been found that best adapted for the preservation of the animals, by its resemblance to the seaweeds in its neighbourhood, on the one hand, and, on the other, by its affording complete aeration, abundant supply of food, and security to the little architects and their delicate plumes.

In the interior of the cavities and canals of the semitransparent cœnœcium numerous opaque masses (the polypides) and

* *Rhabdopleura Normani*, Allman, and *R. mirabilis*, Sars.

large ova are situated. The former often occur in groups, each individual, however, except in the case of buds, being perfectly free, at liberty to wander anywhere along the chambers or externally through the apertures. In some cases they are packed closely together in the cavity: but such may have been due to the condition on immersion in spirit; for thin partitions, bridles, and pillars of the transparent cœnœcium often separate the individuals. Moreover, in turning out the latter, an operation performed with ease, owing to the friability of the cœnœcium, at first sight it may almost be fancied that an ovigerous envelope containing embryos is before us, so remarkable is the profusion of eggs and animals, and apparently so active is the reproductive function. The aspect of the adults and their caudal buds, the proportionally large size of the ova, and other features, however, negative such a supposition.

Each adult polypide (and they are somewhat uniform in size) measures, from the extremity of the cephalic plumes to the tip of the pedicle, about 2 millim.; and of this length the body proper (that is, from the buccal disk to the posterior bulbous region above the pedicle) is rather more than 1 millim. The body in most is bean- or kidney-shaped, generally more rounded and bulbous posteriorly, since there is a tendency to a forward curve before the pedicle comes off. The dorsal surface is smooth and convex, a slight lateral constriction being evident just behind the anterior region bearing the red pigment-spots. The posterior end is generally bulbous and prominent; and in many a slightly elevated median ridge leading to the anus is evident. As the pedicle is often curved forward or projected outward at a small angle to the body, the ventral surface is comparatively short; indeed, in those which are much bent the base of the pedicle touches the buccal disk. This contour of the body is interesting in relation to the oblique direction of the cup-like body of *Loxosoma*. When the pedicle is extended the ventral surface is nearly straight and continuous with the pedicle, which leaves the body at the ventral edge, while the kidney-shaped mass of the body projects dorsally. The pedicle is shorter than the body, nearly cylindrical, and terminates apparently in a rounded end; it is marked ventrally by various longitudinal striæ from the muscular bands.

The anterior region of the body curves somewhat suddenly downward and backward, and forms a flattened surface on which the great buccal disk rests. On the ventral surface are two large and conspicuous pigment-spots or eyes, which are placed a little in front of the anterior margin of the oral lamella, and in ordinary preparations are wholly covered by the disk. They are circular or irregularly rounded, of various shades of reddish brown, with occasionally a tinge of violet. In transverse section the eyes show a pale centre or a large clear globule, with an external ring of dark brownish cellular pigment. They lie over the ovary, and in dissection often remain attached to the eggs. They would appear to be mainly of service to the animal during the protrusion of the buccal disk and plumes. This form thus shows in the adult state what Prof. Vogt and Dr. Barrois found in the embryonic *Loxosoma*; for in the latter the double disk-like organ is connected with two eye-spots.

The great buccal disk forms a thin plate with two slight and generally bilaterally arranged elevations in the centre anteriorly, and divided into two regions by a notch at each side, the anterior moiety being the larger and thicker. The surface of the latter is marked by an arch of brownish pigment-grains, which are densest in the centre of the curve, and shade off gradually on each side; while a very conspicuous and well-defined brownish-red band commences in the posterior division at the notch, and runs with a backward curve to the opposite side. Between this and the posterior margin a brownish pigment-belt (less developed than that in front) occurs. The two bands just mentioned form when complete a somewhat flattened ring. In many specimens, however, the brownish pigment is entirely removed by the spirit, leaving only the well-defined reddish posterior band. In transverse section the external or ventral surface of the disk is formed of finely granular and rather firm hypodermic tissue, closely marked with vertical striæ. As we pass deeper (*i. e.* towards the dorsal surface) there is a tendency to form cells; while near the dorsal margin ovoid granular cells are very evident. These gland-cells are tinged in this region of a brownish hue by transmitted light. A basement-layer, possibly with a few muscular fibres, intervenes between the thin median hypoderm and the free parts of the disk on the dorsal aspect. The structure of this organ accords in most respects with the careful researches of Prof. Allman on the organ in *Rhabdopleura**. It seems chiefly to be a glandular hypodermic structure with secerning powers of great activity, probably in relation to the remarkable cœnœcium.

This disk differs from that in *Rhabdopleura* by its much greater size and its thickness. In the form just mentioned the organ is more nearly allied to the truncated and thickened opercular process of certain annelids; while in *Cephalodiscus*,

* Journ. Linn. Soc. Zool. vol. xiv. p. 585.

instead of forming a mere anterior appendix, it overlaps the adjoining parts to a great extent. In *Cephalodiscus* it is attached to the anterior end of the body, in front of the mouth, by a central pedicle, but its broad scale-like margin is quite free all round and can readily be raised. Transverse sections show that the pedicle of the organ has three main pillars, viz. two lateral and one central. The outer surface of the lateral is covered by the hypoderm continued from the dorsal surface of the disk, and which passes to the basal region of the branchiæ. Beneath the basement tissue, under the foregoing, strong bands of muscular fibres pass along each side of the pedicle to radiate into the outer region of the disk. The central pillar is composed mainly of what seems to be elastic tissue, which is continued upward to a granular glandular area, which fills the space between the ovaries. The upper region of the latter space is angular, the lower convex and rounded, and having the foregoing pillar connected with the elastic tissue which bounds the entire area. The central region of the latter is filled with granular glandular tissue, and probably is an anterior process of the buccal region. Whether any space exists on each side of the central pillar or lamella is an open question; but in some of the preparations a finely granular substance like coagulated fluid occurs.

Attached to the posterior part of the disk, and apparently running from edge to edge so as to become connected with the broad apron-like lamella on each side of the mouth, is the basal tissue of the plumes, most of which remain fixed to the disk on its removal, only one or two clinging externally to the margin of the lamella. This basal collar is tinted of a brownish hue by transmitted light; and twelve plumes* arise almost in linear series from its dorsal edge, six on the one side of the median line and six on the other. The plumes are nearly of uniform size, and consist of a central stem, slightly crenate posteriorly, and furnished with a series of longitudinal muscular fibres; while distally it has a peculiar bulbous enlargement, which at first sight resembles the tip of certain medusoid tentacles, bristling with dart-cells and pigment. The rugose appearance, however, is due to large gland-cells containing granules and globules; and the tissue seems to be a further development of the somewhat large hypodermic granules of the tips of the pinnæ. The bulbous end of the stem shows a rather regular disposition of these cells and globules, in transverse section, especially at the circumference; indeed the appearance of such a section recalls that of the

* Hence the specific name *dodecalophus*.

tip of a tentacle of *Coryne* or the spine of an Echinoderm. The ventral surface and sides of the stem are rendered plumose by a large number of long slender filaments having slightly bulbous extremities, and with a linear streak from base to tip, apparently from a groove, though traces of a septum also occur. These pinnæ apparently do not taper, and for the most part, in section, are composed of granular hypoderm with a few brownish pigment-cells. It is probably the latter which give in some a light pinkish or pale violet blush to the feathery plumes, which in life must have been finely tinted; and it is further interesting that the same pigment occurs in *Rhabdopleura*.

The arrangement of these numerous tentacular plumes wholly differs from that in *Rhabdopleura*, in which they form two symmetrical tentacular arms from which the pinnæ spring. Both the latter and the new form widely diverge from the ordinary Polyzoa in this respect, both having very mobile pinnæ that curve gracefully in all directions, instead of the somewhat stiffish corona and straight tentacles of the other Polyzoa. In *Cephalodiscus* they are probably of great tactile service; but there is little evidence from their minute anatomy in support of their branchial function, at least of the ordinary kind. They thus present a much more elementary structure than in *Phoronis*. They do not appear to be of much value as exciters of food-currents, as Prof. Lankester suggests in the case of *Rhabdopleura*; at least they could only produce currents in the cavities of the cœnœcium without special reference to the mouth. Both *Rhabdopleura* and *Cephalodiscus* differ from the ordinary Polyzoa in the absence of the tentacular web at the base. Both have very long pinnæ; but the new form excels *Rhabdopleura* in this respect. *Cephalodiscus* also diverges in regard to the thin postoral lamella, which, instead of being a simple triangular peak on each side, as in *Rhabdopleura*, forms a free apron-like process. Moreover it is not simply continuous with the tentacular arms as in *Rhabdopleura*, but the broad lamella seems rather to arise at each side, at the point of insertion of the basal tissue of the plumose arms, and it is boldly curved outward therefrom. The oral region thus has a different environment from that in *Rhabdopleura*, though the plan of structure is not very divergent. The distinct circular aperture of the mouth lies in the middle line at the anterior margin of the foregoing lamella, and is thus concealed between the opposed surfaces of the latter and the disk; and if these are ciliated, their influence on the conveyance of food into the aperture must be considerable. The oral lamella in some preparations passes straight up to the sides of the mouth and forms a transverse margin anteriorly. The edges of the mouth are slightly raised laterally and posteriorly, the latter often being spout-shaped; anteriorly it is devoid of any well-defined boundary, and leads directly upward into the alimentary canal.

There are no special organs in connexion with the mouth, which leads by a canal with frilled walls into the stomach, situated on the ventral surface of the body. At the posterior end of the latter the intestine turns upward and advances along the dorsum, to open by a large anus on the anterior projection of the body behind the plumes. No part of the alimentary canal enters the pedicle. In minute structure the canal resembles that in the Nemerteans, the first or pharyngeal region, however, being perhaps less firm than the gastric. The folds of the latter show numerous and somewhat regular vertical streaks and granules from the arrangement of the gland-cells; indeed the smooth, firm, gastric ridges have a characteristic granular striated appearance. The canal throughout has proportionally thick walls. Externally is a firm investment, probably containing muscular fibres. Internally the surface seems to be covered by a fine limiting membrane, through which the contents of the glands have in many cases escaped. In the interior of the stomach are cellulo-granular matter, grains of sand, minute spicules, and bodies resembling minute Thalassicollidæ. The canal agrees with that in *Rhabdopleura* in having no differentiation into regions as in the Polyzoa proper. It is probably ciliated during life, after the manner of canals of similar structure.

The body-wall is composed externally of a thin hypodermic layer (for no distinct cuticular coat can be demonstrated in the preparations), within which is the elastic coat, bounded internally by the longitudinal muscular layer. The wall is much attenuated over the distended ovigerous region anteriorly. There is no other investment of the alimentary canal than the foregoing wall, which is probably homologous with the "thin glassy skin" of Sars, surrounding the digestive canal in *Rhabdopleura*. As with the latter, the preparations give no evidence of perigastric fluid.

As previously mentioned, the short ventral surface of the body is continued into the cylindrical pedicle, whereas the dorsal outline rises abruptly above the pedicle. The stomach and the dorsal curve of the intestine would alone require considerable space. The hypoderm on the ventral surface of the body appears to be somewhat thicker than on the dorsal, and in the preparations is generally thrown into bold transverse wrinkles, evidently from the strong muscular fibres passing from the oral region backward to the pedicle. The same hypodermic layer covers the latter, which is likewise ringed all round by rather regular transverse furrows, the coat, moreover, being thicker dorsally than ventrally. Within the foregoing is a thick elastic coat continuous with that on the body, and which in a line with the narrow (ventral) margin is bent inward at a sharp angle, so as to form a longitudinal ridge along the pedicle. Internally are numerous bundles of longitudinal muscular fibres, which are especially dense on each side of the ridge. In longitudinal sections these fibres form large coarse fasciculi; and their origin is as in *Rhabdopleura*, viz. near the oral region. In transverse sections the centre of the pedicle is occupied by a little connective tissue and granules, and there does not seem to be evidence of a distinct canal. At the tip, however, in longitudinal sections a central cavity is sometimes seen—containing cells and granules, and which may be homologous with the peduncular gland of *Loxosoma*. The buds arise from the latter region, often from the ventral aspect. It is interesting that Prof. Allman found at the end of the funiculus of *Rhabdopleura* a somewhat reniform dark-brown body, which he considered a statoblast. The spot from which the buds arise in *Cephalodiscus* is likewise towards the tip. No trace of a nervous system was observed.

In most of the specimens a pair of large rounded whitish masses conspicuously distend the body-wall anteriorly under the eyes; and, indeed, one or other of the latter generally clings to the undeveloped ova adjoining it. In transverse section through the ovary one of the ova is found to be considerably larger than the other, often twice the size; and thus the outline of the body is asymmetrical. Each shows germinal vesicle and spot, and is surrounded by a transparent investment. Moreover each has developing ova of various sizes abutting on it ventrally; and since the extension of the large ova is mainly external, the smaller ova and their clear globules are compressed towards the middle of the body as well as ventrally. A fine membrane (ovisac ?) appears to surround the large and the small ova in common, while each of the latter has its own hyaline investment. On extrusion (whether by anus, mouth, or otherwise is yet unknown) the large and somewhat pyriform ovum is provided with a well-formed pedicle of the transparent investment—truncated at the extremity for attachment. An ovum is occasionally found amongst the tentacular plumes, as in *Phoronis*, with its swarms of minute eggs; but such is probably accidental. The ova are filled with the usual granular contents, and each is attached to the wall of the chamber by the pedicle; but many seem to have become detached and lie loose in the cavity. The products of these ova are yet unknown, though in all probability they are motive embryos which would carry to fresh sites the construction of the cœnœcium. Their comparatively large size recalls the condition in the Artisca, in which the great ova produce embryos about a third the size of the adult.

Prof. G. O. Sars found in *Rhabdopleura mirabilis* (between the dorsal wall of the gullet and the anal region) a clear cellular body, in which several nuclei were visible. He was of opinion that it could scarcely be a nervous ganglion, since it did not lie in the substance of the body itself, but only within the external skin. There would seem to be little doubt that this cellular body in *Rhabdopleura* is the homologue of the ovary in *Cephalodiscus*.

The large ovigerous bodies over the eyes appear to be the homologues of the remarkable organ which occurs on the dorsal side of the œsophagus in the young *Pedicellina* (and which, according to Dr. Hatschek, is mesoblastic), and more especially of the double organ of the same kind described by Prof. Vogt and Dr. Barrois in the embryo of *Loxosoma*. The lamented Prof. Maitland Balfour was in doubt about Dr. Hatschek's interpretation of the remarkable dorsal organ as a bud, since, "owing to the deficiency of our observations on the attachment of the larva, this suggestion has not received direct confirmation; yet the relations of the dorsal organs in *Pedicellina* and *Loxosoma* respectively strongly confirm Hatschek's view of their nature" *. The very great development and unequivocal condition of the double organ in *Cephalodiscus* place the subject in a fair way for solution. There cannot be much doubt as to their being ova in this form, while, again, the great distance from and independence of the actual buds on the distal end of the pedicle negative any close relationship between them. It is also worthy of note that in *Cephalodiscus* the eye-spots are so closely related to the surface of these organs that they are generally removed with them in dissection. It is further interesting that the buds in *Loxosoma* arise from a region corresponding more or less to that containing the foregoing ova in *Cephalodiscus*, and not from the pedicle. The objection of Prof. Allman † to Oscar Schmidt's view that the apparent buds in *Loxosoma* are really detached from the ovary and developed on the body of the parent is clearly shown to be right, not only because the immature buds

* Comparative Embryology, i. p. 245.
† Journ. Linn. Soc., Zool. xv. p. 2.

both in *Loxosoma* and *Cephalodiscus* bear other buds, but because the position of the large ova in the latter cannot be confounded in any respect with the buds either in their early or subsequent stages.

No differentiation was noticed in regard to sexes; and there seems to be no dimorphism of the zooids, as in Prof. Ehlers's remarkable burrowing form (*Hypophorella expansa* *). Nothing is more striking, however, than the profusion of buds and the abundance of ova, one of the chief ends of the species apparently being propagation. The chambers of the cœnœcium are loaded with the large ova; and almost every adult bears one or more buds attached near the tip of the pedicle.

The early buds consist of minute and somewhat pale clavate or pyriform bodies attached by the narrow end to the pedicle. They are situated either on or near the tip. Very soon the pedicle is differentiated from the disk, the young animal consisting of a large, flat, and somewhat thick disk and a short, broad, and sometimes crenate pedicle attached to the parent. The disk is shield-shaped, broader distally than proximally. Two ovoid opaque thickenings are observed dorsally. The hypoderm of the bud resembles that of the adult. At this stage no trace of the tentacular plumes exists.

As development proceeds the anterior or disk-bearing region of the body increases much more in proportion than the posterior. The disk is rapidly enlarged, and shows traces of the broad arch of pigment anteriorly and the reddish band posteriorly, as well as the two median elevations on the ventral surface. The posterior moiety of the disk is especially large. Moreover the body superiorly begins to project outward, and first one or two and then four or five rounded papillæ indicate the commencement of the tentacular plumes. These papillæ form a slightly curved row in front of the dorsal projection of the body.

In the next stage the disk is almost completely formed, though of smaller size and thicker than in the adult. The pigment bands are well developed. So little has the pedicle advanced, that the free posterior margin of the disk almost touches the pedicle of the parent to which the bud is attached. The anterior dorsal projection of the body has greatly increased, forming a large rounded boss. The tentacular or branchial plumes are now more numerous, and form an irregular and prominent double row from side to side above the disk. The short pedicle almost immediately follows the anterior dorsal projection of the body; and as a peculiar bending of the latter has now taken place, the tip of the pedicle hardly

* Abhandl. der königlichen Gesellschaft der Wiss. zu Göttingen, 1876.

projects beyond the margin of the disk. The tentacular plumes soon exhibit a symmetrical series of filaments on each side, the general outline of each process being still abbreviated and rounded. Shortly after this stage the bud separates from the parent (the plumes being still small). The pedicle is fairly developed; and as soon as it is detached (and sometimes before) a little bud appears near the tip. The pedunculated bud in *Rhabdopleura* somewhat resembles this form, though the tentacular plumes greatly diverge.

Cephalodiscus thus differs from *Rhabdopleura* in regard to the cœnœcium, in the much greater size of the buccal shield, in the remarkable branchial or tentacular plumes, in the structure of the pedicle, and in the perfectly free condition of the polypides.

Cephalodiscus and *Rhabdopleura* agree in the absence of the calyciform membrane connecting the bases of the tentacles, in the position of the mouth, which opens ventrally behind the buccal shield, in the general structure of the alimentary canal, and in the position of the anus. The development of the young buds is similar. Both connect the ordinary Polyzoa with *Phoronis*.

Cephalodiscus naturally falls under Prof. Allman's section Polyzoa Aspidophora, and further demonstrates the correctness of that author's opinion in regard to the systematic position of these anomalous forms. Prof. Lankester's designation "Pterobranchia," as applied to *Rhabdopleura*, is less suitable than the foregoing.

CEPHALODISCUS, n. g.

Cœnœcium consisting of a massive, irregularly-branched, fucoid secretion resembling chitine, hispid with long spines of the same tissue, and honeycombed throughout by irregular apertures, channels, and spaces, in which the separate and independent polypides occur singly or in groups.

Lophophore richly plumose, with an enormous buccal shield and large oral lamella, the mouth opening between the two. Anus on the anterior dorsal prominence, behind the plumes. Two large eyes abutting on the ovaries. The homologue of the funiculus is short and quite free, its tip serving for the development of buds.

XXXV.—*Additional Notes on the* Trochamminæ *of the Lower Malm of the Canton Aargau, including* Webbina *and* Hormosina. By Dr. Rudolf Häusler, F.G.S. &c.

[Plate XV.]

In my last paper on the *Trochamminæ* of the Lower Malm of the Canton Aargau (Switzerland) reference was made to some polythalamous species as probably belonging to *T. squamata*, *T. inflata*, *T. coronata*, *T. vesiculata*, and *T. Reussi*.

All the regularly septate rotaline Foraminifera, which in a previous memoir I described as Rotalidæ with their shells entirely changed by pseudomorphoses analogous to those which altered the chemical nature of other organic remains of this zone, have been found to be true *Trochamminæ*, since more abundant material has been obtained from the Upper Bathonian stage and almost all the various zones of the Argovian Malm.

In accordance with Brady's views on the relationship of some fixed and other free *Nodosaria*-like forms to the typical *Trochamminæ*, we unite a small number of interesting forms of *Webbina* and *Hormosina* with the genus *Trochammina* in its widest sense. However dissimilar the external appearance of these new Jurassic fossils may be when compared with the rotaline *Trochamminæ*, yet the microscopical texture of their shells gives sufficient reason for placing them in the immediate neighbourhood of the unilocular varieties of *Ammodiscus*.

We are at present not prepared to give an exhaustive treatise on all the numerous varieties, from want of sufficient material; but the most characteristic forms shall be briefly described, in order to add further proofs of the wide geological range of certain species which have hitherto been but little if at all known from the Upper Jurassic formation.

As a rule their tests are minute, thin, and very fragile; for this reason their examination presents great difficulty, especially when they are imbedded in hard marly material, from which perfect specimens are extremely difficult to extract.

The forms allied to *Hormosina* were described (*l. c.*) as silicified *Nodosariæ* and *Dentalinæ*; but there can be no doubt as to their true position among the arenaceous Foraminifera.

The fixed *Trochamminæ* (*Webbinæ*) are very feebly developed in the whole Jurassic series; and only two distinct species have been found in the zone of *Ammonites transversarius*.

Amongst the rotaline *Trochamminæ* all the species except *T. constricta* are very variable, and furnish us with new series of intermediate forms or "missing links," by which the great number of multilocular varieties can be united in one uninterrupted chain of imperceptible gradations. Nevertheless we always come across typically built individuals, from which we are able to recognize the previously recorded species.

Beginning with the simplest septate *T. constricta*—which, with a minute variety of *T. coronata*, agrees in the composition of the delicate tests with *T.* (*Ammodiscus*) *incerta*—we arrive at the conclusion that the more the species differ from those primitive types the more the shells become proportionally coarsely sandy, finishing the series with *T. helveto-jurassica.* An analogous change distinguishes also the more complicated *Ammodisci* from the simple planispiral varieties.

It would be absolutely impossible to consider all the different varieties without taking notice of specimens from the Upper Dogger and the younger zones of the Malm, which for the present we cannot include in this short paper. Much work has still to be done to obtain a complete knowledge of the innumerable modifications as results of adaptation to considerable changes in the configuration of the sea-bottom.

The more we become acquainted with the microscopical faunas of the Jurassic formation, the more the difficulties of fixing *true species* increase; yet, on the other hand, the resemblance of many Jurassic forms to those obtained from the recent deep sea offers interesting examples of the constancy of certain types, from which countless varieties have developed themselves during enormous intervals of time.

The fact that many arenaceous Foraminifera were first described as hyaline forms altered by a replacement of the carbonate of lime by silica, can easily be accounted for by the presence of other organic remains which had undergone complete changes, as, for instance, Polyzoa, Echinoderms, and Mollusks, while the siliceous sponges were transformed into carbonate of lime or iron-pyrites.

A. Trochammina, J. & P.

The multilocular rotaline *Trochamminæ* belong to the whole Jurassic formation, though in the Lias and Lower Dogger they are only known in one minute form, probably an intermediate form between *T. squamata* and *T. inflata.* Like *Ammodiscus*, they first appear in greater number in the Bathonian stage, and reach their maximum development in the Lower Malm. From the zone of *Ammonites transversarius* the following species were obtained:—

T. constricta, *Häusl.*	T. globigerinoides, sp. nov.
T. coronata, *Brady* (var.).	T. helveto-jurassica, *Häusl.*
T. squamata, *J. & P.*	T. vesiculata, *Uhl.*
T. inflata, *Mont.*	T. Reussi, *Uhl.*

1. *Trochammina constricta*, Häusl.

2. *Trochammina coronata*, Brady*.

The forms which in the first paper I mentioned as probably belonging to *T. coronata* may be a variety of this species; but the minute size of 0·3 millim. diam., and the very thin, almost hyaline test are different, while the mode of growth is nearly alike. It is very rare; and as almost all the Jurassic arenaceous varieties are much smaller than their recent representatives, they may be regarded as produced by unfavourable conditions of life.

3. *Trochammina squamata*, J. & P.

Shell free, rotaline, composed of convolutions forming a regular conical spiral, resembling *Valvulina triangularis.* Chambers regularly increasing in size, more than three in one whorl. Upper surface conical, trochoid; inferior almost flat, concave, or slightly umbilicated. Test thin, fragile, subtransparent; cement colourless or ochreous. Surface rough. Diam. 0·4 millim.

Typical specimens are very rare in the *Amm.-transversarius* beds; they differ but little from the descriptions given by Jones and Parker, Carpenter, Karrer, &c.

4. *Trochammina inflata*, Mont. (Pl. XV. figs. 5–7.)

Test rotaline, inflated, thin, composed of few convolutions, of which only the last is visible from the lower side. Peripheral margin rounded; umbilicus excavated. Segments large, regularly increasing in size. Earliest chambers often irregularly arranged, sometimes corroded; last chamber occasionally very large. Colour brown. Surface rough. Diam. 0·5 millim.

Many specimens agree fully with recent forms, as described by Williamson†.

The Jurassic *T. inflata* is very variable, passing from *T. squamata* into *T. globigerinoides.* The sutural lines of the oldest part are often invisible from a partial corrosion of the primary chambers.

* Brady, "Notes on some of the Reticularian Rhizopoda of the 'Challenger' Expedition," Micr. Journ. vol. xix. p. 39, pl. v. fig. 15.

† Williamson, Rec. For. Gt. Brit. p. 50, pl. iv. figs. 93, 94.

The shells erroneously described as *Rotalina suprajurensis*, *R. macrocephala*, *R. universa*, *R. pygmæa* represent the principal Jurassic modifications.

T. inflata is a common species throughout the whole Malm, and it is the most abundant arenaceous form in the Bathonian zone of *Rhynchonella varians*.

5. *Trochammina globigerinoides*, sp. nov. (Pl. XV. figs. 8, 9.)

The few specimens are, as a rule, found in unfavourable preservation, owing to the minute size and thinness of the delicate shells.

Test rotaline, inflated; superior surface slightly convex, inferior excavated at the umbilicus. Convolutions few; oldest chambers small, regularly increasing in size; last four segments large, globular, of nearly equal size.

Test very thin, finely arenaceous, the hyaline sandy constituents imbedded in a subtransparent or almost glass-like colourless cement. Surface more or less rough.

T. globigerinoides is easily distinguished by its thin, almost hyaline test, and the globigerine mode of growth, not attempted by any other Jurassic species.

6. *Trochammina helveto-jurassica*, Häusl.
(Pl. XV. figs. 10, 11.)

Test free, crozier-shaped, spiral only in its earlier stage, afterwards straight. Spiral part resembling *T. inflata*, composed of globular, regularly increasing chambers arranged in convolutions. Superior surface convex; first chambers often irregularly heaped or corroded; inferior umbilicated.

Rectilinear younger part consisting of few broad segments of nearly equal size.

Test finely arenaceous, cement generally subtransparent or ferruginous. Surface rough. Long. 0·6 millim.

This interesting species holds a similar position among the rotaline *Trochamminæ* as *T. centrifuga*, Brady, amongst the *Ammodisci*, *T. planorbiformis* among the *Webbinæ*, and *T. lituiformis* among the simpler septate *Trochamminæ*.

The species is very rare, and generally in a bad state of preservation; no aperture is visible, for this reason. Imperfect specimens with the oldest chambers removed were described as *Lituola* (*Haploph.*) *helveto-jurassica*.

7. *Trochammina vesiculata*, Uhlig*.

This species, described by Uhlig from the same zone, is not

* Uhlig, "D. Jurabild. v. Brünn," Beiträge z. Paläont. Oest.-Ung. vol. i. part iii. p. 181, pl. xvi. figs. 4–6, and Neues Jahrbuch f. Min. 1882, p. 155.

a rare form of the Swiss Jurassic formation. As a rule, the Argovian specimens are more convex, and the surface more rough, though in every other respect they agree fully with Uhlig's description. This variety is chiefly interesting as it is more abundant in the younger zones of the Swiss Malm. Kübler and Zwingli mention a similar form as *Rotalina badensis* from the zone of *Terebratula impressa* (Argovian II.).

8. *Trochammina Reussi*, Uhlig.

The occurrence of this Upper Jurassic *Trochammina* in the Argovian deposits is still somewhat doubtful, as most of the forms resembling it can hardly be separated from the above-mentioned varieties. The specimens in my collection are, as a rule, less involute; but in all the other characteristic features they agree with Uhlig's *T. Reussi.*

B. Webbina.

Although *Webbina* seems to be present in almost every Jurassic zone, beginning with the Lias, only two or three species could be discovered, of which *W. irregularis*, Orb., and a new form, *W. planorbiformis*, were found in a few specimens in the *Amm.-transversarius* beds of the canton Aargau.

1. *Trochammina* (*Webbina*) *irregularis*, Orb. (Pl. XV. fig. 15.)

Test thin, fragile, finely arenaceous, one-or more-chambered; monothalamous variety consisting of a small pyriform or almost hemispherical chamber; polythalamous variety straight or irregularly curved, consisting of few small rounded segments joined by short stolons. Attached to the valves of Brachiopoda. Probably the one-chambered forms represent the earlier stage of the moniliform variety; they are very small (0·1 millim.), always elongated at one pole, thus differing from *W. hemisphærica*, J. & P.; the surface is also rougher than in the latter species. Some of the specimens answer well the description given by D'Orbigny, Carpenter, Jones and Parker, &c.

2. *Trochammina* (*Webbina*) *planorbiformis*, sp. nov. (Pl. XV. figs. 16, 16 *a*.)

Test serpuloid, forming in its earlier stage a regular spiral, in its younger part straight or irregularly bent. Typical specimens may be considered as fixed forms of *T. centrifuga*, Brady; the others imitate the mode of growth of some *Serpulæ* found in the same zone (*S. spirolinites*, *S. pla-*

norbiformis). Test thin, finely arenaceous, the sandy constituents imbedded in a subtransparent colourless cement. Attached to the shells of *Terebratulæ*; very rare. This species was first united with the *Nubeculariæ*; but the texture of the shell places it with the *Trochamminæ*. *W. planorbiformis* is very variable, but easily recognized from its oldest part forming a regular flat spiral. The younger part of the tube often resembles *T. filum*, Schm., and *Hyperammina*, being irregularly bent and twisted. Often two or more individuals form small colonies on the shells of Brachiopoda.

C. HORMOSINA, Brady.

The group of straight or arcuate moniliform *Trochamminæ* is represented in the Swiss Jurassic series by several small species, none of which has, so far as I am aware, been recorded previously. While in respect of their external appearance they are isomorphs of well-known *Nodosariæ* (and *Dentalinæ*), with which I at first united them, their finely arenaceous tests place them nearest to the simple *Trochamminæ*. Besides some doubtful lageniform modifications, which are probably mere isolated segments of multilocular varieties, we possess at least three different species from the Argovian zone of *Ammonites transversarius*, of which two are preserved in several perfect specimens, while the third is never found entire, and is therefore not determinable.

The two species which I have described as *Nodosaria chrysalis* and *N. transversarii* are both good types of the genus *Hormosina*.

1. *Trochammina* (*Hormosina*) *chrysalis*, Häusl.*

The description given of this form as *N. chrysalis* applies to all the specimens I had then collected from this zone, though since several others have been discovered in various localities. It appears that *T. chrysalis* is the most constant of all the Jurassic *Trochamminæ*. As the above-cited paper is out of print, it may be useful to repeat the description.

Test straight, pupiform, composed of four or five segments, rapidly increasing in size. First chamber small, last long, almost half of the total length of the shell, slightly acuminated, bearing the small rounded aperture.

Test finely arenaceous; cement colourless or slightly ferruginous; surface smooth, resembling thus *T. incerta* of the same beds.

* Häusler, 'Untersuchungen über die microscopischen Structurverhältnisse der Aargauer Jurakalke,' p. 34, pl. ii. fig. 51.

In one of the specimens a broad ring was observed at the base of the last chamber. Not common.

2. *Trochammina* (*Hormosina*) *transversarii*, Häusl.*

Test straight, elongated, slender, composed of five segments, regularly increasing in length. First segment often globular; younger chambers long, subrectangular, last pyriform.

Test thin, finely arenaceous, fragile, subtransparent; cement calcareous, colourless; surface smooth. L. 0·3 millim.

H. transversarii is found together with the former species, but very rare. It is variable, but easily recognizable by the thin, finely sandy, smooth test. Both *H. chrysalis* and *H. transversarii* occur also in the Upper Argovian and Lower Sequanian stages of the canton Aargau.

If we examine the long list of Upper Jurassic arenaceous Foraminifera, the large number of *Trochamminæ* is surprising; and it is doubtful if in any other period this genus reached such an extraordinary development.

Fully illustrated notes on the mutual relationship of the Jurassic *Trochamminæ*, with special regard to the numerous intermediate forms and monstrosities, will appear in a future paper during the coming winter.

List of Trochamminæ *from the Argovian zone of* Ammonites transversarius.

T. (Ammodiscus) incerta, *Orb.*
T. (——) gordialis, *J. & P.*
T. (——) charoides, *J. & P.*
T. (——) pusilla, *Gein.*
T. (——) filum, *Schm.*
T. (——) jurassica, *Häusl.*
T. (prop.) constricta, *Häusl.*
T. (——) coronata, *Brady.*
T. (——) squamata, *J. & P.*
T. (prop.) inflata, *Mont.*
T. (——) globigerinoides, sp. nov.
T. (——) helveto-jurassica, *Häusl.*
T. (——) vesiculata, *Uhlig.*
T. (——) Reussi, *Uhlig.*
T. (Webbina) irregularis, *Orb.*
T. (——) planorbiformis, sp. nov.
T. (Hormosina) chrysalis, *Häusl.*
T. (——) transversarii, *Häusl.*

Further Notes on Trochammina (Ammodiscus) incerta.

Since my first paper on the *Trochamminæ* of the Lower Malm appeared in this magazine careful researches in every successive layer of the zone have yielded thousands of perfect specimens, of which several not or only cursorily named in the above-cited notes deserve special mention.

By the use of new methods the most fragile forms were obtained in considerable number, while it was formerly im-

* Häusler, *loc. cit.* p. 34, pl. ii. fig. 52.

possible to extract their perfect tests from the hard materials. One thin layer, without any traces of larger fossils, is exceptionally rich in *T. incerta*, so that on one occasion a single drop of the washing contained twenty-five specimens. In this bank the minute tests of a curious new variety are not uncommon:—

Trochammina incerta, var. *granulosa*, nov. (Pl. XV. fig. 1.)

Test free, discoidal, small, regularly convoluted in one plane. Convolutions numerous, partly embracing, of nearly uniform diameter; oldest convolutions covered with variously distributed minute tubercles; last convolution smooth. Aperture simple, at the non-constricted end of the chamber.

Test fine, arenaceous, transparent; cement calcareous, colourless. Surface smooth, rarely rough. Diam. 0·1 millim.

This little transparent variety is sometimes difficult to distinguish from a *Spirillina* when viewed with a low power, as the small tubercles, when arranged regularly in radial or spiral rows, give the shell the appearance of a perforated species.

T. (*Amm.*) *incerta*, var. *granulosa*, resembles some liassic varieties of *Involutina* *, sometimes also *Spirillina margaritifera* †; but the shell is never biconvex as in the former, so that generally all the convolutions are visible.

Trochammina incerta, var. *gracilis*. (Pl. XV. fig. 3.)

Cornuspira gracilis and *C. media*, Kübler & Zwingli, *l. c.* p. 17, pl. ii. fig. 4, p. 33, pl. iv. fig. 2.

Test free, discoidal, regularly convoluted in one plane, composed of a non-septate rounded tube of almost invariable diameter. Convolutions numerous, eight to twelve; aperture simple.

Test fine, arenaceous; cement calcareous, hyaline. Surface almost smooth. Diam. 0·1 millim.

Trochammina incerta, var. *megaspira*, nov.
(Pl. XV. fig. 4.)

Test free, discoidal, regularly convoluted, composed of a non-septate, generally angular tube of nearly uniform width, constricted at irregular intervals. Convolutions numerous, eight to twelve, in one plane.

Test thin, very finely arenaceous; cement calcareous, brownish. Surface smooth. Diam. 0·1 millim.

* Mém. Acad. Imp. Metz, 1860–61, pl. vi. fig. 22; Zeitschr. deutsch. geol. Ges. 1874, pl. xviii. fig. 3.

† Williamson, Rec. For. Gt. Brit. pl. vii. fig. 204.

Trochammina incerta, var. *crassa*. (Pl. XV. fig. 2.)

Cornuspira crassa, K. & Z. *l. c.* p. 19, pl. ii. fig. 2.

Test free, discoidal, regularly convoluted in one plane. Convolutions few, four or five, of nearly uniform width. Aperture large, simple.

Test thin; cement calcareous, colourless. Surface smooth. Diam. 0·15 millim.

The same beds C contain the compressed varieties (*Cornuspira elliptica*, and *C. concava*, K. & Z.) and a form resembling *C. oolithica*, Schm., in greatest number.

Appendix.

There remain two species of arenaceous Foraminifera, which belong probably to the genus *Trochammina*.

The first (figs. 17 and 18) consists of a simple cylindrical tube, which at its commencement forms a completely closed ring or a part of a spiral. The test is fine, arenaceous; cement calcareous, colourless. Surface smooth. L. 0·18 millim.

This peculiar form resembles *T.* (*Amm.*) *filum*, Schm., or *Uncinulina polymorpha*, Terq.

Another doubtful species (fig. 19) is free, crozier-shaped, multilocular, the septa hardly visible externally.

Test very fine, arenaceous, subtransparent; cement calcareous. Surface smooth. L. 0·2 millim.

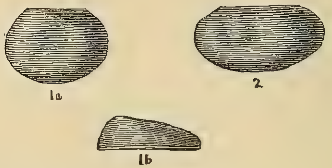
The few small imperfect specimens are not sufficient to describe these forms exactly; but as the shell-substance resembles that of *T.* (*Amm.*) *incerta* of the same beds C, they may at present find their place among the polythalamous *Trochamminæ* nearest to *T. lituiformis*, Brady, and *T. helveto-jurassica*, Häusl.

EXPLANATION OF PLATE XV.

Fig. 1. *T.* (*Ammodiscus*) *incerta*, var. *granulosa*.
Fig. 2. *T. incerta*, var. *crassa*.
Fig. 3. *T. incerta*, var. *gracilis*.
Fig. 4. *T. incerta*, var. *megaspira*.
Figs. 5–7. *T. inflata*.
Figs. 8, 9. *T. globigerinoides*.
Figs. 10, 11. *T. helveto-jurassica*.
Figs. 12, 13. *T.* (*Hormosina*) *chrysalis*.
Fig. 14. *T.* (*Hormosina*) *transversarii*.
Fig. 15. *T.* (*Webbina*) *irregularis*.
Fig. 16. *T.* (*Webbina*) *planorbiformis*.
Fig. 17. } *T.* (*Ammodiscus*)?
Fig. 18. }
Fig. 19. *T.* (*Ammodiscus*)?, sp.

XXXVI.—*Notes on the Palæozoic Bivalved Entomostraca.*—No. XV. *A Carboniferous* Primitia *from South Devon.* By Professor T. Rupert Jones, F.R.S., F.G.S.

In June last Mr. J. E. Lee, F.G.S., of Torquay, having discovered two casts of small Entomostraca in the red schist of the Lower Culm-measures of South Devon, sent them to me for examination. He had found one of the few patches of Culm-stone left by denudation in that region at Lord Clifford's farm, Waddon-Barton; and before the place was bricked up he removed a cart-load of the stone to his own residence. It proved to contain *Orthoceras striolatum* and *Goniatites*, with a small *Pecten*, *Posidonomya* (rare), *Cylindraspis* (also rare), and the two little fossils here referred to. These interesting specimens are two internal casts of one species of *Primitia*, lying at nearly a right angle one to another, on a roughish bed-plane of hard, purplish-red, schistose mud-stone. They have suffered somewhat from lateral pressure. One (fig. 1), 2·5 millim. long, has heen probably rather shortened; and



Casts of a *Primitia* from the Lower Culm of South Devon.

Fig. 1 *a*.—Internal cast of a right valve; possibly somewhat shortened by pressure.

Fig. 1 *b*.—Edge view of the same, showing the posterior convexity.

Fig. 2.—Internal cast of a right valve, much elongated by pressure.

All magnified 5 diameters.

the other (fig. 2), 3 millim., has decidedly been lengthened and attenuated by the squeeze to which the rock has been subjected since the imbedding of the organisms. The figures represent them magnified five diameters.

Some obscure traces of other fossils, and many minute cavities due to the former presencc of organic remains, occur on the same rough bed-plane which bears the two casts. Many similar little holes, along nearly regular lines, parallel with that plane and with the schistose structure, are visible on a face of fracture perpendicular to the bed-plane of the old mud-stone.

Of the two Entomostracan casts (internal moulds) the shorter form has a squarish Leperditioid outline, with a centro-dorsal depression (fig. 1 *a*) and a marginal rim and furrow along the ventral border (fig. 1 *b*). The surface of the cast is smooth, and its convexity is greatest in the posterior half (fig. 1 *b*). The other specimen has these features modified by the pressure which has affected it crosswise from ventral to dorsal region.

It is usually difficult to determine the species of *Primitiæ* (see 'Monograph Silur. Fossils of Girvan,' by Nicholson and Etheridge, fasc. ii. 1880, p. 221), and hazardous to attempt the specific allocation of their shell-less casts. At first sight this *Primitia* has much resemblance to *P. prunella*, Barrande (Syst. Silur. Bohême, vol. i. Suppl. p. 550, pl. xxvi. figs. 5 and 6), and to *P. Fischeri*, Œhlert (Bull. Soc. Géol. France, ser. 3, vol. v. p. 584, pl. ix. fig. 5); but its edge view (fig. 1 *b*) gives a different profile, and, instead of being symmetrically and gently convex, is much elevated or swollen behind and depressed in front, like that of *P. Barrandiana* (not well drawn in fig. 11, *e*, pl. xv. 'Girvan Fossils,' 1880). Indeed the valve of the variety of *P. Barrandiana* shown in fig. 11 *c* (*op. cit.*) approximates very closely in form to the cast before us (fig. 1 *a*). The latter, however, has not so deep a dorsal sulcus as some internal casts of *P. Barrandiana* from Girvan exhibit.

To refer our Carboniferous *Primitia* from Devon to a Lower-Silurian species may be regarded as bold and heterodox; but some Ostracodous Entomostraca (so far as valves bear evidence) are already known to range from the Silurian to the Carboniferous system (for example, *Beyrichia intermedia*, see Ann. & Mag. Nat. Hist. ser. 4, vol. xv. p. 55), and others from Silurian and Carboniferous strata appear to be undistinguishable (see Geol. Mag. dec. 2, vol. viii. p. 74).

A very fine Leperditioid *Primitia* is known from the Lower-Carboniferous strata of Brunton, near Chollerford, in Northumberland, namely *P. Tatei*, Jones (described as a *Beyrichia* in 1863, see Proc. Berwicksh. Naturalists' Club for 1864, p. 88, fig. 3). Its more ovate outline and more symmetrical and central convexity distinguish it from the Devonshire species; and its very *Leperditia*-like shape, its neatly defined dorsal sulcus, and its acutely ovate edge view separate it from the other *Primitiæ* mentioned above.

Doubtless all these *Primitiæ* were closely related, however wide apart their habitats and however long the period through which they existed. Their exact points and degrees of relationship cannot be defined by means of the valves alone without the organs; still less can casts satisfy us in this matter.

With regard to Mr. J. E. Lee's rare little specimens from Devon, in the absence of their valves we can do no more than refer them to the genus *Primitia*, defined in the Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 415, and point out that *apparently* their closest ally is the Lower-Silurian *P. Barrandiana*. It is, however, just possible that, had the casts not been modified by lateral pressure, fig. 1 *a* might have been much more Leperditioidal and like *P. Tatei*, whilst the posterior convexity in fig. 1 *b* may have been increased, if not brought about, by the same cause. Under these circumstances it is not advisable to venture on a specific determination.

XXXVII.—*Note on* Rhacodes inscriptus, *Koch, and* Armadillo officinalis, *Duméril, terrestrial Isopoda.* By the Rev. A. E. Eaton, M.A.

Dr. A. Gerstäcker, in a recently published part of Bronn's 'Klassen und Ordnungen des Thier-Reichs,' Bd. v. Abth. ii. p. 209, brackets *Rhacodes*, Koch, as a synonym of the genus *Tylos*, Latreille. As this combination, if unobjected to, is liable to cause trouble, it may be well to notify that the characters attributed by him to the genus apply in essential particulars to *Tylos* exclusively.

Rhacodes inscriptus, Koch, described in Rosenhauer's 'Die Thiere Andalusiens,' p. 422 (1856), is a woodlouse very nearly akin to *Armadillidium*, Brandt and Ratzeburg (1833), judging from the make of its head and antennæ, its tail-segments, their modified legs, and their breathing-organs; and in these distinctive structures it exhibits no affinity with *Tylos*. Koch's description is sufficient for the recognition of the animal. The most obvious difference between it and *Armadillidium* is in the eyes: those of this latter genus are multiple, whilst *Rhacodes* has only a single unfaceted eye on each side of its head. The species was found by Rosenhauer near Malaga at the end of April, not uncommonly. I have met with it in Portugal, near Porto, and at Ponte de Morcellos, in Beira Baixa, at altitudes of from 30 to 600 feet above the sea; also in Madeira, where it is common at altitudes of 2500–5450 feet. In the Hope Museum at Oxford are four examples, collected in the same island by the late Mr. Wollaston, without indications of altitude.

Tylos, Latr., is thus spelt by every author excepting Dana, U.S. Expl. Exped. xiii. (2) 717, pl. xlvii. 1 (1852), who writes, orthographically, *Tylus*.

