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

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

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

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

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH 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. 1. JANUARY 1888.

I.—*On the Structure and Affinities of the Genus* Parkeria, *Carp.* By H. Alleyne Nicholson, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen.

[Plate III.]

The genus *Parkeria* was originally described by Dr. W. B. Carpenter (Phil. Trans. vol. clix. p. 721, 1870), and was regarded by this eminent authority as belonging to the arenaceous Foraminifera. At a later date the structure of the genus was investigated by Mr. Carter (Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 208, 1876, and vol. xix. p. 55, 1877), who came to the conclusion that the skeleton was not arenaceous in its composition, and that the genus was properly referable to the Hydractiniidæ. Mr. Carter's views have, in the main, been accepted by subsequent writers, such as Steinmann ('Palæontographica,' 1878, p. 118) and Zittel ('Handbuch der Palæontologie,' Bd. i. p. 283, 1879).

The purpose of the present communication is not so much that of entering into a critical examination of the views of previous observers as of recording the results of an entirely independent investigation into the structure of *Parkeria*. The observations and conclusions of both Dr. Carpenter and

Mr. Carter were based essentially upon specimens of *Parkeria* in one state of preservation, viz. specimens in which the chambers are non-infiltrated and the skeleton largely composed of phosphate of lime. The beautiful illustrations which accompany Dr. Carpenter's memoir were similarly derived mainly from specimens in the above condition of mineralization. This condition was regarded by Dr. Carpenter as being the one most nearly representing the original constitution of the fossil, whereas Mr. Carter recognized that it was secondary and the result of changes produced during the process of fossilization or at some subsequent period. The correctness of Mr. Carter's conclusion on this point does not, in my opinion, admit of reasonable doubt; and I propose in what follows to briefly describe the structure of *Parkeria* as exhibited by what I regard as normal examples of the genus, viz. examples in which the skeleton is composed of non-crystalline carbonate of lime and the chambers are infiltrated with calcite. Specimens in this condition of preservation are by no means uncommon; the phenomena which they present differ in no respect from those shown by similarly preserved examples of other calcareous fossils, such as corals, Polyzoa, Stromatoporoids, &c.; and their internal structure is so admirably preserved that they can be readily studied by means of thin sections. For much of the material with which I have worked I am indebted to the generosity of my friend Prof. T. M'Kenny Hughes, who was good enough to present to me a large series of specimens in all states of preservation. I have also to express my gratitude to Dr. P. Herbert Carpenter, who furnished me with the opportunity of examining the beautiful and instructive series of preparations of *Parkeria* upon which Dr. W. B. Carpenter had based his original memoir. Lastly, I have to thank Dr. John Millar for the free use of a large and interesting series of thin sections of *Parkeria*. My observations, however, are in the main founded upon an extensive series of slides which I have prepared myself.

1. *General Form and Mode of Growth.*

The ordinary form of *Parkeria* (*P. sphærica*) presents itself, as is well known, in the shape of spherical bodies, which vary in diameter from less than half an inch to about two inches. The surface in unworn specimens exhibits rounded or elongated elevations, separated by intervening depressions, or, in other instances, may present an alveolar or honeycombed aspect. Rough fractures show that the skeleton is composed of numerous cylindrical columns ("radial pillars"), which pass in a radiating manner from the centre to the circumference of the fossil, and are united at more or less regular intervals by imperfect concentric layers, which are separated from one another by concentrically disposed interspaces ("chamberlets").

As regards the mode of growth, most specimens must have been entirely free in the adult condition, since the entire surface is covered equally with the ends of the radial columns. Some examples, however, are pierced by a central cylindrical canal, as if they had grown upon some such body as the stalk of a Crinoid, which had been subsequently dissolved out. In other cases there is a similar central canal, but this does not extend more than halfway through the fossil. A similar complete or incomplete central perforation is common in the genus *Porosphæra*, Steinm., though my examination of this latter genus would lead me to conclude that it is in no way related to *Parkeria*. In most of the examples of *Parkeria* which I have examined, I have been unable to detect in the centre of the fossil any foreign body round which the organism may have grown. In this respect most examples resemble the singular fossil which I have recently described as *Mitcheldeania gregaria*. In some cases, however, the innermost or primordial layer of *Parkeria* has unquestionably been attached to the exterior of a foreign body, which appears generally to have been the shell of a small Nautilus or Ammonite. I have figured (Pl. III. fig. 6) a vertical section across the centre of such a specimen, showing the chambered Cephalopod round which the *Parkeria* has grown in successive concentric layers. It does not appear to me to admit of doubt that the chambered "nucleus" ascribed to *Parkeria* by Dr. W. B. Carpenter is really a foreign body of the above nature.

2. *The Chemical Constitution of the Skeleton.*

If any large series of specimens of *Parkeria* be examined, it will be found that different examples present great differences as regards the mineral nature and composition of the skeleton. The following are the principal variations which may be recognized in this respect:—

(*a*) In a certain proportion of specimens the skeleton is composed of carbonate of lime and the chambers of the fossil are occupied by calcite or by an infilling of the matrix in which the fossil was originally imbedded. The skeleton-fibre in these specimens is not in the condition of ordinary calcite, but is composed of subcrystalline granules of carbonate of lime.

(*b*) In a second group of specimens the skeleton is more or less extensively composed of phosphate of lime, and the chambers of the fossil may be occupied, throughout or in part, by phosphatic infilling. The greater proportion of the specimens which I have examined are in this condition; but the extent to which the skeleton is phosphatic varies greatly. In some examples the chambers of the fossil are filled throughout with phosphatic material, and the whole skeleton seems to be more or less largely made up of phosphate of lime. Even in such specimens, however, a certain amount of carbonate of lime is present in the skeleton, since the application of a drop of acid to a thin section of an apparently altogether phosphatic specimen is followed by an evolution of carbon dioxide. In most of the specimens belonging to this group, however, it is only *part* of the skeleton which is in the condition of phosphate of lime, and the remainder is in the condition of carbonate of lime. In such specimens it is invariably the *outer* portion of the specimen, for a zone of greater or less depth, which is phosphatic and has its chambers filled with phosphatic material, while the *inner* or central part of the specimen is composed of carbonate of lime and has its chambers filled with calcite.

(*c*) In a third group of specimens the skeleton is more or less largely composed of phosphate of lime and the central portion of the fossil, or the whole of it, has its chambers empty and non-infiltrated.

(*d*) In a fourth group of specimens the chambers of the fossil are infiltrated with silica. I have never seen an example in this condition of preservation; but such a specimen is stated by Dr. W. B. Carpenter to exist in the Museum of Practical Geology in Jermyn Street. The condition must, however, be one of great rarity.

The question now arises, What was the original composition of the skeleton of *Parkeria?* Dr. W. B. Carpenter regarded the specimens of the third of the above-mentioned groups as those least altered from their original constitution. He therefore considered that the skeleton was composed of a small proportion of sand-grains cemented together by a mixture of phosphate and carbonate of lime. Mr. Carter, on the other hand, regarded the phosphatic condition of the skeleton as of secondary origin and as being due to mineralization subsequent to fossilization. He appears to think that the skeleton may have been originally chitinous in nature, and that the chitine may have been replaced during fossilization by calcspar, which in turn might be more or less largely replaced at a later stage by phosphate of lime. My own view is that the skeleton of *Parkeria* was composed originally of carbonate of lime, and that phosphatization, when it has occurred at all, has been the result of secondary processes which have operated subsequently to fossilization. The arguments for regarding the phosphatic condition of the skeleton as superinduced and not original may be briefly summed up as follows :—

1. The phosphatization of calcareous organisms is a well-known and readily intelligible phenomenon. Thus all kinds of calcareous fossils in phosphatic deposits (as in the Greensand near Cambridge) are liable to have their carbonate of lime more or less extensively replaced by phosphate of lime.

2. On the other hand, if we suppose an originally phosphatic organism to have its phosphate of lime replaced by carbonate of lime, then the latter mineral would certainly appear in the form of crystalline calcite. This is not the case, however, with the purely calcareous examples of *Parkeria*, the skeleton-fibre of which is composed of *granules* of carbonate of lime and not of definite *crystals*. Mr. Carter has described a specimen in which the skeleton-fibre is composed of calcspar; but I have never personally met with a similar example, and such a condition must be regarded as the result of some secondary change.

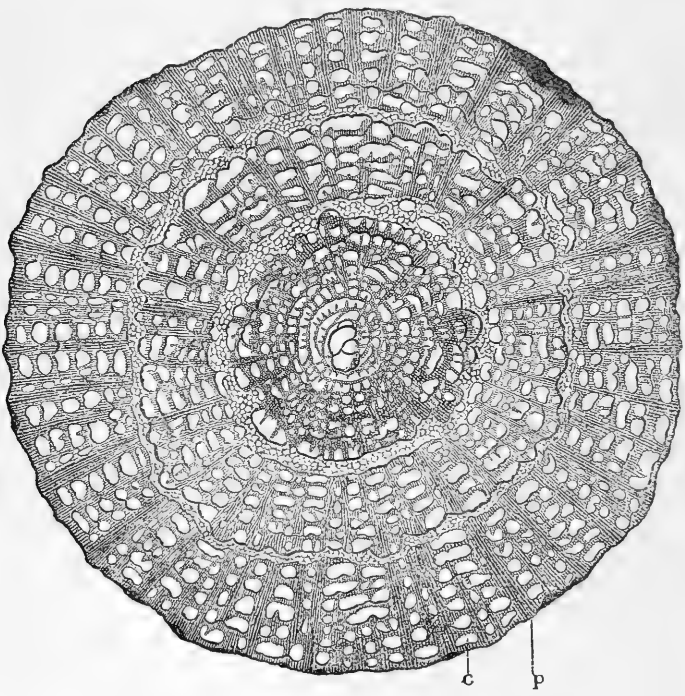
3. In all those specimens of *Parkeria* which are partly phosphatic while parts are in the condition of carbonate of lime, it is invariably the *exterior* parts—which, necessarily, are those most exposed to chemical actions originating *ab extra*—which are phosphatic, while the internal and central portions are those which are calcareous. Moreover, even in the most highly phosphatic portions of such specimens, effervescence is produced by weak acids, showing that the original carbonate of lime has not been wholly removed or replaced.

4. Thin sections of phosphatized specimens, or of the phosphatized parts of a specimen, show a more or less imperfect preservation of the minute structure of the skeleton. On the other hand, in specimens in which the skeleton is composed wholly of carbonate of lime the minute structure is exquisitely preserved.

Upon the whole, then, I cannot doubt that the skeleton of *Parkeria*, like that of the Stromatoporoids, was originally composed of carbonate of lime. The granules which compose the skeleton-fibre are not, however, infinitesimally minute, but are, on the contrary, of considerable size and of a subcrystalline character. A closely similar composition of the skeleton out of large subcrystalline granules is seen in *Hydractinia circumvestiens*, S. V. Wood, and, very conspicuously, in certain recent species of *Allopora.* In the phosphatized specimens of *Parkeria* the original granules of carbonate of lime have been replaced by granules of phosphate of lime; and if the specimen is non-infiltrated, *i. e.* has its chambers empty, the skeleton-fibre then assumes a peculiar "sandy" aspect. I have, however, failed to find in decalcified sections of any of the specimens which I have examined any sand-grains properly so-called; and I am therefore led to conclude that they did not exist, since it cannot be supposed that grains of quartz should have been replaced during fossilization by grains of phosphate or carbonate of lime.

3. *Minute Structure of the Skeleton.*

The skeleton of *Parkeria* consists of radiating columns ("radial pillars"), united by concentrically disposed lamellæ,



Vertical section across the centre of a specimen of *Parkeria*, enlarged twice. *p*, one of the radial pillars; *c*, one of the chamberlets.

which are separated by interspaces broken up into irregular "chamberlets" (see woodcut). One of the most remarkable points about *Parkeria* is the structure of the tissue which composes the radial pillars and concentric lamellæ. The nature of this tissue can be admirably studied in thin sections of calcareous examples of *Parkeria* (Pl. III. figs. 1–4), which show that it is composed of innumerable, minute, cylindrical or polygonal tubuli, which have a radial disposition and are united to one another by their walls. The walls of the tubuli are porous, thus allowing of a free communication between the cavities of adjacent tubuli. Vertical sections (Pl. III. figs. 2 and 4) show that the tubuli are vertical to the surface in the axes of the radial pillars, but that they become oblique to the surface as they proceed upwards. Hence each individual tubule has a proportionately short vertical course, beginning in the axis of the pillar and then gradually bending outwards so as to open obliquely on the circumference of the pillar. In cross sections of the pillars (Pl. III. figs. 1 and 3) the tubuli in the centre of the pillars are cut at right angles to their course and therefore present themselves as a polygonal network, like that of a Monticuliporoid. On the other hand, the tubuli in the peripheral portions of a cross section through a pillar are necessarily cut more or less obliquely, and their mouths are shown at the actual circumference of such a section. In the concentric lamellæ which connect contiguous pillars the tubuli are necessarily short; they originate from the calcareous membrane which forms the inferior surface of the lamella, and they open by minute apertures superiorly either into the cavities of the "chamberlets" or, in the case of the last-formed lamella, upon the outer surface of the cœnosteum.

The diameter of the tubuli composing the general cancellated tissue of *Parkeria* is about $\frac{1}{20}$ millim. The tubuli exhibit nothing of the nature of radiating septa, nor do they possess any "tabulæ" or transverse internal partitions. Owing to the fact that the tubuli are slightly flexuous, and owing also to their very minute size, longitudinal sections rarely divide a tubule in a single plane, but pass from side to side of its middle line, allowing the porous wall of the tubule to be seen at intervals, or here and there actually cutting the wall. Hence in longitudinal sections (Pl. III. figs. 2 and 4) there is often an appearance of tabulæ; but this appearance is due to the cause just mentioned. In the same way, sections which cut the tubules obliquely give the appearance not of proper tubes, but of rows of elongated polygonal cells. The general cancellated tissue of *Parkeria* may be regarded as cœnosarcal in its origin, and it may be compared with the canaliculated cœnosarcal tissue of *Distichopora*, *Allopora*, *Pliobothrus*, &c., or with the clathrate cœnosarcal tissue of the Hydractiniidæ.

While the main mass of the skeleton of *Parkeria* is composed of the finely tubulated tissue above described, a coarser kind of cancellated tissue is commonly developed at particular points in the skeleton. The tissue in question (Pl. III. fig. 5) consists of wide, irregular, intercommunicating tubuli or elongated cells, united by a coarse reticulated tissue; and it is usually developed periodically in thin concentric layers, which separate thick strata of the ordinary skeletal tissue (see woodcut, p. 6). In small specimens it may not be developed at all, or there may be only a single external layer of it; but in large specimens there may be two or three successive layers in a section passing from the centre to the circumference. Sometimes also a similar tissue may occupy parts of the centre of a radial pillar. I am disposed to connect the periodic production of this coarse trabecular tissue, with its large vesicles, with the periodic development of reproductive zoöids, and to compare it with the periodic production of "ampullæ" in the Stylasterids.

4. *The Zoöidal Tubes.*

Traversing the general tubulated tissue of the radial pillars in *Parkeria* we find a larger or smaller number of comparatively wide circular or oval tubes, which have an average diameter of about $\frac{3}{20}$ of a millimetre. Owing to their being slightly oblique instead of accurately vertical to the surface, and owing also to the shortness of each individual tube, these structures are often badly exhibited in longitudinal sections of *Parkeria*. On the other hand, they are regularly and easily recognizable in tangential sections of the cœnosteum (Pl. III. figs. 1 and 3, *t*). These wide tubes vary in number in different specimens, but they are invariably present. They have no radiating septa, nor, so far as I have seen, transverse tabulæ. They open by rounded apertures upon the surface of the fossil or into the chamberlets—each successive concentric row of chamberlets having at one time formed the surface of the cœnosteum. I regard these large tubes as having contained zoöids, and as corresponding therefore to the gastropores and dactylopores of the Hydrocorallines.

5. *The Chamberlets and Concentric Lamellæ.*

The first-formed layer of *Parkeria* has the form of a thin calcareous membrane, which was probably always at first attached by its lower surface to some foreign body, such as a fragment of shell, though this latter seems to have been commonly absorbed in process of growth. The upper or free surface of the primordial lamina supports a layer of the characteristic tubulated tissue of *Parkeria*, which is prolonged upwards at small intervals into long pointed spines. This condition can be studied in vertical sections traversing the centre of the skeleton, and at this stage of its existence the organism must have presented a close resemblance to the crust of *Hydractinia echinata*, allowing for the fact that the cœnosteum is calcareous and not horny. In the further progress of growth the spines or primordial radial pillars throw out from their summits lateral outgrowths, which coalesce with one another more or less completely, and thus give rise to a second lamina, separated from the original one by an intervening space. This second lamina agrees with the first in having a calcareous membrane below and in being composed of tubulated tissue prolonged upwards into spines, which are mostly radial continuations of the primitive spines. The interspace between the first and second lamina is necessarily crossed by the primitive radial pillars, and hence appears in section as if broken up into separate "chamberlets" (Pl. III. fig. 6). As development proceeds the spines of the second series produce again a third lamella, thus giving rise to a second series of chamberlets; and so the process goes on till the organism has attained its full growth. The later lamellæ are generally thicker than the earlier ones and the rows of chamberlets proportionately more contracted (woodcut, p. 6); but there is no reason to think that the former are produced in any way differently from the earlier ones. After a certain number of lamellæ, with their corresponding rows of chamberlets, have been formed, it is common to find that a thin concentric layer of coarse cancellated tissue is produced, this possibly representing, as before suggested, a stage in the life of the organism in which reproductive zoöids were developed. Then the ordinary lamellæ and spines are again formed, and we have a new series of concentric lamellæ and chamberlets. It is also not uncommon to find that growth is at first unilateral, the first two or three lamellæ being on one side only of the primordial crust, while the later lamellæ form complete concentric envelopes round the first-formed portion of the organism. It follows from the above account of the mode of development of the skeleton in *Parkeria* that each successive tier of chamberlets necessarily represents what was at one time the *surface* of the organism.

Bearing the above in mind, it is easy to understand the phenomena presented by sections of *Parkeria* vertical to the surface (woodcut, p. 6, and Pl. III. figs. 2 and 4). All such sections exhibit the radial pillars, the concentric lamellæ, and the concentric rows of chamberlets; and there is no difficulty in the recognition of the nature and mode of origin of these structures, if the plane of the sections corresponds accurately with the direction of the radial pillars. Sections tangential to the surface are not quite so easy of interpretation, though they present no special difficulties. Such sections differ according as the plane of the section corresponds with that of one of the concentric lamellæ or with a row of chamberlets. As the lamellæ are curved, an ordinary tangential section (Pl. III. figs. 1 and 3) passes partly through one of the concentric lamellæ and partly through a tier of chamberlets. Hence such a section usually shows more or less clearly the cut ends of the radial pillars (*p*) connected by a reticulated tissue representing the transversely divided tubuli of the concentric lamellæ. Here and there we also see irregular spaces (*c*), which represent the chamberlets opened from above. In places where the section corresponds with a row of chamberlets, we see simply the cut ends of the radial pillars. In either case, tangential sections clearly exhibit the transversely-divided zoöidal tubes (*t*).

6. *Relation to Recent Organisms.*

With regard to the systematic position of *Parkeria*, there can be little hesitation, in the light of our present knowledge, in accepting Mr. Carter's reference of the genus to the Hydrozoa. All the known facts as to the chemical constitution, mode of growth, and general structure of the cœnosteum, no less than the minute structure of the skeleton-fibre, point unequivocally in this direction. With regard to the precise place which *Parkeria* should occupy in the series of the Hydrozoa, it may be regarded as intermediate between the Hydrocorallines and the Hydractiniidæ, but with nearer relationships to the latter than to the former. In the minute structure of the skeletal tissue *Parkeria* most closely resembles the Hydrocorallines; but in the general arrangement of its parts, and more particularly in its mode of growth by the production of successive concentric lamellæ separated by rows of chamberlets, it approaches most nearly to the Hydractiniidæ, with which group the genus may in the meanwhile be ranked.

7. *Relations to Extinct Organisms.*

There are various extinct organisms which have, or have been supposed to have, relationships with *Parkeria* which may be briefly glanced at here. Foremost amongst these may be placed the singular spheroidal fossils from the Triassic rocks of Kashmir, which Prof. P. Martin Duncan described under the family name of the Syringosphæridæ ('Scientific Results of the Second Yarkand Mission,' 1879). By the great kindness of Mr. Medlicott, the Director of the Geological Survey of India, and of Dr. Henry Woodward, I have been supplied with specimens of *Syringosphæra*, of which I have made a careful examination by means of thin sections. In their general aspect the fossils of the genus *Syringosphæra* present an exceedingly close resemblance to *Parkeria*, with which they also agree in the possession of a tubulated cœnosteal tissue. On the other hand, the cœnosteum in *Syringosphæra* does not increase by the formation of successive concentric lamellæ with intervening rows of chamberlets, and I have been able to demonstrate the presence of well-marked zoöidal tubes ("gastropores") occupied by reticulate styles or columellæ. I shall be able, in fact, to show that the genus *Syringosphæra*, Duncan, is referable to the Hydrocorallines and is nearly related to the recent genera *Allopora* and *Sporadopora*; but I need not enter further into this point on the present occasion, as I purpose treating of the genus more fully in a separate memoir.

The genus *Porosphæra*, Steinmann, was referred by its author ('Palæontographica,' N. F. Bd. iii.) to the Hydrozoa, and was looked upon as related to *Parkeria*, a view which had previously been put forward by Mr. Carter (Ann. & Mag. Nat. Hist. 1877). I have prepared and examined a number of thin sections of *Porosphæra globularis*, Phill. sp., from the White Chalk of Britain, and do not feel able to coincide in the above view. Without expressing any dogmatic opinion on the subject, I am disposed to think that *Porosphæra* will be found to be truly referable to the group of the Lithistid sponges, and to be related to the genus *Hindia*, Dunc. It is, at any rate, certain that the genus has no special relationship with *Parkeria*, and the minute structure of its skeleton does not resemble that of any Hydrozoön with which I am acquainted. *Bradya tergestina* of Stache is unknown to me, and I am unable to express any opinion as to its affinities.

The genus *Loftusia*, H. B. Brady (Phil. Trans. 1869), has been regarded by Steinmann, Carter, and others as likewise referable to the Hydrozoa, and as more or less nearly related to *Parkeria.* I have only had the opportunity of studying *Loftusia* through the medium of thin sections; but I am quite satisfied that its resemblances to *Parkeria* are superficial, and are not indicative of any real affinity. I do not recognize in the structure of *Loftusia* any thing distinctively Hydrozoal, whilst it possesses structural features, apart from its spiral mode of growth, that are strongly Foraminiferal. Upon the whole, therefore, the present evidence seems to me to fully warrant Mr. Brady's reference of the genus *Loftusia* to the arenaceous Foraminifera.

The curious spheroidal fossils which constitute the genus *Mitcheldeania*, Wethered, present some striking resemblances to *Parkeria.* The minute structure of the skeleton of the former is, however, in essential respects different from that of the latter, while the chamberlets which are so characteristic of *Parkeria* are wanting in *Mitcheldeania.* As I have, however, treated fully of the structure of the genus *Mitcheldeania* in another communication (Geol. Mag., Jan. 1888), I need not enter here into a further consideration of its characters and relationships.

Lastly, there are unquestionable points of resemblance, as well as marked points of difference, between *Parkeria* and the great Hydrozoal group of the Stromatoporoids. No Stromatoporoid, however, possesses the peculiar tubulated cœnosteal tissue of *Parkeria.* The nearest approach to this is seen in the genera *Stromatopora*, Goldf., *Stromatoporella*, Nich., and *Parallelopora*, Barg.; but the skeleton-fibre in these genera is vesicular rather than tubulated, and the general structure of the skeleton is fundamentally different from that of *Parkeria.* The genus *Labechia*, E. & H., which might in some points be compared with *Parkeria*, is even more widely removed from it than are the above genera as regards the internal structure of the skeleton.

EXPLANATION OF PLATE III.

Fig. 1. Tangential section of *Parkeria sphærica*, enlarged about ten times. *p*, one of the radial pillars transversely divided; *t*, one of the zoöidal tubes; *c*, one of the chamberlets.

Fig. 2. Vertical section of the same, similarly enlarged. *p*, one of the radial pillars; *c*, one of the chamberlets; *l*, calcareous lamina supporting one of the concentric lamellæ.

Fig. 3. Tangential section of *Parkeria*, enlarged about twenty times; the letters as before.

Fig. 4. Vertical section of the same, similarly enlarged; letters as before.

Fig. 5. Tangential section through one of the periodically-formed layers of coarse cancellated tissue, enlarged about twenty times.

Fig. 6. Central portion of a vertical median section of a specimen of *Parkeria* growing upon a chambered Cephalopod, enlarged about ten times.

II.—*Notes on some Australian Polyzoa.* By T. Whitelegge *.

In the British Museum Catalogue of Marine Polyzoa, part ii. (1854), the late Mr. Busk, F.R.S., described two species of Polyzoa from the Philippine Islands, which he referred to the genus *Lunulites*, at the same time remarking that they were "curious forms and would appear to constitute a peculiar group." In the years 1879, 1880, and 1881 the Rev. J. E. Tenison-Woods, Mr. W. A. Haswell, and the Rev. T. Hincks published papers describing several species which are closely allied to those described by Mr. Busk. The various species have been assigned to four or five genera. I intend in this paper to show that the undermentioned species form a very distinct group, having little in common with those with which they have usually been associated except habit or form :—

Lunulites philippinensis, Busk.
—— *cancellata*, Busk.
Cupularia crassa, Tenison-Woods.
Conescharellina depressa, Haswell.
Lunulites angulopora, Tenison-Woods.
Conescharellina conica, Haswell.
Lunulites incisa, Hincks.
Eschara umbonata, Haswell.
Flabellopora elegans?, d'Orb.

Mr. A. W. Waters, in a paper "On some Fossil Polyzoa from New Zealand" (Quart. Journ. Geol. Soc. Feb. 1887, p. 71), states that he had received from New South Wales recent specimens of the last-named species, "which is either *Lunulites cancellata*, Busk, or very closely allied to it."

The published descriptions and figures show that the species in the above list have not as yet been fairly understood, nor has the operculum-bearing aperture or the very exceptional method of growth been fully described. Nearly all the figures representing zoœcial characters are the wrong side up, whilst the peristomial orifice has been described as the true oral aperture, and a special pore situated above the mouth has been mistaken for the sinus in the lower lip.

Mr. Woods figures the oral aperture in *Cupularia crassa*,

* From vol. ii. (2nd series) of the 'Proceedings of the Linnean Society of New South Wales' (June 29th, 1887). Communicated by the Author.

but he omits to mention details in his description. Mr. Waters (Quart. Journ. Geol. Soc. 1882) gives figures of *Lunulites cancellata* in which the oral aperture is shown, but these are also the wrong side up, and in his description he simply refers to it as a secondary orifice with a proximal sinus. It is in my opinion clear that he did not at the time recognize the true significance of this "secondary orifice." Another prominent feature which is figured by Mr. Woods and well described by Mr. Haswell as "a narrow semilunar slit with the concavity directed outwards" has in most cases been overlooked and its true import hitherto unnoticed.

The facts as to the actual structure of the species already mentioned have been derived from an attentive study of specimens in the collection of the Australian Museum, Mr. Woods's types in the Macleay Museum, and some lent to me by Mr. J. Brazier.

The structural features presented by the various species of this group are of such an exceptional character that it will be necessary to remove them altogether from the family Selenariadæ, in which most of the species have been placed. In fact they appear to possess characters which are either unknown or rarely found in other species of Polyzoa; and possibly when they have been fully investigated they may form the nucleus of a new family.

The method of growth (not habit or form) or increase in size of the zoarium by the addition of new zoœcia is intercalary, taking place on the surface between cells already formed, and not at the outer margin, as in most other known Polyzoa. The only instances of intercalary growth, so far as I have been able to ascertain, are recorded by Mr. Hincks; but in these cases it is confined to the ovicelligerous cells of *Schizoporella hyalina* and *S. linearis*.

The formation of new zoœcia does not appear to be confined to any particular part, but may take place at any point between the centre and the margin; when near the latter the zoœcium is formed in the space intervening between two, and when nearest to the former in the intervening space bounded by four zoœcia. The direction of the zoœcia is also apparently reversed, from the fact that the free distal edge of the operculum is nearest to and directed towards the apex in those of a conical form, and to the apparent base in those which are flattened, while the hinged or proximal end is nearest to the outer margin of the zoarium.

The manner in which the peristomial orifice is formed appears to be just the opposite to what obtains in other peristomiate Polyzoa, and there is a special feature of an important character which, if not new to the class, is exceedingly rare, and so far I have searched in vain for the record of a similar structural element.

The first indication of the formation of a new zoœcium appears on the upper surface of the zoarium as an elevated or depressed round spot bordered on one side by a thin layer of epitheca. At this point the "semilunar slit with the concavity directed outwards" is formed, and by the gradual extension of this slit to a circular form a piece of the calcareous lamina is cut out, the resulting opening being that of the peristome, and at a short distance below the true oral aperture is seen to be also in a fully formed condition. It is the rule to speak of the operculum-bearing aperture as the primary and of the peristomial as the secondary orifice; but in this case it appears doubtful which ought to rank as primary or secondary.

In a median line above the mouth, close to or upon the margin of the peristome, there is a circular or subcircular pore usually covered by a membrane. It is this pore, when in an imperfect or broken state, that has been mistaken for the proximal sinus in the lower lip of the oral aperture; but the true oral sinus is much wider and at the opposite end of the mouth to that of the pore.

The shape of the oral aperture generally approaches that of *Cellepora eatonensis* as figured by Busk in the 'Challenger' Polyzoa, pl. xxix. fig. 5 *b*; but the sinus varies in width so much that in some cases the aperture might be described as oval, with two lateral denticles at the base.

It is evident that the seven species already enumerated are closely allied to each other and can no longer remain in the various genera to which they have been referred. They do not belong either to the genus *Lunulites* or to *Cupularia*, and the genus *Conescharellina*, as at present defined, would not admit them; the same may also be said of *Flabellopora*. Mr. A. W. Waters, in referring to *Lunulites incisa*, H., says it "is a species of the Schizoporellidæ." Nevertheless, to whatever family they may ultimately prove to be related, at present I venture to make a new genus for their reception.

Bipora, n. g.

Zoarium uni- or bilaminate, conical, or forming lobate or flabellate expansions; growth intercalary; zoœcia immersed, erect, side by side, with their bases resting on a cancellated lamina, forming alternating rows directed to the primary part of the zoarium; oral aperture with a well-marked sinus in the lower lip. A special pore above the mouth; peristomial orifice formed by the gradual extension of a narrow slit and the removal of a portion of the calcareous lamina. Oœcia external, globose.

1. *Bipora cancellata* (Busk).

Lunulites cancellata, Busk, Brit. Mus. Cat. Polyz. 1854, part ii. p. 101, pl. cxiii. figs. 4–7.

Zoarium conical, plane or slightly convex beneath; zoœcial apertures rounded above, with a distinct sinus below; peristome elevated above, depressed below, with a circular pore on its upper border; an avicularium on each side of the mouth, with a subcircular mandibular space.

I have examined several fossil examples of this species which appear to agree with Busk's description and figures, and which may be identical with the form figured as *L. cancellata*, Busk, by Mr. Waters in his paper on fossil Bryozoa from Bairnsdale; but both in this species and in the next the identity can only be definitely settled by comparison with the types.

Loc. Living: Philippine Islands; fossil: Muddy Creek, Victoria.

2. *Bipora philippinensis* (Busk).

Lunulites philippinensis, Busk, *op. cit.* part ii. p. 101, pl. cxiii. figs. 1–3.

Zoarium depressed, conical, plane or concave beneath, usually about $\frac{1}{8}$ of an inch in diameter; zoœcial orifice elongate, rounded above, and with a wide rounded sinus below; operculum oval; peristomial orifice ovate, the margin produced above at the sides, then suddenly depressed below, with a subcircular pore on the upper border; an avicularium with a subcircular mandible on each side, and sometimes one in front below the mouth, a number of similar avicularia on the under surface of the zoarium, some on rounded elevations, and others in circular depressions. Oœcia external, globose, smooth, with a faint fimbriated stigma in front.

Loc. Port Jackson.

This species is frequently to be met with in some parts of Port Jackson, and I have examined a fair number of specimens. The surface of the zoarium is covered with a thin yellowish epitheca; and the semilunar slits which indicate the growth of new zoœcia are to be seen in all stages of development, especially in the young. It is by a careful examination of this species that I have been enabled to work out the structure of the others. The zoarium, when seen in longitudinal section, shows the concave side as having a cancellated layer of varying thickness, from which the zoœcia take their origin; each zoœcium is narrowed at the base and very slightly bent inwards; its direction from this point is outwards, with a gentle curve upwards at nearly right angles to the cancellate layer.

When the zoœcia are seen in transverse section the outline of each zoœcium is irregularly pentagonal.

The anterior pore, when seen from within, appears as a flask-shaped projection on the cell-wall, and is about as long as the shorter diameter of the mouth; in some there appears to be an opening, and in others the base is well rounded, without any opening; it may possibly be the retreat of a protrusible sensitive organ, but in no case have I seen anything at the upper extremity which would indicate the presence of an external vibracular organ. The cancellate structure, which exists more or less in all the species, may originate by the lower portion of the zoœcia being continually partitioned off as the zoarium increases in size.

In some of the specimens lent by Mr. Brazier the oœcia are fairly abundant; but, except when the zoarium is broken into two halves or set on its edge, the orifice cannot be seen. From this fact it will be evident that they are in the usual position above the mouth and nearest to the primary part of the zoarium.

3. *Bipora depressa* (Haswell).

Conescharellina depressa, Hasw. Proc. Linn. Soc. N. S. W. 1880, part i. vol. v. p. 41, pl. iii. fig. 4.

Zoarium biconvex, slightly flattened beneath; oral aperture elongate, rounded above, with a sinus below, about half the diameter of the mouth; or ovate, with a subtriangular denticle on each side near the base. Operculum ovate, with a very slightly thickened border and two circular spots on the upper half; peristome much elevated above and on each side to below the mouth, then suddenly depressed; an avicularium with an elongate triangular mandible situated on a low elevation on one side of the mouth.

"Under surface of zoarium perforated by close-set circular pores, each occupied, either at the surface or at a varying depth, by a thin translucent covering perforated by several minute porules, usually with a rather larger one in the centre."

Loc. Port Denison.

I have only seen some five or six specimens of this species, all of which are immature, and probably when obtained in the adult state the zoarium will be found to be concave beneath. I have seen one specimen in which the base is concave; but it is too imperfect to be certain as to its identity. The figure given by Mr. Haswell is upside down, but the outlines of the peristomial orifices are correct. The outer row of zoœcia are very prominent and without avicularia.

4. *Bipora crassa* (Tenison-Woods).

Lunulites (Cupularia) crassa, Ten.-Woods, Trans. Phil. Soc. Adelaide, 1879–80, p. 5, pl. i. figs. 1 *a*, 1 *b*, 1 *c*.

I have examined the type specimens in the Macleay Museum, which resemble the last species in the peristomial characters, the margin being produced and very much thickened at the sides, hiding to a great extent the oral aperture, which lies in a depression below.

The avicularia, however, have a subcircular mandible, and the pore over the mouth is large. I have no doubt of its being a good species. Mr. Waters, when speaking of the plates which accompany Mr. Woods's paper, mentions the fact that the whole of the species figured are the wrong side up, which is certainly true of all the species except two; but even these were intended to represent the same aspect as the others. The figure of *B. crassa* is, after all, the right side up, and gives an accurate view of the oral aperture with the special pore above. It is also probably the first published figure which exhibits the form of the true operculum-bearing aperture.

I have no doubt Mr. Woods saw the important structural difference between this species and those belonging to the Selenariadæ.

Loc. Off Cape Three Points and Port Stephens (70 to 80 fathoms).

5. *Bipora angulopora* (Tenison-Woods).

Lunulites angulopora, Ten.-Woods, *op. cit.* p. 7, pl. i. figs. 3 *a*–3 *c*.
Conescharellina conica, Hasw. Proc. Linn. Soc. N. S. W. 1880, vol. v. part i. p. 42, pl. iii. figs. 7, 8.
Lunulites incisa, Hincks, Ann. & Mag. Nat. Hist. ser. 5, 1881, vol. viii. p. 127, pl. iv. figs. 1–3.

Zoarium conical, plane or slightly concave beneath; zoœcia in alternating rows, sometimes with an incomplete row of four or five cells near the base; oral aperture immersed, rounded above, and a sinus below which is about $\frac{1}{3}$ the diameter of the mouth; operculum ovate, constricted (?) near the base, with two circular spots on the upper half; peristome elevated on each side, depressed below the mouth; orifice ovate, with a pore on the upper margin; avicularia forming elevated rows between the zoœcial orifices; mandibles triangular, with an acute point; under surface of zoarium when perfect covered with a calcareous lamina, with a number of avicularia, some on elevations and others in circular depressions; on the summit of the zoarium there is usually a cluster of irregular avicularia bearing cells with long acute mandibles.

Loc. Holborn Island, Port Stephens, and Bass's Straits.

The question of priority in this species is, I think, in Mr. Woods's favour. His paper was read in September 1879, and would probably be published early in 1880. Mr. Haswell's was read in January 1880, and would probably be issued in April or March, while that of Mr. Hincks did not appear until August 1881.

The figures of the zoœcia given by Mr. Haswell and those also of Mr. Hincks are, I think, upside down, judging from the shading and the very narrow sinus shown, but which is really more like the pore above the mouth than the true oral sinus; the latter is in perfect specimens about $\frac{1}{3}$ the diameter of the mouth. The zoœcial apertures in Mr. Woods's figure are badly drawn; still it is the right side up, and shows a correct view of a "semilunar slit with the concavity directed outwards" and an avicularium below pointing downwards. It will be also interesting to note that it is on the elevated ridge which carries the avicularia; and, further, it shows the intercalary method of growth as well as the formation of an incomplete row of zoœcia. Altogether this figure gives the general features of what really takes place in the species.

The slit which indicates the formation of a new cell invariably has an avicularium below, with the mandible pointing downward at first; but as growth goes on this is usually forced to one side of the mouth, though occasionally it remains in front.

6. *Bipora umbonata* (Haswell).

Eschara umbonata, Haswell, *op. cit.* p. 41, pl. ii. figs. 5, 6.

Zoarium free, bilaminate, flat, simple or forming trilobate expansions; "surface ornamented with numerous rounded knobs of various sizes;" zoœcia immersed, directed towards (what appears to be the base) the primary part of the zoarium. Oral aperture rounded above, with a wide sinus below; peristomial orifice nearly round, margin slightly elevated, with a subcircular pore on the upper border; an avicularium on each side of the mouth, frequently a third one in front; mandible triangular, generally pointing upwards.

Loc. Holborn Island (20 fathoms).

There are three specimens in the collection of the Australian Museum, one a flat piece $\frac{1}{4}$ of an inch by $\frac{1}{8}$ of an inch, the other two have each three lobes; the central one in the larger specimen is $\frac{5}{16}$ from base to summit, and the lateral lobes $\frac{1}{8}$ of an inch in length, and nearly as wide; all the lobes taper a little outwards. The "semilunar slit" is not seen in any of the specimens, but the peristomial opening is, I believe, formed in the same manner as in the others; several of the zoœcial openings are closed by a calcareous plate, and have the appearance of young zoœcia; the plate is seen to be thinner at the margin; probably the slit-like opening is not formed.

Mr. Haswell's description of the mouth of this species clearly shows that it was the anterior pore which he mentions as the sinus in the lower lip. He says "mouth varying in form, the lower lip sometimes straight, sometimes with a small sinus, sometimes with a rounded central lobe." This exactly describes the appearance of the anterior oral pore in various stages of perfection. The peristomial orifice with the pore broken down closely resembles the figure given on pl. xlv. fig. 3, in Hincks's 'British Marine Polyzoa,' of *Schizoporella hyalina*; and it was only after repeated examination that I saw the true oral aperture, owing to a belief that the pore and the opening represented it. Although the true aperture is not deeply immersed, it is difficult to see at first on account of the peristome obstructing the view; but when once seen it presents a well-formed sinus in the lower lip at the opposite end of the mouth to that of the pore. It is from the apparent double character of the mouth that the name *Bipora* is given to the genus.

7. *Bipora* (?) *elegans.*

Flabellopora elegans, d'Orb., Waters, Quart. Journ. Geol. Soc. Feb. 1887, p. 71.

Zoarium free, bilaminate, flabelliform in large examples, $\frac{1}{2}$ an inch wide by $\frac{3}{8}$ of an inch deep, with a projecting nodule in the centre on the concave side; zoœcia wholly immersed, erect, side by side, their bases separated by a thin cancellated layer, forming alternate rows, and directed towards the projecting nodule; oral aperture rounded above, with a rather wide sinus below; peristome slightly higher above the mouth than below; orifice nearly round, with a median pore above, a depressed avicularium on each side, usually below the mouth, occasionally another in front; mandibles subcircular, pointing upwards and outwards, a number of irregular avicularian cells on the nodular projection similar to those on *B. angulopora.*

Loc. Port Jackson.

If this species should prove to be different (as I think it will) from the fossil form described by d'Orbigny as *Flabellopora elegans*, it can remain as *B. elegans*, Waters. D'Orbigny's figure (Paléont. Franç. Bryoz. tom. v. pl. 661) certainly resembles the recent form. The same may be said of *B. umbonata*, which comes nearest to d'Orbigny's species; if it were not for the elevated nodules, the last-named might pass for the fossil species. I have examined about nine specimens in all, two of them being less than $\frac{1}{8}$ of an inch in their greatest diameter, which, when placed on their convex edges and viewed from above, greatly resemble *B. angulopora*, and if a little less compressed might be mistaken for that species at first sight. The avicularian cells are present in both specimens on the nodular projection and the semilunar slits on various parts of the zoarium. The slits can be seen even in very old specimens scattered about on the surface. It is not difficult to trace the stages by which the conical form might be changed into the flabellate, and afterwards into the lobate form, which has probably taken place. If we imagine the internal cancellated layer to become less developed, accompanied by a gradual compression and the addition of a few more rows of zoœcia towards the outer margin, we can easily see that we should have a form like *B. elegans*, which is in reality only a flattened cone with the base widely extended, and in *B. umbonata* the flabellate form is changed into a lobate one by the non-development of a portion of the colony. So that the broad non-divided end of the last-named species and the nodular portion of the former correspond with the apex of the cone.

POSTSCRIPT.—Since the foregoing was written I have been fortunate in obtaining some living examples of *Bipora philippinensis* (Busk), which I have had under observation for three days. Nearly every specimen possesses a pair of tubular filaments inserted on each side of the zoarium, about midway between the margin and the summit on the upper surface; each tube is about ½ an inch long, and in some cases attached to the tubes of an annelid, and in others to fragments of shell. Some of the specimens have begun to form new attachment-tubes, which are about three times the height of the oœcia. Each tube is seen to be lined with a layer of sarcode similar to that seen in the growing offshoots in *Victorella pavida*, S. Kent, consisting of granular and fusiform bodies which form a kind of network. The tube appears to grow out of an avicularium either at the side or in front of the zoœcial orifice. After repeatedly counting the number of tentacles I find that they vary from thirteen to fifteen. The pore above the mouth is covered by a membrane, and the marginal row of zoœcia have the peristome produced below into an acute, triangular, hyaline point.

III.—*Description of two new Chamæleons from Nossi Bé, Madagascar.* By G. A. Boulenger.

[Plate II.]

Chamæleon Guentheri. (Pl. II. fig. 1, ♂; fig. 2, ♀.)

Casque elevated posteriorly, with strong, curved parietal crest; the distance between the commissure of the mouth and the extremity of the casque equals the distance between the end of the snout and the posterior border of the orbit; lateral crest strong and distinct all round the head, strongest and tubercular on the canthi rostrales; upper head-scales very unequal in size; the snout terminating in the male in a short, horizontal, bony process, broader than long, half as long as the diameter of the eye, concave above (like the frontal region, of which it is the continuation), and notched mesially; a mere indication of this rostral process in the female; casque angular posteriorly; no trace of occipital lobes. Body covered with moderate-sized granules intermixed with numerous slightly enlarged ones. A dorsal crest of large conical tubercles, stronger in the male than in the female; a strong ventral crest, interrupted from or subcontinuous with a less developed gular crest. No tarsal process. Tail longer than head and body. Uniform black.

	♂. millim.	♀. millim.
Total length	260	237
From end of snout to extremity of mandible	30	27
From end of snout to extremity of casque	41	33
Greatest width between lateral cranial crests	16	13
Depth of skull (mandible included)	27	21
Width of head	19	16
Body	95	80
Tibia	21	17
Tail	135	120

Several specimens, male, female, half-grown, and young.

Chamæleon Bœttgeri. (Pl. II. fig. 3.)

Casque scarcely elevated posteriorly; no well-marked crests; occiput convex, forehead concave; upper head-scales very unequal in size; a compressed, rounded, scaly dermal lobe on the end of the snout in both sexes, as in *C. nasutus*; the length of this appendage a little less than the diameter of the eye; a rather large occipital dermal lobe, not notched mesially. Back and sides with unequal-sized, small, flat granules; ventral granules equal; limbs with scattered, distinctly enlarged, round, flat tubercles; male with a dorsal crest of widely separated, isolated, soft spines; no gular nor ventral crest. No tarsal process. Tail a little longer than head and body. A blackish streak on each side of the head, passing through the eye; male with a light lateral band.

	♂. millim.	♀. millim.
Total length	110	94
Length of head	18	15
Rostral appendage	4	3
Width of head	8	7
Body	37	35
Tibia	8	7
Tail	55	47

Three specimens, two males and one female.

IV.—*On a rare American Newt,* Molge meridionalis, *Cope.* By G. A. Boulenger.

The Natural-History Museum has obtained from Mr. W. Taylor, of San Diego, Texas, three specimens of a newt noticed by Cope in 1880 (Bull. U. S. Nat. Mus. no. 17, p. 30) under the name of *Diemyctylus miniatus*, Raf., subsp. *meridionalis*, from south-western Texas and Matamoras, Mexico. A comparison with the numerous specimens of *Molge viridescens* (=*D. miniatus*) in the Museum convinces me that the southern form deserves to rank as a distinct species, to be called *Molge meridionalis.* One structural difference noticed by Cope is that the outer finger is more than half as long as the penultimate, while in *M. viridescens* it is less than half as long. To this character I have to add that the head is more depressed, broader, with the lores less vertical, in fact very similar to that of *M. alpestris.* The gular fold is strongly marked (absent or scarcely distinct in *M. viridescens*). The colour, in spirit, is olive above, with lighter marblings and small black spots; yellow inferiorly with round black spots, which are larger than in *M. viridescens.* The largest specimen, a female, measures 55 millim. from snout to cloaca.

Prof. Cope notices "that the presence of the temporal pits cannot be used as a definition of the genus *Diemyctylus*, since they are as often wanting as present." I find that these three large pits are present in all male and absent or very small in all female specimens I have examined. They are the openings to so many small pouches directed backwards, the coating of which is strongly glandular. What the object of these secretory organs is, is unknown, and may perhaps long remain so, judging by the analogous case of the femoral pores of lizards, the use of which is still unexplained. Considering that *M. viridescens* is as common in the Eastern and Central States as *M. vulgaris* in Northern and Central Europe, it is to be hoped that American zoologists will soon pay attention to this point.

V.—*On the Affinity of the North-American Lizard-Fauna.* By Prof. Angelo Heilprin.

The November number of the 'Annals and Magazine of Natural History' contains an article under the above heading in which Mr. Boulenger seeks to invalidate my conclusions as to the non-neotropical character of the North-American Lacertilian fauna, as set forth in my 'Geographical and Geological Distribution of Animals' and elsewhere. Mr. Boulenger quotes the following paragraph from the work above mentioned:—"M. Boulenger has recently attempted to show (Ann. & Mag. Nat. Hist. August 1885) that the North- and South-American Lacertilian faunas are, strictly speaking, one, the Neogean, a conclusion which is not borne out by the facts of distribution. The misconception arises from the incorporation of the tract lying south of the line indicated above [a line drawn from San Francisco to Galveston, in Texas] with the North-American faunal region proper, while in reality it is a transition-tract more nearly Neotropical in character than Nearctic."

"What the facts are," Mr. Boulenger then continues to say, "that do not bear out my conclusion the author omits to state, unless they be the presence of the 'Old-World genus of skinks, *Eumeces*,' and of the glass snake (*Ophisaurus*)."

The facts relating to the question in point are fully set forth in my paper on "The Value of the 'Nearctic' as one of the Primary Zoological Regions," published in the 'Proceedings of the Academy of Natural Sciences of Philadelphia' for 1882 (pp. 331, 332), to which reference is made in the preface of my work on distribution. An analysis of the families and species of the North-American Lacertilian fauna there given shows two facts very distinctly, which I have stated as follows:—1. The South-American (Neotropical) forms of Lacertilians—Teidæ, Iguanidæ, Anolidæ—stop *almost immediately* on the borders of the Nearctic region, sending but an extremely limited number of representatives beyond the Sonoran subregion [the transition-tract]; and 2. The *very great paucity* of Lacertilian forms in general throughout the great mass of the North-American continent. Excluding the Sonoran and Californian provinces, and the immediate border-line of the region, there would appear to be in all *but about twenty species* of Nearctic Saurians, *thirteen of which belong to the Old-World* genus *Eumeces*! The most widely diffused form of North-American *Eumeces*, moreover, is a Palæarctic species *! A further relationship with the Palæarctic fauna is maintained by *Ophisaurus*, the only New-World representative of the glass snakes.

The range of a few species has been extended since the above analysis was formulated; but the facts stand substantially as stated, and fully bear out the general conclusions of

* More recently separated as a distinct species by Boulenger.

the paper—that the North-American Lacertilian fauna proper is quite distinct from the South-American, and that a transition-fauna, leaning towards the Neotropical, exists on the border-land of the two realms. This transition-fauna is characterized by the large development of the Neotropical family Iguanidæ, whose representatives, however, belong *not to South-American genera*, but to genera (*Phrynosoma*, *Sceloporus*) whose species are almost exclusively restricted to the transition-tract in question and to a comparatively insignificant region lying immediately north and south of it. The number of species that transgress these boundaries is limited, although a very few go considerably beyond them. None of the species of *Sceloporus*, which, according to Boulenger's catalogue, numbers some twenty-five species, has a range extending south beyond Costa Rica, and of but few does the range extend beyond Mexico and Guatemala. Similarly, none of the species of *Phrynosoma*, of which there are enumerated some twelve species, penetrate beyond Mexico. Neither of these two genera, therefore, can be said to be Neotropical, nor can they any more be considered to be Nearctic (Holarctic), since the number of forms penetrating much beyond the transition-tract above referred to—transitional in other respects beyond what is indicated by the Lacertilian fauna alone—is extremely limited. The peculiar Iguanoid forms, then, are largely distinctive of the transition-tract, whose fauna they serve to characterize.

Removing this element from the North-American Lacertilian fauna, we have remaining only some twenty species, of which, as I have shown, thirteen belong to the genus *Eumeces*. Mr. Boulenger objects to *Eumeces* being considered an Old-World genus; but surely it is a genus largely developed in the Old World, and one that is practically excluded from the Neotropical fauna. In his most recent catalogue Boulenger recognizes some thirty-one species, of which thirteen belong to the United States, eight are Mexican, eight Eur-Asiatic, one African, and one insular (Bermudas). The range of no western species extends further south than Campeche. These being the facts, does not the genus *Eumeces* in the North-American fauna indicate a distinct relationship with the fauna of the Old World (Eur-Asiatic)? Surely it indicates no affinity with the South-American (Neotropical) fauna. Furthermore, the most broadly distributed North-American *Eumeces* (*E. fasciatus*) is a form most nearly related to an Asiatic species (*E. marginatus*, Japan), with which, indeed, it has generally been united. What, then, are the features which unite the North-American fauna with the South-

American? So far as I am aware these still remain to be discovered.

When, however, Mr. Boulenger asserts (*l. c.* p. 346) that "A list of the lizards of any northern district of the United States would equally well support my [Boulenger's] view," I can but say that this statement so far traverses beyond the facts that it can only be met with a most emphatic denial. In the whole of the United States east of a north and south line connecting the mouth of the Rio Grande with Canada, or over an area of approximately 1,500,000 square miles, there is scarcely a single lizard which has any Neotropical affinities whatever, and still less so in any northern section of this area.

In the fact that some four or five species of lizards, of a somewhat southern type (*Sceloporus*, *Phrynosoma*), range as far north as British Columbia there is about as much reason for uniting the North- and South-American Lacertilian faunas as there is for uniting the equivalent bird-faunas because along the same limited tract several species of humming-birds range deep into Canada (and Alaska!), or because a parrot and the scarlet tanager (&c.) are found in the eastern and southern United States. Similarly we might unite the northern and southern mammalian faunas on the equally obvious ground that the couguar, skunk, and bear range deep into South America, and, conversely, the peccary, opossum, &c. far into North America.

VI.—*Contributions to the Knowledge of the Reproduction of* Euglypha alveolata, *Duj.* By Dr. F. Blochmann *.

[Plate IV.]

In the glasses with mud from the two basins in the garden of the Schwetzinger Schloss, in which I formerly detected *Hæmatococcus Bütschlii*, the *Euglyphæ*, which were at first not very numerous, increased considerably. This induced me to seek for divisional stages, which also occurred in abundance. Mr. Schewiakoff undertook to submit the more delicate processes in the division, especially that of the nucleus, to a thorough investigation, and his memoir upon this subject will appear shortly. For my own part I made an observa-

* Translated by W. S. Dallas, F.L.S., from the 'Morphologisches Jahrbuch,' Band xiii. pp. 173–183 (1887).

tion upon this occasion which, when followed out, led to results which were of some interest, and these I describe in the following pages. They may in some respects serve as a supplement to Gruber's beautiful investigations *, by which the process of division in the shell-bearing freshwater Rhizopods was first thoroughly elucidated.

As is well known, the process of division runs as follows :— In an animal which has already formed the necessary shell-lamellæ in its interior the protoplasm is protruded from the orifice in the form of a small bud covered with shell-lamellæ. This flowing forth of the plasma continues until the mass outside the original shell, now covered with the new shell-lamellæ, has attained the same volume and the same shape as the original animal. During this process the nucleus also divides and one half of it passes into the newly produced individual, so that in this way *two* perfectly similar animals are produced, and these soon separate from each other to live as individual animals.

However, the separation of the animals thus produced does not always occur; but by no means unfrequently we may observe a very remarkable process, by which, while it is true that two shells and two nuclei are produced, only a single animal proceeds from such a division.

Thus after the division has taken place quite normally and the nucleus of the newly formed individual has occupied its ordinary position at the bottom of the new shell, the protoplasm is retracted out of the newly formed shell (Pl. IV. fig. 1), still, however, remaining attached to the bottom of the shell, so that from this point a comparatively thin cord stretches towards the aperture along the axis of the shell, passing about in the middle of the shell into a larger mass of plasma. The greater part of this cord appears quite hyaline, containing only extremely fine granules; this is caused by the position here of the nucleus (n^2), which has now become nearly cylindrical.

In the principal mass of the plasma, especially between the two orifices now pressed close together, active flow-phenomena are observable, just such as were also observed by Gruber during division. Upon continuing the observation it is seen that the cord in the new shell is drawn out into a thin thread, while the nucleus again acquires its regularly spherical form (fig. 2).

This thread is now seen to become alternately thicker and

* "Der Theilungsvorgang bei *Euglypha alveolata*," in Zeitschr. für wiss. Zool. Bd. xxxv. pp. 431–439 (1881). See 'Annals,' ser. 5, vol. ix. p. 135.

thinner, by the flux and reflux of plasma from the large plasma-mass. All at once, however, the thread becomes thinner and thinner, until it is suddenly ruptured. At the same moment a distinct reticulated structure (fig. 3) makes its appearance suddenly and sharply in the nucleus (n^2), which was previously perfectly limpid, like the nuclei of *Euglypha* in general, a structure such as we can call forth in the normal nucleus by the addition of acetic acid or any other reagent causing coagulation. From this, as also from the further behaviour of this nucleus, which will be immediatelv described, it follows with great certainty that at the moment when the plasma-thread is ruptured it also dies. This fact is of particular interest on account of the close relation of the nucleus to the plasma which is proved by it. The nucleus therefore is not capable of retaining its normal vital condition even for a moment when isolated from the plasma.

The nucleus thus thrown off remains enclosed in a thin layer of plasma, as shown in the figures; this appears to be only the peculiar plasma-zone which may be detected even in normal individuals in the neighbourhood of the nucleus, and which also behaves towards colouring-matters differently from the rest of the plasma.

After the cell-nucleus of the newly formed individual has been thrown off in this way two cases may occur. In the first case the plasma withdraws itself completely from shell II., and the normal animal separates from it. In water which contains numerous * *Euglyphæ* in process of division there are therefore always empty shells which show at the bottom the expelled cell-nucleus as a yellowish strongly refractive corpuscle.

The second case, which probably occurs just as frequently, is represented in figs. 5–9. In this, after the plasma has been retracted almost entirely into the old shell, it suddenly begins again to flow over towards II., during which process one (fig. 5) or more thickish or very fine pseudopodia are formed, which move about, as if groping, through the cavity of shell II. As soon as they meet with the expelled cell-nucleus they flow round it, just like any foreign body serving for food. It becomes detached from the bottom of the shell where it was seated, and is carried away with the plasma, now again flowing back towards I. (figs. 6–8). We see that it is finally drawn into shell I. Here it may now remain

* In our waters the animals were so numerous that every drop taken from the bottom of the vessel and put upon a slide showed twenty or thirty specimens.

until the shells have separated, and then be again finally expelled, or this expulsion may take place before the separation of the shells (fig. 9). During its sojourn in the plasma of the intact animal the nucleus n^2 changes its constitution. At first it still distinctly shows the reticulated structure which appeared in it at the time of the rupture of the plasma-thread uniting it with the body of the animal. Gradually this structure disappears, and the nucleus acquires a more homogeneous strongly shining appearance, while its outlines become irregular (figs. 8 and 9). It therefore has exactly the aspect which is presented by other nuclei which have perished. Therefore it is like the nuclei undergoing degeneration during the conjugation of Infusoria, or like the nuclei of Protozoa which have been devoured by other Protozoa and partially digested. As already stated, the nucleus is finally again expelled. Then, however, the plasmatic envelope which it originally possessed seems to be lost. It has therefore no doubt been digested, while the nuclear substance itself appears not to be assimilable.

In this process therefore there results from a division which, so far as one can judge, was normally commenced and carried on, only a single individual, the plasma becoming retracted again from the new-formed shell into the old one, while one of the nuclei is thrown off.

If we meet with a pair of animals, such as is represented in fig. 1, and observe in it the processes described, of course it seems a very probable notion that the two animals have united by copulation. Now actual copulation and conjugation * do really occur, as I shall show further on. It is, however, easy to distinguish a conjugation-pair from one produced by division. In the animals united by conjugation there is very generally a mass of shell-lamellæ in the plasma, while this is not the case in the products of division, as it is exactly the superfluous shell-plates of the parent animal that are employed in the formation of the new shell. Further, in stained preparations the young shell (II. in the figures) is usually recognized with facility, because the individual plates have separated from each other at different places. In conjugated animals I have always found, placed before the nucleus,

* As will be shown hereafter, both copulation (in which the plasma-bodies of two animals become completely fused together to form a new individual) and conjugation (in which the animals, after long-continued union, separate again from each other, and in which hitherto no demonstrable changes have been observed) do occur. For the sake of simplicity I speak here always of conjugation-pairs, as they certainly constitute the great majority of the united states which come under observation.

the dark zone formed by aggregation of granules, which is wanting in freshly divided animals. In the latter the granules are uniformly distributed throughout the plasma, and for this reason and on account of the inception of water requisite during division, the plasma of divided individuals appears much lighter, so that with a little practice one may distinguish a divisional pair from a conjugation-pair even with the lens.

The consideration of all these differences would not, however, completely exclude mistakes. To attain this object I isolated animals in which the plasma was just beginning to protrude from the aperture as small buds covered with shell-plates, and which therefore were certainly at the beginning of division. As the division advanced, the division of the nucleus might also be observed with facility in living animals. By this mode of investigation all mistakes are excluded. In this way I isolated and observed a great number of *Euglyphæ*, and it appeared that after the conclusion of the division either the two individuals separated and continued to live independently, as was already observed by Gruber (*loc. cit.*), or that the process above described took place, so that only *one* individual resulted, which, indeed, contained nearly the whole of the plasma of the parent animal, but only half its nuclear substance.

I have investigated the most different stages of both processes of division and of nucleus-expulsion in preparations killed with chrom-osmium-acetic acid and stained in different ways, without, however, observing in them anything essential more than in fresh objects or objects treated with 1 per cent. acetic acid.

If we ask ourselves what significance this remarkable process has for the animal, it is at present very difficult to find any answer that may be satisfactory even to a limited extent. In the individuals thus produced I have observed nothing remarkable; they lived for a time in the preparations like others, then perished or became encysted.

At the first glance one might imagine a comparison of this process of nucleus-expulsion with the removal of the products of division of the nucleoles in the conjugation of the Infusoria. In connexion with this Prof. Bütschli has suggested that possibly such animals as had lost in this way the half of their original nuclear substance afterwards proceeded to copulation. Hitherto, however, we have no positive observations in favour of this view. But in the most recent observations of Maupas* upon the conjugation of the Infusoria we may find some sup-

* 'Comptes Rendus,' June 28 and September 6, 1886.

port for such a supposition. According to them a number of the divisional products of each nucleolus would perish, as indeed was previously known, whilst of the two nucleolar derivatives remaining in each of the conjugated animals one would pass over into the other animal and become amalgamated with that remaining in it. By this, as Maupas points out, the conjugation of the Infusoria is brought into closer relation to the process of fecundation in the Metazoa than was previously possible.

According to this line of thought we might find a certain relation between the process described in *Euglypha* and the formation of the direction-corpuscles in the ova of the Metazoa. In both cases the final result is the removal of a part of the nuclear substance. In both cases this is effected by an indirect division of the nucleus connected with a cell-division. But whether these suppositions have any real foundation must be left to further extended investigations to show.

Similar processes to those here described in the case of *Euglypha* have not hitherto, so far as I know, been noticed in any other Rhizopod. I think, however, that careful investigation will show a wider diffusion of these processes. Thus I feel certain that the supposed copulation-stage of *Difflugia globulosa*, Duj., described by Jickeli *, was a similar case of retrogressive division with expulsion of the nucleus. He states expressly that one of the two shells (*i. e.* the newly produced one) was clearer, and that in forty-eight hours the whole of the plasma, originally filling both shells, had passed over into the darker (*i. e.* the original) one, in which careful examination showed two normal nuclei and one in course of disintegration.

All this agrees with the processes observed by me in *Euglypha*. We should therefore have to understand that Jickeli discovered a completely finished division of the *Difflugia*, that this then retrograded, the plasma withdrawing itself from the newly formed shell, leaving behind it the nucleus, and that it then subsequently again took up the dead nucleus. After this had taken place the animal was killed; but the decaying nucleus would certainly afterwards have been again expelled.

In another case, in the formation of the resting-cysts of *Actinosphærium Eichhornii*, Ehrb. †, it has been directly

* "Ueber die Copulation von *Difflugia globulosa*, Duj.," in Zool. Anz. Jahrg. vii. pp. 449–451 (1884). Translated in 'Annals,' ser. 5, vol. xiv. p. 297.

† On the literature see Bütschli, 'Protozoa.'

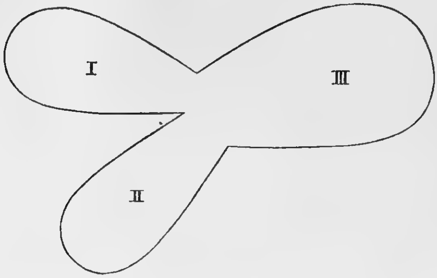
observed that two individuals just produced by division become again completely fused together. Nothing indeed is said of an expulsion of the nucleus; but to establish the matter with certainty an investigation specially directed to that end would be necessary. In general, however, this process has a very great resemblance to what occurs in *Euglypha.*

I have also observed true copulation in *Euglypha*, but unfortunately only in one instance, and not so thoroughly as I could have wished.

When many *Euglyphæ* are living together one often meets with several animals which have placed themselves with their shell-apertures together, and of which the plasma has become amalgamated. As has already been stated, such conjugation-pairs may be distinguished with certainty from the pairs produced by division. But in order to be absolutely certain in these investigations I always got a small number (six to ten individual animals) into the suspended drop, and observed them here. Any conjugation-pairs that might be present were taken out and isolated in another drop for further observation. In this way it appeared that in most cases the conjugation is again dissolved, without any noticeable change having taken place in the animals. To see whether any changes were perceptible in the nucleus I examined many stained preparations of animals united in pairs or several together, but always without result.

The separated animals also behaved differently; some of them divided normally, while others became encysted like ordinary individuals.

Once, however, I observed the following:—In a preparation with a number of individual animals there were two united pairs at a quarter to six in the evening of the 26th May of last year (1886). Both pairs were isolated in suspended drops. On May 27 no alteration was observed; so also at seven in the morning of May 28. But about seven in the evening I found the condition shown in the accompanying woodcut. While one pair was still unaltered, the plasma of the two other individuals (I. and II.) had united, and had formed from the shell-lamellæ previously in the interior of the two animals a new large shell (III.) of somewhat irregular shape, at the aperture of which the two original shells, completely empty, were attached. The length of this newly formed shell was 100 μ and its greatest breadth 67 μ, while the average of twenty shells taken at random from different culture-vessels amounted to 82 μ for the length and 47 μ for the greatest breadth. From this it appears that the newly formed shell of the individual produced by copulation exceeded the normal measurement by about 20 μ in each dimension.



× 300.

In the large animal III. a nucleus was visible in the usual position. As to the behaviour of the two nuclei of the copulating animals I. and II., I could make no observations owing to the nature of the case. The most natural supposition seems to me to be that the two nuclei were fused together. The large individual crept about briskly in the drop for several days and was finally encysted on June 2. The two other conjugated animals in the same preparation separated again from each other, and one of them divided in the normal manner.

In this instance, therefore, there can be no doubt that actual copulation occurs in *Euglypha*, only it seems to be comparatively rare; and hence its exact observation must depend upon favourable circumstances, which, considering the importance of the matter, is much to be regretted.

When through recent investigations, and especially by Gruber's memoirs, the process of division in the freshwater Monothalamia was elucidated in all essential particulars, it appeared only too natural that there should be a great tendency to assume, as indeed had even previously been done by Hertwig and Lesser *, that all statements as to the copulation and conjugation of the shelled freshwater Rhizopods were founded upon such divisional stages misunderstood. In many cases this might probably apply, in some perhaps not. Of course from the figures and descriptions it will be difficult or even impossible in special cases to decide in favour of one or

* "Ueber Rhizopoden und denselben nahestehenden Organismen," in Arch. für mikr. Anat. Bd. x. Suppl. pp. 35–243 (1879).

the other view. In fact there is not much use in testing the extant instances for this purpose, as usually some special mode of increase connected with the conjugation was observed, although not with certainty. In one instance, however, such a special kind of multiplication after an undoubted conjugation seemed to be very probable, namely in *Arcella vulgaris*, Ehrbg., according to Bütschli's observations *. In this it was observed that in two out of three conjugated *Arcellæ* amœboid offshoots were produced in great numbers after the dissolution of the conjugation †.

In my subject I have hitherto observed nothing of the kind, although I examined numerous animals united in pairs and several together, both living and in stained preparations.

The proof here adduced of true copulation in *Euglypha*, in which from two normal individuals a single animal agreeing with them in structure but exceeding them in size is produced, is, however, of importance. I rejoice that in this way I have made the first step towards the confirmation of the supposition expressed by Bütschli in his work on the Protozoa, that, as in the other Protozoa, so also in the Rhizopoda, the processes of copulation and conjugation might have assigned to them an important part in reproduction.

In the case of shelled Rhizopods, so far as I know, an actual copulation has never previously been demonstrated, although it is sufficiently well known in the nearly allied Heliozoa.

Finally, it may further be indicated that in the process of copulation in *Euglypha alveolata* we cannot overlook a certain resemblance to the formation of axospores in the Diatomaceæ.

Although, as is to be expected, future investigations will demonstrate the wider diffusion of conjugation and copulation in the Rhizopoda, we may nevertheless already say with considerable certainty that they will never occur with the same regularity as in many Flagellata and Infusoria, but that they will always be rather occasional phenomena, the importance of which, however, must not on that account be underestimated, as in any case they certainly are the first commencement of processes to which, in the life of animals in general, an extraordinarily great, although still by no means clear, significance belongs.

* Arch. für mikr. Anat. Bd. xi. pp. 459-467 (1874).

† I have convinced myself of the occurrence of conjugation in *Arcella*. In a vessel which contained enormous quantities of *Arcellæ* I found by no means unfrequently two animals with perfectly similar deep brown shells united, while the pairs produced by division, which were present in abundance, were readily recognized by the nearly colourless shell of one offshoot.

EXPLANATION OF PLATE IV.

All the figures, with the exception of fig. 4, are from the living subject. Fig. 4 is from a preparation treated with 1 per-cent. acetic acid. Enlargement 400 diameters.

I. First individual (parent animal).
II. Second individual, produced by division from I.
n^1, nucleus of the first animal.
n^2, nucleus of the second animal.
CV, contractile vacuole.