The nomenclature of *Armadillo officinalis*, Duméril, seems to demand revision, being utterly corrupt. According as the limits assigned to the genus are large or small, so will its right designation vary; but in no case can it be correctly named *Armadillo*, Latr. If the genus be restricted to its smallest compass, the name *Orthonus*, Miers (1877), is valid; but if it be extended to the more comprehensive scope advocated by Dr. Gerstäcker in the place referred to above, it might very justly be called *Cubaris*, Brandt (1833), enlarged. The genus cannot take the name *Armadillo*, for two reasons: —first, because this name was preoccupied in zoology for a genus of the Mammalia by Brisson in 1756; secondly, because (if that objection be waived) in Crustacea it can only be applied to the genus described as *Armadillo* by Latreille in 1804. Now the genus under consideration was unknown to Latreille; the woodlice named by him *Armadillo* are all without exception species of *Armadillidium*, Brandt and Ratzeburg (1833); and these joint authors erred in diverting the appellation from that group of species to one which they newly founded on the present animal, previously described as *Armadillo officinalis* by Duméril in Dict. des Sc. Nat. iii. p. 117 (1816). Simultaneously they altered the name of the species from *officinalis* to *officinarum*. In 1835–41 Koch renamed the animal, calling it *Pentheus punctatus*. The name *Penthea*, Dej. (1834), in Coleoptera having priority over *Pentheus*, precludes its adoption in place of *Orthonus*, Miers, if the restriction of the genus be upheld. The oldest name of the species is *Oniscus globator*, Cuv., in Journ. d'Hist. Nat. ii. 24, pl. xxvi. fig. 19 (1792); this will supersede *officinalis*, Duméril. Cuvier's figure and description of this woodlouse seem to have been completely forgotten for ninety years.

In the countries bordering upon the Mediterranean *Cubaris* or *Orthonus globator* appears to be common at moderate and low altitudes; it is found also upon the principal islands. Beyond that area it abounds in Marocco near Tangier, and is locally plentiful in Western Portugal. In the British Museum are specimens, seemingly of this species, from the Isle of Pines and New Caledonia, and one, possibly identical, from Sikkim; but these need further examination.

As the present note is virtually a partial criticism of Dr. Gerstäcker's work, I am tempted to cast one more stone at him with respect to his bracketing *Haplophthalmus*, Schöbl (1860), with *Trichoniscus*, Brandt (1833), as one genus.

But the language which it would be necessary to employ would resemble so closely what has been used above touching *Rhacodes* and *Armadillidium*, that it might be wearisome to your readers. The qualities of Dr. Gerstäcker's work are too well known to make it necessary to conclude with compliments as a set-off against fault-finding.

Croydon,
October 4, 1882.

XXXVIII.—*Spermatozoa, Polygonal Cell-structure, and the Green Colour in* Spongilla, *together with a new Species.* By H. J. Carter, F.R.S. &c.

[Plate XVI.]

As time progresses so experience throws light upon the nature of objects previously unrealized, and thus, much of what was simply (if correctly) recorded years before may derive explanation from more recent discoveries that have been made *public.*

When I was studying the freshwater sponges of the tanks in Bombay, about 1850, Lieberkühn was engaged with those from the river Spree, at Berlin; and although we were both working on the same subject, our facts were differently handled; for while Lieberkühn had for friend and adviser Johannes Müller at Berlin, I not only had no one of the kind at Bombay, but at that time was beholden to others for the loan even of a microscope, so that literally I then felt that all I could do was to describe and delineate faithfully what came before me both for text-book of reference and publication.

Yet was I not altogether without assistance and advice; for at University College, London, I had been educated in part under my kind and dear friends Professors Grant and Sharpey, whose exemplary love of truth stood by me when alone, and has ever kept me in the path of fearless accuracy.

For the purpose of recording my observations, I kept a "journal," in which was not only described, but delineated in colours, every thing that appeared to me worth recording; so that after many years this journal, still continued, often furnishes me with the means of confirming and realizing discoveries which I myself had long since unwittingly made—although often imperfectly, from the limited power of my microscope.

Thus Mr. Saville Kent, in his excellent 'Manual of the

Infusoria' (p. 345, pl. iii. fig. 1), has recognized and reproduced a sketch which I made in the month of April 1855 (from a colony of organisms on a filament of *Cladophora*) as a "*Salpingœca*" or a "*Monosiga*" of his order Choano-flagellata, upwards of ten years before these remarkable Infusoria were first brought to notice in the late Prof. H. James-Clark's memorable paper (Memoirs Bost. Soc. Nat. Hist. vol. i. pt. 3).

Again, in the month of February 1855, at pp. 99 and 101 of this "journal," I find the discovery of the "starch-granule" in *Spongilla* (*S. Meyeni*) not only described, but figured and coloured under the effect of iodine, which I did not mention publicly until the following year ('Annals,' February, vol. xvii. p. 106), and did not delineate for publication until 1859, when I endeavoured to show the close alliance in structure and composition that exists between the "seed-like" body of *Spongilla Carteri* and the winter-egg of the polyzoon *Lophopus* ('Annals,' vol. iii. p. 331, pl. viii. fig. 7).

Also again, at p. 77 of the first volume of this "journal," on the 12th August, 1854, I find sketches of the monociliated sponge-cell (spongozoon) with the supposed zoosperm attached to it, as represented in the 'Annals' of August 1856 (vol. xviii. pl. vi. fig. 43)—but with the two then-called "ear-like processes" or "spines" to which I have alluded ('Annals,' November 1879, vol. iv. p. 382), these having been omitted in the published figure because I was not certain of their general occurrence until 1859 (*ib.* vol. iii. p. 14, pl. i. figs. 12–14), after which they were identified (under a higher power probably) with the outlines of the "collar" by Prof. H. James-Clark in September 1867 (*op. cit.* p. 21, footnote).

It is the absence of the "collar" or these "ear-like processes" in the supposed zoosperm and their presence in the sponge-cell (spongozoon), together with the much smaller size of the former and its spherical head, that appear to constitute the outward differences between the two, all of which, excepting the "ear-like processes" (which were not known then), may be seen in Lieberkühn's figures of the monociliated sponge-cell and the zoosperm respectively from *Spongilla* in 1856 (Archiv f. Anat. Physiologie &c., Heft iv. Taf. xv. figs. 34 and 36); but no one since seems to have confirmed this publicly, while the sperm-cell in the marine sponges has often been figured, and in all instances *without* the "collar." Accompanying my sketches are the following notes, viz. :—"The above drawings of the *Spongilla*-zoosperm were very distinctly seen, particularly no. 1 [Pl. XVI. fig. 8, *b*], a transparent cell with a single granule in contact with the wall. No. 2 [Pl. XVI. fig. 8, *a*] was also monociliated, but larger and more granuliferous; it had occasionally the two remarkable [ear-like] processes better seen in no. 3 [Pl. XVI. fig. 8, *c*, where both "*a*" and "*b*" are figured together]. This form [viz. with the ear-like processes] I have so often seen that, if it is not constant, it is very frequent." Hence at that early period I had not only noticed the "ear-like processes," which were subsequently identified with the "profile" outlines of the "collar," but the cilium of the same form of sponge-cell which I afterwards found to take in particles of food (indigo), and finally called "spongozoon," in connexion with a much smaller *spherical* cell that in the previous year, viz. 1854 ('Annals,' vol. xiv. p. 334, pl. xi. figs. 1–6), I had taken for the zoosperm of *Spongilla*; and although some little time afterwards I thought otherwise, still I *now* see, from its comparative smallness and the subsequent representations of others, that I was probably right in my original conjecture. Fortunately figures were published in the 'Annals' about the same time these facts were noticed; and therefore what has just been stated cannot be considered a mere afterthought of the present day.

Lastly, I have to allude to a figure in my "journal" on the 29th March, 1857, which I have always regretted that I did not represent with the description of the "isolated ovi-bearing sponge-cell" in the "Ultimate Structure of *Spongilla*" ('Annals,' July 1857, vol. xx. p. 26), and which in the course of development becomes the ampullaceous sac *, since, besides being isolated in the watch-glass wherein a young *Spongilla* after having been fed with carmine had been torn to pieces, it may present a *vibratory* movement of the cilia *inside*, while the continuity of its capsule outside is indicated by its having refused throughout to admit any of the colouring-matter (Pl. XVI. fig. 7); thus, instead of the ampullaceous sac, it *now* appears to me to have resembled the "Spermaballen" first pointed out in *Spongilla* by Lieberkühn in 1856 (*op. cit.* Heft v. Taf. xviii. fig. 10), then by F. E. Schulze in *Halisarca lobularis* in 1877 (Zeitschrift f. wiss. Zool. Bd. xxviii. Taf. iii. fig. 18), and lately by Metschnikoff in 1879, in *Halisarca Dujardinii* (*ib.* Bd. xxxii. Taf. xx. fig. 2). The subjoined note in my "journal" on the last occasion that I saw this cell is dated 31st March, 1859, and runs as follows:— "In the last examination an isolated sponge-cell was seen

* The so-called "ovi-bearing sponge-cells" in this paper are the *spherical* cells of the *statoblast*, which contain the germs (formerly viewed by myself as ova, and hence the appellation). On the contents of the statoblast issuing under germination, these "spherical cells" and their contained germs appear *bodily* to become the ampullaceous sacs in the young *Spongilla*, and, in some if not in all instances, to end in becoming respectively developed into new statoblasts.

with the cilia waving *in* it." By the "last occasion" is meant that in which the young *Spongilla* was grown from the statoblast in a watch-glass, as usual, for microscopical examination, which is the only convenient way of examining it, as then a perfect sponge is obtained which can be brought under a higher power without molestation (and eventually torn to pieces if necessary) during the whole course of its development. Detaching a portion from a large mass does not offer all these advantages, from the shock to the living functions occasioned by such a procedure; while to obtain the young *Spongillæ* it is only necessary to get a portion of an old *living* specimen bearing statoblasts, and, having taken out a few (six to twelve) of the latter, to roll them gently between the folds of a towel to free them from all extra material as much as possible, place them in a watch-glass so as *not* to touch each other, with a little water, in a saucer or dish filled with small shot, to keep the saucer upright, and, covering them with a glass shade, transfer the whole to a window-bench opposite the light. In a few days the young *Spongilla* may be observed (from its white colour) issuing from the statoblast and gluing the latter as well as itself to the watch-glass, when it will be ready for transfer to the field of the microscope for examination, care being taken that it is *never* uncovered by the water, which may be replenished as often as necessary; but of course the object-glass (when $\frac{1}{4}$ inch with high ocular is used for viewing the minuter structure) must admit of being *dipped* into the water *without suffusion* of the lens.

Returning to the "Spermaballen," it is even *now* difficult to recognize them in the living or dead state, on account of their being so much like the ampullaceous sacs (Geiselkammer) on the one hand and ova of the same size on the other. Their being unconnected with the branches of the canal-system may help to distinguish them from the ampullaceous sacs, which in diameter are much of the same size, viz. "0·05 millim." (Schulze), in addition to their minute granular contents, which are the heads of the young spermatozoa; but this again confounds them with the ova at an early stage of the latter. When the spermatozoa are fully developed *within* their capsule at the time of examination, of course they may be easily recognized; but this coincidence does not happen often. Even in one of Prof. Schulze's exquisite preparations which he kindly sent me, of the "Spermaballen" in *Halisarca lobularis*, I can only see one with the cilia inside it, while the rest I should not recognize if not told by the label on the slide what they are; hence, by the inexperienced thus unassisted, the "Spermaballen" may be often seen without being recognized.

So long as these monociliated cells are only seen in the structure of *Spongilla* their nature remains doubtful, as they may belong to something else; but when they are found in distinct cells in the midst of this structure there can no longer be any room for such doubt. In their isolated state the spermatozoa have been seen and figured by many; but no one has ever witnessed their entry into the ovum (which is the concluding point), except Prof. Häckel. The four cilia attached to the ovum of *Leucandra aspera* figured by Keller are, of course, only conjectural of this (see 'Annals,' 1879, vol. iv. p. 383).

Fain would I now with my present knowledge return to the examination of *Spongilla* in its living state; but the time and opportunity for this are past, while upwards of five-and-twenty years have elapsed since Lieberkühn and myself worked at the subject; and no one having again taken it up leads me to hope that ere long the coincidence of taste and a residence where *Spongilla* grows may be followed by resumed investigation; for there is yet *very* much to be learnt of the histology and vital economy of the sponges generally, and none afford such facilities for this as those which grow in *fresh water*.

My chief object now, however, is to call attention to the presence of a cell-structure in *Spongilla*, which is like that of the polygonal parenchyma of plants, and the presence of which could hardly be anticipated by those who have only studied the marine sponges, and know no other persistent structure beyond the spicules and the horny fibre, especially one which if seen by itself would unhesitatingly be pronounced to be *phytoid*. Nevertheless it is a fact, as I first showed in 1859, when I made the illustrated comparison between the statoblast of *Spongilla Carteri* and the winter-egg of the Polyzoon *Lophopus*, to which I have already alluded (pl. viii. figs. 1–4). By reference to this communication it will be seen that there *is* a tissue of this kind in *Spongilla*, and that it surrounds the statoblast of *S. Carteri* in the form of a thick layer composed of hexagonal cells regularly arranged in columns perpendicular to the following coat *inwards* of this spheroidal body. This I noticed again last year to be the case with the statoblast of *Spongilla nitens* ('Annals,' 1881, vol. vii. p. 89, pl. v. fig. 3, *d* and *i*); but although so large in these two species as to be visible with a "doublet," it cannot be seen in the statoblasts of other sponges with the same power, although it is more or less present in a great many, and gives them that white colour which often characterizes this reproductive organ. When too minute to be seen without a very high power, as in *Spongilla alba*, *Parmula* (*Spongilla*) *Batesii*, &c., it presents a granular appearance, for which

I have used the term "microcell-structure" (*ibid.* p. 83, pl. v. fig. 2). In *Parmula Brownii*, however, it is much larger than in *P. Batesii*, and thus can be well seen under a power of 300 diameters, when it is found to be composed of spherical cells of different sizes, heaped together with the utmost irregularity (Pl. XVI. fig. 12); so that in structure and composition, although not in form and arrangement, it differs markedly from the uniform size and hexagonal figure of the cells in *S. Carteri* and *S. nitens*.

Lately another instance of the latter kind has been brought to my notice by Mr. Ed. Potts, of Philadelphia, in a species allied to *Spongilla fragilis*, Leidy ('= *S. Lordii*, Bk.'), var. *segregata*, Potts. This *Spongilla*, which is found at "Chester Creek" and other places in the State of Pennsylvania, is remarkable for having its statoblasts developed in *fours*, so as to present the tetrahedral form of the sporangium in *Selaginella cernua* &c. (Pl. XVI. fig. 9), surrounded in like manner by a capsule or layer composed of hexagonal cells like those of *S. Carteri* &c. (figs. 9, *d d d*, and 11, *a*, *b*), arranged in a columnar form throughout, but most evident in the angles between the statoblastlets, because it is thickest there, since it fills all the intervals between the four statoblastlets, thus causing the whole to assume a globular, tetrahedral shape. As this species will be more particularly described by Mr. Potts hereafter, the only part that concerns us now is this vegetable-looking cell-structure; and although, as I have before stated, starch-granules are mixed up with the germinal contents of the statoblasts, as in most seeds, yet the polygonal cell-structure of the capsule, when tested for cellulose in the usual way with sulphuric acid and iodine, presents nothing but a light amber colour, identical with that of the pith of Elder (*Sambucus nigra*) under the same circumstances; so that, although the blue colour of starch may not be produced in the polygonal cell-structure of *Spongilla*, it does not follow that it is a bit less composed of cellulose than Elder.

If we turn to the marine sponges for an instance similar to this parenchymatous tissue of *Spongilla*, I know not where to find it, unless the core or pith in the Ceratina be of this nature (see 'Annals,' 1881, vol. viii. p. 115, pl. ix. fig. 11, *f*). The "granules" here, which I have conjectured to be "*cellulæ in embryo*," form a light substance of a whitish-grey colour, very like the "microcell-structure" to which I have above alluded (Pl. XVI. fig. 12).

With reference to the "green colour" in *Spongilla*, I can state no more than I did in 1849, which is thus recapitulated:—"It is impossible, therefore, under these circumstances to say, without further research, if the 'green colour' is owing to an additional tint to the colouring-matter of the cells or granules themselves, or to the presence of some foreign organism" ('Annals,' vol. iv. p. 97, "Descriptive Account of the Freshwater Sponges in Bombay"); and here is Mr. Sorby's statement in 1875 ("On the Chromatological Relations of *Spongilla fluviatilis*"), viz.:—"Though . . . the solution contained a small quantity of chlorophyll, yet I could not be certain that it had not been derived from a small portion of some alga accidentally enclosed in the sponge. The exact nature of the green substance is therefore still open to slight doubt" (Quart. Journ. Micros. Sci., n. s., no. 57, January, p. 47).

Now the "green colour" in *Spongilla* (which in Bombay chiefly shows itself in *S. Carteri*, and here in those parts which are most exposed to the light) is situated in the little spherical granules (? cellulæ) of the sponge-cell, the former of which vary under the 12,000th, and the latter under the 1000th of an inch in diameter: it is what they call "transparent;" that is, the tint, which presents a bluish emerald-green colour, is unaccompanied by any visible material; but as this part of the sponge comes into contact with the minute algæ of the water, which, in its growing state, it often encloses, it becomes, as before stated, almost impossible to say how much of one or how much of the other contributes to the green colour—not of course under the microscope, which can easily deal with organisms 1000th inch in diameter, but for separation to ascertain the position of the "spectral band," in order to see if it be the same as that of chlorophyll (hence Mr. Sorby's observation).

This, however, is not the case in *Hydra*, where the "green colour" is accompanied by visible material; that is, the green bodies themselves are granuliferous and much larger than the "green granules" in the sponge-cell, being about 1-4300th inch in diameter, and scattered plentifully throughout the ordinary tissue or sarcode of the animal, just as in *Difflugia pyriformis*, Perty ('Annals,' 1863, vol. xii. p. 253, "On the Presence of Chlorophyll-cells and Starch-granules as Normal Parts of the Organism, &c.," continued, with illustrations, in 1864, vol. xiii. p. 21, pl. i. figs. 1–4), and also in *Acanthocystis turfacea* (*ibid.* p. 36, pl. ii. fig. 25, *g*), in both of which instances they are accompanied by separate starch-granules.

Here I might observe that there is a point in the description of these two Rhizopoda which may be of interest to those who accept the views lately put forth by Dr. K. Brandt of Berlin, viz. that "the green bodies found in *Hydra*, *Spongilla*, *Stentor*, &c." do not "correspond to the green chlorophyll-bodies of Algæ, but are themselves independent organisms, unicellular Algæ" ('Nature,' 1882, vol. xxv. p. 377); for both *Difflugia pyriformis* and *Acanthocystis turfacea* in England are often found in a colourless state, *i. e.* without the so-called green "chlorophyll-cells" (*op. et loc. cit.*)—facts which have been confirmed by Prof. Leidy in his memoir on the Freshwater Rhizopods of North America, pp. 99 and 267, pl. x. fig. 3, and pl. xliii. fig. 4, respectively (United-States Geological Survey, vol. xii.) *.

New Species of Spongilla.

I have now to describe, as far as the specimens will allow, a species of *Spongilla* from the island of Bombay, whose existence has only just now become known to me under the following circumstances, viz.:—On the 8th of March last, Prof. Dr. Margo, of the University at Budapest, kindly sent me a small jar containing a specimen of *Spongilla Carteri* from Lake Balaton, in Hungary, which he had recognized there; but not having any from Bombay for comparison, he submitted the question for my decision. Fortunately, still possessing the first and best specimen I had ever found of it in Bombay (viz. in 1847), which in my descriptive account I provisionally named *S. friabilis*, Lam. ('Annals,' 1849, vol. iv. p. 83)—*ten* years afterwards recognized by Dr. Bowerbank as a new species, and named by him "*Spongilla Carteri*," although not described and illustrated by him until 1863 (Proc. Zool. Soc. p. 31, pl. xxxviii. fig. 20)—I turned to this specimen for a bit to send to Dr. Margo, and thus came upon the statoblasts of the new species to which I have alluded, and which I will now describe, as far as possible, under the name of

Spongilla bombayensis, n. sp. (Pl. XVI. figs. 1–6.)

General form of the sponge itself unknown to me. Statoblast sessile, globular, more or less grouped and firmly at-

* A copy of this magnificent "memoir," containing forty-eight coloured plates of some thousand of figures, evidencing an amount of conscientious labour almost unparalleled, was liberally sent to me through the "Smithsonian Institution" at Washington; but of the 'Challenger' Reports I have only received *one* paper, and that, too, from a foreign author, viz. Prof. Dr. F. E. Schulze, of Gratz, who kindly sent me one of the "extra copies" of his contribution on *Euplectella aspergillum*, although at my own cost and labour I had long since published descriptions and illustrations of all the sponges dredged on board H.M.S. 'Porcupine' from the Atlantic sea-bed in 1869!

tached to the stems of the herbaceous plant around which the specimen of *Spongilla Carteri* had grown (Pl. XVI. fig. 1); variable in size under 1-51st of an inch in diameter (fig. 2); composed of a spiculiferous capsule (figs. 2, *d*, and 3, *c*), a chitinous coat *which is also spiculiferous* (figs. 2, *c*, 3, *b*, and 4), and the usual germinal contents (figs. 2, *a* and 3, *a*), but no distinct cellular coat. Spicules of the statoblasts slightly curved, thick, cylindrical, more or less obtuse at the ends, about 9 by 2-6000ths inch in greatest dimensions (fig. 5, *a*), or comparatively thin, fusiform, and more or less pointed at the ends, about 10 by 1-6000th inch in greatest dimensions (fig. 5, *b*); both thickly spined and varying in stoutness inversely with their proximity to the surface; arranged horizontally, so that the ends do not project beyond the level of the statoblast, where they more or less cross each other and are held together by granules (? the microcell-structure, (fig. 2, *d*); appearing also in the chitinous coat, where they do *not* cross each other, but form a *single* layer, in which the spicules lie more or less parallel to each other in various directions, so as to present a damaskened appearance (fig. 4). Skeleton-spicules of one form only, viz. acerate, curved, fusiform, gradually sharp-pointed, smooth, or microspined, about 22 by 1-1800th inch in its greatest dimensions (fig. 6, *a*, *b*). Aperture of the statoblast sunken, single or in plurality (3–4), lined by a tubular projection of the chitinous coat (fig. 3, *d*).

Hab. Freshwater tank.

Loc. Island of Bombay.

Obs. The most characteristic part of this species of *Spongilla* is, that the chitinous coat is spiculiferous, as above described, and that, when the statoblast is divided through the middle or the outer layer crushed, it also comes out divided or entire as the case may be (fig. 3, *b*), when it may be mounted in Canada balsam, and then presents the damaskened appearance to which I have alluded, which becomes a very beautiful microscopic object, owing to the layer of spicules lying more or less parallel to each other, although in different directions, being immersed in the transparent light amber-coloured chitinous substance of which the coat is otherwise composed (fig. 4). The way in which the statoblast is firmly fixed to the stem of the plant is also peculiar, inasmuch as the thick spiculiferous or external coat is continued onto the wood, thus forming a kind of neck or expanded base, which is so strongly attached as to bring away a portion of the wood when removed; while the "aperture," single or in plurality as above stated, varies in position on the *free* surface. They are for the most part more or less emptied of their germinal contents, and surrounded by a little sponge-structure, in which the skeleton-spicules above described are found, one of which *being microspined* at once distinguishes them from those of *Spongilla alba* and *S. Carteri*, by whose statoblasts respectively and only they are frequently accompanied. As the specimen of *Spongilla Carteri* was taken from the tank (an old quarry in the Trap) in the month of October, and the living green herbaceous *annual* on which it was found grew near the edge, while the water of the "rainy season" in the tank did not reach this until the end of July, the specimen of *S. Carteri* being globular and *three* inches in diameter, embracing the stem of the plant, it follows that this, together with every thing else that accompanied it, must have been developed there in less than three months.

EXPLANATION OF PLATE XVI.

N.B.—Figures 2, 3, 6, 9, and 10, with all their detail, are relatively magnified on the scale of 1-24th to 1-1800th inch. The rest are more magnified.

Fig. 1. *Spongilla bombayensis*, n. sp., statoblasts *in situ*. Natural size.

Fig. 2. The same. Section of the statoblast through the aperture. *a*, cavity filled with germinal matter; *b*, membrane enclosing the same; *c*, chitinous coat charged with statoblast-spicules; *d*, thick or external spiculiferous coat; *e*, aperture. Diagram.

Fig. 3. The same. Statoblast broken open. *a*, germinal matter issuing; *b*, chitinous coat charged with statoblast-spicules; *c*, portion of thick or external spiculiferous coat; *d*, apertural tube of chitinous coat. Diagram.

Fig. 4. The same. Portion of chitinous coat, more magnified, to show arrangement of the spicules with which it is charged. Diagram.

Fig. 5. The same. Spicules of the statoblast generally, much more magnified. *a*, inner, *b*, outer form.

Fig. 6. The same. Skeletal and statoblast-spicules, relatively magnified. *a*, smooth, *b*, spinous skeletal spicule; *c*, statoblast-spicules.

Fig. 7. *Spongilla alba*. Sketch of "isolated" cell, with cilia waving internally, but no aperture; in appearance and size like the "ampullaceous sac," viz. 1-700th to 1-560th inch in diameter. (Sketched March 1857.)

Fig. 8. The same. Group of monociliated cells, consisting of:—*a*, monociliated sponge-cell (spongozoon); *b*, ? sperm-cell, zoosperm or spermatozoon; *c*, the latter attached to the former. (Sketched August 1854).

Fig. 9. *Spongilla segregata*, Potts. Section of the quadrilocular statoblast near the centre, to show that it is tetrasporal. *a a a a*, statoblastlets; *b b b b*, chitinous coats of the same, respectively; *c c c c*, position of apertures of the same; *d d*, crust or cellular coat; *e e*, spiculiferous or external layer; *f*, single spicule of the latter, to show that it is spiniferous; *g g g*, apertural tubular prolongations of the "cellular coat," opposite the statoblasts respectively. Diagram.

Fig. 10. The same. Young form of the quadrilocular statoblast, before the cellular coat &c. is added. *a a a a*, cavities of the young statoblastlets respectively; *b b b b*, chitinous coats; *c c c c*, apertures repectively.

Fig. 11. The same. *a*, surface of the cellular coat, or crust; *b*, vertical section of the same, to show the hexagonal form of the cells, and their resemblance to plant-structure.

Fig. 12. *Parmula Brownii.* Portion of the crust, or cellular coat, much magnified, to show that it is composed of spherical cells of variable diameter heaped together irregularly.

XXXIX.—*Descriptions of new Species of Lepidoptera from Tenasserim.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The Lepidoptera described in the present paper form part of a fine series of rare and interesting species collected in the Thoungyeen valley by Capt. Charles Bingham, and generously presented by him to the national collection.

Among the more valuable species in this series the following are worthy of note:—

Several new or interesting members of the subfamily Euplœinæ, amongst which is one supposed to be *E. Adamsonii*, Marshall, and which is my *E. margarita*; *Thaumantis pseudaliris* (the type of which was collected in Malacca); *T. Louisa*; *Penthema Binghami* and *P. darlisa*; males of a *Charaxes* (apparently *C. scylax*); *Papilio zaleucus*, *P. evan*, and *P. telearchus*; also both sexes of *Adolias xiphiones*, the male only of which was previously known to me.

Rhopalocera.

1. *Loesa fervida*, sp. n.

Allied to *L. oroatis* of Hewitson. Above bright orange-ferruginous, with dusky diffused brownish external borders to the wings; primaries with a small blackish blind ocellus on the first median interspace, its zone a little clearer than the ground-colour: body brownish. Under surface olivaceous brown; basal two thirds of wings darker than the outer third, crossed in the middle by a slender blackish angulated line, and limited externally by a slender lilac stripe: primaries with small white-pupilled black ocelli, with narrow yellow iris, dusky margin, and pale zone on the upper radial and first median interspaces: secondaries with eight ocelli, all small, the fourth and eighth mere points, the fifth largest;

two very indistinct pale submarginal stripes. Expanse of wings 53 millim.

Thoungyeen valley.

In shape this species agrees better with *Lohora dexamena*, but it is not allied to that insect.

2. *Ypthima Marshallii*, sp. n.

Allied to *Y. methora*; similar in shape: wings above brownish grey; basal area more dusky than the external area: primaries with a large oval subapical black ocellus, bipupillated with silver, and with dusky-bordered pale straw-coloured iris; an ill-defined submarginal dusky line: secondaries crossed beyond the middle by an oblique subangulated indistinct dusky line; a small blind ocellus on the second subcostal interspace; two large round unipupillate ocelli on the median interspaces, and two minute blind ocelli placed transversely near the anal angle; a wavy dusky submarginal line; base and an abdominal streak dark grey: body blackish. Under surface whitish stone-brown, finely reticulated with grey; crossed in the middle by two subparallel dusky stripes, those of the primaries most distinct and tinted with yellowish; disk of primaries whiter than the rest of the surface; ocellus as above: secondaries with all the ocelli very minute; an additional punctiform ocellus on first subcostal interspace. Expanse of wings 42 millim.

Meplay, Thoungyeen valley, 11th March 1882.

I have named this species, which appears to be quite constant, after Captain Marshall, who is now engaged upon an illustrated work upon the butterflies of India; the figures in this work, although uncoloured, promise to be extremely useful to collectors.

Of the genus *Lethe* Captain Bingham obtained *Lethe arcadia*, which was previously known from Java; a species probably referable to *L. kansa* of Darjiling; another probably conspecific with *L. alberta* of Benares, though differing from the type of that species in having five instead of four large ocelli on the upper surface of the secondaries, and lilacine instead of greenish zones to the ocelli on the underside*; lastly, the common and widely-distributed *L. europa*.

3. *Papilio tavoyanus*, sp. n.

Greatly resembles a member of the subfamily Euplœinæ to which Mr. Moore has given the above specific name: wings

* A nearly allied though apparently distinct species found in Darjiling has sericeous pink zones to the ocelli.

above reddish piceous: primaries darker than the secondaries, but with a paler almost clay-coloured external border, wide upon the costa, but tapering rapidly towards the external angle, its inner edge regularly arched; a large elongated spot within the extremity of the cell, and an oblique series of about six narrow streaks between the veins from the upper radial to the interno-median interspace dull blue: secondaries with a sordid white submarginal band, crossed by numerous longitudinal brown lines on the veins and folds, much as in *Euplœa alcathoe*, and followed by an imperfect series of whitish spots; a small ochreous spot surmounted by a black crescent at anal angle: body velvety black, spotted with white. Wings below uniformly reddish brown; secondaries with the band of white streaks united to the outer spots; anal spot as above. Expanse of wings 87 millim.

Thoungyeen valley, 26th February 1882.

Heterocera.

4. *Epyrgis Binghami*, sp. n.

Nearest to *E. pieridoides* of Herrich-Schäffer: primaries above similarly marked, with black veins and blotches, but the ground-colour of a purer white tint, and the costal, subcostal, and median veins clothed with emerald-green or blue scales: secondaries white at base and near the borders, but the whole central area covered by a bright chrome-yellow patch; costal and discocellular veins bluish; a narrow black external border, from which tapering streaks run inwards upon the veins from the costal to the first median branch: thorax above emerald-green, spotted with white; abdomen bronze greenish, with a double series of spots, and the hind margins of the segments white. Primaries below with the base of the cell and all the veins green, but the blotches black as above: secondaries nearly as above, but the costal and discocellular veins black and the outer border green; pectus blue-green: legs brown and green above, white below; venter white, with a lateral series of greenish-black dashes. Expanse of wings 75 millim.

"Toonyah," Thoungyeen valley, 20th October 1881.

5. *Histia cometaris*, sp. n.

♂. Form of *H. flabellicornis*; style of coloration of *H. selene*. Primaries above black to beyond the middle; grey, with dusky borders, black veins, and broad black longitudinal internervular stripes on the external area: secondaries above black, with the veins green; abdominal area soft greyish green to beyond the middle, the green area terminating abruptly in a large trifid white spot, above which, and just within the end of the cell, are two small squamose white dashes: head and collar carmine, spotted with black; thorax black; a carmine U-shaped marking on the metathorax; abdomen rosy carmine, with a dorsal series of black spots, which are large and quadrate towards the base. Primaries below grey, tinted with green towards the base, and marked with broad black internervular streaks: secondaries nearly as above: body below rosy carmine; legs and proboscis brown; venter with lateral black spots. Expanse of wings 81 millim.

Thoungyeen valley, Tenasserim.

6. *Milionia pyrozonis*, sp. n.

Nearly allied to *M. zonea* of Moore, from Darjiling, but altogether more brilliant in colour; the veins towards the base of the wings brilliantly steel-blue, more so than in *M. lativitta* (*pulchrinervis*, Felder); the band across the primaries and the external half of secondaries deep fiery orange, shot with rose-pink, instead of cadmium-yellow; the inner edge of the orange area of secondaries almost straight, instead of arched, and the marginal black oval spots generally smaller; the body brilliant Prussian-blue, more or less tinted with green. Expanse of wings 65 millim.

Houndraw, Thoungyeen valley, 29th December 1881, and 25th March 1882.

Had I only seen a single example of this species I should have supposed it to be a very highly coloured and broadly bordered variety of the Darjiling species, of which we possess five specimens. I have, however, seen four of the Tenasserim species, all perfectly uniform in pattern and coloration.

7. *Euschema lunulata*, sp. n.

Intermediate between *E. Roepstorfii* of the Andamans and *E. bellona* of Moulmein and North India; distinguishable from both by the more oblique subapical series of white spots on the primaries, thus leaving the bluish series and the white series distinct, as in *E. militaris*; from *E. Roepstorfii* it also differs in having bright chrome-yellow (instead of grey-blue) lunate markings beyond the yellow area of the secondaries; and from *E. bellona* in the number of these yellow markings, which in that species are obliterated excepting towards the abdominal margin, and in its narrower purplish-black external border. Expanse of wings 85 millim.

Thoungyeen valley, 27th March 1882.

Mr. Moore has Burmese specimens of this species in his cabinet with *E. bellona.*

Captain Bingham also took *E. excubitor* in the Thoungyeen valley on the 25th February.

XL.—*On the Species of* Ocypoda* *in the Collection of the British Museum.* By Edward J. Miers, F.L.S., F.Z.S., Assistant in the Zoological Department.

[Plate XVII.]

Having had occasion to rearrange and rename the specimens of this genus in the collection of the British Museum, with the aid of Mr. J. S. Kingsley's recently published revision†, I have thought it would be useful to publish the following notes on the species represented in the national collection (among which are included nearly all the well-established ones), to indicate at the same time the few which are *desiderata*, and to describe and figure with more precision than has been hitherto done their principal distinctive characters, especially such as are afforded by the form of the antero-lateral angle of the carapace (or exterior orbital angle) and by the structure of the stridulating-ridge, which is developed upon the inner surface of the palm or penultimate joint of the larger chelipede in nearly all the species, and to which particular attention has been drawn by Dr. J. G. De Man in his careful account of the species in the collection of the Leyden Museum‡.

In this memoir certain forms are characterized which are not included in the revision of the American naturalist, whose material seems to have been insufficient for the correct identification of some of the Old-World species.

In the following notes I have usually followed De Man pretty closely in his definitions (so far as they serve); and I

* This generic name has been variously written *Ocypoda* and *Ocypode* by authors. I myself formerly adopted the latter; but perhaps the former mode of spelling the word (although not that of Fabricius) is preferable, as being etymologically more correct. It would be merely productive of additional confusion to adopt (as I have been advised) *Ocypus* in place of either, since this word has been used by a later author (Kirby, in 1819) for a genus of Coleoptera.

† "Revision of the Genus *Ocypoda*," in Proc. Acad. Nat. Sci. Philad. pp. 179–186 (1880).

‡ Notes from the Leyden Museum, iii. pp. 245–256 (1881).

have not thought it necessary to reproduce the synonymical references which have already been given by Kingsley.

For the correct identification of a species of *Ocypoda* it is necessary to have adult examples, since the characters are subject to great variation or are even totally lost in younger specimens, on which I doubt not several of the nominal species characterized by former authors have been founded. Even Mr. Kingsley, extensive as are his synonymical citations, has probably admitted two or three which an examination of the types would show to have been established upon insufficient grounds.

I admit in all ten apparently well-established species, and also one species (*O. africana*, De Man) which I must regard as of doubtful permanence, but which is not at present represented in the British-Museum collection. Of these species four (*O. ægyptiaca*, *O. rotundata*, *O. Kuhlii*, and *O. africana*) are not included in Kingsley's report; but *O. rotundata* and *O. africana* were not described at the time of its publication. On the other hand, Mr. Kingsley admits three species (*O. Urvillei*, Guérin, *O. convexa*, Quoy and Gaimard, and *O. Ryderi*, Kingsley) on, as it seems to me, insufficient grounds; but of *O. Ryderi* I have seen no specimens, and this species is, moreover, but very briefly characterized.

Of the species referred to in the following notes, three (*Ocypoda ceratophthalma*, *O. Kuhlii*, and *O. cordimana*) are widely distributed through the Oriental region; *O. cursor* occurs on the coasts of the Mediterranean and also in the Red Sea (*Heller*), and at the Canaries, Cape-Verds, and on the West-African coasts southward to Acra d'Elmina; *O. arenaria* ranges along the east American coast from New Jersey southward to Rio de Janeiro, Brazil; *O. Gaudichaudii* along the western coast of the same continent from Panama to Chile; *O. ægyptiaca* occurs on the Red-Sea coasts and also at Nossy Faly, Madagascar (*Hoffmann*); *O. rotundata* is only known from the west coast of India; *O. macrocera* and *O. platytarsis* occur on the coasts of India (*O. platytarsis* also at Ceylon), and both species are also recorded by Heller from the Nicobars and Tahiti. *O. africana*, De Man (a species which I have not seen, but must regard as doubtfully distinct from *O. Kuhlii*), is found on the coasts of Liberia and the Congo.

Some other localities given for certain species are probably erroneous, as (*e.g.*) Brazil for *O. macrocera*, mentioned by Milne-Edwards in his earlier but not in his later account of the genus *.

* See Hist. Nat. Crustacés, ii. p. 49 (1837); Ann. Sci. Nat. sér. 3, xviii. p. 142 (1852).

Kingsley mentions the occurrence of *O. arenaria* on the west coast of Mexico (*t. c.* p. 185); but I think it possible that the specimens from this locality should be referred to *O. Kuhlii*, var. *occidentalis*, Stimpson. In the following notes the names in brackets which follow the localities are, with few exceptions, the names of the donors (and not necessarily the collectors) of the specimens in the Museum collection.

The principal characters separating the species of *Ocypoda* may be briefly tabulated as follows:—

I. Ocular peduncles prolonged beyond the cornea as a spine or style.
  A. The terminal style tipped with a pencil of hairs.
    Stridulating-ridge finely striated .... *O. cursor* (Linn.).
  B. The terminal style without hairs at apex.
    * Fingers of both chelipedes acute.
      Sides of the carapace straight behind the rather acute orbital angles. Stridulating-ridge coarsely striated above, finely striated below .. *O. ceratophthalma* (Pallas).
      Sides of carapace slightly arcuated behind the scarcely acute antero-lateral angles. Stridulating-ridge finely striated throughout ...... *O. ægyptiaca*, Gerstäcker.
      Sides of carapace strongly arcuated; antero-lateral angles obsolete. Stridulating-ridge developed only in its lower portion, and the striæ separated by very wide intervals. *O. rotundata*, Miers.
      Carapace broader, with the sides straight behind the acute antero-lateral angles. Stridulating-ridge narrow, tuberculate throughout .. *O. platytarsis*, M.-Edw.
    ** Fingers of the smaller chelipede dilated at the distal extremity.
      Stridulating-ridge rather broad, finely and evenly striated .... *O. macrocera*, M.-Edw.
    *** Fingers of both chelipedes dilated and truncated at the distal extremity.
      Stridulating-ridge narrow, tuberculated above, striated below .... *O. Gaudichaudii*, M.-Edw. & Luc.

II. Eyes rounded at the distal extremity, not terminating in a spine or style.
    * A stridulating-ridge developed.
      Stridulating-ridge narrow, tuberculated. Ambulatory legs with the penultimate joints dilated and compressed, nearly smooth, with long marginal hairs............ *O. arenaria* (Catesby).
      Stridulating-ridge narrow, usually tuberculated. Ambulatory legs

with the penultimate joints tuberculated, not dilated and compressed, and without long marginal hairs . *O. Kuhlii*, De Haan.
Stridulating-ridge striated below. Ambulatory legs as in *O. Kühlii* . . *O. africana*, De Man.
** Chelipede without a stridulating-ridge.
Penultimate joints of the second and third legs tuberculated, not dilated, and fringed with short stiff hair . . . . *O. cordimana*, Desm.

I. *Ocular pedicels prolonged beyond the cornea as a spine or style.*

1. *Ocypoda ceratophthalma* (Pallas).
(Pl. XVII. figs. 1, 1*a*.)

The series in the British-Museum collection includes specimens from the Mauritius (*Dr. Leach* and *Lady F. Cole*); Amirante Islands (*Dr. R. W. Coppinger, H.M.S. 'Alert'*); Port Natal; Indian Ocean (*Gen. Hardwicke*); Philippine Islands (*Cuming*); Japan; Celebes, Macassar, and Batjan (*coll. Dr. Bleeker*); Duke-of-York Island (*Rev. G. Brown*); Moreton Island, New South Wales; Friday Island, Torres Straits (*Dr. R. W. Coppinger, H.M.S. 'Alert'*); Fiji Islands (*H.M.S. 'Herald'*); Samoa Islands (*Rev. S. J. Whitmee*); and Sandwich Islands (*W. H. Pease*).

Two females are in the collection, labelled as having been received from St. Christopher's (*Dr. J. E. Gray*); but the locality certainly needs confirmation, since it would appear, from the details furnished by Kingsley (*t. c.* p. 180), that this species has not hitherto been recorded from localities beyond the limits of the Oriental region.

In this species the exterior orbital angles of the carapace are nearly right angles, or slightly acute and projecting laterally very slightly beyond the lateral margin of the carapace; the terminal styles of the ocular peduncles in the adult male usually project far beyond the outer orbital angles, but are sometimes much shorter, and in the young may be tuberculiform or even obsolete. The stridulating-ridge on the inner surface of the larger chelipede in the adult (both male and female) consists in its uppermost part of small tubercles, which widen out into small transverse secondary ridges; in the lower part the stridulating-ridge is usually very closely and finely striated, and is bordered externally (in the adult male at least) by a patch of fine close hair; there is an inferior patch of thick hair on the penultimate joints of the second and third ambulatory legs.

M. De Man is, I think, right in regarding the *Ocypoda Urvillei* of Guérin (which Mr. Kingsley retains as distinct) as a synonym of this species. I may note that the greater length of the ocular styles is not *exclusively*, although generally characteristic of the male sex, since I have observed adult males from Duke-of-York Island in which they are much shorter, projecting little beyond the outer orbital angle.

In adult male specimens from the Sandwich Islands (*W. H. Pease*), which otherwise do not differ from the typical *O. ceratophthalma*, the transverse striæ on the stridulating-ridges of the chelipedes are separated throughout by equal intervals, so that the ridge appears to be very evenly but coarsely striated throughout its length.

2. *Ocypoda cursor* (Linn.).

Of this species, which has been recorded from various Mediterranean localities and from the coast of Senegal, the Congo, Acra d'Elmina, and the Cape-Verds, and in which the carapace is broadest at the antero-lateral or exterior orbital angles, which are acute, the ocular styles short and terminated by a pencil of hairs, and the stridulating-ridge of the larger chelipede very finely striated, there are at present no adult examples in the Museum collection.

In a series of young specimens of small size from Syria (*Dr. O. Staudinger*), which may possibly be immature *O. cursor*, the eyes are distally rounded, without any indications of a terminal style, and the sides of the carapace straight for a short distance behind the antero-lateral angles, the stridulating-ridge is very narrow and indistinct, but finely striated.

I may refer to Savigny's figure of this species in his large work on Egypt for a representation of the characteristic peculiarities of the carapace and eyes *.

The deficiencies of the Museum collection as regards adult examples of *O. cursor* will doubtless be supplied whenever opportunity shall offer for the examination of the large series of 'Challenger' Brachyura, at present unpacked and awaiting transference to the galleries of the new Natural-History Museum, since Mr. Moseley expressly records the occurrence of this species (as *Ocypoda ippeus*) at St. Vincent, Cape-Verds †.

* 'Description de l'Egypte,' Atlas, Crustacés, pl. i. fig. 1.

† 'Notes by a Naturalist on the 'Challenger,'' pp. 48, 49 (1879, with a woodcut).

3. *Ocypoda macrocera*, Milne-Edwards.
(Pl. XVII. figs. 2, 2 *a*, 2 *b*.)

Of this species, of which Mr. Kingsley had seen no specimens, there are in the British Museum but three males, one obtained at Pondicherry and two at the mouth of the Hoogly (*Hon. East-India Co.*). They are at once distinguishable from *O. ceratophthalma*, typical examples of which they resemble in the greatly elongated terminal styles of the ocular peduncles &c., by the form of the fingers of the smaller chelipede, which are lamellate and dilated to the apices, which are broad and subtruncated; the dilatation, however, is much less than in *O. Gaudichaudii*. The lateral margins of the carapace are, moreover, more distinctly angulated than in that species and *O. ceratophthalma*.

The stridulating-ridge on the inner surface of the palm of the larger chelipede is rather broad, closely, finely, and evenly striated, and bordered externally with hair; the fingers subacute. The penultimate joints of the second and third legs are hairy on their inferior surface, as in *O. ceratophthalma*, of which species a larger series of examples might show *O. macrocera* to be merely a variety, though I could not venture to unite the two forms at present.

4. *Ocypoda ægyptiaca*, Gerstäcker.
(Pl. XVII. figs. 3, 3 *a*.)

This species, upon the distinctness of which from *O. ceratophthalma* I have already remarked*, is united by Mr. Kingsley, who follows Kossman, with *O. ceratophthalma*, but is retained as distinct by Dr. De Man (*t. c.* p. 247), who summarizes its principal specific characters. It is, in fact, easily distinguishable by the form of the carapace, which is arcuated and bulges out laterally behind the more or less rounded exterior orbital angle, by the finer, more crowded transverse striæ of the upper part of the stridulating-ridge on the chelipede of the male, and by the existence of a patch of thick hair on the penultimate joints of the *second* legs only, and not, as usual in *O. ceratophthalma* and allied species, on the penultimate joint of the third legs also. The terminal styles of the eye-peduncles are usually curved. It should be stated that Kingsley had seen no specimens of this species.

Specimens are in the British-Museum collection from Egypt (*Sir J. G. Wilkinson*), Red Sea, Gulf of Suez (*R. MacAndrew*), Gulf of Akaba (*Major Burton*), El Tor

* Ann. & Mag. Nat. Hist. ser. 5, ii. p. 409 (1878).

(*Major MacDonald*), and others without special indication of locality.

Two much mutilated specimens from the Red Sea, designated by White *O. Fabricii*, are doubtless a less mature condition of this species, from adult examples of which they are only distinguished by their smaller size, the less obtuse angles of the carapace, and by the very short ocular styles (which now only exist in one specimen).

I have seen no specimens which I can refer with certainty to the *Ocypoda Fabricii* as characterized by Kingsley, which in the structure of the stridulating-ridge somewhat resembles *O. platytarsis* and also *O. ceratophthalma*, as described by the American author. May it not be the young of the latter species?

5. *Ocypoda rotundata*, sp. n. (Pl. XVII. figs. 4, 4 *a*.)

I am obliged thus to designate an adult male of very large size (length of carapace $2\frac{1}{12}$ inches, 53 millim.; greatest breadth $2\frac{1}{3}$ inches, nearly 60 millim.), in which the carapace is very coarsely granulated, the granules much less crowded than in *O. ceratophthalma* and *O. ægyptiaca*, with the exterior orbital angles very broadly rounded, so that the antero-lateral margins of the carapace sweep round in a continuous curve to the upper margin of the orbits, which curve is only slightly interrupted by a shallow notch at the point occupied by the projecting angle of the orbit in *O. ceratophthalma*. The terminal styles of the eye-peduncles are short, straight, not reaching to the lateral margins of the carapace. There are scarcely any indications of the upper part of the stridulating-ridge on the inner surface of the palm of the larger chelipede; the lower part of the stridulating-ridge is composed of a series of widely-separated secondary ridges; the palm itself is very massive, with a few scattered granules on its outer surface; the margins both of arm, wrist, and chela are armed with spinules or small tubercles; the merus joints of the ambulatory legs are armed with a strong tooth or spine at the distal ends of their upper margins; there exists, as in *O. ægyptiaca*, a patch of hair on the inferior surface of the penultimate joint of the second legs only.

The specimen, which is much mutilated, is labelled "Dukhun, Col. Sykes" (*coll. India Museum*), and was probably obtained at some locality on the western coast of India.

The form of the carapace and of the stridulating-ridge serve to distinguish it from any specimen of the genus in the Museum collection; but upon the whole it most nearly resembles *O. ægyptiaca*, and the distinctions may possibly be either abnormal and due to the age and large size of the specimen, or characteristic of a well-marked local variety. More specimens are needed to decide this point with certainty.

6. *Ocypoda platytarsis*, Milne-Edwards.
(Pl. XVII. figs. 5, 5 *a.*)

This species is nearly allied to *O. ceratophthalma*, but is distinguished by the relatively broader carapace, with more strongly sinuated upper orbital margin, the exterior angle of which is not acute, by the form of the stridulating-ridge on the inner surface of the large chela, which consists in both sexes of a series of small tubercles which do not widen out into striæ and are not bordered by hair, and by the absence of hair from the under surfaces of the penultimate joints of the ambulatory legs in both sexes. The dactyli of the ambulatory legs are somewhat dilated in the adult.

There is in the British-Museum collection an adult male from Madras and a small male without special locality (*coll. East-India Museum*), also an adult female without special locality (*Gen. Hardwicke*), a smaller male from the collection of the Hon. East-India Company, and a fine adult male and smaller mutilated example from Ceylon (*Dr. J. Davy*).

In some young specimens from Ceylon (*E. W. H. Holdsworth*) the ocular styles are small or rudimentary, or even (in the smallest examples) wholly deficient; and in these specimens the carapace is relatively narrower and the dactyli of the ambulatory legs slender and styliform, so that were it not for the existence of large specimens in the same phial the species could not be certainly identified.

7. *Ocypoda Gaudichaudii*, Milne-Edwards & Lucas.
(Pl. XVII. figs. 6, 6 *a.*)

Of this species, which is at once distinguishable by the broad and squarely-truncate fingers both of the right and left chelipedes, there are in the British-Museum collection two males and a female from Panama (*Bridges* and *Smithsonian Inst.*), and a female from Esmeralda, Ecuador (*Fraser*); also an adult male from Chile (*Rev. Dr. Hennah*).

The antero-lateral angles of the carapace in these specimens are slightly acute and project laterally; the ocular styles are prolonged but little beyond them; and the stridulating-ridge of the larger chela, alike in males and females, is narrow, consisting in its upper part of a row of granules or small tubercles, which widen out into close-set striæ in the lower portion. The ambulatory legs are granulated and rugose, but almost entirely destitute of hair.

I have seen no specimens referable to the *O. Ryderi*, Kingsley (*t. c.* p. 183), from the coast of Natal, which is described as closely allied to the American *O. arenaria*, but distinguished by the existence of a minute terminal ocular spine and by having the ambulatory legs roughened by subspiniform granules. Unless it differ in the form of the stridulating-ridge, I see no reason why it should not be a variety of *Ocypoda ceratophthalma* (Pallas).

II. *Eyes rounded at the distal extremity, not terminating in a spine or style.*

8. *Ocypoda arenaria* (Catesby).
(Pl. XVII. figs. 7, 7 *a*, 7 *b*.)

Specimens are in the collection of the British Museum from the eastern and southern coasts of the United States (*Smithsonian Institution*), Georgia (*T. Say*), Jamaica, St. Christopher's (*Dr. J. E. Gray*), Vera Cruz (*F. Du Cane Godman*), Pernambuco (*W. Forbes*), and Rio Janeiro (*Dr. Cunningham*), besides others without special indication of locality.

In all the specimens I have examined the carapace is more coarsely granulated on the hepatic and sides of the branchial regions than on the gastric and cardiac regions, the lateral (or exterior orbital) angles are acute and rather prominent. The stridulating-ridge on the inner surface of the palm of the larger chelipede consists in the adult (both male and female) of a series of tubercles, which do not lengthen out into ridges or striæ. The ambulatory legs are dilated and compressed, the dilatation being most marked in the merus and penultimate joints; and the penultimate and antepenultimate joints (and usually the merus) are clothed along their margins and partially on their inferior surfaces with long fulvous hairs.

In one adult male example from Georgia the stridulating-ridge is nearly obsolete; it is represented merely by a few irregularly disposed tubercles.

There is in the British-Museum collection an adult female (unfortunately without chelipedes), obtained by purchase as from Japan with other Crustaceans undoubtedly Japanese, which closely resembles *O. arenaria* in the nearly smooth, dilated and compressed, and hairy ambulatory legs. Probably there is here some mistake regarding the locality at which the specimen was collected.

9. *Ocypoda Kuhlii*, De Haan.
(Pl. XVII. figs. 8, 8 *a*, 8 *b*.)

This species, reference to which is not made in Mr. Kingsley's revision of the genus, was only known by the very brief and insufficient diagnosis of its author until fully redescribed by Dr. De Man (*t. c.* p. 250), who records it only from Java and the Indian archipelago. In the typical form of this species the carapace is granulated more coarsely toward the sides than in the middle line, the antero-lateral (or exterior orbital) angles are acute and rather prominent, and the stridulating-ridge in the adult (both male and female) consists of a series of small tubercles, as in *O. arenaria*; but the ambulatory legs are never margined with hairs as in that species, and the penultimate joints are much less dilated and compressed and more coarsely granulated.

To this species are referred :—a series of rather small specimens from Thursday Island, Torres Straits (*Dr. Coppinger, H.M.S. 'Alert'*) ; an adult male from Shark Bay, W. Australia (*Surgeon Rayner, H.M.S. 'Herald'*), and other adult examples collected during the same expedition and probably from the Australian seas, but without special indication of locality ; also an adult female from Japan and small specimens from the New Hebrides (*W. Wykeham Perry*) and Sandwich Islands (*W. H. Pease*), and an adult female and smaller male from Madagascar (*Rev. Deans Cowan* and *Dr. J. E. Gray*).

In certain specimens, as (*e. g.*) in the adult female from Madagascar, the tubercles of the stridulating-ridge show a tendency to widen out into small secondary ridges. This specimen further resembles the following variety in having the carapace much more evenly granulated, the granulations on the gastric and cardiac regions being very nearly as coarse as on the sides of the branchial and the hepatic regions. In certain smaller specimens, as, for instance, in two from the New Hebrides, the antero-lateral angles of the carapace are much less prominent.

I can see no reason why the *Ocypoda convexa* of Quoy and Gaimard*, from Australia, should not be referred to this species or to *O. cordimana*. The original description does not state if there be a stridulating-ridge, although the words "*chaque pince a deux rangs de petites granulations à son extrémité*" may refer to this structure. In the figure the penultimate joints of the ambulatory legs of the first and second pairs are represented as fringed with short hairs on their anterior margins.

I consider the *Ocypoda occidentalis* of Stimpson † (to which no reference is made by Mr. Kingsley), from California, Cape

* Voy. de l'Uranie, Zool. iii. p. 525, pl. lxxvii. fig. 9 (1824) ; Kingsley, *t. c.* p. 185 (1880).

† Ann. Lyc. Nat. Hist. New York, vii. p. 229 (1860).

St. Lucas, as probably a variety of this species. Three specimens are in the British-Museum collection from Cape St. Lucas (*Smithsonian Institution*). They are distinguished from *O. arenaria* by being destitute of the long hair from the margins of the ambulatory legs, whose penultimate joints are less dilated than in *O. arenaria*, and by having the carapace very evenly granulated over the whole of its dorsal surface. This latter character will also distinguish this variety from the typical condition of *O. Kuhlii*; yet, in the specimen from Madagascar above referred to, the granulations of the carapace are as even and regular as in the Californian examples. The penultimate joints of the ambulatory legs are smoother below and more thickly clothed with short thick lines than in adult Australian examples of *O. Kuhlii*; but a specimen from the New Hebrides resembles Stimpson's variety in these particulars. To illustrate the very different character of the hairs which clothe the ambulatory limbs in the two species, I have figured (fig. 8 *b*) the under surface of the first ambulatory leg of one of the specimens designated *O. occidentalis* in the Museum collection, and probably named by Dr. Stimpson, with which may be compared the drawing of the same limb of *O. arenaria* from one of Say's Georgian specimens (fig. 7 *b*). If (of which there is no evidence in the Museum collection) intermediate conditions occur connecting *O. Kuhlii* and *O. africana* with *O. arenaria*, the latter name, having priority, would have to be used for the species, which would have an almost cosmopolitan distribution throughout the warmer temperate and tropical seas of the globe.

10. *Ocypoda africana*, De Man.

I have seen no specimens of this species, which inhabits the West-African coast (Liberia to the Congo), and is described by M. De Man as very nearly allied to *O. cordimana*, but differing in the possession of a stridulating-ridge, in which it is allied to *O. Kuhlii*, typical specimens of which it further resembles in having the under surface of the penultimate joints of the second and third legs devoid of patches of hairs. It is distinguished from typical specimens of *O. Kuhlii* principally, it would seem, by the more evenly granulated carapace and the striated (not tuberculated) stridulating-ridge; but I have observed specimens of *O. Kuhlii* which approach it in both these particulars.

The linear tubercle of the ischium joint of the larger chelipede, specially mentioned by De Man, against which the stridulating-ridge impinges, exists more or less distinctly in all the species of *Ocypoda* I have examined except *O. cordi-*

mana, where it is absent, as well as the stridulating-ridge itself.

Were it not for the locality of *O. africana*, I should have supposed this form to be a mere variety of *O. Kuhlii*, with which M. De Man does not even compare it.

With this species the *Ocypoda hexagonura* of Hilgendorf*, which also inhabits the coasts of Loango, Liberia, and Rufisque, is probably identical; in the specimens described by Hilgendorf the striæ of the stridulating-ridge pass into small tubercles in the upper portion; the penultimate joint of the ambulatory legs is hairy only on its distal parts.

11. *Ocypoda cordimana*, Desmarest. (Pl. XVII. figs. 9, 9 *a*).

Specimens are in the British-Museum collection from the Mauritius, Rodriguez (*H. H. Slater*); Seychelles, Amirante, and Providence Islands (*Dr. Coppinger, H.M.S. 'Alert'*); Indian Seas, Ceylon (*E. W. H. Holdsworth*); Koo Keang San (*H.M.S. 'Samarang'*); Borneo, Fiji Islands, Ovalau, Totoya (*H.M.S. 'Herald'*); New Hebrides (*Mr. MacGillivray*); and others without special locality.

This species, as De Man has shown, is at once distinguishable from *O. Kuhlii* by the absence of a stridulating-ridge from the inner surface of the palm of the larger chelipede in both sexes. The carapace is quadrate, very slightly transverse and very convex, and is somewhat more coarsely granulated toward the sides than on the gastric and cardiac regions. The antero-lateral angle is acute and moderately prominent. The chelipedes are less elongated and usually more finely granulated than in *O. Kuhlii*; and the under surfaces of the penultimate joints of the second and third ambulatory legs are usually provided with a fringe of short thick hairs.

In the report on the Crustacea collected by the Transit-of-Venus expedition at Rodriguez † I confounded under the designation *O. cordimana* specimens both of this species and *O. Kuhlii*. The distinctive characters of the two species were indeed never known until indicated by Dr. De Man.

EXPLANATION OF PLATE XVII.

⁂ The figures (unless otherwise noted) represent the exterior orbital angle and the stridulating-ridge on the inner surface of the palm of the larger chelipede in each species, and are drawn, of the natural size, from

* Sitz. Gesellsch. naturforsch. Freunde zu Berlin, 1882, p. 23.
† Phil. Trans. clxviii. p. 489 (1879).

adult male examples. Some of the outlines of the orbits are drawn slightly foreshortened on account of the convexity of the dorsal surface of the carapace. The character of the stridulating-ridges will be better made out if examined with a lens.

Figs. 1, 1 *a.* *Ocypoda ceratophthalma* (Pallas).
Figs. 2, 2 *a.* *O. macrocera,* Milne-Edwards.
Fig. 2 *b.* Outer view of smaller chela of the same species, showing the somewhat dilated fingers.
Figs. 3, 3 *a.* *O. ægyptiaca,* Gerstäcker.
Figs. 4, 4 *a.* *O. rotundata,* sp. n.
Figs. 5, 5 *a.* *O. platytarsis,* Milne-Edwards.
Figs. 6, 6 *a.* *O. Gaudichaudii,* Milne-Edwards and Lucas.
Figs. 7, 7 *a.* *O. arenaria* (Catesby).
Fig. 7 *b.* Under surface of part of first ambulatory leg of the same species, showing the long marginal hairs.
Figs. 8, 8 *a.* *O. Kuhlii,* De Haan.
Fig. 8 *b.* Under surface of part of the first ambulatory leg (from a specimen from Cape St. Lucas designated by Stimpson *O. occidentalis*).
Figs. 9, 9 *a.* *O. cordimana,* Desmarest.

XLI.—*Embryogeny of the Bryozoa ; an Attempt at a General Theory of their Development, founded upon the Study of their Metamorphoses.* By Dr. Jules Barrois.

[Concluded from p. 279.]

V. Cyclostomata.

My recent researches upon the Cyclostomata, which were undertaken specially with the object of studying the phenomena of the metamorphosis, were all carried on in the Mediterranean, which is so rich in various forms of Cyclostomata, and more particularly at Villafranca. The two principal types to which I have paid attention are the Frondiporæ and the Discoporæ ; the former, remarkable for the large size of the larva, which is peculiarly well adapted for observation, and with which it is easy to obtain sections, are unfortunately difficult to obtain in great abundance. The latter are common at Villafranca about the wet dock : their larvæ are small, and only moderately well fitted for the study of the fixation ; but they have the advantage of belonging to a type which closely approaches the type of the Chilostomata, and may serve perfectly as a means of comparing together the larvæ of these two great groups. Those of the Frondiporæ do not differ at all from the ordinary type that I have already described.

Larva.

When we open the young ovisac of any Cyclostome, we find it filled with small morulæ, of which the size varies from the most minute dimensions up to those of a pretty large and well-formed blastula. I had thought, on studying these little morulæ, that they were formed directly by means of a series of planes of segmentation, all passing through the centre of the primitive ovum, as is the case in numerous animals in which segmentation directly gives origin to a stage with a single layer of radiating cells.

1. A thorough investigation of these youngest stages has shown me that this was not the case; the segmentation does not at all resemble the type indicated in the preceding lines. From the very first stages the vitelline spheres glide over each other, so as to form by epibolism a kind of gastrula; and we soon meet with stages of extremely minute size, and already composed of an ectodermic layer and of a free endodermic mass in its interior. The endodermic mass becomes rapidly atrophied, and we get a small blastula, which does not follow upon a stage composed of radiating cells in which a central cavity is formed, but which has, on the contrary, originated from a true gastrula produced by epibolism in the first stages of the segmentation, and in which the endodermic mass has already disappeared.

2. It is then that the great increase commences which transforms the above little blastula (*pseudo-blastula*) into a large and spacious blastula, which becomes invaginated to give origin to a stage presenting a perfectly illusive resemblance to an archigastrula. The invaginated portion which is thus produced has nothing in common with the endoderm; it represents the sac which exists in the same fashion as in the Escharina, and is likewise formed by invagination.

3. After the gastrula (*pseudo-gastrula*), the ectoderm divides into a thick and a thin part: the former, occupying the half of the embryo which surrounds the external opening of the sac, consists of long cylindrical cells ciliated at the surface, and represents the oral surface; the second, occupying the opposite half, is formed of wider, very thin, and non-ciliated cells, and represents the aboral surface.

4. To pass from this to the complete larva, we see the whole aboral surface with flat cells bury itself suddenly in the interior of the embryo, so as to form a pallial cavity entirely covered by the oral surface.

In the hatched larvæ the median portion of the aboral surface projects into the interior of the pallial cavity, so as to form the homologue of the *hood*; but this hood, which, however, is not so well indicated as in the Chilostomata, never projects out of the cavity.

Moreover the bottom of the sac rises here, as in the Cellularina, into a sort of papilla, which more or less fills the whole of the cavity.

The larvæ of the Discoporæ are remarkable in that their general aspect is the same as that of the larvæ of the Chilostomata. Their general form is more or less discoidal; and their posterior part, inflated by the sac, is much thinner than their anterior part: the latter, which is flattened, forms in the middle a very slight depression in the form of an elongated fissure, which is very visible, especially after the fixation. We have here therefore as it were a last trace, very feeble indeed, but still perceptible, of the pyriform organ of the larvæ of the Chilostomata.

On the other hand, we do not see in the larvæ of the Discoporæ (any more than in the other types of Cyclostomata) any trace of a ciliary circlet; but this difference is not fundamental. We may regard the cells of the circlet as produced by the increase of the last row of the cells of the margin of the oral surface, an increase which may or may not exist without affecting the great structural features. The segmentation shows that these cells are formed at the expense of the aboral half of the ovum; but the study of the phenomena of the metamorphosis proves that they manifestly belong to the oral surface, of which we have every right to regard the circlet as forming the boundary. If we pass from the larvæ of the Discoporæ to those of the ordinary types, such as those of the Frondiporæ, Crisiæ, and Tubuliporæ, we shall see that a change has been effected analogous to that which takes place between the Escharina and *Bugula*; that is to say, the anterior part of the oral surface has quitted the oral pole to become vertical (adapting itself to the enclosure of the anterior part of the oral surface in the circlet). In consequence of this change the larva loses its discoidal aspect to acquire that of a small cylinder, entirely constituted by the oral surface, and pierced at each extremity by an aperture; the superior aperture gives access to the sac, the inferior one to the pallial cavity. This is the type that I have figured in my first memoir.

Metamorphosis.

This greatly resembles that of the Escharina.

1. The sac becomes devaginated to give origin, at first, as

in the Cellularina, to a lamina with two mamillæ, which, however, soon becomes flattened, and then only forms a single rounded plate, by means of which fixation is effected.

2. At the same time the issue of the aboral surface from the pallial cavity occurs, a phenomenon which takes place, like the devagination of the sac, with some rapidity; we see the devaginations (devagination of the sac and devagination of the aboral surface) effected at once at the two poles of the larva, while the oral surface which unites these two poles at first remains nearly of the same length.

3. Finally, the oral surface rolls up on itself so as to give origin to a torus nearly resembling that of the Escharina. By this process the margin of the aboral surface is brought into contact with the adhesive plate, and the cell is completely closed. The calcareous incrustation of its surface is preceded, as in the Escharina, by the secretion of a cuticular envelope, the formation of which commences here very early, and immediately after the devagination of the aboral surface.

4. The torus constituted by the oral surface and the upper portion of the adhesive plate is destined, as in the Escharina, to fall subsequently into degenerescence, forming a mass of opaque globules; further, the essential part of the polypide is also formed by the invagination of the apex of the aboral surface (representing the hood).

5. The aspect of a flattened disk, which is at first assumed by the young cell of the Cyclostomata, makes its appearance very rapidly after the margin of the aboral surface has come into contact with the adhesive plate. It long retains its circular form, with the rudiment of the polypide occupying exactly its centre. Soon after the invagination of the hood (which is effected in a straight line and not obliquely, as in the Escharina) this rudiment presents its two distinct layers; but I cannot say what is the origin of the external muscular layer. A remarkable fact, and one that shows that the Cyclostomata separated earlier from the ancestral type and are of more ancient existence than the Chilostomata*, is that the complete rudiment of the polypide retains for a considerable time (during the whole of the stage of the discoidal cell) its

* It is no doubt through this that their larvæ present a greater reduction of the internal organs than those of the Chilostomata (see the filiation of the larvæ in the conclusions); the two facts confirm one another and furnish a mutual support. Every one knows also that the Cyclostomata are much more widely distributed in geological formations than the Chilostomata, and that they especially predominate in the most ancient strata. The study of the structure of the larva and of the formation of the cell, and palæontology furnish us with perfectly concordant results, and are conclusive as to the antiquity of the Cyclostomata.

rounded structure, composed of two concentric hemispheres, suspended from the place where the hood was situated. It is only later, at the period when the cell loses its radiate symmetry and acquires a bilateral structure, that the rudiment becomes converted into a small closed sac with a double wall, as in the Chilostomata. The epoch of this change coincides with that in which the internal torus becomes emarginate on one side to acquire a horseshoe-like shape—a change which is itself connected with the appearance of the first indication of the vertical tube of the definitive cell. The formation of this tube commences by an elevation of the anterior part of the discoidal cell. In conclusion it may be mentioned that the transparent collar with which the base of the discoidal cell is furnished is produced at the expense of the adhesive plate, of which it represents the cuticular part.

VI. Lophopoda.

The facts which I have described for the preceding species lead us to give a new interpretation to the facts already acquired as to the freshwater Bryozoa (embryogeny of *Alcyonella*), facts which suffice to enable us, notwithstanding their still incomplete state, to correlate them closely with the marine forms and to assign them a well-defined position.

Larva.—The known development is very simple:—(1) a blastula is formed, in the midst of which appears (2) a fold which rises above one of the two halves, so as to envelop it completely; lastly (3) a young polypide buds forth internally upon the part thus enveloped.

There seems to me to be no doubt from what precedes (especially if we refer back to the development of the Cyclostomata) that this blastula is a *pseudoblastula*, and the annular fold the *mantle of the larva*. The covered half, together with the internal lamina of the mantle, represents the *aboral surface*; the second half, in conjunction with the external lamina of the mantle, represents the *oral surface*. Lastly, the apex of the covered half, which gives origin to the polypide by its internal budding, represents the *hood*.

Metamorphosis.—The study of the metamorphosis confirms these homologies. The larva, in fact, becomes fixed by the oral pole—that is to say, by the extremity opposite to the aperture which leads into the pallial cavity.

Afterwards the reversal of the mantle takes place, in consequence of which the whole aboral surface issues from the pallial cavity to form the integument of the cell; while the oral surface is entirely covered so as to form a thick internal mass, which soon becomes degenerescent, forming a mass of globules comparable to that with which we are acquainted in the other Ectoprocta. There is nothing in these phenomena which does not agree absolutely with what I have described in the marine species.

To sum up, the larvæ of the freshwater Bryozoa are distinguished only by three principal characters:—1, the absence of the ciliary circlet, which is replaced by a general ciliary covering; 2, the absence of the endodermic mass; 3, the absence of the internal sac. The first two characters are common to them and the larvæ of the Cyclostomata; the third is peculiar to them; nevertheless the Ctenostomata, in the group Chilostomata, present us with an analogous example of the reduction of the sac, a reduction which is very complete, if not total as in the Lophopoda. We see therefore that the freshwater Bryozoa, in their development, do not present any important phenomenon with which the investigation of the marine types has not already made us familiar.

We may remark in passing that the great resemblances of the larvæ of Lophopoda and Ctenostomata to those of the Cyclostomata and Chilostomata seem to justify a distribution of the Ectoprocta into two great divisions:—1. Cyclostomata-Lophopoda; 2. Chilostomata-Ctenostomata.

Conclusions.

Characters of the larva.—Filiation of the larvæ.—Leaving out of consideration the accessory organs, we may endeavour to give a purely diagrammatic representation of the principal larval types, by bringing together their essential parts, which the detailed study of the metamorphosis has shown us to be of the most importance. We shall then find that a Bryozoan larva consists essentially of five principal parts:—

1. The aboral surface, or the integument of the cell (A).
2. The peripheral part (O) of the oral surface, with the circlet which is formed by its margin, destined to form the mass of globules which fills the young cell, and, no doubt, originally the connective reticulum of the general cavity.
3. The incubatory pouch (1) with the central part of the oral surface destined to form the intratentacular space.
4. The intestine (2).
5. The rudiment of the polypide (3), a portion which is already preexistent in the larvæ, in which it very generally forms a special organ called the *hood*, and takes a variable part in the formation of the polypide, sometimes forming only the aperture of the cell (Entoprocta), sometimes constituting almost the whole polypide.

1. ENTOPROCTA.—Figure 1 (Pl. XIV.) represents the ar-

rangement of these parts in the larvæ of Entoprocta. It is here that they affect an arrangement nearest to that they will have in the adult. The aboral surface already forms the integument of the larva, and the oral surface is retractile and capable of closing to form a vestibule; it only needs a rotation of the organs (1) and (2), the incubatory pouch and intestine, these quitting the vestibule to place themselves in connexion with the organ (3), the *labial thickening* of the larvæ of Entoprocta, to pass from the larval to the adult form. All the five parts are well represented, and occupy an arrangement as near as possibte to that which they are to present in the adult.

2. Chilostomata.—In figure 2 it is otherwise; the circlet has grown towards the aboral pole, raising itself above the aboral surface, and thus giving origin to a new cavity, the *pallial cavity*. At the same time the oral surface has lost the power of retracting itself into the interior in the form of a vestibule. From all this we can foresee that there will be a necessity for greater changes in the metamorphosis. In the Entoprocta, in order to pass to the first stage following fixation, it suffices for the larva to rest upon the margin of the circlet; here a greater change is necessary; before arriving at the corresponding stage a preliminary phenomenon must take place; and this consists in the *reversal of the mantle*.

The three internal parts (sac, intestine, and hood) are certainly present; but the second has become degenerescent, and now only consists of a mass of globules in which one can no longer distinguish any organization.

3. Ctenostomata (fig. 3).—The type represented by the larvæ of Escharina has attained its full development among the Ctenostomata. Here the pallial cavity has become enormous, and the cells of the circlet form long ribs which occupy nearly the whole integument of the larva; the latter now merely represents a sort of little cask formed entirely by the ribs of the circlet, and at each end of which appears what remains of the primitive oral and aboral surfaces. The three internal parts are as in the larvæ of Escharina; nevertheless we find that the sac is reduced to quite rudimentary dimensions, and is evidently in course of disappearance.

4. Cyclostomata.—Figure 4 is a Cyclostome larva. The circlet is deficient all through this larval type; but the oral surface, of which it is only the boundary, has continued to grow towards the aboral pole, until at last it closes altogether above the apex of the aboral surface. Here we find carried to its highest expression the process which we have seen becoming more and more strongly marked starting from the Entoprocta, and in consequence of which the oral surface, at

first enclosed in the interior of a cavity (the vestibule) and entirely concealed by the aboral surface, gradually encroaches more and more upon the outer surface, until it forms by itself the external integument, in its turn pushing back the aboral surface into the interior of a cavity, the pallial cavity. In the most differentiated types of the group of the Chilostomata and Ctenostomata we have already seen that the aboral surface was almost entirely buried in the interior (fig. 3); nevertheless in this type the apex of that surface, which constitutes the organ called the *hood*, never ceases to project externally, and is never concealed by the cells of the circlet. In the Cyclostomata it is quite otherwise; the pallial cavity attains its maximum of extension, becomes transformed into a closed cavity, and the oral surface closes completely over the invaginated aboral surface.

As internal organs we find the sac very well developed and quite comparable to what we had in the Escharina; the thickening of the hood also exists; but we find that there is a complete disappearance of the vitelline mass of the two preceding types; the intestine, which is very well developed in the larvæ of Entoprocta, and reduced to a mass of globules in the larvæ of Chilostomata and Ctenostomata, disappears completely in the larvæ of Cyclostomata.

In a general way, the larva consists of an entirely ciliated sac pierced at each pole by a single aperture, which is very dilatable, but scarcely visible when it is closed; this sac is formed entirely by the oral surface. The superior (oral) aperture leads into the internal sac (1), the inferior (aboral) aperture into the pallial cavity. We see that the phenomenon of the reversal of the mantle must produce here a transformation still more complete than in the larvæ of Escharina; the larvæ of the Cyclostomata have diverged still more than the latter from the original arrangement (Entoprocta), which was nearer that which occurs in the adult.

5. Lophopoda.—The larvæ of the Lophopoda are to the larvæ of Cyclostomata what those of the Ctenostomata are to the Chilostomata; they resemble larvæ of Cyclostomata of which the sac has completely disappeared. This disappearance is only more complete than that I have indicated in the larvæ of Ctenostomata; the sac is suppressed without leaving any traces. Thus of the three parts indicated in the interior we no longer find more than one, namely no. 3, which of itself forms the entire polypide. The rest of the structure is comparable to that of the Cyclostomata, as in the latter the oral surface forms the whole of the integument and is closed up completely over the invaginated aboral surface.

The following Table, which reduces to three great types the different forms of the larvæ of Bryozoa, will show a recapitulation of these different characters :—

Entoprocta	Predominance of the aboral surface; vestibule at the maximum. Intestine well formed.
Chilostomata and Ctenostomata (sac reduced)	Predominance of the circlet; pallial cavity. Intestine reduced to a mass of globules.
Cyclostomata and Lophopoda (without sac).	Predominance of the oral surface. Pallial cavity at the maximum. Intestine has disappeared.

If we place ourselves, in the first place, at the point of view of the larval forms alone, it would appear that we have here an essential character based upon the antagonism of the two great cavities which occupy the two poles, and, in final analysis, upon the greater or less *development of the mantle.* It is in accordance with the extension of the latter that each of the two surfaces of which the embryo consists may be by turns enclosed in the interior (the oral surface invaginated as a vestibule, or the aboral surface as a pallial cavity) or may form the totality of the integument of the larva; further, we ascertain that when the *medium extension of the mantle* (2) occurs, we also find the state of incomplete disappearance of the intestine (replaced only by a mass of globules), while the complete disappearance of the intestine corresponds to the case of maximum extension. In one word, it would seem, to a certain extent, that we have here an essential character, to which all the others appear to be subordinated, and which enables us to arrange all the larval forms in a single series, at the same time progressive from the point of view of the extension of the mantle, and decrescent as regards the development of the internal organs.

If we now place ourselves at a more general point of view, embracing at one glance the entire development, we shall see that this character of *development of the mantle*, although serving to establish the filiation of the larvæ, has nevertheless no considerable importance as regards the development taken as a whole, since all the forms of larvæ, to whatever type they may belong, are invariably brought to the same type by the first changes which follow fixation, a common type in which all trace of the mantle disappears to give place to a stage in which the oral surface is immersed as a vestibule and the aboral surface exposed as integument.

Conclusion.—In (1) the development of the mantle in the larvæ of Bryozoa, as well as in (2) the reduction of the internal organs which accompanies it, and even in (3) the very existence of this mantle, we must see only a series of *purely adaptive* characters, which, although very important in the distribution of the larvæ of Bryozoa in a natural series, do not belong at all to the normal development, and are only products of life in a free state, between the hatching of the larva and its fixation.

All this is demonstrated :—1, by the important fact that the larvæ of Entoprocta (which, as every thing indicates, must be regarded as the ancestral form) are of all the *least different* from the adult form; 2, by the fact that, starting from this first form, we can now follow step by step the modifications of the different other forms; lastly, 3, by the fact that with all these other forms the first phenomena of the metamorphosis consist in a return, not to the state of a cystide, but to an arrangement analogous to that of the larvæ of Entoprocta, and nearer to that of the adult form; for this is the signification that must be ascribed to the important phenomenon of the reversal of the mantle, with disappearance of the pallial cavity, and reconstruction of the cavity of the vestibule.

The regular course of development would consist in the direct transformation into the adult of an organism resembling a larva of Entoprocta; the rest (that is to say, all that serves to change the Entoproct larval type to give origin to the other larval types that I have described) only constitutes purely adaptive phenomena, perturbatory of the regular course of the embryogeny, and acquired during the course of life in the free state.

Mechanism of the Transformation.—Characters of the Adult.

Let us now endeavour to form a general idea of the manner in which the adult state is fashioned, starting from the common stage which follows fixation; by this means alone we shall find the answer to the problem that we set before us at the commencement—namely, *to unite the two successive forms* (larva, adult) *of the embryogeny*, and especially *to appreciate the structure of the adult according to the data of embryogeny.*

It is not difficult to refer to the same type the two principal modes that we have described of the passage from the larva to the adult in the Entoprocta and Ectoprocta. The first phenomenon in either case consists in the immersion of the oral surface within the embryo, accompanied by an extension of the aboral surface, which spreads out so as to form the whole of the integument which will give origin to the definitive cell.

We then see that the oral surface, entirely invaginated into the interior of the embryo, divides into two completely different parts, one of which remains adherent to the base of the cell, while the second advances upwards to connect itself with the special invagination of the aboral surface (invagination of the hood in the Ectoprocta, labial thickening in the Entoprocta), and constitute with it the future polypide.

In the Entoprocta this second part, or superior division of the vestibule, is greatly developed, and consists of the median portion of the oral surface, which bears the incubatory pouch, and to which the intestine is suspended; it forms of itself almost the entire polypide, while the invagination of the aboral surface hardly gives origin to more than the aperture of the cell. In the Ectoprocta it is otherwise: the upper part of the wall of the vestibule only consists of a small cellular mass which comes to surround the principal portion of the polypide, of which it will form no more than the musculo-connective appendages; the essential part or epithelial lamella of the future polypide is here furnished entirely by the invagination of the aboral surface.

To sum up, we see that in both cases the polypide is formed by the union of two rudiments of very distinct origin; these rudiments encroach upon each other in such a manner that sometimes one, sometimes the other, plays the essential part in the formation of the polypide. This proves nothing against the general concordance which otherwise exists in the general phenomena. We have already noticed that in the Ascidia we see in the same way one of the most important portions, the *cloacal sac*, situated between the two primitive lamellæ, and formed sometimes by one, sometimes by the other of these lamellæ. It must further be noted that, in the Ectoprocta, the great development of the invagination of the hood, and the predominant part which it takes in the formation of the polypide, also depend certainly in great part upon the degenerescence of the intestine, which is itself the sequel of the larval state. In most types, moreover, we see the mass of globules which represents the digestive tube of the larva join itself onto the cæcal extremity of the polypide, so as likewise to take part in its formation.

The lower portion of the vestibule, including the circlet which forms part of it, enters into degenerescence in both types, so as to form the thick mass of globules which plays such an important part in the embryogeny of the Chilostomata. It would appear nevertheless, as is especially noticeable in the Entoprocta, that the primary function of this lower part is to give origin to a connective reticulum, which fills the whole cavity of the peduncle, and which, I think, we may regard as the homologue of the funiculus of other Bryozoa. It seems probable that all the oral surface must, in the ancestral type, be regarded as divided into three parts:—1, the upper part, destined to form the tentacular chamber, and into which would open in the types in question, below, the digestive tube and above, the invagination of the aboral surface destined to form the aperture of the cell; 2, the pedal gland, formed by the circlet; and 3, the intermediate portion, the margin of the vestibule, reduced to a cord uniting the gland with the polypide, entirely composed of connective cells, and representing the funiculus in the Ectoprocta, and in the Entoprocta the connective reticulum of the peduncle.

If from these data we attempt to construct a general type of adult Bryozoon, we shall see that there are grounds for distinguishing three surfaces:—1, the *foot*, corresponding to the oral pole; 2, the *frontal surface*, corresponding to the surface which answers to the mouth (figs. 6, 7, 8, *Fr*); and 3, the *tergal surface*, corresponding to the anus (figs. 6–8, *Tg*), the two latter surfaces both forming parts of the *aboral surface* which forms the entire integument.

In the Entoprocta these three distinct surfaces are easily recognized; and fig. 6, in which I have further carefully indicated the separation of the calice and peduncle, will show plainly at the first glance the distinctness of these three great divisions.

In the Ectoprocta the original arrangement seems to me to be that in which the cell comes to be developed in the direction of its height, as in the *Serialariæ*, *Bugulæ*, &c.; in these forms (fig. 8) we also very clearly distinguish the three surfaces, *pedal* (*Pd*), *frontal* (*Fr*), and *tergal* (*Tg*). Lastly, in the forms which are spread out into a plate, such as the Escharina and the majority of the Chilostomata, we can strictly establish the same distinction as I have shown in fig. 7. It is indeed to be noted that, in this last type, it is the tergal face whose growth almost always gives origin to the first bud*.

* In a multitude of groups the terms *ventral* and *dorsal* have been the source of endless confusion and ambiguity—among the Bryozoa, to take only a single example. The authors who give the name of the ventral surface to the surface applied against the ground for reptation, will regard the fixed surface (*Pd*) as ventral and the free surface as dorsal; on the contrary, those who regard as ventral the surface upon which the mouth opens will regard the free surface as ventral and the fixed surface as dorsal. The two kinds of interpretation have already been made use of without either of them satisfying the mind; for both characters (application against the ground and the existence of a mouth) are justly

There remains, however, a fact that I cannot explain, and which is shown by the series of figs. 6, 7, 8: while in the Entoprocta the *frontal* and *tergal* surfaces correspond to the *posterior* and *anterior* surfaces (that is, in the opposite direction) of the larva, we see, on the other hand, that in the Ectoprocta the frontal and tergal surfaces correspond to the surfaces of the same name [in the larva], the *frontal* to the *anterior*, and the *tergal* to the *posterior**. Figs. 6, 7, and 8 will show this difference; it is an anomaly that I cannot explain, at least unless we assume that the pyriform organ (figs. 7, 8, *ant.*), hitherto regarded as indicating the anterior part in the morphological sense—*i. e.* corresponding to the subbuccal appendage (fig. 6, *ant.*) of the larvæ of Entoprocta—corresponds, on the contrary, to the posterior part, which certainly seems at least doubtful, although, perhaps, its impossibility is not demonstrated.

Signification of the Metamorphosis.

The Table of larval forms, already given, justifies us in regarding fig. 1, the Entoproct larva, as representing the ancestral type of the entire group. To this, in fact, we have referred all the larvæ, showing by what series of modifications, from this primitive form, were produced all the other types that we know; we have seen that the Entoproct larva possessed the most complete organization of all, and that in all the other forms the primordial type has been altered.

On the other hand, the study of the metamorphosis has shown us that there exist in all two great types of the transformation of the larva into the adult, types which present the same general phenomena, but in a more explicit manner in the former. In a word, the development of the Entoprocta may be regarded as a dilated (palingenesic) and ancestral type of embryogeny, while that of various Ectoprocta, on the contrary, represents the condensed (cænogenesic) and derived form.

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employed to characterize the ventral surface. We avoid these ambiguities, and at the same time conform to all morphological and physiological requirements, by calling the fixed surface *oral*, and the free surface *aboral*, the latter being divided again into *frontal* (bearing the mouth) and *tergal* (corresponding to the anus).

* If we suppose that in fig. 6 the digestive tube is turned through a semicircle, so that its anal and buccal apertures are directed downwards, we shall see that the mouth will come to be superposed upon the subbuccal organ, *ant.* If we perform the same operation with figs. 7 and 8 we shall see that it is the anus that comes to be superposed upon the prebuccal mass, *ant.* It is in this that lies the want of concordance that I cannot explain.

Thus, if we would now inquire what signification must be ascribed to the mode of development just explained, we cannot do better than take as our exclusive basis the development of the Entoprocta, since it is this which serves as a starting-point for all the rest. An ideal type, based upon a mixture of the essential characters observed in the different types, would furnish us only with a sort of mean between the characters of the different families. The larvæ of Entoprocta, on the other hand, represent the primitive type from which all the others are derived; and this is what we want if we desire to appreciate the nature of the embryogenic phenomena and arrive at comparisons with neighbouring groups.

Without wishing to prejudge any thing with regard to the affinities which it is desirable to attribute to the Bryozoa, it may be remarked (and this no one can deny) that in the whole extent of the subkingdom *Vermes* the Bryozoa are perhaps the only forms, with the exception of the Rotifera, in which the *telostomian* arrangement is manifested in a constant manner throughout the whole group, whether during the course of development or in the adult state. It may be said, taking up a general point of view, that the Bryozoa, as also the Rotifera, are organisms *constructed upon the telostomian plan*—that is to say, in which the division of the body recalls the primitive division of the gastrula, with an oral and an aboral pole. These are, apparently, the only two groups of Vermes in which this arrangement continues so permanent.

Moreover, among the primitive Bryozoa (Entoprocta), as in the Rotifera, the aboral surface forms from the first the entire integument, while the oral surface is retracted into a vestibule, surrounded by a more or less developed circlet of cilia.

As a matter of fact (whatever may be the value of this approximation, whether it constitutes a real relationship or is only a simple analogy), an Entoproct larva, at least in the free state, represents a form constructed on the same plan as a Rotifer; it is a perfectly comparable organism as regards the great divisions of the body. This being established, we shall come to conceive of the original formation of a Bryozoan at the expense of its larva *as resulting from a simple change of life* in an organism resembling a Rotifer. We know that frequently the larvæ of Entoprocta, instead of swimming through the liquid in the manner of a Rotifer, reverse their position and proceed to creep upon their oral surface, as shown in fig. 9. Now if this habit becomes more frequent, the larva gradually abandoning its first mode of life to adopt the second, this change of manners might be the source of the metamorphosis that we have observed. The larva, in creeping, must, by means of its cilia, give rise to a current destined to carry towards its mouth the alimentary particles upon which the animal feeds; now we may suppose that this current, passing beyond the mouth, comes to strike against the anal extremity of the vestibule, pushing back the latter gradually towards the superior extremity of the larva, and finally producing the movement of rotation of all this part of the oral surface, carrying with it the digestive tube. We thus obtain a mechanical explanation of the fundamental phenomenon of the metamorphosis.

To conclude, we may put forward the hypothesis of the very ancient existence of a group of *Probryozoa*, composed of swimming organisms, free, and possibly analogous to the Rotifera (at least as regards the aspect and general arrangement of the body), and of which the few larvæ of Entoprocta that we know now-a-days represent the sole survivors; from this group the existing Bryozoa are derived by adaptation to a new mode of life: certain larvæ have accustomed themselves to creep, as indicated by fig. 9, upon their oral surface, instead of swimming freely through the water; and hence the changes already described, which produce the Bryozoan form, and the efficient cause of which may be ascribed to the current which flows into the mouth of the animal.

EXPLANATION OF PLATE XIV.

Explanation of the letters.

1. Rudiment of the polypide (*hood*).
2. Intestine or vitelline mass.
3. Internal sac or cloaca.

Fr. Frontal surface of adult.
Tg. Tergal surface.
Pd. Inferior surface or foot.
ant. Subbuccal (Entoproct) or prebuccal (Ectoproct) organ indicating the anterior part of the larva.
o. Vestibule.
a. Pallial cavity.
fun. Attenuated portion of the oral surface, uniting the half which forms part of the polypide to that which forms the rest of the invaginated vestibule.

Explanation of the figures.

The parts in black represent the oral surface, the parts in grey the aboral surface; the internal organs are left white.

Figs. 1–5 represent the five principal larval types, showing the variable extent of the oral (black) and aboral (grey) surfaces in each of them, as well as the extent attained by the three principal internal organs (1, 2, 3).

Fig. 1. Larva of an Entoproct. The aboral surface is very large and forms the whole integument. The oral surface is small and sunk into a vestibule. The three internal organs are well developed.

Fig. 2. Larva of a Chilostome. The two surfaces are of nearly equal importance; the chief part of the integument is formed by the circlet which represents the margin of the oral surface. The latter has lost the faculty of becoming retracted into a vestibule; and the aboral surface is invaginated into a *pallial cavity.* In the internal organs we observe the reduction of a first internal organ (no. 2), which, instead of forming a complete intestine, has become reduced to a mass of vitelline globules.

Fig. 3. Larva of a Ctenostome. Characters as in the preceding, but further presenting the reduction of a second internal organ, the sac (no. 3), which has become reduced to a little mass with no cavity.

Fig. 4. Larva of a Cyclostome. The oral surface forms the whole of the integument of the larva, and is completely closed over the aboral surface. The pallial cavity is thus transformed into a closed cavity. Of the internal organs the vitelline mass (2) has completely disappeared.