Fig. 1. The plasma begins to withdraw itself from the animal II., produced by division from I. At the bottom of the shell it is still firmly attached and encloses the nucleus n^2, which is somewhat elongated.
Fig. 2. The process is further advanced, and the plasma is drawn out into a thin thread. The nucleus n^2 has again assumed its normal form.
Fig. 3. The thread is ruptured and the nucleus n^2 shows distinct reticular structure; it is dead.
Fig. 4. The expelled nucleus n^2 of another animal, after treatment with acetic acid of 1 per cent.
Fig. 5. The plasma is flowing again into shell II., and emits a pseudopodium towards the nucleus n^2.
Fig. 6. The pseudopodium has flowed round the nucleus n^2, and is drawing it back towards shell I.
Fig. 7. This process has further advanced.
Fig. 8. The nucleus n^2 has lost its structure, and appears as a strongly refractive irregular mass.
Fig. 9. The nucleus n^2 is again expelled.

VII.—*Notes on the Determination of the Fossil Teeth of* Myliobatis, *with a Revision of the English Eocene Species.* By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate I.]

Of all the numerous teeth of Selachian fishes met with in a fossil state none seem to have been studied with less satisfactory results than those of the well-known genus *Myliobatis*. Abundantly represented in nearly all the marine Tertiary formations, detached fragments of its dentition have been described under almost endless specific names from various parts of the world; and the most precise measurements have often been given, without the slightest reference to differences of age or even to variations in the individual jaw. Occasionally, moreover, the most distinguished naturalists have been led by imperfect specimens to enumerate as specific characters features that are wholly due to the effects of post-mortem abrasion; and other equally unreliable points have likewise been emphasized, owing to misapprehensions as to their significance and constancy.

Such mistakes are quite inevitable whenever materials are scarce and fragmentary, and especially when the observer has had but few recent specimens for comparative study. When, however, it is possible to examine and compare a large series of fossils from the same formation and locality, data are provided for much more certain and philosophical conclusions. And as the National Collection now comprises a very large number of the dental plates of *Myliobatis* from the London Clay of Sheppey and the Middle and Upper Eocenes of Bracklesham and Barton, the present seems a favourable opportunity for attempting some slight revision of the group. Here are preserved the type specimens of nearly all the species hitherto described from these formations, besides many other beautiful fossils from the cabinets of Mr. Frederic Dixon, Dr. Bowerbank, Sir Philip Egerton, and the late Earl of Enniskillen; and the whole are suggestive of some interesting considerations, which do not appear as yet to have been sufficiently recognized, at least by those who have examined the genus from a palæontological point of view. I therefore propose, in the present communication, to offer a few remarks upon the subject, based upon a careful study of the fossils I have recently been able to make; and the conclusions will lead to some slight reduction in the number of specific types supposed by previous authors to be represented.

Specific Characters afforded by Dentition.

Referring in the first place to the more general questions, it will be convenient to commence with a notice of the deceptive appearances due to post-mortem abrasion. To this may be added some remarks upon individual variations and differences in the teeth corresponding to differences of age. And the discussion will appear to result in determining at least three points of certain taxonomic value.

One of the most conspicuous of the accidental characters is the granular or punctate ornamentation produced by the removal of the superficial gano-dentine and the exposure of the vertical medullary tubes. There are several specimens in the British Museum demonstrating the process of wear and showing portions both of the original surface and that resulting from its removal (*e. g.* no. 25658); and the circumstance has already been briefly noted by Le Hon *. Agassiz †, however, founded the species *M. punctatus* upon such an abraded fragment probably referable to the upper jaw of *M. striatus*, and Delfortrie ‡ and Issel § have more recently described fossils that appear to be similarly imperfect under the names of *M. microrhizus* and *M. granulosus*.

A less amount of abrasion of the grinding-surface often imparts to it a remarkable smoothness, which has also been occasionally relied upon as a specific character in determining dental plates. All the types of *M. Dixoni*, for example, are remarkably smooth; and though this feature was not especially alluded to in the original diagnoses of Agassiz and Dixon, the circumstance seems to have been sometimes regarded as an essential peculiarity of the species; fossils truly belonging to this form, but having the grinding-surface preserved, and thus showing striations, have been wrongly referred to *M. striatus*, as is proved by specimens in the National Collection. The specific name of *striatus* in fact might have been as appropriately applied to *M. Dixoni* and others as to the form that now bears it, if only unworn specimens had originally been available; though it so happens that other peculiarities in the species thus named render it nevertheless valid.

A further effect of post-mortem wear, or even perhaps of masticatory trituration, has led to the founding of still another species by Agassiz—the so-called *M. suturalis* ‖. This is described as possessing teeth in all respects similar to those of *M. toliapicus*, but united by jagged sutures rather than straight edges. Such a peculiarity is to be observed more or less in all the specific types when the dentition is deeply worn, as already hinted by Issel and Le Hon, and the fragment just referred to may undoubtedly be placed in the well-known species from Sheppey. Leidy's *M. serratus* ¶ may also be mentioned in this connexion, the chief character in the diagnosis being similarly misleading.

Among individual variations liable to be quoted as of

* H. le Hon, 'Préliminaires d'un Mémoire sur les Poissons Tertiaires de Belgique,' 1871, p. 13.

† L. Agassiz, Rech. Poiss. Foss. vol. iii. p. 322, pl. xlvii. figs. 11, 12.

‡ E. Delfortrie, "Les Broyeurs du Tertiaire Aquitanien," Actes Soc. Linn. Bordeaux, vol. xxviii. (1871), p. 225, pl. x. fig. 37.

§ A. Issel, "Cenni sui *Myliobates* fossili dei terreni terziarii Italiani," Ann. Mus. Civ. Stor. Nat. Genova, vol. x. (1877), p. 335.

‖ L. Agassiz, *tom. cit.* p. 322, pl. xlvi. figs. 12–16.

¶ J. Leidy, Journ. Acad. Nat. Sci. Philad. vol. viii. (1877), p. 239, pl. xxxii. fig. 5.

specific value the most striking perhaps is the variability sometimes so conspicuous in the antero-posterior measurements of the series of median teeth. This is a feature occasionally exhibited in every form, and there are good illustrations among the national fossils in dental plates of *M. Dixoni* and *M. toliapicus*, besides another specimen originally figured by Dixon under the name of *M. Edwardsii*. In the imperfect diagnosis of the latter species, however, the peculiarity is mentioned as one of the leading distinctive points *.

Equally inconstant are the small differences in the antero-posterior curvature of the median teeth, which are sometimes referred to with undue emphasis. In some species it is true there is a greater tendency towards the curvature of the plates than in others, and the present materials are insufficient to decide whether or not the sharp flexure of the extremities of the median teeth in certain forms is likewise a more or less fixed character; but it appears to be unsafe to rely upon the point when the specimens for study are few and fragmentary.

A prominent feature that seems to be entirely due to the effects of "overgrowth" has also been cited as the main characteristic of one other fossil form—the *M. irregularis* of Dixon †. In this species the median plates are slightly more than nine times as broad as long and very irregular both in their borders and surface-contour. But, as will be shown in the sequel, almost every gradation can be found between the type specimen, which forms an extreme, and the more normal teeth known as *M. striatus*; and there can thus be little hesitation in regarding this unique form as a very large variety of the latter—perhaps an unusually aged individual. The same irregularity, indeed, appears to exist in the teeth of overgrown examples of other species, e. g. *M. toliapicus*; for a single specimen probably referable to the last-named form, in which the ordinary adult ratio of length to breadth in the median series is about 1 : 6, exhibits a corresponding ratio of 1 : 7·5, and has all the inequalities of surface-contour presented by Dixon's fine fossil.

But the most fundamental consideration of all to be taken into account when determining the fossil dental plates of *Myliobatis* relates to their mode of growth; and this I have not found mentioned in any contribution to the palæontology of the genus, except that of Issel quoted above ‡. As

* F. Dixon, Foss. Suss. p. 199.

† F. Dixon, *op. cit.* p. 199, pl. xi. fig. 15.

‡ A. Issel, Ann. Mus. Genova, vol. x. (1877), p. 316.

already pointed out by Dr. Günther * there is no median series of larger teeth in very young individuals, all the plates being originally of nearly equal size and more or less regularly hexangular. But as growth proceeds the middle row begins to exhibit the familiar lateral elongation; and with the progressive increase in the size of the animal this peculiar character becomes more and more marked, until in the largest individuals—generally the most aged—there is the maximum ratio between length and breadth. In any one species, therefore, the median teeth have different relative dimensions at different ages, and in dealing with the fossils it is obviously necessary to take note of absolute size when stating these relative measurements for diagnostic purposes.

Another peculiarity which appears to be of equal importance to the last and can be employed with less restrictions is the form of the small dental plates arranged in the lateral rows. Species with broad lateral teeth seem to retain them correspondingly broad throughout life, and those in which they are narrow or small have them narrow and small at all ages; and when there is any prominent obliquity or irregularity this likewise exhibits but the slightest change as the successive plates follow one another during growth.

Lastly, the coronal surface-contour of the lower teeth may often be relied upon to a certain extent as a diagnostic character when the specimen is unabraded. The flatness or transversely arched form of the crown and its relative thickness are features of some specific value, though even in this respect I have found considerable variations in the young stages of one of the English species (*M. striatus*) described below.

Revision of English Eocene Species.

Applying the foregoing results to the revision of the English Eocene fossils it appears that as yet only four distinct species can be recognized with certainty, while three others remain incompletely defined and cannot at present be accepted. The well-marked types are *M. Dixoni*, *M. striatus*, *M. toliapicus*, and a hitherto undiscovered form which I propose to name *M. latidens*; and it will be convenient to treat of them in the order mentioned.

* A. Günther 'Catalogue of Fishes in the British Museum,' vol. viii. (1870), p. 489.

Myliobatis Dixoni, Agassiz. (Pl. I. figs. 1–4.)

1833–43. *Myliobatis Dixoni*, Agassiz, Poiss. Foss. vol. iii. p. 319.
1833–43. *Myliobatis heteropleurus*, Agassiz, *tom. cit.* p. 323, pl. xlvii. figs. 6–8.
1850. *Myliobatis Dixoni*, Dixon, Foss. Suss. p. 198, pl. x. figs. 1, 2, pl. xi. fig. 14, pl. xii. fig. 3.
1850. *Myliobatis contractus*, Dixon, *op. cit.* p. 200, pl. xi. fig. 17.
1850. *Myliobatis striatus*, Dixon (non Agass.), *op. cit.* pl. xii. fig. 2.

This species was named by Agassiz on inspecting the drawings of Mr. Dixon's fossils prepared for the well-known 'Geology and Fossils of Sussex,' all of which represented the upper jaw. Its main peculiarities were rightly noted as (i.) the strongly arched [upper] coronal surface, and (ii.) the great length of the median teeth compared with their breadth —the ratio rarely or never being more than 1 : 5. There are three rows of lateral dental plates on each side, which are all much elongated in shape.

The national specimens now render it possible to advance a step further, by indicating the changes in the relative dimensions of the median teeth resulting from differences of age (or absolute size), and the following series of measurements will show eight successive stages. In this table, as in each of the others, the numbers are expressed as decimal fractions of the metre, and the length in every case is approximately the average of three or more plates.

Upper Dentition of Myliobatis Dixoni.

No. of Specimen, Brit. Mus.	Breadth of Median Plate.	Length of Median Plate.
I. P. 1498 *a*	0·026	0·007
II. P. 3044 *a*	0·033	0·010
III. 25623	0·039	0·010
IV. P. 3044 *b*	0·044	0·011
V. 25621	0·047	0·012
VI. 25614	0·058	0·013
VII. 38839	0·066	0·014
VIII. P. 434	0·094	0·020

The lower dentition has not hitherto been recognized as such, although two or three examples have been figured under other specific names. There can be little doubt, however, that the following series of specimens is rightly so determined, and the measurements, it will be noticed, correspond very closely with those of the upper dental plates. Four of these specimens (nos. I., V., VII., and VIII.) are shown of the natural size in Pl. I. figs. 1–4, and a transverse section of the largest is given in the accompanying woodcut, fig. 1.

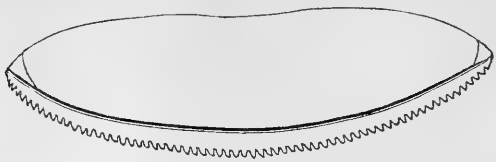


Fig. 1.

The crown is deep and the grinding-surface has a slightly arched contour, flattened in the middle.

Lower Dentition of Myliobatis Dixoni.

No. of Specimen, Brit. Mus.	Breadth of Median Plate.	Length of Median Plate.
I. P. 4457 *c*	0·023	0·0065
II. 25660	0·027	0·008
III. 25620	0·030	0·008
IV. 37758	0·035	0·010
V. P. 438	0·038	0·0105
VI. 25821	0·045	0·0105
VII. P. 1508 *a*	0·047	0·010
VIII. 25641	0·061	0·012
IX. P. 4458	0·078	0·012

Of these fossils the third was figured by Dixon as the type of a new species, *M. contractus*, while in the sixth the original surface is preserved—a fact which led the same author to refer it to *M. striatus*. The so-called *M. heteropleurus* may also be placed here with considerable certainty, the median teeth of the type specimen measuring 0·022 by 0·0065, and the lateral teeth, so far as preserved, likewise exhibiting the characters of those of *M. Dixoni*. I have seen no other fossils like this from Sheppey, and, as already stated by Agassiz, his determination of its being derived from the London Clay is hypothetical.

Range. Barton and Bracklesham Beds.

Myliobatis striatus, Agassiz. (Pl. I. figs. 5–9.)

1833–43. *Myliobatis striatus*, Agassiz, Poiss. Foss. vol. iii. p. 320.
1833–43. *Myliobatis punctatus*, Agassiz, *tom. cit.* p. 322, pl. xlvii. figs. 11, 12.
1837. *Myliobatis striatus*, Buckland, Geol. and Min. 2nd edit. vol. ii. pl. xxvii. *d*, fig. 14.
1850. *Myliobatis irregularis*, Dixon, Foss. Suss. p. 199, pl. xi. fig. 15.
1850. *Myliobatis Edwardsii*, Dixon, *op. cit.* p. 199, pl. xi. fig. 16.

A specimen of the lower dentition from the Barton Clay, figured by Buckland in his 'Bridgewater Treatise,' was selected by Agassiz as the type of this species, and described as noteworthy for its superficial striation and the relatively considerable breadth of the median plates. The latter are shown to be six times as broad as long, and almost invariably exhibit a greater or less amount of antero-posterior curvature. The teeth of the first lateral series are somewhat longer than broad, though both these and those of the second series are not so elongate as in *M. Dixoni.* The coronal contour is flat in the adult, as shown in the accompanying woodcut (fig. 2), and almost so in the young.

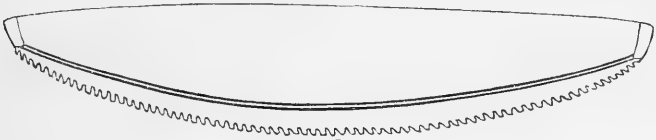


Fig. 2.

The following specimens of lower teeth seem to represent successive stages in the dentition of this specific type, and five (nos. I., II., IV., VI., IX.) are shown in Pl. I. figs. 5–9. Nos. IX. to XI. are unusually large, and may be certainly regarded as pertaining to overgrown individuals, although the last was described by Dixon as the type of a new species, *M. irregularis.*

Lower Dentition of Myliobatis striatus.

No. of Specimen, Brit. Mus.	Breadth of Median Plate.	Length of Median Plate.
I. P. 1507 *a*	0·013	0·003
II. P. 1507 *b*	0·023	0·0045
III. P. 1505 *a*	0·031	0·006
IV. P. 3049 *a*	0·038	0·007
V. P. 3043	0·042	0·0075
VI. 38838	0·054	0·009
VII. P. 3040	0·059	0·0085
VIII. 25666	0·065	0·009
IX. 40252	0·074	0·009
X. 25667	0·080	0 009
XI. P. 423	0·100	0·011

In the same series also we may evidently place the specimen figured by Dixon as *M. Edwardsii* (B. M. no. 25615), which is intermediate in size between nos. III. and IV., and has similar relative proportions. This fossil is very much abraded, and thus not so satisfactory as could be wished; but, like several others, it appears only to differ from the most typical examples of the lower dentition of *M. striatus* in the straightness of the median plates—a character scarcely sufficient to justify specific separation. It is quite possible, of course, that it represents a form in which the successive stages of the dentition "run parallel," so to speak, with the earlier stages of *M. striatus*, and yet indicate an animal of much smaller dimensions when adult. But if so, it requires more than the present palæontological evidence to establish the fact, and *M. Edwardsii* must therefore be provisionally regarded as a synonym of the species under consideration.

More uncertain are the relationships of the fossil described by Agassiz as the type of *M. goniopleurus* *. This, there can be no doubt, is a fragment of a lower jaw. It is a much-rolled specimen from the London Clay of Sheppey, having approximately the dimensions of no. VII. of the foregoing list, but differing in the more raised contour of the crown; and it is noteworthy that the British Museum collection comprises no other corresponding fragment from the same formation and locality.

Of the upper dentition of *M. striatus* no particulars have hitherto been published, and, compared with the lower jaw, it appears to be represented by but few specimens in the National Collection. It is, however, impossible at present to distinguish with certainty the earlier stages of these teeth from the upper dentition of *M. toliapicus*, and we cannot venture to publish measurements of more than the following five specimens. It is not improbable also that the small fossil shown in Pl. I. fig. 10 may be placed in the same series; and, if this determination be correct, it is interesting as revealing the characters of all the three rows of lateral teeth.

Upper Dentition of Myliobatis striatus.

No. of Specimen, Brit. Mus.	Breadth of Median Plate.	Length of Median Plate.
I. 25659	0·033	0·0075
II. 40313	0·041	0·008
III. P. 1502	0·042	0·008
IV. 40312	0·065	0·010
V. P. 3047	0·068	0·009

Range. Barton and Bracklesham Beds; ? London Clay.

Myliobatis toliapicus, Agassiz.

1833–43. *Myliobatis toliapicus*, Agassiz, Poiss. Foss. vol. iii. p. 321, pl. xlvii. figs. 15–20.

* L. Agassiz, *tom. cit.* p. 319, pl. xlvii. figs. 9, 10.

1833–43. *Myliobatis suturalis*, Agassiz, *tom. cit.* p. 322, pl. xlvi. figs. 12–16.
1833–43. *Myliobatis nitidus*, Agassiz, *tom. cit.* p. 325.
1847. *Myliobatis striatus*, Owen, Ann. & Mag. Nat. Hist. [1] vol. xix. pp. 25–27, woodcut.

The well-known species of Sheppey is readily recognized by the flat, comparatively thin crown of the lower dentition and the broad, diamond-shaped lateral teeth; but there is little to add to the original descriptions of Agassiz, who made known both the upper and lower jaws. The following table, however, may be interesting, as illustrating some of the changes in the relative dimensions of the median teeth corresponding to an increase in absolute size. Specimen no. VII., as already mentioned (p. 39), exhibits irregularity of growth, and probably belongs to an unusually large individual.

Lower Dentition of Myliobatis toliapicus.

No. of Specimen, Brit. Mus.	Breadth of Median Plate.	Length of Median Plate.
I. P. 1507 *c*	0·016	0·0035
II. P. 1505	0·023	0·004
III. 38854	0·027	0·005
IV. P. 1505 *c*	0·029	0·005
V. 25669	0·032	0·005
VI. P. 3038 (type)	0·036	0·0055
VII. P. 3042	0·052	0·007

It may also be added that, so far as the type specimen of Agassiz, *M. nitidus*, will allow of determination, this fossil is referable to the upper jaw of the present species. The name, however, was published without definition, and so has not been employed in the nomenclature of other fossils. The specimen consists of a connected series of six upper median teeth, from the London Clay of Sheppey, and is now preserved in the British Museum in the Egerton Collection (no. P. 528). Each dental plate has a breadth of 0·024 and measures 0·0045 in length, and all the lateral teeth are destroyed.

Range. Barton and Bracklesham Beds; London Clay.

Myliobatis latidens, sp. nov. (Pl. I. figs. 11, 12.)

A hitherto unrecognized species appears to be indicated by some small examples of the lower dentition from Bracklesham, and with these may also be associated one or two series of upper median teeth from the same locality. The originals of figs. 11 and 12 may be regarded as typical, and they are remarkable for the great relative breadth of their median teeth, as shown both by the figures and the following measurements :—

	Breadth.	Length.
I. P. 1507 *g*	0·020	0·002
II. 25630 *a*	0·020	0·0025–0·003

The lateral teeth are likewise comparatively broad and irregularly hexangular, and the coronal contour is flat.

A connected series of median teeth (no. P. 1506 *a*), of which each measures 0·040 by 0·0045, is also probably referable to this species, and testifies to the dimensions to which it sometimes attained; and the specimen shown in fig. 13, though somewhat fragmentary and belonging to the opposing dentition, may possibly be similarly determined.

The specific name of *latidens* suggests itself as appropriate for the form thus imperfectly recognizable ; and, so far as can be judged from teeth alone, it may be regarded as allied both to *M. toliapicus* and to the small fossil with narrower lateral teeth from the Upper Miocene of Aquitaine described by Delfortrie as *M. dimorphus* *.

Range. Bracklesham Beds.

With regard to the two species, *M. gyratus* and *M. jugalis*, ascribed by Agassiz † to the London Clay of Sheppey, I am unable to make any definite statement, not having examined the types. It appears, however, almost certain that the specimens are abraded fragments of the early dentition of one or other of the species defined above.

EXPLANATION OF PLATE I.

Fig. 1. Lower dentition of *Myliobatis Dixoni.* (No. P. 4457 *c.*)
Fig. 2. Ditto. (No. P. 438.)
Fig. 3. Ditto. (No. P. 1508 *a.*)
Fig. 4. Ditto. (No. 25641.)
Fig. 5. Lower dentition of *Myliobatis striatus.* (No. P. 1507 *a.*)
Fig. 6. Ditto. (No. P. 1507 *b.*)
Fig. 7. Ditto. (No. P. 3049 *a.*)

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* E. Delfortrie, Actes Soc. Linn. Bordeaux, vol. xxviii. (1871), p. 227, pl. xi. fig. 39.

† L. Agassiz, *op. cit.* vol. iii. pp. 323, 324, pl. xlvi. figs. 1–3, pl. xlvii. figs. 13, 14.

Fig. 8. Ditto. (No. 38838.)
Fig. 9. Ditto. (No. 40252.)
Fig. 10. Fragment probably of upper dentition of *Myliobatis striatus*, showing three series of lateral teeth. (No. 25671.)
Fig. 11. Lower dentition of *Myliobatis latidens.* (No. P. 1507 *g.*)
Fig. 12. Ditto. (No. 25630 *a.*)
Fig. 13. Fragment of upper dentition, probably of *Myliobatis latidens.* (No. 25656.)

All the figures are of the natural size. The original specimens are preserved in the British Museum, and the numbers refer to the Register of the Geological Department; all are from the Middle Eocene of Bracklesham Bay, Sussex.

VIII.—*On three extremely interesting new Moths of the Family* Chalcosiidæ *from Kilima-njaro and Natal.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

Two of the following species were collected by Mr. F. J. Jackson near Kilima-njaro and were presented by him to the Museum.

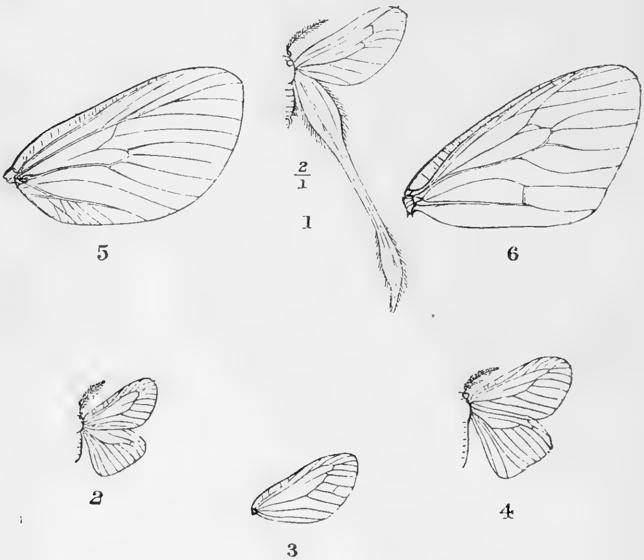
It will be remembered that in the 'Annals' for 1884 I described a remarkable genus of moths under the name of *Pedoptila*; that in 1885 I referred to the allied genus *Doratopteryx* of Rogenhofer, and pointed out how it differed from *Pedoptila*; and, lastly, in 1887 I described a third genus of the same group under the name of *Semioptila*, all three genera being African.

Mr. Jackson has now brought to light a second species of *Doratopteryx*; and although every specimen has unfortunately arrived in a more or less broken condition, I am now in a position to point out certain inaccuracies which occur in Herr Rogenhofer's description of the genus.

The species figured and described by Herr Rogenhofer proves to be a female, not a male as he supposed; the males have distinctly pectinated antennæ.

The secondaries certainly have two veins as stated, but they have more than that; the subcostal vein passes down the tail; at the third fourth of its length the tail expands, and here the subcostal vein throws off a branch which terminates near the end of the expanded portion, whilst the main vein continues on to the point of the tail; the median vein, which is double, emits a short branch just before the tail, and terminates just beyond the expansion, a little beyond the subcostal branch.

The tail very easily becomes twisted or folded, rendering it almost impossible to see the smaller branches, and therefore it is only by the examination of several examples that one is enabled to describe it correctly; no blame therefore is due to Herr Rogenhofer for his failure to observe them in the single specimen before him.



Doratopteryx plumigera, sp. n. (Fig. 1.)

Primaries semitransparent fuliginous grey; the discoidal cell and interno-basal half golden fulvous; veins black: secondaries golden fulvous to the commencement of the tail, the latter blackish, crossed by a belt of ochreous at the commencement of its expansion, which is beyond the middle: head and thorax shining pitch-brown; collar and two spots on the prothorax orange; abdomen dull orange, legs brown. Expanse of wings 13–20 millim.

Mouth of the River Ozy, in dense brush; on a large bush of jessamine, on a fearfully hot day, about 11 A.M.

DIANEURA, gen. nov.

Wings hyaline; all angles obtuse: primaries with slightly sinuous costal margin, oblique and slightly convex outer margin, and slightly concave inner margin; costal vein slender, extending to about second third of costal margin, united to the margin by four or five slightly oblique transverse veinlets, reminding one of the Sialidæ among the Neuroptera, or the Orthoptera generally; subcostal vein strongly developed, five-branched, the first three branches emitted at regular intervals before the end of the cell, which is prolonged to the fourth fifth of the wing; the fourth and fifth branches forking from a short footstalk; upper discocellular veinlet long, oblique, with a short angle from which the upper radial is emitted; lower radial scarcely separated from a recurrent vein which divides the outer two fifths of the cell, and appearing to form a fourth median branch; median vein thick, slightly bent upwards in front in continuation of the lower discocellular veinlet; the first and second branches wider apart than the second and third; a slender internomedian vein running from the outer margin almost to the base; submedian vein slightly sinuous: secondaries subpyriform, the costal and outer margins sinuous, the inner margin concave; costal and subcostal veins anastomosed near the base and only separating in the form of a subcostal branch at the apical third; subcostal vein emitting its two ordinary branches near together from the anterior extremity of the cell, which is prolonged as in the primaries; the remaining veins correspond exactly in character with those of the primaries: body rather slender, sparsely clothed, excepting on the collar and patagia, which are woolly, with coarse scales; antennæ widely pectinated; mouth-parts aborted; legs short, thick, with the spines aborted, only showing as minute processes on the middle tibiæ.

Dianeura Goochii, sp. n. (Fig. 4.)

General form of *Agalope*, but coloured more like *Anomœotes*: wings hyaline, the bases and inner borders suffused with pale tawny, the apices and outer margins grey; veins blackish: body reddish brown, antennæ black; legs buff. Expanse of wings 32 millim.

Natal (*Gooch*).

This very remarkable moth is the one referred to in my paper on *Doratopteryx* (Ann. & Mag. Nat. Hist. ser. 5, vol. xvi.

p. 52) as intermediate between *Pedoptila* and *Agalope*; the transverse veining of the costal border of primaries, nevertheless, is wanting in both these genera; but I find it extremely highly developed in the Chalcosiid genus *Callamesia* (fig. 6), even extending to the second subcostal branch, and it is not at all unlikely that other genera of the same family may prove to have traces of the same unusual structural peculiarities.

It will be remembered that when I described a fossil butterfly (Geol. Mag. 1873, vol. x.) Mr. Scudder objected to its being regarded as a lepidopterous insect on the ground that he had discovered what he believed to be traces of transverse veins upon the wings, a feature which he characterized (see Geol. Mag., Oct. 1874) as "decidedly anti-lepidopterous." To this opinion he still adheres, although I have shown that cross veins of the nature of those which he believed to exist in *Palæontina* are by no means unusual in some families, such as, for instance, the Cossidæ, Hepialidæ, or Psychidæ: had I described a fossil specimen of *Callamesia* as a moth there is every probability that Mr. Scudder would, and with greater excuse, have referred it to the Sialidæ; whilst the genus *Scopelodes*, fig. 5 (Limacodidæ), which has imperfect transverse veins across the costal borders of both primaries and secondaries and a series of divergent transverse veins across the inner border of the primaries, would, I think, be a poser, in spite of its possession of these Orthopterous characters.

Dianeura Jacksoni, sp. n. (Figs. 2, 3.)

♂ ♀. Hyaline white, the base of primaries and basal half of secondaries suffused with pale yellow; the veins and antennæ blackish: body above pale brown, below brownish testaceous, the legs almost bare. Expanse of wings, ♂ 22 millim., ♀ 31 millim.

Manda Island, June 1886 (*F. J. Jackson*).

The discoidal cell of secondaries in this species is much less prolonged in front than in *D. Goochii*. I have figured a curious abnormality in the neuration of the female at fig. 3.

BIBLIOGRAPHICAL NOTICES.

Contributions à l'étude des Bopyriens. Par Alfred Giard et Jules Bonnier. 4to. Lille, L. Danel, 1887.

Our knowledge of the parasitic forms of Crustacea has increased remarkably of late years, and with each advance that has been made the interest attaching to them has widened. In 1840, when Milne-Edwards published the third volume of his classical "Histoire naturelle des Crustacés," the parasitic forms noticed by him, besides the well-known Entomostracan fish-parasites, were limited to the *Cyami* and three species of Bopyridæ, namely an *Ione* and two *Bopyri*. In the same year, however, Duvernoy described a species of Bopyrian from the Mauritius as the type of a new genus to which he gave the name of *Kepon*, and from that time the number of known forms of Bopyrian and Cirripedian parasites has gone on steadily, and indeed rapidly, increasing. In both groups the animals infested have been for the most part Crustaceans of the Decapod group, and it may be remarked that the study of the life-history of the parasites has revealed some most curious circumstances in connexion with the phenomena of double parasitism presented in some cases, the influence of the parasites upon the external characters of the animals infested by them, and the singular taxonomic parallelism which appears in many instances to exist between the parasites and their hosts.

The keynote of these curious investigations was no doubt struck by Dr. Fritz Müller, the distinguished naturalist of Desterro, in his contributions to the 'Archiv für Naturgeschichte' and the 'Jenaische Zeitschrift,' and in his remarkable work "Für Darwin;' but many interesting points had already been indicated by Steenstrup and Lilljeborg, and by Darwin himself, before the influence of his ideas set Fritz Müller to work upon the materials with which the Brazilian coast furnished him for such researches. Since the appearance of these memoirs, in 1862 and 1864, and especially within the last ten years, many European zoologists have worked vigorously and successfully upon the investigation of these parasites, particularly the Bopyride forms, with the result of adding greatly to our knowledge of the European types and their life-history.

A place in the front rank of these investigators must certainly be assigned to Prof. Giard, one of the authors of the work of which the title stands at the head of this notice; with the aid of the resources of the zoological laboratory at Wimereux, and by his own personal researches on other parts of the French coast, he has accumulated a great number of interesting details upon the Bopyride parasites, which he has from time to time communicated in papers read before the Academy of Sciences and elsewhere, translations of some of which have appeared from time to time in our pages.

Some two years ago, as we are told in the preface to the present work, Prof. Giard and M. Jules Bonnier (Demonstrator at the laboratory of Wimereux) resolved to combine their efforts in order to prepare a monograph of the Bopyride Crustacea or Epicarides; but the difficulties inherent in the work proved to be greater than they expected, and they have thought it best to publish as much as they could at once work up, without waiting to finish what would require years of labour for its completion. Here, therefore, we have the history of only two of the groups into which the Epicarides are divided, the subfamily Ioninæ and the Entoniscidæ.

The treatment of the subject which the authors have adopted is as follows:—Selecting as the type of the group to be discussed some species which they have had the opportunity of examining thoroughly, they describe in detail its external and internal structure, notice its mode of occurrence, its development and mode of life, and finally its relationships, the last-named subject leading to a submonographic revision of the genera and species referred to the group of which it is taken as the representative. Thus in the first section of their memoir, which is devoted to the Ioninæ, they take as the type a species described under the name of *Cepon elegans*, parasitic upon *Pilumnus hirtellus* at Wimereux, and following the mode of treatment above indicated, furnish full particulars of the structure and natural history of the creature, with occasional references to the writings of other authors who have noticed members of the same group. This special description is followed by a systematic summary, giving a list, with synonyms, of all the genera and species of the subfamily Ioninæ, with characters of the genera and frequently of the species, and notes on the habits and mode of occurrence of the latter. For the Entoniscidæ the type selected is the parasite of the common Shore-Crab, described by Giard under the name of *Entoniscus mænadis*, but now placed by the authors in a new genus, *Portunion*. In their treatment of this group the authors, while specially describing the form selected as illustrating it, refer more to characters and peculiarities presented by other forms, and, especially in the section on the ethology of the parasite, they go into various most interesting questions connected with the history of these crustacean parasites, and with the phenomena of parasitism in general.

We are quite conscious that in what has been said above we have given a very imperfect account of a most excellent and exceedingly important work, but to do more would have carried us to a much greater length, and we can only hope that the few lines which we have been able to devote to it will suffice to indicate to those interested in the subject the rich store of material which is here opened up to them. So far as one can judge without special study of the objects, the authors' work has been most admirably done; in fact, in some respects, in its thoroughness and evident truthfulness especially, it reminds one not a little of the work of the great English naturalist whose loss we all still regret so heartily. It is, in fact, a book that Charles Darwin would have welcomed with open arms.

Forming the fifth volume of the "Travaux de l'Institut zoologique de Lille et du Laboratoire de Zoologie maritime de Wimereux," its titlepage bears, not inappropriately, a woodcut of the little "chalet" at Wimereux where so much of the work recorded in its pages has been carried on. Throughout the work a number of woodcuts are intercalated in the text, whilst the general illustration of the book is provided for by the beautifully executed plates, in which many of the figures are coloured. We can only hope that MM. Giard and Bonnier may some day be able to complete their proposed monographic work, and to furnish us with an equally good account of the remaining groups of the Epicarides.

Freshwater Sponges: a Monograph. By Edward Potts. *Including 'Diagnosis of the European* Spongillidæ.' By Prof. Franz Vejdovsky (Prague). Pp. 279, with 12 plates. (Proceedings of the Academy of Natural Sciences, Philadelphia, 1887, p. 157 *et seq.*)

Our acquaintance with the Sponges has of late years become so extended that they can no longer be regarded by the naturalist with that indifference which characterized their study when this branch of living beings was only considered for its commercial value. The part which the Spongida have taken, and are still taking, in transforming the invisible into the visible objects of the world has latterly been so realized that to ignore it any longer in failing to direct attention to it seriously would be to disregard the existence of a vast number of living forms which we could or did not care to understand.

Thus the sponges *generally* have now become objects of much interest, for they are not only to be found in great abundance living in their natural habitats all over the world, but also, to an almost equal extent, in a fossilized condition; while lately Dr. G. J. Hinde, F.G.S., has shown that their presence has considerably changed even the composition of whole geological strata by the diffusion of silica which has become liberated from the disintegration of their spicules (Geol. Mag., Oct. 1887, p. 435 &c.).

Thus the study of the Spongida not only becomes an essential part of biology, but also one of palæontology and geology. Of course the former led to the latter, as it is mainly by the study of what is taking place at the surface of the earth at the present time that we are enabled to interpret the past.

As the products of the earth were at first sought after for their direct utility to man, so the species which served that purpose were the first to attract attention; hence the sponges of commerce have been known from great antiquity, and the most useful ones being marine, those of the sea were the first to be noticed; but when man began to find that all objects were of interest, if not of indirect utility, similar ones in freshwater accumulations claimed his notice, and thus from their intimate resemblance he learnt that sponges were to be found in fresh as well as in salt water.

Latterly many valuable contributions have been made to our knowledge of the Marine Sponges, both living and fossil: and now we have to chronicle one of not less consequence on the Freshwater Sponges, viz. that the title of which heads this article.

Of this contribution we must observe *in limine* that having been published in the pages of a scientific journal shows that it is not to be regarded as written for pecuniary emolument, but rather as a "labour of love," which, when backed by the enthusiasm of a *bonâ fide* naturalist (that is, an ardent desire to pursue truth and nothing but the truth), guarantees a result that in this respect is seldom equalled by one undertaken for mere pecuniary remuneration.

The 'Monograph' embraces all of any consequence that has been published up to the present day, and much more that has not been published at all, which has been obtained by Mr. Potts from the abundance of species and varieties of Freshwater Sponges existing in the neighbourhood of Philadelphia, where he would appear not to have "left a stone unturned;" while in all other instances he has possessed himself of actual specimens of the species or varieties described before putting pen to paper; so that with this determination to state nothing but what has been confirmed by his own ocular demonstration, he has produced a work that must be one of reference for a long time to come.

In quotations, where possible, Mr. Potts prefers the exact words of the author, and only where absolutely necessary substitutes condensation; while references to titles, dates, &c. accompany everything that he has stated; so that in this matter Mr. Potts has been as scrupulously careful as in his identification of the species described by means of actual specimens.

The plan of the 'Monograph,' after a list of "Contents" and a "Preface," is to begin with a few words of elementary information, "to aid those who for the first time undertake the study of Sponges," in which many useful hints will be found that were suggested to the author during his numerous excursions in search of Spongidæ.

Then comes the translation into English of a valuable paper (originally written in German) by Prof. F. Vejdovsky, of the University of Prague, entitled "Diagnosis of the European Spongillidæ," which was drawn up at the request of Mr. Potts, as his own personal experience had been chiefly confined to North America; but although this adds greatly to the value of the work, the author tells us that he has found it most convenient to follow in his descriptions the more general classification proposed by Mr. Carter, introducing his own *new* genera, species, and varieties in their appropriate places as he proceeds.

And in this part (which forms the bulk of the 'Monograph') it is that we see what an immensity of time and labour the author must have bestowed on his subject both in compilation and actual research. Here the result of that indomitable perseverance appears which could only arise from an enthusiastic love for the work and a conscientious determination *not* to put forth anything but that which would be a safe guide to the young and inexperienced student. While in his concluding remarks he observes that in closing his 'Monograph' "it is with the consciousness that the work of classification occupies a very humble place among biological efforts and that all systems must of necessity be tentative and temporary, soon to be superseded by others, the results of a larger knowledge gained by the contemplation of a wider horizon." Thus the reader must not expect to find any more in this respect than exists in the table of "Contents" at the commencement of the 'Monograph.'

Still, after some suggestions towards the attainment of this object, the author states that "there is no more hopeful field of labour for a young naturalist seeking for 'new worlds to conquer' than that provided by the Freshwater Sponges."

Truly there is much yet to be done in spongology generally, both specifically and physiologically, towards classification before it can be put on a par with botany in these respects; but who can expect this to be otherwise with a science that is hardly a century old?

The text is accompanied by twelve plates, the numerous representations in which, with copious explanations, are, in point of exactness, in keeping with all that has preceded. They are not on the *scale* which commands attention from its great size (that is, like the figures over a caravan at a country fair), but, on the contrary, so small and unpretending as almost to require a lens for the examination of their detail, whose minuteness and truthfulness to nature will then be found to present objects of much admiration.

We congratulate Mr. Potts on having produced a 'Monograph' which is characterized throughout by modesty, ability, and, pre-eminently, practical utility.

A Manual of Zoology for the Use of Students, with a General Introduction on the Principles of Zoology. By HENRY ALLEYNE NICHOLSON, M.D. &c. Seventh Edition, rewritten and enlarged. 8vo. Blackwood: Edinburgh and London, 1887.

WE have had occasion so frequently to call attention to the publication of successive editions of this 'Manual,' that it would be hardly necessary to do more than to notice its reappearance, were it not that the author has made so many additions and alterations in the present edition as to place the book upon a new footing. It is, as announced on its titlepage, to a great extent rewritten, and is very considerably enlarged; and an examination of the contents will show that the author's labours have not been thrown away, as the book is a very great improvement upon its predecessors.

Of course the general treatment of the subject is the same as before, and the work is cast in the same shape; but throughout we find evidence of the influence of the most recent additions to the literature of scientific zoology. This is marked not only in the systematic portion of the book, but also in the general introduction, in which the author has touched, briefly indeed, upon all the more important points which have come to the front of late years, especially those raised by the promulgation of the Darwinistic theory of evolution.

In connexion with the system of classification adopted we may remark that Dr. Nicholson has separated the Sponges from the Protozoa, but without uniting them with any recognized group of the Metazoa—he treats them "as a separate subkingdom under the name of Porifera." In this course, considering the difficulties surrounding all attempts to deal with the Sponges, we think he is in the right, judging from our present lights, and he carefully indicates some of the difficulties in question arising from the peculiarities of certain constituent elements of the sponge-body.

The Cœlenterata are treated in considerable detail and evidently with reference to recent investigations, especially those of Prof. Moseley on the Hydrocorallinæ. It may be noted in passing that Dr. Nicholson cannot be charged with taking part in that "conspiracy of silence" upon which the Duke of Argyll descanted so eloquently in a recent number of 'Nature.' He even says that the recent researches of "Semper, Murray, Guppy, &c. have shown that Darwin's theory cannot be accepted as a universal explanation of the mode of origin of atolls and barrier-reefs, even if it be partially true."

Prof. Huxley's subkingdom Annuloida is given up by Prof. Nicholson, who, however, retains the class Scolecida, as including the whole of the Entozoa, the Turbellaria, the free Nematoid worms, and the Rotifera—a somewhat incongruous assemblage, the principal distinctive characters of which are the presence of a water-vascular system and the absence of a ventral chain of ganglia. The remainder of the Annulosa are divided into Anarthropoda and Arthropoda, and the classification adopted is that generally employed by systematic zoologists. The weakest portion of this section, and, indeed, of the whole book, seems to us to be that treating of the Insecta; but this is a reproach which may be made to most text-books of zoology. The division Molluscoidea is still retained for the Brachiopoda and Polyzoa, the Tunicata being inserted between the Mollusca and Vertebrata. The latter are treated at very considerable length, occupying three eighths of the systematic portion of the book; but the space bestowed upon them is certainly well employed, and this section furnishes one of the best guides to the structure and classification of vertebrate animals with which we are acquainted. In saying this we have no intention of making a comparison of the vertebrate and invertebrate sections to the disadvantage of the latter—the greater complexity of the machinery of life in the Vertebrata necessitates their being treated at greater length than their invertebrate fellows, and this is especially the case when the book to be written is intended especially for the use of students.

This Manual is in fact, to a great extent, a treatise on the morphology of animals. References to habits and mode of life are of necessity cut down to the smallest possible dimensions; but the author carefully indicates the general distribution of the representatives of the various groups in time and space, and of course some notice of the living relations of the animals to each other and the outer world is indispensable in many cases. The book is an admirable guide for the zoological student, and its value is greatly increased by the copious lists of authorities given at the end of each chapter and by the copious glossary with which it terminates.

We have yet to say a few words upon the illustrations of the work. These, as in former editions, are all woodcuts; but their number has been greatly increased in the present issue, the new figures being for the most part derived from the most important of the many valuable memoirs which have appeared during the last few years. The execution of these new figures is admirable, and as they have been most judiciously selected they add greatly to the value of the book.

Living Lights; a Popular Account of Phosphorescent Animals and Vegetables. By C. F. Holder. London, 1887.

We must own to being a little disappointed with Mr. Holder's last book, for it bears obvious marks of haste in the structure of many of the sentences and the form in which scientific terms have been allowed to pass the "reader's" eye. However, we do not suppose that these failings will strike the kind of reader whom we imagine Mr. Holder wishes to attract. The book is strictly a popular one, the "systematic portions necessary to the student," which have been "placed in an appendix," being very unequal: to whom, pray, is the information addressed that *Ophiura* is so called "on account of the resemblance to snakes in its arms"? The scientific man does not want it, and if the schoolboy does he will wonder whether the author means really that *Virgularia* is derived from *vira*, a rod; for the schoolboy (happy youth!) knows not of misprints. The "Neiridæ and Eunicedæ" are not "genera of the group Annelida." The Bibliography is simply shocking—*e. g.* "Ehrenberg. Das Leuchten des Meeres. Abhandlung," or "Leydig, Professor. Bonn, Germany. Phosphorescence of Fishes. 10 plates;" but this, perhaps, is the gem for an English book, "1875. Darwin. Voyage d'un Naturaliste autour du Monde. Paris."

The illustrations are fairly good, and we hope Mr. Holder or his publishers have made some pecuniary recompense to those who first produced them, for no acknowledgment of assistance is made in the book itself.

The book is hardly one for the ordinary readers of the 'Annals;' but those who are blessed with children will probably find that they think the writer in their father's journal a great deal too severe.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 23, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "Note on a New Wealden Iguanodont, and other Dinosaurs." By R. Lydekker, Esq., B.A., F.G.S.

The new species of *Iguanodon* was founded upon a left ilium and ischium, parts of the pubis and tibia, two metatarsals, several dorsal, lumbar, and caudal vertebræ and other bones, obtained by Mr. C. Dawson, F.G.S., from the Wadhurst clay of the Hastings Sand. The species now described, which was named after the discoverer, and *Iguanodon Prestwichi*, were shown to form a peculiar and aberrant group of the genus *Iguanodon*. A maxilla from the Wealden of the Isle of Wight was also described and referred to *Ornithopsis*.

The recent examination by the author of the remains of Dinosauria in the British Museum for the purpose of preparing a Catalogue, had enabled him to make several notes on the various forms represented in the collection, and these notes were embodied in the present paper. The principal subjects mentioned were the following:—The identification of *Iguanodon Seeleyi* with *I. bernissartensis*; the genera *Sphenospondylus* and *Cumnoria* of Prof. Seeley; a British species of *Trachodon* from the Cambridge Greensand; an ilium, provisionally referred to *Hylæosaurus*, from Cuckfield; the genera *Vectisaurus* and *Regnosaurus*; the relations of the Sauropoda and Theropoda; the type specimen of *Ornithopsis Hulkei*; the similarity of the humerus in *Pelorosaurus* and *Brontosaurus*; the vertebræ and other remains of *Cetiosaurus brevis*; the humerus of *C. humerocristatus* and its relations to *Ischyrosaurus*, Hulke, *Gigantosaurus*, Seeley, and *Ornithopsis Leedsii*, Hulke; the affinities between *Cetiosaurus oxoniensis* and *Morosaurus*; the occurrence of *Titanosaurus* in the Wealden of England and the possible identification of that genus with *Dinosaurus* of Owen; the vertebræ described by Owen as *Bothriospondylus magnus*; the types of the genera *Thecospondylus* and *Bothriospondylus*; and some Megalosaurian teeth.

2. "On the Cae-Gwyn Cave." By T. McKenny Hughes, M.A., F.G.S., Woodwardian Professor of Geology, Cambridge.

The subject fell into two divisions: the Age of the Drift outside the Cave, and the relation of the deposits in the cave to that Drift. The Author contended that the drift outside the cave was a marine deposit *remanié* from older beds of glacial age, but was itself postglacial and of approximately the same date as the St.-Asaph drift; in confirmation of which he gave the following list of shells from that drift outside the cave:—*Ostrea edulis*, *Pecten varius*, *Mytilus edulis*, *Cardium echinatum*, *C. edule*, *Cyprina islandica*, *Astarte borealis*, *A. sulcata*, *A.* var., *Venus gallina*, *Tellina balthica*, *Psammobia ferroensis*, *Mya truncata*, *Fissurella græca*, *Littorina littorea*, *Turritella terebra*, and *Buccinum undatum*; pointing out that there was only the one species of *Astarte* among them which was not common on the adjoining coast, just as there were in the older postglacial river-gravels of the S.E. of England two locally extinct forms, the *Corbicula fluminalis* and the *Unio littoralis*, and discussing various difficulties, stratigraphical and palæontological, in the way of accepting the view that the cave-deposits were glacial, interglacial, or preglacial. For instance, he remarked that there were no marks of glaciation on the face of the rock in which the cave occurred; that the cave-deposits were like drift because derived from it, but that no continuity existed between the drift and the cave-deposits; that there was a much greater thickness of rain-wash and resorted marine-drift looped down over the upper opening into the cave than over the adjoining surface. The upper part of this resorted drift is exactly similar to the material which had accumulated against the old fence, the very existence of which had been denied. The swallow-hole action to which he referred the phenomena was proved by the opened fissures and vertical cylindrical holes in the limestone and by the occurrence of a land-shell (*Zonites cellarius*). He held that there had been a break-down of the roof and wall of the cave under the drift, and that angular masses of limestone, due to this cause, were found all along in front of the upper opening to the cave. No bones were found outside that barrier, there being no bones in the shell-bed and no shells in the bone-bed except the land-shell washed down through a fissure.

Instead, therefore, of the difficult task of proving that there were in the district many well-known processes connected with subterranean denudations, which might explain the superposition of the marine drift upon the bone-earth, each of which had played a part in producing the results observed, he maintained that we had now the clearest evidence as to the exact manner in which it was all brought about, namely, that the marine drift was deposited before the occupation of the cave by the animals whose remains have been found in it; that at the time of the occupation of the cave the upper opening now seen did not exist, but the animals got in by the other entrance; that against the wall of the cave where it approached most nearly to the face of the cliff the drift lay thick as we now see it; that by swallow-hole action the cave was first partially filled, and then the thinnest portion of its wall gave way gradually, burying the bone-earth below it, and letting down some of the drift above it, so that some of it now looks as if it might have been laid down by the sea upon preexisting cave-deposits.

December 7, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Discovery of Trilobites in the Upper Green (Cambrian) Slates of the Penrhyn Quarry, Bethesda, near Bangor, North Wales." By Dr. Henry Woodward, F.R.S., V.P.G.S.

The absence in Wales of organisms in the Longmynd and Harlech group renders any discovery of fossils in beds of this early horizon of the utmost importance.

A portion of a Trilobite (*Palæopyge Ramsayi*) and Annelide burrows had already been found; but Dr. Hicks, at St. Davids, has added a sponge, 2 Ostracods, 6 Trilobites, 2 *Lingulellæ*, and 2 *Thecæ* (*Agnostus, Plutonia, Paradoxides, Conocoryphe Lyelli, C. bufo*, and *Microdiscus sculptus*).

Dr. Hicks has pointed out the singular absence of organic remains in the Longmynds in Shropshire, N. Wales, and Ireland, and has urged the need of further explorations. As if in answer to this, the Author has received from Prof. Dobbie an impression and counterpart of a Trilobite from Bethesda, near Bangor, about $3\frac{1}{2}$ in. long and $1\frac{3}{4}$ in. broad, also the head of a second specimen of the same species. These specimens were obtained from the Upper Green bed of the quarry, which immediately underlies the grits forming the brow of Bronllwyd and above the Purple Slates. The glabella is marked by three oblique furrows on each side, the cheek-sutures are very obscure, and the eyes, which are minute (probably rudimentary), occupy the centre of the free cheek, the suture obliquely dividing the free cheek from the fixed. The outline of the head is rounded. There are fourteen free thoracic segments. The pygidium consists of about three coalesced somites.

Comparing the Bangor fossil with *Paradoxides*, we find that *Paradoxides* has about twenty free segments.

Asaphus, Ogygia, and *Niobe* have only eight thoracic rings, and the caudal shield is very large.

Angelina agrees with the Bethesda specimen in the number of its free segments; but the glabella is smooth, the pleuræ are broader, and the cheek-spines very long.

Olenus has fourteen rings; the glabella is furrowed, but the head-shield is shorter and broader, and the ends of the pleuræ and margin of the caudal shield are usually produced into spines. *Olenus* is also smaller.

Conocoryphe has fourteen free segments; the axis is parallel-sided, and does not diminish backwards from the head to the pygidium: each ring of the axis is notched on its posterior border, and the ends of the pleuræ are rounded; the glabella is furrowed obliquely; the eyes are often wanting or are minute.

From these considerations the Author considered the Bangor fossil to be referable to *Conocoryphe*, and to a new species, *C. viola*.

The Trilobite was found by Robert E. Jones and Robert Lloyd, two quarrymen, at Bethesda. Afterwards Prof. Dobbie found a detached head of the same species near the spot where the original was obtained. The Author desired to return thanks to Prof. J. Dobbie, of the University College of North Wales, Bangor, for the opportunity of describing these specimens.

2. "On *Thecospondylus Daviesi*, Seeley, with some Remarks on the Classification of the Dinosauria." By Prof. H. G. Seeley, F.R.S., F.G.S.

The Author described the anterior third of a vertebra from the Wealden, which was recognized by Mr. Davies as the cervical vertebra of an animal allied to the genus *Cœlurus*, Marsh. The only European genus hitherto described in which the vertebræ are similarly elongated, compressed, and enveloped in a dense external film of bone is that indicated by the sacrum, named *Thecospondylus Horneri*, whose vertebræ are about 11 centimetres long, whilst the cervical vertebræ now under discussion were 9 centimetres long when complete. The specimen has lost the prezygapophyses and cervical ribs. If these were restored they would probably approximate in shape to those of *Cœlurus fragilis*.

The Author gave an outline-restoration. The points of resemblance were chiefly the elongated form, lateral compression of centrum and neural arch, inclined articular face of centrum, mode of attachment of the ribs, the convex external surface of the neural arch, almost total suppression of the neural spine, and the thin texture of the bone. But this affinity does not amount to generic identity, and he indicates the points of difference. In estimating the resemblance to *Thecospondylus* he regards the thinness of the investing layer of bone, the smoothness of its internal surface, the elongation and lateral compression of the vertebræ, and a certain general approximation in form; the most remarkable difference is the absence from the cast of *Thecospondylus Horneri* of indications of films of bone, or evidence of internal plates, such as are seen in the present specimen. The Author observed that Prof. Marsh regards *Cœlurus fragilis* as a generalized Sauropsid, with more resemblance to Dinosaurs than to Pterodactyles.

Professor Marsh has formed an Order, Sauropoda, which includes *Cetiosaurus* and *Ornithopsis*. The Author remarked that he had already suggested Cetiosauria as separable from the rest of the Dinosaurs. When an additional Order is instituted for animals with cavernous or pneumatic vertebræ, the Theropoda of Marsh, under which *Cœlurus* is grouped, it becomes necessary, in order to determine the systematic position of *Thecospondylus*, to review its relations. The Author would unite Sauropoda with Theropoda into one Order, the Saurischia, whose pneumatic skeleton is an approximation towards Ornithosaurs and Birds.

MISCELLANEOUS.

Note on the Genus Lophopus.

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

GENTLEMEN,—My attention has been directed to a paper in the 'Journal of the Linnean Society of London,' Zoology, no. 117, vol. xx. June 1887, by Stuart O. Ridley, M.A., "On the Characters of the Genus *Lophopus*, with a Description of a new Species from Australia." In the paper Dr. R. von Lendenfeld is credited with the discovery and preservation of the species described. If there is any credit due it is to me, from the fact that I collected, preserved, and exhibited the specimens from which the species has been described; and the first time Dr. Lendenfeld saw them was in the rooms of the Linn. Soc. of New South Wales (see 'Proceedings,' vol. x. p. 760, 1885) after they had been in spirit for some time. In a letter of mine which appeared in the 'Ashton Reporter,' Saturday, March 20, 1886, published at Ashton-under-Lyne, Lancashire, England, an account of the same specimens is given; and in the 'Transactions of the Manchester Microscopical Society' for 1886 will be found an account of "A Method of Killing Polyzoa" by myself, which is that employed in the preservation of the species in question. A few days before Dr. Lendenfeld left Sydney I gave him a bottle containing portions of my first gathering which were without statoblasts; but in order to render the species complete for description I made a special journey to Parramatta, in my own time and at my own expense, to obtain specimens which possessed them. I found them in plenty, but only in those in a dying or dead condition; and I added a small twig which was covered with the remains of the animals and full of statoblasts. I may also say that the bottle together with the specimens was given to Dr. Lendenfeld by me for him to give them to Prof. Allman, F.R.S., for description. From the above facts your readers will be able to judge who is deserving of credit in this matter.

I am, yours faithfully,
THOMAS WHITELEGGE.

Australian Museum,
Sydney, New South Wales,
October 31, 1887.

On the Existence of a Fish belonging to the Genus Neopercis *in the Atlantic.* By M. LÉON VAILLANT.

In dredging no. cvii. of the 'Talisman' (1883), at a depth of 75–90 metres, between St. Vincent and St. Antoine, in the Cape-Verd Islands, a fish was obtained of some interest as a matter of geographical distribution. It belongs to the family Trachinidæ and to the genus *Percis*, or to that division of the genus named *Neopercis* by Steindachner.

Neopercis includes four known species, all shore-fishes—one from the Bay of St. Vincent (Australia), *N. Ramsayi*, Steind., the three others from Japan, *N. sexfasciata*, Schl., *aurantiaca*, Död., and *multifasciata*, Död.

The Cape-Verd species seems to approach the last-named most closely; in fact it has to be carefully examined to find distinctive characters. The general coloration agrees; but in the Cape-Verd species the bands of the body occupy the whole depth instead of ceasing at the lateral line, the nuchal spot is produced on each side upon the opercular plates, and a band bordered with black descends obliquely upon the cheek behind the lower margin of the orbit. The pectoral fins do not notably pass the origin of the anal, the interorbital space is scarcely one third of the diameter of the eye, and the maxillary stops at the anterior margin of the orbit.

The species is named *Neopercis atlantica*, and its presence among the African islands is the more singular because not only all the other species of *Neopercis*, but the more numerous representatives of the genus *Percis*, are known only from the warm or temperate parts of the great Pacific Ocean or the Indian seas.—*Comptes Rendus*, November 21, 1887, p. 1032.

On the Pelagic Fauna of some Lakes in Auvergne. By M. J. Richard.

Last summer the author investigated the pelagic fauna of the following five lakes in the region of Mont Dore:—Pavin, Chambon, Guéry, Montcineyre, and Bourdouze. He generally worked at depths between 2 and 3 metres, but sometimes lower, down to 11 metres. He obtained twenty species belonging to the groups of Cladocera, Copepoda, Rotatoria, and Cilioflagellata.

The distribution of the species in these five neighbouring lakes is irregular, which may be explained by the difficulties in the way of the dispersion of pelagic animals. Thus *Hyalodaphnia cucullata*, Sars, var. *apicata*, Kurz, occurred only in Lake Chambon, and *Polyphemus pediculus*, De Geer, was met with only in Lake Pavin.

A remarkable species, regarded as characteristic of mountain-lakes, *Holopedium gibberum*, Zaddach, occurred in immense numbers in the lake of Guéry at a height of 1240 metres. It was also found, but less abundantly, in Lake Montcineyre, the most southern point reached by this species*.

In the neighbouring lakes Montcineyre and Bourdouze several species common to both occurred only in small numbers, being stray littoral species, namely:—*Sida crystallina*, O. F. Müll., *Alona affinis*, Leyd., *Acroperus leucocephalus*, Koch, and *Chydorus sphæricus*, Jurine.

Besides these few examples of very restricted dispersion, there are many cases of wide distribution: thus, *Daphnia longispina*, Leyd., is

* It was found recently, and for the first time in France, by MM. Dollfus and Moniez in the lake of Gerardiner.

wanting only in Lake Chambon; *Diaptomus castor*, Jurine, is wanting in lakes Chambon and Guéry; and both species abound in the other lakes. In Lake Pavin, to 7 or 8 metres from the shore, *D. castor* was of a bright vermilion-red; in the middle, to a depth of 11 metres, it was colourless.

Cyclops strenuus, Fischer, which is very abundant in small pieces of water, occurred in innumerable troops in all the lakes except Montcineyre. In the lakes it is colourless, while in small sheets of water it is generally red. The pelagic variety in the lakes is more slender, and in some respects approaches *C. lucidulus*, Koch. *Bosmina longirostris*, O. F. Müll., is wanting only in Lake Pavin; it abounds in lake Guéry, in company with *Holopedium gibberum*. These last four species are very common and abundant, and thus have the better chance of dispersion.

Ceriodaphnia pulchella, Sars, found abundantly in the lakes of Bourdouze and Montcineyre, is here clearly pelagic, as in the lakes of North Germany and in Gerardiner. Lastly, *Daphnella Brandtiana*, Fisch., occurred in immense numbers in lakes Chambon and Bourdouze.

With regard to the Rotatoria and Cilioflagellata the same remarks as to regularity of dispersion will apply. *Anuræa longispina*, Kellicott, was abundant in Lake Pavin, rare in Lake Chambon; *A. cochlearis*, Gosse, free, but very rare in Lake Montcineyre, and in the stomach of *Asplanchna helvetica*, Imhof, in Lake Bourdouze. *Asplanchna helvetica* was also met with in Lake Guéry. In Lake Chambon examples of *Anuræa curvicornis*, Ehr., were found in the stomachs of many specimens of *Asplanchna Girodi*, De Guerne. Colonies of *Conochilus volvox* were found abundantly in Lakes Pavin and Montcineyre.

Among the Cilioflagellata the author mentions only *Ceratium longicorne*, Perty, as being rare in Lakes Montcineyre and Bourdouze. He also refers to the Hydrachnids, *Atax crassipes*, O. F. Müll., *Axona versicolor*, O. F. Müll., *Nesæa rotunda*, Kram., and *N. reticulata*, as occurring in the lakes.

Among the Cladocera, *Hyalodaphnia cucullata*, Sars, var. *apicata*, Kurz, of which the latter author makes a distinct species, is new to the French fauna. This variety had hitherto been found only in Bohemia. A new Rotifer, *Asplanchna Girodi*, has been studied by M. J. de Guerne *.

Comparing the pelagic fauna of the lakes of the Auvergne with those of various European countries, we find that it has some points in common with all and that it differs from all in other points. Thus the following species are common to the lakes of the Mont

* 'Excursions zoologiques dans les îles de Fayal et de San Miguel (Açores),' Paris, 1887. In a monographic note on the genus *Asplanchna* M. J. de Guerne describes and figures *A. Girodi*.

Dore and those of North Germany:—*Ceriodaphnia pulchella*, Sars; *Hyalodaphnia apicata*, Kurz; *Bosmina longirostris*, O. F. Müll.; *Conochilus volvox*, Ehrbg.; *Anuræa cochlearis*, Gosse; *A. longispina*, Kellicott; *Asplanchna helvetica*, Imhof. But many other species do not occur in the Auvergne, while, on the other hand, *Holopedium gibberum*, Zaddach, has not been found in the lakes of North Germany. A comparison with the various European faunas gives similar results.

Comparisons thus made are not of great importance, especially for the establishment of regions with distinct pelagic faunas. In the first place it is necessary to make continuous and methodical investigations at different periods of the year. The European lakes will then, for the most part, present a multitude of common species, transported from the north of Europe, their centre of dispersion, from lake to lake, in the state of winter-eggs, by birds or by the winds. It is only by passive migrations that we can explain the existence of the pelagic fauna in the artificial lakes of Bohemia, for example, and particularly in the lakes of the Auvergne, as is shown by their geological situation. It is only in this way that we can understand how M. J. de Guerne * could have found in the Azores a perfectly European pelagic fauna in a crater-lake which dates from the fifteenth century.

Forel and Pavesi have established two groups which they regard as very distinct in the population of the middle of the lakes—that of the *eupelagic* species, which live only in the middle, and that of the *tychopelagic* species, which are littoral forms adapted to a life in the open water. According to this division there are in the lakes of Mont Dore only two *eupelagic* Cladocera, namely *Holopedium gibberum* and *Hyalodaphnia apicata*. This second species, however, is very numerous in the littoral zone. This is the case also with all the Rotatoria enumerated, several of which are regarded as *eupelagic* by Pavesi. These species, which, according to the definition given, ought only to occur in the middle of the lakes, seem, considering their number, to have adapted themselves to the life of the littoral animals. Ought we to invent for them an analogous term in opposition to the term *tychopelagic*? Probably no one will regard this as necessary.

What is certain is that a great number of species can live equally well in the pelagic region and in the littoral region. In the former case the animals become hyaline, more slender, and better swimmers.

Diaptomus castor is a striking example of the well-known fact just referred to. This animal is very abundant on the Mont Dore, and has all the characters of the eupelagic species. It does not occur, according to Zacharias, in the middle of the lakes of North Germany. Sars says that it seems to constitute an exception from the other Calanidæ by occurring only in small pools. Lake Pavin, which is 800 metres in diameter, with a depth of 95 metres, should hardly be ranged under this category. It is but small indeed

* *Loc. cit.*

when compared with the Norwegian lakes. But then *Holopedium gibberum* of Lake Guéry lives in a shallow pool of water! This lake is, in fact, of less extent than Lake Pavin and hardly 8 metres in depth.

With creatures of the size here in question the mass of water in Lake Pavin and much more considerable masses will hardly prove to be very different in their action.

Two principal conclusions may be drawn from the facts hitherto ascertained:—

1. The peopling of the lakes of the region of the Mont Dore appears to have been effected by passive migrations.

2. The pelagic fauna of these lakes is constituted in a general way like those of the rest of Europe, and presents common points and points of divergence when compared with these different faunas. —*Comptes Rendus*, Nov. 14, 1887, p. 951; Dec. 12, 1887, p. 1186.

The Fauna of the Podophthalmous Crustacea of the Bay of Marseilles. By M. Paul Gourret.

The author states that the number of Podophthalmous Crustacea observed by him, of which he proposes to publish a revision, amounts to 124 species or varieties, 11 of which are new. These are:—

Pinnotheres Marioni, *Galathea Parroceli* *, *Crangon Lacazei* *, *Gnathophyllum elegans*, var. *brevirostris* *, *Alpheus Gabrieli* *, *Hippolyte Marioni* *, *Pontonia vagans*, *Callianassa subterranea*, var. *minor* *, *Siriella intermedia*, *Leptomysis Marioni*, and *Nebalia bipes*, var. *elongata*.

The fauna greatly resembles that of the Adriatic—90 species are common to both. There is almost as close a similarity to the faunas of Naples, Nice, and Algeria, the number of common species oscillating between 82 and 66. The difference is much greater from the Spanish carcinological fauna (Balearic Islands and Madeira), which seems to include only 34 of the species obtained at Marseilles. This difference may be due to our imperfect knowledge of the Spanish fauna.

The following species obtained at Marseilles do not occur in any of the principal Mediterranean stations:—

Plagusia chabrus, *Pachygrapsus transversus*, *Ebalia nux*, *Eupagurus Bernhardus* and *lævis*, *Axius stirhynchus*, *Gebia deltura*, *Munida tenuimana*, *Galathodes Marionis*, and *Crangon trispinosus*.

Of these species, however, the first two are imported into Marseilles by ships from the Pacific, whilst *Ebalia nux*, *Eupagurus lævis*, *Munida tenuimana*, and *Galathodes Marionis* are species dredged from great depths. The four remaining species present a curious distributional fact, although *Gebia deltura* has been taken

* These forms were briefly described in a paper communicated by the author to the Academy on November 21, 1887.

y Costa in the Bay of Tarentum and *Eupagurus Bernhardus* at ·pezia by Neumann.

Eleven Marseillese species occur in a single other locality in the Mediterranean or at a few points distant from Marseilles and from each other, namely :—

Gebia deltura, *Axius stirhynchus*, *Eupagurus Bernhardus* and *timidus*, *Crangon trispinosus* and *spinosus*, *Atelecyclus heterodon*, *Macropsis Slabberi*, *Siriella Clausii*, *armata*, and *crassipes*.

On the other hand, some species are found in all the localities, at Nice and Naples, in the Adriatic and in Algeria, or on the western coast of Spain, such as :—

Heterograpsus Lucasii, *Pachygrapsus marmoratus*, *Carcinus mœnas*, *Pisa tetraodon* and *Gibbsii*, *Stenorhynchus phalangium* and *longirostris*, *Ilia nucleus*, *Dromia vulgaris*, *Clibanarius misanthropus*, *Pagurus striatus*, *Eupagurus anachoretus* and *Prideauxii*, *Scyllarus ursus*, *Nika edulis*, and *Crangon cataphractus*.

These are species peculiar to temperate seas with the exception of the *Clibanarius*, which has been noted in boreal regions. Some others occur only along the western shores of France without passing north of the Channel; such are *Pachygrapsus marmoratus* and *Carcinus mœnas* [?]. Others ascend higher and abound in England, namely *Pisa Gibbsii*, the two *Stenorhynchi*, *Dromia vulgaris*, *Eupagurus Prideauxii*, *Scyllarus ursus*, and *Nika edulis*. A single species, *Pisa tetraodon*, exists in England, but seems to be absent in Gascony.

Of the 124 Marseillese species there are 45 common to Gascony and 55 belonging to the English fauna. On passing further to the north the relationship becomes more distant—the boreal provinces have scarcely 33 species which also occur at Marseilles. There is scarcely any relationship to the arctic seas—only three species are common, namely *Geryon longipes*, *Eupagurus Bernhardus*, and *Nebalia bipes*, and the first and third of these are abyssal.