Fig. 5. Larva of a Lophopode. Characters as in the preceding, except that here the disappearance of the vitelline mass is associated with the complete disappearance of the sac.

Fig. 6. Young cell of a Chilostome immediately after the metamorphosis. We see the construction of the polypide at the expense of the three parts 1, 2, 3.

Fig. 7. Young cell of an Entoproct, showing the agreement with the preceding figure. In the polypide the white part represents what is derived from the organ no. 1 (*hood*), the grey part what is derived from the oral surface; the dotted part recalls the part taken sometimes by the residue of the opaque globules in the formation of the cæcum of the stomach: the polypide thus shows that it is composed of three parts (1, 2, 3), which may be regarded as corresponding to the three internal organs (1, 2, 3) of the larvæ.

Fig. 8. Young cell of a Ctenostome (*Serialaria*) represented in the same way.

These two figures, which alone may give a complete idea of the adult organism in the Ectoprocta, do not exist in nature, the invaginated vestibule always disappearing before the complete formation of the polypide; but it is necessary to represent the two things simultaneously, in order to form a general idea of the animal. These two figures show us the position of the polypide with relation to the invaginated vestibule.

Figs. 6, 7, 8 show, further, the homologies of the different surfaces in the pedunculate Bryozoa (fig. 6), the Bryozoa with flat cells (fig. 7, Escharina), and the Bryozoa with tubular cells (fig. 8, Cellularina, Ctenostomata, &c.). The correspondence is complete in all respects except the orientation of the polypide.

Fig. 9. Entoproct larva in the creeping state, to show the commencement of the immersion of the vestibule in the interior.

XLII.—*On the Affinities of the Genus* Pothocites, *Paterson.* By Robert Kidston.

Probably no genus of Carboniferous fossil plants has created so much interest amongst botanists as *Pothocites*.

The first specimen was described by Dr. R. Paterson in 1840 *, and was regarded by him as a Monocotyledon "either belonging to an extinct species of the genus *Pothos*, or to some extinct genus of plants closely related to it." This view has generally been accepted by subsequent writers "†.

The specimen remained unique until 1876, when Mr. R. Etheridge, Junr., described a second species, *P. Patersoni* ‡.

From an examination of both of these plants I have been led for some time to doubt their Monocotyledonous nature; and this view is now proved correct by a specimen collected by Mr. T. Stock from the cement-stone group of the calciferous sandstone series, Glencartholm, Eskdale.

This specimen, which I provisionally name *Pothocites calamitoides*, is fully 7 inches long; of this the spike occupies about 5½ inches; and it is, as far as I am aware, the first specimen in which this plant is shown up to its extremity.

The spike contains eight segments; and the stem, which is jointed as in ordinary *Calamites*, shows three nodes.

Leaves are given off from the nodal regions of the spike and stem. The jointed nature of the stem is equally well shown in *P. Patersoni*, Ether.

The small projection from the side of the stem in Dr. Paterson's original specimen, previously supposed to be the origin of the spathe, is the remains of a branch which bore a similar spike, as an example shows two such spikes terminating the branches of a dichotomous stem.

The so-called stellate "perianth-segments" are probably the deflected segments of sporangia which have shed their spores, and their component parts do not spring from a central tubercle, as represented in Dr. Paterson's enlarged sketch: what has been mistaken for the central column is merely a central depression; and the appearance caused when these minute bodies are viewed with lateral illumination has probably led to this error.

From the facts brought out by the recently found specimen and a careful reexamination of the original *P. Grantoni*,

* Trans. Bot. Soc. Edin. vol. i. part 1 (1841).

† Prof. Balfour, 'Vegetable Palæontology;' Carruthers, Geol. Mag. vol. ix. (1872); Geikie, 'Text-book of Geology,' 1882, p. 732.

‡ Trans. Bot. Soc. Edin. vol. xii. pp. 151, 163 (1876).

Pater., I am inevitably led to the conclusion that *Pothocites* is not the inflorescence of an Aroid, as has hitherto generally been supposed, but the fructification of a *Calamitaceous* plant.

At an early date I hope to illustrate and describe these interesting fossil plants more in detail.

P.S.—Since writing the above, my attention has been called to a lecture by Prof. Williamson, in which some doubts are expressed as to the usually accepted notions of the affinities of *Pothocites*. After alluding to the modern reference of *Antholites* to the group of gymnospermous exogens, he adds, "I expect that further research will lead to some similar change in reference to *Pothocites*" ('Essays and Addresses by Professors and Lecturers of the Owens College, Manchester,' 1874).

XLIII.—*On some apparently undescribed Rhopalocera.* By W. L. Distant.

Melanitis Libya, n. sp.

Wings above fuliginous brown; anterior wings with a large and very dark fuscous subapical patch, containing two large white spots, the margins of which are pale bluish; the first of these spots is subquadrate, placed above and resting upon the first median nervule; the second is rounded, placed beneath the outer edge of the upper spot and between the first and second median nervules. Anterior wings beneath dull ochraceous; basal portion beneath cell and second median nervule, and three transverse fasciæ crossing cell (the first somewhat obscure and the outer one broadest), dark and dull violaceous; beyond the cell the wing is crossed by two very obscure transverse fasciæ, concolorous, but darker in hue than the area on which they are placed, and a small, distinct, rounded white spot between the first and second median nervules. Posterior wings beneath dark and dull violaceous; costal area from above and including extreme base of cell ochraceous; this colour is continued downwards beyond discocellular nervules in a somewhat indistinct streak; outer margin brownish, and a submarginal row of very small and indistinct whitish spots placed between the nervules. Body and legs more or less concolorous with wings.

Expanse of wings 82 millim.

Hab. Masassi, East Africa.

In general shape and form this species resembles *M. ismene*, Cramer; but the colour and markings both above and beneath are of a very distinct nature.

Ypthima Robinsoni, n. sp.

Wings above very dark fuliginous; anterior wing with an ovate ocellated spot (black, with two small bluish centres and an ochraceous margin) placed a little beyond cell, its upper margin reaching just above the upper discoidal nervule, and its lower margin extending a little beneath first median nervule. Posterior wings with two small rounded ocellated spots (black, with a bluish centre and ochraceous margin) placed between the median nervules. Anterior wings beneath slightly paler than above, with the ocellated spot brighter and crossed by two dark transverse fasciæ, the first near apex of cell and the second somewhat submarginal. Posterior wings beneath greyish, with numerous dark strigæ, which are very thickly and confluently situate at basal area and crossed by three dark fuscous fasciæ, the first and narrowest very slightly curved, passing through centre of cell, the central very oblique, crossing apex of cell, and the third submarginal, broadest near apex, and narrowing towards anal angle; between the second and third fasciæ the colour is very pale greyish, and contains a small ocellated spot between the subcostal nervules; on the outer dark fasciæ are three ocellated spots, placed two between the median nervules and one between the third median nervule and submedian nervure; all these spots are black, with bluish centres and ochraceous margins. Body and legs more or less concolorous with wings.

Expanse of wings 37 millim.

Hab. Pulni and Rhodicanal, S. India (*F. E. Robinson*).

This species is allied to *T. Chenui*, Guér., from which it differs, on the underside, by the darker coloration, the different direction of the two dark fasciæ on the anterior wings, which do not approximate towards each other on inner margin, as in Guérin's species, and also by the second and third dark fasciæ to the posterior wings, which in *Y. Robinsoni* are subparallel and placed somewhat close together, the ocellated spots much smaller, &c.

Cynthia Cantori, n. sp.

♂. Closely allied in marking and coloration to *C. deione*, Erichs., from which it differs above on the anterior wings by the more angulated markings in the cell, and the central transverse fuscous line being placed much nearer to apex of cell; and on posterior wings this line is seen to be *abruptly broken and deflexed near bases of first and second median nervules*; on under surface this appears much more distinctly; the basal curved line which crosses the cell in *C. deione* is also broken and looped in *C. Cantori.*

Expanse of wings 68 millim.

Hab. Malay Peninsula; Province Wellesley.

This species will be figured in 'Rhopalocera Malayana.'

BIBLIOGRAPHICAL NOTICES.

Synopsis of the Classification of the Animal Kingdom. By HENRY ALLEYNE NICHOLSON, M.D. &c. 8vo. Blackwood: Edinburgh and London, 1882.

DR. NICHOLSON appears to be indefatigable in the production of educational works on zoology and palæontology. The book now before us makes no pretence to originality of treatment; it is, in fact, an illustrated synopsis of the classes, orders, and principal families of the animal kingdom in close accordance with the classification adopted by the author in his well-known 'Manual of Zoology,' and is intended by him to serve chiefly as a sort of memorandum-book, to which the student may refer to get a general view of the relations of the various groups of organisms. For this purpose it seems to be exceedingly well fitted: the classification adopted reflects very fairly the present views of zoologists in general; and in several cases, where considerable differences of opinion exist, the author has briefly discussed the questions still unsettled, and indicated the changes of classification which would be necessitated by the adoption of views opposed to those which have guided him in his arrangement of the groups. The most important of these little discussions is to be found under the head of the Sponges, which Prof. Nicholson treats as a class of the Protozoa distinct from, but most nearly related to, the Infusoria, and as possibly holding an intermediate position between the Protozoa and the Metazoa, with the latter of which certain zoologists, following Leuckart and Häckel, would place them. This intermediate position is that which the late Prof. Balfour was inclined to assign to the Sponges on embryological grounds, and taking it as demonstrated that the "gastrula" of the sponge proceeds from a true fecundated ovum; but many good observers, including the most recent writer on the subject (Mr. Saville Kent), hold that the ovular nature of the reproductive body in question is by no means proved; and to this opinion our author is inclined to adhere.

The woodcut illustrations, of which there are a great number, especially of the lower Invertebrata, are for the most part exceedingly good. They are generally taken from the figures published by trustworthy authorities, and have been most carefully reproduced. The selection has also been judiciously made, and the student, in turning over the leaves of the book, has an excellent and characteristic series of types brought visibly before him. Under the different families two or three characteristic genera are cited; and the references to the figures are appended to the names of these. The author also appends a very limited bibliography to the different classes and orders, referring the reader to the most important publications upon the structure and natural history of the various groups.

Proceedings and Transactions of the Natural-History Society Isis *in Dresden.* [Sitzungsberichte und Abhandlungen &c.] For January–June 1882.

Among the many interesting papers and notices in this part are:— 1. The Diamonds in the Royal Mineralogical Museum at Dresden, crystallographically examined by A. Purgold. 2. The fossil Flora from the "Jesuits' quarry" near Kundratitz, in the Leitmeritz district, enumerated by H. Engelhardt, who quotes 284 species, including Papilionaceæ (30), Celestrineæ (21), Cupuliferæ (20), Myrsineæ (10), and Rhamneæ (11); 40 species are new. The plant-bearing lignite or carbonaceous shale (Brandschiefer), accompanied by a diatomaceous earth (Polirschiefer), lies on basalt-tuff, and is overlain by a loose gravel of basalt. It contains also some animal remains, and is referred to the "Aquitanian" stage. 3. Meteorological Observations at Dresden for 1880–81. 4. An obituary notice of Edward Desor. 5. A fossil Pseudo-scorpion (*Kreischeria Wiedei*) from the Coal-formation of Zwickau, by H. B. Geinitz. 6. On some fossil Blattidæ from the Brandschiefer of the Lower Dyas (Permian) of Weissig, near Pilnitz. Dr. J. V. Deichmüller here describes and figures *Etoblattina flabellata*, Germar, var. *Stelzneri*, nov., *E. carbonaria*, Germ., var. (?), and *Oryctoblattina oblonga*, nov. sp. 7. Baron D. von Biedermann gives a sketch of the group *Rhizantheræ*, Endl., particularly *Rafflesia*, with a plate illustrative of the inflorescence.

MISCELLANEOUS.

Investigations on the Circulatory Apparatas of the Regular Echinoidea. By M. R. Kœhler.

In the regular Echinoidea, at the upper surface of the lantern, there are two periœsophageal vascular rings, the upper one of very small diameter, the lower one a little larger. In the lower ring the vessels of the ambulacral zones and the vessel called by authors the *sand-canal* open; in the upper ring the inner marginal vessel of the intestine and a second vessel parallel to the sand-canal, which loses itself in the excretory organ or ovoid gland of M. Perrier.

Each of the two œsophageal rings emits branches to the Polian vesicles.

If we examine carefully and with a low power the sand-canal of a *Sphærechinus* for example, it is not difficult to recognize side by side with the sand-canal, which appears as a small whitish canal running along the ovoid gland to the madreporic plate, a second canal, closely applied to it, but distinguished from it by a darker colour, and which, at the level of the lower extremity of the gland, seems to widen a little and to become continuous with the tissue of the latter. On injecting this canal from the direction of the lantern, the material readily fills an œsophageal ring, passes into the Polian vesicles, and penetrates into the inner marginal vessel; if the injection be made in the opposite direction, *i. e.* from the direction of the gland, we may inject a rich network of small capillaries which ramify on the surface of the latter. If by chance the gland be pricked with the canula, quite a different result is obtained; the excretory canal which opens at the madreporic plate is injected, but never any vessels.

From these facts it follows that the sand-canal is not a simple canal, but formed of two canals intimately united, one of which, the only one that has hitherto been described, is independent of the ovoid gland, while the other is connected with it. This result is confirmed by the study of transverse sections of the sand-canal, which show a first canal lined with a very regular epithelium, and, close beside it, a second canal, the lumen of which is partly filled up by some connective trabeculæ which start from the wall to form a delicate network bearing cells with a clear protoplasm, and furnished with processes and pigment-grains. By continuing the sections as far as and including the ovoid gland, the first canal is seen to retain always the same characters, and not to communicate with the gland; on the other hand, the second canal, in proportion as it approaches the gland, increases in diameter; the partitions which divided its cavity become more numerous, and the elements that they support closer; the vessels which ramify on the surface of the organ become distinct, and, by continuing the sections, we arrive at the proper tissue of the gland, formed, like the homologous organ of the irregular Urchins, by very delicate connective trabeculæ bounding alveoli filled with cells, the protoplasm of which is furnished with processes and granular nuclei, and more or less considerable aggregations of pigmentary masses.

If, in a specimen already injected by the half of the sand-canal communcating with the excretory organ, we force in an injection through the ambulacral vessels, we shall fill, below the œsophageal ring lately mentioned, a second ring, which likewise sends forth branches to the Polian vesicles: it is from this second ring that starts the half of the sand-canal which is independent of the ovoid gland.

The communication between the two rings occurs at the level of the Polian vesicles; and in order that the liquid of one ring may pass into the other it must traverse the glandular tissue of those vesicles. Injection made though the ambulacral vessels does not generally pass the inner marginal vessel, except when the injection is made with a rather strong pressure. We then find that the vesicles are completely inflated by the material; by means of the pressure the latter has been able to traverse the tissue of the vesicles to penetrate into the superior ring.

As in the *Spatangi*, there are two vessels in each ambulacral zone, a superficial and a deep-seated vessel, and each of them emits a branch to each ambulacral vesicle. These two vessels are independent of the nervous band which is closely applied to the wall of the test. At the level of the lower margin of the lantern the ambulacral vessels, from being double, become simple, and ascend along the pyramids to debouch into the inferior ring.

When an injection is made through the superficial ambulacral vessel or through the deep-seated one, the same result will be arrived at; that is to say, the inferior periœsophageal ring will be filled.

Teuscher, who also admits the existence of two ambulacral vessels (although, according to him, one of them surrounds the nervous band), thought that in transverse sections of the pharynx he recognized the section of five vessels; he believed that these five vessels were the continuation in the interior of the lantern of his perinervian ambulacral vessels, and that they opened into the superior periœsophageal ring. Now, these vessels do not exist, and the superior œsophageal ring is in communication with the ambulacral vessels only by the intermediation of the Polian vesicles.

The anatomical arrangements of which I have just given a summary, namely the existence of two periœsophageal rings, the existence of two vessels in each ambulacral zone, the complete independence of the nervous and circulatory systems, and the communication of the excretory organ with the circulatory system by the intervention of the sand-canal, approach the facts which I have already indicated in the irregular Echinoidea.—*Comptes Rendus*, Sept. 4, 1882, p. 459.

On Lieberkuehnia, *a Freshwater Multinucleated Rhizopod.* By E. Maupas.

When, in July 1879, I presented to the Academy a note on some multinucleated animal and vegetable protorganisms, I expressed my opinion that a number of new facts would certainly have to be added to those already known concerning multinucleated cells. Among the Algæ I mentioned the group of Siphoneæ as being likely to possess the same structure. This supposition was no longer such at the time I expressed it, as, contemporaneously with my notice, there appeared in Germany a memoir by Fr. Schmitz, in which that skilful observer pointed out the plurality of nuclei in several of the Algæ belonging to this group. Since then the researches of Treub, Berthold, Johow, and Guignard have still further increased the number of cases of nuclear plurality in vegetable cells.

I now submit a new and similar case observed in a Protozoan already known, but hitherto insufficiently investigated. Its organization is, moreover, so curious that its description will be gladly received by those who are interested in the morphology of unicellular organisms.

This Protozoan, which I found in the basin of the experimental garden at Hamma, near Algiers, is *Lieberkuehnia*, a freshwater rhizopod first described by Claparède and Lachmann, and afterwards reexamined by Cienkowski. This latter author did not identify the forms observed by him with those of Claparède and Lachmann, and called them by the new name of *Gromia paludosa*; but this mistake has already been corrected by Bütschli in his 'Protozoa' (p. 106). The observations of these authors, although extremely interesting, are far from being complete; they are moreover erroneous in some essential points.

The form of the body is variable, and may be perfectly spherical, ovoid, oblong, or even fusiform. Each individual can assume all these forms; and when the same specimen is under observation during several days, it is seen to pass through all these changes. These changes take place very slowly. The carapace is very transparent, and is closely applied to the surface of the body, and changes with it, lengthening, expanding, contracting, and returning to the spherical form at the same time with it. It also shares in the fissiparous division. I therefore cannot regard it as a true carapace in the same sense as that of the *Arcellæ* and the *Difflugiæ*. In these latter the carapace is a product of chitinous secretion of the nature of a skeleton, and has a very different morphological value. In *Lieberkuehnia* the seeming carapace is in reality only an integument or ectosarc, which can be isolated by certain reagents from the endosarc, but which resists less than the latter certain dissolving reagents.

The pseudopodia spread out at the extremity of a laterally inserted peduncle. They are capable of extending to a great distance. I have measured some which attained the length of 2·26 millim., the body of the animal having a diameter of from 0·15 to 0·16 millim. The circulatory movement of the sarcode is one of the most rapid that I have yet observed. The granules move through a space of 0·66 millim. a minute, the surrounding temperature being 23° C. (73° F.). The Infusoria which strike against the meshes of their network are arrested and rendered motionless, as has already been observed in the case of many other Rhizopods. In this way *Lieberkuehnia* is able to capture large Infusoria, such as *Paramecium aurelia*. The Infusoria when taken are absorbed in various ways: sometimes they are swallowed whole; sometimes, on the contrary, the sarcode of the pseudopodia envelops them on every side and constitutes around them a digestive vacuole, in which they are dissolved outside of, and frequently at some distance from, the body. They do not reach this till later on, when they are already assimilated to the substance of the pseudopodia in whose circulatory movement they disappear. The digestion takes place and is finished entirely outside of the body. With small Infusoria, such as *Cyclidium glaucoma,* the operation hardly lasts five or six minutes; but *Paramecium aurelia* resists more than an hour before it is dissolved and disappears by being drawn into the current of the pseudopodia. The sarcode of the mass of the body is in constant motion. This motion does not take place regularly in the same direction, like the cyclosis in *Paramecium aurelia.* It is quite as rapid as in that Infusorium; but splits up into currents with diverse and varying directions. This sarcode is hollowed out by numerous vacuoles of different volume and size, which are carried along by the currents, in which they are often seen to change their form and sometimes to amalgamate one with another. They always end by coming to the periphery of the body, where they contract in a similar manner to that of the so-called contractile vacuoles. *Lieberkuehnia* is therefore not, as has been stated, destitute of these organs of excretion. It is, on the contrary, perhaps more richly furnished with them than many other Protozoa. There is simply this difference, that the contractile vacuoles are neither permanent nor localized in any region of the body, every part of which may serve as a basis for their formation.

Lieberkuehnia, also contrary to what has been asserted, likewise possesses a great number of *nuclei* disseminated in the substance of the body; these nuclei are spherical, and measure 0·004 millim. I have already described another Rhizopod * likewise combining in its structure the instability of the contractile vacuoles and the multiplicity of nuclei. Further researches will undoubtedly increase the number of examples of this type of organization; and every thing leads me to believe that the *Biomyxa vagans* of Leidy † will, when more fully examined, show the same structure. The American naturalist has correctly recognized the numerous ephemeral vacuoles; but the nuclei have escaped his notice. These types are further characterized by the great mobility of their sarcode, by the incessant variability of their general outlines, and by the large development of their pseudopodia.

Lieberkuehnia increases by transverse division, which has been well described by Cienkowski. I will state, in addition to his observations, that I have seen individuals divide, not only into two but into three. The body lengthened out into a long spindle, which, after the formation of two new peduncles bearing pseudopodia, became constricted at two points, and was thus divided into three nearly equal segments. One specimen, resulting from one of these divisions into three, developed, as soon as it was detached, a second peduncle bearing pseudopodia situated at the opposite extremity to the one it already possessed. It continued thus to live with two places of emission of largely expanded pseudopodia. I observed it in this state for more than a day without any further changes taking place than those slow ones in the form of the body above mentioned. In this, therefore, there was no preparation for a

* See 'Comptes Rendus,' t. lxxxix. (1879), p. 252.
† Freshwater Rhizopods of North America, p. 282.

further fissiparous division. This *Lieberkuehnia*, so constituted, with its two places of emission of pseudopodia situated at the two opposite extremities, would answer to the morphological type which has served to establish the family of the Amphistomina. It may be considered therefore one of those intermediate forms which connect separated families.—*Comptes Rendus*, July 24, 1882, p. 191.

On the Development of the Alcyonaria. By MM. A. Kowalewsky and A. F. Marion.

During the months of May, June, and July we studied at Marseilles the embryogeny of three Alcyonida, namely two *Clavulariæ* and *Sympodium coralloides*. The segmentation, which had not previously been completely observed in any Alcyonarian, was seen and followed in all its phases in the ova deposited by *Clavularia crassa*. The fecundated ovum remains for some time without dividing. At this period the principal histological reagents (Kleinenberg's liquid, osmic acid, chromic acid, carmine with borax) are powerless to show any nucleus in its interior, while subsequently, when the segmentation is completed, the nuclei of the cells, notwithstanding their extreme minuteness, are easily recognized. Sections of the fecundated ovum show simply a finely granular peripheral protoplasmic zone and a central mass of fatty nutritive vitellus. The segmentation is rapid and of a quite unexpected nature. The primitive nucleus must be unable at its first division to carry with it the whole mass of the vitellus as nutritive substance. The derived nuclei undoubtedly emigrate towards the periphery, as is the case in some Crustacea; and when they are numerous enough, they determine a splitting-up of the vitellus, which becomes rapidly marked, producing segmentation-balls which penetrate angularly to the centre of the ovum. There is consequently no division into two. The ovum appears all at once broken up into at least six balls. After this division the distinction between a central nutritive part, and a peripheral evolutive part persists in the segmentation-balls themselves. These first balls, the number of which has increased, divide transversely, so as to constitute a peripheral layer of evolutive cells, and a central mass of cells in which the nutritive vitellus predominates. The same characters are still shown when the number of cells has considerably increased by the progress of the segmentation. The peripheral protoplasmic cells soon become regular, and form a very distinct ectodermic lamella. Beneath this the nearest layer of deutoplasmic cells arranges itself into a second lamella, the endoderm. The remainder of the deutoplasmic cells still occupy the centre of the ovum; but the contours of these elements begin to grow indistinct, and we soon see that, under the influence of degenerescence, a great number of the nuclei themselves are destroyed. The mass of vitellus in reserve decreases pretty rapidly; and empty spaces, gradually becoming larger, appear in the centre of the embryo, which acquires an ovoid form. The larva, when it issues from the ovum with its characteristic aspect, still possesses at its two ends a certain quantity of nutritive globules floating in the liquid which occupies the whole cavity. The endodermic cells, which at first were as distinct as those of the ectoderm, have been more slowly evolved, neither increasing in number nor becoming differentiated so much as those of the external lamella. They are charged with fatty globules, have acquired a clavate form, and their contours have become a little confused. The larva adheres by its larger end, which was carried in front during its errant life, which is usually very short. The smaller end becomes gradually depressed, forms at first an ectodermic plate, in the middle of which there often rises a knob representing the extremity of the larva, then becomes invaginated and constitutes the œsophageal sac, the bottom of which has to become perforated to place the mesenteric cavity in communication with the exterior.

As these phenomena take place the ectoderm becomes thickened by the appearance of a conjunctive layer, which will become the pseudomesoderm. A primitively structureless substance is secreted by the cells, and interposes itself between these ectodermic elements, which become less close-pressed by this means alone. Below, this conjunctive substance accumulates and receives into its mass cells which become detached from the peripheral layer. In *Sympodium* these migratory cells of the ectoderm early give origin in their interior to small calcareous nuclei, which become the sclerites. These corpuscles enlarge rapidly as the conjunctive layer thickens, while the cellular ectoderm diminishes in importance and now covers the pseudomesodermic zone only with one layer of flat cells.

In the *Clavulariæ*, and especially in *Clavularia petricola*, the ectoderm at the beginning undergoes quite different differentiations. The appearance of the sclerites is late. On the other hand, the errant larva already possesses a complex ectoderm. Cells with urticating threads have become differentiated in the outer portion; in the deeper region the cells are prolonged into the midst of the conjunctive substance secreted by filaments which resemble the epithelio-muscular and epithelio-nervous histological elements of the Actiniaria. The mesenteric dissepiments are always formed before the œsophageal invagination, in proportion as the larva becomes fixed. In *Sympodium* they present a great regularity from the very first. In *Clavularia petricola* we see as many as twenty-six primitive dissepiments appear at the bottom of the mesenteric cavity, their axis being formed by conjunctive streaks attached to the base of the ectoderm. It is only at the moment when the mouth is formed that these dissepiments become regular; eight of them grow rapidly to join the œsophagus, while the others become effaced by degrees.

Side by side with the normal embryonic process, *Sympodium* has presented us with facts of the highest interest, showing, in the larvæ of these Cœlenterata, a remarkable plasticity in the course of their morphological and histological differentiation.

We shall here mention only the most important peculiarities. In the same laying of *Sympodium* we find, together with normal larvæ which become quickly transformed, larvæ of delayed fixation, in which the dissepiments become sketched out even while the vermiform stage persists. The most curious character of these larvæ consists in the structure of their integuments. No sclerites are as yet formed, but the ectoderm has become differentiated after the fashion of the *Clavulariæ*. The cells have pushed forth muscular processes. At the base of the pseudomesoderm a fibrous layer corresponds to an annular muscular band. Very numerous primitive mesenteric folds have been formed; and the whole endoderm is associated with a layer of longitudinal muscular fibres. The transverse section of these larvæ is almost identical with that of an Actinia.—*Comptes Rendus*, September 25, 1882, p. 562.

On the Histological Structure of the Digestive Tube of Holothuria tubulosa. By M. E. Jourdan.

Throughout its length the intestinal tube consists essentially of three distinct fundamental layers—an external or peritoneal cellular covering, a fibro-muscular coat, and an inner epithelial layer.

Outer or Peritoneal Epithelial Layer.—The cells forming this are of two kinds. There are simple endothelial cells arranged in a single layer; in their frequently cylindrical form and the presence of vibratile cilia they differ widely from the endothelial elements of the Vertebrata. Their aspect also varies with the region examined and state of contraction or extension of the intestine. The other elements, which are much scarcer, are of the type described by Semper as *mucous cells*.

Muscular Layer.—This is represented by circular and by longitudinal fibres. The former constitute a continuous and regular muscular layer; the latter are much more numerous in the anterior region of the intestine. In the œsophageal region they are internal to the circular fibres; at the commencement of the middle intestine and throughout the rest of the tube they are placed immediately above the peritoneal layer of cells; that is to say, they are external to the circular fibres.

Conjunctive Layer.—In this there is an external zone, in which the fibres are intercrossed in all directions and form a close lamina, and an internal zone, in which they are much looser. In this part of the fibrous coat there are many vacuities; and in it the vessels circulate; it displays numerous nuclei, and some yellow granular bodies, like those of the liquid of the general cavity.

Inner Epithelial Layer.—This layer presents remarkable differences in the different regions. It is composed of epithelial cells and of glandular elements belonging to two distinct types.

The epithelial cells in the anterior and middle regions are excessively long, like slender fibrils, and terminate at their free extremities in a thick plate. At the beginning of the terminal intestine they become true cylindrical cells.

Of the glandular cells, some have finely granular contents, the others a protoplasm like that of the mucous cells so common in the

Holothuriæ. The cells with granular contents are always ovoid or spherical; they exist in the anterior intestine and in the anterior part of the middle intestine, and then entirely disappear. The cells with contents resembling those of the mucous cells of the peritoneal cavity are much more general; but they vary in form, distribution, and number in the different regions of the digestive tube. Thus they are ovoid and large at the commencement of the middle intestine, but soon become club-shaped and so numerous in the greater part of that region, that the epithelial cells seem to have entirely disappeared. In the terminal part of the middle intestine and in the posterior intestine they form spherical cells, and then resemble the mucus-cells of Vertebrata.—*Comptes Rendus*, September 25, 1882, p. 565.

On Animal Polymorphism. By E. B. Wilson.

This paper gave a brief discussion of the nature of polymorphism in animal colonies, with especial reference to the so-called polymorphism of the Pennatulacea. In studying the development of the colony in *Renilla* it was found that the peculiar and characteristic mode of budding shown by the sexual polyps is characteristic also of the rudimentary polyps or " zooids." There is a manifest relation between this mode of budding in the sexual polyps and the environment of the organism; and in view of the structure of other Pennatulacea, we seem to be justified in the conclusion, in accordance with the prevailing views of symmetry, that the mode of budding in the sexual polyps is directly dependent on the relation of the organism to its environment. If this conclusion is well founded, then it follows with considerable probability that the rudimentary zooids cannot have acquired their present mode of budding in their present position; for they agree with the sexual polyps in the law of budding, but differ widely from them in their relation to the environment. And, furthermore, it is impossible to conceive how the zooids can ever have occupied such a position as to agree with the sexual polyps in this relation.

From these considerations it seems probable that the zooids are not degenerated polyps, but are new formations which have inherited certain peculiarities from the sexual polyps. It is immaterial whether we call them organs which simulate individuals or individuals in a state of arrested development; in either case the various members of the colony are not of morphological equivalence; that is, they are not the *direct* descendants of like individuals. This suggests that in such organisms as the Siphonophora a similar condition may exist, some of the members being the direct descendants phylogenetically of fully developed buds, while others have arisen *de novo*, and are to be regarded morphologically as organs or as imperfectly developed buds. This view would harmonize the conflicting theories of Leuckart, Häckel, Gegenbaur, and others on the one side, and of Huxley and Metschnikoff on the other.—*Johns Hopkins University Circulars*, May 1882, p. 203.

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[FIFTH SERIES.]

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XLIV.—*Mimicry between Butterflies of Protected Genera.* By RAPHAEL MELDOLA.

IN 1879 the late Charles Darwin called my attention to a paper by Dr. Fritz Müller, in 'Kosmos'*, in which this naturalist attempted to explain the outstanding cases of mimicry, viz. those cases in which both the genera concerned are protected by distastefulness, by an extended application of the principle of natural selection, thus bringing the whole of these interesting phenomena under the action of Darwinian factors. I was at the time so much struck by the ingenuity of the reasoning employed, that I published a translation of the paper in the 'Proceedings of the Entomological Society of London' (1879, p. xx). The same author has recently published a second paper on this subject, an account of which has already been given in 'Nature'† by Mr. A. R. Wallace, who not only states Fritz Müller's case with his usual force and clearness, but gives the additional weight of his own authority to the proposed extension of the meaning of the term "mimicry." It is not necessary here to recapitulate Fritz Müller's arguments; I need only remind entomologists that he shows how it is advantageous for one species to

* "*Ituna* and *Thyridia*; a remarkable case of Mimicry in Butterflies," 'Kosmos,' May 1879, p. 100.

† "Remarkable Cases of acquired Resemblance among Butterflies," 'Kosmos,' 1881; 'Nature,' vol. xxvi. p. 86.

resemble another which is more abundant in individuals, although both may possess distasteful qualities. The chief factor concerned in bringing about this resemblance is the inexperience of young birds and other insectivorous foes, which necessitates the sacrifice of a certain number of distasteful individuals before they are recognized as inedible. In the papers published in 'Kosmos' no direct evidence of such inexperience is adduced; and in a subsequent number of 'Nature'* Mr. W. L. Distant, whose special knowledge of Lepidoptera gives considerable weight to his opinion, objected to the theory advanced by Fritz Müller and accepted by Mr. Wallace, on the ground that a knowledge of eatable and uneatable insects is hereditary in birds, and that no individuals of protected species would be sacrificed to the inexperience of young birds as required by the theory. In his recently published part of the 'Rhopalocera Malayana' (part ii. p. 33), Mr. Distant adduces some further arguments against the new view of mimicry; and I have only delayed entering into the discussion up to the present time in order to give Fritz Müller the opportunity of defending his views. Having just received a letter from this eminent naturalist, I will now venture to consider the validity of the objections referred to.

The experiment of the late Mr. Spalding, quoted by Mr. Distant in support of his objection, will be found, on close analysis, not to have any direct bearing on the class of cases under consideration. A young turkey bred in confinement displays fear when for the first time in its life it comes across a bee; and similarly chickens "gave evidence of instinctive fear of these sting-bearing insects." Now the alarm displayed by a young bird at the sight of a bee has no analogy whatever with the inexperience of a young bird as regards nauseous butterflies, as I will immediately attempt to show.

The swallowing of a stinging-insect like a bee would probably be attended by very unpleasant if not serious consequences in the case of a young bird; and it is not in the least surprising therefore that a dread of such insects should in this instance have become hereditary. But I cannot see how we are warranted in reasoning from this experiment that a knowledge of uneatable butterflies should also have become hereditary in all young insectivorous birds. No very serious result would arise from a young bird pecking at and killing such butterflies; and amidst the countless swarms of insects in the tropics there must be a vast choice of food offered, so that the knowledge of nauseous species at first sight is not a matter of life and death, and there is thus no reason why this

* Vol. xxvi. p. 105.

knowledge should have become unerringly fixed by heredity in all young birds. In the case of the very bird in question, there is, in fact, direct evidence that no such instinctive knowledge exists. Mr. Stainton relates (Proc. Ent. Soc. 1866, p. xlv) that he was in the habit of killing moths that had been attracted by light by the fumes of burning sulphur, and on one occasion, on throwing the useless specimens to a brood of young turkeys, "amongst a number of *A. exclamationis*, there was one specimen of *Spilosoma menthastri*; and though not one of the young turkeys rejected a single *A. exclamationis, they each, in succession, took up the* S. menthastri *and put it down again*, and it was left, conspicuous as it was, on the ground." In the case of insectivorous foes other than birds there is also evidence upon record that even adult lizards and frogs do not know some nauseous insects till they have actually seized them, as has been shown by the experiments of A. G. Butler with the caterpillar of *Abraxas grossulariata* and the imago of *Zygæna filipendulæ* (Trans. Ent. Soc. 1869, p. 27).

Passing from these old and now well-known experiments, I will give an extract from Dr. Fritz Müller's last letter:—

"It appears to me always worth while to discuss thoroughly the question whether birds and other butterfly-eaters know eatable and uneatable species through instinct *à priori*, or whether they have to learn this through individual experience. I hope to be able to do this shortly in 'Kosmos.' In the case of birds, I have as yet no direct proof; but in insects, and especially in bees, my brother Hermann Müller and I have repeatedly observed that they neither know instinctively the flowers which serve to provide them with honey or pollen nor the way in which their booty is best to be obtained. To-day, for the first time, a new illustration has been furnished by *Trigona ruficrus* in visiting a *Cypella* which offers easily accessible honey and pollen, and which the majority of these bees nevertheless could not at first find. Thus, by analogy, the same would occur in birds with respect to eatable insects as in insects with respect to flowers yielding nutriment."

As one piece of evidence bearing upon this subject, Dr. Müller encloses in his letter a specimen of a *Heliconius* which had apparently been seized, when at rest, by some bird, as there is a notched piece bitten out of the two fore wings; and I have in my possession another specimen of *Heliconius* which is similarly notched on both hind wings.

There is one other argument which may be adduced from psychology in favour of the proposed extension of the theory of mimicry. It is admitted by psychologists that there is a strict analogy between the development of bodily structure and of psychological characters, both in individuals and in species. The law of embryonic development formulated by Häckel as the "fundamental biogenetic law," teaches that the individual, in the course of its development from the egg (ontogeny), recapitulates with more or less disguise and abbreviation the phases through which its ancestors have passed in the course of the development of the race (phylogeny). Ancient characters are retained to a late stage of life only in cases where they are of direct service to the species, as, for example, in the retention of a subdorsal line by certain ocellated sphinx-caterpillars *. Why should not this same law be extended to instinct? If instinct is habit acquired during the former experience of the race, and accumulated and fixed by heredity, we may fairly expect that an animal, in the course of its mental development (psychological ontogeny), would pass through the stages of inexperience which were gone through by its ancestors in the course of their evolution. Only where an "instinct" was of vital importance to the young would it become fixed upon the early stages of growth by the law of inheritance at corresponding periods. The instinctive fear of bees shown by Mr. Spalding's turkey may be a case in point. But if, as I believe, the knowledge of a nasty butterfly is not a matter of vital importance, there is no reason why young birds should know such species antecedent to experience. This part of the discussion may, I think, be very well left at this stage pending the appearance of some satisfactory experiments with young tropical insectivorous birds and inedible butterflies.

The arguments advanced by Mr. Distant in discussing the question of mimicry in his 'Rhopalocera Malayana' are based on a consideration of the case of *Euplœa Distanti* and *E. Bremeri*, and may be thus stated :—

The male *Euplœa Distanti* closely resembles *E. Bremeri*, but is distinguished by the possession of a "pseudo scent-gland." To continue in the author's own words :—"It is at least a question whether the term 'mimicry' should be used here, both species belonging (as I consider, and most entomologists till recently considered) to the same genus. All the species of *Euplœa* with which we are acquainted, and as Mr. Wallace has informed us, have, with the remaining *Danainæ* of the Old-World tropics, the 'same protective odour.' In this case, if we adopt the explanation of mimicry for the resemblance of these two species, we must presumably consider *E. Distanti*

* Weismann's 'Studies in the Theory of Descent,' Engl. edit. Appendix, p. 529.

as the mimicked species, as it possesses a pseudo scent-gland, which may reasonably be considered as adding to its protective or uneatable character, and which is absent in *E. Bremeri.* We thus have the 'mimicking' very much more abundant than the 'mimicked' species, which is contrary to the usually observed phenomena, though Fritz Müller has recorded some similar exceptions as occurring in Brazil, and the same observer has also endeavoured to show that there is an advantage in two nauseous species resembling each other, as occurs between two American species, both of which belong to genera which are protected from birds and other enemies by distasteful qualities. Such propositions are, of course, at present hypothetical, and are at least supplementary to the carefully observed facts on which Mr. Bates originally disclosed and argued the admirable doctrine of 'mimicry,' which accounted for the strange external resemblances, long known to entomologists, which existed between insects belonging to distinct genera, families, and even orders, between which there was no real affinity" (Rhop. Malay. p. 33).

It seems to me, on carefully considering the foregoing extract, that the author has mixed up two very distinct things as being "at present hypothetical," viz. (1) the statement that a mimicking species is sometimes more abundant than its model, and (2) the demonstration that there would be an advantage in one distasteful species resembling another distasteful and more abundant species. The former is a simple record of observation and involves no hypothesis whatever. Thus in the case of such mimetic pairs as *Mechanitis lysimnia* and its imitating *Leptalis*, and *Papilio nephalion* and its mimicking *Euterpe tereas*, there can be no doubt as to which is the model; and Fritz Müller has observed that the models are, in these instances, "hardly more common" or are much rarer than the mimics. This was at least the case in the part of Brazil where he made this observation *.

The second "proposition" is hypothetical only to the extent of our not having any direct observations upon the inexperience of young insectivorous birds and other enemies. If we grant, as appears to me most probable, and as Fritz Müller and Mr. Wallace have admitted, that a certain number of individuals of distasteful species have to be sacrificed to inexperience, it follows mathematically that there would be a great gain in one distasteful species resembling another which exceeded it in numbers. If therefore, in the case of *Euplœa Distanti* and *E. Bremeri*, we accept Mr. Distant's position, and with him "adopt the explanation of mimicry for the resem-

* Ann. & Mag. Nat. Hist., Feb. 1878, p. 157.

blance of these two species," we can only admit the mimetic theory in Fritz Müller's sense, and the question as to which species is the model and which the mimic need not cause any anxiety. *In such cases the rarer species would always be adapted in external characters to the commoner one.* The inference that *E. Distanti* is the model is therefore erroneous from the new point of view; and, in spite of its "pseudo scent-gland," I believe that we must regard it as the mimic of *E. Bremeri*.

To bring the argument home to entomologists, I will once more venture to state the case numerically, with special reference to the species under discussion, using Fritz Müller's own figures for this purpose. Let us suppose that at the time when *E. Distanti* and *E. Bremeri* were quite distinct there existed in a certain area during one season 10,000 individuals of the latter and 2000 of the former. If, say, 1200 individuals of a nauseous species are necessary for the education of young birds, this number would in each case be sacrificed, and the total number of butterflies lost would be 2400. But if the two species were so much alike that their foes could not distinguish them, then we should have what, from a mimetic point of view would be, as regards birds &c., only one species, consisting of 12,000 individuals, of which 1200 have to be sacrificed. Now the loss would in this case fall upon the species in the ratio of their numbers, viz. 5 : 1; so that *E. Bremeri* would lose 1000 and *E. Distanti* 200 individuals.

In the former state of affairs (before the resemblance) each species would have lost 1200; now *E. Distanti* gains 1000 individuals by its resemblance and *E. Bremeri* only 200. The total number of individuals with which we started was 10,000 of *E. Bremeri* and 2000 of *E. Distanti*; so that the last species gains $\frac{1000}{2000}$ or $\frac{1}{2}$, and the first species $\frac{200}{10000}$ or only $\frac{1}{50}$ of its whole number. The advantage in favour of the rarer *E. Distanti*, conferred upon it by its being mistaken for *E. Bremeri*, would thus be twenty-five times as great as the advantage which the commoner *E. Bremeri* derives from resembling *E. Distanti*. Surely in such a case the question as to which is the model does not admit of a doubt.

This extension of the theory of mimicry, as far as I am able to see, makes no greater claim upon the credulity of naturalists than the older and more restricted view which made it essential that the model should always belong to a protected group, and the mimic to a family devoid of distasteful qualities. The factors concerned are in both cases the same—variation and natural selection; and the term "mimicry" is as applicable to one class of cases as to the other. Mr. Distant, however, not only refuses to admit the Batesian theory in the case of two protected species (because they happen to be nearly allied or even in the same genus), but would restrict the original theory within such narrow limits that no philosophical entomologist can possibly accept his interpretation. Thus he states:—"The original argument that butterflies which were *known by observation* to be uneatable or protected were mimicked in appearance by different butterflies which did not possess distasteful qualities for the sake of a similar protection, does not warrant the conclusion that because two or more butterflies or other insects (of or not of the same genus) resemble each other, therefore, *without observation of the fact*, it is proved that one must be protected or uneatable, and the other or others are mimickers" (Rhop. Malay. pp. 33, 34).

If, in accordance with this statement, we are to confine the term "mimicry" to those cases only in which the model is "known by observation" to be uneatable, it may be fairly asked how far we know that such imitated groups as *Heliconius*, *Euplœa*, *Danais*, *Acræa*, &c. are distasteful. But very few direct observations have, as far as I am aware, been made even upon these groups which are generally admitted to be the objects of imitation; and I certainly know of no systematic experiments conducted with these models and insectivorous foes. Thus the resemblance of *Diadema misippus* ♀ to *Danais plexippus* may be called "mimicry," because *Danais* is "known by observation" to be a protected genus. But are the resemblances between such genera as *Apatura* and *Athyma*, *Laogona* and *Neptis*, &c. not to be considered as "mimicry" simply because we do not know with certainty which form to call the model? If we refuse to admit the theory of mimicry in such cases as the latter, we should leave unexplained a very large number of most exact imitations between very distinct genera—a retrograde step which few scientific entomologists will be disposed to take.

In the case of the two *Euplœas* upon which Mr. Distant bases his objections, the fact of their being near blood-relations seems to be the great stumbling-block which prevents him from admitting the mimetic explanation. But it is somewhat surprising that an author, whose work is so far in advance of all other works of the kind in the knowledge displayed in the philosophical portions of his subject, should have overlooked or should have failed to mention the fact that Mr. Bates in his original memoir admits mimicry between nearly related (and distasteful) groups. He says:—"Not only, however, are Heliconidæ the objects selected for imitation, some of them are themselves the imitators; in other words, they counterfeit each other, and this to a considerable extent. Species belonging to distinct genera have been confounded owing to their being almost identical in colours and markings; in fact many of them can scarcely be distinguished, except by their generic characters. It is a most strange circumstance connected with this family that its two sections or subfamilies have been mingled together by all authors, owing to the very close resemblance of many of their species. Analogies between the two subfamilies have been mistaken for affinities. It is sometimes difficult to understand in these cases which is the imitator and which the imitated. . . ." (Trans. Linn. Soc. vol. xxiii. p. 507).