The northern shores of Algeria have 71 species in common with Marseilles. The Canarian fauna contains scarcely 25 Marseillese species, a number which rises to 32 by the addition of some species from Senegambia and the Cape Verd. These are :—

Plagusia squamosa, *Nautilograpsus minutus*, *Pachygrapsus marmoratus*, *Gonoplax rhomboides*, *Carcinus mœnas*, *Bathynectes longipes*, *Liocarcinus holsatus*, *Portunus corrugatus* and *pusillus*, *Eriphia spinifrons*, *Xantho rivulosa*, *Lambrus massena*, *Pisa armata* and *tetraodon*, *Maia squinado*, *Machus dorhynchus*, *Calappa granulata*, *Dorippe lunata*, *Dromia vulgaris*, *Porcellana platycheles* and *longicornis*, *Diogenes varians*, *Galathea strigosa* and *squamifera*, *Virbius viridis*, *Eupagurus excavatus* and *Prideauxii*, *Scyllarus ursus*, *Gnathophyllum elegans*, *Palœmon treillianus*, and *Squilla mantis*.

Thus the Podophthalmous fauna of Marseilles includes 33 species which ascend into the boreal provinces and 33 in common with the Canaries, Cape Verd, and Senegambia. Of the latter 10 do not go further north than Marseilles or Portugal, namely :—

Plagusia squamosa, *Nautilograpsus minutus*, *Lambrus massena*, *Pisa armata*, *Ethusa mascarone*, *Dorippe lunata*, *Pagurus striatus*, *Diogenes varians*, *Gnathophyllum elegans*, and *Palæmon treillianus*.

The author considers that the Bay of Marseilles forms a very important geographical centre. The invertebrate faunas which it possesses present a mixed character, containing boreal and tropical species. This proves the existence of wide open communications during the Tertiary epoch, on the one hand with the boreal provinces through the Bay of Biscay and the south of Spain, on the other with the equatorial Atlantic.—*Comptes Rendus*, December 5, 1887, p. 1132.

On the supposed Peripheral Processes of the Clionæ. By M. E. Topsent.

In the calcareous walls of the galleries of the *Clionæ* numerous greenish-yellow or green filaments are found ramifying in the thickness of the perforated stones and shells, becoming slightly dilated here and there, and anastomosing or intercrossing in all directions. These have been described by M. N. Nassouow * as processes of the mesoderm of *Cliona stationis*, Nass., and he supposes them to indicate the points of activity of the perforating sponge. The author remarks that *à priori* this function seems very improbable, and on investigation he found that the filaments may be entirely wanting in shells attacked by *Cliona*, while they abound in old imperforate shells. He identifies the filaments with those of the vegetable parasites which have been long well known as perforating the calcareous parts of aquatic organisms, and suggests that when associated with *Cliona* the plants in question have simply availed themselves of the passages formed by the sponge to penetrate readily into the interior of the shells.—*Comptes Rendus*, December 12, 1887, p. 1188.

On the Formation of Vegetable Mould by the Action of certain Animals. By Dr. C. Keller.

The author's investigations, made under the tropics, and especially in the island of Madagascar, strikingly corroborate the discoveries of Darwin in this domain lying on the confines of biology and geology. Earthworms in point of fact have a most important action in the preparation of humus, and in Madagascar the principal part is performed by a colossal worm a metre in length, *Geophagus Darwinii*. In the coast region, as also in the mangrove-forests, the part of the earthworms in this work is fulfilled by Crustaceans, especially crabs.—*Session de la Soc. Helvétique des Sci. Nat.*, Août 1887; *Bibl. Univ.*, Nov. 15, 1887, p. 429.

* "Zur Biologie und Anatomie der *Clione*," in Zeitschr. für wiss. Zool. Bd. xxxix. (1883).

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IX.—*On some new Species of the Genus* Spongodes, *Less., from the Philippine Islands and the Japanese Seas.* By Dr. Th. Studer, Berne.

The following new species form part of a collection of Alcyonaria collected by Dr. Doederlein in the Japanese seas, also a specimen from the Philippine Islands kindly communicated to me by Professor Semper, of Würzburg.

I am greatly indebted to these gentlemen for having communicated their materials to me for description.

Spongodes Semperi, n. sp.

A thick, cylindrical, barren trunk, the base of which is fixed in the sand by means of stolons; from its upper end, which is bounded by a circular fold covered on the margin with polyps, it gives off a number of conical branches. These together form a rounded head, the middle branches being higher than the lower ones. Each branch is covered with relatively large polyp-heads, each of which is surmounted by a bundle of spicules. These heads are arranged on the branches in close spirals, the branches thus acquiring the form of spikes. The colony is rigid; the wall of the trunk is incrusted with large spindle-shaped spicules.

Colour in spirit greyish white.

Locality. Philippine Islands. Collected by Prof. Semper.

Spongodes glomerata, n. sp.

The colony forms a low bush, which appears to be divided into several spherical lobes. It is of a whitish colour, with reddish polyp-heads. Height 12 millim., breadth 45 millim. The short stem divides shortly above the base into diverging branches, which are covered from the commencement with polyp-bearing lobules; these arise from a very rapid ramification of the twigs, which bear bundles of polyps at the ends. The lobules are spherical, from 6 to 9 millim in diameter, and contain up to twenty polyp-heads, each surmounted by a stout spicule 2 millim. long. The folded tentacles, armed with small spicules arranged *en chevron*, form an eight-lobed operculum. The consistence of the whole is soft and yielding.

The species is most nearly related to *S. Savignii* (Ehrbg.), which also it most resembles in external habit.

Locality. Japan. Collected by Dr. Doederlein.

Spongodes punicea, n. sp.

An upright branched colony, 50 millim. high and 40 millim. in diameter, with a short stem and a lobose head, crowded with polyps. Colour purplish red, with yellowish-white polyp-heads. The stem rises from an incrusting base; it has a thickness of 10 millim. and a height of 10 millim., and then divides into thick branches, which, after a short course, terminate in somewhat flattened twigs. Previous to the final ramification they give off also several small branchlets, which come off at right angles. The ramification of the terminal twigs, which latter are about 2 millim. thick, takes place in a corymbose manner, in which the three to six terminal twigs bear the polyp-heads laterally, the polyp-heads being surmounted by bundles of spicules. The terminal twigs diverging from separate lobes of 5 to 10 millim. in diameter, which bear from ten to twenty calices. The two large spicules at the base of the tentacles converge ∧-like and form an operculum.

Locality. Japan. Collected by Dr. Doederlein.

Spongodes pumilio, n. sp.

The colony forms a low lobose mass, 25 millim. high and 85 millim. broad; of a whitish colour, with red polyp-heads, surmounted by silvery white bundles of spicules. A short trunk divides near its base into several thick branches, which are horizontally expanded. Each of these branches divides at the end into several divergent twigs, first, however, giving off lateral twigs on two sides. The terminal twigs speedily divide into little twigs, which are arranged in a corymbose manner and bear bundles of polyps in which each calyx is surmounted by a spicule of from 2 to 2·5 millim. in length. The heads are red, the lateral bundles of spicules white. In each bundle of polyps one polyp appears to be more strongly developed than the others and projects above them.

Locality. Enoshima, Japan. Collected by Dr. Doederlein.

Spongodes rigida, n. sp.

The colony is a loosely ramified, shortly pedunculate, head-like mass of rigid consistence. The colour of the mass is dark purple, of the polyp-heads yellow. Height of the colony 33 millim., diameter 35 millim. The short cylindrical stalk divides at a height of 12 millim. into a number of branches coming off on all sides. The branches are directed in part horizontally outwards, in part obliquely upwards, and bear at the end divergent twigs, which divide in a corymbose manner into the polyp-bearing terminal twigs. Each of the latter bears a bundle of from three to five polyps, whose heads are supported by a spicule from 2 to 3 millim. in length. Each head possesses an eight-rayed operculum, composed of yellow spindles 0·25 millim. in length. Numerous spindles occur imbedded throughout the entire mesoderm, which thereby acquires a firm rigid condition.

Locality. Japan. Collected by Dr. Doederlein.

Spongodes coccinea, n. sp.

The colony forms an irregular lobose mass, placed on the end of a short barren stalk, which has a leathery consistence. The head is thickly covered with polyps and is of a dark carmine-red colour. Height of the colony 45 millim., diameter 45 millim., length of the stalk 17 millim.

The ramification takes place in such a fashion that the main stem divides into a few (four) large flat branches, speedily giving off along their course and from their ends smaller secondary branches, which divide into smaller secondary and terminal twigs. These bear bundles of from four to six polyp-heads. These terminal lobules are united with the others into larger groups, and these again into four lobes which correspond to the four main branches. The polyp-heads are small. The dorsal bundle of spicules is only feebly developed and projects only slightly above the head. Eight groups of spicules form an opercular cover.

Locality. Enoshima, Japan. Collected by Dr. Doederlein.

Spongodes flabellifera, n. sp.

The colony forms an upright stem, 73 millim. high, from which, at a height of 30 millim. and upwards, branches come off on all sides. These speedily ramifying form at the end small umbels, in which each terminal twig bears a bundle of from three to eight polyps; but here and there also single polyps occur. The lowermost branches are flat and their twigs are fused together; they thus form fan-shaped serrated folia, the margins of which are beset with rows of polyps. The ramification is loose, so that it can easily be made out everywhere. The polyp-heads are pedunculate, free from one another for a short space, and slightly surmounted by bundles of spicules. The heads are surrounded by eight groups of spicules arranged *en chevron*, which project like teeth above the margin.

	millim.
Height of the sterile stem	30
Diameter	16
Height of the polyp-bearing portion	43
Diameter	35

The colour of the polyp-umbels is dark fleshy red, the stem and branches are white.

Locality. Enoshima, Japan. Collected by Dr. Doederlein.

Spongodes Klunzingeri, n. sp.

Spongodes ramulosa, Klunzinger, Korallthiere des rothen Meeres, p. 37, pl. iii. fig. 2.

Non *Spoygodes ramulosa*, Gray, Proc. Zool. Soc. 1862, pp. 28 and 29, figs. 5 and 6.

After a comparison of the typical specimen of *Spongodes ramulosa*, Klunzinger, which Professor von Martens most kindly lent me from the Berlin Museum, with specimens of Gray's species, it became evident that the two are specifically distinct. Hence the name *S. Klunzingeri* might be adopted for the species from the Red Sea described by Klunzinger.

X.—*Polyzoa of Mauritius*. By R. Kirkpatrick, Assistant in the British Museum (Natural History).

[Plates VII.–X.]

I have great pleasure in taking this opportunity of thanking the Rev. Thomas Hincks, F.R.S., for his kindness in reading my manuscript and offering many valuable suggestions.

Most of the forms described below were fragments incrusting the stem of a large *Gorgonia*; several specimens incrusted pieces of rock.

This small collection is remarkable for the large proportion of what seem to be new forms. Out of 36 species 23 appear to be new.

Family **Bicellariidæ.**

DIPLŒCIUM, nov. gen.

Zoarium dichotomous. Zoœcia in pairs back to back, each pair at right angles to those above and below; the pairs separated by short cylindrical corneous internodes; orifice of cell with notch in lower border.

Diplœcium simplex, n. sp. (Pl. VII. fig. 1.)

Zoœcia semitransparent, marked with a mosaic pattern; each pair, viewed laterally, forming a triangle (with the angles truncate); orifice suborbicular, with a rounded notch below; peristome not raised; no avicularia. Oœcia depressed, flattened.

In some parts of the branches the internodes are suppressed; but the general arrangement of the zoœcia is as described above.

It is doubtful in what family *Diplœcium simplex* should be placed. I have placed it in the Bicellariidæ merely provisionally.

Family **Cellulariidæ.**

Genus SCRUPOCELLARIA.

Scrupocellaria minuta, n. sp. (Pl. IX. fig. 3.)

Zoarium very slender, branched dichotomously. Zoœcia small, oblong; area occupying $\frac{1}{3}$ of cell; spines 4 on outer side, 2 on inner, operculum fan-shaped, entire; lateral avicularia large in comparison with cell, curved at apex; no anterior avicularia; vibracular cells vertical, with short vibracula; radical fibres simple (not hooked). Oœcia?

Genus NELLIA.

Nellia simplex, Busk. (Pl. IX. fig. 4.)

Nellia simplex, Busk, B. M. C. p. 19, pl. lxv.; 'Chall.' Rep. p. 27, pl. v. fig. 6.

The Mauritius specimen is in some parts crowded with oœcia, which I have not seen figured or described. The oœcia are half immersed in the superjacent zoœcium, cucullate, rather flattened from before backwards; marked with a short vertical ridge bifurcating above, and by a horizontal ridge formed by the lower border of the zoœcium above.

Family **Membraniporidæ**.

Genus Membranipora.

Membranipora defensa, n. sp. (Pl. VIII. fig. 8.)

Zoœcia corneous, large, ovate, slightly produced below; aperture oval, with raised, slightly crenulated margin; one short, thick, upright, bifurcate, oral spine at each upper angle, and 6–8 flattened spines on each side, bending over the aperture, interdigitating. No avicularia. Oœcia?

In some instances the spines have fused, thus forming solid bars above the aperture, and foreshadowing what takes place more completely in *Membraniporella*.

Membranipora marginalis, n. sp. (Pl. VII. fig. 2.)

Zoarium incrusting. Zoœcia large, oval, slightly produced below the area, the produced portion being thick, hyaline, marked with concentric curved lines; area oval, wider below than above; margin thick, sloping inwards to aperture, slightly crenate; no internal calcareous lamina; no avicularia. Oœcia cucullate, smooth.

Membranipora mauritiana, n. sp. (Pl. VII. fig. 3.)

Zoarium incrusting. Zoœcia varying in shape, generally oval; separated from each other by short tubes; very slightly produced below the area; walls of zoœcia hyaline in younger, opaque in older cells, granulose; area surrounded by a high crenulated border, oval, wider below than above; lamina hyaline, granulose; aperture (portion uncovered by encroachment of lamina) shaped like a wide figure of eight; orifice of zoœcium at top of cell semicircular, not truly articulated. Oœcium cucullate, smooth, opaque, not punctured.

The inter-zoœcial tubes are hardly discernible in the older parts of the colony; also the portions of the zoœcia produced below the area are obliterated.

Whether those forms of the Membraniporidæ with a calcareous lamina partially covering the "area" should be included under a distinct genus (viz. *Amphiblestrum*) or not is a vexed question.

The forms with the lamina seem to be intermediate between *Membranipora* proper and *Micropora*, the latter genus being apparently derived from *Membranipora* by the growth of the lamina over the whole area (excepting, of course, the operculum), and by the suppression of the infra-areal portion of the zoœcium; the circum-areal ridge of *Membranipora* would be represented by the raised line round the cell in *Micropora*.

In *Amphiblestrum* the operculum is still attached to the chitinous covering of the area to however great an extent the lamina may be developed.

In the opinion of many, to make a separate genus of those forms with the lamina is to make an artificial group.

Family **Microporidæ.**

Micropora coriacea, Esper.

Family **Steganoporellidæ.**

Steganoporella Rozieri, Audouin.

The Mauritius specimen belongs to the "normal form," with marginal tubercles, bilobate oœcium, without avicularia.

Family **Cribrilinidæ.**

Genus Cribrilina.

Cribrilina radiata.

Innominate form without avicularia.

Cribrilina radiata, var. *flabellifera*, nov. var. (Pl. X. fig. 4.)

The zoœcia in almost every respect resemble those of the "innominata" form of *Cribrilina radiata*, but a considerable modification has taken place in the avicularium. As in the Madeiran variety described by Mr. Hincks, the avicularium is developed as a distinct cell; but the mandible has a remarkable shape, being broad at the base, then tapering and branching out into two rib-like processes, and from the conjoined bases of the latter a thin triangular chitinous expansion arises.

Family **Microporellidæ.**

Stephanopora, nov. gen.

Zoœcia with semicular orifice, lower margin straight, not dentate, without sinus; peristome raised posteriorly; from anterior margins of wall thus formed a process is given off on each side uniting in front to form with posterior wall a tubular peristome incomplete below. From lower margin of peristome a broad branched process is given off uniting with processes from other zoœcia to form a secondary cribriform roof. Special pore wanting.

Stephanopora cribrispinata, n. sp. (Pl. X. fig. 5.)

Zoarium incrusting, loosely attached. Zoœcia broad, ventricose, smooth, hyaline, perforated by large, well-defined pores; margin of secondary orifice crowned by short spines. Avicularia none. Oœcia?

The specimen is placed in the family Microporellidæ, from its possessing a mouth of the shape characteristic of the Microporellidæ, and from the absence of features indicating an affinity with other groups.

The genus is based on the following characters:—Secondary cribriform roof, Microporellidan mouth, and absence of special pore.

Genus Microporella.

Microporella ciliata, Pallas.

Family **Porinidæ**.

Genus Anarthropora.

Anarthropora horrida, n. sp. (Pl. VIII. fig. 2.)

Zoœcia broadly expanded and rounded below, tapering upwards towards a tubular peristome; surface verruco-spinose (wart-like processes with short spines on the summit), punctured; primary orifice semicircular, with concave lower border; secondary orifice varying from oval to circular; on the front surface of the zcœcia (and occasionally apparently between the cells) short tubular avicularia, lengthening out above in the form of grooved spout-like processes. Oœcia?

Family **Myriozoidæ**.

Genus Schizoporella.

Schizoporella venusta, Norman.

Lepralia venusta, Norman, Ann. N. H., Jan. 1864, p. 84, pl. x. figs. 2, 3.
Gemellipora glabra, forma *striatula*, Smitt, Flor. Bry. pt. ii. p. 37, pl. xi fig. 207.
Schizoporella venusta, Hincks, Brit. Mar. Pol. p. 276, pl. xxx. figs. 6, 7.

The Mauritius form possesses most of the characteristics of the British one, but there is no umbo on the former.

On the other hand the two forms resemble one another in the shape of the orifice, the presence of modified and aborted cells, &c.

Schizoporella ampla, n. sp. (Pl. VII. fig. 4.)

Zoarium incrusting. Zoœcia ventricose, somewhat irregularly heaped; walls smooth, white, thick; orifice orbicular with articular notch; on one or both sides on a level with the articular notch, a small subcylindrical avicularian cell with small subtriangular mandible; scattered over the zoarium large avicularian cells with long pear-shaped mandibles. Oœcia prominent, globose, vitreous, punctate, fertile cells generally with two avicularian cells.

The form of the orifice in *Schizoporella ampla* was made the sole characteristic of a genus (*Gemellipora*) by Prof. Smitt (Flor. Bry. pt. ii. p. 37). Mr. Busk retains this genus in his 'Challenger' Report, but mentions as an additional character the presence of a median avicularium. *Schizoporella ampla* possesses the orifice characteristic of *Gemellipora*, but has, in place of a median avicularium, a similar organ on one or both sides of the mouth.

Genus Mastigophora.

Mastigophora Dutertrei, Aud., var. *pesanseris*.

Hippothoa pesanseris, Smitt, Flor. Bry. pt. ii. p. 43, pl. vii. figs. 159, 160.

The small avicularia (or vibracula) on each side of the mouth possess the peculiar "web-foot" mandibles.

In the British form these appendages are slender setæ. The difference of form in these appendages is merely varietal.

Genus Gigantopora.

Gigantopora lyncoides, Ridley. (Pl. VII. fig. 5.)

G. lyncoides was described by Mr. Ridley in his Report on the 'Alert' Polyzoa (Proc. Zool. Soc., Jan. 1881).

The type specimen in the British Museum consists of only a few fully developed cells.

In that specimen there is but little indication of the manner in which the tubular peristome and large pore are developed; but in the Mauritius specimens the manner of development of these secondary structures is evident.

The vibraculoid avicularia on each side of the orifice are elevated above the surface of the zoœcium, and arch over the orifice, forming a bridge over the latter. By the growth in breadth of the interavicularian portion of the bridge the tubular peristome and "pore" are formed. A calcareous rim grows up round the pore, thus rendering obscure the mode of formation of the latter.

The primary orifice of the zoœcium is subquadrate, the lower border sinuated.

From the mode of development of the tubular peristome and pore it is clear that *G. lyncoides* has no affinities with the Microporellidæ or Porinidæ, but belongs to the Myriozoidæ or Schizostomatous group of Escharidæ.

A supraoral bridge is formed in *Gephyrophora* in the same manner as in *Gigantopora*.

The presence of this bridge, formed in the manner indicated, may scarcely seem a character of sufficient importance on which to found a genus.

Genus Rhynchopora.

Rhynchopora bispinosa, Johnst.

In the Mauritius form the oral avicularium is only present on a few cells.

The oœcium is marked in front by a less thickly calcified area semicircular in shape.

Until I saw the oral avicularia the specimen seemed to me to be a new species of *Schizoporella*.

Family **Escharidæ**.

Genus Lepralia.

Lepralia gigas, Hincks.

Lepralia gigas, Hincks, Ann. & Mag. Nat. Hist. March 1885, pl. ix. fig. 8.

The Mauritius form is only loosely incrusting. The dorsal surface shows the zoœcia separated by broad bands; the square areas marked out are pitted by numerous large punctures.

Loc. Trincomalee, Mauritius.

Lepralia judex, n. sp. (Pl. VIII. fig. 4.)

Zoarium incrusting. Zoœcia radiating from a centre, rhomboidal, narrowed inferiorly, surface flattened; walls opaque, rough, granulose; orifice oblong, broader below than above; round the orifice, laterally and behind, a thick semicircular wall, extending on each side as far as the lower border of the mouth; on the upper border of the wall from fifteen to twenty marks, indicating the presence of as many stout spines in the perfect state. Avicularia none. Oœcia?

Lepralia Poissonii, Audouin. (Pl. VIII. fig. 1.)

? *Escharella setigera*, Smitt, Flor. Bry. pt. ii. pl. x. fig. 206.

This species is figured in Savigny's 'Description de l'Egypte.' The vibracula are represented as two apparently solid knob-like processes, and there are no setæ.

The Mauritius specimen is remarkable for the length of the setæ, which are in several instances more than twice the length of the cell. Perhaps it would be more correct to speak of the setæ as vibraculoid mandibles.

Lepralia mosaica, n. sp. (Pl. VIII. fig. 6.)

Zoœcia in linear series, by the branching of which and junction of adjacent cells an irregularly-shaped zoarium is produced. Zoœcia large, ventricose, surface shining, marked with a mosaic pattern, punctured; along the mid-line of the cell a longitudinal beaded line; orifice quadrangular, constricted above lower margin of the orifice by a projection on each side. Avicularia none. Oœcia?

The zoœcia are attached to the surface on which they grow and to each other, when contiguous, by a fringe of membranous processes, with a perforation at the base communicating with the body of the cell.

In one cell which had the misfortune to bridge over a chasm the basal fringe of processes is strongly developed in the endeavour of the zoœcium to attach itself securely.

Genus Phylactella.

Phylactella columnaris, n. sp. (Pl. VIII. fig. 3.)

Zoarium incrusting. Zoœcia large, ventricose, walls thick, white, punctured; orifice quadrangular, constricted on each side about the middle; lower border slightly concave; round the front and sides of the orifice a high peristome; rising from the body of the zoœcium a tubular avicularium, with small triangular mandible. Oœcia globose, punctured, below the level of and embraced by lateral walls of peristome.

The tubular avicularia in two instances rise from the front of the peristome. On one cell two columnar avicularia rise from the same base and diverge at an acute angle.

Genus Smittia.

Smittia tubula, n. sp. (Pl. X. fig. 6.)

Zoarium incrusting. Zoœcia hyaline, ventricose, slightly verrucose, separated by raised lines; primary orifice orbicular, with one broad denticle; peristome tall, tubular, with six tall spines; secondary orifice horizontal, notched; a small avicularium, with small rounded mandible on one side of orifice. Oœcium globose, punctured.

The raised lines are in one part of the specimen developed to such an extent that the zoœcia appear to grow out of a common crust.

Smittia rostriformis, n. sp. (Pl. VIII. fig. 7.)

Zoarium incrusting. Zoœcia rhomboidal, hyaline, glistening, granulose; primary orifice suborbicular, with three denticles; peristome vertical, with three tall spines; one long avicularium on each side, with long, slender, pointed mandible nearly the length of the cell, margins of avicularian cell serrate; on centre of anterior surface a small avicularium, with triangular mandible pointing downwards; replacing one of the lateral avicularia on some cells, a large avicularium with thickly serrate margin and long hastate mandible. Oœcia small, punctured; on the front and upper part a curved beak-like avicularium projecting vertically upwards; orifice of oœcium opening within peristome.

Smittia latiavicularia, n. sp. (Pl. X. fig. 3.)

Zoarium incrusting. Zoœcia depressed, subimmersed, white, granulose, not punctured, margins faintly areolated, separated by raised lines; primary orifice oblong; one median denticle (traces of rudimentary lateral denticles in a few cells); peristome deficient posteriorly, rising on each side into a triangular eminence, bearing on its outer side an avicularium with acute mandible pointing forwards; over front of zoœcia one or more shallow avicularia with spatulate mandibles. Oœcium globose, punctured; orifice surrounded by a rim terminating above in a triangular area, supporting an avicularium with pointed mandible.

Smittia murarmata, n. sp. (Pl. VIII. fig. 5.)

Zoarium incrusting, covered by a thin, orange-tinted, iridescent membrane. Zoœcia oblong; surface glistening, granulose, areolated round the margins; primary orifice horseshoe-shaped, lower margin straight, with one very prominent hammer-shaped denticle; peristome raised, with wide sinus in front, one lateral wall higher and longer than the other; along the higher side of peristome an avicularian cell with triangular mandible pointing upwards and forwards. Oœcia?

Smittia marmorea, Hincks.

Smittia marmorea, Hincks, Brit. Mar. Pol. p. 350, pl. xxxvi. figs. 3–5.

Smittia reticulata, J. MacG.

The zoœcia of the Mauritius specimen are smaller than those of the British form; the lateral denticles are rudimentary and have disappeared in some cells. The avicularium points obliquely instead of vertically downwards, as in the British form.

Genus Porella.

Porella nitidissima, Hincks.

Porella nitidissima, Hincks, Ann. & Mag. Nat. Hist., July 1880.

The only specimen hitherto found comes from Madeira.

Genus Mucronella.

Mucronella porelliformis, n. sp. (Pl. IX. fig. 1.)

Zoarium incrusting. Zoœcia small, rhomboidal, surface glistening, verrucose; orifice suborbicular, lower margin not dentate; peristome raised in front into a broad, convex, hammer-shaped process, finely crenate at the top; in young cells a small process rising from the peristome on each side of the orifice and bending inwards; six oral spines; on each side of the orifice a slender avicularium, with acute triangular mandible pointing upwards and outwards. Oœcia small, recumbent, vitreous, not punctured.

The species is called "*porelliformis*" from the appearance presented by the orifice. The large pouch-like mucro arches over the orifice in such a way as to give the cell the appearance of possessing a secondary orifice resembling that of *Porella*. This is especially the case when one or both of the lateral processes blend with the median. There is no avicularium on the inner side of the pouch thus formed.

Mucronella cothurnica, n. sp. (Pl. IX. fig. 5.)

Zoarium incrusting, zoœcia forming linear series; walls thick, coarsely punctate. Zoœcia large, oval below, rising to a tall peristome surmounted by about twenty stout jointed spines nearly encircling the orifice, except a small space in front; orifice subquadrangular; anteriorly a grooved, triangular, horizontal mucro. Avicularia none. Oœcia small, globular, punctured.

Genus Escharoides.

Escharoides discus, n. sp. (Pl. IX. fig. 6.)

Zoarium discoid, spreading by a thin calcareous lamina; marginal zoœcia decumbent, central erect, heaped up; surface of zoœcia hyaline, verrucose; primary orifice semicircular, entire, not toothed; peristome at first shallow and notched, with an avicularium with pointed mandible on inner side of one of the processes forming the notch; avicularium forming a prominent triangular projection; peristome in older zoœcia high, tubular, crowned by blunt processes; an avicularium on the front of the cell with triangular mandible projecting forwards and upwards. Oœcia small, globular, punctured.

In one of the specimens one disk is superimposed on an older colony. In old cells with a tall peristome the internally projecting avicularium appears like the denticle present in *Smittia* &c.

Family **Reteporidæ.**

Genus Retepora.

Retepora tenuis, n. sp. (Pl. VII. fig. 6.)

Zoarium with large oval fenestræ, much wider than the slender trabeculæ. Surface of zoœcia verrucose, semihyaline; primary orifice semicircular, secondary orifice orbicular; peristome with fissure and præoral pore (often obliterated); very small spatulate avicularia scattered over the zoarium. Dorsal surface glistening, granulose, divided into irregularly shaped areas. Oœcia lofty, prominent, with trifoliate stigma consisting of a long, broad, vertical arm terminating at the summit of the oœcium in an umbo, the other two arms short, just above the orifice.

The specific characters consist in the large fenestræ, slender trabeculæ, absence of specially situated avicularia, or of avicularia with pointed mandibles, the shape and markings of the oœcium. In one or two oœcia lateral pressure has caused the horizontal arms to curve inwards, so as to meet and form a small complete circle.

Chitinous appendages consist of the small semicircular mandibles, of the circular avicularia, and of the operculum, which is semicircular, with straight lower border (see Pl. VII. fig. 6*c*).

Retepora Hincksii, n. sp. (Pl. VII. fig. 7.)

Zoarium erect, branching in one plane; branches free, subdichotomous. Zoœcia rhomboidal, opalescent, glistening, granulose, not punctured; older zoœcia immersed, the orifices of the separate cells alone being visible; primary orifice oval (long diameter transverse); peristome with a slit-like fissure terminating in a round pore; on one side of peristome a small avicularium with small hemispherical mandible. Dorsal surface glistening, granulose, divided into irregular areas by raised lines. Oœcia long, oval, depressed, marked with a broad, median, beaded band, narrowing superiorly to a slight ridge. Chitinous appendages.

Family **Tubuliporidæ.**

Genus Idmonea.

Idmonea radicata, n. sp. (Pl. IX. fig. 2.)

Zoarium about ½ an inch high, ramose, branches flattened, subdichotomous, anastomosing, giving off cylindrical calcareous processes, fixing it to the base from which it grows; anterior surface hyaline, finely punctured. Zoœcia in pairs in younger, and threes in older parts of branches, forming subparallel alternating rows; zoœcia closely connate for about half their length, then diverging, curved so as to be concave downwards, increasing in height from within outwards; dorsal surface flat, faintly marked with transverse concentric rings of growth, finely punctured and marked with fine parallel longitudinal striæ. Oœcia anterior, formed by an inflation of the branch; surface punctured; four or five zoœcia subimmersed.

Idmonea tortuosa, n. sp. (Pl. X. fig. 2.)

Zoarium erect, flattened, branching dichotomously, branches subtriangular. Zoœcia in two or three series, increasing from within outwards, large, free only for a quarter of their length; punctured both in the adnate and free portions. Dorsal surface covered by thick, punctured, tortuous, intertwining tubes. Oœcia?

In this form aborted zoœcia instead of forming radical tubes, as in some species, are closely adpressed to the dorsal surface of the zoarium.

Genus Hornera.

Hornera spinigera, n. sp. (Pl. X. fig. 1.)

Zoarium flabellate, irregularly pinnate; branches cylindrical, surface marked by ridges and punctures, both on the front and dorsally. Zoœcia in series one to three on alternate sides of front of branches, in subparallel oblique series; zoœcia increasing in height from within outwards, innermost almost level with surface, outermost long, slender, exserted, and projecting out on a plane with the general surface of the zoarium; outer zoœcia with long vertical spines, inner with short spines, bent in at right angles to orifice; intermediate zoœcia with vertical and horizontal spines. Oœcia?

It was at first a matter of doubt whether *H. spinigera* was not a form of *H. pectinata*, Busk; but an examination of the type specimen of the latter showed several important differences. The zoœcia of *H. pectinata* are larger and of stouter build and are not so regularly arranged as in *H. spinigera*. The zoœcia in *H. spinigera* are arranged almost as regularly as those in the genus *Idmonea*; but the presence of the interzoœcial striæ and punctures indicates that the specimen belongs to the former rather than to the latter genus.

EXPLANATION OF THE PLATES.

Plate VII.

Fig. 1. *Diplœcium simplex*, nov. gen. et sp. 1 *a*. Magnified. 1 *b*. Showing suppression of internode and oœcium.
Fig. 2. *Membranipora marginalis*, n. sp.
Fig. 3. *Membranipora mauritiana*, n. sp. Cells from edge of colony, well separated.
Fig. 4. *Schizoporella ampla*, n. sp. 4 *a*. Magnified cell, showing two avicularia. 4 *b*. Pyriform mandible of large avicularian cell (see fig. 4).
Fig. 5. *Gigantopora lyncoides*, Ridley. 5 *a*. Cell in which the avicularia have not joined to form the bridge and pore. 5 *b*. Primary orifice.
Fig. 6. *Retepora tenuis*, n. sp. 6 *a*. Trabecula, magnified. 6 *b*. Fertile zoœcium, enlarged. 6 *c*. Operculum. 6 *d*. Spatulate mandible.
Fig. 7. *Retepora Hincksii*, n. sp. 7 *a*, *b*. Magnified trabecula and cell. 7 *c*, *d*. Operculum and mandible.

Plate VIII.

Fig. 1. *Lepralia Poissonii*, Audouin.
Fig. 2. *Anarthropora horrida*, n. sp.
Fig. 3. *Phylactella columnaris*, n. sp.
Fig. 4. *Lepralia judex*, n. sp.
Figs. 5, 5 *a*. *Smittia murarmata*, n. sp.
Fig. 6. *Lepralia mosaica*, n. sp.
Figs. 7, 7 *a*. *Smittia rostriformis*, n. sp. 7 *b*. Lateral view, showing avicularium on oœcium.
Fig. 8. *Membranipora defensa*, n. sp. 8 *a*. Cell, showing junction of spines.

PLATE IX.

Figs. 1, 1 *a.* *Mucronella porelliformis*, n. sp.
Fig. 2. *Idmonea radicata*, n. sp. 2 *a.* Enlarged, showing two oœcia.
Fig. 3. *Scrupocellaria minuta*, n. sp. 3 *a.* Dorsal view.
Fig. 4. *Nellia simplex*, Busk, showing oœcia.
Fig. 5. *Mucronella* (? *Lepralia*) *cothurnica*, n. sp. 5 *a.* Three cells, showing arrangement of zoarium.
Fig. 6. *Escharoides discus*, n. sp. 6 *a.* Marginal cell, showing avicularium on one side of notch. 6 *b.* Central cell, with peristome developed.

PLATE X.

Fig. 1. *Hornera spinigera*, n. sp. 1 *a.* Anterior surface. 1 *b.* Posterior surface.
Fig. 2. *Idmonea tortuosa*, n. sp. 2 *a.* Anterior surface. 2 *b.* Posterior surface, showing tortuous tubes.
Fig. 3. *Smittia latiavicularia*, n. sp. 3 *a.* Lateral view, to show avicularium on oœcium.
Fig. 4. *Cribrilina radiata*, var. *flabellifera*, nov. var.
Fig. 5. *Stephanopora cribrispinata*, nov. gen. et sp. 5 *a.* Cell, showing shape of orifice.
Figs. 6, 6 *a.* *Smittia tubula*, n. sp. 6 *b.* Primary orifice, with denticle.

XI.—*Note on the Extinct Reptilian Genera* Megalania, *Owen, and* Meiolania, *Owen.* By A. SMITH WOODWARD, F.G.S., F.Z.S., of the British Museum (Natural History).

THE relabelling of the Australian fossils in the British Museum, at various times described and figured by Sir Richard Owen under the names of *Megalania* and *Meiolania*, has lately necessitated a careful examination of the literature of the subject and comparison of specimens. Recent discoveries are generally admitted to have proved that several of the original determinations, founded upon imperfect materials, were erroneous; some of the fossils are truly Lacertilian, others are known with equal certainty to be Chelonian, and I am able to add on the present occasion that the remainder are Mammalian. The nomenclature of the genera is also somewhat confusing, and it may therefore be of interest briefly to summarize the present aspect of the questions involved.

The "Gigantic Land-Lizard" (*Megalania prisca*) of Australia was first made known in 1858 by Sir Richard Owen *,

* R. Owen, "Description of some Remains of a Gigantic Land-Lizard (*Megalania prisca*, Owen) from Australia," Phil. Trans. 1859, pp. 43–48, pls. vii., viii.

who described three undoubtedly Lacertilian vertebræ from the alluvial deposits of the Condamine River, west of Moreton Bay, Queensland, discovered by Dr. George Bennett and presented by him to the British Museum. They were shown to be very similar, except in size, to the vertebræ of the existing Australian Monitors; and it still remains doubtful whether the differences they present are really of generic value. The vertebræ "rival in bulk those of the largest living crocodiles." More than twenty years after this discovery Sir Richard Owen added a description of a complete dorsal vertebra from the same district of Queensland, and of a sacral vertebra from the neighbourhood of Melbourne, Victoria, as also of an occipital skull-fragment and associated caudal vertebra from Gowrie, Darling Downs *. Interesting portions of a large cranium were also described, which had been found by Mr. G. F. Bennett in King's Creek, associated with bones of *Diprotodon*, though not with vertebræ of the *Megalania* type. The latter fragments were *hypothetically* assigned to the same genus and species as the original fossils discovered in 1858, and the presence of bony horn-cores upon the skull led to a comparison with the small Australian *Moloch horridus*, which is also provided with dermal horns, though never of an osseous character. A restoration of *Megalania* was given, upon the assumption that the extinct and surviving types were closely allied. In 1881 a tail, completely ensheathed in bony armour like that of *Glyptodon*, was found at the same spot in King's Creek, whence had been obtained the fine portion of skull described in the previous year, and this, too, was determined † as belonging to what had now become known as the "Great Horned Lizard." *Uromastix princeps*, from Zanzibar, was next compared with the fossil, and Sir Richard Owen pointed out that the caudal armour of this lizard only differed from that of *Megalania* in the same manner as the horns of *Moloch* were distinguished from those upon the Queensland skull, namely, in the absence of bony tissue in their structure. The tail of *Moloch horridus* was also shown to be encased in horny scutes similarly disposed, these even "more closely repeating the number and arrangement of *Megalania*" than the scutes of *Uromastix*. Still another contribution to the subject was made in 1886 ‡, when a sacral vertebra from Gowrie, Darling Downs, was described, and also a number of foot-bones, supposed to show

* *Ibid.* part ii., Phil. Trans. 1880, pp. 1037–1050, pls. xxxiv.–xxxviii.
† *Ibid.* part iii., Phil. Trans. 1881, pp. 547–556, pls. lxiv.–lxvi.
‡ *Ibid.* part iv., Phil. Trans. 1886, pp. 327–330, pls. xiii.–xv.

that *Megalania prisca* was truly terrestrial, with well-developed claws.

Discoveries in a small island 200 miles from the Australian coast next commanded attention. A number of fossil remains from a superficial coral-sand formation in Lord Howe's Island, transmitted to the British Museum by Robert D. Fitzgerald, Esq., Surveyor-General, Sydney, New South Wales, were soon found to comprise parts of an animal very similar to the possessor of the horned head and armoured tail already known from a locality 400 miles distant in Queensland. Of these specimens Sir Richard Owen* described and figured portions of the skull and mandible, tail, and the (partly restored) pelvis, besides briefly noticing an anterior vertebra, a portion of the scapula, and a fragment of humerus. He concluded that they belonged to a new subgenus—perhaps a new genus—to be named *Meiolania*, comprising apparently two species, *M. platyceps* and *M. minor*. Associated with the described fossils, however, were numerous other fragments, which Mr. William Davies had placed among the Chelonia; and the whole were subsequently reexamined by Professor Huxley, who arrived at the conclusion that they were *all* Chelonian †. The animal was now considered to be most nearly allied to *Chelydra* and *Gypochelys* (*Macroclemmys*) and other Cryptodiran genera of that type; and Mr. G. F. Bennett's Queensland skull and tail were unhesitatingly removed from their association with the Megalanian vertebræ ‡ and referred to this new genus, for which Professor Huxley thought the name of *Ceratochelys* would be more appropriate than that of *Meiolania*. He also renamed *Meiolania platyceps*, *Ceratochelys sthenurus*. A new element was thus added to the Reptilian fauna of Pleistocene Australia, the Cryptodiran Chelonia being totally unrepresented there both at the present day and among known fossils from the superficial deposits. Still more satisfactory specimens of *Meiolania platyceps* afterwards reached Sir Richard Owen, who again presented descriptions to the Royal Society §, and concluded that the

* R. Owen, "Description of Fossil Remains of two Species of a Megalanian Genus (*Meiolania*) from Lord Howe's Island," Phil. Trans. 1886, pp. 471–480, pls. xxix., xxx.

† T. H. Huxley, "Preliminary Note on the Fossil Remains of a Chelonian Reptile, *Ceratochelys sthenurus*, from Lord Howe's Island, Australia," Proc. Roy. Soc. vol. xlii. (1887), pp. 232–238.

‡ All the vertebræ found with *Meiolania* in Lord Howe's Island are truly Chelonian and none like those named *Megalania prisca* have been met with in this locality.

§ R. Owen, "On Parts of the Skeleton of *Meiolania platyceps*, Owen," Abstract in Proc. Roy. Soc. vol. xlii. (1887), p. 297. The complete memoir has not yet appeared.

animal displayed affinities both with the "orders Chelonia and Sauria," but was more nearly allied to the latter, of which he proposed to form the new suborder Ceratosauria. These, with all other known specimens, were lastly submitted to a most careful examination by Mr. G. A. Boulenger *, who regarded Professor Huxley's general conclusions as unquestionable, but offered cogent reasons for placing the genus, not with the Cryptodiran Chelonians, but with the Pleurodira, which are at the present day so characteristic of the Australian region. Mr. Boulenger regards *Meiolania* as herbivorous and more terrestrial in habit than all known existing Pleurodires.

Another contribution to the correct interpretation of the "Megalanian" fossils is unwittingly made by Mr. Lydekker in the last volume of his Fossil Mammalian Catalogue just issued. Among the foot-bones assigned to uncertain members of the marsupial families of Nototheriidæ and Phascolomyidæ † are included specimens precisely similar to those described by Sir Richard Owen in part iv. of his memoir on "*Megalania*" as affording information in regard to the characters of the feet of this reptile. These specimens were not improbably all obtained at the same time and place, and there can be no doubt of the correctness of Mr. Lydekker's interpretation; some of them indeed bear Sir Richard Owen's MS. label "*Phascolonus*?" They were all registered by Mr. William Davies as pertaining to marsupials (nos. M. 3659, 60).

It thus appears that under "*Megalania prisca*" have been included (i.) lacertilian vertebræ and an occipital fragment, (ii.) a chelonian skull and tail-sheath, and (iii.) marsupial foot-bones. The first necessarily form the type specimens of the genus and species, and the last are obviously at once excluded from consideration. The second series of fossils, however, require a name.

Professor Huxley, as already remarked, unhesitatingly places Mr. Bennett's Queensland skull and tail in the same genus as the Lord-Howe's Island fossils, and the reference appears fully justified by the specimens at present known. But, as Mr. Boulenger observes, the rules of nomenclature do not permit of the adoption of a new name, *Ceratochelys*, however appropriate it may be, and the genus must henceforth be termed *Meiolania*.

With regard to species, the figures and descriptions of the

* G. A. Boulenger, "On the Systematic Position of the Genus *Meiolania*, Owen (*Ceratochelys*, Huxley),' Proc. Zool. Soc. 1887, pp. 554, 555.

† R. Lydekker, 'Catalogue of the Fossil Mammalia in the British Museum,' part v. 1887, p. 169.

Queensland specimens are at once conclusive of their distinctness from any form yet determined from the distant Lord Howe's Island, though they were not specifically distinguished or named by Professor Huxley. They are thus at present nameless; and I would venture to suggest that they may be most appropriately known as *Meiolania Oweni*, in honour of the distinguished comparative anatomist who has contributed more than any other to our knowledge of the Pleistocene Vertebrata of the far-off antipodes. Sir Richard Owen has often undertaken the interpretation of fragments which many would have looked upon as quite undeterminable; and by this bestowal of labour upon most unpromising materials he has aroused the enthusiasm of his colonial correspondents, which has resulted in the enormous mass of information now available concerning these ancient faunas, and has secured for the British Museum of Natural History that unrivalled series of Australasian remains which is one of its most distinctive features.

In conclusion it will be convenient for reference to tabulate the foregoing results as follows:—

Megalania (?*Varanus*) *prisca*, Owen.

Megalania prisca, Owen, Phil. Trans. 1859, pp. 43–48, pls. vii., viii. (Vertebræ.)
Megalania prisca, Owen, *ibid.* 1880, pp. 1037–1040, pls. xxxiv.–xxxvi. (Vertebræ and occipital fragment.)
Megalania prisca, Owen, *ibid.* 1886, pp. 327, 328, pl. xiii. (Vertebræ.)

Meiolania Oweni, A. S. Woodw.

Megalania prisca, Owen (*errore*), *ibid.* 1880, pp. 1041–1048, pls. xxxvii., xxxviii. (Cranium.)
Megalania prisca, Owen (*errore*), *ibid.* 1881, pp. 547–556, pls. lxiv.–lxvi. (Tail-sheath.)
Ceratochelys sthenurus, Huxley (in part), Proc. Roy. Soc. vol. xlii. (1887), p. 237. (Queensland cranium and tail-sheath.)

Meiolania platyceps, Owen (? also *M. minor*, Owen).

Meiolania platyceps, Owen, and *M. minor*, Owen, Phil. Trans. 1886, pp. 471–480, pls. xxix., xxx. (Portions of skull and tail-sheath, &c.)
Ceratochelys sthenurus, Huxley (in part), Proc. Roy. Soc. vol. xlii. (1887), pp. 232–238. (Various parts of skeleton.)

Marsupial Foot-bones.

Megalania prisca (*errore*), Owen, Phil. Trans. 1886, pp. 328–330, pls. xiv., xv. (Foot-bones.)

XII.—*New Species of Butterflies collected by Mr. C. M. Woodford in the Solomon Islands.* By F. D. GODMAN and O. SALVIN.

Danais cometho, sp. n.

Alis fuscis, maculis parvis, submarginalibus, in seriebus duabus positis albis; anticis fascia maculosa transversa ultra cellulam macularum septem composita, fascia altera interiore juxta eam, maculis duabus elongatis juxta ramum medianum primum; posticis macula magna trans cellulam venis septem-partita alba, ultra eam ad marginem externum maculis indistinctis ferrugineis inter venas notatis: subtus ut supra, maculis omnibus multo magis distinctis; posticis maculis albis ad costam lineisque ad marginem internum a basi radiantibus. Exp. 3·2 in.

♀ mari similis. Exp. 3·2 in.

Hab. Solomon Islands, North-west Bay, Saa and Tyoh in Maleita Island (*C. M. Woodford*).

This *Danais* takes the place in Maleita Island of *D. decipiens*, the common species in the greater part of the Solomon group with the exception of Ugi Island and San Cristobal Island, where *D. insolata* occurs.

D. cometho differs from *D. decipiens* in having more clearly defined submarginal white spots, a large discal spot cut by the nervures on the secondaries, and an elongated white spot on either side of the first branch of the median nervure of the primaries.

Euplœa Woodfordi, sp. n.

Alis fuliginoso-brunneis ad margines externos vix pallidioribus; posticis maculis septem submarginalibus ab angulo anali usque ad venam medianam aliisque quatuor minutis ad angulum apicalem margini propioribus: subtus pallidioribus, alis ambabus maculis quinque parvis ultra cellulas et una intra eas lilacino-albis; posticis fascia lata submarginali venis divisa, ad angulum apicalem attenuata sordide alba; anticis linea squamosa infra ramum medianum primum grisea. Exp. 3·7 in.

♀ alis fuliginosis; anticis plaga arcuata ad angulum apicalem venis divisa, sordide alba; posticis fascia lata submarginali ejusdem coloris, maculis quibusdam parvis albidis ad angulum apicalem: subtus mari similis, sed maculis omnibus discalibus multo majoribus aliter fasciis ut in pagina superiore sed latioribus; anticis margine interno late albido. Exp. 3·95 in.

Hab. Solomon Islands, North-west Bay in Maleita Island (*C. M. Woodford*).

Obs. E. Batesi ex Nov. Guinea forsan affinis, sed in ♂ maculis posticarum submarginalibus, in ♀ plaga anticarum subapicali et fascia posticarum submarginali albidis primo visu distinguenda.

This species has no brand on the primaries and the inner margin is nearly straight; these characters are shared by *E. Batesi*. *E. resarta* belongs to the same group, but has submarginal spots on the primaries, an obvious difference.

Euplœa pyrgion, sp. n.

E. fraudulentæ similis, sed posticis ad angulum analem lactescenti-albis: subtus stigmate anticarum infra ramum medianum primum grisescentiore; posticis lactescenti-albo marginatis. Exp. 3·8 in.

♀ anticis macula magna apicali altera ad angulum analem lactescenti-albis et posticis margine externo late ejusdem coloris. Exp. 3·95 in.

Hab. Solomon Islands, Cape Astrolabe and North-west Bay in Maleita Island (*C. M. Woodford*).

This species bears to *E. fraudulenta*, so far as regards its coloration, the same relationship that *E. pronax* does to *E. honesta.*

Euplœa pronax, sp. n.

E. honestæ affinis, sed posticis ad marginem internum dilutioribus, maculis tribus lactescenti-albis fere confluentibus, submarginalibus ab angulo anali ad medium marginis externi extendentibus: subtus stigmate anticarum nigricantiore et posticis area submarginali ab angulo anali ad venam medianam extendente alba distinguenda. Exp. 3·9 in.

♀ anticis plaga magna apicali venis divisa altera minore ad angulum analem et margine posticarum externo late lactescenti-albis. Exp. 4·0 in.

Hab. Solomon Islands, Cape Astrolabe, North-west Bay, and Saa in Maleita Island (*C. M. Woodford*).

This is evidently the form of *E. honesta* inhabiting Maleita Island and has a large dark brand beneath the first median branch of the primaries, as in that species. The female differs more than the male from that sex of *E. honesta*, and has no spots on the inner area of the primaries above; moreover, the whitish spots on the apex and anal angle of those wings and on the outer margin of the secondaries are conspicuous differences.

Euplœa prusias, sp. n.

E. honestæ quoque similis, sed anticis ad apicem plaga magna albida notata; posticis quoque externe albido late marginatis, ab *E. pronaci* plaga apicali anticarum facile distinguenda. Exp. 3·65 in.
♀ adhuc ignota.

Hab. Solomon Islands, Ulaua Island, St. Anna Island (*C. M. Woodford*).

The male of this species resembles the female of *E. pronax* so far as regards the colour of the primaries, but differs obviously from the male of that species.

Euplœa polymela, sp. n.

Alis brunneis ad margines externos paullo dilutioribus; anticis macula ovali infra ramum medianum primum lilacina; posticis stigmate permagno dimidium cellulæ costalem occupante cervino, area sericea circumcincta: subtus brunneis unicoloribus; anticis macula magna inter ramos medianos, altera minore ad costæ medium aliisque quinque minutis ad apicem lilacino-albis, plaga magna cervina infra venam medianam et ramum suum primum stigmatem parvum ovalem includente; posticis maculis quinque parvis ad angulum apicalem. Exp. 3·85 in.
♀ mari similis, anticis immaculatis; posticis maculis duabus albidis ad angulum apicalem: subtus quoque mari similis, maculis submarginalibus septem albidis notatis. Exp. 4·1 in.

Hab. Solomon Islands, Alu Island, Fauro Island, Aola in Guadalcanar Island, Ulaua Island, North-west Bay, Uru Bay, and Saa in Maleita Island (*C. M. Woodford*).

This species is allied to *E. pasithea*, Feld., from Amboina, and has the inner margin of the primary wings arched in a similar way; *E. perdita*, Butler, from New Britain is another very closely allied form. From both these insects *E. polymela* differs in the total absence of a submarginal row of spots on the upperside of the primaries. The examples from Maleita Island have the spots near the margin on the underside rather larger and more numerous, but they do not differ essentially.

Euplœa asyllus, sp. n.

Alis saturate brunneis, anticis ad marginem internum et posticis ad angulum analem dilutioribus; anticis maculis tribus ultra cellulam (una subcostali), una infra ramum medianum primum, aliisque quinque parvis submarginalibus ad angulum apicalem lilacino-albis; posticis plaga magna sericea cellulam fere totam includente: subtus brunneis, maculis submarginalibus in seriebus duabus positis serieque altera cellularum fines approximata albis lilacino limbatis. Exp. 3·5 in.

♀ mari similis, sed alis pallidioribus et marginibus externis pallidis, maculis submarginalibus obsoletis aliisque ultra cellulam albidis. Exp. 3·9 in.

Hab. Solomon Islands, Alu Island, Guadalcanar Island (*C. M. Woodford*).

Var.?

♀ anticis fere immaculatis, macula costali unica parva notatis; posticis macula unica distincta prope angulum apicalem, ceteris obsoletis: an species altera?

Hab. Maravo Island (*C. M. Woodford*).

In the curvature of the inner margin of the primaries and the position of the silky patch on the secondaries this species resembles *E. pasithea*, but the latter is not fawn-colour as in *E. pasithea*; moreover, the underside of both wings has three concentric bands of spots.

We have a single female specimen from Maravo Island which differs as stated above from examples of the same sex from Alu Island. In the absence of the male we do not think it prudent to give it a name, though we believe it will, on the receipt of more examples, prove distinct.

Euplœa gerion, sp. n.

♀ *E. asyllo* certe affinis; anticis maculis discalibus nullis, punctis duobus ad costam, plaga acuata venis divisa ad angulum apicalem albida; posticis margine interno et margine externo late albis, illo vix lilacino induto: subtus maculis submarginalibus in fasciam latam albam fere absorptis. Exp. 3·9 in.

♂ adhuc ignotus.

Hab. Solomon Islands, North-west Bay in Maleita Island (*C. M. Woodford*).

Though we have only a single female specimen of this species, its distinctness is so obvious that we feel we may safely give it a name. From the position of the ultra-cellular spots on both wings its relationship to *E. asyllus* is shown. *E. gerion* is doubtless the Maleita Island form of that species.

Euplœa heurippa, sp. n.

Alis saturate brunneis; posticis ad marginem externum saturatioribus et purpureo-tinctis; anticis macula elongata ultra costæ medium et maculis sex parvis submarginalibus obscure lilacinis;

posticis area costali late albida, cellula fere tota cervino-brunnea, maculis quibusdam obsoletis ultra cellulam: subtus saturate brunneis; anticis vix dilutioribus, maculis octo submarginalibus albidis aliisque minutis ad medium marginis externi; maculis quoque ultra cellulam septem (eis inter ramos medianos maximis) albis, macula altera ad cellulæ finem introrsum furcata, margine interno late albido; posticis maculis submarginalibus aliisque ultra cellulam et una minuta ad finem ejus lilacino-albis. Exp. 5·3 in.

♀ mari similis, sed alis pallidioribus, posticis maculis ultra cellulam minutis notatis. Exp. 5·3 in.

Hab. Solomon Islands, Alu Island, Fauro Island, Aola in Guadalcanar Island, North-west Bay in Maleita Island (*C. M. Woodford*).

E. unibrunnea of New Ireland seems to be the most nearly allied species to *E. heurippa,* but the latter is darker on both surfaces of the wings, the cell of the primaries not so clear a fawn-colour.

There is some variation in this species in the different islands of the Solomon group. The examples from Alu Island are the darkest and have the submarginal spots on the primaries more distinct than in the Fauro-Island and Guadalcanar-Island individuals; but the differences are very slight.

Euplœa pyres, sp. n.

Alis nigricanti-fuscis intense purpureo suffusis, maculis marginibus externis parallelis albis lilacino limbatis, ea ad angulum anticarum analem introrsum furcata, maculis quoque duabus post medium anticarum costæ ejusdem coloris; posticis a cellulæ medio ad costam fusco-cervinis: subtus fuliginosis, maculis in seriebus duabus positis marginibus externis parallelis serieque interiore cellulam propiore maculaque ad cellularum fines aliisque ad basin quoque albis; anticis plaga magna infra venam medianam et ramum suum primum griseo-albida. Exp. 3·0 in.

♀ mari similis quoad maculas alarum submarginales, sed colore alarum purpureo nullo et maculis aliis juxta cellulas notatis. Exp. 3·0 in.

Hab. Solomon Islands, Savo Island, Aola in Guadalcanar Island (*C. M. Woodford*).

The collection contains three specimens of this pretty species, two males and a female, the former from Guadalcanar Island, the latter from Savo Island. The species most nearly allied to it seem to be *E. darchia* of Australia and *E. priapus,* Butl., and like them it belongs to Mr. Butler's genus *Callipλœa.*

Hamadryas evages, sp. n.

H. zoilo affinis et anticis eodem modo maculatis; posticis plaga centrali alba parva et lineis transversis nigris fere integris tripartita, margine externo lato. Exp. 2·1 in.

Hab. Solomon Islands, Aola in Guadalcanar Island (*C. M. Woodford*).

We are unable to find any specimens of *H. zoilus* and its immediate allies agreeing with these examples from Guadalcanar Island. The central spot on the secondaries is crossed by two dark bands, one almost entire through the end of the cell, the other along the line of the submedian nervure. The male appears to have no costal spot on the secondaries, but this spot is present in the females. We have three examples of a *Hamadryas* from Mysori Island, on the north-west coast of New Guinea, sent us by Dr. A. B. Meyer, which hardly differ from *H. evages* now described. The white patch of the secondaries, however, is rather more elongated, and thus approaches that of *H. zoilus*.

Hamadryas hiero, sp. n.

H. assarico proxima, posticis plaga alba centrali magis rotundata lineis duabus transversis nigris fere integris tripartita, margine externo nigro latiore. Exp. 2·1 in.

Hab. Solomon Islands, Fauro Island (*C. M Woodford*).

The collection contains a pair of this species, which is allied to *H. assaricus* of Ceram and Amboina, but differs in the points indicated above.

Cynthia sapor, sp. n.

C. arsinoæ affinis, sed posticis supra et subtus plaga magna discali alba notata facile distinguenda. Exp., ♂ 4·4, ♀ 5·5 in.

Hab. Solomon Islands, Alu Island, Fauro Island, Aola in Guadalcanar Island (*C. M. Woodford*).

This *Cynthia* belongs to the same group as *C. arsinoë*, to which in colour and the general distribution of its markings it bears a strong resemblance; but besides having the two ocelli on the secondaries further from the outer margin, *C. sapor* has a large white patch extending beyond the cell nearly to the outer margin and from the anal angle to the subcostal branch. The posterior ocellus is included in this white patch, and it is cut by the rufous nervures and contains a submarginal undulating black line. Beneath the two insects are much alike, but the inner submarginal line is much more strongly shown in *C. sapor*, and the transverse line through the end of the cell is bordered outwardly by a whitish edge.

The females of the two insects are much alike, but that of *C. sapor* has the outer half of the secondaries more freely sprinkled with dusky scales, the ocelli are further from the margin, and there are other minor characters.

Mr. Mathew's collection contains a female *Cynthia* from Ugi Island, but without a male for comparison it is not possible to say to which species it belongs.

Cynthia catenes, sp. n.

C. arsinoæ quoque similis et alis ejusdem coloris, sed minor: subtus linea submarginali interiore multo magis distincta, posticis linea transversa per cellulam extrorsum pallide fulvo limbata, alis totis lilacino suffusis, distinguenda. Exp. 3·2 in.

Hab. Solomon Islands, St. Anna Island (*C. M. Woodford*).

The range of this *Cynthia* is separated from that of *C. arsinoë* by *C. sapor*, which occupies several intermediate islands, and by *C. clodia*, of the island of Ulaua. *C. sapor* is by far the most distinct of them all from *C. arsinoë,* and it is a curious fact that it occupies islands intermediate between New Guinea and the extreme islands of the Solomon group, the two forms of *Cynthia* from the latter being very similar to the true *C. arsinoë.*

Cynthia clodia, sp. n.

C. arsinoæ quoque affinis, posticis fascia submarginali interiore multo latiore, area inter ocellos fusco nebulosa; subtus fascia submarginali interiore magis distincta. Exp., ♂ 3·7, ♀ 4·5 in.

Hab. Solomon Islands, Ulaua Island (*C. M. Woodford*).

There is a pair of this form in the collection, the male showing sufficient marks of distinction to admit of its separation. It is next to *C catenes*, but is larger and has the under surface of the wings almost devoid of the lilac tint which suffuses those of the allied form. The inner of the two submarginal lines is broader and more distinct both above and below.

Messaras Woodfordi, sp. n.

Alis murino-brunneis; anticis triente apicali nigricante, fascia transversa ultra cellulam costam haud attingente ad angulum analem attenuata alba; posticis maculis septem nigris ferrugineo circumcinctis in serie fere recta positis a costa angulum apicalem juxta ad angulum analem, fascia lunulata interiore nigra extrorsum lilacino limbata, altera exteriore albida extrorsum fusco marginata lineolaque indistincta fusca submarginali; subtus gilvis anticis fascia alba sicut in pagina superiore, macula nigricante ad marginem internum, ultra eam saturate ferrugineis linea lunulata submarginali albida; posticis maculis sicut in pagina superiore utrinque lineis albidis lunulatis limbatis, linea altera submarginali quoque albida, margine ipso pallide cinnamomeo. Exp. 3·15 in.

♀ mari similis, sed paullo major alis pallidioribus magis distincte notatis. Exp. 3·2 in.

Hab. Solomon Islands, Fauro Island (*C. M. Woodford*).

A beautiful and distinct species, of which Mr. Woodford captured a good series of specimens, all on Fauro Island. Though evidently a member of this genus, the coloration of the wings renders it at once easy of recognition.

Messaras pallescens, sp. n.

M. melichryso similis, sed alis omnino pallidioribus posticis ocellis submarginalibus et lineis juxta eos multo magis distinctis ut videtur distinguenda. Exp. 2·6 in.

Hab. Solomon Islands, Tyoh in Maleita Island (*C. M. Woodford*).

Specimens of both sexes of this form are in Mr. Woodford's collection. They conform to the general tendency of many of the Rhopalocera of Maleita Island to be paler than their representatives elsewhere. The difference from *M. melichrysus* is slight, but enough to require recognition.

Atella ephyra, sp. n.

A. alcippæ similis, sed anticis magis acutis, lineis omnibus submarginalibus nigris latioribus maculis quoque discalibus magis distinctis, subtus maculis anticarum discalibus multo magis obviis. Exp. 2·0 in.

Hab. Solomon Islands, North-west Bay and Cape Astrolabe in Maleita Island (*C. M. Woodford*).

We have compared this with Ceram specimens of *A.*

alcippe. The differences it is true are not great, but seem sufficiently constant, add to which the difference in distance between their respective localities is so great that we feel justified in separating them.

Doleschallia sciron, sp. n.

Alis rufo-brunneis; anticis plaga mediana fulva ultra eam usque ad apicem nigricantibus, maculis tribus ultra cellulam fulvis aliisque quatuor subapicalibus albis; posticis ad marginem externum fuscescentibus, linea submarginali saturate fulva, maculis duabus discalibus nigris una intra ramos medianos altera infra ramum subcostalem: subtus fuscescenti-rufis rufo marmoratis, anticis dimidio costali et posticis ad basin maculis magnis albis nigro cinctis notatis, linea communi discali nigra utrinque albido limbata, in anticis sinuata in posticis fere recta, anticis maculis septem submarginalibus fuscis albo pupillatis, posticis ocellis duobus ad marginem externum. Exp. 3·3 in.

♀ mari similis, sed alis magis rufescentibus, anticis ad apicem et marginem externum angustiore nigricantibus plaga nigra insulata ad cellulæ finem. Exp. 3·55 in.

Hab. Solomon Islands, Alu Island, Fauro Island, Guadalcanar Island (*C. M. Woodford*); Treasury Island (*G. F. Mathew*).

This species is closely allied to *D. Browni* of New Ireland, of which we have the type specimen (a female) before us. The wings are rather darker, and the tawny patch in the primaries more conspicuous than in that species. We have no male specimen that we can with certainty call *D. Browni*, at least none from New Ireland, so that we cannot compare the male.

Diadema scopas, sp. n.

♂. *D. unicolori* similis, sed posticis litura submarginali alba venis divisa notatis. Exp. 3·9 in.

♀. Eodem modo differt litura alba multo latiore et in anticis extendente. Exp. 4·0 in.

Hab. Solomon Islands, North-west Bay in Maleita Island (*C. M. Woodford*).

This species in this island takes the pattern of *Euplœa gerion.*

Neptis pisias, sp. n.

N. fissizonatæ similis, sed fascia alarum submarginali alba in anticis ad angulum analem obsoleta in posticis omnino absente. Exp. 2·75 in.

Hab. Solomon Islands, Alu Island, Fauro Island (*C. M. Woodford*).

This species is very closely allied to *N. fissizonata*; the differences are pointed out above. We have several specimens of both sexes.

Mynes Woodfordi, sp. n.

♂. *M. Geoffroyi* similis, sed anticis plaga lactescenti-alba multo minore, ad basin et marginem internum versus nigro atomata; posticis costa anguste, et margine externo late, nigris: subtus anticis costa, apice et margine externo late nigris, linea lata submarginali, macula triplici interiore, altera duplici costali albis, plaga coccinea submarginali inter venam medianam et ramum suum secundum; posticis plaga ovali undique nigro circumcincta; aliter *M. Geoffroyi* persimilis. Exp. 2·55 in.

♀ adhuc ignota.

Hab. Solomon Islands, Alu Island (*C. M. Woodford*).

Mr. Woodford's collection contains a single male example of this species which seems sufficiently distinct from the very variable *M. Geoffroyi*. It also differs more widely from the species we described from New Ireland as *M. eucosmetos*, in which the whole of the central portion of the secondaries is intensely yellow and the spots of the apex of the primaries are blended into one continuous patch divided only by the black nervules.

Papilio ptolychus, sp. n.

♂. Alis nigris, macula quadripartita ultra cellulam aliisque quatuor submarginalibus lunulatis, maxima ad angulum analem, minima supra venam medianam, maculis sex in margine ipso lactescenti-albis; posticis fascia continua a costa fere ad marginem internum lactescenti-alba introrsum fere recta, extrorsum a vena mediana ad costam profunde serrata, lobulo anali macula fulva ornato, margine externo inter venas lactescenti-albo: subtus purpureo-nigris; anticis plaga ultra cellulam et maculis marginalibus sicut in pagina superiore, sed lunulis submarginalibus nullis; posticis maculis sex submarginalibus fulvis et fascia obsoleta discali squamis sparsis cæruleo-albis composita notata, margine externo inter venas albido. Exp. 5·5 in.

♀ adhuc ignota.

Hab. Solomon Islands, Aola in Guadalcanar Island (*C. M. Woodford*).

Mr. Woodford's collection contains four male specimens of this species, all from Guadalcanar. It is allied to *P. Erskinei*, recently described by Mr. Mathew from a specimen captured by himself on the island of Ugi. It differs from this specimen in having the discal band of the primaries completely severed, the costal portion being concentrated in a patch beyond the cell; the rest of this band consists of four spots placed close to the outer margin instead of at some distance from it. In other respects the two species are very much alike.

Papilio Woodfordi, sp. n.

Alis nigricantibus, fascia discali ultra cellulam ad marginem internum extensa venis nigris partita lactescenti-alba, margine externo punctis ejusdem coloris inter venas notato; posticis fascia transversa a costa per cellulæ finem ad marginem internum ducta, margine suo interno fere recto, externo dimidio costali profunde serrato lactescenti-alba, macula parva coloris ejusdem ad lobulum analem, margine externo unduloso, ad finem venæ medianæ sensim producto, inter venas omnes albido notato: subtus purpureo-nigris; anticis maculis quatuor ultra cellulam atomisque paucis submarginalibus ad angulum analem sordide albis; posticis fascia transversa discali maculosa sordide alba maculisque atomosis extra eam cæruleo-albis, iis inter ramos medianos maximis, maculis submarginalibus indistinctis sordide albis, ea ad lobulum analem maxima et introrsum fulvo lavata. Exp. 5·8 in.
♀ mari similis, sed alis magis sordidis, fascia anticarum angustiore sordide alba, fascia posticarum quoque sordida.

Hab. Solomon Islands, Alu Island, Fauro Island (*C. M. Woodford*).

As the discal band of the secondaries does not follow the costal margin, this species resembles *P. Erskinei* and *P. ptolychus*; but the position of this band and the absence of a red spot on the anal lobe at once show its complete distinctness. Mr. Woodford's collection contains several examples from both of the above-named islands.

Papilio pisidice, sp. n.

P. codro et *P. papuensi* similis, sed fascia maculosa anticarum supra et subtus læte aurea nec viridi distinguendus. *P. segonaci* quoque similis, sed fascia integra haud interrupta diversa. Exp. 5·35 in.

Hab. Solomon Islands, North-west Bay in Maleita Island (*C. M. Woodford*).

A single damaged specimen from this locality evidently belongs to a species distinct both from *P. codrus* and its near ally *P. papuensis*, and also from the New-Ireland *P. segonax*. The secondaries are a good deal broken, so that we cannot trace their form. There is a second specimen from Alu

Island (a female) which may possibly belong to another species, since the band of spots on the primaries are much smaller and their colour less brilliant. Additional specimens can alone settle whether there is a second species in these islands.

Papilio orsippus, sp. n.

P. joesæ similis, sed colore cæruleo saturatiore et minus extensa, margine nigro latiore, macula nigra ad cellulæ anticarum finem haud insulata: subtus multo magis nigricantibus, anticis parte apicali vix pallidiore squamis albidis sparsim notatis, posticis margine externo pallido nullo. Exp. 5·2 in.

Hab. Solomon Islands, Aola in Guadalcanar Island (*C. M. Woodford*).

A single male specimen in beautiful fresh condition is in Mr. Woodford's collection. The species is closely allied to *P. joesa* of N. Australia and also to the insect from New Ireland which we attribute to *P. Montrouzieri* from Woodlark Island. From both of these it differs in having the under surface of the wings nearly uniform; the apical portion of the primaries, too, is very slightly paler than the rest of the wings.

XIII.—*Descriptions of new Reptiles and Batrachians from Madagascar.* By G. A. Boulenger.

[Plates V. & VI.]

Uroplates phantasticus. (Pl. V. fig. 1.)

Head large, oviform in outline, deepest at the ocular region; interorbital space concave; snout once and three fourths the diameter of the eye; the distance between the eye and the ear equals that between the eye and the nostril; ear-opening minute, not larger than the nostril; supraciliary edge produced posteriorly in a long, triangular, horn-like lobe, the length of which equals half the diameter of the eye. Limbs slender; the adpressed hind limb reaches the shoulder. Digits one-third webbed. Body compressed, back tectiform; a slight, non-denticulated fold from axilla to groin. Scales finely granular, larger on the middle of the belly; a straight transverse ridge from the supraciliary horn to the interorbital region; three slight chevron-shaped ridges on the anterior part of the back; a small spine-like tubercle above the ear, another at the elbow, and two or three on each side of the body; a larger conical tubercle at the knee. Seventeen upper and eighteen lower labials. Tail (apparently intact) not half so long as the head, compressed, ending in a tubercle. Reddish, with scattered black dots.

	millim.
Total length	65
Head	17
Width of head	12
Body	41
Fore limb	24
Hind limb	32
Tail	7

A single specimen, a gravid female. Collected by the Rev. R. Baron.

Scelotes macrolepis.

Snout very short, obtuse, not projecting; eye moderate; lower eyelid scaly; ear-opening minute, like the nostril; supranasals forming a median suture; a postnasal between the supranasal and the first labial; frontal more than twice as long as the frontonasal, much narrowed anteriorly and emarginate on each side by the first supraocular; no præfrontals; four supraoculars; no frontoparietals; interparietal longer than broad, about half as long as the frontal, its convex anterior border fitting into an emargination of the frontal; third upper labial below the centre of the eye and entering the orbit. Eighteen scales round the middle of the body, the two median dorsal series broader than the others. Limbs pentadactyle, very short; the fore limb, stretched forwards, does not reach the ear; the length of the hind limb is one third of the distance between axilla and groin. Tail thick, a little longer than head and body. Rufous above, with longitudinal series of blackish spots; a pale dorso-lateral streak; lower parts whitish, with longitudinal series of dark brown dots, interrupted on the throat and middle of the belly, larger under the tail.

	millim.
Total length	74
Head	6
Width of head	3·5
Body	28
Fore limb	4
Hind limb	6
Tail	40

A single specimen (*R. Baron*).

Chamæleon gastrotænia. (Pl. V. fig. 2.)

Casque feebly raised and rounded posteriorly, swollen, without crests; the distance between the commissure of the mouth and the extremity of the casque equals the distance between the former point and the nostril; snout pointed, without rostral appendage; canthus rostralis obtuse; no occipital lobes. Body coarsely granular; a dorsal crest of conical tubercles; no gular or ventral crest. No tarsal process. Tail a little longer than head and body. Upper half of body slaty grey, lower dark purple, the two colours separated by an ill-defined lighter band, along which are three small, round, whitish spots; inner surface of limbs pure white; a very broad white band, divided into two by a median grey band, extends from the chin to near the end of the tail.

	millim.
Total length	118
From end of snout to extremity of mandible	16
From end of snout to extremity of casque	20
Width of head	10
Body	40
Tibia	9
Tail	62

Two specimens, male and halfgrown (*R. Baron*).

The same collection contained several specimens of *Chamæleon Campani*, Grand., which enable me to supplement Bœttger's excellent description with the statement that the male develops no secondary sexual characters.

Coronella torquata. (Pl. V. fig. 3.)

Snout short, obtuse; eye small. Frontal once and two thirds as long as broad, considerably longer than its distance from the end of the snout; præfrontals longer than the internasals; rostral moderate, scarcely visible from above; loreal as deep as long; one præ- and two postoculars; a single anterior temporal; eight upper labials, fourth and fifth entering the orbit; five lower labials on each side in contact with the chin-shields, of which the posterior pair is larger than the anterior. Scales in 17 longitudinal series, without apical pores. Ventrals 186; subcaudals 67. Pale brown, vertebral zone (seven scales wide) darker; a series of small black spots forms a vertebral line, and another runs on each side along the third series of scales (counting from the ventrals); upper surface of head mottled with blackish; a white streak along the upper half of the labials, from below the nostril to the commissure of the mouth, edged above with black; a blackish cross band, three scales wide, behind the head; belly white, with minute, irregularly scattered, black dots, disappearing towards the tail, larger and more numerous towards the throat, which is brownish, with white, black-edged markings.

Total length 41 centim., in which the tail enters for 9.

A single specimen (*R. Baron*).

Coronella microps. (Pl. V. fig. 4.)

Snout short, obtuse; eye small. Frontal once and a half as long as broad, considerably longer than its distance from the end of the snout; præfrontals longer than the internasals; rostral moderate, posterior angle visible from above; loreal as deep as long; one præ- and two postoculars; a single anterior temporal; eight upper labials, fourth and fifth entering the orbit; five lower labials on each side in contact with the chin-shields, which are subequal in length. Scales in 19 longitudinal series, without apical pores. Ventrals 137–143; subcaudals 40–47. Pale brown, with six or eight dark brown longitudinal lines, the median pair bordering a band of darker brown than the ground-colour; upper surface of head with dark brown variegations; a dark brown streak on each side of the head, passing through the eye, bordered below by a white streak; upper lip dark brown; throat brown, with white markings; belly pale brown, each shield with a darker anterior margin.

Total length 140 millim., in which the tail enters for 28.

Two young specimens (*R. Baron*).

Dromicus Baroni. (Pl. V. fig. 5.)

Frontal once and a half as long as broad, as long as its distance from the end of the snout; internasals and præfrontals subequal in length; loreal a little deeper than long; two præ- and two postoculars; three temporals in contact with the parietal, the two anterior resting on a larger temporal; eight upper labials, fourth and fifth entering the orbit; six lower labials on each side in contact with the chin-shields, of which the posterior pair is larger than the anterior. Scales in 19 longitudinal series, without apical pores. Ventrals 162; subcaudals 72. Blackish brown above, powdered with yellowish; ventrals, median third yellowish, with a series of large, more or less confluent, black spots; rest blackish, with yellowish posterior edge; subcaudals tessellated black and yellow.

Total length 73 centim., in which the tail enters for 17.

A single specimen (*R. Baron*).

Langaha intermedia. (Pl. V. fig. 6.)

Intermediate between *L. nasuta* and *L. crista-galli.* Rostral appendage half as long as the head, tapering to a sharp point and serrated above at the end, of equal depth throughout the basal half; the length of the appendage thrice and one third its depth. In other respects like its allies. Scales 19; ventrals 142; subcaudals 125. Coloration as in *L. crista-galli.*

A single specimen, measuring 85 centim.

Nossi Bé.

Rhacophorus opisthodon.

Vomerine teeth in two strong oblique series behind the level of the choanæ, which are large. Head large, much depressed; snout rather long, truncate; canthus rostralis distinct, straight; loreal region concave; nostril much nearer the end of the snout than the eye; interorbital space broader than the upper eyelid; tympanum large, three fourths the diameter of the eye. Fingers with a very indistinct rudiment of web; toes nearly entirely webbed; disks rather large, measuring about three fifths the diameter of the tympanum; a small inner metatarsal tubercle. The tibio-tarsal articulation reaches between the eye and the nostril. Skin smooth, belly and lower surface of thighs granular; a strong fold from the eye to the shoulder. Brown above, with blackish marblings; loreal and temporal regions blackish; a whitish streak on the upper lip, from below the eye to below the tympanum.

From snout to vent 87 millim.

A single female specimen.

Rhacophorus albilabris. (Pl. VI. fig. 1.)

Vomerine teeth in two very small widely separated transverse groups behind the level of the choanæ. Head large; snout rounded; canthus rostralis angular; loreal region concave; nostril equally distant from the eye and the end of the snout; eye large; interorbital space broader than the upper eyelid; tympanum half the diameter of the eye. Fingers much depressed, extensively webbed; the web between the two outer fingers extends to the disks, that between the second and third from the middle of the latter to the disk of the former; toes webbed to the disks; disks as large as the tympanum; subarticular tubercles moderate; a small inner metatarsal tubercle. The tibio-tarsal articulation reaches the tip of the snout. Skin smooth above, granular on the throat and belly; the gular granules very unequal in size; a strong fold from the eye to the shoulder; a slight dermal ridge along the outer side of forearm and tarsus. Bluish above (green in life), limbs with rather indistinct narrow darker cross bands; a white streak round the upper lip and along the outer side of forearm and tarsus; lower parts pale brownish. Male with an external vocal sac on each side behind the angle of the mouth.

From snout to vent 75 millim.

A single male specimen. Eastern Imerina (*R. Baron*).

Mantella Baroni. (Pl. VI. fig. 2.)

Differs from *M. betsileo* in having the skin of the back smooth, not granular, and in coloration. Head, body, fore limbs, and femora black; tibiæ, tarsi, and feet reddish (vermilion during life?); a greenish streak along the supraciliary edge and the canthus rostralis, continuous with its fellow on the other side; a very large, circular, greenish spot at the shoulder, continued as a band along the upper surface of the fore limb to the wrist; another similar large spot at the groin, continued on the femur; three roundish greenish spots on the chin, a pair on the belly, one under the elbow, and one under each thigh; upper surface of tibia and tarsus with irregular, large, black spots or cross bars. Male with an internal subgular vocal sac.

From snout to vent 27 millim.

A single male specimen (*R. Baron*).

Platypelis pollicaris. (Pl. VI. figs. 3, 3 *a*.)

Head as long as broad; snout rounded, as long as the diameter of the eye; canthus rostralis scarcely distinct; interorbital space a little broader than the upper eyelid; tympanum two fifths the diameter of the eye. Fingers with a rudiment of web, first shorter than second, third much longer than the others, the tips dilated in rather large round disks; a large, oval, compressed tubercle or rudimentary inner finger; toes short, one-third webbed; inner metatarsal tubercle narrow, very feebly prominent. The tarso-metatarsal articulation reaches beyond the end of the snout. Skin smooth. Brownish above, with small darker and lighter marblings;

thighs and lower surfaces uniform pale brownish. Male with internal vocal sacs.

From snout to vent 26 millim.

A single male specimen (*R. Baron*).

EXPLANATION OF THE PLATES.

Plate V.

Fig. 1. *Uroplates phantasticus.*
Fig. 1 *a.* *Uroplates phantasticus.* Side view of head, × 2.
Fig. 2. *Chamæleon gastrotænia.*
Fig. 3. *Coronella torquata.* Upper and side view of head and anterior part of body.
Fig. 4. *Coronella microps.* Upper and side view of head and anterior part of body.
Fig. 5. *Dromicus Baroni.* Side view of head and lower view of segment of body.
Fig. 6. *Langaha intermedia.* Side view of head and lower view of rostral appendage.

Plate VI.

Fig. 1. *Rhacophorus albilabris.*
Fig. 1 *a.* *Rhacophorus albilabris.* Open mouth.
Fig. 2. *Mantella Baroni.*
Fig. 3. *Platypelis pollicaris.*
Fig. 3 *a.* *Platypelis pollicaris.* Open mouth, × 2.

XIV.—*On the Affinity of the North-American Lizard-Fauna.* By G. A. Boulenger.

In my paper "On the Geographical Distribution of the Lacertilia," published in the 'Annals' for August 1885, I made the following remarks:—"The Neogean Realm may, in this summary review, be described in few words. Its fauna is very uniform as regards groups of higher rank, and the changes from the centre towards the North and South are very gradual. And it is noteworthy that the Central-American fauna (of which the North-American is but an offshoot) presents a greater variety of types than South America; thus it possesses representatives of every one of the eleven families which occur in the realm, viz. Geckonidæ, Eublepharidæ, Iguanidæ, Xenosauridæ, Anguidæ, Aniellidæ, Helodermatidæ, Xantusiidæ, Teiidæ, Amphisbænidæ, and Scincidæ; whereas South America lacks the small groups Eublepharidæ, Xenosauridæ, Aniellidæ, Helodermatidæ, and Xantusiidæ.

As the greater abundance and variety of forms of the Anguidæ occur in the northern half and the West Indies, and the reverse is the case as regards the Teiidæ (especially with reference to variety of genera) and the Amphisbænidæ, we may safely draw the boundary-line between two regions or subregions, as it may be thought fit to term them, at the Isthmus of Panama."

I have quoted this passage in full because Prof. Heilprin, in his note in the last number of the 'Annals,' appears to have lost sight of the origin of our controversy.

In his work on the distribution of animals his reproach was that "The [my] misconception arises from the incorporation of the tract lying south of the line indicated above [a line drawn from San Francisco to Galveston, in Texas] with the North-American faunal region proper, while in reality it is a transition-tract more nearly Neotropical in character than Nearctic."

To this misstatement I replied by placing before him the list of the lizards of the northernmost province in America from which this type of Reptile has been recorded—British Columbia. Instead of admitting his error Prof. Heilprin now attempts to shift the question by misrepresenting my statement; for he now puts it as if it was by *not* including the Mexican district that I have formed what he considers a misconception of the affinity of the North-American Lizard-fauna. And his remark "What, then, are the features which unite the North-American fauna with the South-American?" is uncalled for, as I have clearly stated that the North-American fauna is but an offshoot of the *Central-American*; and I have not said that as regards minor groups (genera) it does not differ from that of South America *. This of course is a totally different charge, in fact the very opposite of that which he first preferred, and to which I have replied.

My statement that "A list of the lizards of any northern district of the United States would equally well support my view" is met by Prof. Heilprin "with a most emphatic denial. In the whole of the United States east of a north and south line connecting the mouth of the Rio Grande with Canada, or over an area of approximately 1,500,000 square miles, there is [he says] scarcely a single lizard which has any Neotropical affinities whatever, and still less so in any northern section of this area."

* As regards higher groups it is scarcely necessary to repeat that the families Iguanidæ and Teiidæ are essentially American and characteristic of both northern and southern continents.

To such a statement I can only reply by placing before the reader the full list of the lizards occurring in the district now indicated by Prof. Heilprin as affording support to his views.

Lacertilia of the United States east of the Mississippi.

[The species with an asterisk prefixed are the only ones which reach 40° N. lat.]

GECKONIDÆ	1.	*Sphærodactylus notatus.*
IGUANIDÆ	*2.	*Sceloporus undulatus.*
	3.	—— *floridanus.*
	4.	*Anolis carolinensis.*
	5.	—— *Cooperi.*
ANGUIDÆ	6.	*Ophisaurus ventralis.*
TEIIDÆ	*7.	*Cnemidophorus sexlineatus.*
AMPHISBÆNIDÆ	8.	*Rhineura floridana.*
SCINCIDÆ	9.	*Lygosoma laterale.*
	*10.	*Eumeces quinquelineatus.*
	11.	—— *anthracinus.*
	12.	—— *onocrepis.*

XV.—*On some Points in the Anatomy of the* Temnopleuridæ. By Prof. P. MARTIN DUNCAN, M.B. (Lond.), F.R.S., &c.

[Plate XI.]

THERE is a great group of Echinoidean genera which is well characterized by a raised costulate or reticulate ornamentation of the plates, more or less grooved, furrowed and pitted sutures, small peristome, feeble branchial grooves, and small external branchiæ. The ambulacral plates are compound, the pairs in series of three, the tentacles homiopodous, the foramen of the pyramids closed above, and the teeth keeled. This group falls readily under that subfamily of the family Glyphostomata which my colleague Mr. Percy Sladen and myself called the Temnopleuridæ in our description of the Tertiary fossil Echinoidea of Kachh and Kattywar (Pal. Ind. ser. xiv. 1883, p. 54). But it is now necessary to advance the subfamily to the dignity of a family, for the group is large, requires subdivision into subfamilies, and is well separable from the other divisions of the Glyphostomata, such as the Triplechinidæ, A. Agass. It is the presence of a considerable number of fossil genera and a recent one, characterized by a large apical system with some of the radial plates entering the ring, a raised costulate ornamentation, without furrows and pits in relation to the sutures, having *Glyphocyphus*, Haime, as the type, that necessitates the subdivision. This group may become the Glyphocyphinæ, and the remainder of the genera, characterized by depressions, furrows, and pits of the sutures, dowelling between the coronal plates and a compact apical system, may enter the subfamily Temnopleurinæ. It is advisable to raise the position of the Glyphostomata into a suborder of Regulares.

According to Forbes's definition of *Temnechinus* and the result of the examination of the fossil forms from Sind, by my colleague and myself, there can be no valid reason for separating the genus from the Temnopleurinæ, and it might be urged that the genus has not more than a subgeneric value in relation to *Temnopleurus*. But when the admirable description of the recent *Temnechinus maculatus*, A. Agass. ('Revision of the Echini,' p. 286, pl. viii.), is studied, it is impossible not to agree with the author, and although there are some anomalies present the form must, from our present knowledge, enter *Temnechinus*. This being the case, it will be found that there are some decided distinctions between the species and any one of *Temnopleurus*, such as the large anal plate, the grooving around the tubercles, and the absence of true pits and deep grooves at the angles of the sutures, the grooving of the transverse sutures being slight. There is, however, a very great difficulty to be overcome before *Temnechinus* can come within the Temnopleurinæ, and it is the result of A. Agassiz's examination of the sides of the coronal plates. In the "Report on the 'Blake' Echini," Mus. Comp. Zool. Harvard, Memoirs, vol. x. no. 1, xxiv. pt. 1, 1883, p. 37. A. Agassiz wrote, "The specimens of different sizes which I have examined show no trace of pits nor of this system of dowelling at the junction of plates." The importance of this deficiency is great, and yet the peristome, the spines, and some of the pedicellariæ are the same as those of *Temnopleurus*. It appears then that the modern *Temnechinus* must be decidedly separated from *Temnopleurus*; but should the knob-and-socket arrangement of the union of the plates be discovered, *Temnechinus* will enter the Temnopleurinæ. It appears correct to associate the modern *Trigonocidaris*, A. Agass., with the Glyphocyphinæ.

The following observations upon some important structures of species of *Temnopleurus*, *Salmacis*, *Microcyphus*, &c. were made with a view of comparing the similar structures of *Temnechinus* and *Trigonocidaris* when an opportunity presented itself. It was also thought to be advisable to investigate the real value in a classificatory sense of the crenulation of primary tubercles and the presence or absence of grooves between the pores of a pair—two matters which have been made a great deal too much of in the classification of the fossil forms of Echinoidea.

The Sutures of the Plates.

The method of the union of the coronal plates of the Temnopleurinæ was discovered six years since, and the remarkable dowelling of the opposed edges of plates was described in species of *Temnopleurus*, *Salmacis*, and *Amblypneustes*, and subsequently in *Pleurechinus*, together with the nature of the sutural groovings and pits (Journ. Linn. Soc., Zool. vol. xvi. pp. 343 and 447).

I have now had the opportunity of examining better specimens of *Amblypneustes ovum*; and there is no doubt that the knob-and-socket structure upon the sides of plates is very well developed. The former specimens noticed were not in good condition as regards preservation, and it is a fact that if the fracture of any Temnopleurid is crumbling and very white in tint, changes have gone on which tend to destroy the appearance of dowelling, which, moreover, is not very visible in wet specimens.

Mespilia has the same junction-structure, and I find that *Holopneustes purpurescens*, Lütk., has knobs and sockets upon the opposed surfaces of the plates, with the exception of the component plates of the geometrical plates of the ambulacra. I do not find dowelling upon these plates in any genus, although it is recognized between the compound plates.

It would be expected that the thick tests of such a species as *Microcyphus zigzag*, Agass., would present some anomalous arrangement of plate-junction; but the knobs and sockets are in considerable numbers near the outer parts of the edges of the plates. On the plates on either side of the median ambulacral suture (Pl. XI. fig. 1) there are also some more or less straight rows of knobs or sockets, passing from within towards the outer part of the edge. This *Microcyphus* has a remarkable amount of union of the plates free from dowelling, and it appears that the ambulacro-interradial vertical sutures are inseparably united. In all other genera the test fractures very readily along this line, but in *Microcyphus zigzag* the test will break in the poriferous zone rather than separate at the suture.

There appears to be an amount of superficial growth of test which overrides the plates here and there in the ambulacra of *Microcyphus*, and this has to do with the abolition of the suture, as well as a remarkable blotting-out of plates, which will be mentioned further on.

The Sutures as seen in Decalcified Specimens of Temnopleurus toreumaticus.

After decalcifying in dilute hydrochloric acid in spirits of wine, washing, staining with hæmatoxylon, placing in absolute alcohol, clearing and mounting, the sutures between the interradial plates become beautifully distinct, on account of the presence of a lamina or ribbon-shaped process of reticular connective tissue, which dips down between the contiguous edges of the plates. It appears to be that part of the connective tissue of a plate or plates in which the knobs and sockets, made up of very reticular spicules of carbonate of lime, are deposited as the test grows. In some parts, especially in the apical region, the suture between two plates is recognized by a cross-layering close to the divisional line.

The Structure of the Ambulacral Plates.

The ambulacral plates of all the Temnopleurinæ are compound, and the pairs of pores are in triplets, which vary in their obliquity, vertical closeness, and horizontal distance. The least complication is seen in the genera *Temnopleurus* and *Salmacis*, and the greatest is observed in *Microcyphus* and *Holopneustes*. It is evident that two factors produce complexity, and they are diminution of the vertical dimensions of the compound plates and thickening of the test during growth.

Simple as the ambulacral plates of *Temnopleurus* and *Salmacis* are, they afford a good introduction to the study of the more complicated forms.

Temnopleurus and *Salmacis*. (Pl. XI. figs. 2, 3, 4.)

In all the species of these genera the ambulacral plates are in compound geometrical forms, which are low and broad in *Salmacis* and taller and narrower in *Temnopleurus*. In all species the compound plates are made up of three components; the upper or aboral component (*c*) is a long low primary, and the middle one (*b*) is a low short demi-plate with a very curved inner or adoral suture which reaches the adoral suture of the primary just noticed, as it passes upwards. The lower or adoral component plate (*a*) is a large primary, and it occupies most of the compound plate. This is a very usual arrangement, and is similar to that of *Echinus* and its allies; but the inner suture of the demi-plate differs in the nature of its curve, and it is not simply oblique, as in *Echinus* proper.

The triple pairs of pores are more in arcs in *Salmacis* (fig. 4) than in *Temnopleurus* (figs. 2, 3), and in both genera the pores of pairs are much wider apart on the inside of the test than they are in the peripodia (compare figs. 2 and 3).

Mespilia. (Pl. XI. fig. 5.)

The same arrangement of plates and pairs of pores as is seen in *Temnopleurus* and *Salmacis* occurs, slightly modified, in *Mespilia globulus.* The compound plates of this species are decidedly low and broad, and more so than in the genera just alluded to. The pairs of pores are in triplets, the pairs being close vertically. The middle pair of pores of the triplet (*b*) is close to the ambulacro-interradial suture in a rather broad, low, demi-plate, whilst the aboral pair (*c*) is nearly vertical to the adoral pair (*a*). Both of these pairs are in primary plates, the adoral being in the largest. As in the other genera the pores of a peripodium are much closer than their continuations within the test.

Microcyphus. (Pl. XI. figs. 1, 6–12.)

There are some very remarkable and, in my experience, unique structural characters about the ambulacra of *Microcyphus zigzag*, Agass., which appear to be due to the growth in thickness, externally and internally, of the plates and to the very oblique paths of the canals of the pores. Blocking out of the ends of component plates occurs, and some plates which are perfectly visible on the inside of the test are not seen on the outside, and they have been hidden by the continuous superficial deposit of test material. Moreover, parts of the component plates of compound ones are sometimes separated from their sutures in a very unusual manner (fig. 1).

On looking at the ambitus of a specimen (fig. 6) the low broad ambulacral plates, which are broader superficially than within, are noticed to have an adoral pair of pores (*a*) nearer the median line of the ambulacrum than the other pairs, which are oblique and close to the ambulacro-interradial suture; a number of plain tubercles and miliaries are upon the plate, some small ones being amongst the pairs of pores, which are large and in peripodia and separated by a narrow process. On looking at the inside of the corresponding part of the test (fig. 7) it is impossible to recognize the external arrangement. The pairs of pores are in a very slightly curved vertical series, and the adoral pair of perforations (*a*) is not much or at all out of the direction of the other two pairs. But the obliquity of the canals of the adoral pair is great (fig. 8), and in all cases there is more plate-structure between the pairs of pores and the ambulacro-interradial suture than is visible on the outside. The pores are quite 1 millim. to 1·5 millim. apart, on the inside of the test.

The test is very thick, and the ambulacro-interradial sutures are quite obliterated, and fracture will most certainly not occur along that line. The sutures between the compound plates are slightly depressed or broadly grooved on the free outer surface of the test, and the pits are exceedingly shallow.

Taking a plate at the ambitus which is normal, and they are rare, and applying benzule, a line of suture is seen to pass below the upper peripodium of the triplet with a downward curve across the plate, to reach the median sutural edge close to the aboral median angle. This suture marks the adoral boundary of the upper component of the plate, and it is a primary (fig. 6, *c*).

A line passes adorally to the middle peripodium (*b*) of the three, and curves with a slant upwards and joins the other suture at no great distance towards the median line. This line is the adoral suture of the median plate of the compound, and it is a small demi-plate (fig. 6, *b*).

The line just mentioned nearly touches the aboral edge of the lowest or adoral peripodium (*a*) of the innermost pair of pores, and they are placed in a primary plate, which carries the ornamentation of the greater part of the combination (fig. 6, *a*).

An inner view of this plate (fig. 7) shows a simple curved series of pores, the width apart of the pores of a pair being much greater than in a peripodium. The path of the sutures is very distinct and is very like that of *Salmacis*. The obliquity of one of the canals of the adoral pair is shown in fig. 8.

Near the apical system the compound ambulacral plates are narrower than at the ambitus, but are made much upon the same plan; but a little lower down very remarkable differences are seen on the inside of the test.

A compound plate will be seen not far from the apex, within, and its component plates are all primaries (fig. 9, *x*), and if their middle sutures were more curved, the arrangement would be Diadematoid; but the adoral suture of the upper and the aboral suture of the lower primary are nearly transverse. Nearer the ambitus are some arrangements of plates unlike any hitherto noticed. There is an upper compound ambulacral plate (fig. 10) and the aboral component is a long low primary (*c*) with its adoral suture dipping towards the next plate in adoral succession. This plate (*b*) is a small triangular one, and its adoral suture *does not reach the adoral pore of the pair belonging normally to the plate.* Under the use of evaporating benzule I cannot detect *any suture coming from the adoral pore.* Consequently the adoral component (*a*) of the plate under consideration is a large primary, and includes the adoral pore of the pair properly belonging to the demi-plate above. In the compound plate next below, the upper component plate (*c*) is the usual primary, and the next (*b*) is a demi-plate with its suture *passing from the adoral pore of its pair vertically* to the corresponding or adoral pore of the pair of the primary above. The dotted line is in the path of a thickening which recalls the position of the suture in fig. 9.

In the next plate (fig. 11) the suture of the adoral pore of the middle plate (*b*) is plainly turned obliquely upwards and *outwards* to reach the small demi-plate, and the first stage of the exclusion of a pore from its plate is exemplified. Fig. 11 is of two compound triple plates, and in the upper one the aboral member is a low primary (*c*); the next plate (*b*), which should have been a perfect demi-plate, is one which only contains the aboral pore of its pair, and is excluded from the ambulacro-interradial suture. The adoral pore of the pair (*b*) has its suture just touching the union of the adoral suture of the single pore-bearing plate with the adoral suture of the upper primary (*c*).

The lowest plate (*a*) is a large irregular primary. The same condition of things is seen in the next or actinal compound plate (the lowest of fig. 11), but the aborted plate (*b*), with only one pore, is not excluded from the ambulacro-interradial suture. Below the ambitus of the test the variety in the distribution of the sutures, as seen from within under benzule, is as extraordinary as abactinally, for (fig. 12) in a well-marked example the upper (*c*) component is a low primary with a dip down of its adoral suture towards the space between the pores of the middle (*b*) component plate, and the adoral pore has got above and out of the touch of the adoral suture. The middle pair of pores (*b*) has its aboral pore in a demi-plate; but the adoral pore *is on the line of the adoral suture of the upper* *primary plate* (*c*). The lower component is a normal primary (*a*).

If the ambulacral plates are separated along the ambulacral median suture the usual knobs and sockets are seen upon the opposite edges of the plates, and amongst them dark lines are seen under benzule (fig. 1). The knobs and sockets in the figure are in lines and groups, and most are near the outer part of the test; the lines are almost straight and some reach from one surface to the other, and all are the joined sutures of primary components of compound plates.

Some lines, however, have a slant, and whilst most are simple, others have a curved offshoot which starts below the outer surface and, after curving, becomes straight. As the space included between two lines of sutures is a plate or part of one, so the surface between the bend and the straight suture is a part of a plate. That this is the case is easily noticed in such plates as fig. 9* (*a*), for the line of the adoral suture of the upper primary (*c*) can be traced to the median edge of the plate and partly upwards, but not to the surface of the test; it is represented in fig. 9 at *x*. In every instance of this bending of a sutural line as it passes from within outwards in the test there are proofs of the outward addition of material having buried the suture and its plate, so that the outer markings of such a plate would not tally with the inner, and these last are relics of the early state of growth of the test.

Amblypneustes.

The ambulacral plates of *Amblypneustes* (fig. 13) are low, broad, and thin, and the pairs of pores are in large peripodia; the adoral pair of a triplet is not placed relatively so far inwards as in *Microcyphus*; but the appearance on the inside of the test is very different. In *Amblypneustes* the middle pair of a triplet is nearest the ambulacro-interradial suture, and the aboral pair is placed obliquely above and inwards to the middle pair; and this obliquity is continued to the adoral pair of pores of the plate next in vertical succession. Hence there is the common appearance presented of sets of oblique pairs in threes, and this is shown to perfection inside the test, and the appearance is intensified by the obliquity of succeeding sets of three having their inner pores along the same oblique line as the outer pores of triple pairs placed above and below.

A primary plate, which is the aboral constituent of *Microcyphus* (*c*, fig. 6), does not exist, however, in *Amblypneustes*, for the aboral component (fig. 13, *c*) is a low broad demi-plate; the middle plate (*b*) is a low narrow demi-plate, and the adoral pair of pores is in a large primary plate (*a*).

Holopneustes.

The nature of the ambulacral plates of *Holopneustes purpurescens*, Lütk. sp., is much easier to comprehend than that of the other and broad poriferous zoned species, *H. porosissimus*, Agass. But the same method of examination must be employed as in other polypores, and when it has been mastered in the first-named species the difficulty vanishes with regard to the apparent confusion of the plates in the other form. The rule must be followed which enables the adoral pair of pores or their peripodium to be distinguished; and it must be remembered that in the great majority of instances the pair is nearer the ambulacral median line than the other pairs of a compound plate.

In *Holopneustes purpurescens* (figs. 14, 15, 16) the ambulacral plates are low and broad, and usually there are double plates near the ambitus (fig. 14) consisting of two vertical sets of triplets combined in a geometrical plate; elsewhere the plates are single, or there may be an alternation of single and double plates. The test is rather thin and the poriferous zone is rather broad, the peripodia being triserial in arrangement. The pairs are close vertically and rather distant horizontally. One vertical row of pairs is very regular and is internal, that is nearest the interporiferous area, and each pair is in the adoral plate (*a*) of a compound plate. This adoral plate is a primary, and forms most of the interporiferous part of the geometrical plate; it extends to the median suture; but it may be excluded from that part of the poriferous zone which is close to the ambulacro-interradial suture (figs. 14–16), or, as is the case near the apical system, it forms all the adoral part of the compound plate and reaches the ambulacro-interradial suture (fig. 15, *a*).

The outer vertical series of pairs of pores is also a very regular one and consists entirely of those belonging to the middle components (*b*, figs. 14 and 16) of compound plates, the component plate being a narrow demi-plate. Near the apical system the little demi-plate (*b*, fig. 15) is separated from the adoral suture of its geometrical compound by a low part of the primary just noticed; but usually there is no such interval, and the expansion of the demi-plate has caused the *exclusion of the portion of the primary immediately adoral to it* (figs. 14–16). It is this blotting-out of part of a plate which causes the outer and inner pairs of pores of a triplet to be so nearly on the same horizontal line.

The middle series of pairs (*c*) confused or not in vertical succession relates invariably to the upper or aboral plate of a compound geometrical plate; and this should not be forgotten in investigating the distribution of plates in the very complicated poriferous zones of the other species of the genus. Each pair of the middle series is in a low but broad demi-plate, and is placed remotely from the ambulacro-interradial suture (fig. 14, *c*).

Every compound plate consists therefore of a low triple set of pairs. It should be noticed that the pores are very oblique in a peripodium.

On examining the test from within, a different arrangement of the pores is observed, but the great dissimilarity noticed in *Microcyphus* does not occur. Nevertheless the pores of a pair are much further apart than on the free surface, and the great horizontal distance of the pairs is not recognized.

Seen on the inside of the test (figs. 15, 16) the pairs of pores are in zigzag, but the adoral pair can be recognized by a certain vertical arrangement and by the inner or adoral pore of the pair being large and at the end of a short groove; the other or aboral pore is small, circular, and is placed obliquely upwards and outwards. Fig. 15 is a view, slightly diagrammatic, of two compound plates near the apex, seen on the inside of the test during the action of benzule. The adoral pairs of pores are readily distinguished, because the adoral pore is upon the lower horizontal suture of the compound plate. The contact of the adoral primary plate is seen with the ambulacro-interradial suture. In fig. 16 the exclusion of the corresponding plate *a* is seen, and in all plates a singular curvature of the lower horizontal suture occurs, and it is curved up towards the upper pore of the pair before passing outwards to the ambulacro-interradial suture. This curving is very anomalous, and is especially distinct when the primary is excluded.

The outer and more or less vertical row of pairs of pores, with one of the pores close to the ambulacro-interradial suture, is the middle pair of the compound, and is in a small demi-plate; its pores are much more horizontal when seen from within than in the peripodium (figs. 15, 16, *b*). The highest pair of pores of a plate is further from the ambulacro-interradial suture than the pair just described, and its pores are variably placed as regards verticality, and they often overlap the outer pore of the adoral pair and the inner pore of the pair in the demi-plate; the inner pore of this aboral pair is usually nearly vertical to the outer pore of the adoral pair.

The pair corresponds to one of the middle vertical series (*c*) seen on the outside of the test, and is in a low broad demi-plate.

It is not difficult to make out the sutures of the compound plates with benzule near to the apical system; but the crowding of the plates lower down and the absorption of a part of the adoral primary, together with the horizontal curvatures of some of the sutures, place considerable difficulties in the way.

The adoral suture of a compound plate (fig. 15, *a*) is horizontal near the apical system, and usually but not invariably so when the primary is not partly excluded (fig. 1). The adoral or large pore of the primary plate, *a*, is of course traversed by the more or less horizontal adoral suture of the geometrical plate; but the small circular aboral pore of the pair is not remote from the suture, as is usually the case in Echinoidea, for the suture bends up to it more or less. The direction of the suture from the aboral pore outwards is either straight or in a slight curved convexity directed upwards. In this last instance the suture is in contact with the adoral pore of the narrow demi-plate *b*, fig. 16. It is anomalous for one line of suture to cross the adoral canals of a lower and upper plate; but it is well exemplified in the case of this *Holopneustes*.

When the primary is not excluded (fig. 15, *a*) the middle demi-plate of the compound has an adoral suture of its own, and at or close to the adoral pore of the pair it turns upwards with a curved concavity towards the ambulacral median line, to reach the adoral suture of the aboral or upper component of the compound plate. The aboral or outer pore of the pair is not remote from the horizontal suture (fig. 15, *b*), and is often upon it.

The aboral plate of the compound seen from within (figs. 15, 16, *c*) is a low demi-plate which is longer than the middle demi-plate, and when the primary (*a*) is not excluded its adoral suture is horizontal and turns up with a curve to reach the upper edge of the compound plate just between the pores of the adoral pair of the next geometrical plate in vertical succession. But when the primary is excluded the adoral suture of this upper component is curved convexly downwards, and it has its curvature continued so as to join the horizontal suture between the compound plate and its fellow above, a little external to the adoral pore of the pair belonging to the adoral primary component of the plate above. The appearance given under benzule is of a number of low ellipses placed vertically, and they are formed by the adoral sutures of the upper plates and the aboral sutures of the lower plates in succession (fig. 16).

The Pits.

The pits at the sutural angles and elsewhere are described in the communication already alluded to (Journ. Linn. Soc., Zool. vol. xvi.).

The distinctness of the pits in *Amblypneustes* and their slight depth in *Mespilia*, *Microcyphus*, and *Holopneustes* is evident, and A. Agassiz has pointed them out along the lines of sutures as well as at the angles in *Pleurechinus* and in a species of *Amblypneustes*. But the pitting is in excess in *Temnopleurus* and *Salmacis*, and is less in the genera just mentioned. The pits near the peristome in *Temnopleurus toreumaticus* have a large and rather depressed spheroidal sphæridium at their entrance *, and many others have a pedicellaria close by. It does not appear that there are any special functions relating to the pits, and the same thing may be said in respect of the deepening, grooving, widening, and depressing of the outer surfaces of the plates close to the sutural lines; but it is clear that these modifications of the test enable a larger amount of outer test surface to come in contact with water.

The Articulation and Muscles of the primary Spines.

The spines are for the most part slightly compressed, and some are very much so; they have a well-developed milled ring, which is broader than the rest, and which has its milling continuous with the longitudinal fluting of the spine. The spine diminishes in breadth below the milled ring very rapidly, and the hollow cotyloid cavity has a blunt free edge more or less notched.

The spines are cellular within, with a double series of radiating processes and a very narrow circular central space (fig. 28).

The primary tubercles have a well-formed scrobicule, which slants down from the boss and is often slightly raised externally, so as to present a prominent circular border; it is plain and smooth, except close to the boss, which has a decided crenulation upon it close to the neck of the imperforate and projecting globose mamelon. The cotyloid cavity of the spine fits upon the mamelon, and the notched free edge comes

* Lovén, Études, pl. x. fig. 38.

in contact with the crenulation of the boss, so that the mamelon is well hidden. As Valentin described in 1841, the joint of the spine and tubercle has three layers—the outer an epithelial, pigmented and ciliated, thin layer, a middle thin and more or less fasciculate layer of muscular fibres, and an inner articular capsule.

Valentin's researches were made upon species of *Echinus* with smooth bosses, and as those of *Temnopleurus* are crenulate their examination is not devoid of interest, especially as the question of the classificatory value of crenulation is constantly arising.

In *Temnopleurus* the inner structure surrounding the joint is the articular capsule, which is a white, soft, mass of imperfectly differentiated matter, with granules, connective tissue, and extremely indistinct fibres. The microscopic appearances are very negative. The white matter adheres to the lower part of the spine, below the milled ring, and to the edge of the cotyloid cavity; it is firmly adherent to the crenulation on the top of the boss of the tubercle. A quantity of the white enclosing substance is spread over the surface of the boss and scrobicule like a flap, but there is some definite connexion between the hard and soft parts. This soft capsular structure is very weak, however, and if the outer muscular layer is ruptured, soon gives way to a slight pull or to unusual depression of the top of the spine. The fracture occurs at the point where the free edge of the lower end of the cotyloid cavity is movable upon the crenulation of the boss. Dislocation of the spine then occurs.

The muscular layer is considerable in height, although very thin, and it reaches from its origin around the edge of the scrobicule of a tubercle, upwards to the inferior edge of the milled ring of the spine; it covers the articular capsule and neither receives fibres from the boss nor from its crenulation. The muscular fibres arise from the connective tissue of the outer edge of the scrobicule, and they are very delicate, separate under the microscope, and exceedingly simple. There are no differentiated structures in them, and the distribution in bundles is not striking, and indeed it does not usually exist. The nervous supply is considerable, beneath the muscular fibres, and the very minute nervous fibres have ganglion-shaped parts upon them*. The delicate layer of

* The minute anatomy of most of the parts of some species of Echinometradæ and Echini has been of late worked out with great success, and published by Otto Hamann ("Beiträge zur Histologie der Echinodermen," Jenaische Zeitschrift, Bd. xxi., Neue Folge, Bd. xi. p. 87, 1887).

cells which is situated upon the muscular layer may deceive a young microscopist into crediting that there are cross light and dark marks in the muscular fibres; but careful illumination and the use of a lens capable of good definition expose the error.

Diadema setosum has the primary tubercles with crenulated bosses and perforated mamelons, and the part of the spine between the lower end or edge of the cotyloid cavity and the milled ring is very long. I find that the muscular investment of the joint greatly resembles that of *Temnopleurus*, that it arises from the outer edge of the scrobicule of the primary tubercle, and is inserted at the lower edge of the milled ring, and possibly here and there upon the outside of the spine below the milled ring and the capsule of the joint. This capsule covers the ends of the spine and the top of the boss and covers the crenulation and extends as a flat layer beyond it.

No muscular fibres penetrate this capsule, and none arise from the crenulation. It is interesting to note that in the same specimen of *Diadema* some of the bosses are perfectly crenulated, others are half crenulated, and not a few may be destitute of the structure. This is not uncommon in other forms.

It would therefore appear that crenulation and perforation of the tubercles is not of sufficient physiological importance to distinguish genera, although it may be useful in grouping species.

The Branchiæ. (Pl. XI. figs. 17–21.)

The branchiæ of *Temnopleurus* and *Salmacis* are small and narrow, although moderately long. They are situated upon the peristomial membrane, close to the small so-called "incisions" or rather grooves, one of which is placed close to each ambulacro-interradial suture at the peristomial margin. The branchiæ protrude and reach up over the edge of the grooves and may be 2 millim. in vertical measurement. In *Temnopleurus* (fig. 17) the narrow branchiæ are in finger-shaped processes, from six to twelve or more in number; they arise from a hollow stem and rarely bifurcate, but some are in tufts which come from the same source. All are tumid, rounded at the free end, and hollow. Decalcified specimens show that there is an outer thick layer of columnar epithelium (fig. 18), the cells containing granules which are most numerous at their bases (fig. 19); but it appears that there may be groups of cells so crowded with pigment corpuscules that a definite pattern is presented on the outside of the finger-shaped body, consisting of longitudinal, irregular, narrow, wavy lines. This ornamentation is also seen upon the main stem or water-tube.

The hollow of a process is lined with a smaller and less columnar endothelium, with granules, and it appears to line a somewhat irregular basement membrane (fig. 18). Between the outer and inner series of cells is a somewhat wide space readily transmitting light, and having no definite structures in it, and in specimens which have not been decalcified calcareous spicules are found there in some abundance.

In *Salmacis* (fig. 20) the branchiæ are larger and stouter than in *Temnopleurus*; they are, however, narrow and spring from a larger and higher stem. The processes are more in tufts, and are shorter and more numerous than in *Temnopleurus*. These branchiæ pass up over the margin of the peristome at the branchial grooves and reach along the flanks of the ambulacra for a line or two. The principal structure to be noticed is that which is visible before applying acids. The calcareous spicula are separate, moderately numerous, and variable in size and shape. "C"-shaped spicula are seen, but are not common, and the others are bifurcate or pinnate; and on the water-tube there are numerous fenestrated elliptical or irregularly shaped plates.

The Ampullæ. (Pl. XI. figs. 21, 22.)

Decalcified portions of the ambulacra of *Temnopleurus toreumaticus* stained with hæmatoxylon were used. The ampullæ are small and bolster-shaped near the apical disk and become gradually larger and closer in vertical succession towards the ambitus, where they are large, long, from side to side, and tallest near the median ambulacral water-tube (fig. 21). Their actinal edge is tumid and more or less gibbous, a swelling being noticed close to the water-tube and a contraction midway between the two ends, and there is more or less of a narrowing quite at the part which corresponds to the poriferous zone. The abactinal edge is less irregular and runs up to a blunt point at the poriferous zone end. They are broader than high and tumid. The opening into the water tube is seen by transmitted light very plainly, but the holes for the tentacular canals are indistinct. They are placed in the interradial side half of the ampullæ and are recognized as a dull elliptical space, which appears to be more or less occupied by fibres of the inner part of the base of a tentacle which have become compressed over the openings of the pores externally.

The structure of the walls of the ampullæ is very interesting, and they are not simple bags with a contractile coat. The bag is composed of very delicate, close, exceedingly narrow circular fibres, which in the main are vertical, although they depart from that direction in the gibbous parts. The accessory structures are irregular transverse rows of small elongate pigmented spots, which, in sections or oblique views of the ampullæ, are seen to be the outer terminations of fibres resembling the usual unstriped fibres of small spines, which pass inwards to varying depths in the hollow of the ampullæ, and are attached to reticulations of connective tissue (fig. 22). These fibres exist in *Psammechinus* and are very suggestive of less definite structures, which may be noticed in the abactinal branchial tentacles of *Cœlopleurus*. These spots give a very marked aspect to the outside of the ampullæ, and their inner prolongations probably prevent too sudden expansion of the calibre of the ampulla, and may also assist in the contraction required for the infilling of the tentacle. A very delicate epithelium and endothelium * occur.

It is interesting to notice the great size of the ampullæ in relation to the dimensions of the bases of their tentacles at a slight distance from the apical system, and to observe that the bags reach quite across the whole breadth of the ambulacral plates.

It appears from the examination of the bases of the tentacles, that the so-called geminous or reverse condition of the pores of the pairs is not of the least physiological importance, and whether there is a groove externally on the test between the pores or whether there is a granule or nodule between them is of no significance in a natural system of classification.

In the specimens which gave the above results the ampullæ were tense and tumid, but in some others, in which they were seen to be empty and flaccid, there was some departure from the exact shape, and moreover the internal fibrous arrangement was not visible. This was doubtless due to the considerable time during which the test had been in impure alcohol. The two openings for the tentacular canals were, however, very visible, and there was no vestige of any valvular structure. But a fortunate section of the tentacle of one of the ampullæ showed that the inner membrane is continuous through the pores with that of the ampulla.

The Tentacles. (Pl. XI. figs. 26, 27.)

These well-developed structures of *Temnopleurus* are similar throughout the ambulacra, and the genus is therefore homœo-

* See also Hamann, *op. cit.* pl. xiv. fig. 3.

podous. The tentacles are moderately long and stout in alcoholic specimens, and their bases are broad and encircle the not very strongly marked peripodia; the stem soon becomes cylindrical and very slightly tapering, and it diminishes somewhat suddenly in diameter close to the large suctorial or cup end. The hollow of the tentacle is well seen, and it is the outcome of the junction of two short canals which come through the two pores of each pair. The separation between these canals is very slight in the base of the tentacle.

The plan adopted was to decalcify some specimens and to colour and mount in balsam, and to mount others without decalcifying them.

In the decalcified specimens the tumid edges of the sucker end are more or less faintly lobed, and there is evidently some circular arrangement of fibres there. This would tighten the grasp of the cup-shaped end, and would act upon the quadripartite calcareous circlets which will be mentioned further on. A thick epithelium and much connective tissue below it form the bulk of the cup, and are continuous with the similar structures of the outside of the body of the tentacle. On the body this structure is very delicate, and the epithelium is rather more columnar than flat, it contains granules and has cilia. In some tentacles there is much thickening of the epithelial part near the neck of the cup, and much transverse folding of it and the subjacent structures, but elsewhere the cells may be excessively thin and transparent.

Four sets of muscular fibres are visible in a tentacle: first, the circular fibres of the cup; secondly, the concentric and radiating fibres of the top of the tentacular cavity and base of the cup (see Lovén, 'Pourtalesia,' p. 49, pl. xi. figs. 112–115); thirdly, the outer layers of circular fibres; and fourthly, the innermost muscular layer composed of longitudinal fibres. The circular fibres are most developed near the cup and in what may be called the neck of the tentacle; but elsewhere their presence varies most remarkably. In some tentacles a delicate close layer can be distinguished composed of exceedingly narrow, close, circular fibrils of great slenderness; they appear to be nucleated here and there and separate; striation does not occur. In other examples the circular fibres are very scarce and wide apart; in some they do not exist.

The longitudinal fibres reach from the base at the peripodium, where they are stout and very visible, up the shaft, where they become excessively attenuate and slightly distant, to the base of the cup below the calcareous structure. They are often slightly wavy, nucleated, and unstriated (see also Hamann, *op. cit.* pl. xiv. fig. 7).

The circular fibres are placed over a delicate membranous tissue which may sometimes be seen projecting beyond the cut end of a tentacle, and this is clearly epitheliate and very minutely granular. Probably it is ciliated, but no trace of cilia came under observation. The longitudinal fibres are usually somewhat coloured naturally at the peripodia, and arise by broadish bases, and soon attenuate; they are apparently separate and not in fascicles. As is the case around the origin of the muscles of the spines, there is a very fine lax entanglement of threads much less in diameter than the thinnest muscular fibre around the peripodium, and it is apparently nervous in character. The nerves have small simple ganglionic swellings, and conform to Lovén's well-known description, except that I have not seen multipolar cells uniting.

The tentacles which are between the ambitus and apical system are larger than those situated actinally, and their calibre and middle space are greater, the muscular walls are more attenuate, and the cup end is more tumid and smaller. These tentacles have a more baggy appearance than the others, and when decalcified the muscular layers are very distinct, especially the transverse or circular series, which is so feebly developed in the actinal set. In fact these tentacles resemble in a minor degree the similarly placed structures of *Salmacis*.

The muscular fibres which close in the free end of the tentacle pass inwards from the stout continuous calcareous spicules which form the foundation of the circlet of calcareous reticulation of the cup; this more or less quadrangular continuous structure Lovén has called the foot-ring or "psellion" (Lovén, *op. cit.* pp. 49, 50). The muscular fibres unite at the centre of the neck of the tentacle and form the floor of the sucker or adhering apparatus.

The psellion is so arranged that the spoke-like spicules of the four parts of the calcareous circlet spring generally from the middle of one of the four main spicules of it, and the junction of one main spicule with another marks the line of separation of the parts of the circlet (figs. 26, 27). Immediately below the psellion are two very slender spicules of the same length, and they are connected by vertical and distant short spicules. Sometimes a ragged areolar lamina extends slightly over the edge of the muscular circle.

The calcareous circlet of the cup, springing as it were from the psellion, and nearly reaching the circumference of the free end of the cup, is very decidedly divided into four parts, and each part is composed of a reticulation which has five or six spoke-like processes which traverse the lamina of the circlet and are free at its circumference, some ends being simple points, others double or cellular. Between the spokes are cross pieces, and hence the reticulate and fenestrated appearance. At the sides of each lamina, that is at the four divisions of the circlet, the radiating spicular elements are stouter and not on the same plane; the consequence is that the space between the contiguous side spicules is not very distinct and sometimes it is clearly vacant, or there may be a slight reticulation in parts. Lovén considered that probably there are muscular fibres between the side spicules of the four parts of the circlet in *Toxopneustes*, and although they are not visible in the specimens before me, the possibility of their existence in fresh specimens is very considerable; certainly these separate parts of the circlet would be approximated by the contraction of the circular fibres of the soft parts of the cup.

Very few "C"-shaped spicules are present in the tentacles of *Temnopleurus*, and I have only seen one instance of an acerate spicule.

The circlet of the cup of the larger and wider abactinal tentacles is smaller than that of the actinal and is less elaborately ornamented.

Salmacis differs decidedly in the construction of its tentacles from *Temnopleurus*. The abactinal tentacles are large, long, baggy, and have small terminal cups; the actinal have stout walls, are shorter, thicker, have a narrow calibre, and the cup is large, fleshy, and the circlets are well developed and very large.

A circlet of an actinal tentacle has six or even seven divisions, and each is as distinct as it is in *Temnopleurus*; the spoke-like processes are much more numerous and pointed, and on the same circular line. The psellion is well developed, and its accessory processes also. The central muscular structure is larger than in *Temnopleurus*, and there are many "C"-shaped spicules all about the cup and the upper part of the tentacle. The muscular structures are as in *Temnopleurus*. Now the cup of the abactinal tentacles supports a very small circlet, and its divisions are fewer in number than they are in the actinal tentacles, but the "C"-shaped spicules are in greater profusion, and the muscular layers are composed of better developed circular fibres and very distinct longitudinal ones.

The Pedicellariæ. (Pl. XI. figs. 23, 24, 25.)

These beautiful organs occur in vast numbers in *Temnopleurus toreumaticus,* but it must be understood that dry tests do not furnish a moderate proportion of those which may be seen in specimens preserved in alcohol immediately after capture. The reason is that most of all kinds of the pedicellariæ have soft and long or short flexible limp necks, others are placed upon solid stalks. The majority of the soft-necked pedicellariæ fall off in drying and are lost. This can be easily proved by examining dry specimens and collecting their pedicellariæ, and then comparing the results with the appearances presented by decalcified and coloured parts of the test preserved in balsam. Every pedicellaria of an ambulacrum and of a radial plate can then be preserved, and it is remarkable how they crowd some spots and how long the necks are in relation to tentacles. The very fleshy look of the heads of pedicellariæ is striking, and so are the muscular developments of many.

The removal of some of the larger spines is necessary before parts of the test are decalcified, but care must be taken to notice the numerous pedicellariæ which are around the scrobicular circles. Some of the pedicellariæ are very large, and on the other hand the majority are exceedingly small. Sladen's gland within the body is visible and moderately developed in one group; but the glandular structure common on the stems of the pedicellariæ of some other genera are absent.

There is no difficulty in distinguishing four kinds of pedicellariæ in *Temnopleurus.*

1. Large tridactyle forms with a broad base to the body and very long prongs which are moderately broad, arched, becoming slightly narrower and not very sharp-pointed at the free end, being well fenestrated, and having a wide space between the lower parts of the prongs of contiguous valves. The sides of the prongs are slightly dentate, but there are no terminal teeth.

These largest forms are rare and are seen near the basal plates upon the interradia, and here and there close to an ambulacrum. One or two are upon short stalks, others are upon long and slender ones placed upon small secondary tubercles or upon miliaries, and having muscles at the joint. The most interesting series has a long, soft, transparent neck placed upon a stalk and consisting of a glairy-looking structure, in which a few longitudinally placed muscular fibres, some indefinite granular tissue, and pigment-spots occur. These necks are long or short and limp, and they are found curled around neighbouring structures after death; they are continuous with the outer tissue of the stalk, and are excessively fragile.

2. Common tridactyle pedicellariæ with smaller valves than the above, the base wide and suddenly diminishing, the prongs narrow, slender, very wide apart, long, and ended by a sharp curved point, below which are two others, one on each side (fig. 23). The whole is fenestrated. The largest of these forms are seen actinally, as well as close to the apical system, and around the bases of the large spines. The ambulacro-interradial sutural region is a common spot.

Smaller tridactyles with slightly stouter prongs are very common, and are found very generally distributed.

Both of these forms of tridactyles often have long, soft necks and are placed upon long or short spinules; some are without necks, and are either sessile or with stalks.

3. The globifera (fig. 24)* are very common, and there are a few very large ones near the apical system and a host of smaller forms very generally placed, and notably along the ambulacra and the median area of the interradia. The large and small have the same structure. The base is broad and tumid, gracefully merging into the broad, moderately long, broad, boldly curved, slightly angularly-ending prongs. The sides of the valves are distantly serrate, and a stout calcareous ridge runs along the median line, and has lateral offshoots, and in the hollows between are minute openings. This is a very marked character. These pedicellariæ are, as the others, either placed upon soft necks or upon stalks of varying length, some 1 millim.

4. The triphylta or ophiocephalous pedicellariæ (fig. 25) are in vast numbers, and are at once recognized by their very small size, their blunt free ends, tumid subcylindrical shape slightly longer than broad, and their very minute perforations. They have very blunt terminations to their valves, no teeth, and when looked at from above a trefoil appearance is seen. They occur in vast numbers in the actinal region of the ambulacra and around all primary and secondary spines, around many tentacles, and upon the radial plates. There are none upon the peristomial membrane or upon buccal plates. Most are

* The globifera of authors, not especially of Otto Hamann, who would term them gemmiformes. The globifera of that excellent microscopist are large tumid tripartite globose-looking pedicellariæ without calcareous heads, and with a very strong muscular layer. They secrete, and are, according to Hamann, very generally found on certain species of Echinoidea. I have evidence of their occurrence in *Temnopleurus*, near the apical disk, although I was not fortunate enough to discover them in *Sphærechinus*.

placed upon soft necks, and these are of different lengths, and so are the stems on which the necks are situated.

In *Salmacis* the distribution of pedicellariæ is not the same as in *Temnopleurus.*

The peristomial membrane of *Salmacis bicolor* has ten buccal plates, which not only carry tentacles but a crowd of rather long-stemmed ophiocephalous pedicellariæ or tryphylta occurs, and with them are sometimes found small globifera with unusually long valves; these may be on stalks or they may have soft long necks besides stalks, and they are smaller and not so tumid as the globifera of the test itself.

Upon the test there are many pedicellariæ, and the globifera are usually tumid at the base, but with a duck-mandible shaped valvular end; they are very regularly fenestrate, but the median thickening and ridge observed in *Temnopleurus* are wanting. In both genera there are usually pedicellariæ close to the pits of the sutures.

The pedicellariæ with long and short soft necks are common and are of all kinds.

The Madreporite.

The madreporite of the Temnopleurinæ is not like that of *Echinus* and *Cidaris*, for instead of the upper surface being spongy-looking and with very irregular openings, it is well defined in *Temnopleurus*, *Salmacis*, *Amblypneustes*, &c., and the water-openings are separate and large, and when decalcified they are tubular, and resemble distant cylindrical straight pipes; they have thick edges or sides lined with epithelium. The height of these cylindrical pipes is not great. The madreporite is well separated from the structure of the basal plate in which it is placed.

Valentin described and drew some fusiform, band-like muscular slips which arise at the inner edge of the periprocteal ring and pass inwards to the edge of the anus. He called them "motores ani." They are well seen in *Temnopleurus*, and staining with carmine shows very thin fibrillar muscular slips, with a considerable quantity of nerve filaments. The slips are distinct and separated.

EXPLANATION OF PLATE XI.

Fig. 1. *Microcyphus zigzag*, Agass. Side view of the plates on one side of the median ambulacral suture; knobs and sockets; dark lines indicating the sutures of the component plates of the geometrical ambulacral plates. × refers to fig. 9. Mag. Pp. 111, 113, 116.

Fig. 2. *Temnopleurus toreumaticus*, Agass. A compound ambulacral plate. *a*, adoral primary; *b*, middle demi-plate; *c*, aboral primary component plate. Mag. P. 112.
Fig. 3. A plate seen from within, during the drying of benzule, showing the great separation of the pores of the pairs. Mag. P. 113.
Fig. 4. *Salmacis bicolor*, Agass. Inner view of ambulacral plates. Same references as in fig. 3. Mag. P. 113.
Fig. 5. *Mespilia globulus*, Agass. An ambulacral plate seen from within the test under benzule. Mag. P. 113.
Fig. 6. *Microcyphus zigzag*, Agass. An ambulacral plate, sutures seen under benzule. Mag. Pp. 113, 114.
Fig. 7. Same plate from within. Mag. P. 114.
Fig. 8. Diagram of an adoral canal of a pair, oblique and reaching the peripodium. Mag. P. 114.
Fig. 9. Ambulacral plates near the apex, seen from within, under benzule. Mag. P. 114.
Fig. 10. Plates nearer the ambitus, abnormal distribution of sutures. Mag. P. 115.
Fig. 11. Plates still nearer the ambitus, abnormal, under benzule. Mag. P. 115.
Fig. 12. Plate below the ambitus, abnormal. Mag. P. 115.
Fig. 13. *Amblypneustes ovum*, Lamk., sp. Ambulacral plates with sutures under benzule: *c* is a low, broad demi-plate. P. 116.
Fig. 14. *Holopneustes purpurescens*, A. Ag. A single and double compound ambulacral plate under benzule: *a*, the adoral component plate, is a primary which is excluded at the ambulacro-interradial suture. P. 117.
Fig. 15. Inside view of plates nearer the apex. Mag. Pp. 118, 119.
Fig. 16. View corresponding to fig. 14, from within. Mag. Pp. 118, 119.
Fig. 17. *Temnopleurus toreumaticus.* A branchia decalcified and mag. 30. P. 122.
Fig. 18. Part of a finger-shaped process highly magnified. Mag. 60. P. 122.
Fig. 19. Epithelium. Mag. 120. P. 122.
Fig. 20. A small tuft of the branchia of *Salmacis* not decalcified. Mag. P. 123.
Fig. 21. Ampullæ of *Temnopleurus*, decalcified: *a*, water-canal. Mag. P. 123.
Fig. 22. Spots upon the ampullæ, with muscle-fibres leading inwards into the ampulla. Mag. 80. P. 124.
Fig. 23. End of a prong of a tridactyle pedicellaria of *Temnopleurus.* Mag. P. 129.
Fig. 24. Head of a large globifera. Mag. P. 129.
Fig. 25. A triphyltous pedicellaria, with a soft stalk placed upon a spinule. Mag. P. 129.
Fig. 26. Part of the calcareous circlet of a tentacle of *Temnopleurus.* Mag. P. 126.
Fig. 27. The psellion. Mag. P. 126.
Fig. 28. Section of a spine of *Temnopleurus.* Mag. P. 120.

The amplification in most of these drawings is small.

XVI.—*An Account of three Series of Lepidoptera collected in North-west India by Major Yerbury.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

SINCE the publication of my paper on Lepidoptera from Campbellpore and Murree (Proc. Zool. Soc. 1886, pp. 355–395) Major Yerbury has forwarded to me from time to time no less than three collections, containing eight hundred specimens, accompanied by many additional notes of interest; the series thus brought together enables one to form a very good idea of the fauna of Campbellpore and the neighbourhood, and also of the constancy or variability of the species; some of those which were represented in his first collection by single specimens are now represented by perhaps a dozen or more, whilst numerous species are added*, of which one is new to science.

The following is a list of the species.

RHOPALOCERA.

Nymphalidæ.

DANAINÆ.

1. *Tirumala limniace.*

Papilio limniace, Cramer, Pap. Exot. i. pl. lix. D, E (1779).

♂ ♀. Khairabad, 25th July, 1886.

Var. *a*. *Danais leopardus.*

Danais leopardus, Butler, Proc. Zool. Soc. 1866, p. 52. n. 36.

♂. Campbellpore, 30th March, 1886; Futeh Khan's bungalow, 23rd April.

Var. *b*.

Like *T. leopardus* this has the patch on the interno-median interspace of primaries divided, but the upper half is united by a pedicle to the inner spot of the discal series.

* Since this paper was commenced Major Yerbury has come to England and has brought his private collection and numerous other specimens with him, enabling me to introduce many additional species into this account of his captures. All that were required for perfecting the Museum series were most generously presented to the Trustees by Major Yerbury.

♂ ♀. Campbellpore, 8th and 16th May, 1886.

T. leopardus and var. *b* would appear to be the early forms of *T. limniace*.

"Common round Campbellpore in May and June; a few at Murree; not seen on Thundiani."—*J. W. Yerbury.*

2. *Limnas chrysippus.*

Papilio chrysippus, Linnæus, Mus. Lud. Ulr. p. 263 (1764).

Var. ♂. Campbellpore, 13th July, 1886.

"Common everywhere except Thundiani; not seen on the hill, but was common about Abbottabad."—*J. W. Y.*

Var. *Limnas alcippoides.*

Limnas alcippoides, Moore, Proc. Zool. Soc. 1883, p. 238, pl. xxxi. fig. 1.

♂, 16th June, ♀, 15th July, 1885; ♂, 30th May and 12th July, 1886.

"Ten or twelve specimens taken in May and June, 1885; only two specimens seen in 1886. Varies greatly in amount of white."—*J. W. Y.*

3. *Salatura genutia.*

Papilio genutia, Cramer, Pap. Exot. iii. pl. ccvi. C, D (1782).

♀, Campbellpore, 25th; ♂, Hassan Abdal, 27th June; Hurripur, 14th October, 1886.

"A few at Campbellpore, June and July 1886; common at Hassan Abdal in June; seen about Abbottabad, August 1886; uncommon at Murree, August and September 1885; a single specimen seen on Thundiani, 12th September, 1886—the only *Danais* seen on the hill."—*J. W. Y.*

SATYRINÆ.

4. *Aulocera saraswati.*

Satyrus saraswati, Kollar, in Hügel's Kaschmir, iv. 2, p. 445, pl. xiv. figs. 3, 4 (1848).

♂. Thundiani, 19th August, 1886.

"Common at Cotton's Folly, below Murree; rare on Thundiani."—*J. W. Y.*

5. *Aulocera swaha.*

Satyrus swaha, Kollar, in Hügel's Kaschmir, iv. 2, p. 444, pl. xiv. figs. 1, 2 (1848).

♂. Thundiani, 10th August; Nandar, 25th September, 1886.

"Common at Murree and Thundiani in August 1885 and 1886."—*J. W. Y.*

6. *Hipparchia parisatis.*

Satyrus parisatis, Kollar, Denkschr. Akad. Wien, Math.-nat. Cl. i. p. 52. n. 7 (1850).

♂. Khairabad, 2nd May, ♂ ♀. 6th June; ♀. Kala Pani, 1st September, 1886.

"Common on the hills round Abbottabad in August. Common at Khairabad in May and June. Seen at Attock and Tret."—*J. W. Y.*

7. *Callerebia nirmala.*

Erebia nirmala, Moore, Proc. Zool. Soc. 1865, p. 501. n. 91.

Between Kala Pani and Thundiani, 10th August, 1886.

Major Yerbury mentions a second species, *C. annada*, Moore (*C. hybrida*, De Nicéville, nec Butler), as being "common on the lower slopes of the hill below Kala Pani—a few taken above Tret, 8th October, 1885," and he thinks "it is possible that the Thundiani specimens are the former and the Tret specimens the latter species."

No specimens having been forwarded in the three series before me, I cannot speak positively; but the species sent in the last collection, identified as *C. hybrida* by Mr. De Nicéville, was simply typical *C. annada*, and therefore I think it highly improbable that the hybrid form between *C. annada* and *C. scanda* occurs in the neighbourhood; if it does, *C. scanda* must be there also, yet nothing like it has yet been sent home by Major Yerbury.

Of another species not yet sent to us and the identification of which I consider extremely doubtful *, viz. *Callerebia daksha*, Major Yerbury writes:—"Not uncommon at Murree in company with 583 (*C. nirmala*), a few at Thundiani, August and September 1886."

The male of *C. daksha* differs from that sex of *C. nirmala* in its distinctly longer wings, the ocellus of primaries more transverse and oval, with equal pupils and very indistinct iris; on the upper surface of the secondaries are three ocelloid white spots in addition to the ocellus, which is large and has a conspicuous white pupil, as in the female of *C. nirmala*; the under surface of the wings is quite plain, not mottled with paler scales as in *C. nirmala* (when seen through a lens), and

* Specimens of *C. nirmala* were identified as *C. daksha* in the former collection, and I have no doubt that such is the case in the present instance.

therefore is of a richer brown colour; the secondaries also are distinctly marked with five snow-white spots, followed by two ocelli, the first twice the size of the second. I have taken this comparative description from a Cashmere example of *C. daksha* labelled and presented to us by Mr. F. Moore, and doubtless a co-type; although in some respects it approaches the female of *C. nirmala*, the uniform rich brown colouring below and the sharply defined pure white spots on the wings give it a very different aspect *. The supposed specimens of *C. daksha* sent in the former collection were typical females of *C. nirmala*. *C. daksha* is not in Major Yerbury's boxes or cabinet.

8. *Lethe verma.*

Satyrus verma, Kollar, in Hügel's Kaschmir, iv. 2, p. 447, pl. xvi. figs. 1, 2 (1848).

Thundiani, 24th September, 1885.

9. *Lethe dyrta.*

Debis dyrta, Felder, Reise der Nov., Lep. p. 497. n. 860 (1867).

♂. Futch Khan's bungalow near Kooteer, Chittah Pahar, ? 2000 feet; ♀. 14th October, 1886.

" Very common below Bugnoter (Murree and Abbottabad Road), also near Kala Pani in September 1885. A single specimen taken in the Chittar Pahar, 23rd April, 1886; also taken at Dewal, Murree, and the Kashmir Road."—*J. W. Y.*

10. *Amecera schakra.*

Satyrus schakra, Kollar, in Hügel's Kaschmir, iv. 2, p. 446, pl. xv. figs. 3, 4 (1848).

♂. Thundiani, 10th, 15th, and 25th August; ♀. Near Abbottabad, 30th September, 1886.

" Common all along the hills from Murree to Thundiani; descends the hills below Kala Pani and Bugnoter, but was not seen in the immediate neighbourhood of Abbottabad."—*J. W. Y.*

11. *Ypthima avanta.*

Yphthima (sic) *avanta*, Moore, Proc. Zool. Soc. 1874, p. 567.

Kala Pani, 1st September; Bugnoter, 29th; Dhum tower, near Abbottabad, 30th September, 1886.

Evidently occurs in company with *Y. ordinata*, which, in

* After writing the above I looked up Mr. Moore's figure, which is by no means good, since the white spots on the upper surface of the secondaries mentioned in the description are obliterated by the colourer.

the former collection, was forwarded under the same name. Major Yerbury says of it:—"*Ypthima avanta*, De N., *ordinata*, B. Fairly common between Kala Pani and Abbottabad and between Bugnoter and Abbottabad in September."

Although the types of these two *Ypthimas* differ just as De Nicéville's dry- and wet-season forms are supposed to do, they occur together in the same months, and therefore cannot be associated as one species on that supposition; whether they are varieties or good species can only be decided by careful breeding from eggs which have been deposited. They differ as follows:—

Y. ordinata.	*Y. avanta.*
Ocellus of primaries above large and distinct; below larger than in *Y. avanta*.	Ocellus small and indistinct or absent.
Secondaries below without any distinct bands.	With two more or less distinct bands.

Any one seeing only the types of *Y. ordinata* and *Y. avanta* would believe them to be good distinct species; but with the series which we now possess before me, I confess to having serious doubts of their distinctness; at the same time there is not sufficient evidence to allow of their being associated under one name at present.

12. *Ypthima bolanica.*

Ypthima bolanica, Marshall, Butt. Ind. i. p. 231. n. 224 (1883).