This extract from the writings of the founder of the theory of mimicry proves to my mind conclusively that Mr. Bates had himself observed the resemblance between nearly related and protected groups; and Mr. Distant's strictures upon the theory must, in my belief, give way. He admits that true mimicry may occur between different sections of the same genus, as has been shown to be the case in *Papilio* by Mr. Wallace, and more recently by Mr. Wood-Mason. But here, again, I would ask how Mr. Distant knows "by observation" that one section is inedible? The arguments based on the presence or absence of a scent-gland must be used with the greatest caution in determining which group serves as the model. This appears most forcibly from the inconsistencies which Mr. Distant has himself brought to light when making use of this character as a criterion. Thus, he states that if we admit the theory of mimicry in the case of *Euplœa Distanti* and *E. Bremeri*, "we must presumably consider" the former to be the model, because of its pseudo scent-gland. Further on he continues:—"But in the genus *Euplœa* we have at present no knowledge of non-nauseous or non-protected species, and therefore the probability of the species 'mimicked' being *E. Distanti*, because of its possession of a pseudo scent-gland, and hence presumably protective advantage, is somewhat negatived by the fact that some *Euplœas* without these glands are mimicked by other and very divergent species, as, notably, *E. midamus* by *Papilio paradoxa* and *P. œnigma*. The possession of these glands does not therefore appear necessary for distastefulness. . . ." &c. (*loc. cit.* p. 33). Such facts as those mentioned appear to me to be conclusive against the said glands being of any use as a protection. Indeed there are many dull groups, both of butterflies and moths, which we have no reason to regard as being distasteful, and of which the males are provided with large scent-glands or tufts, e. g. *Mycalesis*, *Erebus*, &c. The position which

Mr. Distant takes at the outset of this argument is in fact fallacious. There is not the least warrant for the supposition that scent-glands or tufts have any thing to do with distastefulness. The acrid juices of distasteful butterflies are not generally emitted from any particular organ, but permeate all the tissues of the body. The fact that such organs exist in one sex only is strongly suggestive, if not demonstrative, of the view that they are *secondary sexual characters*; and as such they are regarded by Dr. Fritz Müller, who has systematically investigated these structures, and has in many cases actually detected the odour emitted, which is often of a pleasant character *.

I have entered at some length into this discussion, because I am persuaded that the extension of the theory of mimicry proposed by Fritz Müller marks a great advance in our views on this subject, which is so interesting as having been the first to which the Darwinian Theory of Evolution was applied with such success by Mr. Bates. Not only are we now in possession of a consistent theory which enables us to dispense with mysterious and "unknown local causes," but other groups of facts hitherto incomprehensible are capable of explanation. Thus the prevalence of one type of marking and colouring throughout immense numbers of species in protected groups, such as the tawny species of *Danais*, the barred *Heliconias*, the blue-black *Euplœas*, and the fulvous *Acræas*, is perfectly intelligible in the light of the new hypothesis. While the unknown factors of species-transformation have in these cases caused divergence in certain characters, other characters, viz. superficial colouring and marking, have been approximated or prevented from diverging by the action of natural selection, every facility having been afforded for the action of this agency *by virtue of the near blood-relationship of the species concerned.* When discussing the origin of mimicry, Mr. Darwin long ago suggested that it might have commenced at a time when the species were more nearly related in marking and colouring †.

XLV.—*Black-Sea Mollusca.* By J. Gwyn Jeffreys, LL.D., F.R.S.

My friend Admiral Spratt has, with his usual kindness, given me a few small shells, which he dredged in the Black Sea while surveying in 1855. None of them, except *Mytilus*

* Jen. Zeit. vol. xi. p. 99; Trans. Ent. Soc. 1878, p. 211.
† Origin of Species, 6th ed. p. 377.

edulis, have been noticed by Middendorff in his 'Malacozoologia Rossica,' nor by Weinkauff in the 'Nachrichtsblatt der deutschen Malakozoologischen Gesellschaft' for February and March 1880. One of the dredgings of Admiral (then Captain) Spratt was off Balaclava, in 45 fathoms; and another was 60 miles south-east of the mouth of the Danube, in 50 fathoms. The following list includes a species which I consider new to science.

First Dredging.

Mytilus edulis, Linné; drifted.
Cardium fasciatum, Montagu.
Scrobicularia alba, W. Wood, var. *curta*.
Cerithium pusillum, Jeffreys.
Cerithium reticulatum, Da Costa.
Trophon breviatus, Jeffr., sp. n.

Second Dredging.

Mytilus phaseolinus, Philippi.
Cardium fasciatum.
Scrobicularia alba, var. *curta*.
Cerithium pusillum.
Trophon breviatus.

Trophon breviatus *, Jeffreys.

SHELL forming a short spindle, rather thin, opaque and lustreless: *sculpture*, numerous and slight but irregular longitudinal striæ, which cover every part of the shell; there are also several broader and flattened spiral ridges, about 6 on the body-whorl, 3 or 4 on the penultimate, 2 on the next, 1 on the rest, and none on the two uppermost whorls: *colour* yellowish-white: *spire* short, ending in a smooth and glossy rounded point, which is usually twisted to the left: *whorls* 6, swollen, bluntly angulated above; the last occupies five ninths of the spire: *suture* wide and deep: *mouth* roundish-oval, expanded; length five ninths of the spire: *canal* short, open, turning to the left, and terminating in an excavated notch; externally it is marked only by the longitudinal striæ, which are there close-set and irregular: *outer lip* projecting, bluntly angulated above; edge sharp; inside or throat quite smooth: *inner lip* thin, reflected: *pillar* broad, curved and flattened, with a sharp edge: *operculum* yellow, triangular, marked with curved striæ in the line of growth; nucleus terminal and blunt. L. 0·45, B. 0·225.

* Shortened.

Its nearest ally is *T. muricatus*, a Mediterranean species; but the present species differs in having a much shorter spire, with swollen whorls, in the sculpture being smooth instead of prickly, the longitudinal striæ finer and more numerous, the mouth wider and the throat smooth, and in the canal being much shorter and more open.

Black Sea, 45 and 50 fms. Several specimens.

The Black Sea is zoologically an offset of the Mediterranean, the latter and the Sea of Marmara being the intermediate links in the chain which connects the Black Sea with the North Atlantic. I have endeavoured to show, in the 'Reports of the British Association for the Advancement of Science,' that the Mollusca of the Mediterranean scarcely, if at all, differ from those of the North Atlantic.

XLVI.—*On the Identity of* Ceramopora (Berenicea) megastoma, *M'Coy, with* Fistulipora minor, *M'Coy.* By JOHN YOUNG, F.G.S.

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

GENTLEMEN,

In vol. xviii. (4th series) of the 'Annals,' for 1876, there is a paper by Dr. Gustav Lindström, "On the Affinities of the Anthozoa Tabulata," in which, at pp. 5–9, he calls attention to certain Silurian fossils that have been referred to the Tabulata, but which he says are in reality Bryozoa. As evidence of what he asserts, he refers to the common Silurian *Monticulipora petropolitana*, Pand., which, he says, begins life "as a Bryozoan, as a *Discoporella*, as what Hall has termed *Ceramopora imbricata*," and he then goes on to describe it briefly from its earliest stages of growth until it arrives at the stage where it becomes a *Monticulipora*.

Prof. H. Alleyne Nicholson, in his 'Tabulate Corals,' pp. 285–288, questions the correctness of Dr. Lindström's statements, and says "there are very strong grounds for regarding *Ceramopora* as an independent organism, quite distinct from all the forms of *Monticulipora*."

It may therefore interest some of the readers of the 'Annals' to learn that I have discovered specimens of another Bryozoan, or Polyzoan as I prefer to term it, in the Carboniferous-limestone strata of Western Scotland, that is closely allied to the Silurian *Ceramopora*, and which I have been enabled to follow clearly in all its various stages of growth until it becomes a true *Monticulipora*—the organism in question being the *Berenicea megastoma*, M'Coy, *Diastopora*, Morris's Catalogue, but which has been more correctly referred to *Ceramopora* by G. R. Vine, in his paper "On the Family Diastoporidæ," Quart. Journ. of the Geol. Soc., Aug. 1880, p. 359.

I shall not now enter upon any exhaustive description of this organism in its several stages, but briefly state that it is found in its first or earliest stage in small, circular, incrusting patches, 3 lines in diameter, or what M'Coy terms "spot-like crusts," attached to shells, stems of Crinoids, Polyzoa, Corals, &c., the cells being depressed or oblique, and radiating outwards from a bare central spot or macula.

In its next stage it is found in similar incrusting patches, varying in size from a half inch to two or more inches in extent. In this stage the cells are still much reclined, and have their mouths of a trilobed form when quite perfect, but roundly triangular or pyriform when the outer surface is worn. The more perfect trilobed form of the cell-mouths is due to the occurrence of two short spines that project, one on each side, on the raised lower lip of the cell—a character that has likewise been noticed in some of the Silurian *Ceramoporæ*. In some specimens in this stage of growth the cell-mouths are seen to be closed by a thin calcareous cover, which I now consider to be the commencement of tabulæ in the cells. In the spaces between the cells there are also numerous small polygonal cells that are arranged in from one to three rows. I first called attention to these new characters in *C. megastoma*, M'Coy, in the Trans. of the Geol. Soc. Glasg. vol. vi. p. 213, 1879; but at that time I had not seen Dr. Lindström's paper, and had no idea that the organism afterwards developed into a *Monticulipora*.

The next stage is where we find the organism in thicker incrusting patches, in which the larger cells are seen to become more erect, while their mouths become nearly circular, the openings in some specimens being quite round, with a slightly raised rim to the cell; but the roundly triangular form of the cell-mouths of the earlier stage can always be traced in such specimens when sections of the organism are cut near the base. In this stage, which Dr. Lindström calls the third, we often find the small polygonal cells or tubes that occupy the space between the larger tubes closed by a thin, dense, calcareous outer layer, which leaves only the larger cell-openings visible. This he terms the *Thecostegites*-stage; but when this is the case the smaller tubes can always be exposed by grinding a little way below the surface, so as to remove this layer. It is probable that it is this outer layer that forms the successive tabulæ in the smaller polygonal tubes, just as the calcareous covers found in the larger cells may be the tabulæ of these tubes; for I find these external characters in all the stages of growth.

The last or oldest stage in which I have found this organism is in incrusting patches, varying from 1 to 6 or 8 lines in thickness, the thicker specimens often showing several concentric or zonal layers of growth, in which the larger cells form erect continuous tubes that open at the surface with nearly circular mouths. In all specimens that have their structure well preserved the larger tubes are seen to be tabulated, the tabulæ, which are nearly horizontal, being somewhat irregular in their distance from one another: in some specimens they are less than the diameter of the tube apart; in others they are much wider, which leads me to think that in some cases they have partly disappeared during fossilization. The smaller polygonal tubes, on the other hand, are always closely and more strongly tabulated, the tabulæ being generally horizontal, but sometimes curved or vesicular. In this, the latest stage of the organism (so far as I am acquainted with it), it is identical with the *Fistulipora minor*, M'Coy, which Prof. Nicholson, in his 'Tabulate Corals,' now places with the *Monticuliporæ*. I now find that all the specimens that I had formerly identified with *F. minor* from the limestone strata of Western Scotland must be regarded as only the more advanced stage of *Ceramopora megastoma*, M'Coy. This I have been able satisfactorily to determine, from the preparation of numerous sections of the organism in all its stages of growth that are contained in my own collection, as well as from the careful study of a number of beautifully preserved specimens from the Braidwood limestone, Carluke, Lanarkshire, now in the cabinet of Dr. J. R. S. Hunter, of that district.

In Dr. Hunter's polished sections one is enabled to trace clearly, even in the same specimen, the several phases of the organism, from its first *Ceramopora*-stage, in which the cells are seen to be reclined and with roundly triangular mouths that have thickened, raised lower lips, onwards into the *Fistulipora*-stage, when the larger tubes become erect and open at the surface with nearly circular mouths, and have their interiors partitioned off by tabulæ. I have also well-preserved specimens from the Ayrshire Carboniferous limestones showing the same stages of structure; and this leads me to remark that, as we have only one species of *Ceramopora* in the Carboniferous strata of Scotland which is also found in all the localities with *Fistulipora minor*, there is therefore no room left for doubt in this case as to the direct identification of the above organism in all its stages with that which ultimately becomes *F. minor*, M'Coy.

I may here mention that *Ceramopora megastoma*, M'Coy, is very abundant in certain of the argillaceous limestone-shales in the Lanarkshire coal-field; yet in many localities, except in a few instances, the great majority of specimens have rarely advanced in growth much beyond the first or *Ceramopora*-stage. Probably this arose from the conditions being unfavourable to its fuller growth and development over those tracts of the sea-bottom on which much clayey sediment was being deposited. On other horizons, where the strata are more calcareous, as in some of the limestones, it is found in all its stages of growth. I may also further mention that, on nearly all the specimens that have their surface well preserved, maculæ and monticules are present, and occur at intervals of about 3 lines apart amongst the cells. These maculæ and monticules, so characteristic of the Monticuliporidæ, are present in all the stages of the organism, the maculæ in the younger and the monticules in the older stage; but the latter are sometimes also seen on specimens in the earlier stage, and are sometimes well developed. In stating that *F. minor*, M'Coy, possesses monticules that rise in stellate elevations above the surface I go against Prof. Nicholson, who says, in his definition of *Fistulipora*, M'Coy ('Tabulate Corals,' p. 292), that they "never project as stellate elevations above the general surface." I happen, however, to have one or two specimens that clearly show them as such. Prof. Nicholson also describes *F. minor* (p. 306) as having "few or no tabulæ" in the larger corallites. Prof. M'Coy, on the other hand (Pal. Foss. p. 79), says that they "are only about half their diameter apart." So far as well-preserved specimens in my collection show, I find that the tabulæ in the larger tubes vary in different specimens, being sometimes less than the diameter of the tubes apart, and sometimes much more; but, as a rule, they are moderately common, and are not to be considered absent or rare. The foregoing observations on this organism have been chiefly derived from the study of specimens in my own cabinet and that of Dr. Hunter, and they seem to me to be quite confirmatory of what Dr. Lindström has already shown to be the case with certain of the Silurian Polyzoa. I shall not, however, enter upon a discussion of the vexed question as to the zoological position of the organisms showing these changes, but only state that, as regards the Carboniferous form, one of two things seems certain, viz.:—that if *Fistulipora minor*, M'Coy, be held to be a tabulated coral of the *Monticulipora* group, then *Ceramopora megastoma*, M'Coy, is only its younger stage; if, on the other hand, the latter form be held to be a true Polyzoon, then its later stage is only a fuller development of Polyzoal life, and *F. minor* and the other forms indicated in Dr. Lindström's paper in the 'Annals' must of necessity be removed from the Tabulate Corals.

I am, Gentlemen,
Faithfully yours,
JOHN YOUNG.

Hunterian Museum,
University of Glasgow,
October 14th, 1882.

XLVII.—*Descriptions of two new Species of Birds from Sumatra.* By Captain R. G. WARDLAW RAMSAY, The Highland Light Infantry.

Hemixus sumatranus, sp. n.

Hypsipetes malaccensis, Salvadori, Ucc. di. Sum. p. 57, spec. no. 62.

A representative of *H. virescens* (Temm.) of Java, from which it differs in having the upper surface, wing-coverts, and outer edges of the quills olive-brown in place of olive-green, this colour being much deeper on the head; ear-coverts brown with pale shafts; throat, fore neck, and breast like the back; the shaft and a streak down the centre of each feather white; flanks, abdomen, and under tail-coverts white, tinged with pale yellow, some of the feathers margined with olive-brown; under wing-coverts and axillaries pale yellow; quills dusky brown below, slightly tinged with buff on their inner webs. Wings 3·7, tail 3·7, bill from gape ·85.

I obtained this specimen from Count Salvadori in a small lot of duplicates of M. Beccari's collection. It was obtained on Mount Singalan, in Western Sumatra.

Criniger sumatranus, sp. n.

Represents *C. gutturalis* of Borneo and Malacca, from which it differs in having the head greyish brown instead of rufous brown, the throat purer white, the whole under surface of a much darker shade of yellowish olive, and the lower tail-coverts deep reddish ochraceous. Size about the same.

♀. Iris bluish brown.	M. Sago,	Sept.	2	(*Bock*).
♂. " Indian red.	"	"	"	
? " brown.	Paio	"	"	

Eleven specimens in all were collected by Mr. Carl Bock in Western Sumatra.

XLVIII.—*Descriptions of new Species of* Sphingidæ, *chiefly from Africa.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The following Sphinges have been added to the national collection during the last two or three years :—

1. *Panacra insignis*, sp. n.

Allied to *P. vigil*: primaries rather grey in colour, with more sharply defined and blacker markings; the pale band (following the three oblique black lines of the central band) white, sinuate-angulated; not traversed by black lines as in *P. vigil*, but bounded externally by a wavy black stripe with white outer edge; this is again followed by a continuous brown band, which tapers to the apex; external border silvery white, traversed near its inner edge by a black-spotted olive-brown line; fringe blackish olivaceous: secondaries greyish brown, traversed by a diffused pink band, which encloses an interrupted line of the ground-colour; fringe white-tipped: body much as in *P. vigil*, but the dorsal abdominal stripe more silvery. Under surface quite unlike *P. vigil*, the wings rosy, with greyish-white external borders, bounded internally by an undulated grey line; a discal series of black dots on the veins parallel to the outer margin; discoidal cell of primaries greyish. Body whitish, venter with a lateral series of black dots. Expanse of wings 63 millim.

Andaman Islands.

A more beautiful species than *P. vigil*.

2. *Panacra imitans*, sp. n.

Probably allied to *P. Rutherfordi* of Druce from the Camaroons; form of *P. lignaria*, but the primaries denticulated nearly as in *Angonyx*. Pattern and coloration exactly resembling that of *Chœrocampa geryon* of Madagascar, excepting that there is no large black patch on each side of the basal segment of the abdomen, and that there is a series of ill-defined, subdorsal, brownish tapering spots on each side. Wings below of the same general tint as *C. geryon*, but the primaries with whitish costa and the discal whitish band narrower and confined between oblique black lines somewhat as above: secondaries whitish, crossed by two closely approximated black central lines reflexed at costa, a third line at a short distance beyond them, and a dark grey-brown external border. Body whitish, venter with three pairs of conical black spots towards the base. Expanse of wings 75 millim.

Delagoa Bay (*Mrs. Monteiro*).

3. *Diodosida roseipennis*, sp. n.

Primaries above pale greyish green, with a minute black dot on the lower discocellular, followed (on the lower radial interspace) by an elongate pyriform purplish-brown dash; two oblique indistinct parallel lines slightly darker than the ground-colour, followed by a third more distinct line dotted with black and united by a short oblique dusky dash to the apex; fringe rosy: secondaries greyish, crossed beyond the middle by a rather broad rosy reddish band; external border darker grey: body greyish green; scales white below the surface; a yellowish longitudinal stripe on the tegulæ; antennæ pinky white. Wings below dull lurid red, sparsely striated with grey, external borders grey; an externo-discal series of blackish spots nearly parallel to the outer margin: head below and pectus white; venter pale pink. Expanse of wings 60 millim.

Delagoa Bay (*Mrs. Monteiro*).

Not very close to any described species, nearer to *D. murina* than to any thing else.

4. *Chœrocampa Monteironis*, sp. n.

Allied to *C. celæno* of Natal; differing, however, in its inferior size and more uniformly greyish coloration: the primaries with the central oblique band narrower and not so dark; the whitish band more sinuous towards apex; the dark stripe along its outer edge reduced to a mere line and followed by a less distinctly white line; the tapering band which follows this greyish, not dark brown, and the grey external border not infuscated: secondaries smoky brown, with a single narrow abbreviated submarginal ochreous line upon the anal area of the wing (in place of the broad band, intersected by a dusky line, found in *C. celæno*): body with the inner margins of the tegulæ yellowish instead of white; the lateral abdominal stripes not undulated internally, more distinctly defined; the dorsal double stripe grey instead of silvery whitish. Expanse of wings 56 millim.

Delagoa Bay (*Mrs. Monteiro*).

5. *Darapsa rosæ*, sp. n.

Primaries above silver-grey, slightly clouded with brownish beyond the cell; a large triangular patch on internal area, white internally, otherwise pale buff, transversely striated throughout with blackish and traversed by a conspicuous abbreviated black bar; a whitish-edged black spot at the end of the cell; a dusky spot near the base of the cell, a second less distinct at apical third of costal area, two small ones upon the radial veins, and a short oblique dash at apex: secondaries smoky grey, striated (excepting upon the external border) with blackish and pale sandy brown; an ill-defined blackish stripe limiting the external border, and traces of a second abbreviated stripe parallel to it upon the disk: body silvery grey; sides of head and thorax white, tegulæ olivaceous externally; sides of abdomen pinky whitish; antennæ rose-pink. Wings and pectus below pale flesh-coloured, speckled with grey; legs and venter whitish; antennæ below ferruginous. Expanse of wings 102 millim.

Delagoa Bay (*Mrs. Monteiro*).

A very distinct and beautiful species, little resembling the New-World form (*D. rhodocera*) excepting in the colour of its antennæ, but agreeing well in structure.

6. *Nephele anomala*, sp. n.

Primaries above golden brown towards the base, otherwise dark chocolate-brown; a small black spot at the base of the cell, a basi-internal dusky spot; an oblique greyish olivaceous stripe, edged on both sides with silver, across the basal fourth, its upper extremity connected by a silver subcostal streak and the branches of this vein, which are also silvery, with a broad and slightly oblique stripe, which runs from the costa to the outer margin near external angle; this stripe is silvery white internally and pale green externally, and is ornamented from the first subcostal fork to the second median branch by dark lunate markings, of which the two infero-internal ones are black; an oblique undulated silvery-white line from the afore-mentioned stripe to apex, and all the veins beyond the stripe silvery: secondaries dark chocolate-brown, paler upon the costa; head and thorax chocolate-brown, a dorsal grey line; a whitish-bordered grey spot on each shoulder; abdomen olivaceous, clay-coloured at the sides. Primaries below dark chocolate-brown, costa clay-coloured; external area somewhat lilacine; two abbreviated discal series of closely approximated white spots, the inner series consisting of three well-defined spots, the outer of four dots followed by a well-defined spot, and lastly by a smaller spot; two small white spots placed obliquely at apex: secondaries yellowish clay-coloured, darker towards outer margin; pectus cream-coloured; legs reddish; venter white, crossed by yellowish stripes and speckled with dull blood-red. Expanse of wings 47 millim.

Aburi, Gold Coast (*E. T. Carter*).

This singular little species has the general coloration rather of a *Diodosida* than of a *Nephele*; but in structure it appears to agree with the latter genus.

7. *Diludia macromera*, sp. n.

Nearly allied to *D. discistriga*, with which it has hitherto been associated, but differing in its greatly superior size, the more distinctly defined markings on the wings, the more elongated apical patch on the primaries, the darker secondaries, with distinct grey anal patch crossed by a black stripe. Expanse of wings 130–142 millim.

Three examples, Sarawak (*H. B. Low*).

8. *Pseudosmerinthus Carteri*, sp. n.

Allied to *P. marginalis* ♂ (a species closely allied to *P. Pechuelii*, see Dewitz, Mitth. Münch. ent. Ver. i. Taf. i. fig. 4, 1879), but differing in having black spots on the wings, as in *Triptogon*, and dark lines across the primaries, as in *Polyptychus*. Primaries above sericeous whity brown, crossed by four dark brown lines, the first and third of which are oblique and parallel, the second zigzag, the fourth transverse to the second median interspace, thence to external angle sinuated and indistinct; area between the first and second lines darker than the ground-colour; area between the third and fourth lines darker internally; apical area with darker nebulæ; a conspicuous triangular blackish spot near the base; a whitish-pupilled dusky spot at the end of the cell and a large irregular dark brown spot on the internal border close to external angle: secondaries rosy grey, pale and sericeous on the costa, slightly dusky towards external borders; a large diffused whitish patch, enclosing two closely approximated black spots, at anal angle: body whity brown; thorax with a longitudinal dark-brown dorsal line. Under surface pale sandy brown: primaries with a submarginal series of black dots on the veins; fringe dark brown: secondaries crossed by two parallel dusky discal lines; fringe dark brown, varied with cream-colour. Expanse of wings 71 millim.

Aburi, Gold Coast (*E. T. Carter*).

The preceding species clearly proves that the *Panacra andosa* of Walker should have been referred to *Pseudosmerinthus*; its elongated wings and style of marking induced me to place it in *Polyptychus*, from which, however, its non-dentated primaries at once distinguish it.

9. *Pseudosmerinthus virescens*, sp. n.

Even nearer to *P. submarginalis* than the preceding, the markings being much more like, but the colour wholly dissimilar. Primaries sandy buff, crossed by about seven lines or stripes of sap-green, but all ill-defined, excepting towards the inner margin, where they become blackish; all these lines excepting the fourth are irregularly zigzag or undulated, the fourth is regular and oblique, excepting at its extremities, which are angulated; the second and third and the fourth and fifth lines are most prominent, and, being near together, produce the effect of two narrow divergent bands: secondaries sandy buff; an arched dusky line near to the outer margin, and on each side of it upon the abdominal border a rather large dusky spot, the outer or inferior one being placed at the anal angle and surmounted by a small whitish border; external area beyond the dusky line somewhat greyish: body sandy buff, tegulæ bordered externally with sap-green. Under surface creamy ochreous: primaries with the discoidal cell greyish in the centre; discocellulars and a tapering submarginal streak also greyish; external border whitish; fringe dark brown: secondaries with faint indications of two slightly divergent and darker lines, dusky towards the abdominal margin, the outer one widely arched; anal angle greyish; abdominal area whitish; legs above slightly brownish. Expanse of wings 64 millim.

Aburi, Gold Coast (*E. T. Carter*).

It is possible that the upper surface of the primaries may be wholly greenish in freshly-caught examples, since green almost always sooner or later fades to buff-yellow.

XLIX.—*Remarks on the Genus* Solaster. By D. C. Danielssen and J. Koren*.

The genus *Solaster*, first established by Forbes, has at different times been subjected to various criticisms, certain authors, such as Lütken, Duncan and Sladen, and A. Agassiz, having expressed the opinion that its two species, *Solaster endeca* and *S. papposus*, ought to be placed in two genera. Agassiz has adopted for that containing *S. papposus*, Müller and Troschel's denomination *Crossaster*; while

* A section of a paper giving a preliminary account of the Echinodermata of the Norwegian North-Atlantic expedition, translated by W. S. Dallas, F.L.S., from an advance separate copy received from the authors. The paper is contained in the 'Nyt Magazin for Natur-Videnskaberne,' Bind xxvii. pp. 267–299; and the part here translated occupies pp. 286–293.

others, for example Viguier and Perrier, will not accept any division, and have therefore retained Forbes's original generic name.

Prof. Verrill has established a new genus, *Lophaster*, for a third species, namely *Solaster furcifer*, which some few naturalists are inclined to accept. Thus for three species of the original genus *Solaster*, which is so poor in species, three genera, *Lophaster*, *Crossaster*, and *Solaster*, have been formed; and these we now propose to submit to a critical examination.

Prof. A. Agassiz, who first set up *Solaster papposus* as the type of a new genus and named it *Crossaster*, which is Müller and Troschel's first name for it *, expresses himself as follows in his memoir on North-American starfishes†:—"From an examination of the hard parts it is evident that *Solaster papposus* and *S. endeca* should not be included in the same genus, having really nothing in common beyond the great number of arms. The accompanying descriptions will fully show my reasons for placing these two species in different genera." In his descriptions of *Solaster papposus* and *endeca* we cannot find any such great differences as would justify their separation into two genera; and in this respect we must agree with Dr. Viguier that it is rather difficult to understand why this distinction is made.

Prof. Agassiz himself says, in his important work just mentioned (p. 112):—"In *Solaster endeca* the arrangement and general structure of the ambulacral and interambulacral plates are identical with those of *Crossaster*. . . . The fundamental difference between the genera *Crossaster* and *Solaster* lies in the structure of the abactinal floor. The actinal floor between the arms is composed of small somewhat elongated plates, arranged in more or less irregularly diverging rows, quite similar to those of *Crossaster*."

According to what is here stated, it is principally the dermal skeleton of the back upon which Agassiz lays so great stress that he allows it to be decisive of the division of the genus. Dr. Viguier, in his memoir on the skeleton of the Asterida ‡, has pretty clearly shown that the dermal skeleton in *Solaster papposus* does not differ from that of *S. endeca* in any so essential degree as to render necessary any division of the

* In the 'System der Asteriden' of Müller and Troschel, however, Forbes's generic name *Solaster* is adopted for *papposus*, and *Crossaster* is cited as a synonym.

† Memoirs of the Museum of Comparative Zoology at Harvard College, vol. v. no. 1, p. 98 (Cambridge, 1877).

‡ "Anatomie comparée du squelette des Stellérides," par le Dr. Viguier, Archives de Zoologie expérimentale et générale, tome vii. p. 138 (1878).

genus as a consequence of it. Our investigations lead us herein to agree with Dr. Viguier. It is true that in *Solaster papposus* the meshes of the calcareous reticulation are much larger than in *S. endeca*; but this can only come into consideration in specific determination.

In *Solaster affinis* the meshes are smaller than in *S. papposus*; in *S. furcifer* they are still smaller; and in the new species, *S. glacialis*, established by us, the meshes in size approach very closely to those of *S. endeca*. In all the reticulation is formed by larger or smaller, oblong or angular calcareous pieces, which are imbricated and form longer or shorter beams, by the union of which the reticulation is produced.

The ventral interbrachial space in all the species named is occupied by calcareous plates, which are sometimes oval or nearly round, and contiguous without being truly imbricated, as, for example, in *S. papposus* and *affinis*; sometimes flatter, angular, and imbricated, as in *S endeca*, *glacialis*, and *furcifer*; but these differences cannot serve as generic characters, nor has Viguier adopted them as such.

The paxillæ, which are borne upon the calcareous reticulation, are placed closer together or further apart in the different species, generally according as the meshes are larger or smaller; they are furthest apart in *Solaster papposus*, closest in *S. endeca*. Transitions occur distinctly in the three intermediate species, *S. affinis*, *furcifer*, and *glacialis*. As regards their form and development also we find transitions which may well assist in the discrimination of species, but certainly not of genera. They are longest and have the longest pencil of calcareous needles in *Solaster papposus*; in *S. affinis* they are shorter, still shorter in *S. furcifer* and *glacialis*, and shortest of all in *S. endeca*.

Prof. F. J. Bell, who has paid attention to the genus *Solaster*, is inclined to support Dr. Viguier in his opinion against Agassiz's division; but he nevertheless expresses himself with reserve, and says*, "but that excellent investigator seems to me to have not fully weighed all the facts which can be made out with regard to these two forms, which he retains in one genus." He remarks further that the circumstance that *Solaster endeca* has only ventral and *S. papposus* only dorsal marginal plates may furnish very "considerable support" to Agassiz's opinion. If this were really the case we should admit that there was some justification for making the division, although we cannot see that this peculiarity of the marginal plates alone was a sufficient ground for the division of the genus. Of the five species that were at our disposal

* Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 140 (1881).

we have subjected the parts of the skeleton to a very careful examination, and we shall now state what we have found with regard to the marginal plates.

In *Solaster endeca* there are two rows of marginal plates, one belonging to the dorsal, the other to the ventral surface. They are concealed by the thick skin, and are observed only when this, together with the paxillæ, is removed.

The dorsal marginal plates are flattened, and have a triangular form, with the narrower part turned outward; on the lower surface of this narrower part there is a small button-like elevation, which forms the articular surface for the paxilla. The broader part is directed inwards, and rests with its slightly concave superior surface upon the corresponding ventral marginal plate, while the slightly convex inferior surface contributes, in conjunction with the ventral plate, to form a common point of support for the broad transverse row of paxillæ which is nearest the papillæ of the groove.

The ventral marginal plates are likewise flattened; they are somewhat broader than the dorsal, but, like these, have a triangular form, of which the broader part is turned outwards, and forms with its lower surface a point of support for the dorsal marginal plate. The smaller part of the ventral plate is turned inward; its upper surface is concave, and rests for the most part against the lower rounded margin of the adambulacral plate (in the interbrachial space it is in contact with one of the ventral plates); its lower surface is slightly convex, and, in conjunction with the broader part of the dorsal marginal plate, forms a sort of articular surface for the before-mentioned transverse row of paxillæ.

In the broader parts of the arms and in the angles of the arms both the dorsal and ventral marginal plates stand a little apart from each other; but they become closer and closer together as they approach the ends of the arms.

Solaster papposus has also two rows of marginal plates, which are likewise well covered, but differ essentially from those of *S. endeca* in bearing only one row of paxillæ, while in *S. endeca* each bears its own, and there are therefore two.

The dorsal marginal plates in *Solaster papposus* are rather small, oval in the upper part of the arm, while in the middle and in the narrow part they are nearly cubical. When they bear a paxilla, two stand together and form with their outer ends a concave articular surface, which receives the large paxilla forming the boundary between the dorsal and ventral surfaces; very often, however, the inner end of a calcareous trabecula is contiguous to the above-mentioned articular surface, as if to complete it for the large articular head of the paxilla. Between these dorsal marginal plates which form articular surfaces for the series of paxillæ there are other dorsal marginal plates which bear no paxillæ; but it is only with their outer end that they unite with the general calcareous network. The dorsal marginal plates rest with their inner extremity upon the ventral marginal plates; sometimes two of the former are in contact with one ventral plate. In old animals the dorsal marginal plates which form the articular surface above described are completely amalgamated with the basal part of the paxillæ, and then these articulate with the corresponding ventral marginal plates; if we remove one of these paxillæ it appears as though there were no dorsal marginal plate. The amalgamation is so complete that we have been unable to dissolve it even with solution of caustic potash.

The ventral marginal plates are nearly lancet-shaped; their broader part turns outward; and their lower surface gives off a strong point of support for the dorsal marginal plates. The inner, somewhat narrower part has a concave upper surface, which rests against the lower rounded margin of the adambulacral plate. The lower surface is rough and convex. The ventral marginal plates bear no paxillæ, but serve exclusively for the support of the dorsal marginal plates. As a matter of course, in the interbrachial spaces the ventral marginal plates are in immediate contact with the ventral plates.

The odontophores (interbrachial plates, Agassiz) present no difference worthy of notice; both in *Solaster papposus* and *endeca* they are of the type given for the genus *Solaster*.

The true skeleton is as good as the same in both forms. Both ambulacral and adambulacral plates stand perhaps a little further apart in *Solaster papposus* than in *S. endeca*; but even this slight difference is not constant. The teeth are somewhat stronger in *Solaster endeca* than in *S. papposus*; but in other respects they are the same.

After what we have now brought forward as to the anatomy of these two species, it seems to follow clearly that their differences are not greater than they should necessarily be in order that the species should be sustainable as such, and that, according to our conception, nothing need be said about a division of the genus for any thing relating to the two species under consideration. Should any such division be made, it will become necessary also to form a new genus for our new species, *Solaster glacialis*; for, on this principle, it can belong neither to *Solaster* nor to *Crossaster*, as it stands almost exactly in the middle between them. It forms a transition from *Solaster endeca* to *S. papposus*.

Thus the paxillæ in *Solaster glacialis* stand further apart and are a little longer than in *S. endeca*, but neither so long nor so wide apart as in *S. papposus*; along the margin of the arms there is a series of pretty large penicilliform paxillæ, which are seen most distinctly from the dorsal side, as in *S. papposus*, but without projecting so strongly as in that species, while the transverse rows of paxillæ which are so characteristic of the ventral surface in *S. endeca* are far from being so prominent in *S. glacialis*. And with regard to the dermal skeleton, we find that the small calcareous pieces which form the net have much agreement in form and distribution with those of *S. endeca*, although they most resemble those of *S. furcifer*, which the species exactly resembles in the form and arrangement of the marginal plates. We think therefore that *Solaster glacialis* shows the utter untenability of the above-mentioned division of the genus *Solaster*.

Finally, we shall now take into consideration the genus *Lophaster*, recently proposed by Prof. Verrill for *Solaster furcifer*, Düb. & Kor.

To justify the establishment of this genus Prof. Verrill expresses himself as follows:—"This species differs so widely from *Solaster* in the structure of the skeleton and the small development of the disk as to require the establishment of a new genus for this type. It is specially distinguished by the highly developed skeleton of the underside, differentiated marginal plates, and prominently reticulated dorsal plates" *. Professor Jeffrey Bell is rather inclined to admit that the genus *Lophaster* is well founded, laying great stress especially upon the "differentiated marginal plates, one dorso-marginal and one ventro-marginal." We have already admitted that the marginal plates play an important part in characterizing genera, although we are unable to recognize them as decisive. Verrill says that *Solaster furcifer* differs so remarkably from the genus *Solaster* in the structure of the skeleton and in the small development of the disk that a new genus must be formed for it; it is principally the strongly developed skeleton of the ventral surface, the differentiated marginal plates, and the strikingly reticulated dorsal plates that determine the formation of the new genus.

Now with regard to the size of the disk in proportion to the arms, this varies very considerably, and is only of slight importance in generic determinations; but it is otherwise with the structure of the skeleton. We shall first refer to the dermal skeleton.

* "Notice of recent Additions to the Marine Fauna of North America," by A. E. Verrill (Amer. Journ. Sci. ser. 3, vol. xvi. p. 214).

The dermal skeleton of the dorsal surface in *Solaster furcifer* consists of a tolerably closely reticulated calcareous net, produced by small cross- or X-shaped calcareous plates laying their branches upon one another; between the meshes we see one or more tentacular pores, according as the meshes are large or small. We find almost the same arrangement in *Solaster endeca*, but still more strikingly in *S. glacialis*, in which the only difference is that the individual calcareous pieces are somewhat larger and have rather shorter branches, by which means the meshes are rather smaller than in *S. furcifer*.

The dermal skeleton of the ventral surface, which is particularly prominent in the interbrachial spaces, should, according to Verrill, be more highly developed in *Solaster furcifer*; but in this we cannot agree with him. The calcareous plates of the ventral surface in *S. furcifer* are more or less cruciform, with short arms, which certainly lie in an imbricated fashion upon each other, but which nevertheless leave small vacant spaces; while the calcareous plates in *S. glacialis*, which are nearly cruciform, and in *S. endeca*, where they are more oval, are closely imbricated.

The odontophores in *Solaster furcifer* do not differ from those of the other species; they have the typical form of the genus *Solaster*.

The marginal plates are placed in two series, the one belonging to the dorsal, the other to the ventral surface.

The dorsal marginal plates are small, somewhat oval, thin plates which lie upon the innermost part of the arms a little apart, but approach each other more and more as they advance towards the end, until they come together completely. They have upon the upper surface a small depression which serves as an articulating surface for the dorsal series of paxillæ along the margin, while the lower surface is smooth and rests upon a small part of the corresponding ventral marginal plate, united to it by strong ligamentous tissue.

The ventral marginal plates are a little more oblong and rather larger than the dorsal; their lower surface, besides attaching itself by a small part to the dorsal marginal plate, furnishes articular surfaces for the ventral series of paxillæ; their upper surface is somewhat concave, and rests upon the rounded lower part of the corresponding adambulacral plate.

The skeleton almost exactly resembles that of *Solaster papposus*. The ambulacral plates have perhaps rather broader transverse processes, and the adambulacral plates are somewhat thinner; but beyond these we can find no difference.

From what has been stated it must be seen that *Solaster* *furcifer* has no more highly developed dermal skeleton than several of the other species of the genus; that the marginal plates do not differ in any essential degree from those of *S. glacialis*, *endeca*, *affinis*, and *papposus*; that the skeleton presents no special differences; and that, as a consequence of all this, there are no grounds for the establishment of a new genus for it.

We believe therefore that we have now sufficiently established the opinion formerly expressed by us, that the genera *Crossaster* and *Lophaster* cannot be sustained.

Before closing these remarks we shall think ourselves justified in enlarging the characters of the genus *Solaster* in accordance with the investigations that we have made:—

Body with five or more arms, everywhere beset with penicilliform paxillæ; between these, tentacular pores. Two series of marginal plates, more or less developed, but concealed by the skin. Anus central.

L.—*Descriptions of some new Genera and Species of* Curculionidæ, *mostly Asiatic.* By Francis P. Pascoe.

[Plate XVIII. figs. 1–9.]

Otiorhynchinæ.

Epilaris, n. g.
—— concinna.
Bryochæta palliata.

Erirhininæ.

Lixodes, n. g.
—— tæniatus.

Balaninæ.

Ergania, n. g.
—— gibba.

Alcidinæ.

Alcides mustela.
—— divergens.
—— bisignatus.
—— indigaceus.
—— parilis.
—— distigma.
—— amœnus.
—— bellus.

Alcides Kirschii.
—— dædalus.
—— monilifer.
—— crassus.

Menemachinæ.

Menemachus stigma.

Cryptorhynchinæ.

Aryptæus, n. g.
—— suturalis.
—— pustulosus.
—— trinarius.
—— galeotes.

Zygopinæ.

Tyriotes, n. g.
—— cuneipennis.

Ceuthorhynchinæ.

Diacritus, n. g.
—— pinguis.

Epilaris.

Rostrum crassiusculum, a capite discretum ; *scrobes* curvatæ, laterales. *Oculi* prominuli. *Antennæ* scapo brevi ; *funiculo* 7-articulato, art. ultimo distincto ; *clava* breviter ovata, acuminata. *Prothorax* subcylindricus, basi bisinuatus. *Scutellum* nullum. *Elytra* ovata, prothorace latiora, humeris obliquis. *Pedes* mediocres ; *femora* mutica ; *tibiæ* anticæ apice mucronatæ ; *unguiculi* connati. *Abdomen* segmentis tribus intermediis subæqualibus.

The curved scrobe, the scape barely extending to the eye, and the bisinuate base of the prothorax are the essential characters of this genus. It agrees with *Platyomicus* in that the elytra are broader at the base than the prothorax.

Epilaris concinna. (Pl. XVIII. fig. 1.)

E. oblongo-ovata, dense griseo-squamosa ; medio prothoracis elytrisque basi figura cordiformi reversa et fascia postica fuscis. Long. 5 lin. (rost. incl.).

Hab. Labuan.

Oblong-ovate, closely covered with greyish scales ; stripe on the prothorax, a reversed heart-shaped patch at the base of the elytra, and a broad band behind dark brown ; rostrum twice as long as the head, an impressed transverse line above and another below the eye ; funicle with the first two joints subequal, club black ; prothorax rather broader than long, slightly corrugated ; elytra broadest behind the middle, striate-punctate, sides before the band and apex tinged with metallic green ; beneath covered with greenish and opalescent scales ; legs with scattered black setæ.

Bryochæta palliata. (Pl. XVIII. fig. 3.)

B. obovata, fusca, subtilissime griseo-squamosa ; elytris subglobosis, humeris apiceque viridibus, cæteris rufo-castaneis. Long. 3½ lin.

Hab. West Africa.

Obovate, brown, covered with minute approximate grey scales ; antennæ dark brown, seventh joint of the funicle closely applied to the club ; prothorax somewhat flattish, a transverse raised line behind the middle, followed by a corresponding depression ; no scutellum ; elytra subglobose, scarcely so wide at the base as the prothorax, striate-punctate, the humeral and apical regions green, the rest of the elytra dark chestnut-brown ; beneath and legs covered with greyish subopalescent scales.

Bryochæta is differentiated from *Episomus* by its thick antennæ, the club being very small and not quite so stout as the preceding joints. *Syntaphocerus* has foveiform nearly contiguous scrobes. This species differs from its congeners in the characters of its prothorax and coloration.

Lixodes.

Rostrum arcuatum, apicem versus subdilatatum; *scrobes* antemedianæ, laterales. *Antennæ* breviusculæ, funiculo articulo basali elongato, cæteris gradatim brevioribus; *clava* ovata. *Oculi* laterales, subrotundati, tenuiter granulati. *Prothorax* transversus, lobis ocularibus ciliatis. *Scutellum* punctiforme. *Elytra* elongata, prothorace haud latiora. *Pedes* breviusculi; *femora* antica longiora, infra, atque intermedia, dente parvulo instructa; *tibiæ* curvatæ, apice bicalcaratæ, intermediæ et posticæ apicem versus fimbriatæ; *tarsi* articulo basali triangulari, penultimo late bilobo; *unguiculi* liberi; *coxæ* anticæ haud contiguæ. *Sterna* depressa. *Abdomen* segmento secundo duobus sequentibus longiore.

An anomalous form, not suggesting an affinity with any species known to me; in contour it resembles a *Lixus* (e. g. *L. anguinus*). In the elytra not broader than the prothorax at the base it agrees with *Peliobia*, another peculiar form which I also place in the Erirhininæ.

Lixodes tæniatus. (Pl. XVIII. fig. 8.)

L. elongatus, paulo depressus, brunneus, lineis albo-squamosis notatis. Long. $5\frac{1}{2}$ lin.

Hab. Monte Video.

Elongate, slightly depressed, reddish brown, the prothorax and elytra with lines of whitish scales; rostrum slender, half as long again as the prothorax, the basal half punctured on each side of a median glabrous line; antennæ smooth, first joint of the funicle as long as the three next together; prothorax finely punctured, four white lines (two middle abbreviated) above; scutellum smooth; elytra more than three times as long as the prothorax, each pointed at the apex and having five lines, the one near the suture shortest, all, except the third, united at the apex (the figure is not quite accurate, the inner white line being represented as bordering the suture); beneath closely covered with whitish scales.

Ergania.

Rostrum longum, cylindricum, arcuatum; *scrobes* laterales, postmedianæ. *Antennæ* breviusculæ; *funiculus* 7-articulatus, art. ultimo clava arcte connexa. *Prothorax* subtriangularis, basi bisinuatus. *Scutellum* parvum. *Elytra* subcordata, prothorace latiora, humeris rotundatis. *Pedes* validi; *femora* clavata, infra dentata;

tibiæ apicem versus dilatatæ; *tarsi* breves; *unguiculi* approximati. *Prosternum* elongatum. *Corpus* squamosum.

A stouter form than *Balaninus*, from which it is differentiated by its claws approximate, but not connate at the base, and by the shorter and stouter antennæ. As in some *Balanini*, the pygidium is covered by the elytra. In my specimen, apparently a male, the rostrum is as long as the elytra.

Ergania gibba.

E. breviter ovata, fusca, squamis griseis fere omnino tecta; rostro tenuato, nitide castaneo, basi sparsim setuloso. Long. 5 lin.

Hab. Java.

Shortly ovate, brown, nearly everywhere closely covered by greyish scales; rostrum as long as the elytra, glossy ferruginous; two basal joints of the funicle subequal, as long as the next four together; prothorax above equal in length and breadth, with three stripes of more closely packed scales; scutellum somewhat oblong; elytra with a marked convexity in the middle, substriate, the striæ with approximate black punctures; second abdominal segment nearly as long as the third, separated from the first by a nearly straight suture.

Alcides mustela.

A. elongatus, cylindricus, rufescens vel piceus; elytris postice fascia angusta recurva albida notatis, apice gradatim rotundatis. Long. 3–4 lin.

Hab. Singapore; Sarawak.

Elongate, cylindrical, rufescent or pitchy; elytra with a narrow whitish recurved band posteriorly; rostrum moderately long; first joint of the funicle a little longer than the second; prothorax slightly constricted anteriorly, closely covered with small mamillated granules; scutellum round; elytra rather narrower than the base of the prothorax, coarsely striate-punctate, the punctures large and squarish, the interstices narrow, the apex somewhat gradually rounded; anterior coxæ well apart.

Narrower than *A. angulus*, Fab., and without the longitudinal stripe on the elytra.

Alcides divergens.

A. elongatus, cylindricus, nigro-piceus, prothorace vittis tribus, elytrisque vittis duabus, basi approximatis, obscure rufescenti-squamosis notatis, apice obtuse rotundatis. Long. 4–5 lin.

Hab. Singapore; Sarawak.

Elongate, cylindrical, pitchy black; prothorax with three, elytra with two stripes, approximate at the base, composed of pale reddish scales; rostrum moderately long, coarsely punctured only at the base; antennæ pitchy; first joint of the funicle in the female nearly twice as long as the second; prothorax slightly constricted anteriorly, closely granulate; scutellum rounded; elytra not broader than the base of the prothorax, coarsely striate-punctate, punctures large, squarish; the interstices narrow, the apex obtusely rounded; sterna covered with yellowish scales.

An unusually narrow form, and, *inter alia*, differing from the last in the abruptly rounded apex of the elytron. The stripes are not very distinct; and the scales composing them appear to be very liable to be rubbed off; this, indeed, is often the case in the species of this and other genera.

Alcides bisignatus.

A. chalybeus, nitidus, prothorace utrinque macula laterali, femoribusque posticis supra niveis; elytris oblongo-cordatis; antennis ferrugineis. Long. 2 lin.

Hab. Bouru.

Steel-blue, a scaly spot on each side of the prothorax at the base, and a similar spot along the upper edge of the hinder femora snowy white; rostrum moderately long, coarsely punctured; antennæ ferruginous; prothorax at the base slightly broader than the elytra, coarsely punctured; scutellum black; elytra oblong-cordate, seriate-punctate, punctures linear, approximate: sterna and coxæ sprinkled with white scales; claw-joint rather short.

Differs from the next two species in the form and coarsely punctured basal half of the elytra.

Alcides indigaceus.

A. chalybeus; elytris oblongo-ovatis; antennis rostroque nigris, hoc tenuiter punctato. Long. $3\frac{1}{3}$ lin.

Hab. Mysol.

Steel-blue; prothorax not spotted; upper edge of the posterior femora covered with snow-white scales; rostrum and antennæ black, the former moderately strong, slender, and minutely punctured; prothorax longer than in the last, scarcely as broad at the base as the elytra, and less closely punctured; scutellum black; elytra oblong-ovate, seriate-punctate, punctures linear approximate; sterna and coxæ with white scales.

The finely punctured rostrum of this species will at once distinguish it from the following.

Alcides parilis.

A. chalybeus, antennis nigris; rostro fortiter et confertim punctato. Long. $2\frac{3}{4}$ lin.

Hab. Saylee.

Steel-blue; prothorax not spotted; upper edge of the femora covered with snow-white scales; rostrum rather short, coarsely punctured throughout; antennæ black; prothorax, scutellum, and elytra as in the last; the hind femora are also marked with a similar spot.

This and the preceding species are closely allied; but the characters indicate something more than racial difference depending on locality.

Alcides distigma.

A. robustus, subcylindricus, piceus, griseo-pilosus, elytris singulis in medio macula rotundata nuda notatis; rostro crassiusculo. Long. 6 lin.

Hab. Ceram.

Robust, subcylindrical, pitchy, covered with fulvous setulæ, each elytron in the middle with a large naked glossy spot; rostrum stoutish, the basal half hairy; antennæ rather short; prothorax minutely granulate, an elevated line in the middle; scutellum roundish; elytra slightly broader than the prothorax at the base, striate-punctate, the interstices flattish, each with a row of minute glossy granules; beneath and legs covered with fulvous setulæ.

This well-marked species may be placed near *A. præustus.*

Alcides amœnus.

A. cylindricus, nitidus, niger; elytris, parte tertia apicali excepta, rufis; scutello nigro; pedibus nitide nigris. Long. 4 lin.

Hab. Batchian, Saylee.

Cylindrical, glossy black, anterior two thirds of the elytra yellowish red; rostrum rather long, stoutish, finely punctured; antennæ ferruginous, third joint of the funicle longer than the fourth; prothorax irregularly punctured, the intervals, except at the apex, tuberculiform and setulose; scutellum smooth, black; elytra striate-punctate, punctures linear, approximate, interstices flat, except at the base; beneath reddish ferruginous, covered with minute scales; legs black.

A. præustus, Guér., is larger and stouter in proportion, covered above with a greyish tomentum.

Alcides bellus.

A. angustior, cylindricus, nitidus, niger; elytris, parte tertia apicali excepta, scutelloque stramineis; femoribus basi fulvis. Long. $3\frac{1}{2}$ lin.

Hab. Batchian.

Narrower proportionally than the last, cylindrical, the rostrum more slender, the third joint of the funicle not longer than the fourth, prothorax more coarsely punctured; the scutellum straw-yellow, like the elytra, except their apical portion; the femora at the base the same colour or more inclining to fulvous; beneath pale yellowish, with minute flocculent-looking scales.

Alcides Kirschii. (Pl. XVIII. fig. 2.)

A. robustus, subcylindricus, castaneo-fuscus; elytris maculis quinque, mesosterni lateribus niveo-squamosis; femoribus anticis dente parvo instructis. Long. 5 lin.

Hab. Labuan.

Robust, subcylindrical, covered with minute chestnut-brown scales; a triangular spot common to both elytra at the base, a larger one at the side, an irregular one at the apex, nearly meeting its fellow, and the sides of the mesosternum snowy white; there are also a few white scales forming an undefined line on each side of the prothorax; rostrum thickish; antennæ short, terminal joints of the funicle transverse; prothorax granulate, except at the apex, the intervals with rusty yellowish scales, the base subbisinuate; scutellum subbilobed; elytra broader than the prothorax at the base, striate-punctate, punctures coarsely rounded, interstices convex, narrow, granulate; abdomen and mesosternum in the middle whitish grey; anterior femora with a very small tooth.

This species has two of the characters of the genus reduced nearly to a minimum, viz. the prothorax only slightly bisinuate at the base, and the tooth of the anterior femora almost obsolete. It is an isolated species, having something of the contour of *A. excavatus*. I have named it after the well-known Dresden entomologist.

Alcides dœdalus.

A. subellipticus, niger, prothorace lineis tribus elytrisque quinque, intermediis abbreviatis, subgriseis notatus; rostro valde tenuato. Long. 4 lin.

Hab. Tondano.

Subelliptic, black, the prothorax with three, the elytra with five, pale fulvous lines, the two intermediate basal and abbreviated, the inner running obliquely outwards from the scutellum to the apex, where it joins the outer somewhat flexuous line, and is continued to the shoulders; rostrum very slender, moderate, long; prothorax narrowed anteriorly, slightly rounded at the sides, covered with approximate glossy granules; scutellum punctiform; elytra subcordate, a little broader than the prothorax at the base, striate-punctate, the interstices raised and irregularly granulate; beneath with fulvous scales, multifid at the outer edge.

The nearly elliptic contour and slender rostrum are characteristic of this species. All the above described species of *Alcides*, except *A. Kirschii*, were collected by Mr. A. R. Wallace.

Alcides monilifer.

A. anguste ellipticus, nigro-piceus, setulis rufescentibus, lineis granulatis interstinctis, tectus; pedibus ferrugineis. Long. 4 lin.

Hab. Ceylon.

Narrowly elliptic, pitchy black, closely covered above with rufescent setulæ, divided by lines of small glossy-black granules; rostrum moderately stout, black; antennæ antemedian, scape ferruginous; prothorax short, rounded at the sides, two broad stripes and one on each side composed of minute granules; scutellum slightly transverse; elytra rather broader than the prothorax at the base, the sutural region setulose, but with a short granular line posteriorly, two longer with other shorter lines externally; beneath closely covered with pale fulvous scales, multifid at the outer edge; legs ferruginous.

More narrowly elliptic than the preceding, but not otherwise connected. I know of no other species with which they can be compared.

Alcides crassus.

A. robustus, ferrugineus, setulis tenuissimis albis sparsim indutus; rostro elongato; elytris subcordatis, prothorace multo latioribus. Long. 6 lin.

Hab. Andaman Islands.

Stout, ferruginous, with minute scattered white setulæ; rostrum long, moderately stout, finely punctured at the base; antennæ slender, first joint of the funicle elongate; prothorax short, broadly conical, granulate; scutellum transverse; elytra subcordate, much broader at the base than the prothorax, seriate-punctate, punctures large, squarish, apex rounded; beneath rather closely covered with small fulvescent scales.

As isolated descriptions of the Andaman insects, as well as others, have from time to time been published in some continental works, it may be that this species has already been described. It is one of the stoutest of the genus, and one of its most striking forms *; the rostrum varies considerably in length, as is often the case in parts which pass beyond the normal condition of the typical form. The relative length of the funicular joints is also variable in this and other species, according to sex. The minute setulæ on the upper surface are bifid almost to the base; those on the body beneath are apparently simple, but are crowded four or five together, so as to appear under an ordinary lens as one scale.

Menemachus stigma. (Pl. XVIII. fig. 4.)

M. anguste obovatus, piceus, griseo-pilosus; elytris in medio macula nivea notatis; tibiis anticis valde arcuatis, canaliculatis. Long. 2 lin.

Hab. Angola.

Narrowly obovate, pitchy, covered with greyish hairs; elytra in the middle with a snowy white squarish spot, and another, but less conspicuous, near the apex; rostrum shorter than the prothorax, compressed at the base; head with a sharply elevated line between the eyes; antennæ ferruginous; prothorax closely punctured; scutellum punctiform; elytra scarcely broader than the base of the prothorax, narrowly striate-punctate, punctures linear, inconspicuous; interstices broad, flat; beneath with greyish setulæ; anterior tibiæ much curved, canaliculate, the inner edge ciliated.

The type of *Menemachus* is a rare South-African insect which I have not seen, and which appears to differ specifically from the above in the absence of the central spot and the squamulose, not setulose, vesture. Boheman (in Schönherr, vii. pt. 2, pp. 267, 268) says nothing of the compressed base of the rostrum and the sharp ridge extending to between the eyes.

ARYPTÆUS.

Characteres ut in *Mecocoryno*; sed *clava* antennarum ovata; *mesosternum* depressum, haud cornutum; et *femora* postica abdomen haud superant.

Owing to the shortness of the posterior femora, this genus

* As in many other large genera, the species of *Alcides* vary greatly in appearance; but the technical characters of the genus are fairly constant throughout. An exception, however, must be made with respect to *A. frontalis* (Pascoe, Journ. Linn. Soc. xi. p. 183), which, with a six-jointed funicle and a bisinuate prothorax, has the anterior coxæ contiguous, and a stout rostrum almost continuous at the sides with the head. I propose for this species the generic name of *Acærus*. All the species of *Alcides* are either West and South African or Indo-Malayan, with two or three from Central Asia. The Australian *A. heilipoides* is an *Orthorhinus*.

has a contour decidedly foreign to *Mecocorynus*; in that genus the club of the antennæ is peculiarly elongate and cylindrical. The species here described are not altogether homogeneous; and it would not be difficult to find characters which might separate them into genera.

Aryptæus suturalis. (Pl. XVIII. fig. 6.)

A. obovatus, fuscus, squamis ferrugineis variegatus: elytris nigro-fasciculatis, postice latioribus, sutura basi fulvo-marginata. Long. 4 lin.

Hab. Sarawak.

Obovate, brown, covered principally on the elytra with small ferruginous scales, their sutural margin at the base fulvous; rostrum moderately long, the base with five raised lines; antennæ antemedian, ferruginous, the second joint of the funicle a little longer than the first; prothorax oblong, subcylindrical, with four fascicles of short black hairs, coarsely punctured, each puncture filled with a round concave scale; scutellum elongate, glossy black, rounded behind; elytra much broader than the base of the prothorax, gradually broader behind, slightly striate, striæ with large squarish punctures, the interstices more or less tuberculate, the third interstice with three tufts of erect black scales; legs and body beneath with long pale scales and setæ.

Aryptæus pustulosus.

A. subovatus, niger, squamulis ochraceis brunneisque varius; elytris fere parallelis, tuberculis octo fronteque læte ochraceis. Long. 4 lin.

Hab. Cambodia.

Black, closely covered with ochreous-yellow and reddish-brown scales and setulæ, the former more conspicuously confined to the forehead, rings on the legs, and eight round spots on the elytra, viz. two basal, two humeral, and four in a transverse direction posteriorly, the two central of the latter tufted; rostrum moderately long, without raised lines; antennæ pale ferruginous, first two joints of the funicle subequal; prothorax slightly transverse, irregularly fasciculate anteriorly; scutellum black, scutiform; elytra striate-punctate, punctures mostly bearing a whitish scale, interstices convex; body beneath with approximate smooth convex scales.

A very different contour from the last and a different coloration. The scales beneath resemble small *Acari*. It is probably *Cryptorhynchus pustulosus* of Dejean's catalogue.

Aryptæus trinarius.

A. ovatus, piceus, maculis duabus basi elytrorum, plaga majuscula trifida pone medium, apiceque obscure albidis; prothorace fortiter punctato, antice linea elevata instructo. Long. $4\frac{1}{2}$ lin.

Hab. Dorey, Sarawak.

Ovate, pitchy, a few undefined spots on the upper surface, two, more conspicuous, at the base, a larger trifid patch on the middle of the elytra, and a patch at the apex formed of densely packed greyish-white scales, the rest having only a scattered squamosity; rostrum slender, nearly smooth throughout; antennæ ferruginous, scape short, four basal joints of the funicle subequal; prothorax closely and coarsely punctured, an elevated glossy line not extending to the base; scutellum ovate, scaly; elytra rounded at the shoulders and at the apices, striate-punctate, punctures approximate, squarish, interstices narrow; body beneath and legs closely scaled, femora thickened but not toothed.

The toothless femora might in strictness demand for this species generic separation; but for the present, unless an arbitrary limit is to be enforced, I think it will be better to leave it in *Aryptæus*.

Aryptæus galeotes.

A. subellipticus, piceus, squamulis albis nigrisque, his maculatim varius; prothorace linea elevata instructo; elytris subcordatis, humeris valde productis. Long. 8 lin.

Hab. Sarawak.

Subelliptic, pitchy, with white and black scales, the latter forming well-defined irregular spots; rostrum stoutish, with three slightly elevated lines at the base; first three joints of the funicle subequal; prothorax rather narrow, slightly longer than broad, deeply punctured, the intervals somewhat tuberculate, punctures lined with minute, mostly whitish, scales, a narrow glossy-black elevated line from the apex to the base; scutellum roundish; elytra subcordate, constricted at the base, then expanding at the shoulders into a large conical protuberance, apices divaricate, striate-punctate, punctures large and approximate, interstices very narrow and irregular; legs white, ringed with black.

A handsome well-marked species, owing to the form of the elytra. The white scales on the forehead and legs have an ivory-like texture. One of my specimens has a ternate patch on the middle of the elytra, and the black spots are more irregular.

Tyriotes.

Rostrum tenue, subrectum; *scrobes* submedianæ, obliquæ, infra rostrum currentes. *Antennæ* tenues; *scapus* brevis; *funiculus* normalis; *clava* distincta. *Oculi* ovati, contigui. *Prothorax* subconicus, basi bisinuatus. *Elytra* cuneiformia, humeris rotundatis. *Femora* infra acute dentata; *tibiæ* breviusculæ, unguiculatæ, anticæ curvatæ, intus angulato-emarginatæ; *tarsi* breves, articulo penultimo late subbilobo; *unguiculi* basi fortiter dentati. *Propectus* haud canaliculatum; *coxæ* anticæ contiguæ, posticæ distantes. *Abdomen* segmento primo amplissimo.

This genus may be placed near *Sphadasmus*, with which, however, it has only a partial affinity. Its predominant characters are the form of the elytra, the toothed claws, and the eyes contiguous along the whole of the inner margin.

Tyriotes cuneipennis. (Pl. XVIII. fig. 7.)

T. modice elongatus, niger, squamulis albis pone medium elytrorum condensatis fasciam latam formantibus; corpore infra dense albosquamoso. Long. 4 lin.

Hab. Cameroons.

Moderately elongate, black, with small indistinct patches of white scales, others condensed behind the middle of the elytra, forming a broad band; rostrum nearly straight; antennæ black, but the scape pitchy at the base; funicle with the second joint nearly half as long again as the first, the rest nearly transverse and gradually stouter; club ovate; prothorax slightly convex, closely punctured; scutellum round, sunk in a broad hollow formed by the elytra and prothorax; elytra striate, with linear not approximate punctures, the apex of each rounded and scarcely covering the pygidium; posterior femora extending beyond the elytra; inner edge of the anterior tibiæ towards the apex strongly emarginate; body beneath and sides of the head and prothorax densely covered with white scales.

Diacritus.

Rostrum tenue, lineare; *scrobes* laterales, in medio rostri incipientes. *Oculi* magni, rotundati, supra approximati. *Scapus* antennarum oculum attingens; *funiculus* 7-articulatus, articulis duobus basalibus elongatis, æqualibus, tertio minus elongato, quarto quintoque brevibus, sexto septimoque crassis, obconicis; *clava* elongata, fusiformis. *Prothorax* conicus, basi rotundatus. *Scutellum* minutum. *Elytra* subcordata, valde convexa. *Pedes* anticæ longiores; *femora* omnia incrassata, subtus tridentata; *tibiæ* intus sinuatæ, apice muticæ; *tarsi* breviusculi; *unguiculi* connati; *coxæ* anticæ contiguæ. *Propectus* brevissimum haud canaliculatum. *Abdomen* segmento quarto maximo, ultimo perparvo.

This description is from a single specimen, and may, when other species are known, require to be modified. The peculiar character of the genus (which may be placed near *Ceuthorhynchus*) lies in the antennæ, the last two joints of the funicle apparently forming a part of a loosely-jointed club; in the figure these two joints are represented as much too slender.

Diacritus pinguis. (Pl. XVIII. figs. 9 *a* and 9 *f.l.*)

D. breviter ovatus, fusco-castaneus, supra laxe pilosus; elytris basin versus bituberculatis, humeris rotundatis. Long. 2 lin.

Hab. Tamatave (Madagascar).

Shortly ovate, very convex, dark chestnut-brown, hairy, the hairs paler, those beneath longer and more scattered; rostrum nearly twice as long as the prothorax, ribbed at the base and equally slender throughout; antennæ pale ferruginous; prothorax transverse, gradually broader towards the base; elytra level with the prothorax at the base and slightly broader posteriorly, striate-punctate, interstices flat, but raised towards the base, a round slightly elevated tubercle on the third; pygidium very small; legs slightly hairy.

LI.—*A new Genus of* Anthribidæ. By Francis P. Pascoe.

[Plate XVIII. fig. 10.]

Nausicus.

Caput transversum, postice constrictum, inter oculos latissimum; *rostrum* angustius, breviusculum; *scrobes* foveiformes, infra oculos sitæ. *Oculi* ovati, distantes. *Antennæ* articulis 3^{o}–8^{m} tenuissimis; *clava* elongata, laxa. *Prothorax* transversus, carina a basi remota, ad latera haud producta. *Elytra* subquadrata. *Pedes* breviusculi; *femora* fusiformia; *tibiæ* teretes; *tarsi* articulo basali longiusculo; *unguiculi* dente subbasali instructi. *Propectus* breve.

A well-marked genus, whose nearest affinity appears to be with *Nessiara*, from which it differs in its broad flat front, the small widely separated eyes, the long and very slender antennæ inserted just below the eyes, the prothorax transverse, its carina distant from the base and not prolonged at the sides, &c.

Nausicus cephalotes. (Pl. XVIII. fig. 10.)

N. rufo-brunneus, vage maculatim niger, capite rostroque antice fulvo-griseo-pubescentibus, pedibus annulatis. Long. $2\frac{1}{2}$ lin. (rostr. incl.).

Hab. Java.

Short, pubescent, reddish brown, indistinctly spotted above with blackish; front and rostrum covered with a pale yellow-greyish pubescence; antennæ extending to about the middle of the elytra, the basal joint short, ovate, the second pyriform, last joint of the club slightly obtuse; prothorax with two small conical anterior and two median tubercles; scutellum broadly transverse; elytra flat or even concave above, each with three tubercles, the posterior largest, apex retuse; pygidium small; legs pale, ringed with blackish; fourth segment of the abdomen very short.

EXPLANATION OF PLATE XVIII.

Fig. 1. *Epilaris concinna.*
Fig. 2. *Alcides Kirschii.*
Fig. 3. *Bryochæta palliata.*
Fig. 4. *Menemachus stigma.*
Fig. 5. *Mecocorynus loripes,* Chev. *
Fig. 6. *Arypteus suturalis.*
Fig. 7. *Tyriotes cuneipennis.*
Fig. 8. *Lixodes tæniatus.*
Fig. 9 *a.* Antenna of *Diacritus pinguis.*
Fig. 9 *f. l.* Fore leg of *Diacritus pinguis.*
Fig. 10. *Nausicus cephalotes.*

LII.—Eryoneicus, *a new Genus allied to* Willemœsia. By C. Spence Bate.

Eryoneicus.

Carapace dorsally arched, hemispherical, approximately as broad as long. Pleon narrow. Rhipidura well developed. Telson as long as the lateral plates.

Ophthalmopoda absent or rudimentary, there being no orbital notch in the carapace for their reception.

First pair of antennæ have the first joint of the peduncle cylindrical like the second and third, which terminates in two flagella.

* A highly developed example, which I was at first inclined to consider distinct from the common form.

The second pair of antennæ are scarcely longer than the first and carry a small *scaphocerite* and a long cylindrical *phymacerite.*

The first pair of pereiopoda are long, and carry a narrow and slender chela; the second pair are much shorter than the first and are chelate; the third pair are much shorter than the second and are also chelate; the fourth are a little shorter than the third and are imperfectly chelate; and the fifth are still shorter than the fourth, and terminate in a simple *dactylus.*

Eryoneicus cœcus.

Carapace orbicular, dorsal surface armed with long spine-like teeth that appear to be symmetrically arranged on each side of the median line.

The *pleon* is also dorsally furnished with long and slender spine-like teeth, of which one is in the median line of each somite and one on each side, to the extremity of the telson, which terminates in a long and strong tooth.

The eyes are wanting.

The first pair of antennæ have the flagella unequal; the second have a small *scaphocerite* and a long straight cylindrical *phymacerite.*

The second pair of gnathopoda are pediform, moderately long and slender.

The first pair of pereiopoda are smooth, long, and narrow, the *chela* scarcely broader than the *meros*; the second pair short and spinous; the third and fourth are still shorter, and so are the fifth or terminal pair, which are shortest and monodactyle.

First pair of pleopoda wanting; second and following ones biramose.

The rhipidura symmetrical and distally fringed with plumose cilia.

Telson terminating in a long and slender tooth, with a series of plumose hairs on each side.

Length half an inch.

Hab. Taken by the 'Challenger,' off the Canary Islands, at a depth of 1675 fathoms.

This interesting little animal, having the dorsal surface elevated and carrying the pleon folded against the ventral surface of the pereion, has very much the appearance of a young Brachyuran; but its true position is readily determined by the presence of the scaphocerites attached to the outer or second pair of antennæ and the existence of the *rhipidura* or fan tail.

The animal approximates closely to *Pentacheles*, and adds another link between that genus and *Eryon.*

Mr. Willemœs-Suhm, who had the opportunity of examining this animal when fresh from the sea, says, in his notes, that it is transparent, and that the alimentary canal, including the œsophagus and stomach, was of a bright red colour, while the hepatic lobes were yellow.

He also says that the dorsal spine-like teeth are arranged in longitudinal rows, one of which traverses the median line, the others run in pairs, making a series of four. The posterior margin of the carapace is also similarly armed with teeth.

The pleon has similar spine-like teeth on each of the six somites, both laterally and in the median line. The telson is also spinous, and has the terminal extremity beautifully fringed with hairs.

LIII.—*Note on* Platyarthrus Hoffmanseggii, *Brandt, and* Helleria brevicornis, *Ebner, Terrestrial Isopoda.* By the Rev. A. E. Eaton, M.A.

The frequent occurrence in stone-sheltered ants' nests of *Platyarthrus Hoffmanseggii* has led popular authors to write about its habits; and reputing it to be blind, they reckon it an animal which has lost, by disuse, the faculty of vision [compare Lubbock, 'Ants, Bees, and Wasps,' ed. 2, p. 75 (1882)]. In most of the published descriptions it is positively stated to be eyeless; and in the remainder no mention of eyes is made at all. Quite recently, however, I have ascertained that it is provided with eyes in the usual situations. Each of them is composed of several well-formed ocelli placed close together in a rounded group; but they are destitute of pigment. It is easy to confound them with the minute bluntly conical asperities with which the general surface of the head is beset. It is as sensitive to light as other Oniscidæ.

In the early part of 1868 Ebner described a genus *Helleria*, allied very closely to *Tylus*, Lat., founding it upon a species indigenous to Corsica, Elba, and Sardinia, which he named *H. brevicornis*. In 1879 Budde-Lund changed the name of the genus to *Syspastus*, doubtless because he supposed *Helleria* to have been preoccupied in zoology. But *Helleria*, Norman, a genus of the Gammaridæ, dates only from December 1868 (and therefore must be renamed); and *Helleria*, Czerny, a genus of the Ægidæ, is more recent still (1870). Consequently *Helleria*, Ebner (1868), has priority, and *Syspastus*, Budde-Lund, takes rank as a synonym. Marschall misprints the name of the author, reading Erber for Ebner.

Chepstow Road, Croydon,
November 15, 1882.

LIV.—*Report on the Polyzoa of the Queen Charlotte Islands.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plates XIX. & XX.]

IN 1878 Dr. G. M. Dawson conducted an exploration of the Queen Charlotte Islands, as one of the staff of the Geological Survey of Canada. The results of his expedition are embodied in a valuable report which appears in the official "Report of Progress" for the year 1878–79 *.

A series of dredgings formed a part of the plan of operations; and large quantities of material were obtained at various points off the coasts. Mr. J. F. Whiteaves has reported on the Echinodermata, the principal portions of the Mollusca, and some other Invertebrate tribes. The Crustacea have been dealt with by Prof. S. I. Smith, of Yale College. The Polyzoa and Hydroida have been placed in my hands for examination; and to the former the present Report is devoted.

The Queen Charlotte Islands are situated in the North Pacific, and "form a compact archipelago, separated by wide waterways from the islands which fringe the shore of the mainland of British Columbia to the west, and the coast of the southern extremity of Alaska to the north." They are "included in north latitude between 54° 15′ and 51° 55′, in west longitude between 131° 2′ and 133° 5′. The extreme length from point to point is 156 miles, the greatest width, in a direction at right angles to the length, 52 miles" (*Dawson*).

The average temperature of the surface-water in the neighbourhood of the islands was determined by frequent observations to be 53°.8 F. for the summer months (June to August inclusive). Fifteen observations taken between September 12th and October 17th gave a mean of 50°.7 F.

The dredgings which have been placed in my hands were taken chiefly at three or four stations—one at the extreme north of the islands, and the rest off the south-eastern portions of the coast.

I shall reserve all remarks on the facies of the Polyzoan fauna of the islands and its relation to the general subject of distribution for the close of the Report. The number of undescribed species is large, including some very striking and interesting forms; but so far no new generic type has occurred. The beauty and the luxuriant growth of the specimens are remarkable; the old shells taken up are thickly incrusted

* 'Geological Survey of Canada, Report of Progress for 1878–9: published by authority of Parliament, Montreal, 1880.'

by splendid masses of the different species, each valve usually presenting a rich variety of forms. The fauna, so far as the Polyzoa are concerned, points to very favourable climatic conditions.

List of Species.

Subkingdom MOLLUSCA.

Class POLYZOA, J. V. Thompson.

Subclass HOLOBRANCHIA, Lankester.

Group *ECTOPROCTA*, Nitsche.

Order **GYMNOLÆMATA**, Allman.

Suborder CHEILOSTOMATA, Busk.

Family **Aeteidæ.**

AETEA, Lamouroux.

Aetea ligulata, Busk.

Houston Stewart Channel; off Cumshewa Harbour; Dolomite Narrows*. [Coast of Patagonia; Straits of Magellan (*Darwin*); Victoria.]

Family **Eucratiidæ.**

GEMELLARIA, Savigny.

Gemellaria loricata, Linnæus.

Virago Sound†, 8–15 fms.

Family **Cellulariidæ.**

MENIPEA, Lamouroux.

Menipea ternata, Ellis & Solander.

Virago Sound.

Menipea ternata, form with many cells in an internode.

Cellularia ternata, forma *gracilis*, Smitt.
Menipea gracilis, Busk.

Off Cumshewa Harbour. [Spitzbergen (*Smitt*); Franklin-

* These stations are all on the eastern coast, Houston Stewart Channel being only a short distance from the extreme southern point of the islands.
† This is the most northerly station at which dredgings were obtained.

Pierce Bay (*Feilden, N. Polar Exp.*); Barents Sea (*Dutch Arctic Exp.*).]

Menipea compacta, n. sp., form *triplex*.

Zoœcia in triplets, the two lower cells elongate, enlarged above and tapering off below, the upper one much shorter; area oval, occupying about half the length of the cell; margin raised and thin, four spines on the outer side and two on the inner, with a horn-coloured base, some of them stout and pod-like; operculum slender, simple, acicular, placed on the inner side very close to the bottom of the area. *Lateral avicularia* variable in size, sometimes very large, borne on the two lower cells; *anterior avicularia* wanting. *Oœcium* terminal, rounded, expanded above, smooth and punctured. *Internodes* very short and compact, somewhat wedge-shaped; connecting tubes double.

Loc. On weed, Queen Charlotte Islands.

I am not acquainted with any described species to which the present form can be referred; it belongs to the section of the genus which is so characteristic of the Australian seas. A *Menipea* (apparently undescribed) occurs abundantly off California, and has also been found off Vancouver Island, to which *M. compacta* bears a very close resemblance in the details of its structure, and with which it is probably identical, though the Californian form has more cells in the internode, and is furnished with a more fully developed operculum. A distinctive feature of the species is the position of the operculum, very close to the lower extremity of the area.

Scrupocellaria, Van Beneden.

Scrupocellaria varians, n. sp. (Pl. XIX. figs. 1–1 *c*.)

Zoarium much branched dichotomously, forming a shrubby tuft. *Zoœcia* biserial, alternate, elongate, enlarged above, tapering off downwards; area about half, or sometimes more than half, the length of the cell, oval, margin thin and smooth, three spines on the outer side above and one on the inner; the portion of the cell below the area tapering, smooth; operculum small, usually trifid. *Lateral avicularium* either small and of normal shape (mandible pointed), or more commonly much elongated upwards, in the direction of the line of zoœcia, extending a considerable way above the top of the cell to which it is attached, consisting of a long channelled beak (free through a great part of its length), terminating above in two spinous points, and a slender setiform mandible, bent at the apex, with an expanded triangular base, which, when at rest, falls into the groove traversing the beak; usually at the bottom of the area a prominent sessile *avicularium* with pointed mandible. *Vibracular cell* wedge-shaped, the terminal groove stretching transversely across the back of the cell; seta rather long and very slender. *Oœcium* subglobular, smooth and shining.

Height of the tuft ½ an inch.

Loc. Off Cumshewa Harbour, growing on shell.

The remarkable point in the present species is the curious modification of the lateral avicularium. In form and structure the avicularian appendages are, as a rule, more constant in this and the kindred genera than in most other sections of the Polyzoa. I know of no deviation from the ordinary type except in the present case and in a species (which I hope shortly to describe) which is furnished with an elongate, subspatulate avicularium, very unlike the normal form of the appendage in this tribe.

In *S. varians* both the ordinary and the modified form of the avicularium occur on the same specimens; the two are intermingled, but the latter is much the more abundant. I venture to think that we have here additional evidence of a very striking kind, of that instability of the avicularian structure, upon which I have often insisted.

Apart from its avicularium, *S. varians* presents no very striking features; and, of course, the variability in this organ would not in itself constitute a specific distinction. In other respects, however, it is, I believe, sufficiently distinct from the various described forms.

Scrupocellaria brevisetis, n. sp.

Zoœcia biserial, alternate, elongate, tapering downward, surface smooth and glossy; area oval, about half the length of the cell or less, set somewhat obliquely, surrounded by a rather broad smooth border; three spines on the outer side above, and one or two on the inner; operculum small, placed about the middle of the inner side, when mature entire or with a slightly irregular margin, narrow towards the base, expanding above it, surface smooth. *Lateral avicularium* sometimes gigantic and much swollen below, sometimes very small, with a triangular mandible somewhat bent at the apex; the beak strongly hooked. *Vibracular cell* placed just above the lateral avicularium, rounded and somewhat contracted below, expanding very slightly upward, truncate above, a constriction about the middle, immediately below which is the orifice from which the radical fibre springs, the terminal groove straight or slightly oblique, stretching across the back of the cell;

seta very short, about twice the length of the groove. *Oœcium* (?). *Zoarium* of a stout habit; internodes moderately long (7–10 cells).

Loc. Houston Stewart Channel.

This species bears some resemblance to *S. scrupea*, but is at once distinguishable from it by the differences in the vibraculum.

CABEREA, Lamouroux.

Caberea Ellisii, Fleming.

Off Cumshewa Harbour. [Vancouver Island (*Dawson*); Labrador and Maine, Greenland, Iceland, Scandinavia and Finmark, Britain (North), Brittany.]

Family **Bicellariidæ.**

BUGULA, Oken.

Bugula avicularia, Linnæus.

Houston Stewart Channel, 8–20 fms.; Virago Sound, 8–15 fms. [Spitzbergen, Britain, Adriatic, Australia.]

Bugula Murrayana (normal), Johnston.

Houston Stewart Channel, in shell; Virago Sound. [Vancouver Island (*Dawson*); Britain (chiefly north), Scandinavia, Spitzbergen, Barents Sea, Greenland, Labrador, Gulf of St. Lawrence, New England.]

Family **Cellariidæ.**

CELLARIA, Lamouroux (part.).

Cellaria borealis, Busk.

Virago Sound. Off Cumshewa Harbour; Houston Stewart Channel. Abundant and very fine. [West Greenland, 6–10 fms.]

The internodes in this fine and characteristic species expand regularly from the base upward, and are often of very considerable width above. The specimens from the Queen Charlotte Islands are in some cases very large, attaining a height of more than 2½ inches.

Cellaria mandibulata, n. sp.

Zoarium slender, irregularly branched; the internodes attenuated at the base, joints black. *Zoœcia* contiguous in the same line, bluntly pointed or rounded above, the margin trending outwards to about the middle, and from this point slanting inwards to the base, truncate below (lozenge-shaped); area slightly depressed, smooth, margin distinct, subcrenulate; orifice semicircular, situated in the upper third of the area, lower lip arched. *Avicularian cells* in the line of the ordinary zoœcia, which they resemble, but are shorter and very much broader (about twice the width), prominent above, almost the whole of the upper portion (more than a third of the length) occupied by a semicircular orifice, which is filled in by a stout mandibular plate of a very dark horn-colour, the edge black. *Oœcial opening* at the very top of the cell, and of much the same shape as the orifice.

Loc. Houston Stewart Channel; Virago Sound.

C. mandibulata bears a close resemblance in most respects to *C. fistulosa*, and is separated from it on the strength of the very marked differences in the avicularium, which is found to be the best criterion for distinguishing specific forms in this genus. The avicularium of the latter is (morphologically) a dwarfed cell, with the oral valve slightly modified. In the present species the avicularian cell is in some respects larger than the ordinary zooecium, from which it is distinguished chiefly by its great breadth, its prominence, and its ample, dark-coloured, semicircular mandible (or modified oral valve). It represents one of the earliest stages in the developmental history of this appendage*.

It may be a question, perhaps, whether *C. mandibulata* should not be regarded as a "form" of *C. fistulosa*; but it has much the same kind of claim to specific rank as *C. sinuosa*. After all, these systematic distinctions are only meant to mark the developmental steps.

Family **Membraniporidæ**.

Group *a* (*Flustridæ*).

Flustra, Linnæus.

Flustra membranaceo-truncata, Smitt.

Virago Sound, 8–15 fms. [North Sea, Arctic Seas, common.]

Group *b*.

Membranipora, De Blainville.

Membranipora unicornis, Fleming.

Houston Stewart Channel, 8–20 fms.; very fine. [Spitz-

* We have a very similar form in *Cellaria hirsuta*, MacGillivray, and *Membranipora longicornis*, mihi. See 'History of British Marine Polyzoa,' Introduction, p. lxviii, fig. xxx.

bergen, Greenland, Nova Zembla, Labrador, Britain (north-east.]

Membranipora Rosselii, Audouin.

Houston Stewart Channel, on shells, not uncommon. [Britain, Algiers, Adriatic.]

Membranipora tenuirostris, Hincks.

Off Cumshewa Harbour; Houston Stewart Channel. [Mediterranean; Madeira.]

Membranipora horrida, Hincks.

Houston Stewart Channel, 8–10 fms.; off Cumshewa Harbour. Abundant and very fine, forming very large, reddish-brown patches on shells. [California; Vancouver Island.]

Membranipora patula, Hincks.

Virago Sound; Houston Stewart Channel, &c., very common and of luxuriant growth. [California.]

The oœcium was not observed on Californian specimens, but is present in profusion on those from the Queen Charlotte Islands. It is shallow, cucullate, smooth, and closed in front by a chitinous operculum. The species forms brown or reddish-brown patches.

Membranipora variegata, Hincks.

Dolomite Narrows, in about 8 fms., very plentiful; spreading in large patches over the surface of shells. [California.]

Specimens occur in which there are two of the pedicellate avicularia at opposite sides of the cell, instead of the normal one. The spines are without the dark-coloured base, which is a conspicuous feature in the Californian form.

Membranipora acifera, MacGillivray, form *multispinata*. (Pl. XIX. fig. 4.)

The form from the Queen Charlotte Islands which I refer to MacGillivray's species differs in some respects from his description; but the two agree so perfectly in the most striking and important characters that there is hardly room for doubt as to their identity. He describes his *M. acifera* as having "one or two sharp incurved spines on each side, and usually a small round spine in each upper angle." In the North Pacific specimens, which are finely developed, there are two erect and pointed spines at the top of the cell, and along each side six or seven rather tall, straight, acuminate spines, which slope inwards without meeting. The spines are at best a somewhat variable character; and the single specimen which MacGillivray examined can hardly be accepted as fixing the normal armature of his species. The general character and the remarkable avicularium are the same in both forms.

Virago Sound. [Victoria (*MacGillivray*).]

Membranipora echinus, n. sp. (Pl. XIX. fig. 5.)

Zoœcia quincuncial, oval, distinct, separated by rather deep and wide interspaces; front wall wholly membranous; two spines at the top and from seven to eight slender, closely set, pointed, and rather tall spines down each side, which slant inwards but barely meet in the centre; on each side, springing from behind the second spine from the top, a pedicellate avicularium, the upper part large and much swollen (closely resembling a "bird's head"), very slightly hooked at the extremity, borne on a very thin pedicle; mandible slender, pointed. *Oœcium* (?).

Loc. Houston Stewart Channel; Cumshewa, 20 fms.

A very marked characteristic of this species (which belongs to the *M. spinifera* section) is the distinctness of the zoœcia, which lie so much apart from one another that the whole cell to its very base is visible, the wall flanging outward slightly below. It is very common amongst the dredgings.

Membranipora exilis, n. sp. (Pl. XX. fig. 1.)

Zoœcia very regularly quincuncial, oblong, slightly enlarged about the middle, subtruncate above and below, set closely together, of considerable size and delicate half membranaceous material; margin thin, a good deal raised, the front wall wholly membranous; at the top of the cell two pointed spines, and (usually) two on one side and three on the other situated in the upper half of the cell, slender, acuminate, erect, jointed to a tubular base; a sessile *avicularium* on the margin at one side (often wanting) just below the top; beak much swollen below, inclined upwards, scarcely bent at the extremity; mandible blunt, directed downwards. *Oœcium* (?).

Loc. Houston Stewart Channel, enveloping *Cellaria borealis*, Busk, with a very thin crust.

Membranipora Sophiæ, Busk, form *matura*.
(Pl. XX. fig. 2.)

Zoœcia oval, quincuncial, set very closely together; front wall wholly membranous; margin thin, smooth, on each side from four to six sharply pointed spines, which bend rather abruptly over the area and meet in the middle; an *avicularium* at each side on the margin, just below the upper end, slightly raised, pointed, the mandible directed upwards, a small erect spine at the base of each *avicularium*; at the bottom of the cell a single *avicularium*, with an elongate triangular mandible, variously turned (sometimes two). *Oœcium* rounded, smooth, with a rib arching across the front, frequently carried up into a peak.

Loc. Houston Stewart Channel. [Assistance Bay; Spitzbergen.]

Described as *M. conferta* ('Annals' for September 1882). I am now convinced that it is a form of *M. Sophiæ*. Smitt notices intermediate varieties.

Membranipora nigrans, n. sp. (Pl. XIX. figs. 2, 2 *a*.)

Zoœcia large, ovate (variable in shape, sometimes arched above and narrowing downwards, sometimes broad-ovate, sometimes oval), irregularly disposed; margins much elevated, crenate, the whole front of the cell covered by a rather coarse stout membrane of a black colour; oral valve large; on each side at the top a pointed *avicularium*, placed on the margin, depressed at the base, the beak sloping upwards, mandible directed obliquely downwards; very large *avicularia*, slightly raised in front, with a broad triangular mandible, which is bent abruptly in the middle, scattered amongst the zoœcia. *Oœcium* very shallow, just covering the extremity of the cell, smooth, with a raised rib across it a little above the oral margin. *Zoarium* of a deep black colour, forming large irregularly spreading crusts.

Loc. Houston Stewart Channel; Virago Sound.

A fine characteristic species, distinguished by its dark colour and its remarkably large zoœcia.

Membranipora levata, n. sp. (Pl. XIX. figs. 6, 6 *a*.)

Zoœcia small, oval, distinct, quincuncial; margin very slightly raised, thin, delicately crenate, the whole front closed in by a smooth light-coloured and rather glossy membrane, which lies very much on a level with the edge of the cell; above each zoœcium, on a somewhat quadrate area, a small nodule with a pointed *avicularium* on one side of it, the mandible directed transversely upward. *Oœcium* rounded, smooth, umbonate.

Loc. Houston Stewart Channel, 15–20 fms; Cumshewa; very abundant.

Membranipora protecta, n. sp. (Pl. XIX. fig. 3.)

Zoœcia contracted above, expanded below, disposed rather irregularly in lines, set closely together, front wall wholly membranous; margin thickened, minutely granulous; two erect spines (sometimes bifid) at the top; below them on each side a single bifid spine, and below these two large, branched, antler-like spines, which meet over the aperture; numerous *avicularia* interspersed amongst the cells, placed on a distinct area, beak elongate, slanting upwards, traversed by a narrow groove, mandible with a triangular base, the upper portion long, slender, setiform. *Oœcium* (?).

Loc. Virago Sound; Cumshewa, on shell.

Other species, armed with more or less branching spines, are:—*M. cornigera*, Busk, from Shetland; *M. bellula*, Hincks, Australia, &c.; *M. cervicornis*, Busk, Victoria; and *M. cervicornis*, Haswell *, Queensland, in which the antler-like processes are described as arising from "one side of the cell." This species is also furnished with a strong vibraculoid spine below the area, and seems to be destitute of avicularia. The present form is certainly distinct from all the above.

Membranipora corniculifera, n. sp. (Pl. XX. figs. 4, 4 *a*.)

Zoœcia ovate, much narrowed towards the oral extremity, expanded below, distinct; margin rather thick, granulated; area occupying the whole of the front of the cell, with a membranous covering; from six to nine tall, stout, erect spines round the upper part of the cell; below them about four on each side, bent inward over the area, of which the uppermost pair are the stoutest, the rest being extremely slender and acuminate; two or three very long and much attenuated spinous processes springing from the wall of the cell at the top, behind the marginal spines; oral valve large, filling the narrow neck-like extremity of the cell above; on the outer surface of the side wall, a little below the top, a minute *avicularium* (Pl. XX. fig. 4 *a*), with a pointed mandible directed outwards. *Oœcium* small, rounded, smooth, with a horn-like process projecting from the centre of the oral margin.

Loc. Cumshewa, on shell.

This species is remarkable for its wonderful array of spines. The position of the avicularium on the outer surface of the cell below the margin is also peculiar.

* This name cannot of course be retained, having been previously employed by Busk. I venture to suggest as a substitute for it *M. Haswellii*, in recognition of the services of one of the earnest workers who are doing so much for Australian natural history.

Membranipora minuscula, n. sp. (Pl. XX. figs. 3, 3 *a*.)

Zoœcia small, oval, arranged in quincunx (somewhat irregularly); margin a good deal raised, thin, smooth, no spines; on an oblong area, placed above the cell, occasionally a small circular *avicularium*, slightly raised, the mandible directed upwards. *Oœcium* semicircular, shallow, just covering the extremity of the cell, smooth, with a subcircular membranous space at the back (? avicularian). *Zoarium* forming a thin flat crust, usually of small size.