Attock Bridge, Khairabad side, 4th April; Attock, 10th April; Khairabad, 11th April; Campbellpore, 13th April, 1886.

The ocelli on the under surface vary as much as in some of the supposed dry- and wet-season forms of other species.

"Common on the hills round Campbellpore, Attock, and Khairabad in March and April."—*J. W. Y.*

13. *Ypthima sakra.*

Ypthima sakra, Moore, Cat. Lep. E. I. Co. Mus. i. p. 286. n. 508 (1857).

♂ ♀ (in coitû). Thundiani, 27th August; ♂ var. 14th September, 1886.

The male taken in September has a different formula to the ocelli on the under surface of the secondaries, 1×3 instead of 2×3; the upper ocellus, however, has a projection behind on the right-hand wing and in front on the left-hand wing; the ocellus of primaries also differs from the normal type in being smaller and less distinct above; all the other characters are identical, so that there is no doubt that we have to do here with nothing more than individual variation.

"Common on the lower slopes of Thundiani above Kala Pani; a few at Murree and Dewal, Aug. and Sept."—*J. W. Y.*

14. *Ypthima alemola.*

Ypthima alemola, Swinhoe, Proc. Zool. Soc. 1885, p. 127.

Attock Bridge, Khairabad side, 28th March; Attock, 10th April; Campbellpore, 13th and 17th April; Khairabad, 11th and 18th; Akhor, 22nd; Hassan Abdal, 9th May, 1886.

This and the following are sent under one number and are identified by De Nicéville as *Y. asterope.* We possess thirteen examples of the latter from Aden and Somali, and there is no difficulty in separating the *Y. alemola* type from it, as the latter has very minute oval ocelli on the under surface of the secondaries; both forms are rather browner above, with more ochreous irides to the ocelli; but on the under surface there is really very little to separate *Y. mahratta* from *Y. asterope.*

15. *Ypthima mahratta.*

Ypthima mahratta, Moore, Journ. Asiat. Soc. Beng. vol. liii. pt. ii. 1, p. 16 (1884).

♂ ♀. Khairabad, 11th and 18th April; Campbellpore, 13th April, 2nd June, 11th and 23rd July; Hassan Abdal, 27th June, 18th July; road between Abbottabad and Kala Pani, 9th August; Kala Pani, 1st September, 1886.

It will be seen that most of the specimens of this form with the round ocelli were taken later in the year than *Y. alemola*; but, as four of them were obtained in April, *Y. mahratta* cannot be regarded as a seasonal form of *Y. alemola.*

Major Yerbury says of these two forms:—"Common on the hills round Campbellpore; also on the lower slopes of the hills near Abbottabad."

16. *Ypthima nareda.*

Satyrus nareda, Kollar, in Hügel's Kaschmir, iv. 2, p. 451 (1848).

One example, road between Abbottabad and Kala Pani, 9th August, 1886.

"Fairly common between Abbottabad and Kala Pani; common at Murree in August 1885."

Nymphalinæ.

17. *Melitæa persea.*

Melitæa persea, Kollar, Denkschr. Akad. Wien, Math.-nat. Cl. i. p. 52. n. 6 (1850).

Campbellpore, 23rd and 25th March, 1st April, and 16th May, 1886.

The whole of the specimens are typical *M. persea*, and therefore perfectly distinct from the Afghan *M. Robertsii*, with which Mr. De Nicéville continues to confound it. Major Yerbury says that it was "not uncommon round Campbellpore in June 1885 and again in March 1886; the spring brood seemed to be larger, darker-coloured, and with the base of the wings invaded with dusky: common also at Attock and Khairabad." In the specimens now forwarded I note that those taken in March are darker but scarcely larger than those obtained in May, but the one specimen taken in April is unusually large, though not darker; it is a female. Of the two specimens taken near Attock Bridge in November and recorded in my former paper, one is much larger and slightly darker than the other, so that the specimens sent us by Major Yerbury up to the present time hardly bear out his views; at the same time he is in a far better position to form an opinion upon the matter than I am, and therefore I do not call in question the general accuracy of his distinctions, whilst pointing out that they are by no means constant.

18. *Argynnis issæa.*

Argynnis issæa, Moore, Cat. Lep. E. I. Co. Mus. i. p. 156. n. 323 (1857).

♂ ♀ (in coitû). Thundiani, 11th August; ♂. 15th August, 1886.

"Common on Murree and Thundiani; some of the specimens taken in the latter place have the black markings both on the fore and hind wings confluent, forming almost melanoid varieties."—*J. W. Y.*

19. *Argynnis kamala.*

Argynnis kamala, Moore, Cat. Lep. E. I. Co. Mus. i. p. 156. n. 324 (1857).

Two females. Thundiani, 13th, 18th, and 20th August, and 9th October, 1886.

So far Major Yerbury has only sent us females of this species, and, from a note which he appends to the number in his MS., it would seem that the male is unknown to him;

yet he says that the species was "common at Thundiani in August and September 1886; a few seen at Murree, September 1885."

20. *Atella phalanta.*

Papilio phalanta, Drury, Ill. Ex. Ent. i. pl. xxi. figs. 1, 2 (1773).

Campbellpore, 13th July; Abbottabad, 1st October.

"Fairly common about Campbellpore and at Hassan Abdal in October."—*J. W. Y.*

21. *Pyrameis cardui.*

Papilio cardui, Linnæus, Fauna Suecica, p. 276. n. 1054 (1761).

♂ ♀. Thundiani, 14th and 15th August, 1886.

"Common everywhere."—*J. W. Y.*

22. *Pyrameis indica.*

Papilio atalanta indica, Herbst, Natur. Schmett. vii. pl. clxxx. figs. 1, 2 (1794).

Thundiani, 13th August, 3rd, 9th, and 16th September, 1886.

"Common at Thundiani, August and September 1886; a single specimen seen in a mustard-field near Laurencepore, 7th February, 1886."—*J. W. Y.*

23. *Vanessa kaschmirensis.*

Vanessa kaschmirensis, Kollar, in Hügel's Kaschmir, iv. 2, p. 442, pl. xi. figs. 3, 4 (1848).

Thundiani, 11th, 12th, and 17th August, 1886.

"Probably the commonest butterfly on Thundiani; only two or three specimens taken at Murree."—*J. W. Y.*

24. *Vanessa charonia.*

Papilio charonia, Drury, Ill. Ex. Ent. i. pl. xv. figs. 1, 2 (1773).

♂. Thundiani, 9th and 21st September, 1886.

"Common round Murree; fairly common at Thundiani and Dewal in August and September."—*J. W. Y.*

25. *Vanessa agnicula.*

Grapta agnicula, Moore, Proc. Zool. Soc. 1872, p. 559.

♂. Thundiani, 17th August; ♀. 12th September, 1886.

Incorrectly identified as *V. c-album*, from which (apart from other differences) it may easily be distinguished by its superior size and much blacker markings above. I have fourteen examples of *V. c-album* from Zeller's collection before me, and although they exhibit all the usual varieties of that species, not one of them at all nearly approaches *V. agnicula*; the Indian insect indeed far more nearly resembles *V. hamigera* of Japan, but has a broader external border on the upper surface of primaries, smaller submarginal spots on the secondaries, greyer and darker under surface, and a number of little differences (quite constant) in the details of pattern on the same surface. Dr. Staudinger and others would doubtless regard both the Indian and Japanese forms as varieties of *V. c-album* (this they do in the case of the North-American forms, although the larvæ have been carefully figured in all stages and shown to be wholly unlike that of the European species)! but to attempt to follow them would involve sinking not only the whole of the species of the imaginary genus *Grapta*, but nearly the whole of the more typical *Vanessæ*, since every form from *V. interrogationis* to *V. xanthomelas* (if not to *V. ichnusa*) has about equal specific value. Our species are arranged as follows, and form a pretty complete gradation from one type to the other:—

1. *Vanessa interrogationis*, Fab. (10 examples). N. America.
   Var. *Fabricii*, Edw. (9 examples). N. America.
2. *V. comma*, Harr. (9 examples). N. America.
3. *V. gracilis*, Gr. & Rob. (2 examples). N. America.
4. *V. faunus*, Edw. (9 examples). N. America.
5. *V. silenus*, Edw. (1 example). N. America.
6. *V. zephyrus*, Edw. (2 examples). N. America.
7. *V. satyrus*, Edw. (12 examples). N. America.
8. *V. progne*, Cram. (10 examples). N. America.
9. *V. c-album*, Linn. (14 examples). Europe.
10. *V. hamigera*, Butl. (5 examples). Japan.
11. *V. agnicula*, Moore (3 examples now). N.W. India.
12. *V. Fentoni*, Butl. (1 example). Japan.
13. *V. egea*, Cram. (13 examples). Europe.
14. *V. Pryeri*, Janson (6 examples). Japan.
15. *V. c-aureum*, Linn. (11 examples). Japan, China, &c.
16. *V. i-album*, Boisd. (5 examples). N. America.
17. *V. v-album*, Schiff. (10 examples). Europe.
18. *V. californica*, Boisd. (8 examples). California.
19. *V. polychloros*, Linn. (10 examples). Europe.
20. *V. xanthomelas*, Schiff. (11 examples). Europe and Japan.
21. *V.*, var. ? (3 examples). India and Japan.

If any of the Asiatic or North-American forms above recorded are to be considered conspecific with *V. c-album* there is no reason why the whole 164 examples enumerated here should not be equally regarded as varieties of one species. My view of a true variety is that it is a sport, either individual or often recurring, but never necessarily reproducing itself in the next generation; thus the white females of *Colias* or the dark females of *Argynnis* are true varieties; but to speak of a fixed local form as a variety appears to me to be wholly incorrect; indeed, my expressed opinion that local forms are the highest type of existing species in the Lepidoptera, can never be disproved until the whole world has been collected over, whilst every collection which arrives goes to strengthen it.

Major Yerbury says that he met with a few specimens of *V. agnicula* on Thundiani in August and September 1886, and that it "affects yarrow and ragwort (?)."

26. *Junonia asterie.*

Papilio asterie, Linnæus, Syst. Nat. i. 2, p. 769. n. 133 (1767).

♂. Khairabad, 18th April; ♂ ♀. 23rd May, 25th July; ♂. Campbellpore, 8th May; ♀. Hassan Abdal, 9th May, 1886.

Major Yerbury thinks with Mr. De Nicéville that *J. almana* is the cold-weather form of this species; but from what I can learn the idea of its being a form at all of *J. asterie* (an idea which I never for a moment entertained) is likely to be definitely disproved; even in the collection now before me I see that one of the two specimens of *J. almana* was taken in May; indeed, I do not remember to have received a collection from any part of India in which both species occurred, but they were taken at the same time, often on the same day: as to their being varieties, the totally different form of the wings renders this highly improbable. We have an enormous series of both species, but nothing intermediate between them.

Major Yerbury says that he obtained a few specimens of *J. asterie* at Campbellpore in July, but that it was very common at Khairabad and Hassan Abdal in June and July. Among the specimens brought home in papers is one taken at Kala Pani on the 30th August.

27. *Junonia almana.*

Papilio almana, Linnæus, Mus. Lud. Ulr. p. 272 (1764).

Attock, 2nd May; Hurripur, 14th October, 1886.

"Common round Campbellpore in the cold weather; also at Hassan Abdal. This seems to be the cold-weather form."—*J. W. Y.*

The idea of this species being a seasonal form of *J. asterie* originated, I am told, with a Mr. Doherty (now collecting in Timor, and likely to proceed to New Guinea); but he tells me, in a letter recently received, that he has since seen reason to doubt the correctness of this notion. Mr. De Nicéville has, however, taken up the cause of seasonal dimorphism, and played considerable havoc with the synonymy of the Lepidoptera: some of his suggestions may turn out to be correct; but such as prove to be unfortunate guesses will only have uselessly hindered the advance of knowledge.

28. *Junonia Swinhoei.*

Junonia Swinhoei, Butler, Ann. & Mag. Nat. Hist. Oct. 1885, p. 308.

♂ ♀. Campbellpore, 3rd April; ♀. Attock, 10th April; ♂. Bugnoter, 29th September, 1886.

Major Yerbury says that this is probably the commonest butterfly all the year round both at Campbellpore and Murree, but that on Thundiani it is uncommon.

J. orithyia, with which the Indian species has been confounded, is a much larger Chinese form, having the under surface suffused throughout with rufous-brown, most strongly in the female; the species is found in North-eastern, but not (so far as I know) in North-western India. Of *C. Swinhoei* we now possess a series of twenty-four good specimens.

29. *Junonia œnone.*

Papilio œnone, Linnæus, Mus. Lud. Ulr. pp. 274, 275 (1764).

One bad male, Kala Pani, 1st September, 1886.

"Khairabad (single specimen), 8th November, 1885; a few between Kala Pani and Abbottabad and between Bugnoter and Abbottabad in September 1885 and 1886."—*J. W. Y.*

30. *Hypolimnas bolina.*

Papilio bolina, Linnæus, Mus. Lud. Ulr. p. 295 (1764).

Campbellpore, ♀, 21st, ♂, 27th July, 1886.

"Uncommon, none taken in 1885; two females and one male to date, 1886."—*J. W. Y.*

31. *Athyma opalina.*

Limenitis opalina, Kollar, in Hügel's Kaschmir, iv. 2, p. 427 (1848).

♂. Thundiani, 10th and 19th August; ♀. 10th September, 1886.

"Common at Murree and Thundiani in August 1885 and 1886."—*J. W. Y.*

32. *Neptis astola.*

Neptis astola, Moore, Proc. Zool. Soc. 1872, p. 560.

Chittar, between Tret and Barracoo, 9th October, 1885; Thundiani, 20th September; Hurripur, 14th October, 1886.

Three examples, all more or less worn, mixed up with a series of *N. mahendra.*

33. *Neptis Yerburii.*

♂. *Neptis Yerburii*, Butler, Proc. Zool. Soc. 1886, p. 360. n. 17.

♀. Dhum tower, near Abbottabad, 12th October, 1886.

The female is larger than the male and on the primaries the spots of the oblique series from inner margin are slightly smaller (in which respects it is rather more like *N. nandina* than the male); in the pale lines between the bands, the white markings, and other respects it resembles it. Major Yerbury correctly names this insect, but says "I am unable to recognize this form," from which I conjecture that he is not sure how it can be at once distinguished from *N. mahendra.* The latter is a short-winged species of the *N. columella* group, the males having the white spots on the disk of primaries separated into three distinct patches; in the females, however, the two lower patches are sometimes only divided by the first median branch (blackened); nevertheless the inner edge of the short white band thus formed is invariably angulated internally and deeply excised externally at this point. In *N. Yerburii*, on the other hand, there is an oblique series of white spots as in *N. nandina*, with a straight inner edge; in *N. mahendra* again there is a wide break in the middle of the submarginal series of white spots on the primaries, the triangular spot beyond the cell is short and obtuse, and the pale submarginal stripe on the secondaries is wanting; on the under surface the ground-colour is of a much more uniform coffee-red colour, and the female has no whitish border to the secondaries; there is therefore no difficulty in separating the two species, indeed there are many other species of *Neptis* much less readily distinguishable.

34. *Neptis mahendra.*

Neptis mahendra, Moore, Proc. Zool. Soc. 1872, p. 560, pl. xxxii. fig. 3.

Thundiani, 15th, 19th, 21st, and 29th August, 15th September, 1886.

"Common at Murree and Thundiani, August and September 1886."—*J. W. Y.*

Erycinidæ.

Libytheinæ.

35. *Libythea lepita.*

Libythea lepita, Moore, Cat. Lep. E. I. Co. Mus. i. p. 240. n. 519 (1857).

Thundiani, 13th and 26th August, 2nd September, 1886.

"A few taken round Campbellpore in November and April; very common at Murree and Thundiani."—*J. W. Y.*

Among the specimens in papers recently brought home there is a female of the northern representative of *L. myrrha* from Mir Jani, above Kalabagh, about 9000 feet, taken the 16th September.

Nemeobiinæ.

36. *Taxila durga.*

Melitæa durga, Kollar, in Hügel's Kaschmir, iv. 2, p. 441, pl. xiii. figs. 3, 4 (1848).

♀. Dhum tower, near Abbottabad, 29th September; ♂. Kala Pani, 2nd October, 1886.

"Common at Murree and between Kala Pani and Abbottabad, August and September 1886."—*J. W. Y.*

Lycænidæ.

37. *Panchala dodonæa.*

Amblypodia dodonæa, Moore, Cat. Lep. E. I. Co. Mus. i. p. 43. n. 65, pl. i. *a*, fig. 8 (1857).

♀. Thundiani, 10th October, 1886.

"Common at Dewal, 26th August, 1885; frequents *Ilex* trees. I am not quite sure of the distinction between this species and *P. rama*."—*J. W. Y.*

The distinction between *P. dodonæa* and *P. rama* has never hitherto (to my knowledge) been called in question; the two species are easily separable. Both sexes of *P. dodonæa** have the pattern of the female *P. rama*, but are above of a shining lilac-blue colour, whereas both sexes of *P. rama* are of a deep purplish ultramarine colour; on the under surface, moreover, *P. dodonæa* is of a pale brown or whitish stone-colour, with

* Major Yerbury sent the male in the last collection, the female in this one.

well-defined dusky markings on the primaries, whereas *P. rama* is of a rosy lilac colour, indistinctly banded with bronze-brown.

38. *Panchala rama.*

Thecla rama, Kollar, in Hügel's Kaschmir, iv. 2, p. 412, pl. iv. figs. 1, 2 (1848).

♂. Thundiani, 12th September, 10th October; Bava Gulley, 29th September, 1886.

The males are larger than the females and have a narrower black border to the primaries. This and the preceding are both common species.

39. *Polyommatus bœticus.*

Papilio bœticus, Linnæus, Syst. Nat. i. 2, p. 789. n. 226 (1767).

♂ (dwarfed, with broad border to primaries above). Campbellpore, 2nd June; ♀. 19th July; ♂. Thundiani, 13th August, 1886.

40. *Catochrysops cnejus.*

Hesperia cnejus, Fabricius, Ent. Syst. Suppl. p. 430 (1798).

♂ ♀. Campbellpore, 2nd June; Hassan Abdal, 18th July; ♀. Thundiani, 3rd September; ♂ ♀. Nandar, 25th September; ♂. Hurripur, 13th October, 1886.

"Common round Campbellpore."—*J. W. Y.*

41. *Catochrysops hapalina.*

Catochrysops hapalina, Butler, Proc. Zool. Soc. 1883, p. 148, pl. xxiv. figs. 2, 3.

♂. Khairabad, 11th April; ♀. Campbellpore, 11th September; ♂ ♀. Hurripur, 14th October; ♂. Campbellpore, 21st October, 1886.

"*Catochrysops strabo*, De N. Common on babul-bushes (*Acacia arabica*) near Campbellpore in October 1885."—*J. W. Y.*

C. strabo of Fabricius is one of the commonest Indian *Lycænæ* and closely resembles *C. lithargyria* of Moore, excepting in its lilac instead of silvery blue upper surface. It varies considerably in size, but many of the specimens are almost twice as large as *C. hapalina*, and all of them are totally unlike it in the pattern of the under surface.

One of the males (11th April) and one of the females (14th October) were labelled as *C. ella*, but erroneously; the latter is a brilliantly blue species, with a broad black border to the primaries in the male; it can readily be recognized from its vague resemblance to some of the species of *Jamides* (*J. plato*, for instance); it is not quite so brilliantly coloured, though brighter than any other *Catochrysops*.

42. *Everes dipora.*

Lycæna dipora, Moore, Proc. Zool. Soc. 1865, p. 506. n. 108, pl. xxxi. fig. 8.

♂. Campbellpore, 1st June; (dwarfed), Kala Pani, 2nd October, 1886.

A rare species in collections; yet Major Yerbury says that it is "not uncommon at Campbellpore from July; common at Thundiani, August and September; a pair only taken at Murree in August 1885." The two males now sent are both imperfect, and we only have three others in the Museum series.

43. *Azanus zena.*

Lycæna zena, Moore, Proc. Zool. Soc. 1865, p. 505. n. 107, pl. xxxi. fig. 9.

♂. Hassan Abdal, 13th November; ♂ ♀. Campbellpore, 17th and 21st November, 1886.

"Common on babul-bushes at Campbellpore and Hassan Abdal in the cold weather."—*J. W. Y.*

44. *Azanus uranus.*

Azanus uranus, Butler, Proc. Zool. Soc. 1886, p. 366. n. 40, pl. xxxv. fig. 1.

♀. Campbellpore, 29th October and 21st November, 1885; ♂. 8th June, 1886; Chitta Pahar, Lumbahdoon, 2000 feet, 28th November, 1885.

"Common on babul-bushes near Campbellpore in November 1885."—*J. W. Y.*

It appears from Major Yerbury's notes that this is the *A. ubaldus* of De Nicéville; it is, however, perfectly distinct from the true *A. ubaldus.* It is true that both *A. uranus* and *A. ubaldus* agree in the uniform lilac colouring of the upper surface in the males; but the pattern of the under surface and the colouring of the female on both surfaces in *A. ubaldus* much more nearly agree with *A. zena*; indeed, though the males of *A. zena* and *A. ubaldus* are as unlike and as easy to separate as any two species of *Lycæna*, the females may readily be confounded. The female of *A. uranus* is either pale copper-brown suffused with lilac, or lilac bordered with copper-brown, on the upper surface; on the under surface it only differs from the male in having the black spots of the secondaries rather better defined; the bands on the under surface are (as in the male) grey, whereas in *A. zena* and *A. ubaldus* they are copper-brown; the pattern of the bands differs chiefly in their more macular character.

45. *Tarucus extricatus.*

Tarucus extricatus, Butler, Proc. Zool. Soc. 1886, p. 366. n. 43, pl. xxxv. fig. 2.

♂. Campbellpore, 3rd April, 1886.

This specimen is of about twice the size of my type, or about as large as the smaller examples of *T. nara.* Of this form we now possess six specimens.

46. *Tarucus callinara.*

Tarucus callinara, Butler, Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. p. 185. n. 24 (1886).

♀. Hurripur, 13th October, 1886.

We have nineteen examples of this butterfly, in both sexes.

47. *Tarucus nara.*

Lycæna nara, Kollar, in Hügel's Kaschmir, iv. 2, p. 421 (1848).

♂. Campbellpore, 3rd April, 1886.

Seven examples of typical *T. nara* are in our collection.

48. *Tarucus venosus.*

Tarucus venosus, Moore, Proc. Zool. Soc. 1882, p. 245, pl. xii. figs. 6, 6 *a.*

♂. Kala Pani, 30th August, 1886.

A very distinct species, readily recognizable by the broad blackish border to the wings. The four preceding forms are all associated by Major Yerbury as the *Tarucus theophrastus* of De Nicéville; if *T. extricatus* and *callinara* should prove to be forms of *T. nara,* that species must be very variable. *T. venosus* is distinct beyond all question, and none of them is the *T. theophrastus* of Fabricius. Major Yerbury says they are "common at Campbellpore almost all the year round. Common on the lower slopes at Murree and Thundiani in August and September."

49. *Cyaniris vardhana.*

Polyommatus vardhana, Moore, Proc. Zool. Soc. 1874, p. 572, pl. lxvi. fig. 5.

♂. Thundiani, 6th September; Kala Pani, 11th October, 1886.

50. *Cyaniris kasmira.*

Polyommatus kasmira, Moore, Proc. Zool. Soc. 1865, p. 503, pl. xxxi. fig. 1.

♂. Thundiani, 20th August, 1886.

In 1882 Mr. Moore regards this as a synonym of *C. Kollari*; it is, however, decidedly larger than that species (= *C. cœlestina* of De Nicéville, *vide* Proc. Zool. Soc. 1886, p. 367), whilst its female resembles that sex of *C. Hügelii*, excepting that the outer border of the primaries is narrower; in size this form is intermediate between *C. Hügelii* and *C. Kollari*.

51. *Cyaniris Kollari.*

Lycæna Kollari, Westwood, Gen. Diurn. Lep. p. 491. n. 69 (1852).

♀. Thundiani, 17th August; ♂ ♀. 19th August, 1886.

The three preceding forms were associated under one number; but although it is possible that *C. kasmira* and *C. Kollari* may be races, or even alternating generations of one species, it is quite certain that *C. vardhana* is totally distinct.

52. *Zizera maha.*

Lycæna maha, Kollar, in Hügel's Kaschmir, iv. 2, p. 422 (1848).
Lycæna chandala, Moore, Proc. Zool. Soc. 1865, p. 504, pl. xxxi. fig. 5.

♀. Campbellpore, 17th April; ♂. Hassan Abdal, 9th May, 1886.

These are the only two specimens of typical *Z. maha* that Major Yerbury has sent us hitherto. The species is easy to recognize, the male above being of a pale silvery lilac or azure tint, changing in certain positions to grey and silvery white; the extreme outer margin black, the primaries with a dusky submarginal stripe; the female is steel-blue above, with the costal borders and the outer border of primaries broadly black; the secondaries usually with a broad whitish outer border, on which are some black marginal spots; the pattern below corresponds nearly with that of *Z. diluta*, excepting that the secondaries are browner and the markings on these wings are smaller and less distinct. We have two dozen specimens in our collection, varying only in the tint of the upper surface in the males, which in some examples is silvery blue, in others silvery lilac.

53. *Zizera squalida.*

♀. *Lycæna squalida*, Butler, Trans. Ent. Soc. 1879, p. 4.

♂. Campbellpore, 21st June; Hassan Abdal, 18th July, 1886.

The male varies in colour from silver-grey with a lilac gloss to smoky grey with a faint bluish gloss; the primaries have a blackish external border, considerably narrower than in *Z. diluta* and more sharply defined internally; the secondaries have the costal half brownish; a marginal series of blackish spots; the under surface scarcely differs from that of *Z. maha*, excepting that the discal series of black spots on the primaries forms a more or less pronounced angle below the second median branch.

This form is intermediate in character between *Z. maha* and *Z. diluta* excepting in the angulation of the discal series of spots on the under surface; it may possibly be a hybrid. We possess six examples.

54. *Zizera diluta.*

Lycæna diluta, Felder, Reise der Nov., Lep. ii. p. 280. n. 353, pl. xxxv. figs. 12, 13.

♂. Akhor, 22nd April; ♀. Campbellpore, 4th, 5th, and 9th May; ♂. Hassan Abdal, 27th June, 18th July; Thundiani, 21st August; ♂ ♀. 29th August; ♀. Nandar, 25th September, 1886.

Var. Wings below greyer; black spots with narrower white margins.

♂ ♀. Hassan Abdal, 9th May; ♂. Thundiani, 29th August, 1886.

55. *Cupido ariana.*

Polyommatus ariana, Moore, Proc. Zool. Soc. 1865, p. 504. n. 103, pl. xxxi. fig. 2.

♂. Thundiani, 19th August; ♂ ♀ (in coitû), 29th August, 10th September; ♀. 15th and 24th September, 1886.

All the specimens with the exception of one taken on the 19th August are rather small for the species; the female appears to vary almost as much as in *C. icarus* of Europe.

Major Yerbury says that this species is "common at Murree in August and September, and fairly common at Thundiani in the same months."

Major Yerbury brought home with him specimens of *Cupido nazira* taken at Thundiani on the 29th August, the 4th and 11th September, 1886.

56. *Chrysophanus timeus.*

Papilio timeus, Cramer, Pap. Exot. ii. pl. clxxxvi. E, F (1779).

♀. Thundiani, 20th August; ♂. 24th August and 20th September, 1886.

"Common at Murree and Thundiani in August and September; two specimens taken at Hassan Abdal on the 9th May, 1886."—*J. W. Y.*

57. *Ilerda tamu.*

Polyommatus tamu, Kollar, in Hügel's Kaschmir, iv. 2, p. 417, pl. v. figs. 7, 8 (1848).

♂. Thundiani, 24th August, 1886.

"Common at Murree in August; two specimens taken at Thundiani."—*J. W. Y.*

58. *Ilerda sena.*

Polyommatus sena, Kollar, in Hügel's Kaschmir, iv. 2, p. 415, pl. v. figs. 3, 4 (1848).

♂. Kala Pani, 30th August, 1886.

"A single specimen taken at Khairabad on the 1st November, 1885; uncommon at Murree; very common below Kala Pani and along the hills towards Abbottabad."—*J. W. Y.*

59. *Thecla syla.*

Thecla syla, Kollar, in Hügel's Kaschmir, iv. 2, p. 414, pl. iv. figs. 7, 8 (1848).

♂. Thundiani, 21st August, 1886.

"A single specimen taken at Murree, 26th August, 1885; a few on Thundiani during August and September, 1886."—*J. W. Y.*

60. *Thecla odata.*

Dipsas odata, Hewitson, Ill. Diurn. Lep. p. 66. n. 6, pl. xxx. figs. 13, 14 (1865).

Thundiani, 10th, 11th, and 18th August, 1886.

"A number of worn specimens taken round Thundiani early in August 1886."

61. *Rapala nissa.*

Thecla nissa, Kollar, in Hügel's Kaschmir, iv. 2, p. 412, pl. iv. figs. 3, 4 (1848).

♀. Thundiani, 4th September, 1886.

"Common at Murree in August and September 1885; a few only on Thundiani at the end of August and September 1886."—*J. W. Y.*

62. *Deudoryx epijarbas.*

Dipsas epijarbas, Moore, Cat. Lep. E. I. Co. i. p. 32. n. 30 (1857).

♂ ♀. Thundiani, 21st August; Hurripur, 14th October, 1886.

"Common on Murree; fairly common on Thundiani."—*J. W. Y.*

63. *Spindasis hypargyros.*

Spindasis hypargyros, Butler, Proc. Zool. Soc. 1886, p. 369. n. 55, pl. xxxv. fig. 3.

Khairabad, 18th April; Futch Khan's bungalow, Kooteer, Chittar Pahar, 2000–3000 feet, 23rd April; Campbellpore, 2nd and 31st May, 2nd June, and 23rd July, 1886.

"Common generally in the neighbourhood of Campbellpore in July 1885 and April 1886; the specimens taken April 1886 were, as a rule, smaller than those of July 1885."—*J. W. Y.*

The largest specimen sent to us by Major Yerbury in 1886 and taken that year measures 39 millim. in expanse, the smallest (a very dark little female) only 25 millim.; those taken and forwarded in 1885 measured from 35–38 millim.: the really gigantic example sent in 1886 was taken in May, and there was exactly one month between its capture and that of the smallest one; therefore no supposition as to the large and small specimens being dry- or wet-season forms or seasonal forms of any kind need be suggested.

[To be continued.]

XVII.—*On the Bib* (Gadus luscus) *and Poor-Cod* (G. minutus). By Francis Day, C.I.E., F.L.S., &c.

In June 1886 Professor M'Intosh, in the Ann. & Mag. Nat. Hist., subscribed to the view that the poor- or power-cod was the young state of the bib. As I have now fresh material to investigate, and as it does not confirm this view, I must ask for a small space in order to review what have been the published opinions of British ichthyologists on this point for the last two centuries, as well as to briefly describe some fresh specimens which I cannot help thinking are opposed to this novel classification.

Willughby, in his 'Historia Piscium,' 1686, p. 169, adverted to the bib, or blinds of Cornwall, *Asellus luscus.* He likewise, at p. 171, enumerated as another species "*Asellus mollis minor seu asellus omnium minimus,*" and which latter he referred to "*Anthiæ secunda species,* Rondel. Gesn. 64. An Merlangus Bellonii?" But there is no occasion to allude to all the ancient authors who have similarly held that the bib and poor-cod are distinct species, as the various references are given in Gmelin's edition of Linnæus, where the former fish was classed as *Gadus luscus*, p. 1163, and the latter as *G. minutus*, p. 1164. The Rev. Mr. Jago, of Cornwall, observed, in his 'Catalogus quorundam piscium rariorum' of Cornwall, that he had discovered a new form of British Gadoid in the poor-cod; and in this appendix, published in Ray's 'Synopsis Piscium,' 1713, p. 163, we find "Asellus mollis minimus, *Cornub.* Poor vel Power dictus, fig. 6," and Ray remarked on its being already described in Willughby. If Jago's figure is referred to, it will be seen that he correctly placed the vent in a perpendicular line beneath the last ray of the first dorsal fin, which, as I shall presently show, is a proof that he certainly diagnosed the species.

Pennant, in his 'British Zoology,' vol. iii. 1776, pp. 183 and 184, also separated the two, and figured them as distinct on plate xxx. He referred the bib to *Asellus luscus*, Raii, 'Synop. Piscium,' p. 54, or *Gadus luscus*, Linn. Syst. Nat. p. 437, and the poor-cod to Jago's figure in Ray, or *G. minutus*, Linn. Syst. Nat. p. 438. Shaw likewise considered the two forms distinct species; as did also Turton, 'British Fauna,' 1807, p. 90; Fleming, 'British Animals,' 1828, p. 191; and Jenyns in his 'British Vertebrate Animals,' 1835, pp. 442, 444. The last of the foregoing authors remarked: "first noticed as a British species by Jago, who obtained it on the Cornish coast, where it has since been observed by Mr. Couch." He then continued that he (Mr. Jenyns) had described his fish from a Weymouth example of the unusual length of 8 inches. In the bib he found the "vent directly beneath the commencement of the first dorsal," whereas in the poor-cod it was "in a line with the tenth ray of the first dorsal fin."

Yarrell ('British Fishes,' ed. 1836) gave these two forms as two species (vol. ii. pp. 157, 161), and correctly showed the position of the vent. He did not appear to have any doubt as to their distinctness, and no alteration was made in the subsequent editions of his work, which point out that by the situation of the vent and fins the two species may be readily diagnosed. Thompson, in 1837, observed, at a meeting of the Zoological Society, that among the new species of fishes he had obtained in Ireland was *Gadus minutus*, Linn., the poor-cod, and that from three localities in Down and Antrim; also that two specimens from the coast of Cork were in the collection of Mr. Ball (Proc. Zool. Soc. 1837, p. 57); and in Thompson's 'Natural History of Ireland,' iv. p. 181, the foregoing opinion was retained, and further details of the various specimens added. In White's 'Catalogue of British Fish,' 1851, pp. 88 and 89, they were kept distinct, and also in Günther's 'Catalogue of the Fishes in the British Museum,' vol. iv. 1862, p. 335; while in this latter work it was remarked that "the ribs of this species [the bib] are proportionally longer and stronger than in the preceding [the poor- or power-cod]." Couch ('Fishes of the British Islands,' iii. 1877, pp. 70 and 72, and on plates 138 and 139) did not place these fish under one head, but observed of the poor-cod: "vent nearer the tail [than in the bib], opposite the termination of the first dorsal. The first dorsal also begins further distant from the head; the pectorals are shorter; ventrals also shorter, not reaching halfway to the vent; tail slightly incurved" (p. 73). Dr. M'Intosh, when enumerating the 'Fishes of St. Andrews,' 1875, p. 178, remarked: "*Gadus minutus*, Linn., common; *G. luscus*, Linn., not uncommon." I omit reference to the statements in my 'British and Irish Fishes,' 1882, pp. 286, 288, plates 80 and 81, for obvious reasons, simply observing that the views I then held I see no cause to alter.

The first author of any note in ichthyology who during the last two centuries has separated these forms was, I believe, Winther, in his 'Marine Ichthyology of Denmark,' 1879, p. 29, where he placed, under *Gadus minutus*, two subspecies or varieties: (a) *minutus*, (b) *luscus*. But in the Ann. & Mag. Nat. Hist. 1886, xvii. pp. 442, 443, Professor M'Intosh remarked of the poor-cod, that my "elaborate descriptions in regard to eyes, teeth, fins, scales, lateral line, and colours are not always satisfactory, since they fail to show the relationship existing between the adult and young stages apparently of the same species." Having quoted my observations on Winther's opinion, he concluded that as I stated that I had "not had an opportunity of investigating both sexes in these two species of fish," that such "indicates some uncertainty on the subject." He continued thus:—"my own experience of the species has now led me to conclude that what has been described as the poor- or power-cod (*Gadus minutus*) by several authors is only the young of the bib," concluding that "the confusion in regard to this species has partly arisen from an examination of preserved specimens."

Although my opinion had been here called in question, in my reply (*l. c.* p. 527) I could merely suggest that an account of the intermediate links between these two forms (which up to Winther's time had invariably been held to be distinct species) should be given by Dr. M'Intosh. Personally I possessed no new materials to work upon, and deemed it preferable to wait until such time as I had, for assertions are not proof. I took steps, however, to secure some fresh specimens, and applied to my old friend Mr. Dunn, of Mevagissey, asking him to obtain for me some power-cod and bib of the same size, so as to enable me to compare one with the other. Circumstances, however, have been unfavourable, and it was not until January 5th that I received from Cornwall three specimens, no. 1 being a bib, *Gadus luscus*, 7 inches long, and nos. 2 and 3 being power- or poor-cods, each 8 inches in length, the one being a male, the other a female, while in both the generative organs were very fully developed. This last fact was interesting as demonstrating that poor-cod may be of either sex, while the size of the two forms likewise proved that one 7 inches long may be a bib and others 8 inches long may be poor-cod, rendering it somewhat problematical that the larger form could be the young or immature form of the smaller specimen. This last, I may likewise add, was, except in size, a distinct counterpart in colour and proportion of large examples of the bib in my collection.

As regards the formula of the fin-rays existing in these three fishes, it must not be overlooked that in the Anacanthini or spineless forms these are subject to considerable modification; but taking the numbers for what they are worth they are as follows:—

1. Bib, *Gadus luscus*	D. 12 | 20 | 19.	A. 31 | 18
2 & 3. Poor-cod, *G. minutus*	D. 12–14 | 23–25.	A. 24–25 | 21–23

Eyes.—In the bib the eye was one third the length of the head, one diameter from the end of the snout; while in the poor-cod the eye was two thirds the length of the head and two thirds of a diameter from the end of the snout, or larger than in the bib.

Vent.—In the bib this was beneath the anterior end of the first dorsal fin, or a quarter of the entire length of the fish from the front end of the lower jaw, whereas it was beneath the hind end of the same fin in the poor-cod and one third of the same distance as it was one fourth in the bib.

Fins.—In the bib the first anal commenced just behind the vent and more forward than in the poor-cod, while the two anal fins were connected together by a membrane in the bib, as if the whole had belonged to one consecutive fin; but in the poor-cod they were two distinct fins with a short interspace between. The ventral fin was one fourth longer in the bib than in the poor-cod, while their colours widely differed. Respecting the number of the gill-rakers, on which some authors have laid considerable stress in the classification of species, I found in the outer branchial arch of these two forms as follows:—Fourteen in the middle or ceratobranchial bone of the bib, and eighteen in the same place in the poor-cod.

XVIII.—*Diagnoses of six new Mammals from the Solomon Islands.* By OLDFIELD THOMAS.

THE following new Mammals were obtained by Mr. C. M. Woodford at Aola, Guadalcanar, during his second visit to the Solomon Islands in the course of the past year.

PTERALOPEX, g. n.

Allied to *Pteropus*, but remarkable for the extraordinary cuspidate characters of its teeth, and especially of the upper canines, whose main cusp is bifid and whose postero-internal basal ledge supports two more sharp conical cusps, the whole tooth being therefore quadricuspid. Lower incisors very disproportionate in size. Premolars and molars cuspidate, not longitudinally grooved. Orbits complete behind, their plane directed more upwards than in *Pteropus*. Wings arising from the centre of the back, and attached to between the bases of the first and second toes.

Pteralopex atrata, sp. n.

Size large, about equal to that of *Pt. Keraudrenii*.

Fur thick and woolly. Ears short, rounded, scarcely projecting beyond the fur, thinly covered with hair. Interfemoral membrane narrow in the centre, more or less concealed by the fur. Colour wholly deep black everywhere, except that the wing-membranes are irregularly mottled with white on their under surface.

Upper incisors very large, each with a prominent posterior ledge, and the outer ones with a secondary cusp behind. Upper canines very thick, multicuspid as above described, the posterior external cusp about two thirds the height of the anterior. First premolar minute, persistent; other premolars and molars each with a prominent cingulum and two pointed central cusps.

Lower inner incisors minute, outer ones disproportionally large, not less than about twenty times the bulk of the inner, and separated from one another by a distance barely one third of their transverse or one fourth of their longitudinal diameters. Canines small and low, scarcely as high as the second premolar. First premolar large, quite filling up the space between the canine and second premolar. Third premolar and first molar each with four cusps, two high antero-external, one antero-internal, and one low postero-external. Posterior molars both above and below, first lower premolars, and both upper and lower outer incisors all very much of the same size in cross section.

Dimensions of the type * (an adult male in spirit):—

Head and body 240 millim.; head 78; ear (above head) 15; tip of nostril to eye 26; forearm 143 (=5·6 in.); skull, basal length 63, greatest breadth 39; supraorbital foramen to tip of nasals 26·5.

Two specimens obtained.

Pteropus Woodfordi, sp. n.

Closely allied to *Pt. molossinus*, Temm., but readily distinguishable by its pale grey head, dull rufous nape, pale yellow collar, and generally greyish colour as compared to the wholly uniform dark reddish-brown colour of that species. Ears also less sharply pointed and hairier.

Canines both above and below markedly slenderer than in *Pt. molossinus*, and anterior premolars smaller and placed further from the second premolars. Molars also narrower and lighter.

Dimensions of the type (male):—

Head and body c. 150 millim.; ear 11·5; forearm 99 (=3·9 in.); skull, basal length 36·8.

Seven specimens obtained.

ANTHOPS, g. n.

Allied to *Hipposideros* †, especially to the *Asellia* group of that genus, but distinguished from it by its rudimentary tail, which precisely resembles that of *Cœlops*, consisting of only some three or four slender transparent vertebræ hidden in the base of the interfemoral membrane and not reaching one half the distance towards the back of the membrane. Nose-leaf very complicated, its upright portion emarginate above, the projections not pointed as in *Asellia*, but rounded and hollow behind.

Skull and teeth as in *Hipposideros*.

Anthops ornatus, sp. n.

Posterior nose-leaf tridentate, the projections each forming a little spherical cup, opening backwards; front surface of the leaf divided into four compartments by three very distinct

* A single specimen in each case is selected from the series as the "type," in order to avoid any possibility of future confusion.

† As the genus commonly known as "*Phyllorhina*" should be called (see Blanford, P. Z. S. 1887).

vertical ridges, each running up to the lower side of one of the cups above. Two secondary leaflets outside the horseshoe, the upper one unusually short and little extended, the lower one running back to join the base of the posterior erect leaf. Sella with a blunt projecting central point. Ears when laid forward reaching just to the end of the muzzle, their tips sharply pointed, with a marked concavity in the upper fourth of their outer margin. A small frontal gland, opening transversely, present in the male. Wings from the ankles.

Fur very long, soft, and silky. Colour a finely grizzled greyish buff, the bases of the hairs slaty grey, their terminal halves buff, their extreme tips brown.

Dimensions of the type (female) :—

Head and body 51 millim.; head 21; ear (above crown) 17; forearm 51; index-finger 40; metacarpus of third finger 37; tibia 22; interfemoral membrane, depth in centre 20.

Six specimens.

Mus imperator, sp. n.

Size very large. Fur rather woolly in texture, uniformly dark grizzled ashy grey above, whitish below. Ears short and rounded; laid forward they do not nearly reach to the eye. Mammæ four, consisting of two inguinal pairs only. Soles of feet broad and naked, the pads large, smooth, and but little prominent. Tail rather short in proportion to the size of the animal, naked, scaly, not markedly roughened.

Dimensions (in spirit) :—

	Head and body. millim.	Tail. millim.	Hind foot. millim.	Ear. millim.
Male	350	258	66	19
Female (type)	340	250	64	20

Skull (♀): basal length 60 millim., greatest breadth 35; length of molar series 12·0; palatal foramen, length 7·0.

Two specimens.

Mus rex, sp. n.

Closely allied to *Mus imperator*, but distinguished by its much smaller (although still very considerable) size, and by its much longer and extraordinarily roughened rasp-like tail.

Dimensions (in spirit) :—

	Head and body. millim.	Tail. millim.	Hind foot. millim.	Ear. millim.
Male (type)........	290	296	55	18
Female	270	285	54	16

Skull (♂): basal length 54 millim., greatest breadth 33; length of molar series 11·1; length of palatal foramen 6·8.

Seven specimens.

Mus salamonis, Rams., from Florida Island, is again a much smaller species, with a hind foot only 44 millim. in length.

Mus prætor, sp. n.

General characters, size, colour, spininess of fur, size of ears, &c., as in *M. terræ-reginæ*, Alst., but distinguished by its proportionally shorter hind feet, shorter tail, and by having two pairs of pectoral mammæ, its mammary formula being therefore 2—2=8 instead of 1—2=6.

Dimensions (in spirit) :—

	Head and body. millim.	Tail. millim.	Hind foot. millim.	Ear. millim.
Male	188	134	35·5	15·5
Female (type)	168	118	33·5	15

Skull (♀): basal length 37·5 millim., greatest breadth 22; length of upper molar series 6·6; palatal foramen, length 7·4.

Two specimens.

XIX.—*Diagnoses of four new Species of* Didelphys. By Oldfield Thomas.

Didelphys (*Micoureus*) *lepida*, sp. n

Closely allied to *D. murina*, L., but distinguished by its much smaller size, and by the shortness of its ears, which, when laid forward, barely reach to the centre of its eye.

Dimensions of the type (an adult female, skin) :—

Head and body 105 millim.; tail (imperfect, more than) 105; ear, above head, 9·0; first three molars, combined lengths 4·7.

Hab. Peruvian Amazons (*E. Bartlett*).

Didelphys (*Peramys*) *scalops*, sp. n.

Size of *D. brevicaudata*, Erxl. Head, rump, and tail bright rufous; fore back, shoulders, and belly grizzled olive-grey. Skull long and narrow; teeth very small.

Dimensions (male, skin) :—

Head and body 133 millim.; tail 71; ear 8·0; skull, length 33; combined lengths of first three upper molars 4·9.

Hab. Brazil.

Didelphys (*Peramys*) *Iheringi*, sp. n.

Colours and proportions exactly as in *D. americana*, Müll. (=*D. tristriata*, auct.), but only about half the size of that species.

Dimensions of a male in spirit:—

Head and body 77 millim.; tail 43; hind foot 14; ear 6·3; skull, basal length 22·5; first three molars, length 4·2.

Hab. Rio Grande do Sul (*Dr. H. von Ihering*).

Didelphys (*Peramys*) *Henseli*, sp. n.

Size intermediate between that of the *D. brevicaudata* and the *D. sorex* and *Iheringi* groups. Colour dark grizzled grey along the whole upper surface, deep rufous on the sides and belly. Ears small, reaching when laid forward only halfway towards the eye. Mammæ about twenty-five in number, five central, and about ten pairs of lateral ones.

Dimensions of the type (an adult female, in spirit):—

Head and body 106 millim.; tail 62 (extreme tip imperfect); hind foot 15·5; skull, length 27; three anterior upper molars 4·4.

Hab. Rio Grande do Sul (*Dr. H. von Ihering*).

This is no doubt the intermediate species described but not named by Hensel*, and I have therefore, at the suggestion of Dr. von Ihering, named it after that eminent mammalogist.

MISCELLANEOUS.

Note on Lophopus Lendenfeldi.

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

Gentlemen,—The facts narrated in the letter of Mr. Whitelegge at p. 62 of the January Number of your Journal have been also brought to my notice in detail in a letter from himself, and more generally in one signed by two gentlemen, Messrs. J. Douglas Ogilby and John Brazier, F.L.S., whom I understand to be members of the staff of the Australian Museum, Sydney; and I have before me a printed extract from the 'Ashton Reporter' of March 20th, 1886, describing in general terms a fine Polyzoan and a method of preserving it in such a way as to show the parts much as those of the specimen described by me as *Lophopus Lendenfeldi* in the 'Journal of the Linnean Society' (Zoology), xx. p. 62, pl. ii. It may be almost unnecessary for me to say that I was in total ignorance of these facts when I wrote my paper, but such is the case; and I regret very greatly the injustice which I have thus unconsciously done to Mr. Whitelegge, who has fully vindicated his title to the honours of

* Abh. Ak. Berl. 1872, p. 123.

discovering and preserving the specimens on which the description of the species was based. The details as to discovery and preservation, as given in my paper, require modification in this sense; and I hope that future students will give Mr. Whitelegge the great credit due to him, not only for bringing this very fine species to the knowledge of the scientific world, but for the great skill shown in the preparation of the specimens which came under my notice.

I am, Gentlemen,
Yours faithfully,
STUART O. RIDLEY.

Maryport, Cumberland,
January 16th, 1888.

On Glyphastræa sexradiata, *Lonsdale, sp.* By P. MARTIN DUNCAN, M.B. (Lond.), F.R.S., &c.

In a communication to the Geological Society (Quart. Journ. Geol. Soc. vol. xliii. Feb. 1887, p. 24) I described *Glyphastræa Forbesi*, Ed. & Haime, sp., and stated that its alliance with *Columnaria sexradiata*, Lonsd. (Quart. Journ. Geol. Soc. vol. i. 1845, p. 497), was very close, and I gave the form the name *Glyphastræa sexradiata*, Lonsd., sp. At the time a very careful search was made for the specimen described and figured by Lonsdale, but it could not be found, although all the other types of Lonsdale's N.-American tertiary species which were given to me by Sir C. Lyell were still in my possession. After the publication of the paper a coral was found by the Curator of King's College Museum; it was one of a number of fossils given by me to the College about twelve years since. This coral had upon it in Lonsdale's handwriting, with which I am very familiar, "*Columnastræa sexradiata.*" On examining this coral, which is in the museum of the College in which I am Professor of Geology, I find that the distinctions between it and a specimen of *Glyphastræa Forbesi*, Ed. & H., sp., are not specific, but are due to growth. This last-named species was later in time of description than Lonsdale's, and therefore *Glyphastræa sexradiata*, Lonsdale, sp., is the correct name for *Columnaria sexradiata*, Lonsd., and *Glyphastræa Forbesi*, Ed. & Haime, sp. I am glad to be able to do this justice to the late Mr. Lonsdale. Since I examined the coral, last March, it has been cut without my knowledge or sanction.

King's College, Jan. 16, 1888.

On the first Changes in the Fecundated Ovum of Lepas. By Prof. M. NUSSBAUM.

During the author's residence on the coast of California he was able to obtain an abundance of material. All the ova in the same animal are at the same stage of development, but the animals are very abundant and the breeding-season lasts for several months, so that by continued preparation the different stages may be obtained in different animals.

The author's description commences with the stage at which the copulation of the male and female cells is effected, and the masses of ova enclosed in a thin homogeneous sac protrude from the orifices of the oviducts into the space within the shell on each side of the head. The ova are small and numerous, ovate, with a blunt and an acute pole. The masses of ova are at first soft and compressible, but the two sacs separate from the oviducts, fall into the cavity of the shell, and gradually become converted into harder, flattened masses. The greater firmness is to be ascribed to the increased thickness of the vitelline envelopes of the individual ova, and to the hardening of the material which binds them together. This cement must become softened again when the embryos are ready to creep out.

The fecundation of the ova takes place before the formation of the egg-sac. Living spermatosomata are occasionally found in the sac. Before the ova have reached the end of the oviducts which lead from the peduncle of the parent to the two sides of the head, the vitellus is of uniform structure and permeated throughout with lecythin-globules. On the separation of the directive bodies, which takes place after the penetration of the male element, the contents of the ovum are arranged so that at its rounded pole there is a dome of finely granulated vitellus, while towards the acute pole the lecythin-granules are collected together imbedded in a coarsely granular substratum. The separation of the directive bodies occurs at the obtuse pole and is accompanied in the ovum of *Lepas* by changes in the vitellus somewhat as described by the author in the ovum of *Ascaris megalocephala*. The two pronuclei are also in the neighbourhood of the obtuse pole, with their surfaces of contact and fusion perpendicular to the long axis of the ovum.

The first division takes place, as in *Ascaris nigrovenosa*, perpendicularly to the fusion-surfaces of the pronuclei, and therefore in the long axis of the ovum. The plane of division produces two unequal globules of segmentation; the lecythin is contained only in the larger one. Then occurs a turning of the segmentation-spheres and a displacement of the contents of the nutritive cell, which culminates in bringing the surface of division into the equator of the ovum, perpendicular to its first direction. It is well known that in segmentation the superior animal-cell precedes the inferior vegetative one and grows around it. As to the formation of the germ-layers the information is imperfect; in fresh specimens an invagination-gastrula appeared to be formed. The head of the larva is always at the obtuse and the tail at the acute pole.

The results of the investigation are summarized as follows:—

The processes of maturation and fecundation of the ovum of *Lepas* arranged the vital parts in such a way that with the separation of the directive vesicles all the axes of the future embryo are already defined. The separation of the directive corpuscles and the first and second segmentations take place in the future long-axis of the animal, and the position of the directive vesicles indicates the future position of the cephalic portion of the embryo in course of formation.

If the relative positions of the axes continued in the way first occurring, it might be imagined that the contents of the ovum exclusively possessed the whole power of orientation. But as the first plane of division passes from a longitudinal to an equatorial plane, the envelope and its form must also possess directive powers, which may be most judiciously referred to the principle of least resistance, more especially as the smaller animal-cell which is in advance in division is placed in the wide obtuse pole, and thus is enabled to divide again in the long direction of the ovum.

The first division, taking place in the longitudinal direction, does not, as further observations show, divide the ovum into the materials for the right and left halves of the body, although subsequently the sagittal plane of the embryo again coincides with the long axis of the ovum. This, however, may also be referred to the least resistance as a guiding principle, seeing that both in the embryo and the egg-capsule the longitudinal exceed the transverse axes in extent.

The agreement in the position of the directive vesicles, the first divisional plane of the segmenting ovum, and the future long axis of the embryo would consequently have to be referred to a common cause, which interposed as such in each case, but without the first orientation in space being conditional for any of the following ones.

If it be considered further that the egg-capsule is furnished by the ovum itself, so as the laws laid down by men become a measure and rule of conduct for men, the egg-capsule, although itself without any formative power, becomes in its rigid form the essential regulator of the position of the developing embryo of *Lepas* in the egg.—*Sitzungsberichte der kön. preuss. Akademie der Wissenschaften zu Berlin*, December 8, 1887, pp. 1052–1055.

On the Infection of a Frog-tadpole by Saprolegnia ferax. By Prof. J. B. Schnetzler.

In a glass vessel containing 2 litres of water, in which the oxygen was continually renewed by aquatic plants, the author had two frog-tadpoles which had not undergone their transformation since last year (1886). However, the branchiæ had disappeared, and the tadpoles came to the surface of the water to respire air. These larvæ were nevertheless very lively, and their dejections proved that nutrition was effected in a normal fashion. As the volume of water and the quantity of food have a marked influence on the development of the larvæ of frogs, the author removed one of these tadpoles and placed it in a second vessel with aquatic plants. Both vessels were of ordinary white glass.

The two larvæ remained very lively without undergoing any metamorphosis, until, towards the end of last June, a fly (*Sarcophaga carnaria*) was placed in the first vessel. After death its body became covered with white filaments of *Saprolegnia ferax*. The tadpole, which had continued very lively up to this time, now soon became more sluggish in its movements; its body became quickly covered with filaments of *Saprolegnia*, and within two days after this infection it was dead.

Microscopic examination of the *Saprolegnia ferax*, which covered the body of the fly, showed that the protoplasm of its filaments was transformed into thousands of zoospores, which, by means of their two vibratile cilia, rapidly diffused themselves through the water. As these zoospores swim about and thus spread themselves through the water, a single dead fly may become a focus of infection for a great number of aquatic animals (fishes, newts, &c.). The whole surface of the tadpole above mentioned was covered with *Saprolegnia*, so that death must have been produced by the suppression of the action of the skin. The second larva, placed in a separate vessel before the introduction of the fly, remained quite intact.—*Séance de la Soc. Vaudoise des Sci. Nat.* July 6, 1887; *Bibl. Univ.* November 15, 1887, p. 492.

On the Significance of Sexual Reproduction. By Dr. B. Hatschek.

Dr. Hatschek recently lectured upon this subject before the meeting of German surgeons in Prague.

In the first place he indicated that the most important and probably original of vital phenomena was *assimilation*. By the process of assimilation new living particles (that is to say particles which in their turn possess the faculty of assimilation) are produced. Assimilation is, as Hatschek affirms, *the sole known mode of production of fresh living substance.* We see in the Amœbæ and other unicellular organisms that the parent-creature divides into two daughter-organisms. In the more complex multicellular organisms reproductive bodies in the form of germs and buds are produced; these are developed, and grow into new individuals of the same kind. In the latter instance, however, the formation of such germs is reduced to a process of division of the same kind as occurs in the unicellular organisms, only that in those cases where we have to do with production of ova, spermatozoa, and buds the portions divided off are very unequal in size. This difference, however, is due to no principial distinction.

Besides division, however, the contrary phenomenon occurs in unicellular organisms, namely the fusion of two originally separate individuals into a single one. This is the so-called "conjugation," which is very widely diffused among the Monoplastida. In the multicellular organisms it is the portions characterized as reproductive bodies that become fused together, therefore the individualities in their simplest state. The conjugation of the unicellular organisms represents the process of fecundation, but *not the copulation of the multicellular forms.*

The intermixture of the individualities is most generally diffused throughout the organic world; and although among multicellular animals we frequently meet with asexual modes of reproduction (such as gemmation, division with regeneration, and parthenogenesis), we find this always only along with sexual reproduction, *i. e.* alternating therewith.

When we find any process generally occurring in organisms the question of its significance involuntarily forces itself upon us. We ask directly, What does this arrangement do for the organism, what purpose has it for it? After citing and criticizing the views of Bütschli, Hensen, van Beneden, and Weismann, Hatschek expresses his own theoretical opinion, namely *that in sexual reproduction we must recognize a remedy against the action of injurious variability.*

He supports this theory as follows:—In the first place he starts from the truth, ascertained by the experience of breeders, that a certain degree of difference between the parent individualities is most favourable to the result of a crossing. Such differences which are caused in the organism by the external conditions of life would evidently be of no service in asexual reproduction. A disease which made its appearance in an individual which propagated solely by the method of gemmation would be inherited from generation to generation and endanger the existence of the entire species. But if a mingling of the diseased with perfectly healthy protoplasm (such as must necessarily occur in sexual reproduction) be brought about, we have not merely the possibility, but even the highest probability, of a rectification such as can be obtained in no other way. It is, in Hatschek's opinion, in furnishing the opportunity for such rectification that we must find the chief use of the existence of sexually differentiated individuals among animals and plants.—*Prager mediz. Wochenschrift*, No. 46, 1887; *Biologisches Centralblatt*, No. 21, January 1, 1888, pp. 664–666.

Notice of two new Branchiopod Crustacea from the Trans-Caspian Region. By Dr. Alfred Walter.

The species described are as follows:—

1. *Apus Hæckelii*, n. sp.

A. lamina caudali coniformi, acuminata, incarinata neque spinulosa, duplo longiore quam lata. Sinu postico scuti angulato armatoque dentibus 30. Ramo longissimo primi pedis angulos scuti excedente. Segmentis posterioribus 16–17 scuto non obtectis, postremis 6 apodibus. Colore scuti et corporis in vivo albido flavescente, pedum rosaceo.

Hab. In a desert spring near Karadschabatyr, north of the Lower Atrek, in the Russian Trans-Caspian.

A female was taken early in May, together with species of *Estheria*, *Branchipus*, and some Cladocera and Ostracoda. The species belongs to Grube's second group of *Apus*, in which there is a caudal lamina separating the long caudal appendages (with *A. productus*, *A. glacialis*, &c.). It differs from all known allied species in the unkeeled and spineless caudal lamina.

2. *Artemia asiatica*, n. sp.

A. processibus caudalibus digitiformibus, setas 8–10 gerentibus, antennis primis gracilibus filiformibus, apice setis 3 armatis. Antennis secundis crassis, corniformibus, apice acuminatis, duobus tuberibus non dense setosis ad radicem eminentibus.

Hab. In a salt-spring between Bend-i-nadyr and the well of Agamet, in the mountain-desert east of Murgab, near the Afghan boundary.

Female, taken in April 1887. Colour of the living animal tile-red.—*Bull. Soc. Imp. Nat. de Moscou*, nouv. sér., tome i. (1887), pp. 924–927.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 3. MARCH 1888.

XX.—*On a Collection of Reptiles from China.* By Dr. A. GÜNTHER, F.R.S.

[Plate XII.]

MR. A. E. PRATT, who is engaged in exploring for Mr. J. H. Leech the entomological fauna of the interior of China, has availed himself of the opportunity thus afforded him of collecting the reptiles and fishes of the country near Kiu Kiang, on the Yantsze river. The reptiles were collected in the mountains north of Kiu Kiang. Like all Chinese collections formed at a distance from the coast-line, at some well ascertained locality, the present is a valuable contribution to our knowledge of this fauna. The general features of the reptilian fauna of China are fairly well known; but comparatively few reliable data have been collected which may serve for a more detailed inquiry into the range of the species, and lead to a complete knowledge of the manner in which the tropical fauna gradually merges into that of temperate Asia.

Mr. Pratt, besides, was particularly fortunate in discovering a most interesting new form of Crotaline snake and in rediscovering the genus *Phyllophis*, of which one specimen only was previously known.

1. *Emys Reevesii*, Gray.

The ornamental colours of the soft parts are distributed as follows:—They consist of yellow bands and spots, edged with black; the most conspicuous is a band running from the upper part of the eye along the upper margin of the neck; sometimes it is interrupted in some part of its course, and generally a continuation of it is visible in front of the eye. A short curved band between the eye and the tympanum, another running from the lower part of the eye to below the tympanum; an oblong spot at the posterior angle of the mandible. Tympanum and posttympanic region with curved streaks and spots. Sides and lower part of the neck with parallel straight bands, posteriorly broken up into series of spots. In very young examples these ornamentations are less numerous.

2. *Trionyx sinensis*, Wiegm.

Three young specimens.

3. *Tachydromus septentrionalis*, Gthr.

Numerous.

4. *Tachydromus Wolteri*, Fisch.

One specimen.

Notes on the Species of Tachydromus.

The lizards of this genus (with the exception of *T. smaragdinus*) resemble one another in general appearance so much as to induce some herpetologists to consider certain characters on which I had based the distinction of the species to be of very doubtful specific value. I think the species can be readily and with certainty distinguished; they are based on characters which in my experience are subject to only exceptional variation, and which, slight as they are, must appear significant enough when they are found to be constant in specimens from the same locality and combined with one or more similarly constant characters.

The late Dr. Stoliczka was the first to refuse specific value to the number of mental scutes and inguinal pores. In his notes on a *Tachydromus* from Sikkim (Journ. As. Soc. Beng. xli. 1872, p. 87), which he identified with the archipelagic *T. sexlineatus* and of which he had twenty-five specimens, he says that he has found four specimens with four chin-shields, the others having three, and one specimen with two inguinal pores, the others having three, four, or five. Such an amount of variation I have not found in any species, although I examined equally large numbers of individuals of several species; and in not a single species have I met with a variation of the number of the chin-shields *. In all the numerous specimens of *T. septentrionalis* and *T. smaragdinus* the number of inguinal pores is invariable. More especially with regard to the true *T. sexlineatus*, of which I have examined some forty examples †, the number of chin-shields is invariably three and that of inguinal pores very rarely exceeds two; in three specimens (two from Borneo) I have observed one pore only.

What follows from these observations is :—

1st. That the species examined by Stoliczka differs from the other species of the genus in having a greater number of inguinal pores and, therefore, in being liable to more frequent variation in this respect.

2nd. That that species must be distinct from *T. sexlineatus* and had better be distinguished by another name—*T. sikkimensis*.

Specimens of *T. sexlineatus* from Khassya, in the British Museum, have on the whole a somewhat shorter and less tapering snout, also shorter toes than the typical form, and approach in these respects *T. meridionalis*.

This latter species has been placed by Mr. Boulenger ('Lizards,' iii. p. 4) as a synonym of *T. sexlineatus*, but besides being a less slender species, the four specimens have one inguinal pore only, like *T. septentrionalis*, in which the constancy of this character is a remarkable and incontrovertible fact.

Of the five species united by Mr. Boulenger (*l. c.* p. 5) under the name of *T. tachydromoides*, *T. septentrionalis* is the one the distinctness of which from the Japanese form or forms can be least impugned. We have now no less than twenty-seven specimens before us, a most instructive series as to the value of the characters by which this species has been defined. Only two of the specimens, from Shanghai, differ from the others in having a series of small scales intercalated between the outer pair of large scaled series. According to Stoliczka's estimate of the specific characters in *Tachydromus* these two specimens should be relegated to a distinct species; and if this peculiarity should prove to be constant in the form inhabiting that district, I myself should be inclined to separate it from *T. septentrionalis*.

Schlegel figures in the 'Fauna Japonica' his *T. tachydro-*

* One individual of *T. Wolteri* has three on one and four on the other side, which, of course, proves nothing, as in every lizard almost any two contiguous head-shields may be found abnormally confluent.

† Half of this number belong to the Museum of Genoa, having been kindly forwarded to me by the Marquis J. Doria.

moides with three inguinal pores and strongly keeled ventral scutes. I have seen only one specimen from Japan with three pores, but six others possess only two, and their ventral scutes are remarkably smooth, only those on the side of the abdomen being slightly keeled. Duméril and Bibron also do not seem to have observed more than two pores in this or any other species of the genus.

Whether or not *T. amurensis*, Ptrs., is distinct from *T. tachydromoides* must be left uncertain until more materials are collected. I have not seen this form. But I have much less doubt as to the distinctness of *T. Haughtonianus* from *T. tachydromoides*, on account of the considerable difference in the number of transverse series of ventral scutes.

Finally, three specimens of *T. Wolteri* of Fischer show a remarkable agreement in having a single inguinal pore combined with eight dorsal series, which are composed of scales of nearly equal size. One specimen is the type from the Korea, a second forms part of the present collection from Kiu Kiang, and the origin of the third is unknown. The coloration is also identical, the white lateral band being singularly bright and well defined.

Thus I distinguish from the materials at present at my disposal and from the descriptions of authors eight species, which may be shortly characterized as follows:—

I. Three pairs of chin-shields.

A. Dorsal scales in four series.

1. Inguinal pores three to five; ventral scutes in twelve series. *T. sikkimensis*, sp. n. Sikkim.
2. Inguinal pores two (exceptionally one); ventral scutes in ten series .... *T. sexlineatus*, Daud. Borneo, Java, Birma, Khassya.
3. Inguinal pore one; ventral scutes in twelve series. *T. meridionalis*, Gthr. China.

B. Dorsal scales in eight or nine series, of which the three outer ones on each side are the largest; one inguinal pore. *T. smaragdinus*, Blgr. Loochoo Islands.

C. Dorsal scales in six series, of which the two middle ones contain very small scales, and are represented sometimes by one series only *; one inguinal pore. *T. septentrionalis*, Gthr. Kiu Kiang, Nankin, Ningpo.

* In two specimens from Shanghai a series of small scales is intercalated between the outer pair of large scales.

II. Four pairs of chin-shields.

A. Two or three inguinal pores on each side.

1. Three inguinal pores; dorsal scales in eight series, of which the two middle are smaller than the rest.
T. amurensis, Ptrs. Amoorland.
2. Two (three) inguinal pores; dorsal scales in six series, those of the two middle ones smaller than the others; twenty-two or twenty-three in a longitudinal series between the axils .... *T. tachydromoides*, Schleg., = *T. japonicus*, D. & B. Japan.
3. Two inguinal pores; dorsal scales in six series; twenty-seven in a longitudinal series between the axils.
T. Haughtonianus, Jerd. Assam.

B. One inguinal pore.

Dorsal scales in eight series, subequal in size.
T. Wolteri, Fisch. Corea, Kiu Kiang.

5. *Lygosoma Reevesii*, Gray.

A specimen in the collection has twenty-eight series of scales round the body, and therefore comes nearest to the scink which I have described as *Eumeces modestus*. However, Mr. Boulenger has already stated that the number of series of scales varies in these lizards from twenty-eight to thirty-two *. Like Mr. Boulenger, I am unable to separate these Chinese scinks from the North-American *L. laterale*.

6. *Lygosoma elegans*, Blgr.

One specimen.

7. *Gecko japonicus*, D. & B.

Two specimens.

8. *Calamaria quadrimaculata*, D. & B.

Four adult specimens. Their abdomen is scarlet; all possess a black, median, subcaudal band, which occupies nearly the whole width of the posterior subcaudal scutes, being much narrower anteriorly. Tail very obtuse.

The British Museum possesses also a young specimen from Hongkong.

9. *Simotes chinensis*, sp n.

Scales in seventeen rows. Eight upper labials, the fourth

* Thirty-four series of scales, as stated in the 'Reptiles of British India,' p. 88, for the type of *L. Reevesii*, is an error for thirty-two.

and fifth entering the orbit; loreal square; one præ- and two postoculars; anterior chin-shields in contact with four lower labials. Ventral shields 190, distinctly keeled on the sides; subcaudals 63, anal entire. The ground-colour is a light brownish grey; trunk crossed by thirteen, tail by four narrow, equidistant, black cross bars; these are somewhat broader on the back than on the sides, and indistinctly edged with white. A black band from eye to eye and continued over the fifth and sixth labials. The black arrow-shaped spot on the neck is well defined. Abdomen with numerous square black spots, each occupying one half or the whole of a ventral scute. Subcaudals uniform white.

One young specimen measures $8\frac{1}{2}$ inches, the tail being 2 inches long.

10. *Coluber rufodorsatus*, Cant.

Common.

11. *Elaphis dione*, Pall.

One specimen.

12. *Elaphis sauromates*, Pall.

Nine specimens.

13. *Zaocys dhumnades*, Cant.

Five specimens.

14. *Ptyas korros*, Reinw.

One specimen.

15. *Phyllophis carinata.*

Phyllophis carinata, Günth. Rept. Brit. Ind. p. 295, pl. xxi. fig. B.

The discovery of a second specimen of this singular type settles the question as to its habitat. Both specimens agree in every respect; but in the new specimen a fine brown line begins to be visible in the second half of the body between the third and fourth outer series of scales, disappearing near the root of the tail. A pair of similar lines run along the back of the tail. A series of black spots on each side of the abdomen is formed by very small specks, one on each side of each abdominal scute.

16. *Cyclophis major*, Gthr.

Seven specimens.

17. *Tropidonotus annularis*, Hallow.

Common.

18. *Tropidonotus tigrinus*, Boie.

Very common.

19. *Ophites septentrionalis*, Gthr.

One specimen.

20. *Lycodon rufozonatus*, Cant.

Common.

21. *Bungarus semifasciatus*, Kuhl.

One specimen.

22. *Callophis annularis*, Gthr.

One specimen.

23. *Halys Blomhoffii*, Boie.

Common.

24. *Halys acutus*, sp. n. (Pl. XII.)

This new species may be at once recognized by the upper part of the extremity of the snout being produced into a short, flexible, pointed lobe which projects from between the anterior frontal and the rostral shield. The anterior frontals are small, longer than broad; the posterior very large, intermediate in size between the anterior frontals and the occipitals. Eye surrounded by a ring of small orbitals, of which those in front are rather elongate; that below the eye is likewise long and crescent-shaped, separated by a small postocular from the superciliary shield. Seven upper labials, of which the second forms the anterior wall of the antorbital pit, the third and fourth being the largest. A series of three large temporal shields occupies the lower part of the temple, the space between this series and the occipital being covered by ordinary scales.

Scales strongly keeled, the keels forming a high sharp ridge on the posterior part of the body. Each scale bears, besides the keel, on its extremity a pair of very small nodules; scales in twenty-one rows. Ventral shields 160; anal entire; subcaudals 60, of which the six or twenty anterior may be single. Extremity of the tail compressed, covered with comparatively large vertical scutes, and terminating in a long and compressed spine.

The colour of the upper parts is brown, each side of the body being ornamented with a series of large dark-coloured triangles, the point of each triangle meeting that of the other side in the median line of the back. Lower parts whitish, with a series of large rounded black spots on each side and smaller ones of irregular shape in the middle. The upper part of the head is uniform black; a sharp line, which runs from the eye along the middle of the temporal scutes to the angle of the mouth, dividing the black coloration of the upper parts from the white of the lower.

This species is very remarkable not only on account of the rostral lobe, but also for the modification of the scutellation of its compressed tail. Although this modification cannot in any way be taken as an initial step in the development of the rattle of *Crotalus*, the rattle being a modification of the last dermal scute only into which the vertebral column is not prolonged, yet the tail of this species may exercise in a much smaller degree the same function as in the rattlesnake, and may be an instrument by which vibrations and sound are produced. It is well known also that many innocuous snakes are able to vibrate the extremity of their tail. To judge from its size and from the development of its poisonous apparatus this snake must be extremely dangerous.

Three specimens are in the collection, of which the largest is 46 inches long, the tail measuring $6\frac{1}{2}$ inches.

XXI.—*On two new Genera allied to* Loftusia, *from the Karakoram Pass and the Cambridge Greensand respectively.* By H. J. Carter, F.R.S. &c.

[Plate XIII.]

In the month of December, 1887, Mr. W. Theobald, M.R.A.S., late Deputy Superintendent, Geological Survey of India, submitted for my examination six of the fossils commonly called "Karakoram stones," which were brought from the "Karakoram Pass," in the Karakoram range of mountains, North-east Kashmir, where they were collected by the late Dr. F. Stoliczka. Five of these are undoubtedly *Parkeriæ*; but the other, of which, unfortunately, there is only half, is totally different, and so very like *Loftusia* in composition, although not in form and structure, that (as will be seen hereafter) I have allied it to the latter and proposed for it the term "*Stoliczkiella Theobaldi*," thus coupling two names well known in the Geological Survey of India.

To the five specimens of *Parkeria* I will more particularly refer hereafter; meanwhile let us proceed to the description of

Stoliczkiella Theobaldi, gen. et sp. n. (Pl. XIII. figs. 1–4.)
(Half the specimen.)

General form when entire (according to Mr. Theobald, who had it cut through the short axis into equal halves) a compressed spheroid; hence the outline of the half about to be described represents a hyperbola $1\frac{4}{24}$ in. high, with a nearly elliptical base, whose long axis is $2\frac{5}{24}$ in. and the short one $1\frac{7}{24}$; so that with these dimensions and Mr. Theobald's statement, viz. that the other half was the same in size, the entire shape of the fossil may be easily assumed (Pl. XIII. fig. 1).

Surface of this half remarkable for the presence of a star-like radiation in relief (fig. 1, *a*), of which the centre is on one side of the summit of the hyperbola, and thus eccentric, so that its axis would pass obliquely through the base; but whether this "eccentric" position is natural or caused by the situation of the sectional line or other circumstances, such as rock-contortion &c., the *half* fossil does not enable me to determine; again, the centre of the "star-like" radiation is oval in its circumference, with the long axis directed obliquely across the half fossil on one side of the summit, and this is all that can now be stated of its position with relation to the rest of the fossil when entire. This stelliform group consists of a great number of narrow lanceolate segments, in relief, which, radiating from a central point, vary in length and size under $\frac{1}{12}$ in. long, while they are shorter and more or less overlap each other about the centre, as they lie upon the convexity of the fossil, indicating that they have been successively developed (figs. 1 and 3). Beyond the ends of the "segments" of this stelliform portion come a great number of lozenge-shaped projections, more or less in juxtaposition, which seem to represent the external ends of internal "segments," and in their tessellated arrangement, circumscribed by obliquely intercrossing linear grooves, which separate them, simulate the surface of a fir-cone (fig. 1, *b*). These projections are only partially scattered over the surface, as they are interrupted by the presence of a large quantity of foreign material (fig. 1, *c c*), which in many places occupies so much of the fossil as to frequently insulate the lozenge-shaped projections and thus destroy their continuity (fig. 1, *d*). In composition the segments consist of clouded, striated, granular calcspar of a grey colour; but there is a small fragment of polygonal cell-tissue near the centre (of which the divisions are 1-900th in. in diameter), which not only leads to the inference that the granulated condition of the calcspar composing the segments generally might have originated in this way, but points out that this can only be decided by a specimen where the structure generally is better preserved than in the present instance. On the other hand, the brown foreign material which intervenes between the projections and is composed of foraminiferal detritus also presents, where weathered, a granular character on the surface. So that, in fact, the form of the calcareous development may be said to be struggling to make its appearance through the foraminiferal detritus.

Turning to the *base* of the cone or half-specimen (fig. 2), we find that it presents an indistinct radial structure of the "segments," the axis of which is also eccentric and rather towards one end of the ellipse (fig. 2, *a*), on the surface of which the obliquely cut ends of the segments in juxtaposition here and there, of a lozenge-shape (fig. 2, *b*), indicate that the general structure of the fossil is foretold by that on the surface; while the whole is more or less cut up and thus obscured by the presence of the foraminiferal detritus, which not only separates the segments longitudinally in the form of straggling, unequal, thread-like accumulations, but traverses them in all directions in more or less delicate ones, swelling out here and there into larger masses as on the surface (fig. 2, *c c c*).

Thanks to the fine polish which the lapidary has given this basal plain, one can see by strong light, when well condensed and reflected, under microscopic power the minute elements of which it is composed, and these consist of the above-mentioned clouded grey calcspar and the brown foraminiferal detritus; the former pervaded by the faint remnants of what appears to have been a reticulated membrano-tubular structure, and the latter (as seen under the microscope) consisting of a yellowish substance of a tangled thready nature, infinitely divided dendritically and reticulatingly, like veined marble or frothy, filiferous protoplasm (fig. 4), densely charged with more or less broken-down tests of minute Foraminifera and a great number of opaque scarlet spherules (fig. 4, *b*), following the grooves between the "segments" and those circumscribing the lozenge-shaped projections on the surface, contrasting strongly in colour with the whitish-grey clouded calcspar. This appears to be identical with Brady's "accessory structures" in *Loftusia persica*, which he has aptly compared to "a piece of fine sponge" (Phil. Trans. 1870, p. 745)—the largest foraminiferal test seen being discoid and about 1-164th in. in diameter (fig. 2 *d*) and the scarlet spherules about 1-1500th, but very variable in this respect, from circumstances which will appear hereafter.

As might be expected, the foraminiferal detritus presents a great number of minute and microscopic forms which appear to be chiefly discoid, among which are some like *Discorbina* and *Planorbulina*, wherein the great thickness of the marginal cord and ribs or intercameral septa is out of all proportion to the size of the cavities of the test; but they are one and all more or less broken down in a manner that evidences assimilative digestion; so that it becomes impossible for any one but an expert to say what their original forms were, and thus point out the families or genera to which they respectively belong; while fragments of the marginal cord and intercameral septa, often crossed by transverse striæ like the marginal cord and of tubular appearance, are plentifully scattered through the whole substance, which fragments might be mistaken for the remains of structure *proper* to the fossilized animal, were they not occasionally connected (that is a portion of the striated cord with a bit of the intercameral septum attached to it), so as to reveal their true nature.

But these fragments and the number of foraminiferal tests mixed up with the striated granules of calcspar and the tangled thread-like "yellow substance" produce a confusion of material in which it becomes difficult to distinguish the indistinctly marked "fragments" of the proper animal.

Still of all these parts the most interesting are the opaque scarlet spherules (fig. 4, *b*), which are not only so numerously scattered throughout the mass as in some places to give it a reddish hue, but appear in many instances *in* the chambers of the foraminiferal tests themselves (fig. 5), thus evidencing the source from which they were originally derived, as I shall more satisfactorily show in the "Observations" that will be appended to this description; while in many places they may be seen in linear or reticular arrangement indicative of having been in a tubular structure or investment of the yellow substance, although nothing but the faintest tinge of this remains, so that it might have been no more than a simple line of protoplasm (fig. 4, *a*).

Loc. Karakoram Pass, Karakoram range of mountains. "The so-called 'Karakoram Stones,' *i. e.* corals, occur in dark shales below the limestone, which are capped by a yellowish limestone, well bedded, but of unascertained age:"

such is the only remark that accompanied them, which is extracted from the late Dr. F. Stoliczka's diary, made on the "17th June, 1874," barely two days before his death, for which he was then sickening ('Scientific Results of the Second Yarkand Mission,' published by order of the Government of India, Calcutta, 1879). Would that he had lived to have written more!

Obs. With only half the fossil it may at first appear presumptuous to endeavour to establish a new genus, but with the above data it will appear to those who are acquainted with the structure and composition of *Loftusia persica* to be otherwise; at the same time, if this be objected to, then we must regard the description as "provisional," for under no other circumstances can the facts connected with this apparently unique specimen be recorded.

It may be learnt from the above statements that the fossil is composed to a great extent of foraminiferal detritus or sea-bottom, and thus it may be assumed that the Foraminifera were taken in by the animal for nutritive purposes; while the whole is totally different both in general form and internal structure from any species of Foraminifera that has been made known.

Comparing its composition with that of *Loftusia persica*, it will be found that the two are almost identical; thus, setting aside the misleading resemblance to *Alveolina* &c. in outward form and the "lamino-spiral" development in *Loftusia persica*, we have absolutely nothing left to identify it with *Alveolina* or any other evident form of Foraminifera; while the difference in size of the largest recorded specimen, viz. 3 in. long by 1½ in. broad, so far exceeds that of any known specimen of the Foraminifera, that it alone is almost sufficient to negative such a supposition. Hence there can be no objection on this score to allying the Karakoram fossil to that of Persia, viz. *Loftusia persica*, on which account it becomes necessary to create a new family for *Loftusia persica* and *Stoliczkiella Theobaldi* that may be termed "Loftusiidæ."

It is not my object here to go at length into the minute structure of *Loftusia persica*, for that has been described and illustrated by Mr. H. B. Brady, in the 'Philosophical Transactions' for 1869 (vol. clix. p. 739), in a way which does not require repetition; but there are one or two points in connexion with *S. Theobaldi* which are of great interest as bearing not only upon the identity of composition in *Loftusia persica* and *Stoliczkiella Theobaldi*, but on the propagative elements of the Foraminifera generally; I allude more particularly to the presence of the "opaque scarlet spherules," which are as abundant in *L. persica* as in *S. Theobaldi*, and to be seen in both in the chambers of foraminiferal tests (from which they all originally come) as well as dispersed through the substance of the body generally (figs. 5, *a*, and 4, *b*). I could not specify the kind of test in which they appear in *S. Theobaldi*, for the fragments are too much broken down for recognition; but in the microscopic slice of *Loftusia persica*, about 2 in. long by 1 in. in diameter, which Mr. H. B. Brady, F.R.S. &c., kindly gave me several years ago, the instances are both clear and numerous, among which I have marked one for observation of a discoid form in which four or five of the chambers respectively present an opaque scarlet spherule (fig. 5), and another, a *Textularia*, in which ten of the chambers on one side and upwards of the same number on the other each present an opaque scarlet spherule; so that there can be no doubt whatever that in both *S. Theobaldi* and *L. persica* the opaque scarlet spherules come from the chambers of foraminiferal tests, as above stated, and thus are to be regarded as foreign material in both respectively. And here the difference in size of these scarlet spherules, to which I have already alluded, may be explained, viz. by the spherule when large often presenting the appearance of being composed of a great number of much smaller ones of the same kind in a spherical capsule; so that the scarlet mass, both in the chambers and out of them, may not only when breaking up present an irregular form, but the opaque scarlet body may vary very much in diameter.

That these scarlet bodies are reproductive particles may be learnt from what Max Schultze described and illustrated in *recent* species in 1854 and 1857, all of which was summarized and illustrated by Dr. Carpenter in 1862 ("Introduction to the Study of the Foraminifera," Ray Soc. Publ. p. 37 &c. and pl. xiv.), while all was confirmed by myself, not only in recent but in fossil forms, in 1861 ('Annals,' vol. viii. pp. 318, 325, and 451, pl. xvii. figs. 12 and 13, 14 and 15, and 1, *o*, respectively).

The beautifully infiltrated specimens by which the latter was confirmed I have still by me, for at the time they were obtained, now thirty-six years ago, I ground down their surfaces, covered them with balsam, and attached them to glass slips, through which their minute structure, from its brilliant colours and clear definition, can even now be seen not only as well as ever, from its imperishable nature, but more satisfactorily than in the recent specimen, the shell-structure remaining pure opaque white, the tubular structure between the chambers being filled with bright ochraceous yellow matter, and the opaque scarlet spherules in the chambers of the central plane—especially brilliant in *Orbitoides dispansa*, but less so in *Nummulites Ramondi*, from not being so highly coloured (that is, rather brownish), and being imbedded in the clear calcspar filling one of the central plane of chambers, where they are also a little translucent and separated —look like the "roe of a herring;" so that, but for these specimens, I should never have realized the nature of these bodies either in *Stoliczkiella Theobaldi* or *Loftusia persica*. I have already alluded to the fragments of marginal cord and intercameral septa scattered throughout the body-substance of both these specimens, in which, from the absence of striæ on the calcspar in the microscopic slice of *Loftusia persica*, they are much more evident than in the Karakoram specimen, where, on the other hand, all the grains of this mineral are striated (that is, present the lines of cleavage), and thus by intercrossing more or less obscure their outlines.

At this period I received from my kind friend Dr. J. Millar, F.L.S. &c., several specimens of *Parkeria* that had been obtained from the Cambridge Greensand, both massive and in their microscopic sections, among which was one (noticed by Dr. Millar as different from the rest) which proved on examination to be a species of *Loftusia*, but so unlike *Loftusia persica* and *Stoliczkiella Theobaldi* that it must form the type of a *third* genus of the family Loftusiidæ, for which I would propose the name of "*Millarella*," and for the specimen that of *Millarella cantabrigiensis*, after the friend who gave it to me and the locality from which it was obtained *.

Millarella cantabrigiensis, gen. et sp. n. (Pl. XIII. figs. 6–8.)

General form subspherical, with a small, irregular cup-like, shallow excavation about 4-8ths of an inch in diameter at one end (? accidental) †. Consistence hard and earth-like, *not* crystalline. Surface very rough and irregular, unevenly granuliferous throughout. Granulations of three sizes, viz. small, minute, and microscopic, the former of a brown colour charged

* I was writing this paper, viz. about the 8th January, 1888, and on the 19th, after eleven days' illness of bronchitis, Dr. Millar died. Then lost Natural History one of her ablest advocates and I one of my best and dearest friends!

† This now appears to have been the place where the organism was originally attached to some submarine object (see concluding part of footnote, p. 181).

with foraminiferal detritus, the minute dark green particles consisting of glauconite, and the microscopic ones of fine white silico-calcareous sand, in which the others are imbedded. From the margin of the cup-like excavation there is an indistinct linear radiating arrangement of the larger granulated projections, which extends for a short distance outwards, where it becomes lost among the irregular granulations of the surface, which is amorphous, that is, *without any pattern.*

Internally the composition is the same, only the detail rendered more evident by the polished surfaces of the pieces and the mounted microscopical section, where the "brown-coloured" material is seen to be literally *crammed* with foraminiferal detritus, consisting of minute foraminiferal tests of various forms and sizes, chiefly *Globigerina* and *Orbulina* (?*Globigerina*-ooze) more or less broken down (fig. 8), in some of whose chambers may be seen glauconite (fig. 8, *d d*) and in others the opaque scarlet spherules above mentioned (fig. 8), the instances of the latter being so numerous and the dispersed spherules (fig. 8, *g*) so abundant in some places as to impart a red tint to the surrounding material; also various forms of sponge-spicules (fig. 8, *c*) and a large quantity of (comparatively large) glauconite grains (fig. 8, *e*), which, from what has been just stated, appear to originate in the chambers of the foraminiferal tests, although from subsequent segregation they often present no particular form. I also notice in many places little masses of material like the frothy yellow substance described in *Stoliczkiella Theobaldi*, only of a white colour, looking like the broken-down remains of germinal tests about to be assimilated or discharged.

As regards structure, all that can be learnt from the sections is that, on the surface of the transverse one close to the "cup-like excavation," the material is so condensed in the centre as to occupy a circular space about 3-12ths in. in diameter, which is continued upwards through the axis of the fossil, extending outwards in a less condensed state, and then followed by a great number of little pits or vacuities (interstices of a reticulated structure, figs. 7 *b* and 8 *a*), which, although very irregular both in size and position, shadow forth a tendency to circumscribe circular divisions of more condensed material, each about 1-16th in. in diameter (the pits and the condensed material corresponding with the large granulated projections on the surface of the fossil and their intervals). A little higher up (that is, in the centre of the fossil) the mounted microscopic section presents the same characters without any appearance of "axial condensation;" that is, the "circular divisions" are continued to the centre, about which they are much more defined and uniform (fig. 6, *a*), but lose this again towards the circumference, where the linear disposition of the "pits" (fig. 6, *b*) tends to indicate that they are transverse sections of a columnar structure which on all sides bends outwards towards the circumference. This radiation is more particularly shown by the surface of the section through the line of union between the seventh and eighth parts of the fossil in this direction, of which the eighth part or crown is unfortunately absent, while the other parts when all put together give the "subspherical" form mentioned.

When the mounted microscopic slice from the middle is viewed through a $\frac{1}{4}$-inch focus the circular spaces or divisions are seen to be united by intercommunicating extensions (fig. 7, *b b*) of the more condensed brown material, which, being without the foraminiferal detritus, and thus better seen, becomes resolved, under a power of five hundred diameters, into minute brown granules. I should also have mentioned, however, that in the midst of the foraminiferal detritus there are the remains of a fungoid matted structure, only extremely fine and minute, composed of white, opaque, apparently solid, branched, interunited and tortuous filaments, about 1-3000th in. in diameter, which thus also ought to have been inserted among the elements represented in the illustration, fig. 8. Size of fossil, when all the parts are put together, about $1\frac{1}{2}$ in. in diameter, and, as before stated, subspherical in shape, or like that of a *Parkeria**.

* I have also three other specimens from the Cambridge Greensand, of the same nature as *Millarella*, in which this fungoid filamentous structure is more or less evident, viz.:—1, about $\frac{3}{4}$ in. in diameter, globular, with uneven earthy surface, composed of white chalky substance charged with the usual foraminiferous detritus and permeated by a meandering, defined, tortuous structure of a yellowish tint, entirely made up of the same kind of filament as that noticed in *Millarella*, forming altogether in amount about half as much as the white chalky substance; 2, another specimen about the same size and similarly composed, but in which the meandering development is not evident and the filamentous structure not so plain, while the surface is regularly tuberculated with a brown material, which appears to be nothing more than a condensed or hardened state of the foraminiferal detritus of the interior, so that difference in fossilization may have to be taken into account in these instances; and 3, a specimen which forms the nucleus or support upon which a Parkerian structure has been built. This consists of a slightly fusiform, conical, solid cylinder, in composition like the last specimen mentioned, about $1\frac{1}{2}$ in. long and 9-24ths in. in its greatest diameter, conical at one end and obtuse at the other, which appears to have been broken off from an original attachment. Be this as it may, however, this cylindrical form has been overgrown by a Parkerian development on all parts except the extremities, viz. the conical and the obtuse ends, to the extent of half an inch, so that until the spheroidal mass thus produced was cut through the whole looked like a globular *Parkeria*. Hence it is interesting to find

Loc. Cambridge Greensand.

Obs. Although in general form this fossil might be easily mistaken for a *Parkeria*, the total absence of all distinct tubuliferous structure both externally and internally, together with the quantity of foraminiferal detritus in its composition, is quite sufficient to point out the difference. I have alluded to the presence of glauconite in the chambers of some of the foraminiferal tests, and inferred that all the particles of this mineral originated in this way, although, when increasing in size, assuming forms which are totally unlike a foraminiferal test; but that they are so may be learnt from an examination of the green particles generally of the "Greensand,"—to which it is curious to add that this is going on at the present time in the Globigeriniferous sand of the bed of the Atlantic (see "Deep-sea Sponges dredged on board H.M.S. 'Porcupine,'" 'Annals,' 1876, vol. xviii. p. 474, under "Black Grains"); while it is also remarkable that glauconite is altogether absent in my specimens of *Loftusia persica* and only seen in very small quantity in *Stoliczkiella Theobaldi*.

What the nature of the animal of the Loftusiidæ may have been it is difficult to conjecture further than that, in all three genera, it must have had the power of enclosing foreign material like the *Amœba*, and therefore its substance must have been rhizopodous, hence the absence of all *wall* indicating tubulation. Again, the broken-down forms of the tests mighthave been both for nutriment and skeletal purposes. The rhizopodous character of both Sponges and Foraminifera afford examples of this, *ex gr.* my genus *Holopsamma* ('Annals,' 1885, vol. xv. p. 211) and the arenaceous foraminiferal tests, in both of which the plasmic sarcode or protoplasm builds up foreign material into the specific form which the apparently *identical* simple substance is destined to produce. But here all identification of the Loftusiidæ with the Sponges and *typical* Foraminifera seems to cease, although there is a great resemblance between Brady's "*Syringammina fragillissima*" ('Challenger' Report on Foraminifera, vol. ix., text, p. 242) and *Millarella cantabrigiensis*, especially in illustration "*a*," but not in the tubular structure "*c*" (woodcuts), so that we must look still further for a nearer analogy.

Undoubtedly the same sarcodic structure in *Loftusia persica* which took in foreign material presents in the fossil a

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that the *Parkeria* not only grew upon the *Millarella*, but that the latter presents signs in its obtuse end of having originally been attached to some submarine object, which would seem to be not uncommon, for there are three more instances of it in my cabinet.

membrano-tubular-labyrinthic structure (see Brady's illustration, *l. c.* pl. lxxix. figs. 1–3), remnants of which can, I think, be faintly seen in the more confused substance of *Stoliczkiella Theobaldi*, but not in *Miliarella cantabrigiensis*, where the brown substance alone represents the form *without any wall*. But larger fragments of foraminiferous tests in the two former and longer sponge-spicules than the diameter of the sarcodic divisions in the latter exist as in sponge-tissue after it has become *hardened*; so that one might infer that when they were taken in this tissue was in a plastic amœboid state. And therefore all that I can conjecture of the nature of the animal substance of the Loftusiidæ is that it was a solid plasma, like that of the *Æthalium*, which, during its *active* state, is capable of assuming every form, massive and reticulate, that can be conceived, at the same time that it can and does take in any particles of foreign material that suit its purpose; while, like the other Myxomycetes which present apparently the *same* simple protoplasmic substance during their active life, each protoplasm is destined to end in the specific form which it was intended to develop.

Parkeria, Carp., 1869.

With reference to *Parkeria* I would only add, after the excellent paper written by Prof. H. A. Nicholson on this fossil ('Annals,' Jan. 1888, p. 1 &c.), that as there appears to be more than one British species and Prof. Martin Duncan in his Memoir makes of those from the Karakoram Pass which he examined several species and two genera ('Scientific Results of the Second Yarkand Mission,' Calcutta, 1879, p. 10), it seems to me, as with *Loftusia persica* of Brady, 1879, desirable that it should have a family name, for which I would propose "Parkeriidæ," which, being but a patronymic of Carpenter's "*Parkeria*," established for that species and genus in 1869, when he published his beautifully illustrated description of this fossil in the 'Philosophical Transactions' (vol. clix. p. 721), should take precedence of Duncan's "Syringosphæridæ" of 1879 (that is ten years after), established for the "Karakoram Stones," which we now know to be *Parkeriæ*, not only from what Prof. Nicholson has stated from ocular demonstration ('Annals,' *l. c.* p. 11), but from what I have learned from an examination of the five specimens of these "Stones" mentioned at the commencement of this paper, some of which are identical with Prof. Duncan's representations.

I cannot agree with Prof. Nicholson in his statement that the "tubuli" do *not* present any "transverse internal partitions," as I have a polished section of *Parkeria* which Dr. Millar gave me, on which, here and there, these appear to me to be distinctly evident, and in a section through the centre of one of the *Parkeriæ* from the Karakoram Pass I also distinctly saw one in a portion of the tubuliferous structure which had been raised above the polished surface by etching with dilute nitric acid, while at the same time I could see nothing in this section particularly different from that of *Parkeria*, Carp , except that the lapidification is much more compact and crystalline and that there is an appearance of a darker, tree-like portion branching from the centre to the circumference, which seems to arise from the presence of the bundles of longer-tubed structure having been bent into this form, also seen, but in a straighter one, in the same kind of polished section of the Cambridge *Parkeria.*

It is also worth noticing that *Loftusia* and *Parkeria* are found together both in the "Greensand" of Cambridge and at the Karakoram Pass, in Asia.

Provisional Characters of the Families Parkeriidæ *and* Loftusiidæ.

Parkeriidæ.

Minute or basal structure consisting of tubuli intercommunicating freely with each other in juxtaposition, pierced by larger tubes (the zooidal tubes of Nicholson, *l. c.*), which radiate from the centre to the circumference. Specimens generally nucleated by, or growing upon, a foreign body.

Loftusiidæ.

Minute or basal structure consisting of a *quasi*-membrano-labyrinthic, hollow, reticulated fabric charged with foraminiferal detritus.

EXPLANATION OF PLATE XIII.

Fig. 1. *Stoliczkiella Theobaldi*, nat. size. Half the specimen. Lateral view, showing :—*a*, stelliform group of segments on the surface; *b*, external ends of internal segmentation; *c c*, foraminiferal detritus; *d*, insulated ends of internal segmentation; *e*, portion of fossil broken out.

Fig. 2. The same. Base, nat. size. *a a*, lines of segmentation; *b*, lozenge-shaped ends of truncated segments; *c c c*, foraminiferal detritus represented by the dark shade; *d*, discoid foraminiferal test.

Fig. 3. The same. Outline of the group of segments on the surface, nat. size. Drawn to measurement as if flat.

Fig. 4. The same. Portion of the yellow froth-like substance, greatly magnified. *a*, thread-like extension of the same branched and more or less charged with the opaque scarlet spherules in line; *b*, scarlet spherules dispersed. Diagrammatic.

Fig. 5. Discoid foraminiferal test, much magnified, showing scarlet spherules in the chambers. *a*, spherule. From a microscopic mounted longitudinal section of *Loftusia persica*. Nat. size of test 1-164th inch in diameter. Diagrammatic.

Fig. 6. *Millarella cantabrigiensis.* Microscopic slice from the centre of the specimen, nat. size, indicating the transverse diameter of the fossil. *a*, structure in the centre, composed of more or less circular divisions interunited circumferentially by extensions of the same material: *b*, pits or vacuities indicating the intervals between the "extensions" where the "circular divisions" are not well-defined.

Fig. 7. The same. Portion of the centre, much magnified, to show the mode of union of the circular divisions by the intervening "extensions (reticulated structure)." *a*, circular division; *b*, intervening extensions. Diagrammatic.

Fig. 8. The same. Circular division, still more magnified, to show the character of the foraminiferal detritus with which it is charged. *a*, "intervening extensions (reticulated structure);" *b b*, foraminiferal tests; *c*, sponge-spicules; *d*, discoid test, whose chambers are filled with glauconite; *e*, amorphous portion of glauconite; *f*, test in whose chambers respectively there is a scarlet spherule; *g*, dispersed spherules.

XXII.—*Description of a new Earth-Snake of the Genus* Silybura *from the Bombay Presidency, with Remarks on other little-known* Uropeltidæ. By George E. Mason.

Silybura Phipsonii, sp. n.

Head smaller than in *S. nilgherriensis*; snout rather pointed, rostral shield nearly twice as long as the vertical and one third the length of the head, convex above, produced back but not separating the nasals; frontals somewhat smaller than nasals, broad below, very narrow upwards and only just meeting in front of the vertical; eye rather large, lying in the front of the ocular shield and occupying a third of its size; vertical diamond-shaped, longer than broad; caudal disk flat, not well defined, twice as long as broad; the terminal scute large, broad, and rough, moderately bicuspid, the caudal scales prominently 2–4-keeled; no chin-shields between the first pair of lower labials and the ventrals; scales in 17 rows round the middle of the body and neck; ventrals twice as large as the scales of the adjoining series, from 146 to 148; subcaudals 11 pairs. Length 9–11 inches, girth $1\frac{1}{8}$ inch. Black above, iridescent, with small, irregular, much scattered, yellowish-white spots; upper and lower labials yellow, a very narrow bright yellow line commencing at the angle of the mouth and continued for $1\frac{1}{2}$ inch along the trunk, gradually diminishing to mere spots, which mingle with those scattered over the body; sometimes the presence of the line may be detected along the entire length of the body by an occasional group of confluent spots; belly uniform black, or with a few indistinct yellowish-white spots, a very perfect bright yellow band along each side of the tail and crossing the vent.

Hab. Bombay ghats.

For the series of specimens upon which the above description is founded I am indebted to my friend Mr. H. M. Phipson, Honorary Secretary of the Bombay Natural History Society. There are in the British Museum two snakes with 155 ventrals collected by Dr. Leith in the Bombay Presidency (the exact locality is not mentioned) which probably belong to the above species, but unfortunately they are in such indifferent condition that I cannot determine this point with certainty. I was inclined to endorse the opinion expressed by Col. Beddome (Ann. & Mag. Nat. Hist. (5) xvii. p. 17) that the Bombay form was identical with *S. nilgherriensis*, though a very characteristic variety, but after much consideration and the comparison of the specimens at my disposal with an extensive series of that form and its varieties I have come to the conclusion that, according to the received notions of a species, this must be considered distinct and not merely a variety. Independently of the much smaller head, the rostral is convex above and pointed, and chin-shields are wanting between the lower labials and the ventrals. The caudal disk is also longer and proportionally narrower, while the scales contain a greater number of keels.

Silybura nilgherriensis, var. *picta*.

Silybura nilgherriensis, var. *picta*, Beddome, Ann. & Mag. Nat. Hist. (5) xvii. p. 16.

This variety is founded on a single specimen collected at Peermaad, North Travancore, between 3000 and 4000 feet elevation. In collections I have recently received from the same locality this form is represented by numerous adult and young examples which tend to show that the coloration is very variable, many of the specimens differing greatly in this respect from the type. In one instance it is orange-yellow above each scale, with a fine black margin; a few entirely black scales are scattered over the anterior and posterior portions of the trunk; other specimens present markings such as were described originally by Beddome, except that the black scales are in series of from two to four and form irregular spots distributed over the back; and again in another example the groups of spots flow into one another, thus showing a tendency to form cross bars. The coloration of the young is somewhat remarkable; a yellowish hue is predominant, the scales having a very minute black margin, each one of the central dorsal series black, forming a conspicuous line which extends from the head to the caudal disk; the line is occasionally interrupted by a scale wanting the black mark; an almost undistinguishable dark central spot on the five rows of scales on each side of the dorsal series. The colour of the belly differs little from the type in all my specimens, alternate jet-black and irregular, broad, orange-coloured blotches or cross bars always being more or less present. The ventrals vary from 146 to 156.

Rhinophis sanguineus.

Rhinophis sanguineus, Beddome, Proc. Zool. Soc. 1863, p. 227, and Ann. & Mag. Nat. Hist. (5) xvii. p. 8; Günther, Rept. Brit. India, p. 186.
Rhinophis microlepis, Beddome, Proc. Zool. Soc. 1863, p. 227, cum icon. (young).

I have specimens in my collection from the Wullingy forests near Palghat which do not coincide with the diagnosis given by Beddome and Günther; the ventrals vary from 166 to 183 only and the caudal scales are somewhat prominently keeled on the upper surface of the tail. It is a matter of uncertainty whether they should be regarded as conspecific, and I have refrained from doing so until I can characterize them more fully.

Melanophidium punctatum.

Melanophidium punctatum, Beddome, Madr. Journ. Med. Science, Dec. 1871.

In addition to the remarkable changes of the horny terminal scute of the tail noticed by Beddome (*l. c.*) and by Günther in the 'Proceedings of the Zoological Society,' 1875, p. 230, I have observed it furnished with three well-marked parallel ridges above, each terminating in a spine, side by side, the central one being of far greater length and the ridge more acute. The specimens, which were collected at Peermaad, North Travancore, 4000 feet elevation, are of unusually large size, adults being 23½ inches long, with a girth of 2⅛ inches.

XXIII.—*Descriptions of new Brazilian Batrachians.* By G. A. Boulenger.

Leptodactylus prognathus.

Tongue oval, nicked behind. Vomerine teeth in straight series behind the choanæ. Snout depressed, acuminate, very prominent, slightly longer than the diameter of the orbit; no canthus rostralis; nostril nearer the tip of the snout than the eye; interorbital space a little narrower than the upper eyelid; tympanum two thirds the diameter of the eye. Fingers moderate, first much longer than second; toes moderate, not fringed; subarticular tubercles well developed; two small metatarsal tubercles, inner oval, outer smaller and round. When the hind limb is stretched forwards along the body, the tibio-tarsal articulation reaches the anterior border of the orbit. Back with a few irregular, smooth, flat warts; a dorso-lateral glandular fold; a ventral discoidal fold. Greyish olive above, with blackish spots; a blackish cross band between the eyes; a blackish band from the end of the snout to the eye; a whitish band, between the latter and the blackish margin of the upper lip, extends from below the nostril to the arm; tympanum chestnut-brown, with a linear white border; glandular lateral fold whitish; limbs with blackish cross bands; lower surface white. Male with an external vocal sac on each side of the throat. From snout to vent 33 millim.

Very closely allied to *L. typhonius*, Daud., which differs, however, in the numerous longitudinal dorsal folds.

A single half-grown male specimen from Rio Grande do Sul, through Dr. v. Ihering.

The species recently named *L. glandulosus* by Cope is identical with that previously described by Bœttger as *L. diptyx.*

Eupemphix nana.

Snout very feebly prominent; interorbital space broader than the upper eyelid; tympanum scarcely visible. Fingers moderate, first not extending beyond second; toes moderate, quite free, not fringed, tips obtuse; two very small, oval, blunt metatarsal tubercles; no tarsal tubercle, no tarsal fold. When the hind limb is stretched forwards along the body the tibio-tarsal articulation reaches the tympanum or the eye. Skin smooth; no parotoids; a flat, oval, lumbar gland, as in *Paludicola Bibronii.* Greyish above, with symmetrical dark markings, viz. a **Y**-shaped one between the eyes and a Λ-shaped one on the back, and cross bands on the limbs; a deep black pink-edged ocellus on the lumbar gland; a black temporal band, and a series of black spots on the outer edge of the limbs; lower parts dirty white, throat closely marbled with brown; belly of female uniform, of male also marbled like the throat. Male with an internal subgular vocal sac and brown rugosities on the inner side of the inner finger.

From snout to vent 18 millim.

Two specimens (♂ ♀) from Lages, Santa Catharina, collected by Hr. Michaëlis.

The genus *Eupemphix*, Stdr. (=*Engystomops*, Espada), must, on account of the absence of teeth, be referred to the family Bufonidæ, although it is in every other respect identical with *Paludicola*, to which it stands in the same relation as *Pseudophryne* to *Crinia*; this shows that frog-families founded upon the presence or absence of teeth are artificial associations. I am acquainted with four species of *Eupemphix*, which may be distinguished as follows:—

A. No tarsal tubercle; a lumbar gland; skin smooth.	
a. Metatarsal tubercles large, compressed, sharp-edged	*E. Nattereri*, Stdr.
b. Metatarsal tubercles small, blunt	*E. nana*, Blgr.
B. A conical tubercle on the middle of the inner edge of the tarsus; no lumbar gland; upper parts warty.	
a. Tarso-metatarsal articulation not reaching the end of the snout; tympanum hidden ..	*E. pustulosa*, Cope.
b. Tarso-metatarsal articulation reaching beyond the end of the snout; tympanum more or less distinct	*E. stentor*, Espada.

Hyla bivittata.

Tongue subcircular, notched and free behind. Vomerine teeth in two slightly oblique transverse series between the choanæ, which are of moderate size. Head moderate, as long as broad; snout rounded, as long as the diameter of the orbit; canthus rostralis obtuse, loreal region not very oblique; nostril nearer the end of the snout than the eye; interorbital space broader than the upper eyelid; tympanum moderately distinct, two fifths the diameter of the eye. Fingers webbed at the base; no projecting rudiment of pollex; toes two-thirds webbed; disks a little smaller than the tympanum; no tarsal fold. The tibio-tarsal articulation reaches the anterior border of the eye or the end of the snout. Skin smooth; belly and lower surface of thighs with large granules.

Greyish above, with two parallel darker bands along the back, more distinct in the young than in the adult, widening anteriorly and sometimes uniting on the interorbital region; upper surfaces more or less abundantly dotted with black; a dark line on each side from the end of the snout to the shoulder, passing through the nostril and the eye and above the tympanum; thighs and lower surfaces colourless. Male with a large external gular vocal sac.

From snout to vent 23 millim.

Several specimens from Lages, Santa Catharina, collected by Hr. Michaëlis.

In the number of the 'American Naturalist' for January 1888 (p. 80) the frog recently described by me as *Hyla Copii* is identified with *H. arenicolor*, Cope. If this identification is correct, I can only say that *I* am not to blame. *H. arenicolor*, Cope, is a mere name, proposed to replace that of *affinis*, Baird, preoccupied; on referring to the latter author's description, I find his *H. affinis* differs from my *H. Copii* in the following important points:—

H. affinis.—"Tympanum two thirds the size of the eye. Web of hand extending only to the third joint of the second finger." [The figure represents the fingers distinctly webbed at the base.] "No vermiculation on anterior and posterior faces of hind legs." (*Baird.*)

H. Copii.—Tympanum hardly one third the size of the eye. Fingers without web. Hinder side of thighs mottled or vermiculated with brown.

As the type specimen of *H. affinis*=*arenicolor* is preserved in the United States National Museum, it is to be hoped that further information may be forthcoming to settle the question.

Siphonops Hardyi.

Teeth small, subequal. Snout rounded, moderately prominent, about as long as the distance between the eyes; latter distinct, tentacle in front of and close to the eye, neither above nor below. 104 circular folds, all complete. Uniform blackish.

Total length 145 millim.; greatest diameter of body 4 millim.

Well distinguished from *S. annulatus* by the more slender body, the position of the tentacle, and the uniform coloration, the annuli not being lighter.

Porto Real, province of Rio Janeiro. A single specimen was obtained by M. F. Hardy du Dréneuf.

XXIV.—*Descriptions of a new Genus and of some new Species of Longicorn Coleoptera of the Family* Lamiidæ *obtained by Mr. C. M. Woodford in the Solomon Islands.* By Charles J. Gahan, M.A., Assistant in the Zoological Department of the British Museum.

Leuronotus, n. g.

Head strongly concave between the antennal tubercles, the latter prominent; front moderately narrow, equilateral. Eyes large, lower lobes reaching almost to the base of the mandibles. Antennæ about half as long again as the body; scape cylindric, and having at its apex a narrow cicatrice, which is completely limited by a distinct carina; third joint much longer than the scape, the fourth and following (the last excepted) decreasing in length.

Prothorax with an anterior and posterior transverse groove; disk uneven, and each side armed with a sharp spine.

Elytra square at the shoulders, very much elongated, with the sides parallel, flat on the disk, gradually sloping towards the sides, and then becoming vertical at the margins; sloping also behind towards the apex, which is broadly truncate, with the exterior angles slightly produced, the sutural angles scarcely so.

Legs long and of equal length; femora sublinear.

Prosternum simple; mesosternum with a small conical tubercle in front.

The completely margined cicatrice of the scape of its antennæ and its other characters show that this genus belongs to the *Monohammus*-group. From the other genera of the group it is readily distinguished by its elongated form and the flattened appearance of its elytra above. *Potemnemus* and *Periaptodes*, which have a greater affinity with the *Monohammus*- than with the *Batocera*-group, in which Lacordaire placed them, also have the elytra flattened; but, with other distinguishing characters, these genera are of broader form and have their elytra pointed at the shoulders.

Leuronotus spatulatus, n. sp.

L. elongatus, parallelus, niger, denso pallido cinereo-pubescens; elytris maculis nonnullis calvis, nitidis, æneo tinctis; antennis fusco annulatis.

Long. 32–40 mm., lat. 10–12 mm.

Hab. Solomon Islands.

Black, covered (except a longitudinal glabrous spot on the middle of the prothorax and a few glabrous spots on each elytron) with a pale ashy pubescence, which is of a darker shade and glossy on the legs and underside of the body. Epistoma and palpi piceous; labrum and mandibles black. Face with a few minute scattered punctures and with a median impressed line extending from the clypeus to the occiput.

Anterior margin of the pronotum somewhat angularly produced; lateral tubercles of the thorax directed outwards and upwards, the two dorsal tubercles obtuse and but little raised; between the latter is a median, glossy black, spatulate spot. The punctures on the thorax are not uniformly distributed—a few on the anterior border on each side of the middle line, a few behind each of the dorsal tubercles, and a few on the posterior part of each lateral tubercle.

Elytra minutely punctured, punctures scarcely visible through the pubescence, except at the base and sides. With two or three rows of widely separated asperate punctures on each elytron; two of these rows are along the faint ridges which bound off the median sloping area from the flattened area of the disk on the one side and from the vertical marginal area on the other. There are three or four irregular glossy black spots on the disk of each, and a few small glossy granules on each near the base.

Antennæ with the apical third of the third joint and the apical half of each succeeding joint of a dark brown colour; the first and second joints and the remaining parts of the other joints pale ashy.

Orsidis ampliatus, n. sp.

Niger, squamosa pubescentia tectus fusca et grisea; prothorace supra fusco, dorso minute bituberculato; scutello nigro, lateribus albis; elytris lateribus subparallelis, apicibus truncatis; antennis unicoloribus, scapo vix cicatricoso.

Long. 28 mm., lat. 10 mm.

Hab. Fauro Island, Solomon Islands.

Black, covered with a scaly pubescence, which is sandy grey and fuscous on the head, thorax, and basal two thirds of the elytra and sandy grey on the apical third. Head impunctate; eyes large, lower lobes reaching almost to the base of the mandibles. Antennæ fuscous grey, unicolorous, scape smooth, cylindrical, and with only the faintest trace of a cicatrice. Thorax fuscous brown above, with three small ochreous spots, two of which are placed on the two small tubercles of the disk, without punctures.

Scutellum black in the middle, white at the sides. Elytra minutely and thickly punctured, with the sides subparallel, the basal two thirds with a mixed pubescence of brown and sandy grey, the apical third sandy grey; apices somewhat obliquely truncate, with the outer angles slightly produced.

Heteroclytomorpha, Blanch. (nec Lacord.).

Heteroclytomorpha punctata, n. sp.

Picea, tenuiter pubescens, capite valde punctato; antennis concoloribus; prothorace fortiter punctato, lateribus trituberculato; elytris crebre punctatis, maculis nonnullis pallide ochraceis, apicibus truncatis nec spinosis.

Long. 28 mm., lat. 9 mm.

Hab. Fauro Island, Solomon Islands.

Pitchy, with a faint tawny pubescence, which is denser on the head and the sides of the thorax. Head strongly punctured, scarcely concave between the antennal tubercles. Antennæ nearly half as long again as the body. Prothorax somewhat rugose at the sides and closely and very strongly punctured, in the middle smooth and shining, transversely folded beneath; with three small tubercles on each side, one median, one near the anterior angle, the third (smaller and more dorsally placed) between these two. (In a second specimen the anterior tubercles are less well developed.) Scutellum transverse. Elytra thickly and very strongly punctured; with some small pale ochreous spots, of which two, more regular than the rest, are placed obliquely on each elytron a little in front of the middle, the others behind the middle; apices truncate, with the outer angles very slightly and obtusely produced. Anterior femora rugose in front and armed each with a small tooth at about three fourths of its length.

The two specimens which serve as types are evidently males.

Note.—A second species from the Solomon Islands agrees so well with Blanchard's figure and description that I have little hesitation in regarding it as the *quadrinotata* of that author. In this species, as in the one just described, the claws of the tarsi are decidedly *divergent*, in each the prosternal process is almost contiguous with the mesosternum, and the latter is in each hollowed out in front; the lower margin of this hollow is in *quadrinotata* triangularly concave in front, in *punctata* square or almost convex in front. It will appear from these remarks that Lacordaire's description of the genus (Gen. Col. ix. 2, p. 475), in which he mentions "leurs crochets des tarses divariqués" and their "saillie mésosternale lamelliforme, recourbée en arrière, déclive et obtusement tuberculeuse en avant, non contiguë à la saillie prosternale," is quite inapplicable, and was probably taken from his own species only. For this species (*simplex*, Lacord., *op. cit.*) I propose to substitute the generic name *Sormida*, with characters as given by Lacordaire for the genus *Heteroclytomorpha.*

Trigonoptera Woodfordi, n. sp.

Nigra, subnitida, maculis ovalibus vel oblongis pallide griseis ornata; prothorace lateribus vitta pallide grisea, disco quatuor maculis; elytris ad basin sat dense punctatis, maculis numerosis pallide griseis, apicibus truncatis, angulo externo mucronato; antennis nigris.

Long. 15 mm., lat. 6 mm.

Hab. Fauro Island, Solomon Islands.

Black, subnitid, with oval and linear spots of a pale grey colour. Head with the carinæ of the vertex distinct enough, and with a pale grey interrupted line in the channel between them. Clypeus, labrum, base of mandibles, cheeks, and round the eyes also pale grey. Prothorax punctured above, with a pale grey vitta on each side and four spots of the same colour on the disk; the two posterior spots are at the base, are short, and lie close together. Scutellum nearly semicircular, slightly grey behind. Elytra thickly enough punctured on the basal half, and each with about twelve very distinct pale grey spots, arranged as follows:—four at the base somewhat indistinctly united to each other; two, of which one appears nearly double, beneath the shoulder; three oval spots at the middle, and, with the corresponding three of the other elytron, forming an irregular hexagon; then follow an elongated spot, and, at the apex, two linear spots, one near the suture and one near the margin, which unite posteriorly. The outer angles of the apices mucronate. The legs, underside of the body, except in the middle, and basal joints of the antennæ covered with a slight greyish pile.

By the colour and disposition of its spots, and by the deep blackness of the parts between, this species may be distinguished from the other species of the genus.

XXV.—*On some Species of* Cetoniidæ *from the Loo Choo Islands.* By Oliver E. Janson, F.E.S.

In the Ann. & Mag. Nat. Hist. for March 1887 Mr. George Lewis has given a revision and list of the Cetoniidæ of Japan; but at that time very little was known of the insects of the Loo Choo Islands, and no species is recorded by Mr. Lewis from this locality. Recently my friend Mr. H. Pryer visited these islands and made a small collection, and judging by the Coleoptera received from him it would appear that the insect-fauna is very closely related to that of Japan. Three species of Cetoniidæ have been sent to me by Mr. Pryer; of these the two species of *Cetonia* are apparently undescribed, they bear a marked resemblance one to the other in colour and general aspect, but are not closely allied.

1. *Glycyphana forticula*, Jans.

Glycyphana forticula, Janson, Cist. Ent. ii. p. 608 (1881).

I described this species from a single specimen received from Japan without indication of the precise locality; but it probably came from the island of Kiuskiu. Mr. Pryer has sent a second specimen from the Loo Choo Islands which differs from the type in its rather smaller size and in the absence of the small white discal spots on the thorax and elytra and the four spots on the pygidium.

2. *Cetonia Lewisi*, n. sp.

Viridis, nitida, tibiis tarsisque æneis vel cupreis; elytris postice sparsim albo-maculatis; clypeo elongato, lateribus elevatis, apice anguste reflexo, sinuato; thorace margine postico ante scutellum fortiter emarginato; scutello lato, apice rotundato; processu mesosterni producto valde dilatato.

Long. 26–30 mm.

Var. elytris immaculatis.

Shining green, slightly golden, tibiæ and tarsi brassy or coppery, elytra in some specimens with sparse white spots behind. Head rather coarsely punctured, slightly longitudinally convex, the clypeus elevated at the sides, the apex narrowly reflexed and slightly emarginate. Thorax very finely and sparsely punctured on the disk, the sides more coarsely punctured, slightly impressed on each side behind, the base produced and deeply emarginate before the scutellum, the lateral angles rounded. Scutellum finely punctured at the base, broad and rounded at the apex. Elytra very sparsely punctured on the disk before the middle, behind the middle and the sides with irregular rows of semicircular punctures, which become closer and more confused towards the apex. Pygidium coarsely and sparsely punctured, strongly convex towards the apex, a small deep fovea near the lateral angles. Beneath coarsely strigose at the sides, the abdomen coarsely punctured at the sides and apex; mesosternal process large, strongly dilated, and rounded in front. Legs coarsely punctured and strigose; femora and tibiæ fringed with pale golden-brown hairs, outer apical spur of the posterior tibiæ distinctly bisinuate. The female is larger than the male, more strongly punctured, with the pygidium less convex and broadly impressed on each side; the legs are stouter and the spurs of the posterior tibiæ are broader and scarcely sinuate.

Loo Choo Islands (*H. Pryer*).

This fine species differs from *C. Confuciusana*, Thoms., in having a more elongate clypeus, with the lateral margins strongly elevated and the apex more narrowly reflexed, the thorax more deeply emarginate at the base, the scutellum broader at the apex, the pygidium with a fovea at the sides, the punctuation of the upperside more sparse, the mesosternal process much more produced and dilated, and the spurs of the posterior tibiæ distinctly bisinuate.

3. *Cetonia Pryeri*, n. sp.

Viridi-ænea, nitida, tibiis tarsisque æneis vel cupreis; clypeo lateribus valde elevatis, apice reflexo, emarginato; thorace angusto, margine postico ante scutellum leviter emarginato; scutello apice obtuso; processu mesosterni dilatato, antice rotundato.

Long. 23–26 mm.

Shining brassy green, tibiæ and tarsi brassy or coppery; some specimens with minute white spots near the outer margin and suture of the elytra, on the pygidium, and at the sides of the abdomen. Head coarsely punctured; clypeus convex in the centre, the sides thickened and strongly raised, the apex broadly reflexed and emarginate. Thorax much narrower than the elytra at the base, a little produced behind, and slightly emarginate before the scutellum, coarsely punctured at the sides, more finely punctured on the disk, the median line impunctate except at the apex, a slight impression on each side at the base. Scutellum narrowed and obtuse at the apex, a few punctures at the base. Elytra coarsely punctured on the disk before the middle, behind the middle and at the sides with irregular semicircular punctures, which become confluent towards the apex; a rather strong, smooth, discal costa from the middle to the apical callosity; slightly impressed at the apex of the scutellum and within the humeral prominence. Pygidium short and broad, slightly convex, with coarse confluent punctures and sparse pubescence; a large fovea on each side near the apex. Beneath very coarsely punctured at the sides; mesosternal process dilated and rounded in front. Legs punctured and sparsely pubescent.

Loo Choo Islands (*H. Pryer*).

Compared with *C. Lewisi* this species has the thorax narrower at the base and less deeply emarginate before the scutellum, the scutellum much more narrowed at the apex, the pygidium less convex, and the mesosternal process much smaller; it appears to be allied to the European *C. angustata*, Germ. All the specimens taken by Mr. Pryer are males, and there are also examples from the same locality in the collections of Mr. G. Lewis and the British Museum.

XXVI.—*An Account of three Series of Lepidoptera collected in North-west India by Major Yerbury.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 151.]

Papilionidæ.

PIERINÆ.

64. *Colias Fieldii.*

Colias Fieldii, Ménétriés, Cat. Mus. Petrop. Lep. i. p. 79, pl. i. fig. 5 (1855).

♂. Thundiani, 15th August, 1886.

This is considerably larger and deeper-coloured than *C. edusina*; the latter is, however, perhaps nothing more than the prevalent western type of the same species.

65. *Colias edusina.*

Colias edusina, Felder, Wien. ent. Mon. iv. p. 100. n. 55 (1860).

♂. Murree, 2nd August, 1885; ♂ ♀. Thundiani, 13th, 15th, 17th, and 25th August, 1886.

"Common at Campbellpore and Murree; very common on Thundiani."—*J. W. Y.*

66. *Colias sareptensis.*

Colias hyale, var. *sareptensis*, Staudinger, Cat. Lep. eur. Faun. p. 5. n. 48 (1871).

♂. Campbellpore, 3rd and 20th April; ♀. 2nd June; Hassan Abdal, 9th May; ♂. Abbottabad, 1st October, 1886.

67. *Colias erate.*

Colias erate, var. ♀, *pallida*, Staudinger, Cat. Lep. eur. Faun. p. 3. n. 54 (1871).

♂ ♀. Hassan Abdal, 9th April; ♂. Campbellpore, 20th April; ♂ ♀. Thundiani, 15th and 17th August; ♀. Nandar, 25th September, 1886.

Typical *C. erate* was not sent with the present series, its place being evidently almost entirely occupied by the hybrid form *C. pallida*. Major Yerbury says:—"All these pale forms of clouded yellows are common at Campbellpore, Hassan Abdal, and Murree, but uncommon on Thundiani."

68. *Terias fimbriata.*

Terias fimbriata, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 323. n. 16 (1867).

♂. Abbottabad, 13th October, 1886.

69. *Terias irregularis.*

Terias irregularis, Moore, Proc. Zool. Soc. 1882, p. 253.

♂. Campbellpore, 24th October, 1886.

70. *Terias anemone*, var.

Terias anemone, Felder, Wien. ent. Monatschr. vi. p. 23. n. 7 (1862).

♂ ♀. Hassan Abdal, 9th May; ♂. Khairabad, 23rd May and 6th June; Abbottabad, 1st October, 1886.

Slightly smaller than Japanese examples and usually rather paler; but amongst specimens recently received from Major Yerbury there is a male (taken at Khairabad on the 28th October, 1886) which is quite as large as those from Japan; the early examples (*i. e.* those taken in May and June) are all more or less worn and faded, with the exception of a single male from Major Yerbury's private collection obtained at Hassan Abdal on the 27th June.

71. *Terias suava.*

Terias suava, Boisduval, Sp. Gén. Lép. i. p. 670. n. 28 (1836).

♂. Campbellpore, 8th May; Abbottabad, 1st October, 1886.

Amongst specimens of *Terias* recently presented to the Museum is a small male of *T. silhetana*, Wallace, taken by Major Yerbury at Noor Poor Shahan, near Rawul Pindi, on the 10th April, 1887.

72. *Terias purreea.*

Terias purreea, Moore, Proc. Zool. Soc. 1882, p. 252.

♂. Akhor, 22nd April; Hassan Abdal, 9th May; ♂ ♀. Khairabad, 23rd May; ♂. 6th June; Campbellpore, 30th May and 21st October; ♀. Thundiani, 12th September; Hurripur, 14th October, 1886.

The female obtained at Campbellpore in October was taken *in coitû* with a typical male *T. hecabe*, another proof of the readiness with which distinct species of the *Colias* group of genera will pair together. Both sexes of *T. purreea* can be distinguished easily from the corresponding sexes of *T. hecabe*, and until some reliable lepidopterist can settle down to carefully rear each species of *Terias* from eggs which he has seen deposited upon plants strictly confined in such a way as to prevent all intrusion of other species, I shall continue to believe in the possible constancy of the various forms. As regards Mr. Pryer's experiments in Japan, he has himself proved their untrustworthiness by recording his belief that he has reared *T. læta* (an Indian species) from eggs laid by *T. betheseba*, and, still further, that one of the pupæ from the same batch of eggs produced the almost generically distinct *T. hecabe*, which individual of the batch he says he is "led to believe is a hybrid." What Mr. Pryer means by expressing his faith in anything so utterly impossible I leave him to explain; meanwhile I candidly confess my inability to rely upon his experiments.

73. *Terias fraterna.*

♂. *Terias fraterna*, Moore, Journ. Linn. Soc., Zool. 1886, p. 46, pl. iv. fig. 6.

♀. Hassan Abdal, 14th October, 1885.

It seems probable that this insect, which is intermediate between *T. purreea* and *T. hecabe*, is a hybrid between the two species.

74. *Terias hecabe.*

Papilio hecabe, Linnæus, Mus. Lud. Ulr. p. 249 (1764).

♂. Hassan Abdal, 22nd July; ♂ ♀. Thundiani, 12th and

16th September; ♂. Nandar, 25th September; Campbellpore, 21st October, 1886.

75. *Terias hecabeoides.*

Terias hecabeoides, Ménétriés, Cat. Mus. Petrop. Lep. i. p. 85, pl. ii. fig. 2 (1855).

♂. Nandar, 25th September, 1886.

76. *Terias læta.*

Terias læta, Boisduval, Sp. Gén. Lép. i. p. 674. n. 36 (1836).

♀. Nandar, 25th September, 1886.

77. *Gonepteryx rhamni.*

Papilio rhamni, Linnæus, Faun. Suec. p. 272. n. 1042 (1761).

♀. Campbellpore, 20th March; ♂. Khairabad, 11th April, 1886.

From specimens since received from Major Yerbury it is evident that two males were obtained at Campbellpore on the 3rd March and three at Khairabad on the 11th April. It may readily be distinguished from the more abundant Indian form *G. nipalensis* by its much more uniform (yellower) colour below; in *G. nipalensis* the costal border and apex of primaries and the whole of secondaries on the under surface are considerably whiter than in *G. rhamni*; the margin of the wings is also more scalloped.

78. *Gonepteryx nipalensis.*

Gonepteryx nipalensis, Doubleday, Gen. Diurn. Lep. p. 71. n. 9 (1847).

♂. Akhor, 22nd April; Futch Khan's bungalow, Kooteer, Chittar Pahar, 23rd April; Hassan Abdal, 9th May; ♀. Thundiani, 11th August, 1886.

Of the two preceding species Major Yerbury says:—"Common round Campbellpore in the spring; also in the Chach plain on the banks of the Indus, at Murree, and Thundiani."

79. *Gonepteryx zaneka.*

Gonepteryx zaneka, Moore, Proc. Zool. Soc. 1865, p. 493. n. 35, pl. xxxi. fig. 18.

♂ ♀. Thundiani, 13th August; ♂. 17th, 20th, and 21st August, 1886.

"Common on Thundiani in August and September 1886."—*J. W. Y.*

The female of this species seems to be comparatively rare; of a dozen examples recently brought home by Major Yerbury in papers the whole are males.

80. *Teracolus protractus.*

Teracolus protractus, Butler, Proc. Zool. Soc. 1876, p. 137. n. 37.

♀. Campbellpore, 29th June; ♂ ♀. 12th July, 1886.

Two males and one of the females have the third black spot of primaries expanded so as to reach the inner margin; the under surface of the males is yellow, but that of the females varies from clear yellow to pinkish yellow, approaching flesh-pink.

"Common at Campbellpore, beginning of July 1886."—*J. W. Y.*

There can be little doubt but that the form of this species occurring at Campbellpore will prove to be fairly constant in the slight differential characters which distinguish it from the type; it is, however, extremely doubtful whether it can be separated, inasmuch as we have a female from Kutch with the typical small black spots and deep flesh-pink secondaries on the under surface, males from the same locality being yellow below.

81. *Teracolus puellaris.*

Teracolus puellaris, Butler, Proc. Zool. Soc. 1876, p. 136. n. 33.

♀. Chittar Pahar, Lumbahdun, November 1885; ♂ ♀. Campbellpore, 29th June, 17th July, 1886.

In Major Yerbury's private collection I found one or two females of *Teracolus ochreipennis* taken at Campbellpore on the 29th June. Major Yerbury says it was fairly common for two days, 29th and 30th, and then disappeared.

82. *Teracolus purus.*

Teracolus purus, Butler, Proc. Zool. Soc. 1876, p. 160. n. 113, pl. vii. figs. 14, 15 (1876).

♂. Campbellpore, 13th, 17th, and 25th July; ♀. Hassan Abdal, 18th July, 1886.

It will be seen that this species was obtained at the same time in 1886 as in 1885. Major Yerbury, in his notes, expresses a belief that *T. bimbura*, *farrinus*, *purus*, and a fourth form unidentified by Mr. De Nicéville are all varieties of *T. etrida*. He says:—"All these forms of *Teracolus* are common round Campbellpore. There are two broods, spring and autumn. I obtained specimens also at Hassan Abdal, Khairabad, and near Barracoo on the Murree and Pindee road." The dates of capture seem to me to point to an opposite conclusion, since *T. bimbura* and *T. farrinus*, the two forms least alike, were collected in October and November only by Major Yerbury. I have already shown that *T. farrinus* cannot, however, be the autumnal form of *T. purus*, as Col. Swinhoe obtained specimens at Kurrachee in July, whereas he caught *T. purus* in May and June. On the other hand, the range of *T. bimbura* (which might otherwise be supposed to be the late brood of *T. purus*) appears not to be the same as that of the latter species.

83. *Ixias pygmæa.*

Ixias pygmæa, Moore, Proc. Zool. Soc. 1882, p. 254, pl. xii. fig. 1.

♀. Campbellpore, 21st October, 1886.

"Fairly common round Campbellpore and Khairabad in October and November; very common at Kala Dilli in the Chittar Pahar in November."—*J. W. Y.*

I have examined twenty-two examples recently brought home by Major Yerbury in addition to five previously received; the males vary only in size, the females only in occasionally having the oblique band on the apical area tinted with orange; practically, therefore, the common *Ixias* of Campbellpore and the neighbourhood, in spite of its near relationship to *I. moulmeinensis* of Burmah and many other fixed local types, perfectly holds its own as a constant form and therefore a species. Once begin to associate these local types and the whole genus runs together, as may be seen by arranging them as follows:—1. *I. Reinwardtii*, of Lombock; 2. *I.*, sp.?, of Bali; 3. *I. venilia*, of Java; 4. *I. insignis*, of Formosa; 5. *I. balice*, of Java; 6. *I. venatrix*, of Moulmein; 7. *I. kausala*, of Depalpur &c.; 8. *I.*, sp.?, Himalayas; 9. *I.*, sp.?, Bhotan; 10. *I.*, sp.?, Elephant Island, W. Bombay; 11. *I. moulmeinensis*, of Burmah; 12. *I. pygmæa*, of Campbellpore and Kangra Valley; 13. *I. pyrene*, of the N.E. Himalayas to China; 14. *I.*, sp.?, of Darjiling; 15. *I. sesia*, of Mussowrah, Bengal; 16. *I.*, sp.?, of Silhet to Bhotan; 17. *I.*, sp.?, of Darjiling to Bhotan; 18. *I. dharmsalæ*, of Dharmsala; 19. *I.*, sp.?, of N.W. Provinces and "Afghanistan" (probably incorrect locality); 20. *I. frequens*, of Barrackpore &c.; 21. *I. cingalensis*, of Ceylon; 22. *I. Wattii*, of Bengal; 23. *I. undatus*, of Borneo; 24. *I. evippe*, of Eastern India, from Darjiling to China; 25. *I. latifasciatus*, of Moulmein; 26. *I. anexibia*, of China *; 27. *I.*, sp.?, of

* This species is, however, unknown to me, and may be only one of the three following, badly figured by Cramer.

Salanga; 28. *I. pallida*, of Upper Tenasserim; 29. *I. citrina*, of Upper Tenasserim; 30. *I. andamana*, of the Andamans; 31. *I.*, sp.?, of the Thoungyeen Valley, Tenasserim; 32. *I. mariannæ*, of the N.W. Himalayas, Bombay, Ceylon, &c.; 33. *I. meridionalis*, of Poona and Bombay; 34. *I. agniverna*, of Poona and Bombay; 35. *I. depalpura*, of Depalpur, &c.

Probably no collections but our own and Mr. Moore's are sufficiently rich in the various closely-allied types of *Ixias* to show the perfect gradation which exists in the above series, and, consequently, to many lepidopterists the differences upon which some of them are separated must appear to be trivial in the extreme; nevertheless, I am convinced, after examining the numerous collections which have come to hand during the last twenty-three years, that most of the above are strictly constant to locality, and that only such species as have a wide geographical range (as *I. evippe*) show any tendency to *variability* (*i. e.* individual inconstancy), and even then that there is never any difficulty in deciding to which *Ixias* the aberrant specimen belongs.

In a case like the foregoing, and it is not a solitary one by any means amongst the Lepidoptera, only two courses are open to the systematist: he must either say that the genus consists of one species exhibiting local modifications, the degrees of which are trivial, but the sum of which, comparing the first and last, is prodigious, or he must separate all the forms as species, no matter whether their modification has been due to isolation on islands, by mountain ranges, by rivers, or limitation of food-plant.

84. *Catopsilia jugurthina.*

Colias jugurthina, Godart, Enc. Méth. ix. p. 96. n. 21 (1819).

♂. Hassan Abdal, 27th June; Chuttar, between Tret and Barracoo, Murree road, 9th October; ♀. Hurripur, 14th October, 1886.

This is one of the forms of the *C. crocale* group, of which at present we know too little to be certain whether it is constant or otherwise; it is certainly the commonest of the Indian forms, and its range is enormous, extending along the base of the Himalayas and down the east of India to the Malayan Islands, certainly as far as Waigiou, with scarcely any alteration of pattern. The locality of *C. crocale* is said to be "East Indies;" in the Museum collection we have it (I speak of the typical form) from Ceylon and Malacca only. In my opinion it is highly probable that the latter is an aberrant development of the same species, tending to resemble the

Celebesian *C. flava*; for both *C. jugurthina* and *C. crocale*, together with a third yellower form, occur in Ceylon.

When I wrote my monograph of the genus there was no difficulty; all the forms of the *C. crocale* type were associated as one variable species, and *C. catilla* stood next as a well-marked second species. Since then intermediate forms, apparently constant, have turned up between *C. crocale* and *C. catilla*, whilst collections have come to hand containing only one or two of the supposed "varieties" in considerable numbers, showing that in certain localities these types are either constant or prevalent; thus assurance has turned to uncertainty, and it has become necessary to specify the form received when giving an account of a collection—another evidence of the truism "the more we know the less we know."

85. *Catopsilia gnoma.*

Papilio gnoma, Fabricius, Syst. Ent., App. p. 808 (1775).

♀. Campbellpore, 1st August, 1886.

"A few at Campbellpore, 22nd and 24th July, 1886."—*J. W. Y.*

86. *Catopsilia minna.*

Papilio minna, Herbst, Naturs. Schmett. v. pl. lxxxix. figs. 1, 2 (1792).

♂ ♀. Campbellpore, 12th July; ♂. 14th and 16th July, 1886.

C. pyranthe, with which this was identified, was formerly associated with it; that insect is, however, a narrower bordered species, with slighter markings also on the female primaries: both forms appear to be constant.

87. *Belenois auriginea.*

Belenois auriginea, Butler, Proc. Zool. Soc. 1886, p. 374. n. 74.

♀. Campbellpore, 16th May, 1886.

"Common round Campbellpore in the spring."—*J. W. Y.*

According to De Nicéville this is the spring brood of *B. lordaca* (identified by him as *B. mesentina*); that this is incorrect is evident from the fact that Col. Swinhoe took the supposed autumn brood at Quetta in March and May, and that its African representative, which I regard as the same species, was taken in Somali-land in January and at Haithalkim in April; we also have one male taken by Major Yerbury at Campbellpore in June. It is an interesting fact that the bulk of the supposed seasonal forms are incapable of being tested by dates, that "dry- and wet-season forms" so called are always coming to hand with the same date of capture on their envelopes; but what is most singular is that the publication of facts to this effect does not hinder the repetition of these errors in the writings of those who first promulgated them.

Turning to Major Yerbury's private collection, the first specimen I took up was a dark male (*B. auriginea*) which should have been taken in the spring; but on looking at the label I found it marked "Rawul Pindee, 21st November." I next turned up a pale female (*B. lordaca*), and found it labelled "Campbellpore, 21st May, 85." This remarkable evidence led me to examine seven other specimens recently brought home by Major Yerbury, with the following result:—

Supposed Spring Brood.	*Supposed Autumn Brood.*
♂. Rawul Pindee, 25th November.	♂. Thundiani, 5th May.
♀. " " 5th December.	♂. Campbellpore, 31st October.
	♂ & ♀. Rawul Pindee, 25th November.

88. *Synchloe daplidice.*

Papilio daplidice, Linnæus, Syst. Nat. i. 2, p. 760. n. 77 (1767).

♀. Hassan Abdal, 9th May, 1886.