Loc. Houston Stewart Channel, &c., common.

Membranipora membranacea, Linnæus.

Queen Charlotte Islands, incrusting the stem of a sea-weed. The only specimen that occurs is covered with numerous tall, very stout, membranous processes, which occupy the place of one of the spines at the top of the zoœcium. They are smooth and glossy, narrow at the base, somewhat enlarged about the middle, and taper off to a point above. They are no doubt modified spines; but we have no clue to their history. They must not be confounded with the processes on the so-called "tower-cells," which originate on the membranous front wall of the zoœcium; both are probably abnormal growths with no special function.

[Norway, Britain, Brittany, Adriatic; New Zealand, Australia.]

Membranipora membranacea, form *serrata*.

Zoœcia rectangular-oblong, greatly elongated; margins smooth; at the top of the cell, on each side, a short blunt spine; round the inner margin a narrow crenated border.

Loc. Virago Sound, spreading over the surface of a seaweed.

This is a remarkably pretty variety, and presents a very distinctive appearance. The cells are of unusual length, and exhibit great regularity both of form and arrangement. But the character which distinguishes it most and gives it a very marked individuality is the narrow crenate edging which fringes the inner margin of the cell. The crenulations are small and close-set and for the most part regular; here and there longer spinous processes rise amongst them and project over the area. One of these is always placed in the centre of the lower margin of the cell.

Family **Microporidæ.**

Micropora, Gray.

Micropora coriacea, Esper, var.

The form in which the marginal nodules are wanting is extremely abundant amongst the dredgings. It is, indeed, one of the commonest species, covering many of the shells with its flat glossy crust, and seldom altogether absent from any.

[Bass's Straits, Australia, var.; Britain, Florida, with the nodules.]

Family **Cribrilinidæ.**

Cribrilina, Gray.

Cribrilina furcata, n. sp. (Pl. XX. fig. 5.)

Zoœcia ovate, quincuncial, very regularly disposed, moderately convex; surface smooth and lustrous, often of a reddish brown colour; on each side from four to six shallow grooves, radiating to a median line, and a central one below, which are occupied by a row of roundish pores set very closely together, the ridges between them slightly raised, usually bearing several elliptical pores; orifice arched above, straight below, much broader than high, on each side a stout bifid spine (occasionally simple); peristome much thickened in front and rising into a central mucro. *Avicularia* none. *Oœcium* large (covering about half the cell above it), rounded, taller than broad, depressed in front, with a shallow oral arch; surface smooth, rather thickly punctured, the forked spines showing in front of it.

Loc. Cumshewa; Houston Stewart Channel; common.

The furcate spine is often wanting, especially in the older cells.

Cribrilina hippocrepis, n. sp. (Pl. XX. figs. 6, 6 *a*.)

Zoœcia ovate, quincuncial; surface lustrous, flattish (sutures very shallow), traversed by radiating ridges (from three to five on each side), which pass from the sides to the centre (no median keel), the grooves between them occupied by a line of rather large oblong pores; at the origin of each ridge an elliptical foramen, covered in by a delicate membrane; orifice large, well arched above, constricted a little above the lower margin, which is straight; operculum of a rich reddish brown; peristome not elevated, lower margin much thickened, usually terminating on each side in a knob; large, elongate, depressed spatulate avicularia scattered amongst the cells. *Oœcium* (?).

Surface of *zoarium* very flat; colour brown, with a tinge of red; in old states white and highly calcified.

Primary cell ovate, area occupying about three fourths of the front surface, with a membranous covering; margin slightly thickened; about fourteen spines surrounding the area, which originate outside and a little below the margin.

Loc. Cumshewa; Houston Stewart Channel; abundant.

The primary cell is interesting as giving a clue to the genetic history of the species and of the Cribriline form generally. There can be little doubt that the ridges which constitute the chief framework of the front wall in the adult are modifications of the spines, which are preserved in the early condition of the cell.

EXPLANATION OF THE PLATES.

Plate XIX.

Fig. 1. *Scrupocellaria varians*, n. sp., nat. size. 1 *a*. Zoœcia, magnified. 1 *b*. Dorsal surface. 1 *c*. Avicularia.
Fig. 2. *Membranipora nigrans*. 2 *a*. Large avicularium.
Fig. 3. *Membranipora protecta*, n. sp.
Fig. 4. *Membranipora acifera*, MacGillivray, form *multispinata*.
Fig. 5. *Membranipora echinus*, n. sp.
Fig. 6. *Membranipora levata*, n. sp. 6 *a*. Oœcium.

Plate XX.

Fig. 1. *Membranipora exilis*, n. sp.
Fig. 2. *Membranipora Sophiæ*, Busk, form *matura*.
Fig. 3. *Membranipora minuscula*, n. sp. 3 *a*. Avicularian area.
Fig. 4. *Membranipora corniculifera*, n. sp. 4 *a*. Zoœcium with ovicell, showing the horn-like projection on the latter.
Fig. 5. *Cribrilina furcata*, n. sp.
Fig. 6. *Cribrilina hippocrepis*, n. sp. 6 *a*. Primary cell.

BIBLIOGRAPHICAL NOTICES.

A Monograph of the British Phytophagous Hymenoptera (Tenthredo, Sirex, *and* Cynips, *Linné*). By Peter Cameron. Vol. i. 8vo. London: Ray Society, 1882.

Among the groups of insects which may be regarded as generally neglected by British entomologists, the Hymenoptera, as a whole, occupy a tolerably prominent place. Some few of us pay attention to the bees, wasps, and sand-wasps of the country; and the ants are pretty well known; but the great assemblage of insects forming the

Terebrant section of the order, according to the older systematists, attract few observers; and, with regard to the great bulk of them, the cause is not far to seek. The petiolated forms are so fearfully numerous that no one not possessed of a most determined spirit could ever hope to cope with them successfully, and the foreign works devoted to their classification and description are for the most part fragmentary in their scope; so that, in the case of these creatures, the British collector finds himself face to face with difficulties which can only be overcome by great perseverance, with free access to a very extensive library, and it is no great wonder if he recoils from the task.

With the Tenthredinidæ and other securiferous types, however, things are somewhat different. Hartig's well-known work, 'Die Familien der Blatt- und Holzwespen,' has for the last twenty years furnished the entomologist with a reliable manual of the European forms, while a considerable number of other writers in France, Germany, and Scandinavia have published important contributions, bearing especially on the classification and determination of these insects, most of which apply more or less closely to our British species. Moreover we have in English a work, of rather ancient date it is true, which treats of the Tenthredinidæ of these islands, in the incomplete 'Illustrations of British Entomology,' by James Francis Stephens; and although Mr. Cameron, in the book now before us, speaks rather slightingly of Stephens's labours, a glance through his own synonymy shows that Stephens's determinations of the species were very generally correct, according to the lights of more than forty years ago.

Nevertheless the Tenthredinidæ seem never to have attracted much attention in this country, which is the more to be wondered at as they are for the most part very elegant and often beautiful creatures, and easily bred from the larvæ, so that the natural history of most of the species may be investigated with the same facility as that of the more popular Lepidoptera; and it is therefore with no small gratification that we welcome the appearance of the first volume of a 'Monograph of the British Phytophagous Hymenoptera,' which treats exclusively of a portion of the great family of the Sawflies. The author, Mr. Cameron, has here associated with the true Sawflies, not only the nearly allied securiferous forms of the Siricidæ and their allies, but also the petiolated phytophagous species constituting the family Cynipidæ; and in this way his book, when completed, will treat of the most interesting groups of Hymenoptera outside the Aculeate section of the order.

Taking the present instalment of his work as a sample of the whole, we most sincerely congratulate Mr. Cameron on the admirable manner in which he has performed his task: throughout we find traces of the most careful and conscientious investigation; and every department of his subject appears to have received from him an equal amount of attention. Besides careful descriptions of the genera and species, the author gives an introductory description of the external structure of the insects forming the family Tenthredinidæ, and indicates the parts which are of most importance for taxonomical purposes; and this is followed by a short account of the habits of the perfect insects, and of their transformations, with a list of food-plants and a table for the determination of the larvæ, so far as the latter are known to him. One remarkable point specially referred to is the occurrence of parthenogenesis among the Sawflies, which appears to be a much more general phenomenon than had been supposed. Of many species males only are known; of many others the males are in a miserable minority to the females; and of several it has been directly ascertained that the eggs deposited by unfecundated females are in a greater or less degree prolific. Contrary to the rule observed to prevail among the social Aculeate forms, these unfecundated eggs have occasionally produced male as well as female progeny. From this side, therefore, the Sawflies offer a most interesting and important field of investigation, and one which, from the ease with which the insects may be reared, may be cultivated without much trouble by almost any one. The investigation of the phenomena of parthenogenesis as displayed by the Gallflies, another family of which Mr. Cameron will treat, has already led to important results.

Having cleared the ground, as above indicated, Mr. Cameron briefly discusses the chief systems of classification adopted by his predecessors, and then proceeds to develop his own views upon this knotty point. Of these we need say but little, except that the author seems to us to fall into the error, which is so rife in the present day, of making his classification too complicated. Nearly every systematic writer now appears to think that his main business consists in splitting up every group as much as the most minute analysis will enable him to do, the consequence of which is the establishment of a host of named subfamilies, tribes, groups, sections, divisions, &c., which it is utterly impossible for any one not specially engaged in the study of the group so treated to carry in his head, and which must not only be quite useless for the higher purposes for which classificational units are wanted, but also stand in the way of the usefulness of the work containing them to those general students who may have occasion from time to time to consult special treatises for the mere determination of species. Thus the true Tenthredinidæ form seven tribes; and the first of these, Tenthredina, which alone is treated of completely in the present volume, includes three subtribes, Tenthredinides, Dolerides, and Selandriades; and although we cannot expect a corresponding amount of division in the succeeding tribes, the total number of terminal groups will still be considerable. At the same time Mr. Cameron will hardly be so great a sinner in this way as most of his contemporaries; and he has provided students with a guide through the intricacies of the subject in the shape of an analytical table of the genera, in which all the intermediate divisions of the family are ignored.

The strictly descriptive part of the present volume includes only the first tribe of the Sawflies, the Tenthredina, under which 202

British species are described. This tribe, however, includes the greater number of the species. The descriptions are very carefully drawn up, and include notices of the larvæ and natural history where these are known, while the determination of the species is facilitated by the insertion under each genus of a tabular synopsis of the species contained in it. The synonymy of the genera and species is also given with sufficient fulness; a considerable number of the species and of their larvæ are figured, often with details, upon some of the plates (twenty-one in number) with which the volume is illustrated, the remaining plates being devoted to the illustration of the general terminology of the group and to the representation in outline of the characters of the saw-like ovipositors, upon which, especially in some genera, Mr. Cameron lays considerable stress for specific determination. A bibliographical list, giving explanations of the abbreviations used, and a full index of both names and synonyms, complete the volume, which is in every respect a most valuable contribution to our entomological literature.

We cannot conclude this notice without saying a few words of the admirable society under whose auspices this present book has been produced. The Ray Society has for many years merited the hearty thanks of all British naturalists on account of the important series of works which it has brought out—works which it would be utterly impossible for any publisher to produce in the same style, especially as regards illustrations, except under a certainty of heavy pecuniary loss. We have already on several occasions called attention to some of these works, which we have been glad to see of late dealing more and more with various departments of British entomology; and we think that it behoves the entomologists of this country to lend the society a helping hand, of which, we are sorry to say, it stands much in need. A volume like that under consideration is not dear at a guinea, even if the subscribers get no more for the year; but with increased funds the productiveness of the Society will increase, and we may hope to see it once more rival its own glories of five-and-thirty years ago.

Guide to the Exhibition Galleries of the Department of Geology and Palæontology, British Museum (Natural History), Cromwell Road, South Kensington. 56 pp., with numerous woodcuts. 8vo. Printed by order of the Trustees, (October) 1882.

This is the first *illustrated* catalogue and guide-book issued for the use of visitors to the national collection. The Trustees of the British Museum show their willingness to meet the requirements of progressive knowledge, or at least the awakened intellectual inquisitiveness of the People. They not only set before them the bones and shells of bygone creatures, which are the enduring memorials of the Past, but give them descriptive words and artistic sketches of the extinct animals and their relics, so that the separate fragments and scattered remains should no longer be decipherable by the expert alone, but come into congruous and intelligible forms, readily to be understood by any, even a popular, student of nature.

In this first issue the Mammals and Reptiles have special notice, the Fishes and Invertebrates not having yet been completely arranged in the new rooms and cases. For all, however, there are good general remarks as to their natural classification and occurrence, whilst for the two first-mentioned groups there is much valuable information, with a geological table showing their range in time, and thirty-one good figures, eight of which are original, the others having been borrowed from the publishers of first-class palæontological books.

MISCELLANEOUS.

Norwegian and Scottish Lepidoptera. By M. W. M. Schöyen.

M. Schöyen publishes in the 'Nyt Magazin for Naturvidenskaberne' (vol. xxvii. pp. 1–54) an elaborate account of the investigations he made in 1880 into the Lepidopterous fauna of the district of Romsdal, the coast district of Norway between 60° and 64° N. lat. He gives a list of 356 species, a great many of which occur in this country; and his remarks upon some of them will be of interest to British lepidopterists.

In his introductory remarks he institutes a comparison between the Lepidopterous faunas of Norway, east and west of the mountain-chain, and between those of Norway and Scotland, which will prove of more general interest. His comparison of the known species of Lepidoptera in Eastern and Western Norway under the same latitudes is as follows:—

	Norway west of the Fjeld.		Norway east of the Fjeld.	
Rhopalocera	47		82	
Sphinges	12		29	
Bombyces	36		69	
Noctuæ	83		196	
Geometræ	95		170	
Macrolepidoptera		273		546
Pyralides	37		77	
Tortrices	52		160	
Tineides	66		165	
Pterophorides	7		23	
Microlepidoptera		162		425
Total		435		971

These numbers must of course be regarded only as provisional; but the main point, namely that Norway west of the Fjeld has a much smaller number of species than Norway east of the Fjeld, will certainly hold good. The author indicates the agreement of this with the results indicated in Speyer's well-known work on the geographical distribution of the Lepidoptera of Germany and Switzerland, according to which the number of species decreases pretty uniformly towards the west and north-west—that is, towards the coasts, a phenomenon explicable by the cooler and moister summers of the coast regions as compared with the warmer and more sunny summers of the continental regions, which are far more favourable to the development of the Lepidoptera, and especially of the Rhopalocera and other light-loving species.

The investigation of the Scottish Lepidoptera gives a further confirmation of these results. According to Dr. Buchanan White's "Lepidoptera of Scotland" ('Scottish Naturalist,' 1872, &c.), Scotland possesses only 39 known species of Rhopalocera, against the 47 of Western Norway, which shows the action of the humid insular climate in reducing the number of species of this heliophilous group. Only 25 species are common to both regions, the following 21 species occurring in Norway west of the Fjeld not having yet been observed in Scotland:—*Papilio machaon*, *Aporia cratægi*, *Leucophasia sinapis*, *Polyommatus virgaureæ* and *hippothoë*, *Lycæna argus*, *optilete*, *eumodon*, *argiolus*, and *semiargus*, *Vanessa c-album*, *Melitæa dictynna*, *Argynnis pales*, *lathonia*, and *niobe*, *Erebia lappona* and *ligea* (said to have been found, but the statement is more than doubtful), *Pararge mæra* and *hiera*, *Syrichtus serratulæ*, and *Hesperia comma*. On the other hand, we have in Scotland the following five species, hitherto observed in Norway only east of the Fjeld—*Colias edusa*, *Zephyrus quercus*, *Argynnis paphia*, *Pararge megæra*, and *Syrichtus malvæ*; and the following eight species not yet found in Norway —*Nemeobius lucina*, *Vanessa polychloros* (cited in the 'Enumeratio' as Norwegian, but doubtful), and *V. io*, *Melitæa aurinia*, *Erebia epiphron* and *æthiops*, *Epinephile tithonus*, and *Hesperia thaumas*.

Of Sphingidæ (including Sesiidæ and Zygænidæ) Scotland has in all 25 species, among which are all the West-Norwegian species except three, namely *Sphinx pinastri* (said to be found near Edinburgh, but doubtful), *Sesia spheciformis*, and *Zygæna lonicerœ*.

The Scottish Bombycidæ number 69 species, including also all the Western Norwegian forms but 3, namely *Ocneria dispar* (?), *Pygæra curtula* (the larvæ of both species are said to have been found, but this is uncertain), and *Lasiocampa ilicifolia*.

The 200 species of Noctuæ recorded for Scotland include all the West-Norwegian species except 8, namely *Acronycta auricoma*, *Agrotis grisescens*, *Dianthœcia proxima*, *Hadena lateritia* and *polyodon*, *Amphipyra pyramidea*, *Xylina furcifera*, and *Toxocampa pastinum*; and the 184 Scottish Geometræ also include all but 13 of the Western-Norwegian species, namely:—*Jodis putata*, *Acidalia incanata*, *Gnophos sordaria*, *Pygmæna fusca*, *Lythria purpuraria*, *Lygris dictyides*, *Cidaria quadrifasciaria*, *unangulata*, *vespertaria*, and *ob-*

literata, and *Eupithecia linariata*, *pimpinellata* (both the last-named doubtfully recorded as occurring in Scotland), and *hyperborata*.

Comparing the whole known Lepidopterous fauna of Norway (east and west of the Fjeld) with that of Scotland, but confining the comparison to the Macrolepidoptera, the Scottish Microlepidoptera not being yet sufficiently worked out, we get the results shown in the following Table:—

		Number of species in Norway.		Number of species in Scotland.		Species common to both countries.		Norwegian species not found in Scotland.		Scottish species not found in Norway.	
Rhopalocera			92		39		31		61		8
Sphinges	Sphingidæ	14	30	14	25	12	19	2	11	2	6
	Sesiidæ	12		6		4		8		2	
	Zygænidæ	4		5		3		1		2	
Bombyces			76		69		55		21		14
Noctuæ			210		200		139		71		61
Geometræ			188		184		133		55		51
Together			596		517		377		219		140
Heterocera alone			504		478		346		158		132

Of the 140 species occurring in Scotland and not known in Norway, 80 (or more than half) are met with in Sweden—namely, Rhopalocera 5, Sphingidæ 1, Sesiidæ 1, Zygænidæ 2, Bombyces 12, Noctuæ 37, and Geometræ 22.—*Nyt Magazin for Naturvidenskaberne*, Bind xxvii. pp. 7–13.

On the Evolution of the Peridinina *and the Peculiarities of Organization which approximate them to the* Noctilucæ. By M. Pouchet.

The author brings forward some observations which, he thinks, reveal a new order of phenomena in the genesis of the Peridinians. His observations were made in the Bay of Concarneau, when the towing-net collected daily the following species:—*Ceratium furca*, Ehr.; *C. tripos*, Nitzsch; *C. tripos*, var. *megaceros*; *Dinophysis acuta*, Ehr.; ? *Protoperidium pellucidum*, Bergh; *Peridinium divergens*, Ehr.; ? *Diplopsalis lenticula*, Bergh; ? *Glenodinium cinctum*, Ehr.; ? *Gymnodinium gracile*, Bergh; ? *Prorocentrum micans*, Ehr.

The different varieties of *Ceratium furca* and *tripos* always occurred, as usual, isolated, of equal size, and with no traces of any genesic operations, until, on October 9, a single cast of the net furnished no fewer than three forms of *Ceratia*, namely *C. tripos* and its var. *megaceros* and *C. furca*, arranged in chains of two, three, and up to eight individuals joined end to end. There was a rolling sea; the boat was four or five miles off the shore; and the depth was 80–100 metres. These curious chains are probably formed at the bottom. The mode of union of the individuals is as follows:—The aboral or posterior horn (anterior of Stein) is inserted by a truncated extremity at the left-hand margin of the ventral depression of the succeeding individual, just at the point of termination of the transverse furrow. The individuals in chains were motionless, with neither flagellum nor cilia.

This arrangement, and especially the apparent anterior evolution, would seem to approximate the Ceratina to the Diatoms and Desmids, while other peculiarities appear to indicate a relationship between these creatures and the *Noctilucæ* closer than that accepted by Stein, who places his group Scytomonadina between the latter and the Peridinina. Some large *Ceratia* allied to *C. divergens*, and about 0·160 millim. in length, show remarkable characters. The protoplasm, protected by the carapace, is slightly rose-coloured, with a large spherical nucleus and some drops of oily appearance and of a bright chamois-colour; the creature is asymmetrical, and as if twisted upon its axis; the extremity (truncated as usual) of the aboral horn appears excavated into a groove; and on the right-hand side of the ventral depression there is a strong projection in the form of a lip (Claparède and Lachmann, Stein). All these characters occur in a striking manner in the *Noctilucæ*, especially at the moment of an ascent of these creatures to the surface of the sea:—flagellum (Huxley, Robin, Stein); envelope hyaline, resistant, sometimes distinctly reticulated; rosy coloration of the protoplasm, with a nucleus and oily drops of the same dimensions and the same colour; well-marked asymmetry in the basal piece of the tentacle and lip projecting on the right side (Huxley, Robin).

The analogy becomes still more manifest if, instead of spherical floating *Noctilucæ*, we take the forms which have already puzzled Busch, and which are not found at the surface, but at the bottom of the vessels in which the products of fishing have been collected. In these the internal framework (formed, not by a style or bacillus, but by two kinds of glumes) produces, by its extremities, three processes or horns—two in front, pointed, and more or less recurved, and a third aboral, excavated into a groove. The size of these tricuspid *Noctilucæ* (0·190 millim.) scarcely exceeds that of the large *Ceratia* from which they seem to have issued, to become subsequently swelled up by accumulation of water in lacunæ originally independent of their protoplasm. In these *Noctilucæ* there is often a prominent curved projection, which seems to mark the contour of the ciliary circlet. Of the formation of the tentacle the author can say nothing, and he remarks that the suggested relationship is purely hypothetical.—*Comptes Rendus*, October 30, 1882, p. 794.

Evidence of great Destruction of Life last Winter off the New-England Coast.

In a report upon the dredging-operations carried on in the summer of 1882 under the auspices of the U.S. Fish Commission, Prof. Verrill gives the following account of a remarkable destruction of several usually abundant forms of animals. He says:—

One of the most peculiar facts, connected with our dredging this season was the scarcity or total absence of many of the species, especially of Crustacea, that were taken in the two previous seasons, in essentially the same localities and depths, in vast numbers, several thousands at a time. Among such species were *Euprognatha rastellifera*, *Catapagurus socialis*, *Pontophilus brevirostris*, and a species of *Munida*. The latter, which was one of the most abundant of all the Crustacea last year, was not seen at all this season. An attempt to catch the "tile-fish" (*Lopholatilus*) by means of a long trawl-line, on essentially the same ground where eighty were caught on one occasion last year, resulted in a total failure this year. It is probable therefore that the finding of vast numbers of dead tile-fishes floating at the surface, in this region, last winter, as was reported by many vessels, was connected with a wholesale destruction of the life at the bottom, along the shallower part of this belt (in 70 to 150 fathoms), where the southern forms of life and higher temperatures (48° to 50°) are found. This great destruction of life was probably caused by a very severe storm that occurred in this region at that time, which, by agitating the bottom-water, forced outward the very cold water that, even in summer, occupies the great area of shallower sea, in less than 60 fathoms, along the coast, and thus caused a sudden lowering of the temperature along this narrow *warm zone* where the tile-fish and the Crustacea referred to were formerly found.

As the warm belt is here narrow, even in summer, and is not only bordered on its inner edge, but is also underlain by much colder water, it is evident that even a moderate agitation and mixing up of the warm and cold water might, in winter, reduce the temperature so much as to practically obliterate the warm belt at the bottom. But a severe storm, such as the one referred to, might even cause such a variation in the position and flow of the tidal and other currents as to cause a direct flow of the cold inshore waters to temporarily occupy this area, pushing outward the Gulf-stream water. The result would be the same in either case, and could not fail to be destructive to such species as find here nearly their extreme northern limits.

In order to test this question more fully, Prof. Baird also employed a fishing-vessel, the 'Josie Reeves,' to go to the grounds and fish systematically and extensively for the tile-fish. On her first trip, ending September 25, she did not find any "tile-fish," but took another food-fish (*Scorpæna dactyloptera*), known on the European coast, and first taken by us in 1880.—*Amer. Journ. Sci.*, Nov. 1882, p. 366.

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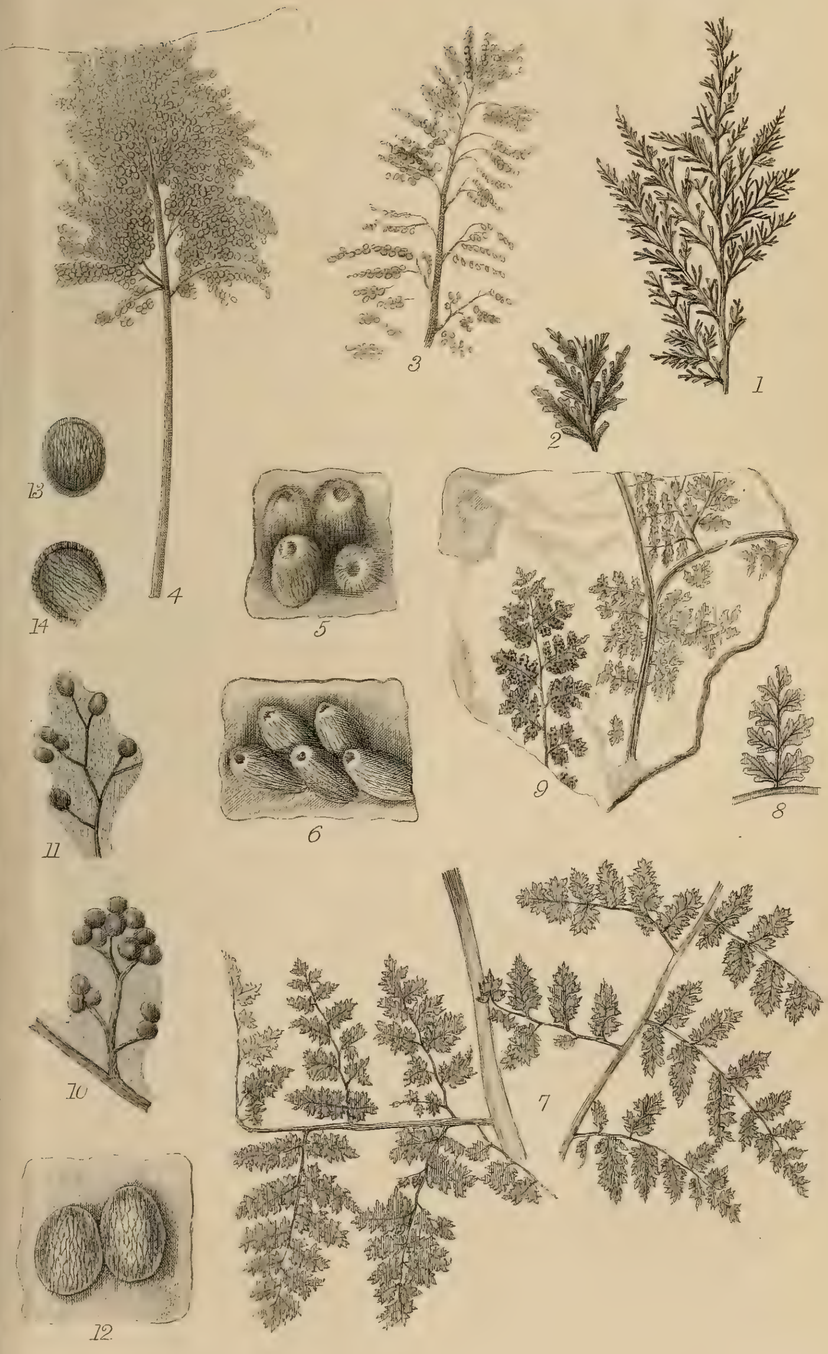

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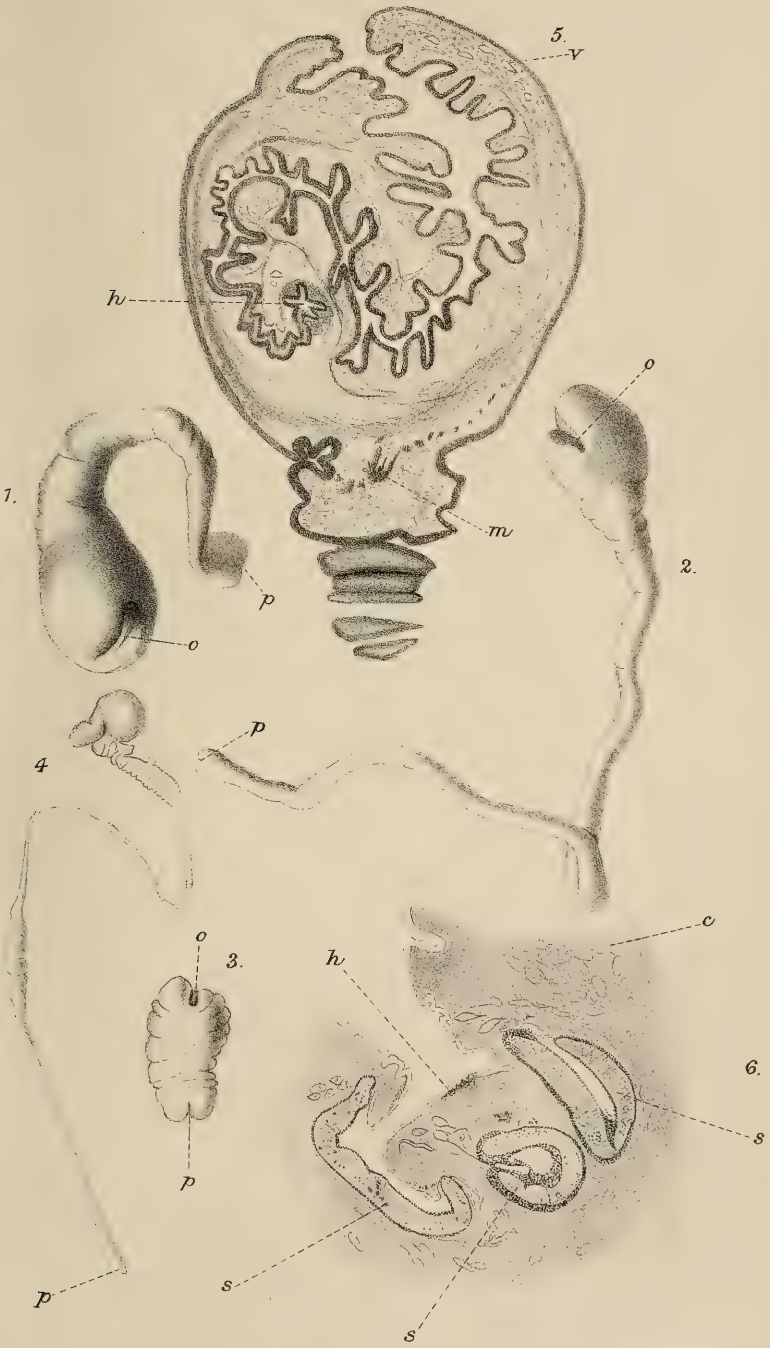

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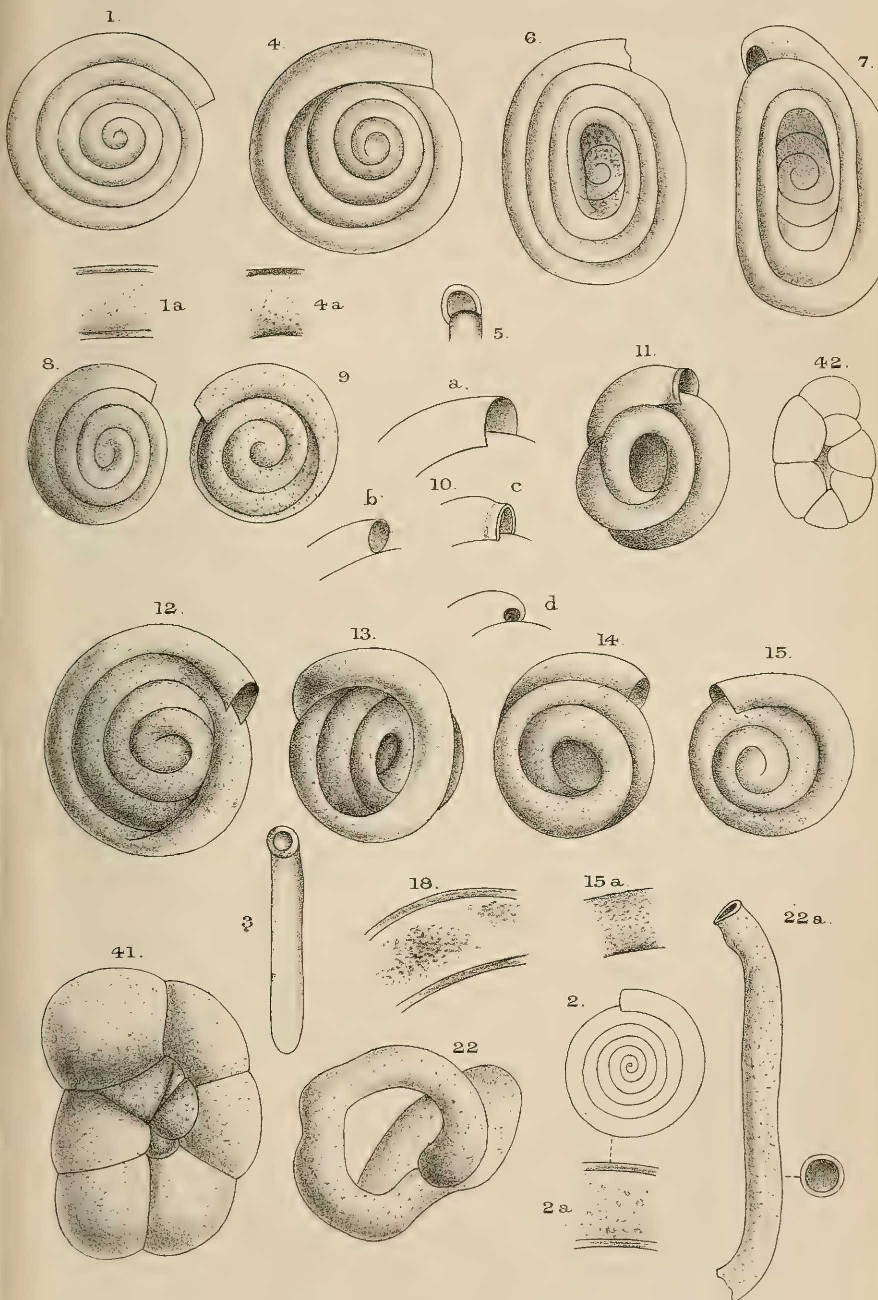

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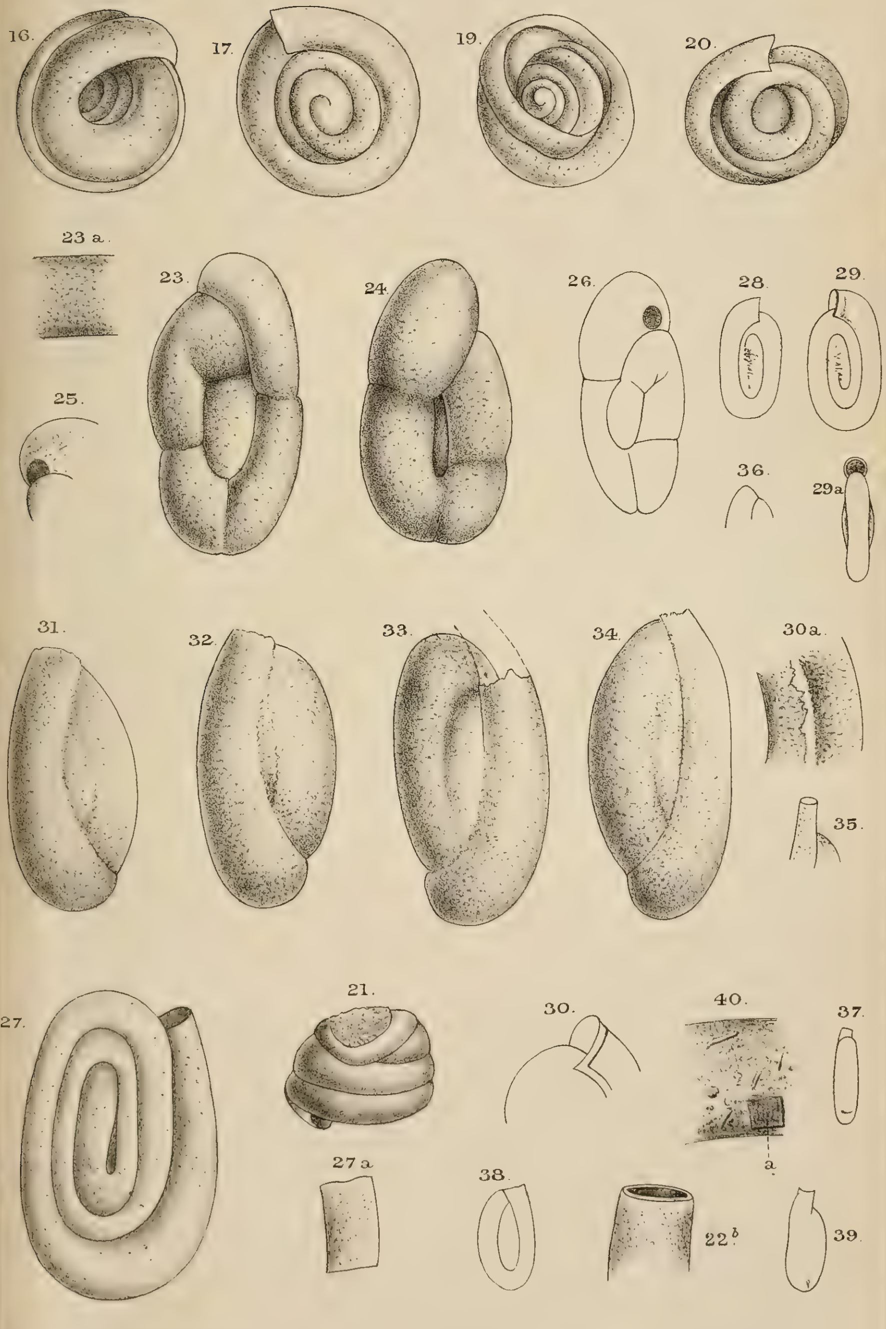

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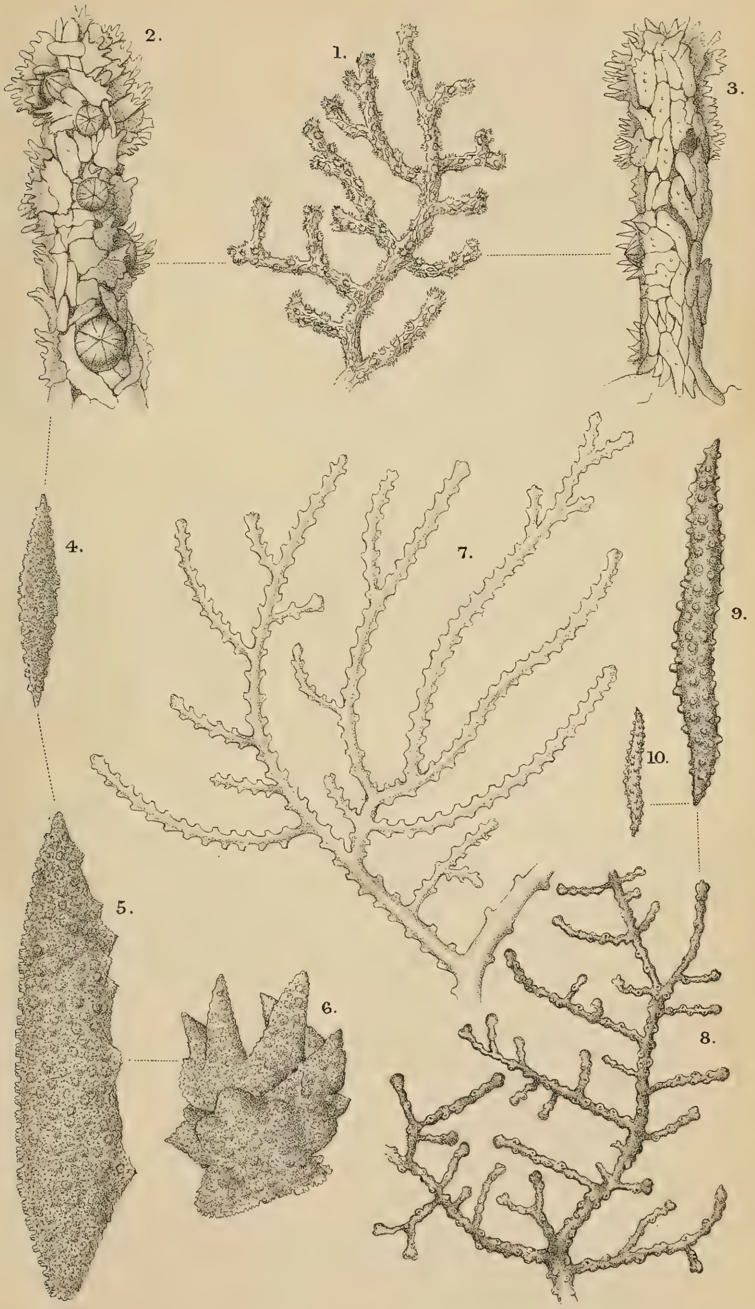

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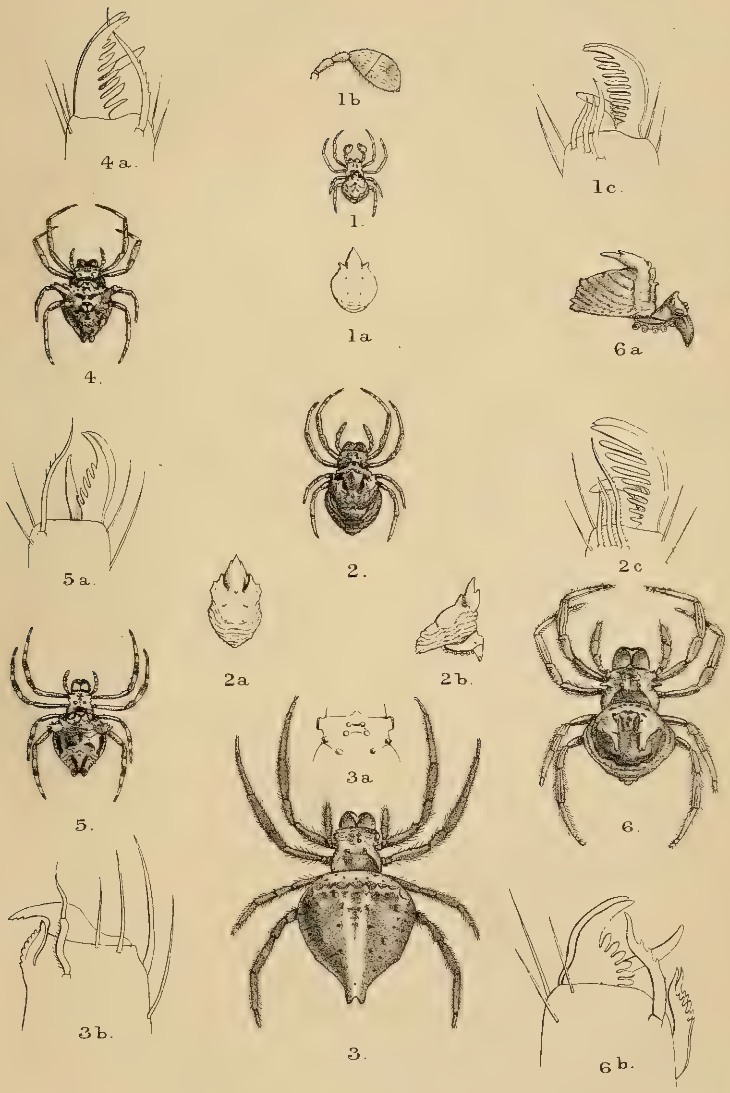