"Common in the neighbourhood of Campbellpore in May and June, and at Hassan Abdal in May."—*J. W. Y.*

Amongst the Lepidoptera brought home this year are ten examples of *Pontia soracta* taken by Major Yerbury at Thundiani on the 3rd, 4th, and 5th of May and at Kala Pani on the 6th.

89. *Ganoris ajaca.*

Pieris ajaca, Moore, Proc. Zool. Soc. 1865, p. 490. n. 21, pl. xxxi. fig. 16.

♂ ♀. Thundiani, 11th, 13th, and 14th August, 1886.

"Common at Murree and Thundiani in August."—*J. W. Y.*

90. *Ganoris gliciria.*

Papilio gliciria, Cramer, Pap. Exot. ii. pl. clxxi. figs. E, F (1779).

♀. Attock Bridge, Khairabad side, 4th April; ♂ ♀. Hassan Abdal, 9th May; ♀. Thundiani, 14th August, 1886.

91. *Ganoris nipalensis.*

Pieris brassicæ, var. *nipalensis*, Gray, Lep. Ins. Nepal, pl. vi. figs. 1 and 3 (1846).

♀. Thundiani, 20th September, 1886.

92. *Euchloe lucilla.*

Euchloe lucilla, Butler, Proc. Zool. Soc. 1886, p. 376. n. 80, pl. xxxv. fig. 4.

Campbellpore, 18th and 27th March, 1st, 7th, 13th, and 14th April; Attock Bridge, Khairabad side, 4th April; Akhor, 22nd April, 1886.

Now that I have a long series of this species before me (that is to say thirteen in the present consignment, fourteen recently brought home, and nine in Major Yerbury's private collection), I am better able to point out the constant differences between it and the Algerian *E. charlonia*. It is invariably smaller, with comparatively shorter costal margin to primaries; the colour of the males is a slightly deeper yellow, frequently gamboge-yellow—the females being pale brimstone, only slightly yellower than some males of *E. penia* of Turkestan; the black spot at the end of the cell is larger and never replaced by a black lunule on the under surface; the outer border of primaries is never triangular, as in *E. charlonia*, but always forms a distinct angle internally on the lower radial vein; on the under surface the white-spotted rose-coloured margin to the primaries is far brighter and clearer, and the apical area of primaries and whole surface of secondaries are frequently, though not invariably in the female, paler and less black-speckled, or even yellow, faintly speckled with olive.

Papilioninæ.

93. *Papilio erithonius.*

Papilio erithonius, Cramer, Pap. Exot. iii. pl. ccxxxii. figs. A, B (1872).

Campbellpore, 20th April, 1886.

"Common at Campbellpore in October and November, 1885."—*J. W. Y.*

94. *Papilio asiaticus.*

Papilio machaon, var. *asiatica*, Ménétriés, Cat. Mus. Petrop. Lep. i. p. 70 (1855).

Futch Khan's bungalow, Kooteer, 26th April; Thundiani, 12th August, 1886.

95. *Papilio arcturus.*

Papilio arcturus, Westwood, Ann. Nat. Hist. ix. p. 37 (1842).

Thundiani, 17th August, 1886.

"Common at Murree and Thundiani in August 1885 and 1886."—*J. W. Y.*

Nevertheless Major Yerbury has only brought home one perfect and three or four mutilated examples; probably he was too generous to entomologists in India to leave many of so attractive a butterfly to add to our series *. In England *P. arcturus* is generally accounted rather a rare species.

96. *Papilio polyctor.*

Papilio polyctor, Boisduval, Sp. Gén. Lép. i. p. 205. n. 18 (1836).

Kala Pani, 1st September, 1886.

"Taken at Murree and Thundiani. In my opinion *P. arcturus* frequents the upper part of the hill, *P. polyctor* the lower slopes; one of these species, probably the latter, very common on the stream near the Dhobis ghat, Abbottabad."—*J. W. Y.*

In Major Yerbury's boxes I found one example of *Papilio cloanthus* taken at Murree on the 30th August, 1885; *P. philoxenus*, taken at Murree on the 5th August. Among the unset things I found *P. dissimilis*, from Noor Poor Shahan, Rawul Pindee, on the 10th April; *P. govindra*, taken on Thundiani, 4th May; and *P. pammon*, at Hurripur, on the 14th October, 1886.

Hesperiidæ.

97. *Hesperia ladon.*

Papilio ladon, Cramer, Pap. Exot. iii. pl. cclxxxiv. G (1782).

Thundiani, 23rd September, 1885.

Only one example was obtained; it was identified as "*Badamia exclamationis*," a nearly allied but apparently distinct butterfly, which will probably be stated to be a seasonal form of it.

98. *Hesperia alexis.*

Papilio alexis, Fabricius, Syst. Ent. p. 533. n. 387 (1775).

♂. Tret, 9th October, 1885.

99. *Parnara mangala.*

Hesperia mangala, Moore, Proc. Zool. Soc. 1865, p. 792.

Murree, 10th September, 1885; Thundiani, 17th and 20th August and 20th and 30th September, 1886.

This species has been identified for Major Yerbury as *Parnara bada*, from which it may easily be distinguished by its superior size, darker coloration, larger hyaline spots, particu-

* See, however, the note to *P. polyctor*, which leaves it doubtful which is the common species.

larly the lowest spot on the primaries, and the more regular arrangement of the spots on the secondaries. I have already pointed out most of these differences, but the name *bada* seems to be still employed for *P. mangala* in India.

100. *Chapra mathias.*

Hesperia mathias, Fabricius, Ent. Syst. Suppl. p. 433 (1798).

♀. Road between Abbottabad and Kala Pani, 9th August; Kala Pani, 20th August; Dhum tower, near Abbottabad, 30th September; ♂. Hurripur, 14th October, 1886.

One of the females enumerated above was labelled as *Parnara bada*, the other two as "*Parnara karsana*;" the male was also identified with the latter in spite of the very distinct oblique brand on the primaries, the dark olive coloration, and more numerous hyaline spots.

101. *Gegenes nostrodamus.*

Hesperia nostrodamus, Fabricius, Ent. Syst. iii. 1, p. 328. n. 246 (1793).

♂. Kala Pani, 30th August; Hurripur, 14th October, 1886.

102. *Gegenes karsana.*

Hesperia karsana, Moore, Proc. Zool. Soc. 1874, p. 576, pl. lxvii. fig. 6.

♂. Futch Khan's bungalow, Kooteer, Chittar Pahar, about 2000 feet, 23rd April, 1886.

103. *Pyrgus marrubii.*

Hesperia malvarum, var. *marrubii*, Herrich-Schäffer, Schmett. Eur. i. *Hesp.* figs. 14, 15 (1845).

Thundiani, 15th and 25th August, 1886.

Identified wrongly as *P. dravira*, and said by Major Yerbury to have been "fairly common on Thundiani, beginning of August 1886."

104. *Pyrgus zebra*, sp. n.

Nearest to *P. sataspes* of South Africa; above black-brown; a spot in the cell, a smaller spot obliquely below it; a subtriangular spot across the end of the cell, two smaller spots obliquely below it, and a dot outside, forming a triangle with the discocellular and second spot; three small spots placed transversely between the subcostal branches halfway between the cell and apex; a curved series of five or six crescentic dots near to outer margin, a marginal series of dots at base of fringe, and a series of larger spots on the fringe white: secondaries with a subtrigonate spot at the end of the cell, a smaller oblong spot between the latter and the abdominal margin on the first median interspace, four or five dots near outer margin, a marginal series of spots, and the fringe white; palpi, edges of collar, and tegulæ greyish. Costal border of primaries below white; five black marginal dashes from the middle, the last dash being short and apical; a whitish patch at base of cell, a second at about centre of interno-median area, and a third at apex; the ordinary white spots larger than above; the fringe whitish, barred with blackish: secondaries greyish brown; the base, an abbreviated, narrow, slightly zigzag, subbasal band, a broad, nearly regular band from costa to anal angle, and a narrow, slightly interrupted stripe from apex to anal fourth of outer margin white; apical three fourths of outer border grey; abdominal border white; fringe dull white, traversed by a greyish stripe: palpi, excepting the tips, basal half of antennæ below, pectus, and legs white; venter white, the sides blackish, with white edges to the segments. Expanse of wings 26 millim.

♀. Campbellpore, 13th April; ♂. Futch Khan's bungalow, Kooteer, Chittar Pahar, 2000 to 3000 feet, 23rd April, 1886.

The under surface of this very distinct species is quite unlike any other Indian *Pyrgus*, the secondaries being alternately regularly banded with brown and white; several of the specimens were labelled as "*P. evanidus*," but they are utterly distinct from that species, the hind wings of which on the under surface are olive-greenish, spotted and blotched with white. Four examples were sent to us in 1886, and in the unset series brought home by Major Yerbury I found eight more (all taken on the 23rd April). In the notes on the various species I find *P. zebra* again recorded as "*P. evanidus*, common at Campbellpore, May and June; very common on the Chittar Pahar, end of April, 1886."

105. *Taractrocera sagara.*

Pamphila sagara, Moore, Proc. Zool. Soc. 1865, p. 792.

Hassan Abdal, 22nd July, 1886.

"Fairly common at Hassan Abdal, 18th July, 1886; a single specimen taken below Kala Pani, *en route* to Abbottabad, on the 30th August, 1886."—*J. W. Y.*

106. *Antigonus Taylori.*

This name has been given by Mr. De Nicéville to a butterfly received by him from the Neilgherries; it is allied to *A.*

vasava and *A. potiphera*, is of the size, shape, and has the front-wing hyaline spots of the latter, but the secondaries are without hyaline spots, and the ground-colour is of a pale cupreous or sericeous clay-colour; the spots of the primaries are black-edged and partly connected by three or four dusky, lunulated, macular stripes, which, however, are better defined on the secondaries; the body is rather dusky in colouring; below the wings are paler, the basal area of primaries and abdominal border of secondaries being whitish and the stripes on the latter wings represented by well-defined blackish spots or dashes. Expanse of wings 35 millim.

Futch Khan's bungalow, Kooteer, Chittar Pahar, probably 3000 feet, 24th April, 1886.

Labelled "*Hesperia*, sp., new." As specimens from the Neilgherries stand in Mr. Moore's collection labelled "*A. Taylori*, De N.," I presume that the species has been described; but after looking through the 'Zoological Records' for the last five or six years and the 'Journal of the Asiatic Society' for 1886 I have failed to find it; perhaps it has been referred to another genus, and therefore I have overlooked it, or possibly it is a MS. name.

Three more or less worn examples were sent home by Major Yerbury, and in the series brought home were two others from the same locality and two taken at Noor Poor Shahan, near Rawul Pindee, on the 10th April.

107. *Plesioneura leucocera.*

Hesperia leucocera, Kollar, in Hügel's Kaschmir, iv. 2, p. 454, pl. xviii. figs. 3, 4 (1848).

Kala Pani, 29th August, 1886.

An account of the moths of these collections will be given in a subsequent paper.

XXVII.—*New Species of Butterflies collected by Mr. C. M. Woodford in the Solomon Islands.* By F. D. Godman and O. Salvin.

Since the descriptions published in the last number of the 'Annals' (*anteà*, pp. 90–101) were prepared Mr. Woodford has returned to England, bringing with him another large collection of butterflies chiefly collected on the island of

Guadalcanar. Many of those previously obtained are contained in this collection; but we find the following species require names.

Danais garamantis, sp. n.

♂. Alis anticis elongatis, margine externo leviter concavo, posticarum margine externo fere angulato, dimidio angulo anali proximo fere recto. Alis fuliginoso-nigris; anticis plaga magna discali venis quinque-partita (una parte in cellula inclusa), plaga altera tripartita subapicali, maculis tribus costalibus et sex submarginalibus semihyalinis; posticis plaga mediana venis bene sexpartita et maculis quinque submarginalibus semihyalinis: subtus fere ut supra, posticis macula basali, altera ad medium costæ et serie duplici submarginali albis. Exp. 3·5 poll. Angl.

♀ mari similis, anticis magis abbreviatis et posticarum margine externo magis rotundato vix angulato.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

A distinct species apparently allied to *D. Schenki*, a common insect throughout the Solomon Islands. Like *D. Schenki* the secondaries are without a sexual brand; but in *D. garamantis* the hyaline spots are of less extent and have no yellow tint whatever.

Mr. Woodford's collection contains a few specimens of both sexes, all taken on Guadalcanar.

Acræa pollonia, sp. n.

A. moluccanæ affinis, sed alis anticis fere unicoloribus medialiter haud semihyalinis; posticis plaga pallide sulphurea fascia fusca bipartita, parte costali quoque venis quadripartita: subtus maculis anticarum submarginalibus vix obviis, margine externo posticarum multo angustiore facile distinguenda. Exp. 3·75.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

A modified but distinct form of *A. moluccana* of Ceram and Amboina.

Charaxes epigenes, sp. n.

♂. Alis nigro-brunneis; anticis maculis quinque parvis ultra cellulam et septem submarginalibus flavidis notatis; posticis unicoloribus, lunulis septem submarginalibus cæruleis exceptis: subtus alis rufo-brunneis, parte apicali et margine externo pallidiore fuscis, maculis paginæ superioris albis et iis ultra cellulam introrsum nigro marginatis, linea nigra ad cellulæ finem lineolis duabus trans cellulam albis exteriore extrorsum interiore introrsum nigro marginatis; posticis lineis duabus albis transvittatis, una per cellulam nigro extrorsum limbata, altera ultra eam introrsum nigro marginata, maculis sex saturate rufis discalibus introrsum lunulis lilacinis cinctis et omnino nigro circumdatis, maculis submarginalibus albido introrsum limbatis notatis, vena mediana et ramo suo primo elongatis. Exp. 3·35.

♀ mari similis quoad maculas alarum paginæ superioris, sed fascia communi lata a ramo mediano secundo anticarum usque ad marginem posticarum internum ducta lactescenti-alba, in his sordide cyaneo vix tincta: subtus alis multo pallidioribus, maculis omnibus majoribus et magis distinctis.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

Mr. Woodford's collection contains a male and several females of this distinct species, which has no near ally that we know of.

Mynes hercyna, sp. n.

M. Woodfordi forsan proxima, sed anticis ad basin multo magis nigricantibus differt, cellula, macula triangulari ultra eam et tribus ovalibus inter ramos medianos tantum lactescenti-albis, area infra cellulam usque ad marginem internum omnino nigricante, maculis indistinctis subapicalibus ejusdem coloris.

♀ alis omnino nigricantibus, maculis omnibus maris minoribus et valde indistinctis.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

Several specimens, all agreeing with one another and differing in the points mentioned from *M. Woodfordi* of Alu Island in Bougainville Straits.

Libythea orientalis, sp. n.

L. batchianæ quoad formam alarum posticarum, angulo anali haud producto; anticis fere unicoloribus lilacino-cæruleis, costa et margine externo anguste et venis angustissime fuscis distinguenda.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

A species of the *L. Geoffroyi* section of the genus, and doubtless closely allied to *L. batchiana*, *L. antipoda*, &c. The rounded anal angle of the secondaries distinguishes it from the latter insect.

Papilio isander, sp. n.

Alis nigris; anticis fascia arcuata ab apice ad marginem internum extensa cyanea, parte distali maculosa, parte proxima integra, macula costali ad apicem ejusdem coloris aliisque lunulatis submarginalibus; posticis fascia anticarum producta fere ad marginem internum, parte costali albida, lunulis submarginalibus sex cyaneis notatis: subtus fere ut supra, sed alis pallidioribus fasciis et maculis glaucescentibus; posticis linea abbreviata ad basin aliisque discalibus utrinque nigro late marginatis coccineis. Exp. 3·8.

♀ mari similis, sed paulo major.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

An ally of *P. sarpedon* as to the colour of its wing-markings, but instead of having a single blue band on the primaries broken into spots in a regular curve towards the apex, the spot below the subcostal nervure is slightly out of line, and above it is another spot close to the costa; moreover there is a series of lunate spots parallel to the outer margin, as in *P. eurypylus.*

P. sarpedon, in various modified forms, occurs over a large area, including India, Borneo &c., the Moluccas, and New Guinea, and under the name of *P. choredon* occurs in Australia and New Ireland. It is therefore of considerable interest to find so distinct a form in the Solomon Islands.

Papilio Mendana, sp. n.

Alis anticis productis, fere falcatis, margine externo leviter concavo; posticis caudatis, vena mediana producta et lobum ferente: nigerrimis, fascia mediana longitudinali macularum decem composita cyanea, ea marginem internum attingente maxima, macula altera costali ad apicem aliisque sex submarginalibus ejusdem coloris; posticis maculis tribus elongatis quoque cyaneis, una fere totam cellulam occupante, maculis parvis tribus supra eam albidis margine interno quoque albo: subtus brunneo-nigris; anticis maculis ut supra notatis, costa ad basin coccinea; posticis nigro nebulosis, macula infra venam costalem, altera ad angulum analem coccineis. Exp. 4·3.

♀ mari similis, sed major et maculis ad posticarum basin omnino albis distinguenda.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

A very interesting species, of which Mr. Woodford only secured a very few specimens. Its alliances are, so far as the coloration of the wings is concerned, with *P. sarpedon*, but in the shape of the secondaries it agrees better with *P. codrus* and its allies. It forms in fact a connecting-link between these two groups.

It seems right that so fine a species should bear the name of Mendana, the discoverer of the Solomon Islands, the details of whose adventurous journey have been recently published by Mr. Guppy in his ‘Solomon Islands and their Natives.’

Papilio solon, sp. n.

P. codro affinis, sed colore alarum paginæ superioris magis saturato sericeo-viridi, maculis anticarum læte cyaneo-viridibus; posticis ad basin albidis, parte distali nigro-viridi latiore et margine suo interiore magis distincto: subtus multo obscurioribus, anticis fasciis indistinctis transversis apud costam notatis. Exp. 6·0.
♀ mari similis, sed major, colore sericeo alarum absente.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

In the dark colouring of the underside this species resembles *P. pisidice* from Maleita Island, recently described by us (*anteà*, p. 100); but the colouring of the band of spots on the primaries is so different that we have no doubt as to its distinctness. Mr. Woodford's collection contains a number of specimens all agreeing with one another and differing from the type of *P. pisidice*. In the latter these spots are golden and not bluish green, as in *P. solon*.

We have little doubt that the specimen from Alu Island referred to in our former description will have to be referred to another species of this group, as it differs considerably from both *P. pisidice* and *P. solon*; but with only a female example before us we prefer to await the arrival of more specimens before describing it.

Papilio hecatæus, sp. n.

♂. Alis nigris; anticis fascia discali maculis octo composita a costa margine externo subparallela ad angulum analem extensa lactescenti-alba, maculis duabus venæ medianæ utrinque positis minimis et a margine magis distantibus; posticis parte costali cum fascia discali conjuncta usque ad marginem internum extensa lactescenti-alba, margine hujus fasciæ externo aliquot profunde dentato, ciliis inter venas albis: subtus nigris; anticis maculis quatuor transversis ad apicem albidis; posticis fascia indistincta discali atomis cæruleis composita, maculis submarginalibus rotundis rubro-aurantiis, ea ad angulum apicalem minima deinde ad angulum analem increscentibus. Exp. 6·1.

♀. Alis fusco-nigricantibus; anticis plaga cellulari maculisque septem discalibus sordide flavidis, tribus intra ramos medianos maximis ea supra venam medianam minima; posticis plaga magna mediana albida venis septem-partita, parte maxima dimidium cellulæ distalem occupante, maculis septem submarginalibus ochraceis, ciliis inter venas quoque ochraceis: subtus ut supra, maculis omnibus majoribus, posticis atomis variis cæruleis infra plagam medianam. Exp. 6·1.

Hab. Aola, Guadalcanar Island (*C. M. Woodford*).

Many specimens. This species is evidently allied to *P. Bridgii*, Math. (Proc. Zool. Soc. 1886, p. 349, pl. xxxiv. fig. 2), from Treasury Island and the islands of Bougainville Straits, whence we have many specimens. The male differs in having the band of submarginal spots on the primaries more broken, and there are four subapical spots on the underside hardly seen in the allied form. The female differs obviously by having the discal series of spots much more irregular, whereas in the female of *P. Bridgii* they are regular intervenal streaks. On the secondaries the submarginal row of spots are rounder, less lunate, and further from the margin.

We have a damaged female of this or an allied species from Florida Island; but without male examples we hesitate to decide as to its position.

Papilio laarchus, sp. n.

♀. Alis fuliginoso-nigris; anticis fascia obliqua ultra cellulam flavida venis quadripartita; posticis fascia lata transversa cellulæ finem transducta lactescenti-albida, margine suo interno fere recto externo profunde serrato: subtus anticis ut supra; posticis lunulis rufo-aurantiis submarginalibus notatis, atomis paucis cæruleis inter ramos medianos. Exp. 6·0.

♂ adhuc ignotus.

Hab. Rubiana Island (*C. M. Woodford*).

Though we have only a single damaged female specimen before us we can recognize its distinctness from that sex of *P. Woodfordi* of the islands of Bougainville Straits. The marks on the primaries are restricted to an oblique short band beyond the cell, and there are no submarginal spots or any near the anal angle. The band across the secondaries is much wider.

XXVIII.—*The Polyzoa of the St. Lawrence: a Study of Arctic Forms.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plates XIV. & XV.]

THE material on which the present Report is founded has been entrusted to me by Sir J. W. Dawson, F.R.S., of McGill College, Montreal, Mr. J. F. Whiteaves, of the Canadian Geological Survey, and the authorities of the Montreal Museum, who have placed in my hands for examination their collection of the Hydroida and Polyzoa of the St. Lawrence. Circumstances have hitherto prevented me from making much progress with the work, and I have to apologize for a delay which I did not anticipate and much regret. As it would only lead to further delay to defer publication until the whole of the material has been examined, I propose to commence at once with studies of new forms as they occur, and such as from any cause seem to require further illustration, reserving the complete systematic list of species and general conclusions for the close of the Report.

Subclass CHEILOSTOMATA.

Family **Bicellariidæ.**

CORYNOPORELLA, n. gen.

Generic character. Stems slender, consisting of cells disposed in single series and facing one way, dichotomously branched; zoœcia more or less clavate, each cell originating from the dorsal surface of the one beneath it, immediately below the summit, elongate, the inferior portion (from a little below the aperture) much attenuated, tubular; aperture at the top of the cell, occupying a small proportion of its length. Avicularia articulated, attached to the side of the aperture.

Corynoporella tenuis, n. sp. (Pl. XV. figs. 1.)

Zoarium minute, transparent; *stems* slender, bifurcating at intervals. *Zoœcia* subclavate, much elongated, slightly expanded towards the upper extremity which is rounded, the inferior portion very slender; aperture extending down rather less than a third of the length of the cell, occupying its entire width above, and tapering off to a rounded point below, margin thin and destitute of spines, upper wall wholly membranous; orifice arched above, straight below; on the margin at one side less than halfway down the cell a rather large articulated avicularium, the dorsal surface sloping abruptly upwards from the peduncle (which is short) and very protuberant, the top flattish, terminating in a long beak-like extremity, not abruptly bent; surface smooth, the whole structure (viewed laterally) somewhat wedge-shaped. Fibrils given off from the dorsal surface of the cell, a little below the summit towards one side. *Oœcium* (?).

Hab. Forming small tufts attached to other Polyzoa.

The cells of this species bear a strong general resemblance to those of the genus *Brettia*, but the articulated avicularium is a link connecting it with *Bugula*. Its place, I think, is in the Bicellarian series. At the same time it possesses characters which probably entitle it to generic rank. Too much importance must not be attached to the uniserial habit; but the small aperture, so unlike that of the true *Bugulæ*, and the tubular prolongation of the cell below are structural features of considerable moment. In the form and position of the avicularia this species agrees with *Bugula*. The genus *Bugulella*, instituted by Verrill for a species which he obtained on the coast of North America, seems, so far as we can judge in the absence of a figure and specimens, to be founded on a different type.

Family **Cellulariidæ**.

CELLULARIA, Pallas.

Cellularia Peachii, Busk. (Pl. XV. fig. 6.)

I have figured this well-known species from a St.-Lawrence specimen to show the cusp on the median cell at the bifurcation of the branches, which it shares with the Australian *C. cuspidata* of Busk. It is true that it is frequently absent (in *both* species I believe), but there is no doubt that it occurs in the North-European as well as the Australian species, and is not by any means a distinctive character *.

Family **Cribrilinidæ**, Hincks.

MEMBRANIPORELLA, Smitt (part.).

Membraniporella crassicosta, n. sp. (Pl. XIV. figs. 5.)

Zoœcia ovate, disposed (rather irregularly) in lines; front wall composed of a few (about six or seven) broad, flat, and rather massive ribs, usually more or less separated by considerable interspaces; no distinct sternum; orifice (secondary) suborbicular, enclosed by two stout rib-like processes which unite in front; oral spines wanting. *Avicularia* none. *Oœcium* (?).

Hab. Spreads in reddish-brown patches over various kinds of Polyzoa (*Escharoides Sarsii* &c.).

The species to which the present form makes the nearest

* See Busk's 'Challenger' Report, part 1, p. 17. Mr. Busk suggests the propriety of recurring to his original name, *Cellularia monotrypa*, in place of *C. cuspidata*, if the presence of the cuspidate point should prove to be also a character of *C. Peachii*.

approach is *Flustra Aragoi* of Audouin; but apart from other differences the latter is at once distinguishable by the peculiar structure of the oral extremity of the cell and the remarkable lobed appendage on each side of the orifice. It is difficult to meet with a perfectly formed cell of *M. crassicosta.* Amongst the St.-Lawrence dredgings it is far from uncommon, and I have had the opportunity of examining a good many specimens; but scarcely a cell has occurred in which the full complement of ribs was present. In a large proportion of cases only the oral ring and the first pair of the rib-like processes are developed, so that the colony presents a most unfinished appearance. The ribs are flat and massive and expanded at the base; their points meet in the centre and unite without much regularity, and there is consequently no straight median line of junction, as in the British *M. nitida.* In the early stages of development the cell is destitute of all covering but the membranous front wall, and is furnished with a plain thickened margin, on which no trace of the rib-like spines is yet visible. The first to appear are the two oral appendages, which originate on each side just below the top, and as they increase in length bend round towards the front and meet in the centre, forming the oral margin, on each side of which there commonly rises a mucronate projection. The first pair of ribs are developed immediately below the margin, to which they are generally closely united throughout a large portion of their length. A second pair originate lower down on each side, and pass diagonally towards the centre, where they unite with the others; and usually one or two ribs more pass upward from the lower margin towards the same point. This is the general plan, but there are many irregularities. The ribs are for the most part separated by rather large lacunæ, so that in this case the protective covering is an open framework and not a solid wall. The reddish-brown colour of the crust seems to be a constant character in fresh specimens.

Other species of this genus are *M. nitida* and *M. melolontha* (Brit.), *M. distans* (Austr.), *M. sceletos* (Madeira), *M. Agassizii* (Florida), *M. Aragoi* (? Medit. or Red Sea).

Family **Membraniporidæ.**

Membranipora, De Blainville.

Membranipora cymbiformis, Hincks. (Pl. XV. figs. 4)

Membranipora spinifera, Smitt, Krit. Förteckn. öfver Skandin. Hafs-Bryoz. pt. 3, pl. xx. fig. 32.

This form was first noticed by Smitt, but he referred it to

M. spinifera, from which it differs in many important particulars. Omitting the differences in the number and character of the spines and the disposition of the zoœcia (though these are sufficiently distinctive) the structure of the cell itself is quite dissimilar in the two forms. In the present species the zoœcium is short, massive, enclosed by comparatively high walls, and furnished with a solid calcareous floor (Pl. XV. fig. 4 *a*). The lower portion of the aperture is covered in by a calcareous lamina *. In these points it presents a contrast to that of *M. spinifera*. Another striking feature of *M. cymbiformis* is the tall pedicellate avicularium. There are commonly two of these appendages on a cell placed one on each side. At the top of the cell there are usually three tall spines.

This form was described as long ago as 1877 †, but no figure accompanied the description. It seemed desirable to supply one, as Smitt's figure, though strictly accurate as far as it goes, is on too small a scale and does not show some of the important characters.

M. cymbiformis seems to be abundant in the northern seas. In the St. Lawrence it occurs in small patches incrusting Hydroids and Polyzoa.

Range. Northern and Arctic seas (18–60 fath.). [Kara Sea, on *Sertularia* and Algæ (*Levinsen*); Jan Mayen, on *Alcyonidium* and Pycnogonidæ (*Lorenz*).]

Family **Escharidæ** (part.), Smitt.

ESCHAROIDES, Smitt (=*Escharopsis*, Verrill ‡).

Escharoides § *Sarsii*, Smitt. (Pl. XIV. figs. 1.)

Cellepora cervicornis, var., Sars, Reise Lofoten og Finmark. p. 28 (sep.).
Eschara rosacea, Sars, Beskr. N. Polyzoa, 1862, p. 3 (sep.).
Eschara Sarsii, Busk, Linn. Soc. Journ., Zool. xv.
Escharopsis lobata (Lamx.), Verrill, Proc. U. S. Nat. Mus.

This interesting form has been investigated by M. Sars

* This character was correctly given by Prof. Smitt, but escaped my notice, and was not included in my description.

† "Polyzoa from Greenland and Labrador," Ann. & Mag. Nat. Hist. for January 1877. The species credited in this paper (through a mistake) to Iceland were really obtained in Davis Straits.

‡ Bull. Nat. Mus. U. S. no. 15, p. 149 (1879). There seems to be hardly sufficient reason for superseding the name adopted by Smitt for this group from Milne-Edwards, and which has found its way into general use. It has been employed by Busk in his 'Challenger' Report.

§ Smitt, in one of his later papers (" Bryoz. of Novaja Semlja," 1878), has referred this species to his genus *Discopora*, a group which is comand Smitt, and it might almost seem superfluous to discuss it further. But Sars's account is unaccompanied by figures, and is so far unsatisfactory. Smitt has supplied this deficiency, and would have left little to be desired if his figures had been drawn on a larger scale. The difficulties of the Swedish language may probably prove a more serious obstacle to the student, and it may not therefore be useless to give a brief account of the development of the zoœcium.

It would be a waste of time to consider whether Lamouroux's *Eschara lobata* ('Exposition Méthodique') was founded on the present form. It may have been; but neither his description nor his figure affords the means of settling the question with certainty. It is only an adequate diagnosis or figure that gives to any name a claim to adoption, and it must be accounted an injury to science to burden its records with merely speculative identifications.

Prof. Verrill refers *Lepralia producta* of Packard to this species; but unless he had the opportunity of examining an authenticated specimen he would find it difficult, I think, to prove his point. Packard's description, even when supplemented by his figure, is quite inadequate.

The changes which the zoœcium passes through in this species are very striking, and show in a very forcible way the necessity of a careful study of the Polyzoan colony through all the phases of its growth.

The young marginal cell presents a smooth or slightly wrinkled surface, perforated round the edge.

The orifice is suborbicular, perfectly simple, and not elevated above the cell-wall (Pl. XIV. fig. 1 *a*). In this stage the cells are convex and the sutures well defined.

The first change consists in a slight sinuation of the lower margin of the orifice, which is accompanied by an elevation of the peristome. In the second row (from the margin of the colony) a rather deep and somewhat irregularly shaped sinus has been developed, bounded by two denticular processes (Pl. XIV. fig. 1 *b*), within which an avicularium has originated, the mandibular portion of which is placed obliquely along one side of the sinus, whilst the avicularian chamber (a pouch-like inflation of the surface) lies between it and the

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posed, as it seems to me, of somewhat heterogeneous elements. Verrill has dismembered it and retains the name *Discopora* for forms "having both median and lateral avicularia, with the former (or both) often raised on a prominence in front of the zoœcial aperture" (Proc. U. S. Nat. Mus.). These changes cannot be discussed here, but I see no reason for merging the genus *Escharoides* in any other group.

boundary of the cell. The pointed mandible of the avicularium is directed upwards. At the same time the elevation of the peristome has been proceeding, and a secondary orifice has been formed which differs widely from its predecessor. The subsequent changes, which produce a marked effect on the appearance of the species, are in great measure due to the progress of calcification. The new features which have been added are to a large extent obliterated by the rapid accretion of calcareous matter. The cells lose their convexity, the sutures all but disappear, the punctures become indistinct, the orifice on which the avicularium was developed is no longer on the surface, but deeply sunk beneath it, and at last the avicularium becomes undistinguishable. The adult orifice is rounded above and produced in front into a rather long pointed sinus (Pl. XIV. fig. 1). In the more advanced stages of growth a dull, minutely granulose, flattish crust covers the zoœcia. The structural elements to which most interest attaches are probably the sinus on the secondary orifice and the associated avicularium. Their development proceeds *pari passu*, and the shape of the sinus is more or less determined by the avicularium.

In this case the sinus seems to be simply a provision for the reception of the avicularium, and, indeed, it is probable that it is in large measure due to the growth of the avicularium along the edge of the secondary orifice. It has therefore a distinctive significance and is not comparable with the (apparently) similar structure amongst the Myriozoidæ. The development of *Escharoides rosacea*, Busk, runs parallel to that of the present species *, and its structural features are almost identical.

I think we may recognize in *Escharoides* the characters of a natural group.

E. Sarsii appears to be abundant in the St. Lawrence and generally in the northern and arctic seas. It forms large coral-like growths composed of many massive branching segments springing from a common base, foliated, contorted, expanding upwards, and terminating above in numerous smaller segments.

Range. Antarctic seas (*Sir J. Hooker*); Tromsö, 20–60 fath. (*Sars*); Spitzbergen, Greenland, Nova Zembla (*Smitt*); Jan Mayen (*Lorenz*); Kara Sea, 49–65 fath. (*Levinsen*).

* 'British Marine Polyzoa,' i. pp. 337, 338.

Porella, Gray.

Porella Skenei, Ellis & Sol., form *plana*, n. var. (Pl. XIV. figs. 6.)

Zoarium erect, bilaminate, compressed, forming broad flattish expansions, slightly divided into segments at the top, which lie very much in the same plane, edged by a smooth border composed of aborted cells; surface smooth. *Zoœcia* large, arranged with much regularity in quincunx, elongate, of about equal width throughout, subcylindrical, convex, distinct, slightly tumid below the orifice (not suberect above), surface shining, minutely granulated; orifice (primary) semicircular; adult orifice subquadrangular, peristome elevated, so as to conceal the primary opening, destitute of spines, lower margin slightly curved outwards, in the centre of it a rounded *avicularium*, facing inward and just visible above the margin; on each side a stout erect process, somewhat enlarged above and rounded at the top, where it curves slightly inward, bearing immediately below the top, looking into the opening of the cell, a small rounded avicularium. *Oœcium* ample, rounded above, closely united to the neighbouring cells, often subimmersed, surface granular, closed in front by a smooth white porcellaneous plate, which stretches down into the cavity of the cell. Circular avicularia often thickly scattered over the zoarium.

It is with some hesitation that I refer this form to *P. Skenei*. There are many striking differences between the two. In the first place there is a remarkable dissimilarity in habit. In the present form the zoarium is much larger * and more massive than in the normal *P. Skenei*, the segments are broader, much in the same plane, and much less numerous than in the other, and not so regularly truncate at the extremity. Specimens present a flattish, smooth, expanded surface, glossy and of a whitish colour; they rise from a small circular disk composed of aborted cells, narrow and stem-like for a short distance above it and then widening out (Pl. XIV. fig. 6 *c*). *P. Skenei*, so far as I have seen, originates in an irregularly spreading crust, largely composed of normal cells, and its surface bristles with tall *mucronate* processes. The latter are *totally* wanting in the variety, and with them the most characteristic feature of the normal form disappears. The central avicularium is placed within the margin of the peristome and is barely visible. In *P. Skenei*, n., the whole

* Every element of structure is on a larger scale in the present form than in the normal *P. Skenei*.

of the cell-wall immediately below the orifice is elevated, and the central portion rises into the very prominent mucro; in the present form the front surface is almost uniform throughout. The lateral aviculiferous processes, which form so remarkable a feature of the variety, are placed one on each side of the orifice at the very top of the cell. They curve inward a little above, and the avicularium is situated just below the top on the inner face. In the var. *bicornis* (*Lepralia bicornis*, Busk) there is a cylindrical process on each side of the orifice, bearing an avicularium on the apex; but this would hardly be a correct description of the analogous processes on the present form. In the var. *tridens* (Busk) two processes are developed *in a line with* the central mucro; in both these cases, however, the *general* characters are those of the normal *P. Skenei*.

On the whole, I think, this form must be regarded as a very remarkable variety of that species. Amongst the partially developed cells on the crustaceous base of the latter the mucro is undeveloped, and occasionally a pair of lateral processes may be met with which closely resemble those of the form *plana*. The *oœcium*, which has some peculiarities, seems to be alike in both. At the same time the amount of divergence from the ordinary type of the species and the change in external aspect which accompanies it are certainly exceptional.

In my 'History of British Polyzoa' *P. Skenei* is ranked in the genus *Palmicellaria*, Alder; but I am now convinced that its true affinity is with *Porella*.

Loc. Gulf of St. Lawrence, Trinity Bay, 96 fath.

Porella elegantula, D'Orbigny. (Pl. XV. figs. 5.)

Eschara elegantula, D'Orb. Pal. Franç. Terr. Crét. v. p. 102; Packard, Southern Labrador Animals, Canad. Nat. & Geol. viii. (1863); Smitt, Kritisk Förteckn., Œfvers. K. Vetensk.-Akad. Förhandl. 1867, p. 24; Dawson, J. W., Postpliocene Geol. Canada, 1872, Canad. Nat. n. s., vi.; Busk, North Polar Polyzoa, Journ. Linn. Soc. xv. 1880; id. Chall. Rep. pt. i. p. 141.

Eschara saccata, Busk, Pol. Norway and Finmark, Ann. & Mag. Nat. Hist. ser. 2, xviii. p. 3; Sars, M., Norsk. Pol. 1863 (sep.).

Eschara glabra, Hincks, Pol. Barents Sea, Ann. & Mag. Nat. Hist. October 1880.

Porella elegantula, Levinsen, Bryoz. f. Kara-Havet. Dijmphna-Togtets zool.-botan. Udbytte, 1886.

Lepralia elegantula, Lorenz, Pol. v. Jan Mayen, 1886.

I am inclined to agree with Levinsen in referring this interesting species to the genus *Porella*. In essential structure it resembles the latter, but the resemblance is somewhat masked by the great extension of the avicularian chamber, which ultimately covers a large proportion of the front of the zoœcium. Before its appearance the latter is very moderately convex, the peristome not elevated, the surface smooth, the orifice arched above and slightly curved below. In most of the marginal cells the avicularium is already outlined. At the top it is of equal width with the orifice; from this point it tapers off for a short distance, and then continues subtubular to the base (Pl. XV. fig. 5 *a*). When it is fully developed and enlarged by the progress of calcification the zoœcium appears cylindrical. In later stages, when there has been a large accretion of calcareous matter, the divisions between the cells become inconspicuous, the surface is nearly level and uniformly granular, and the avicularium, so prominent at first, is deeply sunk in the shaft-like cavity of the orifice. In the lower portion of the zoarium and for a considerable distance above the base the cells are almost wholly obliterated, and the surface is smooth and glossy.

Concurrently with the growth of the avicularium the peristome rises and the secondary orifice is formed. If the "pouch-like" avicularium is not a generic distinction (and the course of its development agrees very closely with that of the corresponding structure in *Porella*) there is nothing to separate this form from the last-named genus.

The variety (*rostrata*) in which the anterior portion of the avicularium is free and rises into a prominent rostrum overhanging the orifice (Pl. XV. fig. 5) occurs in the St. Lawrence. The species seems to be common in this region, and, so far as we know, is confined to the northern and arctic seas. It forms light and very elegant coral-like growths, which originate in a small spreading base, on stones &c., much branched, the main branches somewhat antler-shaped, springing from a little above the point of attachment, divided and subdivided into numerous branchlets, which terminate above in more or less expanded subtruncate segments.

Range. Newfoundland, Labrador, Finmark, Greenland, Spitzbergen, Barents Sea, Kara Sea, off Hare Island, Baffin's Bay, Nova Zembla.

Canadian Postpliocene (*Sir J. W. Dawson*).

Porella proboscidea, n. sp. (Pl. XIV. figs. 4.)

? =*Eschara verrucosa*, Smitt, form 2, Kritisk Förteckn. 1868, p. 142, pl. xxvi. fig. 135.

Eschara cervicornis, forma *verrucosa*, Bryozoa from Nova Zembla, Œfversigt af Kongl. Vetensk.-Ak. Förhandl. 1878, no. 3; Recensio animal. Bryozoorum quæ ad peninsulam Kola invenit F. Trybom, *ibid.* 1878, no. 7.

Zoœcia ovate, quincuncial, decidedly convex, depressed below, and rising rather abruptly towards the oral region; surface white and shining, smooth (in young cells) or slightly roughened, in some states areolated, delicate costæ passing upward from the margin to the base of the avicularian umbo; primary orifice semicircular; immediately below it, placed centrally, an erect process, expanded below, narrowing slightly upward and bending in towards the orifice (which it sometimes overhangs slightly), bearing on its summit a circular *avicularium*, immediately behind which rises a short mucro; peristome in the adult cell elevated, especially in front, embracing the avicularium. *Oœcium* prominent, rounded above, broader than high, flattened in front, surface minutely pitted over (in the young state smooth, glassy, emarginate), commonly a small elongate fissure on the front.

Var. With a smaller avicularian process on each side of the central one and close to it, or sometimes only on one side (Pl. XIV. fig. 4).

Hab. On shells and Hydroida, in small patches.

The *Eschara verrucosa* of Smitt is certainly not identical with the *Lepralia verrucosa* of Johnston, Busk, &c., to which he at first referred it. The latter is a much larger species, with an orifice of a totally different structure. He subsequently ranked it as a form of *Eschara cervicornis* (=*Porella compressa*, Sowerby).

I am by no means sure that I am right in identifying it with the present species. Prof. Smitt has given us a very brief description of it, and unfortunately his figure is too small to be of much service. At the same time I think it more than probable that the two are identical. The present form is clearly a *Porella*. It differs indeed from most of the species of this genus in the costate condition of the front wall of the zoœcium (though we meet with it in *P. struma*, Norman); but in all essential points its structure allies it to this group. One of its most distinctive characters (as a species) is the elevated avicularian rostrum, which may remind us of the similar structure in *Umbonula verrucosa*. The delicate texture, the silvery whiteness, the elevated front wall with the radiating ribs (not always present) are also characteristic features.

Loc. St. Lawrence, Orphan Bank and off Cap Rozier, 38 fath. If I am right in identifying *P. proboscidea* with Smitt's species, it has also occurred in Spitzbergen, Nova Zembla, and the Peninsula of Kola.

MUCRONELLA, Hincks.

Mucronella prælucida, Hincks. (Pl. XV. fig. 3.)

This species was described and figured in my "Report on the Polyzoa of the Queen Charlotte Islands" *. It is figured again in the present paper because the St.-Lawrence specimen differs in some respects from the North Pacific, and notably in the absence of the peculiar projections, placed one on each side of the cell at the base of the raised peristome. These have much the appearance of avicularia, but are not really such. The diminutive zoœcium in the present figure is probably one of those which lie about the primary cell; but all the cells are smaller in the St.-Lawrence than in the Pacific specimen. In the Queen-Charlotte Report I ventured to conjecture that the new forms described in it would probably not be to any great extent arctic. There can be little doubt, however, that *Mucronella prælucida* at least has followed the usual course of migration from the extreme north along both the Atlantic and Pacific coasts of America.

SMITTIA, Hincks.

Smittia Landsborovii, Johnston, form *porifera*, Smitt. (Pl. XIV. fig. 2.)

The only form referable to the above species which has yet occurred to me amongst the St.-Lawrence dredgings would rank under Smitt's *Escharella porifera*. This must, I think, be accounted a "form" of *S. Landsborovii*; the differences between them are hardly of sufficient moment to warrant their separation. They may be briefly summed up. In *S. porifera* the zoœcia are ovate or (frequently) rhombic, very thickly punctured over the entire surface, and of a dull white colour; the peristome is less elevated than in the normal *S. Landsborovii*, the avicularium is larger and rather more elongate, and stands out very prominently below the inferior margin, so as to have a rostriform appearance. The central denticle is sometimes wanting, and when present is less conspicuous than in the ordinary form, owing to the larger size and greater prominence of the avicularium; it is sometimes small and pointed. The orifice is subcircular, whilst in the latter it is more correctly described as "rotundato-

* Ann. & Mag. Nat. Hist. ser. 5, vol. xiii. pl. iv. Reprinted for the Geol. & Nat. Hist. Survey of Canada, 1884, p. 26 (sep.), pl. iv. fig. 1.

quadrangularis." In some forms of *S. Landsborovii* the peristome is much more elevated in the ovicelligerous cells than it is in the present, and forms a deep channelled sinus, at the extremity of which the avicularium is placed. In this condition the secondary orifice is subtriangular.

There seems to be a large amount of variability in the characters of the peristome as well as in the size and shape of the zoœcium itself *. The present form has the leading features of the specific type, with a moderate amount of variation in detail, and there hardly seems to be sufficient reason for separating it from *S. Landsborovii* (Pl. XIV. fig. 3).

Range. Spitzbergen, Hammerfest, Jan Mayen, Peninsula of Kola, Nova Zembla, South Devon †.

Subclass Holobranchia, Lankester.

Family **Pedicellinidæ**, Hincks.

Barentsia, Hincks.

Barentsia major ‡, n. sp. (Pl. XV. figs. 2.)

Zoarium consisting of a rather stout, creeping, and branched stolon, jointed at intervals, along which the pedicels supporting the polypides are distributed ; *pedicels* of great length, extremely slender below, expanding considerably towards the summit, delicately ringed, of a very light horn-colour, rising from a stout cylindrical base, conical above and of a whitish colour, not annulated ; *polypides* large, white, expanding from the base upward, slightly gibbous on one side, tentacles numerous, the fleshy peduncle or stalk connecting them with the pedicel comparatively long, enlarged immediately below the base of the polypide.

This species is allied to *B. gracilis*, Sars, but is of very much larger size. The pedicels for a great proportion of their length are very slender, tubular, rigid, but towards the upper extremity they widen out considerably and appear to be com-

* See Hist. Brit. Mar. Pol. plate xlviii. figs. 6–9.

† The South-Devon specimen agrees very closely with Smitt's figures of his *Escharella porifera* (*op. cit.* plate xxiv. figs. 30, 31).

‡ Busk has substituted, in his 'Challenger' Report (part 2, p. 40), the MS. name *Ascopodaria* for *Barentsia*. As I am unable to recognize the propriety or legality of this change, I have retained the latter, which was the first published designation of this remarkable pedicelline group. I hope to find an opportunity of discussing the grounds of this change on some future occasion.

posed of a membranaceous material. The muscular cylinder is tall and stout, decidedly conical above, and of a whitish colour. The length of the fleshy stalk immediately supporting the polypide and by which it is attached to the pedicel is a distinctive character. It is dilated below the body of the polypide, which is large and pretty regular in shape. The pedicels are developed in great numbers on the stolon; at the point where each originates opposite branches are given off.

Loc. St. Lawrence.

EXPLANATION OF THE PLATES.

Plate XIV.

Fig. 1. *Escharoides Sarsii*, Smitt. Adult zoœcia from the older portion of a colony. 1 *a*. Zoœcia in the earlier stages of development. 1 *b*. Zoœcia, showing the development of the oral avicularium. 1 *c*. Early stages in the growth of the avicularium.

Fig. 2. *Smittia Landsborovii*, Johnston (sp.), form *porifera*, Smitt.

Fig. 3. *Smittia Landsborovii*, Johnston, normal.

Fig. 4. *Porella proboscidea*, n. sp. [This figure and also 5 and 5 *a* are less highly magnified than the rest of the Plate.] 4 *a*. A single zoœcium.

Fig. 5. *Membraniporella crassicosta*, n. sp. 5 *a*. Immature zoœcia.

Fig. 6. *Porella Skenei*, Ellis & Sol., form *plana*, n. var. 6 *a*. Oœcium. 6 *b*. Marginal zoœcium, showing the primary orifice and early stage of the avicularian chamber. 6 *c*. Zoarium, nat. size.

Plate XV.

Fig. 1. *Corynoporella tenuis*, n. gen. and sp. A zoœcium, drawn to the usual scale. 1 *a*. Portion of the zoarium, less highly magnified, showing the dorsal surface, the mode in which the cells are connected, and the position of the fibrils.

Fig. 2. *Barentsia major*, n. sp. A single pedicel and polypide. 2 *a*. Ditto, showing the mobility secured to the polypide by the fleshy stalk by which it is attached to the pedicel. 2 *b*. A pedicel on which a new polypide is in course of development.

Fig. 3. *Mucronella prælucida*, Hincks.

Fig. 4. *Membranipora cymbiformis*, Hincks. 4 *a*. Marginal zoœcium.

Fig. 5. *Porella elegantula*, D'Orbigny, var. *rostrata*. 5 *a*. Young zoœcium, showing an early stage in the development of the avicularium. 5 *b*. The avicularian mandible.

Fig. 6. *Cellularia Peachii*, Busk, showing the cusp on the median cell at a bifurcation.

BIBLIOGRAPHICAL NOTICES.

South-African Butterflies: a Monograph of the Extra-tropical Species. By ROLAND TRIMEN, F.R.S., F.L.S., F.Z.S., F.E.S., &c. Royal 8vo. Trübner and Co.

It is with great pleasure that we welcome the appearance of the first two volumes of this work, the need for which will be evident from the fact that not only has the earlier work by the same author (entitled 'Rhopalocera Africæ Australis') been long out of print, but our knowledge of African butterflies has been very greatly increased during the twenty-one years which have elapsed since the publication of that monograph. Mr. Trimen points out that the total of known South-African forms is at the present time about 380, whereas in 1866 (allowing for erroneous admissions to the list) only 197 natives of South Africa were recorded.

The present work commences with a most instructive Introductory Chapter, invaluable to students commencing the study of the Rhopalocera; the whole of the families, genera, and species are also described at considerable length and with the care and precision for which Mr. Trimen is remarkable; the notes which accompany the descriptions are useful and of interest, whilst at the same time they are free from all those sneering little cuts which too frequently mar the writings of lepidopterists.

Volume I., containing the family NYMPHALIDÆ, is illustrated by six chromo-lithographic and one plain plate, the latter being devoted to the structural features of butterflies and the others to figures of the larvæ and perfect insects; this volume is also accompanied by a useful map of South Africa.

Vol. II., containing the ERYCINIDÆ and LYCÆNIDÆ, is illustrated by three coloured plates; and although chromo-lithography is hardly so well suited to the representation of the smaller species as hand-colouring, the figures are on the whole decidedly good.

Vol. III. remains to be issued, and will contain the PAPILIONIDÆ and HESPERIDÆ, which Mr. Trimen estimates at about 142 species. It will probably be a bulky volume, and if, as may be anticipated, it is as perfect as its predecessors, the work will be one of the most complete monographs of butterflies hitherto offered to the public.

Bergens Museum Aarsberetning for 1886. 8vo. Bergen: John Grieg, 1887.

THE Annual Report of the progress of the Museum at Bergen for 1886, which made its appearance towards the close of last year, forms a volume of considerably larger size than usual. It contains in all 288 pages and 24 plates, twelve of the latter of quarto size. Of course the ordinary reports upon the additions to the Museum and its Library and the affairs of the establishment generally occupy but a small portion of the space, most of which is devoted to the publication of several memoirs of great value and interest.

Foremost among these is an elaborate treatise by Mr. Fridtjof Nansen, the Curator of the Museum, on "The Structure and Combination of the Histological Elements of the Nervous System," a memoir of over 180 pages, written entirely in English and illustrated with eleven quarto plates. About a year and a half ago we published in the 'Annals' (vol. xviii. p. 209) a translation of a preliminary communication by the same author upon the histological structure of the central nervous system in the Ascidia and in *Myxine glutinosa*. His present memoir gives an account of his investigations upon the histology of the nervous system, with some remarkable generalizations and a valuable summary of the literature of the subject. It would lead us too far to attempt to give even a sketch of the results arrived at, which, indeed, would not be very intelligible without figures.

A second paper of importance to British zoologists is Mr. James A. Grieg's "Contribution to the Knowledge of the Norwegian Alcyonaria," containing descriptions of several new species of the group, illustrated with nine octavo plates. In this paper, which is written in Norwegian, with an English summary, the author describes species of the known genera *Sympodium*, *Stenogorgia*, *Paramuricea*, and *Protoptilum*, and proposes the establishment of two new genera, namely *Danielssenia* (sp. *D. irramosa*), an unbranched form with a horny axis, allied to *Gorgonia*, and *Stichoptilum* (sp. *S. arcticum*), a Pennatulid of the family Protoptilidæ, in which there is a strongly marked bilateral symmetry in the arrangement of the polypes. The general characters and structure of the species are admirably illustrated in the plates, which furnish, among other things, a very complete exposition of the characters of the calcareous spicules.

The other natural-history papers in the volume are in German from the pen of Dr. J. Brunchorst, and relate to cases of vegetable pathology. The first is on a very general disease of the potato, produced by a parasitic fungus nearly allied to *Plasmodiophora*, for which the author proposes the name of *Spongospora solani*. This fungus is believed to be the cause of the diseases of the potato known as "Schorf" in Germany and "scab" in England. In a second paper Dr. Brunchorst treats of the disease of cabbage-plants produced by the attacks of *Plasmodiophora brassicæ*, as a remedy or preventive of which he recommends the use of sulphuret of carbon. His third paper relates to the production of nodular swellings on the roots of certain plants and trees by the action of some forms of parasitic fungi, especially those of the genus *Frankia*.

The papers above cited are of so excellent a quality and of so much importance that, although we could do little more than indicate their existence, we have thought it desirable to call the attention of our readers to their existence, seeing that an "Annual Report" is not the place where such productions are generally looked for; and we must congratulate the authorities of the Museum at Bergen upon their having brought out such a valuable set of contributions to the literature of Natural History.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

January 25, 1888.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "On *Ailurus anglicus*, a new Carnivore from the Red Crag." By Prof. W. Boyd Dawkins, M.A., F.R.S., F.G.S.

The specimen described is a small fragment of the right lower jaw with the last true molar tooth in position, and belongs to the Crag collection of the Yorkshire Philosophical Society. It differs in a marked degree from all fossil European Carnivores, and presents no important points of difference when compared with a series of jaws of recent *Ailurus*. The Author gave a description of the fossil and comparison of it with *Ailurus fulgens*, and also a table giving the comparative measurements of the teeth and jaws of the fossil and of recent *Ailuri*. The species from the Crag was a more powerful animal than any recent *Ailuri* in the British Museum. The paper concluded with a notice of the range of *Ailurus* in space and time.

2. "On two New Lepidotoid Ganoids from the early Mesozoic Deposits of Orange Free State, South Africa." By A. Smith Woodward, Esq., F.G.S.

Of the two species of fishes described in the present paper, one was founded on specimens of four individuals brought to England by Dr. H. Exton in 1883, together with the types of *Tritylodon* and *Rhytidosteus*, the other on two examples recently received from the same source. Both were from the Stormberg Beds of the Upper Karoo series.

After giving full details of the structure of both forms, and describing the head and opercular fold, appendicular skeleton and scales in each, the Author showed that one species must be referred to the genus *Semionotus*, and was most nearly allied to the American types referred by Sir P. Egerton to *Ischypterus*. For this species the name of *Semionotus capensis* was proposed.

The other species agreed in its characters with the Dapediidæ, and was especially allied to the genus *Tetragonolepis*; but the nearest ally of all was a fish from the Hawkesbury Beds of Australia, *Clithrolepis granulatus*. The name of *Clithrolepis Extoni* was proposed for the new South-African species.

MISCELLANEOUS.

Bot-larvæ in the Terrapin.

Prof. Leidy remarked that the habits of a naturalist often led him to observe things in our daily life which usually escape the notice of others. In our food he had frequent occasion to detect parasites which he preferred to reject, but which are unconsciously swallowed by others. While he liked a herring, he never ate one without first removing the conspicuously coiled worms on the surface of the roes; and he had repeatedly extracted from a piece of black bass or a shad a thread-worm which others would not distinguish from a vessel or a nerve. While he did not object to the little parasitic crab of the oyster, he made it a point to remove the equally frequent leech from the clam. It was in a piece of ham he was eating that he first noticed the trichina, which was no doubt one of the causes that led Moses to declare the pig to be unclean; and in the hundred tape-worms he had examined from our fellow-citizens during the past twenty-five years he had ascertained that they had all been derived from rare beef. He continued, in a visit to Charleston, S. C., before the late war, at an evening entertainment, among other viands were nicely browned slices of the drum-fish, *Pogonias chromis*. A friend informed him that some portions were more gelatinous and delicate than others, and helped him to what was supposed to be one of such. On cutting into it he had observed imbedded in the flesh a soft mass which appeared of enigmatic character. The following day he procured from market a drum-fish, on the dissection of which he found imbedded in the tail several egg-shaped masses, about 3 inches long and less than an inch thick, which proved to be a large coiled worm (*Acanthorhynchus reptans*)*. This it was that gave delicacy to the dainty, and in this instance the parasite seems to enhance the excellence of the food. At another evening entertainment nearer home he partook of some stewed terrapins. Taking into his mouth what appeared to be an egg, it produced such an impression as led to its rejection. Seeming so peculiar he tied it in the corner of his handkerchief for more convenient examination. The specimen, now exhibited, was a membranous bag which contained thirty yellowish-white maggots from 8 to 12 millim. long by 1·5 to 3 millim. broad. They are the larvæ of a bot-fly, and resemble those of the *Gastrophilus* of the horse. Their characters are as follows:—

Body of the larva fusiform, acute anteriorly, obtuse posteriorly, consisting of twelve segments, including the head, which is armed with a pair of strong, black, hooked maxillæ; terminal segment with a pair of trilateral, oval, chitinous disks, each with three spiracles; intermediate segments with numerous minute recurved hooklets, disposed in incompletely separated bands at the fore and back part of the segments.

* Proc. Acad. Nat. Sci. 1858, p. 111.

The sac containing the larvæ is about three fourths of an inch long and half an inch broad, with a short tubular prolongation open at the extremity. It was uncertain whether the sac formed part of the intestine.

The dish of stewed terrapins was suspected to have been a mixture of the diamond-back, *Emys palustris*, and the red-bellied terrapin, *E. rugosa*. This is not the only instance of the occurrence of bots in turtles, as Prof. A. S. Packard notes the case of larvæ being found in the skin of the neck of the box-turtle, *Cistudo carolina* *.—*Proc. Acad. Nat. Sci. Philad.* December 13, 1887, p. 393.

A new Member of the Deep-water Fauna of the Freshwater Basins. By Dr. O. E. Imhof.

In my first deep-water investigations in the summer of 1883 and during the continuation of these studies I regularly found in a number of lakes (*e. g.* the Lake of Zurich) a fine, transparent, setigerous worm, of which permanent preparations were made from specimens obtained in the Lungeno lake, where it was particularly plentiful, on the 17th March, 1884. I paid no particular attention to it, because from its abundance and the remarkable facilities offered by the nature of its body for exact investigation I regarded it as certainly already described. Zeppelin's memoir upon *Ctenodrilus monostylos* furnished the inducement to examine this Chætopod more carefully. It is a form which can hardly be ranged in any known genus. It comes near to the genera *Ctenodrilus* and *Parthenope*, of which only marine species are known.

According to Forel, Duplessis, and Grube the following Chætopoda occur in the deep-water fauna of lakes:—*Tubifex rivulorum*, Lamk.; *T. velutinus*, Grube; *Clitellio Lemani*, Grube=*Bythonomus Lemani*, Gr.=*B. profundus*, Dupl.=*Lumbriculus pellucidus*, Dupl.

Noticeable anatomical peculiarities of the new form are:—

There is no ciliary coat on the surface of the body. The setæ exist only in one series of tufts on each side, directed towards the ventral surface. The setæ are thin, straight nearly to both ends, where they are slightly bent in opposite directions, and cleft into a fine fork at the free end. At rather more than one third of the length we find a slight enlargement of the part immersed in the body. I have not hitherto found individuals with generative organs, but, on the contrary, always multiplication by division. The body externally appears to be composed only of four segments, each of which bears two tufts of from four to six setæ. All the setæ are of similar structure. The nervous system is distinctly developed. It consists of a cerebral ganglion situated above the wide, thin-walled, anterior division of the digestive canal; this is of a broad band-like form with a slight constriction in the middle.

* 'American Naturalist,' 1882, p. 598.

The œsophageal commissures are pretty strongly developed. The ventral cord presents two closely approximated longitudinal commissures, with a considerable number of ganglionic dilatations, which are in part not very sharply marked off, extending as far as the extremity of the posterior segment of the body. The whole nervous system lies in the body-cavity, not imbedded in the body-wall, as is the case in *Ctenodrilus* and *Parthenope*.

So much for the preliminary characterization of this interesting Chætopod, which measures a few millimetres in length. I name it *Vetrovermis hyalinus*, nov. gen. et spec. As a locality of considerable elevation I may cite the lake of St. Moritz in the Upper Engadine.—*Zoologischer Anzeiger*, no. 270, January 23, 1888, p. 48.

On Psorospermium Hæckelii.
By Dr. Otto Zacharias.

Years ago (1855) Häckel, during a microscopic examination of the tissues of the freshwater crayfish, discovered a peculiar parasite, which does not appear to have been since frequently observed. Grobben * (1877) again found it in the connective parts of the testis in *Astacus*, and recently (1883) Hilgendorf † also observed it, especially in the vicinity of the thoracic chain of ganglia in the crayfish. "In order to fix the structure in question by a definite name" the last-mentioned author has proposed the designation *Psorospermium Hæckelii*.

Last summer (1887) I frequently met with the sporozoon in question during the investigation of Silesian crayfish, and I ascertained its presence also in examples from Galicia (Tarnopol). It must therefore be a generally distributed parasite, but one which does no injury to its host. The specimens of *Astacus* examined by me were apparently quite healthy.

The organisms under consideration possess an elongated oval form and are sharply marked off from the tissues of their host by a firm cuticle. Their longitudinal diameter measures about 0·180 millim., their greatest breadth only 0·040–0·050 millim. Their thickness is also very small. They are flat, tongue-shaped structures, which may be met with in many thousands in a single individual crayfish. It is not impossible that when they increase to too great an extent they may cause epidemics among the crayfish. At any rate it will be advisable to examine (microscopically) from this point of view the tissues of diseased *Astaci*.

According to my observations *Psorospermium Hæckelii* occurs less frequently in young than in old crayfish. I have thoroughly examined all the tissues of individuals two inches long, and found nothing. When on the point of desisting from the microscopic examination I remembered that the eyes of the animals had been

* 'Beitr. zur Kenntn. d. männl. Geschlechtsorg. der Decapoden,' &c., 1878.

† Ber. Gesellsch. naturf. Freunde in Berlin, Sitz. am 20 Nov. 1883.

entirely neglected. These were now examined in their connective parts, and here numerous *Psorospermia* were easily recognizable. This discovery led me to the notion that these parasites possibly make their way in (in a motile young state) and establish themselves first of all in the softer parts of the eye-peduncle in newly hatched crayfish.

However, I have established with certainty that *Psorospermium Hæckelii* is able to multiply in the body of its host. This fact was not previously known. I ascertained it by means of staining with aceto-carmine. The portions of tissue under examination were placed in this approved staining-material for an hour, and then cleared in dilute glycerine. Of the material thus treated I made numerous torn preparations which gave me an insight not only into the reproduction of the *Psorospermium*, but also into its minute structure.

Externally, as already stated, there is in our parasite a thick cuticular zone, which marks the boundary from the tissue of the crayfish. This cuticle does not stain at all with aceto-carmine. On its inner wall there is a lining which greedily takes up the colour and which is divided by fine interstices into a number of portions of different size. This is the "pattern of large meshes" which Hilgendorf also saw. From this lining of the wall proceed the reproductive bodies, large balls (acquiring a dark red colour), which are always present to the number of eight to ten when the time for their appearance arrives.

When these bodies are perfectly mature the cuticle bursts in the sporozoon at one of the two ends, and the issue of the separate balls takes place into the surrounding tissue. Each reproductive body forms a spherical structure, which possesses, quite in the interior, a "nucleus," which remains entirely uncoloured. Externally each spherule is enclosed by an envelope which stains deep red; and between this and the pale nucleus we see a rose-coloured intermediate zone.

By the secretion of a cuticle (after increase in length has taken place) these spherules come to resemble the parent organisms from which they originate. All possible transitions are found between the youngest and oldest stages, so that the very simple cycle of development is quite clearly indicated.—*Zoologischer Anzeiger*, no. 270, January 23, 1888, p. 49.

Two new Genera of Epicarides (Probopyrus *and* Palegyge). By MM. A. Giard and J. Bonnier.

By the kindness of the Direction of the Royal Museum of Natural History at Brussels we have been enabled to study the collection of Bopyrina belonging to that important institution. In it we have found two interesting forms of Epicarides parasitic upon species of *Palæmon* inhabiting the fresh waters of the Dutch Malaysia and probably of the island of Amboyna. It seems to us that these two species must be regarded as the types of two new genera, *Probopyrus* and *Palegyge* *, from which are derived on the one hand the *Bopyri* and on the other the *Gygæ*, which have been previously described. We name them *Probopyrus ascendens*, Semper, and *Palegyge Borrei*, G. & B.

Probopyrus ascendens (*Bopyrus ascendens*, Semper) has already been noticed by Semper † as a parasite of the branchial cavity of *Palæmon ornatus*, Olivier, which, in the Philippine Islands, lives in the brooks up to 4000 feet above the level of the sea. The genus *Probopyrus* is distinguished from *Bopyrus* by the characters of the pleon in the two sexes. In the female on the dorsal surface the segments of the abdomen, although soldered together, are separated by very distinct lines of demarcation, visible even at the middle of the body. In the ventral part the pleopoda, instead of being reduced to a mere rudimentary plate on each side of the abdomen, are formed by pairs of appendages homologous with those which we have indicated by the letters *b* and *c* in *Cepon* and the Ioninæ ‡. This important character appears to have escaped the notice of Semper, who figures simple abdominal plates (*loc. cit.* fig. 38) like those of the typical *Bopyri*. In the male the pleon bears traces of lateral appendages which are absolutely wanting in the *Bopyri*. *Bopyrus palæmoneticola*, Packard (*Bopyrus manhattensis*, Gissler §), a parasite of *Palæmonetes vulgaris*, Stimps., on the Atlantic coast of North America, must also enter our genus *Probopyrus*, judging from the figures given by Gissler.

Probopyrus ascendens differs from *Probopyrus palæmoneticola* by its larger size, the form of the pygidium of the female, that of the pleal plates, &c. The presence of *P. ascendens* in the Dutch East Indies considerably extends the habitat of this Crustacean.

The second species that we have studied has received the name of *Palegyge* * *Borrei*. It is with pleasure that we dedicate it to the learned curator of the Brussels Museum, M. Preudhomme de Borre, well known for his fine writings on the Arthropoda. We met with it in the branchial cavity of *Palæmon dispar*, E. von Martens ‖. Some ten specimens of this species were mixed with those of *P. ornatus* in the Brussels Museum. Only one of them contained a parasite, or rather a couple of parasites.

The *Palegygæ* stand exactly in the same relation to *Gyge* as the *Probopyri* to *Bopyrus*. They represent a less degraded ancestral form, which has retained, in the structure of the pleon, the typical organization of the Ioninæ. In the characters of the foot-jaws, in

* Sic; recte *Palægyge*.

† 'The Natural Conditions of Existence as they affect Animal Life' (1881), p. 147, fig. 38.

‡ See Giard and Bonnier, 'Contributions à l'étude des Bopyriens.—Monographie du genre *Cepon*' (1887), pl. i.

§ Gissler, "A Singular Parasitic Isopod &c.," in 'American Naturalist,' vol. xvi. (1882), p. 6, pls. i. and ii.

‖ Prof. De Man, of Middleburg, has kindly aided us in the determination of this *Palæmon*.

the ventral folds of the last two thoracic segments, and of certain segments of the abdomen in the female, and by the separation of the segments of the pleon in the male, *Palegyge Borrei* closely approaches the genus *Gyge*; but it differs therefrom in that the pleal plates (branchiæ of the older authors) instead of being simple are double (*b* and *c*), as is the case only in the young females in *Gyge branchialis*. The ventral fringes exist only on the last two segments of the thorax and on the first segment of the abdomen. In the male we find traces of pleopoda only on the first three abdominal segments. In the alcohol which contained the infested Palæmons we obtained a male Cryptoniscian which we find it at present impossible to appropriate to one of the genera examined rather than to the other.

It is interesting to find that the archaic types of Epicarides, *Probopyrus* and *Palegyge*, occur upon genera of Palæmons inhabiting fresh water. It is true that *Palæmonetes vulgaris*, the host of *Probopyrus palæmoneticola*, is a littoral species. But most of the *Palæmonetes*, and especially the common *P. varians*, live in fresh or brackish waters. This is the case also with the section *Macrobrachium*, Sp. Bate, to which *Palæmon ornatus* and *P. dispar* belong. The typical *Bopyri* seem to live exclusively upon the Palæmons of the section *Leander*, Desm., as defined by Stimpson. Of this absolutely marine group most of our European species, *P. serratus*, *P. squilla*, *P. rectirostris*, &c., form part, each of which bears a parasite of the genus *Bopyrus* proper.

We know nothing of the embryogeny of the *Macrobrachia*, but the arrangement of the lateral spines of the carapace in these Palæmons presents a character which is only transitory in *Leander*. The development of *Palæmonetes varians*, which has been admirably elucidated by P. Mayer, shows us that in these Crustaceans the abdominal feet originate from before backwards, as in the ancestors of the Carides, and not by an abridged process, as in the Leanders. Although from this point of view, as with regard to ethology, *Palæmonetes vulgaris* forms the passage to the marine Palæmons, we think that it is desirable to attribute to this character a greater phylogenetic importance than that of the absence of the mandibular palpus, upon which P. Mayer relies in deriving the *Palæmonetes* from Palæmon.