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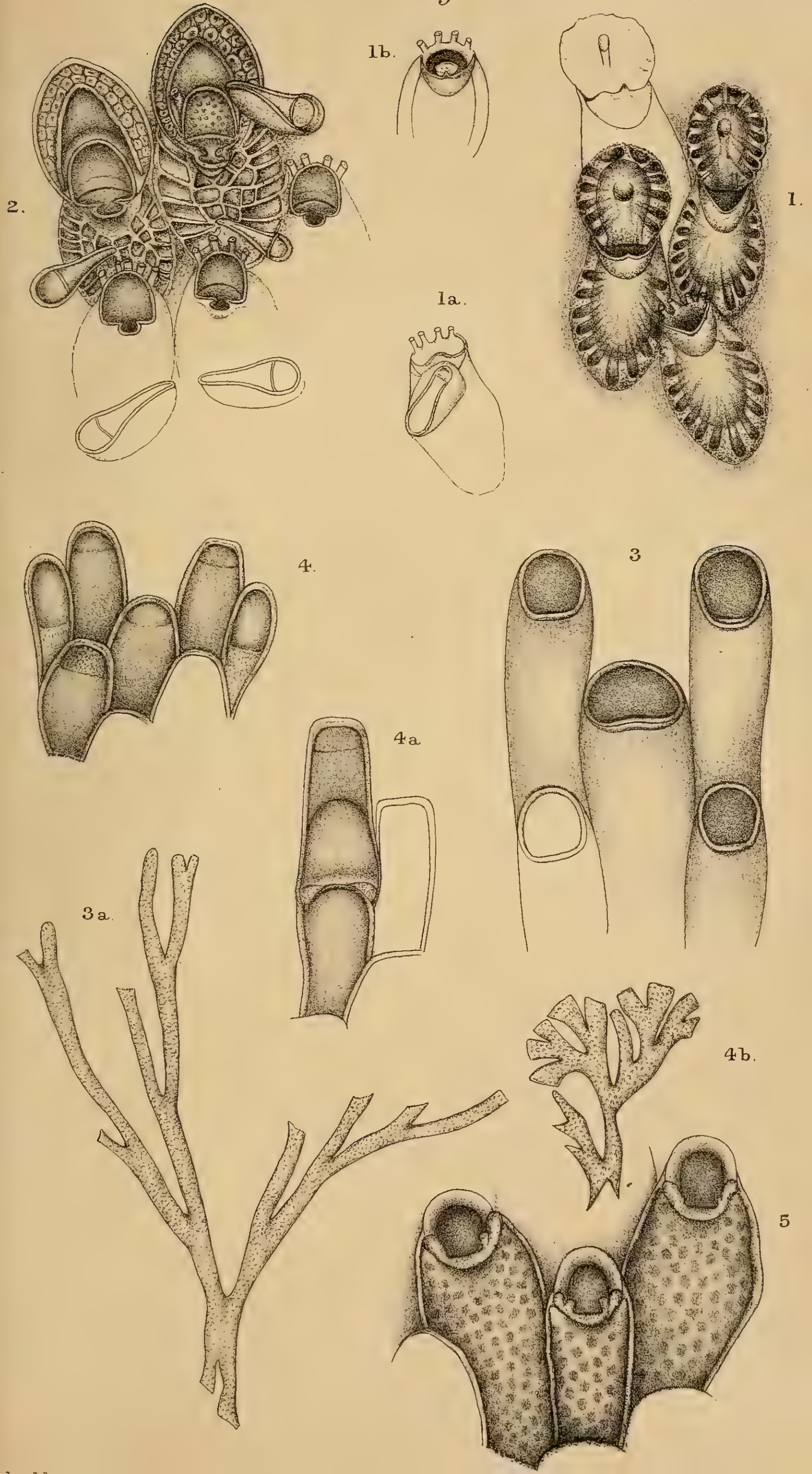

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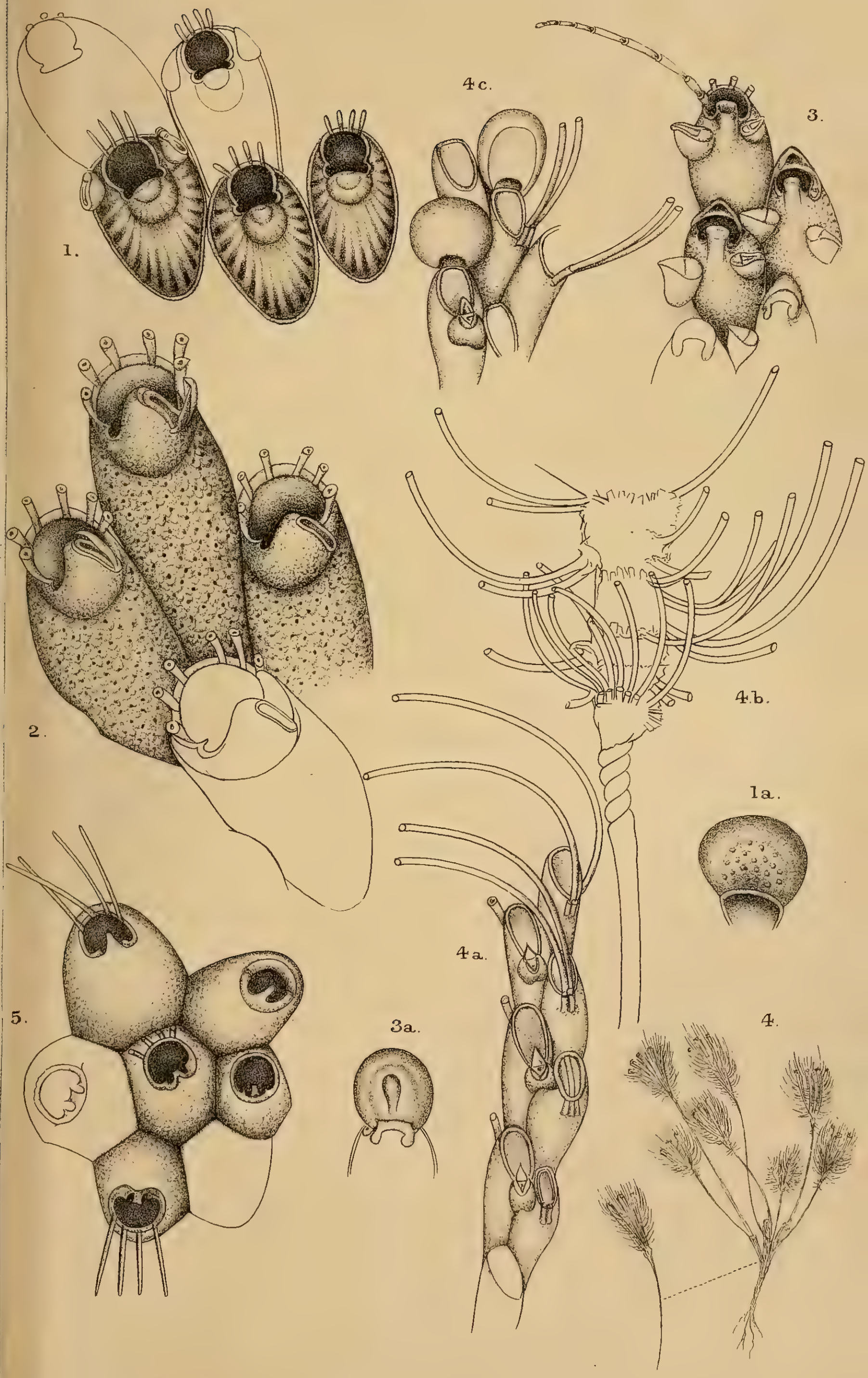

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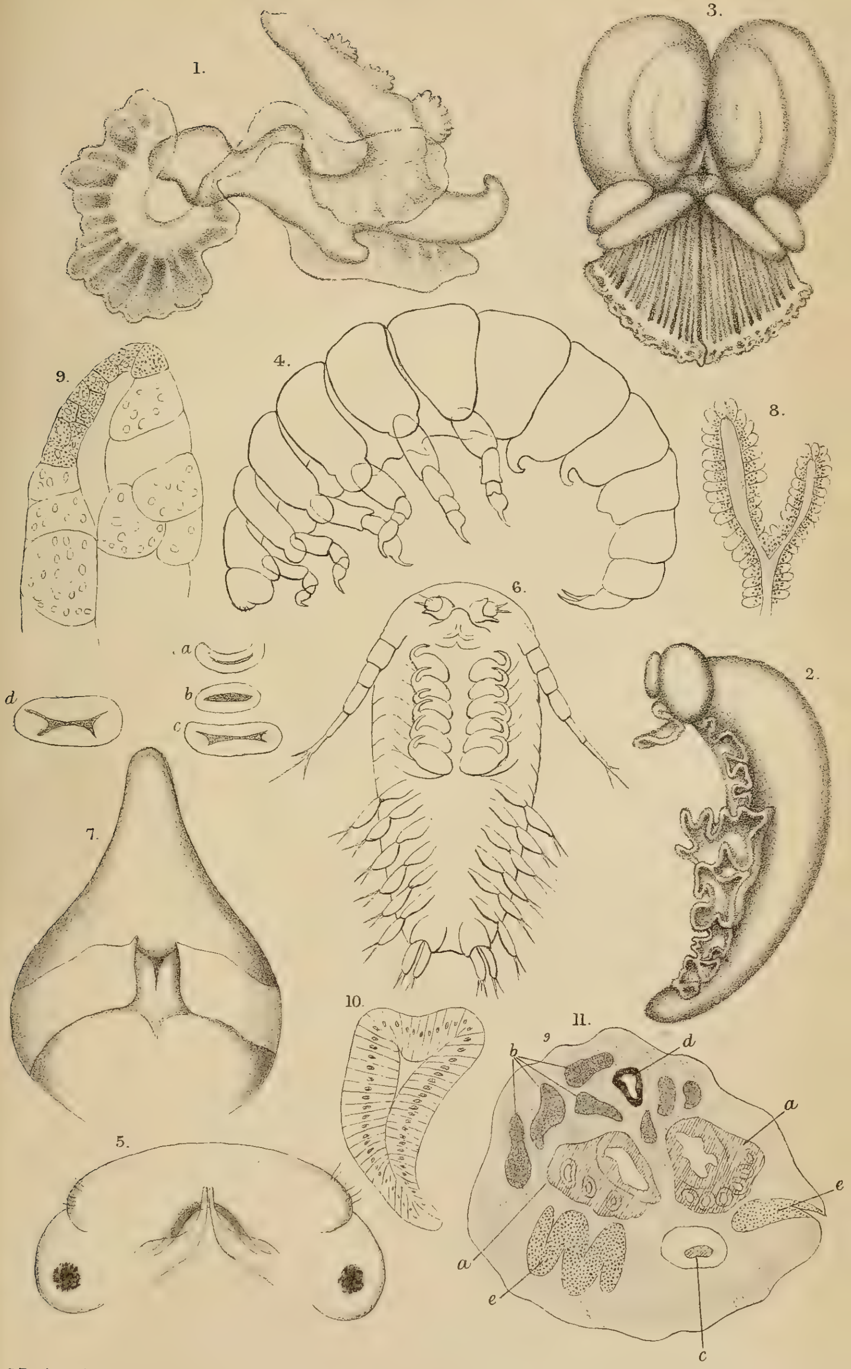

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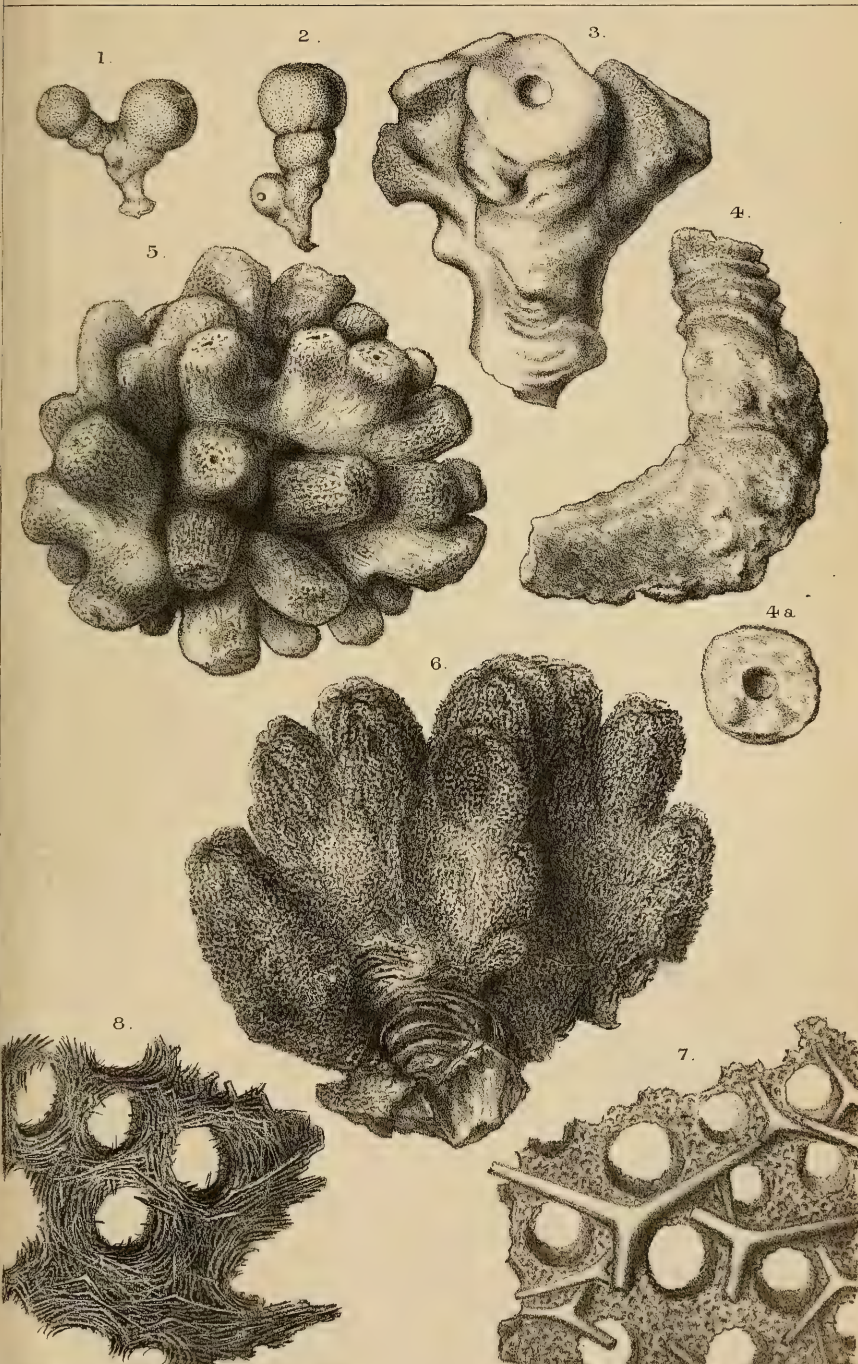

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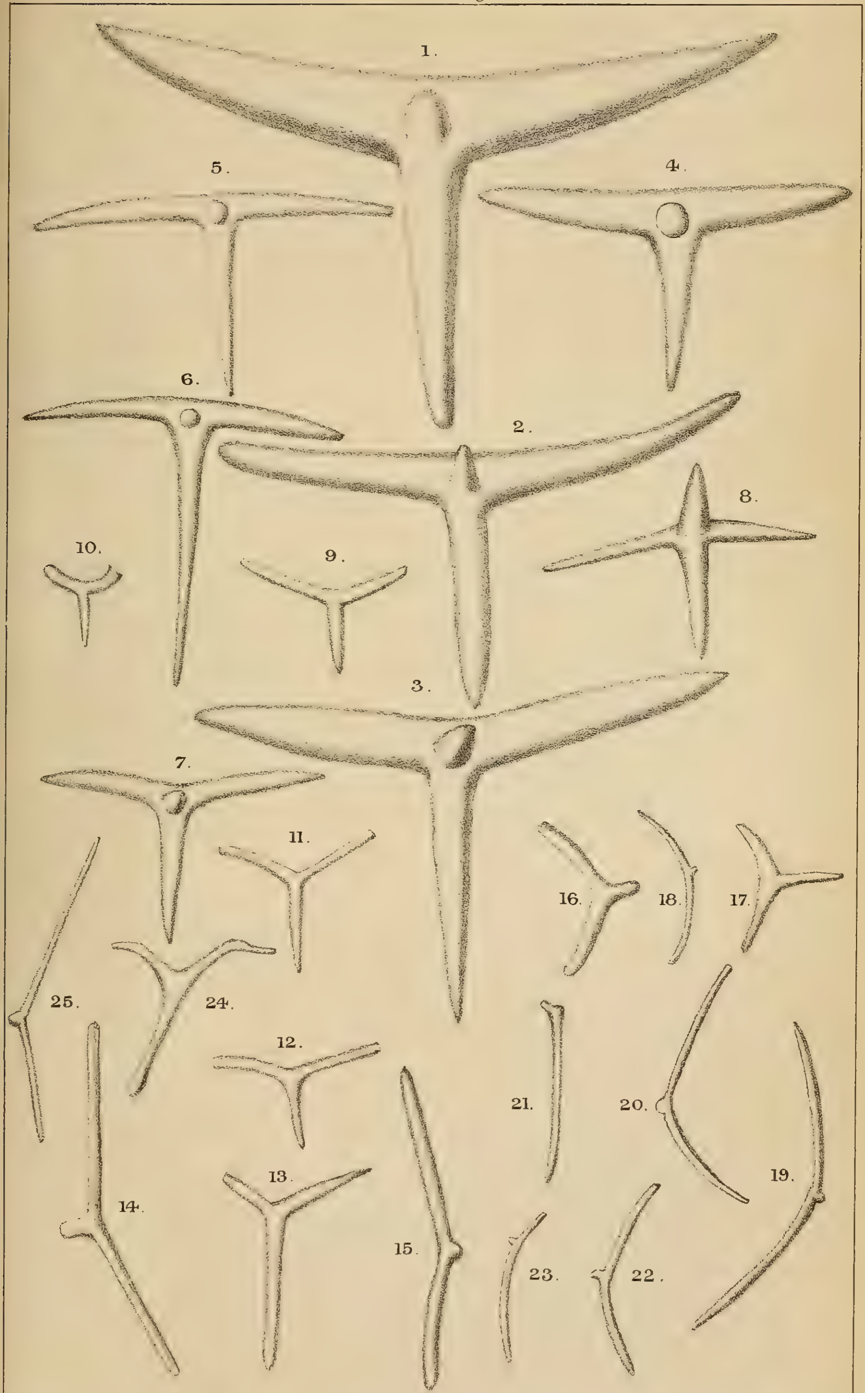

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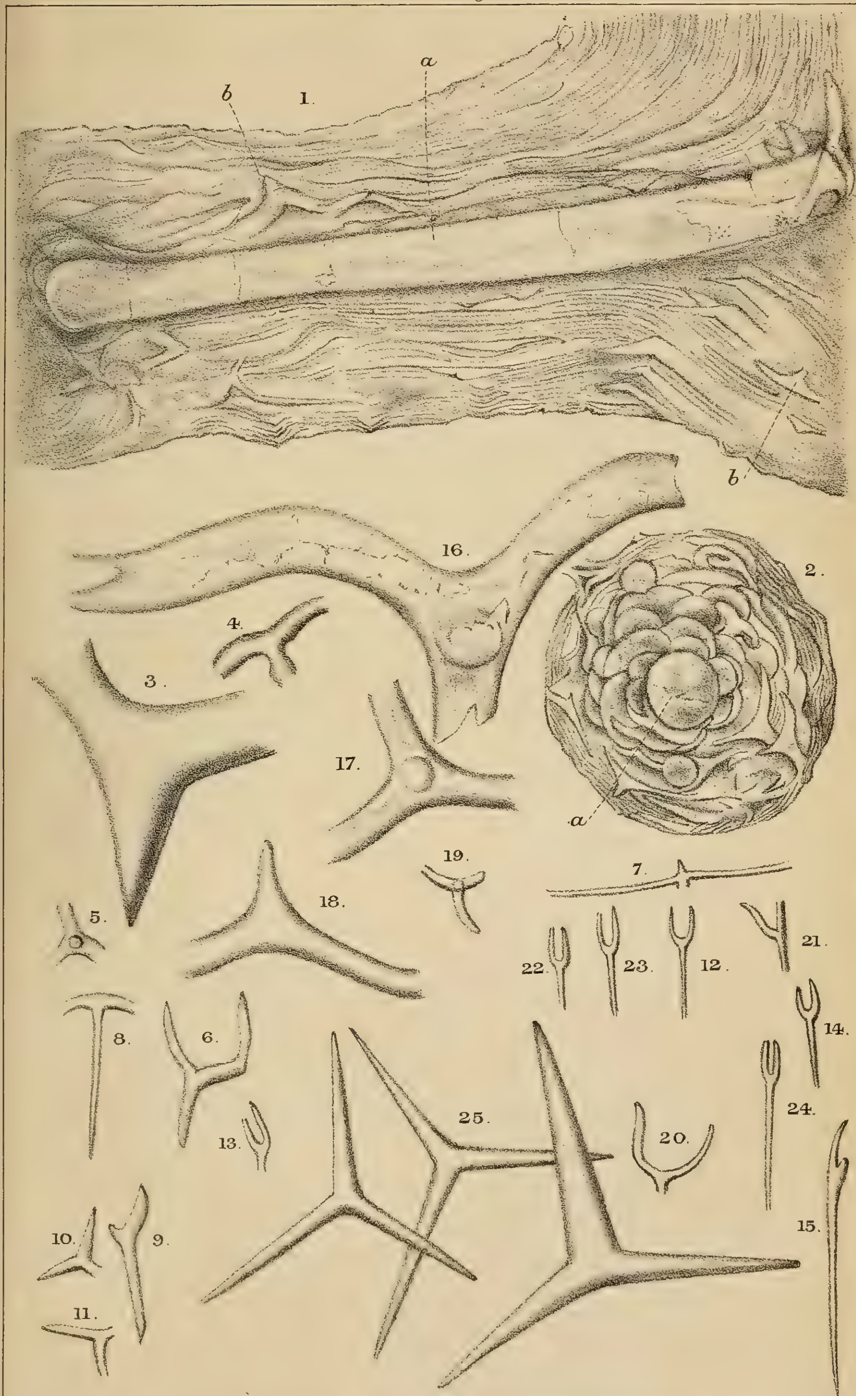

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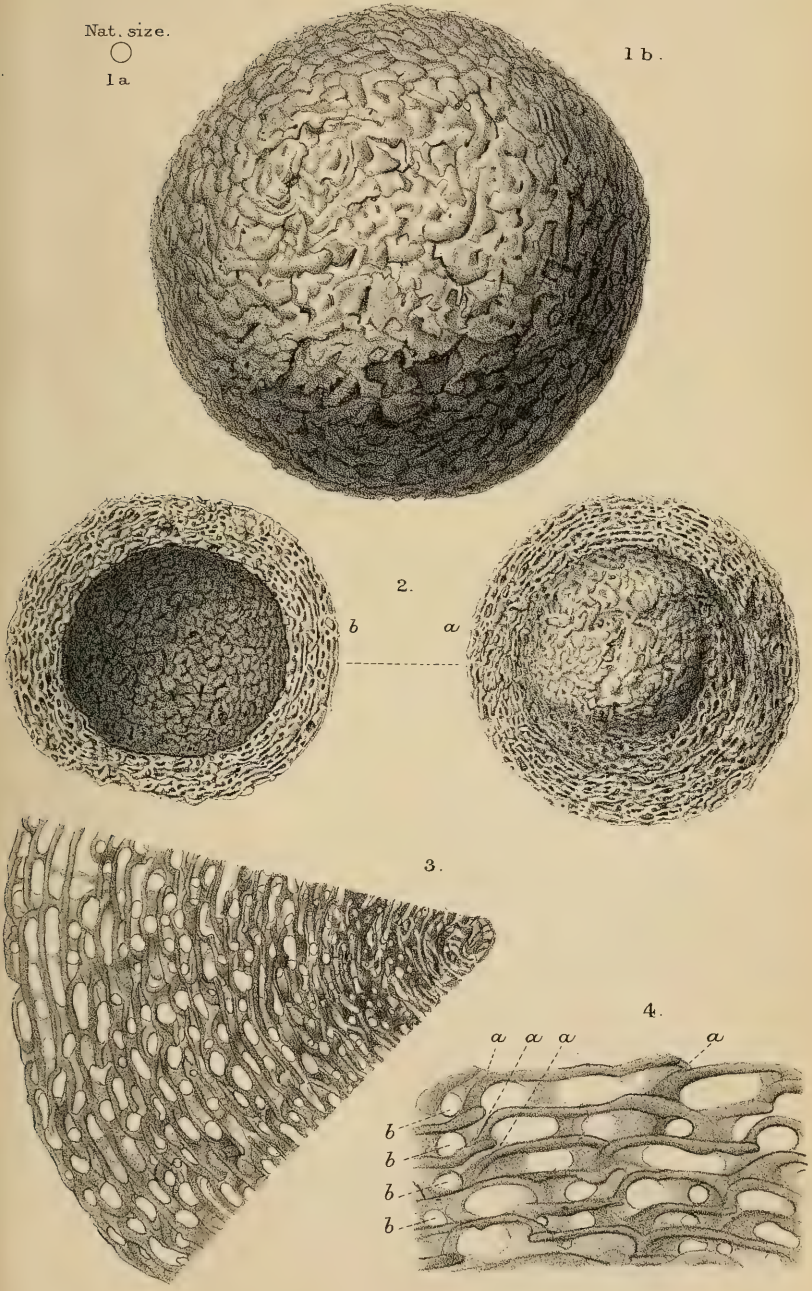

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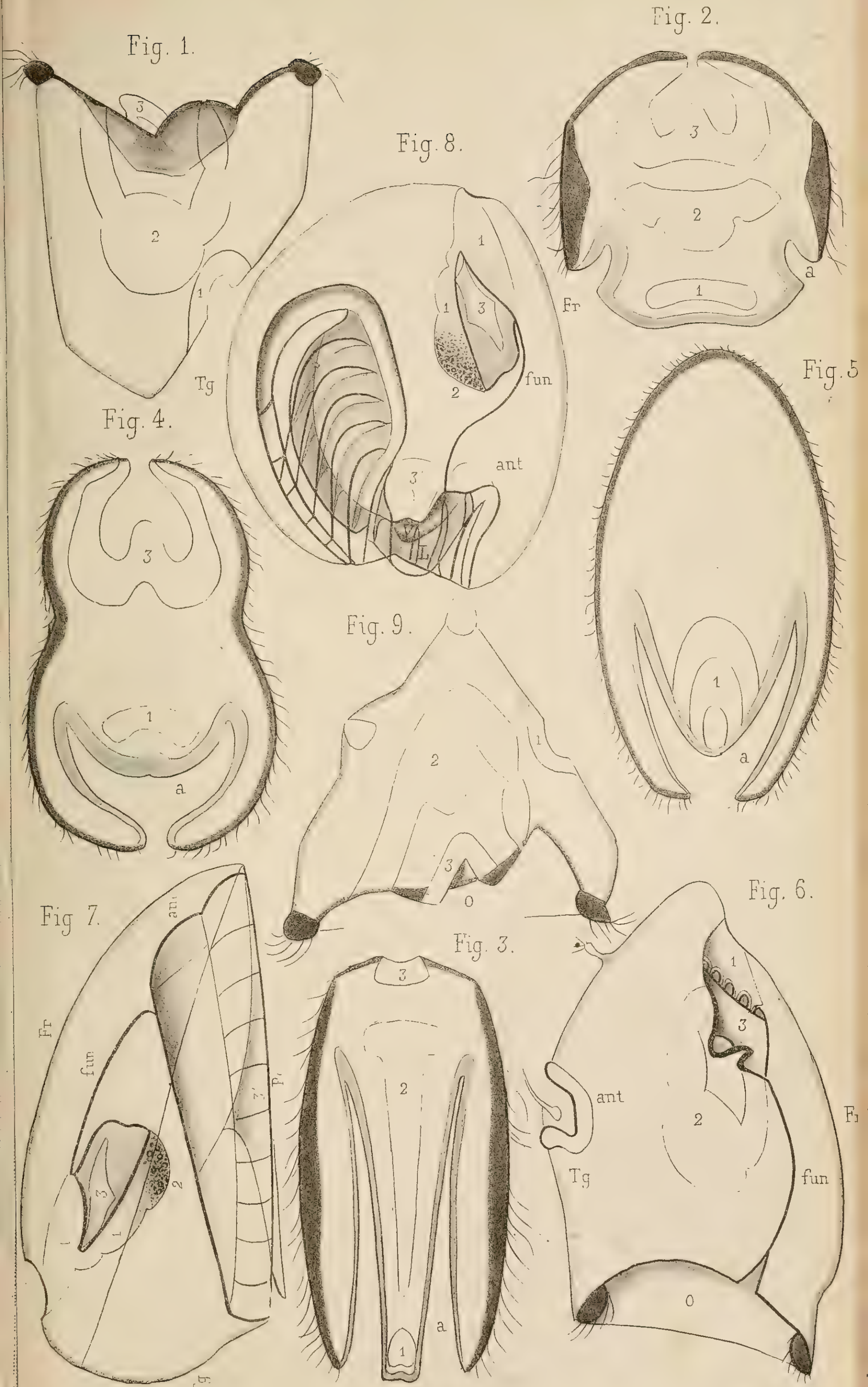

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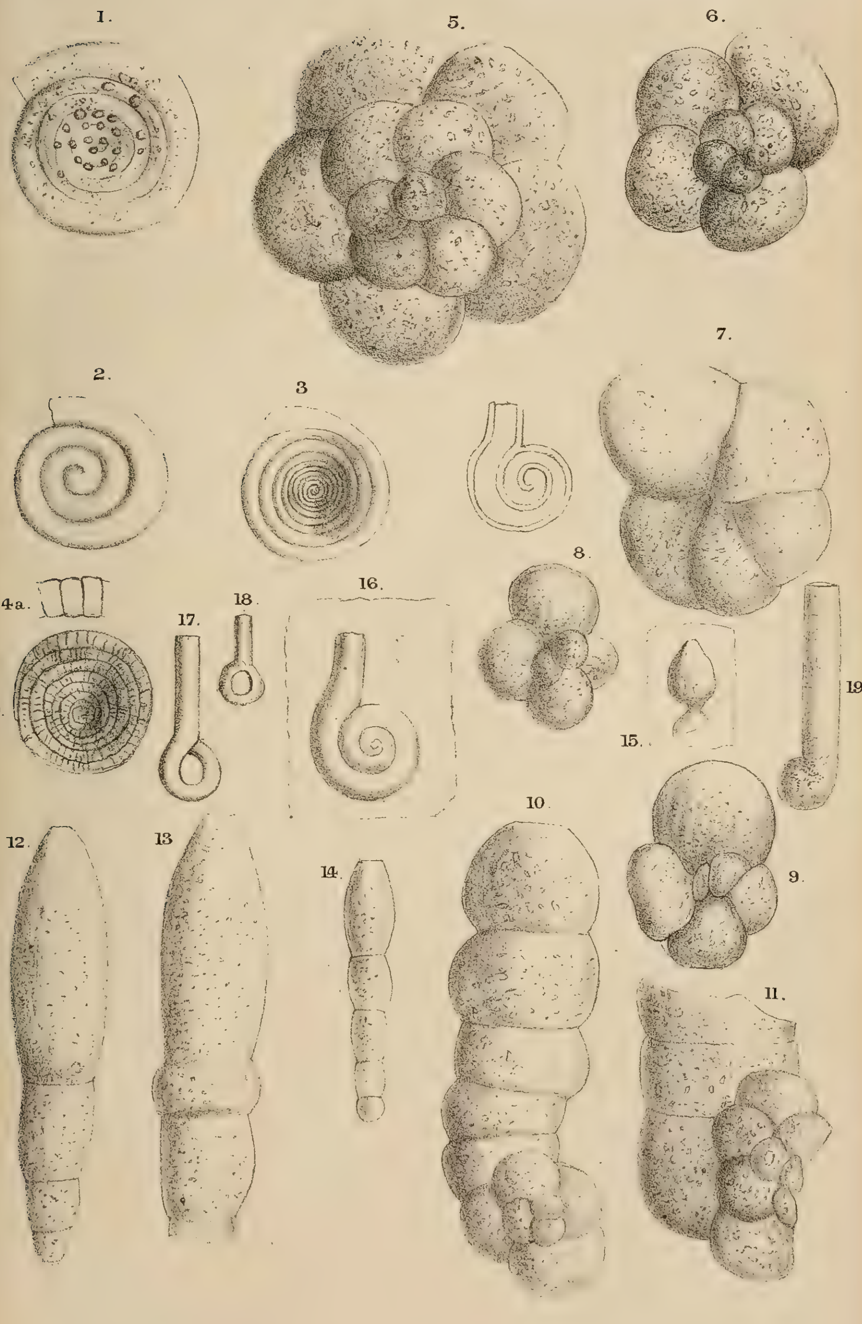

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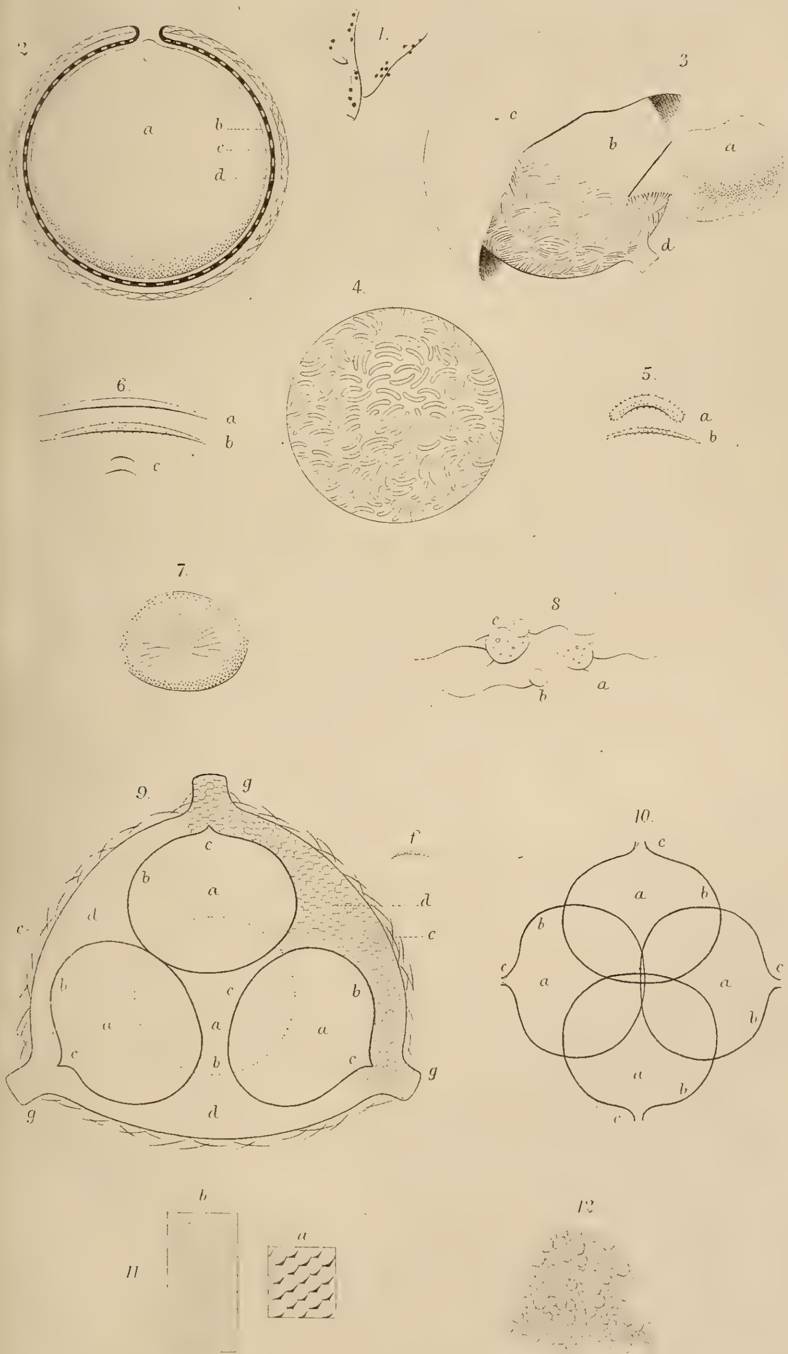

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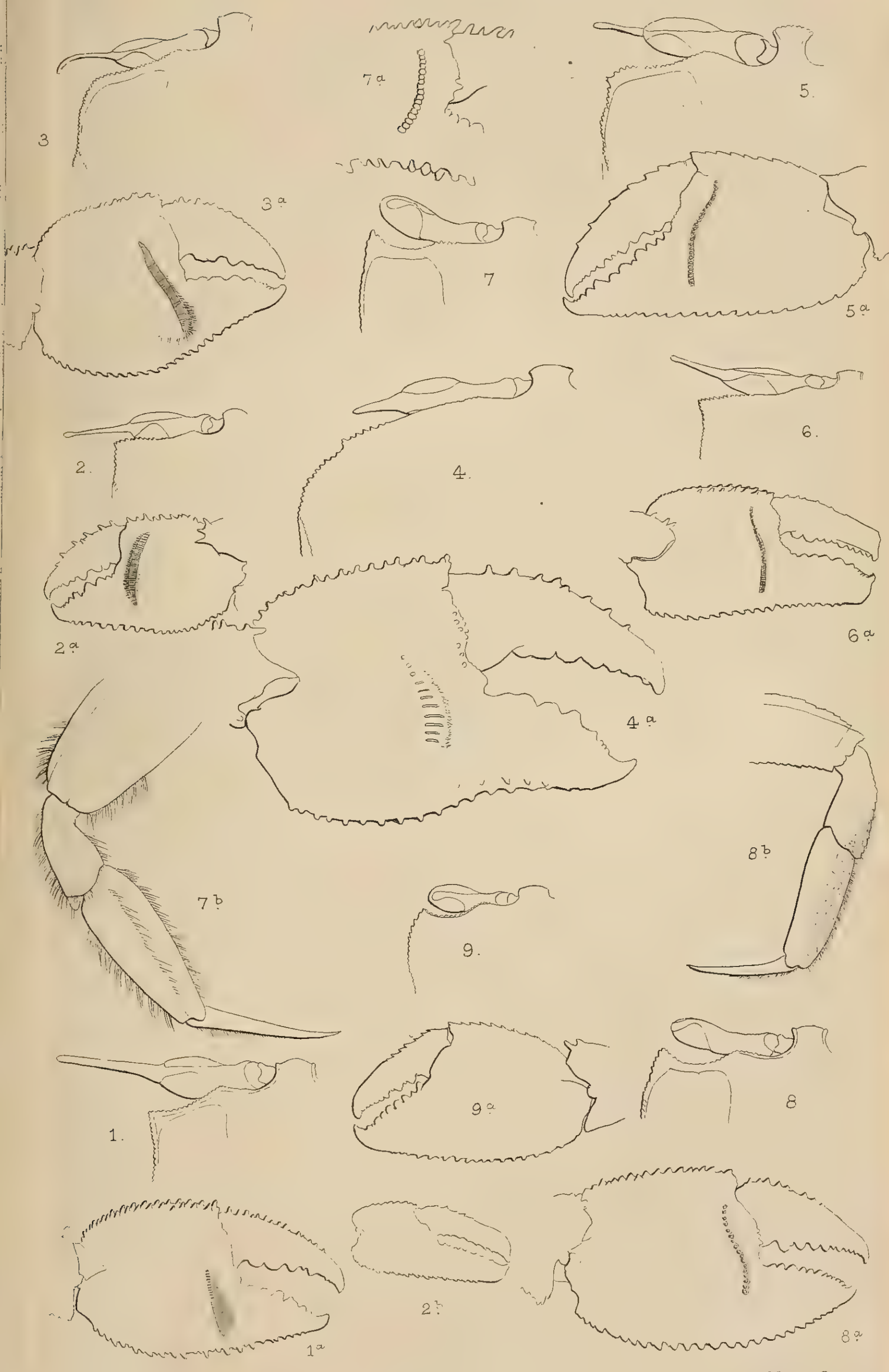

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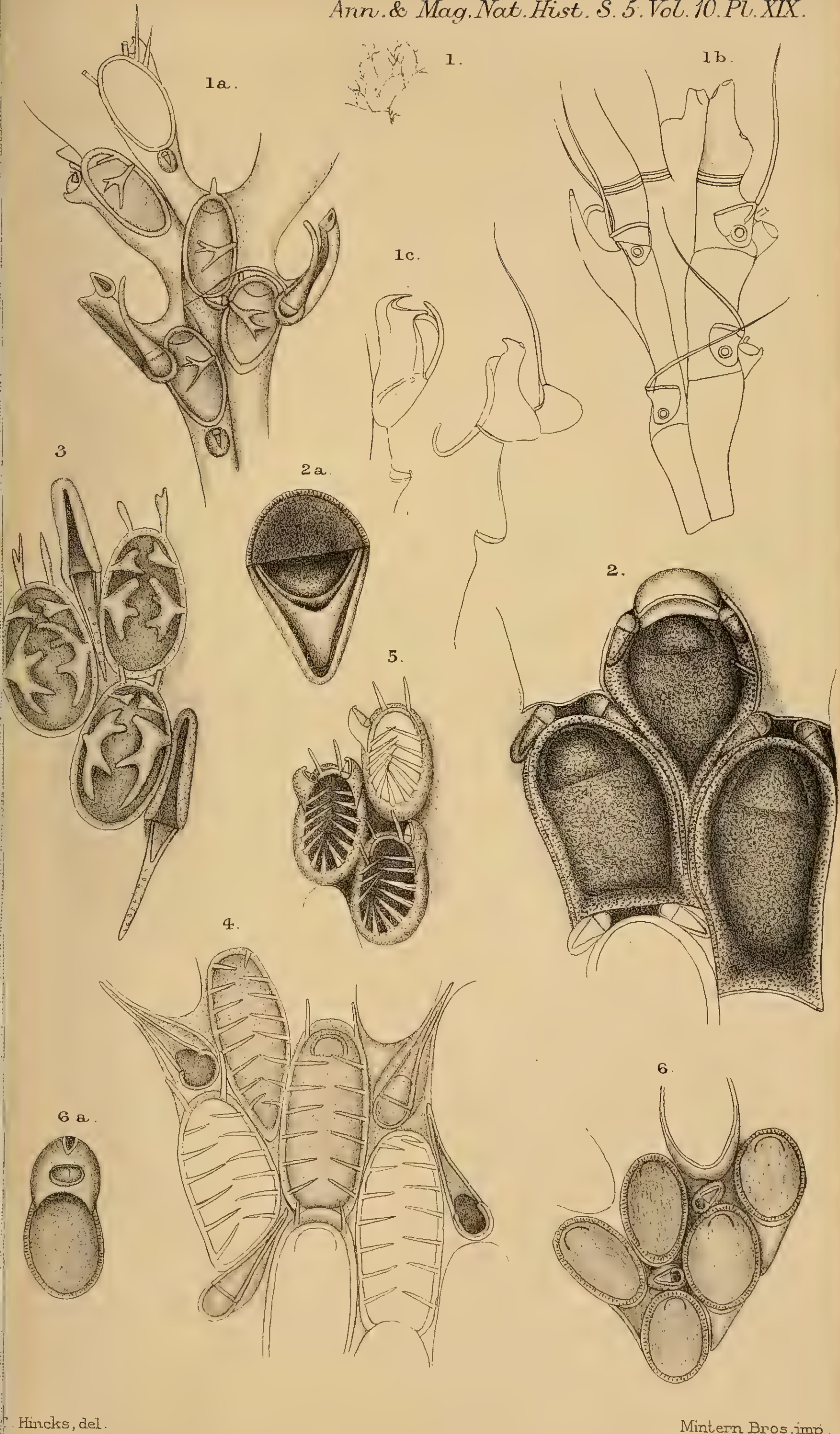

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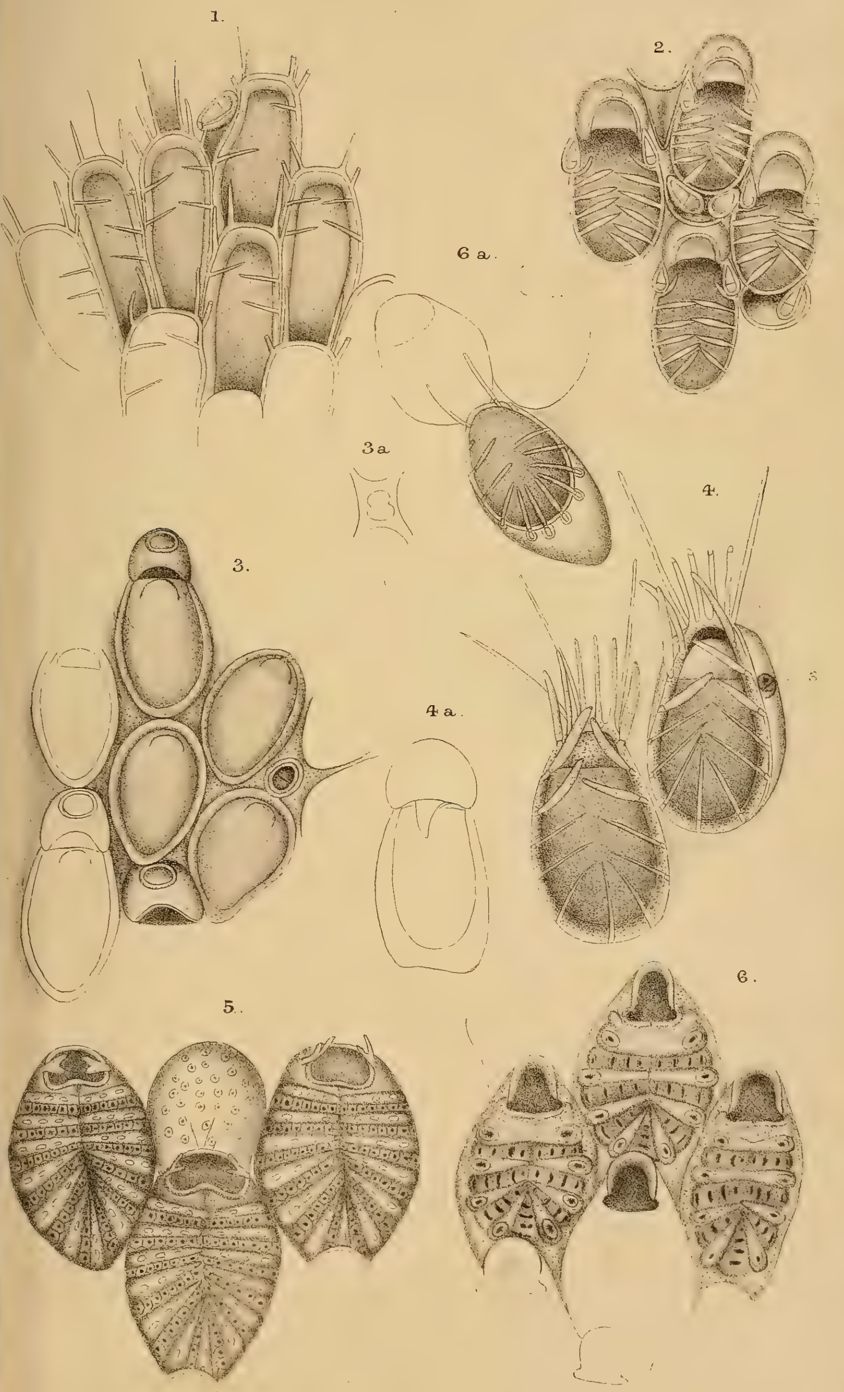

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