We therefore regard the *Palæmonetes* and the *Macrobrachia* as more ancient forms than the *Leandri*, forms which have maintained themselves, thanks to their freshwater habitat. The existence upon these ancestral types of archaic genera of Epicarides (*Probopyrus* and *Palegyge*) is, we think, a fresh confirmation of the law of parallelism between the phylum of the parasites and that of their hosts. —*Comptes Rendus*, January 23, 1888, p. 304.

THE ANNALS

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XXIX.—*On the Structure of* Fistulipora incrustans, *Phill.* (F. minor, *M'Coy*). By John Young, F.G.S.

The interest excited by the researches of recent years amongst the group of organisms forming the Monticuliporidæ has been chiefly due to the methods now employed in obtaining a knowledge of their internal structures, these being seen to differ very much even in organisms that are externally so alike as formerly to have been placed in the same genera or species. Another point of interest in connexion with the group is the doubt that still exists in the minds of many palæontologists as to their proper position in the animal kingdom, one set of observers placing them along with the Polyzoa or Bryozoa, another with the Actinozoa or Corals. It is to be hoped that future investigations will help to clear up this point and settle the question one way or other.

In the 'Annals' for December 1882 I contributed a short paper "On the Identity of *Ceramopora* (*Berenicea*) *megastoma*, M'Coy, with *Fistulipora minor*, M'Coy," and at p. 428 I further referred to one or two external characters I had observed in this organism in its several stages of growth that, so far as I was then aware, had not been noticed by former observers. These were:—1st, that the mouths of the cells in the younger stages are of a trilobed form, this character being due to the occurrence of two short spines that project, one on each side, from the raised lower lip of the cell; 2nd, that the cell-mouths are seen to be closed by a thin calcareous cover (or operculum) which I then considered to be the commencement of tabulæ in the cells; 3rd, that in the spaces (interstitial) between the cells there are also numerous small polygonal cells that are arranged in from one to three rows; 4th, that we often find in the several stages of the organism that these smaller cells are closed by a thin calcareous outer layer, which leaves only the larger cell-openings visible. These characters I stated had been formerly noted by myself in a paper in the Glasg. Geol. Soc. Trans. vol. vi. p. 213 (1879).

In the 'Annals' for Dec. 1885 there is a paper by Prof. H. Alleyne Nicholson, M.D., and Arthur H. Foord, F.G.S., "On the Genus *Fistulipora*, M'Coy," with figures and descriptions of several species. In that paper I am glad to find that my identification of M'Coy's *Fistulipora* in its younger and older stages was admitted by the authors, and further that they had been able to show, from an examination of the type specimen, that Phillips's earlier described *Calamopora incrustans* was identical with *F. minor*, M'Coy, Phillips's species thus becoming the type of the genus *Fistulipora*, M'Coy.

In their remarks upon *F. incrustans*, Phill., as well as on the other species of the genus which they describe, I observe that Messrs. Nicholson and Foord fail to notice some of the external characters seen on the surface of the type species and which are noted in my paper in the 'Annals.' As I consider a knowledge of these characters to be essential, and of importance to any one studying the structure of the organism, also for enabling them to form some opinion as to its zoological relationships, I again take the liberty of bringing the subject before the readers of the 'Annals,' pointing out in more detail the characters I had already noted as well as one or two other internal structures that I have found in the Carboniferous *Fistulipora* since my paper appeared, all of which I have been able to verify in well-preserved specimens and in numerous sections that I have prepared for microscopic examination.

I may first remark, with regard to the trilobed form of the cell-mouths in the autopores of *Fistulipora*, that this is not a character that is exclusively confined to this genus, as Mr. E. O. Ulrich figures and describes several forms, in a paper in the Journ. of the Cincin. Soc. of Nat. Hist. for April 1884, as American genera of Bryozoa that have the same trilobed form of cell-mouths in their autopores, with an internal structure that in some of the forms relates them closely to *Fistulipora*. I also find this same trilobed form of cell-mouth present in two genera of Carboniferous organisms formerly placed with the Polyzoa; these are *Sulcoretepora parallela*, Phill., *S. raricosta*, M'Coy, and *Goniocladia cellulifera*, Eth., Jun. On sectioning these forms I find that they have a series of vesicular cells in the interspaces between the autopores, as found in the Cystodictyonidæ, Ulrich, and I have now placed them in that family (Edinb. Geol. Soc. Trans. vol. v. p. 461, 1887). As stated in my former paper in the 'Annals,' I find also that the trilobed condition of the cell-mouths is characteristic only of the younger stages of the organism in *Fistulipora*. In the older stages of growth, or where it forms thick crusts in which the tubes of the autopores become more erect, the cell-mouths are seen to be more or less circular in form and to have a slightly raised lip or rim all round the margin of the openings. As there is thus so much difference and variability in the form of the mouths of the autopores in the younger and older stages of the organism, I do not feel inclined to place any value on this trilobed form of the cell-mouth as a generic character, as is done by Messrs. Nicholson and Foord, especially when we find that it occurs amongst a group of organisms that do not seem to be generically related to one another in every case, although the above authors would place some of Mr. Ulrich's forms with *Fistuliporæ* that possessed this character.

The closing of the mouths of the autopores in *F. incrustans* by a calcareous cover or operculum is a character that I have found in specimens from various localities and in several stages of growth. These opercula are seen to be more or less convex on their upper surface, and are perforated in their younger stage by a small transverse opening that becomes obliterated or filled up by the organism in the older stages. Mr. Ulrich also notices these perforated calcareous opercula in his paper above mentioned, and finds them also in one species of *Fistulipora*, *F. clausa*, n. sp. He, like myself, is inclined to regard them as the beginning of the successive tabulæ that show themselves in vertical sections of the tubes of the autopores. Their rarity at the surface in the tubes of most specimens is easily accounted for by the somewhat sparse and wide intervals that exist between the tabulæ in many cases, and also often depends on whether the organisms had lived onwards for a period after the formation of the opercula; in that case they would be found deeper in the tubes and not observable at the surface.

In my former paper in the 'Annals' I noted the occurrence in the earlier stages of *F. incrustans* of small polygonal cells that filled in the interspaces between the autopores. In this earlier stage I had accepted as probably correct Mr. G. R. Vine's identification of the organism with *Ceramopora*, in which genus he had placed it, rather than with *Berenicea* and *Diastopora*, in which its younger forms were formerly placed. Messrs. Nicholson and Foord, however, in their paper take exception to this identification with *Ceramopora*, and state that this genus is distinct in all its stages from *Fistulipora*. The presence or absence of the polygonal cells (mesopores) here noted seems to have raised some doubt in the minds of these authors as to the correct identification of the younger stage of *F. minor*, M'Coy, with the organism which M'Coy figures and describes as *Berenicea megastoma*, they stating (p. 503 of their paper) that "it is not possible to be absolutely certain of this without an examination of M'Coy's original specimen, especially as M'Coy's figure of *Berenicea megastoma* does not exhibit any mesopores, nor does his description of the species contain any allusion to the presence of interstitial tubes." Perhaps I may be able to somewhat dispel this doubt by stating that we find in our Scottish limestone-shales examples of the younger stage of *F. minor* that agree exactly with M'Coy's figure and description of *Berenicea megastoma*. That is, they are found as adherent "spot-like crusts" that sometimes show the open mesopores on the surface; in other examples, like M'Coy's specimen, the mesopores are seen to be covered by a thin calcareous layer of sclerenchyma-deposit that I shall notice later on. There is thus every reason to believe that M'Coy's specimen had the mesopores closed by a similar calcareous layer, and the reason why they were not noticed by him is probably due to the fact that he only saw one example of the organism, the one figured. My reason for this belief is that the organism in the early stage seems to be rare in Ireland, he giving only one locality for it and mentioning no other examples. Had he seen other specimens he could hardly have failed to observe the mesopores on the surface of some of them. In our Scottish specimens they are seen to occur on the surface of the organism in all its stages of growth, but are sometimes closed or partially closed by the calcareous outer layer that I noted in my former paper (p. 428), which Dr. Lindström terms the "Thecostegites stage." I also find that Mr. Ulrich has noticed this closed condition of the mesopores in several genera of American Bryozoa, and terms the obscuring layer a secondary deposit of sclerenchyma that has grown at the surface over the cells. That this secondary deposit of sclerenchyma covers the successive growths of mesopores in *F. incrustans* in thicker and thinner layers is well seen in transparent sections of its zoarium, where it presents an entirely different structure from that forming the true cell-walls. In the latter the calcite is seen to be much more dense, and transmits less light through its structure than that of the sclerenchyma-layers. This difference of appearance in the two layers is very observable in nearly all my sections and enables them to be readily distinguished by the greater transparency of the one compared with the other. I first noticed this closed condition of the mesopores on the outer surface of specimens, and thought the calcareous layer was confined to such surface; but sections of the organism show that it is present throughout the whole thickness of the zoarium, from its early incrusting condition to its later stages, where it is seen to increase in the thickness of its layers in many specimens as they reach the outer surface. Vertical and tangential sections show that it is confined chiefly to the interspaces between the autopores, but it is also seen to coat the outer surface of the tube-walls of the autopores, and in their earlier reclined condition, before becoming erect, the sclerenchyma is seen to rest as a thick layer upon the outer concave curve of the tubes, where it forms at the surface of the zoarium the thickened raised lips of the cells that are so noticeable in the younger stages of the organism. In the older stage, in which the autopores become more erect and with circular mouths, the sclerenchyma forms a regular layer around the walls, as well as often a thin deposit in their interior. These layers of sclerenchyma, whether resting upon the mesopores or autopores, are seen to be of very variable thickness throughout the structure and extent of the same specimen, and differ much even in examples from the same locality. In vertical sections some of the layers are not thicker than the true cell-walls, which are always thin. Other layers, however, are seen to be from ten to fifty times this thickness; these are seen in transverse sections to form zonal bands around the circumference of the zoarium and mark successive stages in the growth of the mesopores outwards towards the surface.

Another interesting character shown in vertical sections and illustrating the contemporaneous growth of the sclerenchyma-layers with that of those forming the cell-walls, is where we see that every successive group of mesopore-cells is completely separated from those below by the sclerenchyma-layer, the amount of separation in the true walls in each instance being exactly that of the thickness of the intervening deposit. In tangential sections of the organism taken below its outer surface we also find that where the sections happen to pass horizontally through any of the layers of sclerenchyma there the mesopores disappear, their walls not extending either upwards or downwards through this deposit; but as the obscuring layer passes out of section, as happens in most instances, owing to the curvature of the layers around the specimen, the mesopores are always distinctly visible over those parts where the sclerenchyma is absent, or, owing to the darker colour of their cell-walls, are to be seen shining through a thin layer of the sclerenchyma at its junction with the mesopores.

In connexion with this sclerenchyma-deposit I have also to note the fact that its whole structure is pervaded by a system of very minute pores or foramina which are distinctly visible in all the better-preserved specimens of the organism. This character in *F. incrustans* I first observed on the surface of some specimens from the limestone-shales of the Lanarkshire coal-field, and noticed in a paper in the Glasg. Geol. Soc. Trans. vol. vii. p. 246 (1883). I have also, since then, proved their existence in all the inner layers of sclerenchyma by numerous sections that I have prepared.

When seen on the surface-layer these pores appear as very minute slightly raised tubercles, whilst in the transparent sections they are seen as tubes or foramina, according as they are viewed in vertical or transverse positions. I am glad to find that Mr. Ulrich, in the paper to which I have already referred, both mentions and figures this perforated structure as being found in one or two forms of American Bryozoa, one of which is the *Fistulipora? clausa*, Ulrich. In writing on this species he says (p. 47), "My tangential sections do not show *positively* that this deposit (sclerenchyma) was perforated; but judging from the evidence at hand, and especially that afforded by one or two vertical sections, and the very minute pits shown in many specimens, I should say that such was actually the case, and I do not doubt that I will yet find a section that will show it in an unquestionable manner." I may here state that I have found clear evidence of this perforated structure in the sclerenchyma-layers of all those specimens in which the calcite has not been too much altered through crystallization. When such is the case the foramina are generally obliterated or are, as in some sections, only faintly visible in parts, where it requires the practised eye to detect them under the microscope.

In the paper by Messrs. Nicholson and Foord they notice the peculiarity that exists in the lighter sclerenchyma-layer (although they do not call it such) that rests on the folds or raised lips of the autopores in *F. incrustans*, and state (p. 498), "This lighter portion consists of crystalline calcite of a similar character to that of the matrix or infilling of the cells, though very slightly darker, while the remaining portion of the cell-wall and the walls of the mesopores are composed of a dense, granular, opaque calcite."

It seems to be evident from this statement that their sections did not show any trace of foramina or pores in the calcite that forms the thickened lips of the cells; but they are agreed that the sclerenchyma-layer, which they term a "crystalline calcite," was organically formed, for they further state, "This difference in the mineral composition in the two parts of the cell-wall must certainly have originated in the living tissues of the organism, because the same phenomenon is met with in species from such widely separated localities as Canada and Westphalia."

I do not think that any evidence can be clearer than that such was the case, although the further evidence of organic structure in the form of minute perforations, such as those I have referred to, seems to have been absent in their specimens.

When the sclerenchyma-layers are examined in vertical sections under the microscope it is seen that the foramina or tubes pass upwards through the deposit nearly at right angles to its growth, the only radiation seen in the structure being due to the curving of the sclerenchyma over and around the convex cells of the mesopores. In the thickened layer that is seen resting on the folds of the depressed autopores in the younger stages of growth the foramina also pass through the deposit nearly at right angles to the tubes on which it rests. The foramina or tubes in the sclerenchyma often give the layers a fibrous or brush-like structure, which, when viewed in vertical sections, appears as fine in the texture as very fine velvet.

In tangential sections the foramina in finely preserved specimens are seen as very minute pores. Whether any of these pass through the true cell-walls, either in the autopores or mesopores, is a point on which I have not obtained clear evidence as yet; but I am inclined to think that they do, and this is also the opinion of Mr. Ulrich, from an examination of American specimens. In some of my sections I find a peculiar and minutely broken-up condition of the denser portion of the cell-wall that presents the appearance of having, as it were, been perforated by tubes; but as this is not clearly seen in every section, I am doubtful whether such a structure originally existed or not. Other specimens, however, may yet prove this point one way or other.

Messrs. Nicholson and Foord state that the true cell-walls of the autopores do not surround the whole of the tube in its dense or opaque condition, but blend at the point where the folds occur into the layer of lighter crystalline calcite that forms the raised lips of the cells, stating (p. 498) that "it will be noticed that the fold is of a lighter colour than the other part of the cell-wall." This does not appear to be a character of any value, as I find in my best-preserved sections that the true cell-wall is often quite persistent in its density and darker colour around the tubes, even where they are thickened at the folds by the layer of sclerenchyma. In my sections it is sometimes seen that the walls of certain cells do blend and disappear in some instances where they are covered by the lighter calcite layer; but these same sections also show in other instances the walls quite complete around the majority of the cells, and this complete condition of the walls is seen to exist in nearly all the sections in which the tubes have become erect and the mouths of the autopores more circular. The disappearance of the cell-wall around the folds in those instances where it is seen to be wanting seems to be due to some kind of absorption of the denser calcite and its replacement by the sclerenchyma either when the organisms were living or afterwards by some process or other during fossilization. It, however, is seen to be a variable character even in the same specimen.

Having stated this much regarding the structures I formerly found in *F. incrustans* I will here further notice shortly one other interesting structure that I have recently discovered in specimens obtained from Bowfield, Renfrewshire, near Glasgow. The form of *Fistulipora* found at this place may yet prove to be a distinct species from, or variety of, *F. incrustans*; but beyond the difference in the form of its zoarium and the structure to be noticed there seems to be little difference either in the form of the autopores or in the number and arrangement of the mesopores and maculæ from those seen in the older stages of some specimens of *F. incrustans.* The organism is generally found in the form of fragments of branching, subcylindrical, hollow stems, varying in thickness from one quarter to half an inch in diameter, the interior of the stems being now filled by a deposit of clay-ironstone. The new internal structure that I have to note in this species consists of a group of slender spines that are seen in the sections to radiate from the inner wall of the autopores to near the centre of the tubes. These radiating spines have very much the same character as those seen in the autopores and mesopores of *Heteropora neozelanica*, Busk, which are figured and described by Prof. Nicholson in his 'Monticulipora,' p. 69, fig. 9 (1881). In the Carboniferous form, however, the spines are only seen in the autopores, and in this respect it differs from the species of *Heteropora* above noted, where they are found in both groups of cells. The spines appear to be as slender and as numerous as those of *H. neozelanica*, there being from ten to twelve in many of the sections, in which they are seen to be arranged within the circle of the cells at slightly varying distances from one another. They also vary in their length within the tubes, as in *Heteropora*, and many of them have become thickened by a secondary deposit of calcite that now renders them more conspicuous in the sections. I find them most numerous and best preserved in those portions of the tubes that lie at a little distance below the outer surface of the zoarium. In the younger stage of the autopores the spines are seen to be rare or absent. The tabulæ in the tubes are moderately common, and in those portions where the spines exist the latter are seen amongst the tabulæ projecting inwards from the cell-walls, but apparently in no regular order of arrangement. The species of *Fistulipora* under notice has the outer surface of the zoarium often well preserved. On it the mouths of the autopores are seen to be nearly circular in form, having a slightly raised lip or rim all round the cell. The interspaces between the autopores that are occupied by the mesopores show in most specimens a thick sclerenchyma-layer at the surface that completely conceals the mesopores. This layer also covers the mesopores that lie deeper within the branches, and in certain stages it forms thick zonal layers all round the stem that separate the mesopores in their layers from each other by the whole thickness of the sclerenchyma-deposit.

All over the surface of the sclerenchyma-layer, as well as upon the raised lips of the cells, there exist numerous, small, slightly raised tubercles, that give this surface a minutely granulated appearance. Their structure under the microscope is seen to be identical with the smaller forms of spiniform tubercles (acanthopores) found in many species of the Monticuliporidæ. In this species of *Fistulipora*, however, they seem to be much more numerous than I have yet seen noted in any other member of the genus. One other interesting character of this organism, as illustrated by tangential sections of the branches when cut below their surface, is the occurrence of similar acanthopores in the thicker inferior layers of sclerenchyma that I formerly mentioned as forming the zonal bands within the branches. I am inclined to think, from the evidence presented, that these thickened layers indicate periods in the life of the organism in which the mesopores, from some cause or other, ceased to be developed, or, when present, were small and widely scattered. The evidence also indicates that when the mesopores ceased to grow the sclerenchyma-deposit was ready to take its place, the latter being seen to form a continuous uninterrupted deposit upon the tubes of the autopores outwards to their surface, whereas in the spaces occupied by the mesopores it only alternates with the latter, but does not form a regular continuous outward growth.

From the foregoing remarks it will be seen that the British Carboniferous *Fistulipora* presents several interesting structures upon which little has been formerly written, and which only well-preserved specimens have now revealed. I shall not at present dwell further upon these structures, nor attempt to discuss any of the points relating to the zoological relationships of the genus, beyond briefly stating that none of the structures here noticed are peculiar to *Fistulipora*, they being found in other organisms, some of which are at present placed with the Monticuliporidæ, others with the Polyzoa. The vesicular interstitial cells (mesopores) found in *Fistulipora*, accompanied by a perforated sclerenchyma-structure and a trilobed form of the cell-mouths in the autopores, are characters that are present in both Scottish and American forms of the Cystodictyonidæ, Ulrich. Spiniform tubercles (acanthopores) along with a minutely perforated sclerenchyma-structure, as in *F. incrustans*, are also present and often beautifully preserved in the Carboniferous Fenestellidæ and other Polyzoans—these structures in transparent sections being often quite comparable in all their characters with similar structures found in the Monticuliporidæ. The occurrence also of numerous radial spines in the tubes of the Carboniferous *Fistulipora* is another character that closely relates it to *Heteropora*, a genus that is also found to have its cell-mouths closed in certain stages, according to Prof. Nicholson, 'Monticulipora,' p. 67, with "a calcareous (or more usually chitinous) surface-pellicle," which he further says "is a feature which speaks strongly for Polyzoan affinities," although he afterwards states that this closed condition of the cells "by a calcareous pellicle" is not unknown amongst certain corals belonging to the genus *Favosites*, the species of which he names. I will, on the other hand, only state in conclusion that I have also found in several species of undoubted Carboniferous Polyzoa the cells closed by a calcareous secondary deposit that in its earlier stage is seen to be pierced by a very small pore opposite the cell-mouths, this pore or opening being afterwards filled up in the later stage in many of the specimens.

XXX.—*Are there Deep-sea Medusæ?* By J. Walter Fewkes *.

In a Report on the Medusæ collected by the 'Albatross' in 1883–84 † I have already considered the question whether there are zones of Medusan life in the depths of the sea. I have not, however, from the nature of that paper written all that may be said, even in the present condition of our knowledge, of the facts bearing upon it. It is hoped that the present paper will at least point out the great interest attached to a scientific answer to the question which is taken as the title of this communication.

A study of the fauna of the deep sea is of comparatively modern growth. It is barely thirty years ago that naturalists almost universally believed the abysses of the ocean to be deserts as far as life is concerned. Deep-sea exploration has, however, not only revealed the fact that the ocean-bed at great depths is peopled by a rich and varied fauna, but also that the animals which constitute that fauna are peculiar and markedly different from those found in shallow waters.

It would seem a most extraordinary exception if, after the floor of the ocean at great depths had been found to be inhabited, the fathoms on fathoms of water through which the sounding-weight passes to reach those depths are destitute of life. In mid-ocean, where there is a highly varied nomadic life upon the surface and where the dredge has brought up from the ocean-bed a characteristic assemblage of animals, are we to suppose that between these places there is not a representative fauna, or must we conclude that after we sink a few fathoms below the surface life ceases, and that it is not until we come to the floor of the ocean that life again appears? If between these two limits there is a fauna, is that fauna the

* From the 'American Journal of Science,' February 1888, pp. 166–179.

† "Report on the Medusæ collected by the U. S. Fish Commission steamer 'Albatross' in the region of the Gulf Stream in 1883–84." Annual Report Comm. Fish and Fisheries, 1884, pp. 927–977, pls. i.–x. 1886. Many of the ideas there presented are also noticed in this paper.

same as that found at the surface, or is it characteristic? Can the animals which compose it be circumscribed in bathymetrical zones, out of which they cannot pass with impunity? Do we, in short, have in the nomadic oceanic life a change of fauna as we sink below the surface?

Naturalists have been led to suppose that since we find peculiar modifications in animals living upon the sea-bottom at great depths we should necessarily look for the same variation among nomadic animals at intermediate depths. It would then seem probable that there are bathymetrical zones for free-swimming animals, and that these animals are characteristic as compared with others which live at the surface. An investigation of the character of this fauna, if such there be, has an interest to the evolutionist, for it might be supposed to acquaint him with facts bearing on the general characters of the ancestors of certain genera of surface-life.

I can imagine few places on the earth's surface where the uniformity of physical conditions is greater than in the depths of the sea. I do not mean, as might be supposed, necessarily on the floor of the ocean, but at the depth of say 1000 fathoms separated from the ocean-bed by a wall of water of the same depth. Here, if anywhere, we may look for uniformity of conditions, and if environment has anything to do with modifications in the generic forms of animal life, here we may expect to discover animals which preserve ancestral features. On the surface of the ocean there are changes of temperature and of light and climatic variations; at the floor of the ocean there may be reactions of the interior of the earth upon its crust, perhaps lava-flows or geological oscillations *; but midway between these two places, equally removed from both, disturbing causes only rarely penetrate, and conditions remain more constant year by year. May we not expect to find here a corresponding uniformity in the fauna as compared either with the highly organized animals of the surface or with those of the depths of the ocean? Is that fauna more uniform than any other in the ocean?

No group of animals is better suited for a study of the questions which suggest themselves concerning the bathymetrical zones of characteristic animals, free-swimming at different depths in the ocean, than the Medusæ. The group is a large and very variable one. It is confined, with but few exceptions, to the ocean. Moreover, it is probable that its ancestors were oceanic animals. No group of marine

* Such changes might take place even if the oceans have practically been the same in past geologic times as at present.

animals presents fewer difficulties in studying the questions which we have stated than this.

It was with the impetus of a new enthusiasm for the study of these questions that I undertook, by the advice of Prof. Verrill, the examination of the rich collections of deep-sea Medusæ made in the Gulf-stream by the 'Albatross.' It seemed to me that the examination revealed much of general scientific interest.

I shall not consider in this discussion the Hydroida, as the members of this group are for the most part attached to the ground, and the problems connected with them are the same as those which pertain to all deep-sea animals attached to or partially living on the ocean-bed. We shall also pass by in silence the Ctenophora, no genus of which has yet been ascribed to the deep sea. I propose to consider a few of those jelly-fishes which are known as the *Acraspeda*, and incidentally the *Siphonophora.*

The history of the study of the deep-sea Medusæ belonging to these divisions is a very brief one. In many of the monographs on these groups we have isolated mentions of Medusæ which are ascribed to the deep sea. The jelly-fishes thus mentioned were commonly washed into shallow water by ocean-currents, by storms, or unusual events in the ocean, and the depths at which they were supposed to live could only be conjectural. The specimens themselves were, for the most part, in a mutilated condition.

The first and only paper on the *Siphonophora* of the deep sea is by Prof. Studer *, who describes new species and genera of these animals which were found twisted on ropes and wires used in deep-sea dredging and sounding. All of these are closely related to a genus called *Rhizophysa*, which is itself allied to a Medusa called *Physalia*, or the "Portuguese man-of-war," which habitually floats on the surface of the ocean.

The most important work which we have on the *Acraspeda* (the ordinary jelly-fishes found in shallow waters) of the deep seas is a report † by Prof. E. Hæckel on a collection made by H.M.S. 'Challenger.' No one has done more than he to elucidate the structure of the jelly-fishes, and he stands without an equal in his contributions to a knowledge of the deep-sea members of the group. This work of Hæckel is, up to the

* 'Zeitschrift für wissenschaftliche Zoologie,' vol. xxi.

† "Report on the Deep-Sea Medusæ dredged by H.M.S. 'Challenger' during the years 1873–76." Report on the Scientific Results of the Voyage of H.M.S. 'Challenger' during the years 1873–76, vol. iv. no. ii.

present, the greatest contribution of any naturalist to the study of the Medusan representatives of the deep-sea fauna.

If space permitted one or two other smaller contributions might be mentioned; but these two works are the most important additions to our knowledge of the deep-sea *Acraspeda* and *Siphonophora*.

We have no complete account of the deep-sea jelly-fishes of the Gulf-stream. That great body of water, which sweeps along our coast from the Straits of Florida northward, bears a nomadic life, of the wealth of which no one has yet a just conception. Those who have studied the stream in all latitudes have spoken of this fact, and one needs but to lower a drag-net in its waters for a few minutes to become convinced of its truth. The surface of the Gulf-stream has been but partially explored, the inhabitants of its depths, except on the very bed, are unknown.

The means which have been used for the collecting of animals from intermediate depths are not all that could be wished for. There is a call for greater refinement in this kind of collecting. A common way of obtaining this life is as follows. The dredge, trawl, or drag-net drawn up from a great depth is found to bring with it a Medusa. That Medusa is recorded from the depth of the trawl. What then is the possibility that it entered the dredge on the passage up through the water? I think every one will acknowledge that the possibility is very great, and that the Medusa may or may not have come from the deep sea. A drag-net attached to a dredge-rope or wire is sometimes lowered to a certain depth and then drawn up. Here also we may ask, how is it known that the Medusa found in the net entered it at the recorded depth? A Siphonophore clinging to a wire-rope used in sounding or dredging may or may not, as shown by A. Agassiz, have become twisted upon it at the depth at which the animal appears to be found when brought on deck. "In most cases," writes Prof. Verrill, "it is impossible to say whether the novel forms of Medusæ taken in the trawl and trawl-wings are inhabitants of the bottom waters or the surface, or of intermediate depths. Eventually those that belong to the surface-fauna will doubtless be taken in the surface-nets; but this will require much more extensive collecting of the surface animals than has yet been attempted."

It will thus be seen that the means of determining the depth at which the collecting of free oceanic animals takes place are too imperfect for any accurate knowledge of the bathymetrical limits of so-called deep-sea Medusæ. We are, in fact, on the very threshold of this kind of research, and what is now most needed in the study of bathymetrical zones of marine life are improvements in the method of collecting at any depth, so that we can tell exactly at what distance below the surface a nomadic animal is captured. Devices have been suggested, one of which, the so-called "gravitating-trap" of Lieut. Sigsbee, has been described in the 'Bulletin' of the Museum of Comparative Zoology at Cambridge. I am not aware how extensively this apparatus, or others of similar kind, has been used by those who are in charge of deep-sea exploration, or whether it has been sufficiently tried to test its usefulness *. If Medusæ were always as abundant at great depths as they sometimes are at the surface, a device might easily be invented for the successful capture of at least a few specimens. It seems more probable that Medusæ are not common enough to warrant one in supposing them very numerous, and the difficulty in their capture thus becomes greater, rendering it necessary that some modification of the gravitating-trap be invented †.

In a letter to Mr. C. P. Patterson (Bull. Mus. Comp. Zool. vol. vi. no. 8) Mr. A. Agassiz calls attention to the uncertain methods adopted for ascertaining at what depths free-swimming animals live, and from experiments with the "Sigsbee Trap" concludes (p. 153), while he does not deny that there are certain genera of deep-sea Medusæ, that "the above experiments appear to prove conclusively that the surface-fauna of the sea is really limited to a comparatively narrow belt in depth, and that there is no intermediate belt, so to speak, of animal life between those living on the bottom or close to it and the surface-fauna."

This statement from such a high authority in the study of marine zoology would seem to effectually crush any murmur of belief in intermediate zones in the distribution of oceanic forms of life. While I have the highest respect for this view, I cannot help entertaining an opinion that more observations are necessary before we can accept the proposition that there

* "Results of Explorations made by the Steamer 'Albatross' off the Northern Coast of the United States in 1883," Annual Report Comm. Fish and Fisheries, 1883.

† The small amount of water which enters the Sigsbee gravitating-trap is one great objection to it. Negative results with this apparatus do not necessarily show that life does not exist at the depth at which the door is opened, and the instrument does not collect from a large enough area for a successful determination of the abundance of life which it is intended to capture. From what has been published, and statements of those engaged in deep-sea exploration, I am led to suppose that the "Sigsbee Gravitating-Trap" has given only negative data in regard to the problem of the existence of characteristic nomadic life in intermediate depths of the sea.

are not characteristic belts of pelagic animals at different depths.

With the question whether the recorded depths at which the Medusæ which we shall consider are found are accurate or not we cannot deal. Indeed at this stage of this kind of deep-sea exploration an examination of these methods would be foreign to the purposes of this paper. We take the data as given by the collector and at present leave the improvement of the collecting-apparatus to others.

Can we not approach this subject from another side? Are there any characteristics in the Medusæ themselves which show that they are preeminently fitted to live at the depths or approximate depths from which they are reported? Has their habitat left any traces in the modification of their anatomy? Has the uniformity of conditions in their habitat led to a corresponding simplicity in their structure, and are they nearer the ancestral forms than others with a more varied environment? An account of the singular structure of one or two typical genera may help us to answer this question, or at all events present certain facts which bear upon it. Let us therefore for illustration consider one or two representatives of the Acraspeda and Siphonophora discovered by the 'Albatross' in the depths of the Gulf-stream.

Every one familiar with the anatomical structure of the Siphonophores will recognize how difficult it is to find in those genera like *Rhizophysa* anything to point to an adaptation to a deep-sea life. The 'Albatross' has discovered new Physophores closely allied to *Rhizophysa*, one of which, *Petrophysa*, reaches the enormous size of 20 feet in length in alcohol. The float of this animal is larger than that of any true Siphonophore except *Physalia*. The large size of the float in these Physophores would seem an effective argument against their adaptation to a life in deep water, especially as their nearest ally, *Physalia*, is preeminently a surface form.

It is extremely difficult to gather from the structure of the known Siphonophora ascribed to the deep sea anything to indicate an adaptation to such a life. The group can afford little satisfaction in our answer to the question of whether there is a nomadic deep-sea life or not.

The nature of the argument for the existence of Medusan life in bathymetrical zones may be best illustrated by considering a few examples of the Acraspeda. These are not the only instances which might be chosen, and possibly are not the best. They are thought to be as suggestive as any among the Acraspeda which have been ascribed to great depths.

One of the most characteristic families of Acraspeda is called the Collaspidæ. The family is supposed to belong to the deep-sea and is represented by two genera, *Atolla* and *Collaspis*, which differ from each other rather obscurely in the regular or irregular arrangement of the sexual glands. It is a question whether we have more than specific differences in the features which have been pointed out by Hæckel as separating the two.

Up to the present the genus *Atolla* is represented by a single species collected by the 'Challenger' (*A. Wyvillii*, Hæck.) and two species from the Gulf-stream (*A. Bairdii* and *A. Verrillii*, Fewkes).

The structure of *Atolla* is thought to be more primitive than that of the ordinary inshore genera, *Cyanea* and *Aurelia*. It is so characteristic that I repeat from my paper on the anatomy of this genus a condensed notice of some peculiarities *.

If we compare *Atolla* with our common surface Medusæ, such as *Aurelia*, we notice many marked peculiarities.

In the former we have a coronal furrow, which is not represented in *Aurelia*, although found in a well-known surface Medusa (*Periphylla*). We have in *Atolla* a variable number (generally twenty-two) of sense-bodies or peduncles of the same. In *Aurelia* we have always eight sense-bodies. The coronal muscle is peculiar to *Atolla*.

The sense-bodies of *Atolla* are spoken of by Hæckel as rudimentary, and it is supposed that we have in a deep-sea Medusa an adaptation for a life in the depths into which the

* The umbrella, when seen from the upperside, is found to be divided by a deep ring-shaped groove into a central and a peripheral region. The groove is called the coronal fossa, the central region the *discus centralis*, and the periphery the corona. The corona is formed of a number of wedge-shaped gelatinous blocks, joined together and bearing on their outer rim alternately tentacles and sense-organs. These gelatinous blocks are designated by the term socle, taken from architectural nomenclature, and are of two kinds—those which bear the tentacles, called the tentacular socles, and those which carry the sense-bodies (if such exist), the socles of the sense-bodies. The socles of the sense-bodies bear two thin flaps, called the marginal lappets. On the underside of the disk we have, below the corona, a large ring-shaped muscle, called the coronal muscle, which is highly characteristic and larger in this genus than in any other known Medusa. Axially to this muscle there is a zone formed of eight kidney-shaped sexual glands and a simple mouth, which opens into a bag-shaped stomach. In the interior of the body there is a circular cavity filling the central disk, which opens by four orifices into a ring-shaped sinus, which lies in the gelatinous body of the corona. From the outer edge of this ring-shaped sinus simple, unbranched, peripheral tubes extend through the bell-substance, passing into the cavities of the tentacles and rudimentary marginal sense-bodies.

light never penetrates. We may have here what we so often find in deep-sea animals, a reduction in the size and efficiency of the special organ of sense to fit the Medusa for the conditions under which it must live at great depths. Stated in a startling way, we might speak of *Atolla* as a blind Medusa. This statement would hardly be justifiable, and we can at present go no further than to say that the special sense-bodies of sight * are supposed to be rudimentary. It must, however, be borne in mind that nowhere among Acraspeda do we have so many, twenty-two, sense-bodies as here. In some specimens there are twenty-eight sense-bodies in this genus.

It is extraordinary that one of the known species of *Atolla* (*A. Wyvillii*, Hæck.) comes from the Antarctic Ocean, while our two species were both from the *warm* (?) water of the Gulf-stream. In the southern hemisphere its lowest limit is about 2000 fathoms, while north of the equator it comes from the surface or within a few hundred fathoms.

Among the Medusæ collected by Lieut. Greely in the icy waters of Lady Franklin Bay is an interesting jelly-fish allied to *Atolla*. This genus (*Nauphanta*) has been found but once before, and then by the naturalists of the 'Challenger' in the neighbourhood of the island of Tristan d'Acunha in the South Atlantic. In the latter locality it is recorded from about 1500 fathoms, while in Lady Franklin Bay it is found at the surface. From several differences in these two specimens, those from the Arctic and those from the South Atlantic, I have supposed the boreal form to be new and have called it by the specific name *polaris* †. The 'Challenger' specimens were placed under a new genus, called by Hæckel *Nauphanta* ‡.

Before we consider the relationship between *Atolla*, *Nauphanta*, and other related Medusæ ascribed to the deep sea,

* Whether the "eye" of the jelly-fish can distinguish form or not has not been demonstrated. Simple experiments made by passing rays of light through dishes in which they are confined, or the simple fact that they almost always congregate on the illuminated side of the same, are not conclusive to me that they distinguish *form*. Experiments with sensitive plates to show the depths to which light penetrates the water are most suggestive in this connexion. It seems pertinent to the whole inquiry to ask whether looked at from the physical side there are not rays of light of such a nature that the vertebrate eye is not able to perceive them, but which may act upon the visual organs of other animals.

† *Nauphanta polaris* has a central disk as in *Atolla*, a coronal fossa, and a corona, which, however, is formed of sixteen socles, eight of which bear tentacles, tentacular socles, and eight sense-bodies. The outlines of these socles is more clearly marked than in *Atolla* on the upper surface of the corona which they form, on account of the deep sculpture which separates them.

‡ The name *Nauphanta* was preoccupied in 1879, when applied to this Medusa, having been given to a worm in 1864.

let me mention another new Medusa collected by the 'Albatross' in the Gulf-stream. The genus *Nauphantopsis* is of interesting affinities, since it has the same central disk as *Nauphanta* and *Atolla*, the same coronal fossa and coronal socles. It is most closely allied to *Nauphanta*, but has thirty-two socles instead of sixteen, eight sense-bodies (?), and twenty-four tentacles *. These tentacles are therefore arranged in threes, the series of three alternating with the eight sense-bodies—all with gelatinous socles.

It is easy to interpret the three deep-sea Acraspeda, *Atolla*, *Nauphanta*, and *Nauphantopsis*. At first sight they closely resemble gigantic young *Aureliæ* or *Cyaneæ* in a stage which is called the Ephyra. This is especially true of *Nauphanta*, which has the same number and arrangement of tentacles as the young *Cyanea* or *Aurelia* in the Ephyra stage. It is so close in fact that at first sight they seem identical. In *Nauphanta* we have mature ovaries, and this would seem to indicate the adult form. The existence, however, of ova and a sexual maturity is by no means an indication of the acquisition of the adult form among Medusæ, and many instances might be mentioned of a jelly-fish with mature ova even before embryonic appendages have been dropped. There is nothing then to prove that *Nauphanta* is not the young of some other Medusa, and on the other hand there is no proof that it is not an adult. If it is an adult, it is a mature Medusa with likeness to embryonic conditions of other Medusæ. It would then be nearer the ancestral form of Acraspeda than any of the more common Medusæ like *Cyanea* and *Aurelia*.

At first study I was inclined to regard *Atolla* as a giant Ephyra of some unknown Medusa. Its affinities are certainly very close to *Nauphanta*, and through the latter genus it is connected with Ephyra, the young of *Cyanea*. We may therefore regard both these genera as embryonic in their structure and as close allies of the young of a higher jelly-fish. It is a most interesting fact that two genera with such marked characters are considered deep-sea genera. Exactly what the

* *Nauphantopsis* is an interesting genus in its relationship to the surface-genus *Periphylla*, which has four sense-bodies and twelve tentacles in four series of three each. We likewise have in the same genus marked coronal socles, sixteen in number, while *Nauphantopsis* has thirty-two. *Nauphantopsis* then appears to be a connecting genus between *Nauphanta* and *Periphylla*. I believe we are justified in regarding *Nauphanta* as an adult, although when I first studied it I was strongly inclined to consider it an immature animal. It must be confessed that, with the exception that it has eight sense-bodies, while *Periphylla* has but four, there are strong resemblances between a young *Periphylla* and the genus *Nauphanta*.

evolutionist would expect from the uniformity of conditions which exist in deep water we find manifested in the simple anatomy of two of the more characteristic deep-sea genera of Acraspeda, a simplicity of structure of embryonic and therefore of ancestral nature. It is certainly strange that these two facts are associated. It is an extraordinary coincidence if the deep water at which the Medusæ were found and the embryonic affinities in their anatomy have not the relationship of Cause and Effect. The discovery of a *Nauphanta* in the icy waters of the Arctic zone *, while it shows that the genus may approach the surface when the temperature of the depth at which it lives becomes a surface-temperature, would also indicate that the genus is not confined to the great depth at which it is reported from the South Atlantic. If *Nauphanta* cannot rise to the surface in the latitudes of Tristan d'Acunha, it may be that the elevation of temperature above its habitat keeps it at great depths. At the higher latitude of North Greenland, however, the cold zone, in which *Nauphanta* lives in the South Atlantic, is about the surface-temperature. Here then, as far as thermal conditions go, the Medusa can rise to the surface. We here encounter what I believe will be found to be an influence of more important character in the modification of Medusan life at great depths than the depth of water itself. Medusæ are sensitive to changes of temperature in the ocean; so sensitive, in fact, that for many genera the lines of demarcation between warm and cold oceanic currents are often dead lines to these delicate creatures. It is well known that certain genera can be frozen without being killed by the change, and that Medusæ suffer less from a diminution in temperature than from an elevation of the same. This is particularly true of those genera, like *Aurelia*, *Sarsia*, and others, which habitually inhabit cold water. A temperature of $+70°$ F. is fatal to them, while many tropical forms will easily live even in higher temperatures. Temperature in the ocean has drawn invisible lines in the distribution of Medusæ in depth as well as latitude; and it is at present very difficult to separate this cause from that of pressure in the bathymetrical limits of the jelly-fishes. The poverty of our knowledge of the ranges of temperatures which jelly-fishes can endure is too great to admit of any generalizations of value on this question. Still there are no facts of more vital importance in the discussion of the question of whether there are deep-sea Acraspeda than those

* 'Report on the Medusæ collected by the Lady Franklin Bay Expedition,' Lieut. A. W. Greely commanding. Appendix no. xi.

which bring information of the thermal limits at which the Medusæ can live.

It would be profitable, if space permitted, to consider other genera of Acraspeda made known by the 'Albatross' in their bearings on the question which is the title of this paper. The three genera already considered present us the strongest arguments which can be found in the modification of external and internal anatomy, as indicative of a deep-sea habitat.

"Those Medusæ," writes Hæckel, "may be regarded with greater probability as permanent and characteristic inhabitants of the deep-sea, which have either adapted themselves by special modifications of organization to such a mode of life, or which give evidence by their primitive structure of a remote phylogenetic origin." He then enumerates those which he places in this category, among which are the two remarkable genera *Atolla* and *Nauphanta*. "It is by no means certain," writes Hæckel, "that all the eighteen Medusæ described below (Report on 'Challenger' Medusæ) are constant inhabitants of the deep sea." We have discussed the argument drawn from two of the most characteristic of the Acraspeda, viz. *Atolla* and *Nauphanta*, and can readily subscribe to this statement as far as these are concerned.

The resemblance of *Nauphantopsis* and *Atolla* to Ephyra is believed to have a morphological significance; Ephyra is thought to be the ancestral form of the Acraspeda, and these so-called deep-sea Medusæ still preserve the ancestral form with small modifications, except in size, repetition of organs, and certain other characters. Of the development of *Atolla* or of the Collaspidæ we know nothing, and yet a knowledge of this subject is possibly to reveal the solution of important questions. If the mode of growth should prove to be a direct development without a Scyphostoma, it would certainly increase my belief that these Medusæ somehow resemble the ancestral forms. I have already elsewhere shown that among the Hydromedusæ with alternation of generations and those with a direct development, the latter method is normal, while the former is a secondary modification. Among Acraspeda also the direct development of *Pelagia* is the ancestral method, while the formation of a Scyphostoma is a secondary modification. We should expect to find in *Atolla* a direct development if it be an ancestral genus. From its mode of life in the high seas we should also expect the same *.

* I believe the Lucernarians are degenerate adult Acraspeda, which have attached themselves to the bottom much in the same way as *Cassiopea frondosa*, and become modified in consequence. While it may be said that they are homologous to the Scyphostoma stage, it is not thought

Abandoning for the present as insufficient any evidence which might be adduced from the structure of the Medusæ themselves, and passing to the recorded facts in relation to bathymetrical distribution, we find no more satisfaction from this consideration. It would appear that the strongest arguments for the existence of nomadic deep-sea Medusæ of the Acraspeda are found by Hæckel in the following genera *. The names in brackets are authorities for distribution.

1. *Pectanthis.*—Surface (Hæckel).
2. *Pectyllis.*—200–600 fath. (Hæckel).
3. *Pectis.*—1260 fath. (Hæckel).
4. *Cunarcha.*—"Possibly captured in drawing up the lead" (Hæckel).
5. *Æginura.*—"2150 fath. apparently" (Hæckel).
6. *Periphylla.*—Surface (Fewkes).
7. *Periphema.*—1975 fath. (Hæckel).
8. *Tesserantha.*—2160 fath. (Hæckel).
9. *Atolla.*—2040 fath. (Hæckel); surface (Fewkes).
10. *Nauphanta.*—1425 fath. (Hæckel); surface (Fewkes).

Of the above genera the 'Albatross' has collected many specimens of *Periphylla* and *Atolla* from the surface of the ocean. Greely collected a species of *Nauphanta* from the icy waters of the surface of Lady Franklin Bay; *Periphema* is so closely allied to *Periphylla* that we may well hesitate to accept its limitation to the great depth at which it is recorded (1975 fath.); *Pectyllis* is recorded from 200 to 600 fath. In the present use of the word deep-sea this genus can hardly be regarded as preeminently a deep-sea Medusa. There remain † *Pectis* (1260 fath.) and *Tesserantha* (2160 fath.) as

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that they are ancestral. They are in reality secondarily modified, for the ancestral method of development is direct, without an attached young, in Acraspeda as in Craspedota.

While the primitive structure and relationship of *Atolla*, *Nauphanta*, and *Nauphantopsis* would seem to ally them closely to Ephyra, and stamp them as less modified than such genera as *Cyanea*, in certain anatomical details they might be regarded as higher even than the last mentioned. We cannot consequently draw from their simple relationship to an embryonic form the conclusion that they have retained that likeness on account of the simpler conditions of deep-water habitat. Nor is the argument drawn from the supposed abortion of the sense-body conclusive as far as these Medusæ are concerned, although it looks plausible.

* *Op. cit.* Introduction, p. ii.

† *Cunarcha* was "possibly captured in drawing up the lead," and *Æginura*, 2150 fath., "apparently."

As a bit of positive evidence that *Atolla* is a deep-sea Medusa, Mr.

the only genera in the above list which can be regarded as purely deep-sea in their habit. Each of these is described from *single* specimens, and the former is closely allied to well-known surface-genera. The foundation in observation for a belief in the existence of nomadic deep-sea Medusæ, as far as recorded depths go, is certainly not all that might be desired.

Possibly a stronger argument for the existence of deep-sea Acraspeda may be drawn from the structure of the interesting free genus of Lucernaridæ (*Lucernaria bathyphila*, Hæck.). This species is recorded from 540 fath. The fixed *Lucernariæ* are found in shallow water. The argument drawn from the structure of the free Lucernarian would be stronger if the so-called attached species had been brought up from great depths or if Scyphostoma had been reported from the ocean bed. It is suggested that those who have in charge the collecting of deep-sea animals observe with care the contents of the dredges for attached Scyphostoma and Lucernarians, and it is particularly desirable, from a morphological standpoint, that the development of such genera as *Atolla* be known. If it can be shown that this and related Medusæ have an indirect development, with an attached Strobila living in great depths, they may rightly be called deep-sea Medusæ. A nomadic jelly-fish, limited in bathymetrical habitat, could best fulfil its conditions of life by having a direct development without attached larval conditions.

Why cannot we suppose that deep-sea Medusæ can live at the surface and also at great depths? Why look for bathymetrical zones in the ocean for nomadic animals? The main reason seems to be the exceptional nature of such a wide distribution in places so widely separated in physical characteristics. It may be possible for a Medusa to live equally well at the surface and under a pressure of 2000 fath. of water, and in the different temperatures of these two regions; but if they can endure these widely different conditions, they do not resemble other animals and their own relatives from the shallow waters. The logical inference from what is known of the differences between the facies of deep-sea animals on the ocean-bottom and those from the littoral zone would seem to be true of animals which are not fixed to the ground nor

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Thomas Lee, who has seen the genus when collected, informed me, after I had shown him a specimen of *Atolla*, that he remembers it in deep-water trawls. In new collections made by the 'Albatross' in 1885–86, *Atolla* in several instances is recorded from the "surface," and one of those described in the collections of 1883–84 is recorded from the surface.

dependent upon it, viz. that there are bathymetric limits in the ocean, even to nomadic animals apparently as helpless as the Medusæ.

In closing my short discussion of the question of deep-sea nomadic Medusan life it may be said that, as far as the data thus far gathered go, neither the recorded depths nor the structure of the genera considered demonstrates that we have a serial distribution of free Medusæ in bathymetrical zones. While our present information is insufficient to answer the question, *it seems* to me that the case is much stronger than the arguments which can be advanced in its support. There is little doubt that Medusan life has bathymetrical limitations. Our well-known surface Medusæ probably cannot live at great depths, and their places are probably taken there by others; still, until there are more exact data bearing on this conclusion, it cannot be demonstrated to be true. What is now needed is, in the first place, an accurate determination of the depth at which Medusæ of different genera are captured, and secondly a more accurate study of the peculiarities of anatomy and development of those which are supposed to be thus limited in habitat. It is also equally necessary that the surface-fauna should be better known for comparison. There are at present a few marine stations in the Mediterranean and North Atlantic where the study of surface-life is zealously prosecuted; but it is only when the Müller's net has been used with equal zeal in the South Atlantic, the Indian Ocean, and Pacific that we can have a basis to work upon. An exploring vessel on a cruise through these waters is not enough. It is a reconnaissance. There must be established permanent marine stations where the study will be carried on year after year for a long time in one locality.

XXXI.—*New Species of* Lucanidæ, Cetoniidæ, *and* Buprestidæ *in the British Museum*. By Charles O. Waterhouse.

Lucanidæ.

Hexarthrius Davisoni, n. sp.

Color *Lucani cervi* et eodem sat similis, capite thoraceque magis rugosis; mandibulis elongatis, nitidis, nigris, apicem versus inclinatis, intus quadridentatis, dente basali valido. ♂.

Long. 23–26 lin.; mandib. $11\frac{1}{2}$–13 lin.

Allied to *H. Bowringii* and of nearly the same form, but with the elytra sculptured as in *Lucanus cervus*, except that the suture is smooth and shining. Head very broad, a little broader than long, flatter than in *H. Bowringii*, very closely and moderately coarsely granular, much wider in front of the eyes than behind, where there is a slight swelling. Mandibles very obscurely granulose-punctate, much less deflexed than in most species of this genus, very straight, curving in at the apex, somewhat flat on their upper surface, vertical and flat on the outside. There is a strong tooth close to the base (obliquely truncate at its apex in the larger example), a small obtuse tooth at the middle, a larger one near the apex, and a very small one close to the apex. The clypeus is deflexed, angularly produced in the middle, with a short, truncate, reflexed lobe on each side, which gives the clypeus (when viewed from above) the appearance of being deeply emarginate. Thorax as in *H. Bowringii*, but not quite so short, very slightly narrowed in front, densely granular, the granulation less distinct and the surface more shining on the disk. Scutellum densely and finely punctured. Prosternal process narrow and obtusely keeled, not broad and flat, as in *H. Bowringii*.

Hab. Animallai, Koimbatur (*W. Davison, Esq.*). Brit. Mus.

Cetoniidæ.

Genyodonta Jacksoni, n. sp.

General form and colour of *G. flavomaculata*. Brownish yellow, the elytra with a yellow patch on each, as in *flavomaculata*, not extending to the apex. Thorax with four black spots. Scutellum with two black spots. Each elytron has a distinct black spot at the base close to the scutellum. There is a black spot on the mesothoracic epimera, another on the metathoracic epimera, usually four spots on the metasternum, and one on the underside of the posterior femora.

♂. Head as in *G. flavomaculata*, but with the ridge at the base of the antennæ more elevated, more compressed, with its angle obtusely rounded, not nearly so porrect as in *G. quadricornis*. Length $11\frac{1}{2}$ lines.

Hab. Massai, S.E. Africa. Brit. Mus.

This species may at once be distinguished from its allies by the black spot at the base of the elytra, which are moreover much smoother than in *G. flavomaculata*.

Mr. Jackson met with this species in considerable numbers, and there is very little variation among the specimens.

Macronota ochraceipes, n. sp.

Nigra, supra surda, subtus nitida; capite vittis duabus, thorace vittis quatuor et punctis duobus basalibus ochraceis; elytris rubris, sutura, plaga communi quadrata mediana (medio gutta ochracea notata), vitta obliqua humerali (plaga mediana attingente) maculaque apicali nigris; abdominis lateribus ochraceo-maculatis, pygidio maculis tribus ochraceis ornato; clypeo, tibiis tarsisque rufo-ochraceis.
Long. 10 lin.

Very near to *M. quadrivittata*, but larger and with somewhat different arrangement of colour. The front of the clypeus is reddish yellow and shining, less closely punctured. The thorax is rather broader, impressed at the posterior part. The four stripes are placed nearly as in *M. quadrivittata*, but they do not reach the base of the thorax, and at the base there are two short oblique spots not quite united to the two median stripes. The scutellum has a very narrow yellow border. The oblique black stripe extending from the shoulder to the square patch on the suture unites with the patch in one of the examples. There is a very small yellow spot on the humeral stripe in one specimen. The spots on the pygidium are large, the middle one elongate. Antennæ reddish yellow, with a black spot on the basal joint. The femora are black, with the upper surface and apex reddish. The anterior tibiæ have two teeth besides the apical one. There is a round yellow spot on the outer part of the posterior coxæ.

Hab. Animallai Hills, Koimbatur (*W. Davison, Esq.*). Brit. Mus.

Macronota flavosparsa, n. sp.

Nigra, opaca; capite vittis duabus flavis; clypeo vix emarginato, margine perparum reflexo; thorace vittis quatuor maculisque baseos obliquis flavis; scutello flavo-limbato; elytris macula communi mediana, altera apicali, duabus lateralibus flavis; corpore subtus nigro nitido, ad latera plus minusve flavo.
Elytris vel rubris nigro-vittatis, vel totis nigris.
Long. 7 lin.

Very similar to *M. quadrivittata* ♂ in general appearance, but the two middle stripes on the thorax converge posteriorly and generally unite at a short distance from the base, where there are two separate oblique spots. The yellow stripes on the head are rather broad, and there is a rather large spot above each eye. The thorax is parallel at the sides posteriorly, obliquely narrowed anteriorly, impressed at the basal lobe. The punctures on the disk are moderately close together, confluent and linear at the sides and anterior angles, yellow. The lateral stripe unites with the discoidal stripe at the front margin. The elytra are dull red, the suture, a quadrangular patch (common to both elytra) at the middle, a stripe from the humeral callosity to the middle patch, and a sublateral stripe black. There is a yellow spot across the suture about the middle, a lateral spot on the margin before the middle, and a second behind the middle, and a yellow mark at the apex, which, with its companion on the other elytron, forms an *x*. There are a few other small yellow spots scattered irregularly over the surface. The pygidium is almost entirely yellow, as are all the lateral parts of the underside of the insect. Club of the antennæ moderately long.

Variety 1, ♂.—The discoidal stripes on the thorax narrower, the lateral ones not extended to the anterior angles of the thorax. Elytra black, with the yellow spots as in the preceding. Pygidium black, with a basal line (emitting a short line from its middle) pale yellow. Pale yellow at the sides of the underside of the insect more broken and forming transverse spots at the sides of the abdomen.

Hab. Animallai Hills, Koimbatur (*W. Davison, Esq.*). Brit. Mus.

Variety 2, ♀.—Clypeus distinctly but not deeply emarginate, strongly punctured, the margin not reflexed. Discoidal stripes of the thorax broad, united posteriorly, and forming a V; lateral stripes not extending to the anterior angles. The black on the elytra much more extensive and occupying the greater part of the surface; the lateral spots absent; the apex yellow, but the yellow does not ascend the suture. The striæ near the suture are yellow. The pygidium with a very narrow basal line and a very broad central patch yellow. Underside of the insect with large yellow spots at the sides, those on the abdomen transverse and divided on the margin.

Hab. French Rocks, Seringapatam (*Mrs. Hamilton*).

Variety 3, ♀.—Like no. 2, but with the lateral stripe of the thorax nearly united with the basal spot. The elytra almost entirely red, with only two short black stripes. The spots at the sides of the abdomen simple. Club of the antennæ a trifle shorter.

Hab. French Rocks.

Variety 4, ♀.—Similar to no. 3, but with the discoidal stripes of the thorax uniting before the middle and continued posteriorly as one broad band to the basal spots with which it unites; the lateral stripe reduced to two very small spots. The red colour of the elytra prevails; the yellow at the apex inconspicuous. Pygidium with an oblong spot in the middle. Abdomen with transverse spots at the sides.

Hab. Koimbatur (*M. J. Walhouse, Esq.*).

Buprestidæ.

Chrysochroa alternans, n. sp.

C. fulgidissimæ affinis et similis, obscurior, creberrime fortius punctata, æneo-viridis, subaurata, thorace elytrisque cupreo-rufo-vittatis.

Long. 17 lin.

Very similar to *C. fulgidissima*, but less brilliant, with less golden tints; relatively shorter and more strongly punctured throughout, especially on the disk of the thorax. The elytra are distinctly enlarged at the middle, and are consequently less gradually narrowed to the apex, which is slightly truncate, the sutural angle slightly dentiform. The costæ are strongly marked.

Hab. Loo Choo. Brit. Mus.

XXXII.—*On the Nature of the Opaque Scarlet Spherules found in the Chambers and Canals of many Fossilized Foraminifera.* By H. J. Carter, F.R.S. &c.

In the number of the 'Annals' for last month (p. 172), while describing two new species belonging to the Loftusiidæ, I had occasion to lay particular stress on the presence in them, as well as in *Loftusia persica*, of "opaque scarlet spherules," which, although for the most part dispersed through the substance of the fossil, are nevertheless frequently to be seen in the chambers of the foraminiferal tests that have been taken in by each of these species, from which it may fairly be assumed that all had this origin; and these spherules I have further assumed to be representative of the reproductive bodies of the Foraminifera from observations which led to this conclusion (p. 177). Such observations, however, it was necessary to summarize briefly on that occasion, as my object then was chiefly to describe the new species of Loftusiidæ and not the reproductive process of the Foraminifera. But now that the former has been done I propose to return to the latter (so far as the scarlet spherules are concerned) more particularly, and for this purpose it seems best to describe how I came to regard the scarlet spherules as reproductive bodies, and thus recognized them in *Loftusia persica*.

In limine, then, it should be premised that there is a small portion of Eocene formation on the western side of India, in the neighbourhood of the towns of Surat and Broach, in the province of Guzerat, which is thus described by Medlicott and Blanford in their 'Geology of India,' pt. i. p. 340 (1879), viz. :—"North-west of Surat are thick beds of ferruginous clay, assuming, where exposed, the characteristic brown crust and pseudo-scoriaceous character of laterite, from which they differ in no respect." These rest on "the traps," and "with them are interstratified beds of gravel or conglomerate containing agate pebbles (the agates being derived from the traps) and limestone, sometimes nearly pure, but more frequently sandy, argillaceous, or ferruginous, and abounding in Nummulites and other fossils. The thickness of the whole can only be roughly estimated as between 500 and 1000 feet." From this formation, about midway between Broach and Surat and the town of Bang, at the village of Wasna or Wansa, that is about 39 miles west-north-west of Broach, the late Major Fulljames picked up some fragments, which he sent to me at the Bombay branch of the Royal Asiatic Society in the year 1853, and of which an account will be found in the 'Journal' of that society (vol. v. p. 624 &c.).

Some years afterwards, that is in 1861, I noticed that some of the fragments contained foraminiferal tests in a brilliantly coloured and infiltrated state, to examine which more particularly I broke up a piece, and from it extracted several small specimens of *Nummulites* and *Orbitoides*, which, on being ground down to a smooth surface and thus applied to a "glass slip" by means of Canada balsam, presented under a low power of the microscope sections of unwonted structural clearness and definition, in which the whole of the complicated and delicate parts, both shelly and sarcodic, of the Foraminifera could be seen even better than in the recent specimen. Further, they were more or less charged with the "opaque scarlet spherules" in such situations that they could not be regarded as anything but fossilized parts of the recently living animal; nor could any opinion be formed of their nature than that they were the representatives in a mineralized state of its reproductive elements.

I therefore did not hesitate to regard them as such, and so, for confirmation, gave them, in connexion with similar objects in recent specimens of *Operculina*, as illustrations of the reproductive process, probably in the Foraminifera generally ('Annals,' 1861, vol. viii. pp. 318 and 319, 325, and 451, and pl. xvii. figs. 12–15 and 1, *o*). But being then in India I was not aware that Max Schultze had previously noticed and delineated similar bodies in the chambers of *recent Rotaliæ* ('Organismus der Polythalamien,' 1854, p. 27), nor that he had shortly after, viz. two years, verified this in a species of *Miliola* (Müller's 'Archiv,' 1856, Nos. 1 and 2, p. 165, Taf. vi. B).

However, here I left the subject, and here it would have remained for myself had not accident thrown in my way the fossil for which I have proposed the name of "*Stoliczkiella Theobaldi*," wherein I was surprised to find, both dispersed through its substance and in the chambers of the enclosed foraminiferal tests themselves, red bodies similar in every respect to those observed in the Wasna specimens, as stated in the communication to which I have alluded. I then sought for the same in my mounted slices of *Loftusia persica*, where they were equally abundant; and finally found them again equally plentiful in that species for which I have proposed the name of "*Millarella cantabrigiensis*" (*l. c.*). So that, but for these coincidences and this chain of evidence, which an experience of twenty-seven years has thus brought to light, the nature of the Loftusiidæ in this respect might have remained unknown for a considerable time.

It should be noticed here that the only coloured portions in the infiltrated specimens from Wasna are the sarcodiferous cavities and the scarlet spherules, while the shelly parts remain opaque white or transparent, as the case may be; thus the chambers and the intercameral tubes, together with the canal-system, are all more or less filled with bright ochre-yellow substance, while the reproductive bodies vary both in point of colour and size, as will be stated hereafter, but are of course most striking by contrast where composed of opaque scarlet or bright rusty-red substance, which renders their presence so peculiarly distinct in these instances that they may be counted under the microscope as easily as peas in the palm of the hand.

Among the specimens of infiltrated Foraminifera from the Eocene of the locality mentioned I am enabled, from the varied sections which they present, to select a series which clearly demonstrates the following facts as regards the "scarlet spherules," viz.:—

At the earliest stage in which they can be distinguished they are colourless or slightly opaque, indistinct, and situated singly in the cells of an areolar structure which fills the chamber of the Nummulite. Next they present themselves in a more defined form, of an opaque yellowish-white colour, but still adherent to each other or clustered. In a third stage they are more separated, semitransparent, and of a brown colour, recalling to mind, from their sphericity, when imbedded in clear calcspar, ova in the "hard roe of a herring." Lastly, they present themselves as the "opaque scarlet spherules" above mentioned.

In size the "scarlet spherules" vary from 1-600th in. down to about 1-7000th in. in diameter, which is that of the *interior* of the intercameral tubes, in which they may be seen to be arranged linearly, by reason of the narrowness of the tubes, while in their larger forms they may also be seen in the chambers and in the vessels of the canal-system, grouped in the former, and linearly arranged if in plurality in the latter, for the same reason. But, wherever they may be, they are *always confined* to the sarcodiferous cavities of the test, by which they cannot be confounded with any *in*organic mineralization.

In number they are most abundant where developed in the areolar tissue of the chambers, when they are of medium size, and each areolar cell appears to be tenanted by only one body; when a little larger and in an opaque scarlet state they are less numerous, but vary much in this respect as well as in size in the chambers where they may be present, unless one or more have passed into one of the vessels of the canal-system, in which case they are from its narrowness, as before stated, single, or if in plurality linearly disposed; lastly, in their largest form, that is when 1-600th in. in diameter, they are generally single in a chamber where there appears to be nothing else, when they may be seen to be composed of a delicate spherical capsule filled with extremely minute opaque red spherules.

Under such circumstances it is hardly possible to regard these bodies otherwise than as elements of reproduction, even if we had not recent specimens (where of course they are not *red*, as this is the effect of mineralization) to compare them with; while they are so abundant in some specimens of these infiltrated Nummulites as to fill not only the large marginal chamber but the whole of the shoulder-like processes of this cavity, which are extended laterally on both sides of the Nummulite up to the summit of the disk, thus according with the extremely prolific nature of these Rhizopodous animals, as indicated by the accumulation of their tests in deposits of bygone ages, as well as those of the present day, in localities where they prevail.

What relation the large opaque scarlet spherule has to the smaller ones I am not able to say, nor is it my business here to inquire. Suffice it to observe that it has not yet been shown that *sexual* reproduction exists in the Foraminifera, on which this difference in size may be thought to bear, however clear it may be that some of the opaque scarlet bodies in their living and consequently uncoloured state may become new individuals.

Another point worth noticing in the infiltrated Foraminifera of the specimens from the Eocene of Western India to which I have alluded is that they appear not only to have died in the midst of their fecundity, as many of the chambers are literally crammed with these spherules of one colour or another, but from their wonderful state of preservation generally to have undergone the metamorphism of fossilization before their soft parts had passed into dissolution. Sometimes, however, in some parts the red colouring-matter of the scarlet spherules appears to have become diffused, as if the material which takes the red colour in mineralization had previously been in a diffused state.

Although the Foraminifera taken in by *Loftusia persica*, *Stoliczkiella*, and *Millarella* do not present the brilliant coloration generally which renders the different structures so clear and impressive in the Wasna specimens, their forms are rendered recognizable by the presence of the white shelly skeleton or test with the "opaque scarlet spherules" not only in their cameral cavities, but scattered through the mineralized substance of all three fossil species, which, when living, appear to have fed upon them so abundantly that in some parts the structure is rendered absolutely red by their presence, at once evidencing the great fertility of the Foraminifera, as before stated, and the probable object for which they had been taken in by the *Loftusia*. Neither is the colour influenced in this respect by that of the deposit in which they are found imbedded, for that of *Loftusia persica* is in grey limestone and that of *Millarella cantabrigiensis* in chalk.

In the other specimens of *Millarella* to which I have alluded (footnote, p. 180 *loc. cit.*) the same kind of foraminiferal detritus is present, but there are *no* "scarlet spherules," from which it must be inferred that the tests were taken in and fossilized under different circumstances, that is that they were not in a state of fecundity like those containing the *scarlet* spherules, or that the fossilization failed to render these reproductive bodies *red.* Thus the presence of these bodies in a red-coloured state is of no specific value.

Moreover, I have observed them scantily here and there in Nummulites contained in a specimen of highly ferruginized yellow deposit from Upper Sind, which is almost entirely composed of the larger forms of the Foraminifera, while for the most part their chambers are charged with the same kind of bodies in a defined but uncoloured or whitish-yellow state, like those above mentioned in the Wasna specimens.

Again, when I had discovered them in the Wasna specimens so wonderfully preserved, I was induced to obtain more if possible, so wrote to a friend at Broach to get me some; but all that I received in reply was a packet of *Nummulites* and *Orbitoides*, each about the size of a shilling, which certainly possessed the yellow colour of the deposit, but without the presence of any of the opaque scarlet spherules or even any thing beyond the definition of structure observed in Nummulites generally. Were I to seek for specimens brilliantly coloured, similar to those of the village of Wasna, I should be inclined to search for them in the most *lateritized* parts of the deposit, where they have become brick-red by the profuse diffusion of ferric oxides that characterizes this formation.

In speculating as to the nature of the animal of the Loftusiidæ in the paper to which I have alluded (p. 181), I omitted to notice that at the circumference of the specimen of *Millarella cantabrigiensis* the structure indicates that the whole commenced in a reticulated plastic substance, in which the "pits or vacuities" brought to view in the horizontal section represent the interstices, while, as the animal increased in size, this structure inwardly became more compact and then developed the "circular divisions" or inspissations represented in fig. 6 of my illustrations (pl. xiii. *l. c.*). To which I would add that the so-called "labyrinthic" structure of *Loftusia persica* may be the fossil representative of a similarly composed solid plasmic structure, although it now looks tubular.

How far these organisms may be allied to typical Foraminifera I am not prepared to say; but of this I am certain, that if such Rhizopodous organisms are to be included among them, they should have a distinct and appropriate diagnosis.

N.B.—To get a clear impression of the composition of a fossil under the microscope from the surface of a section it should, when not overlaid permanently by Canada balsam and a glass cover, be overlaid for the occasion by a little *water* and a glass cover; otherwise the roughness of the dry surface alone, however much it may be polished, will render the examination most imperfect and unsatisfactory.

XXXIII.—*On Longicorn Coleoptera of the Family* Lamiidæ. By Charles J. Gahan, M.A., Assistant in the Zoological Department of the British Museum.

[Plate XVI. figs. 1–5.]

Æthalodes, n. g.

Head of moderate size and strongly concave between its antennal tubercles; the latter rather short and somewhat distant; front convex, subequilateral. Last joint of palpi ovate-cylindrical. Antennæ scarcely longer than half the body; scape stout, subcylindrical, slightly curved, somewhat expanded at the apex, the latter with a small but distinct cicatrice; fourth joint equal in length to the second and third united, distinctly shorter than the scape.

Prothorax acutely spined at the sides and with large rounded tubercles on the disk.

Elytra oblong, rough, with alternating rows of larger and smaller granules, rounded at the apex, and each elytron having at its base a small median projection.

Legs subequal, the posterior a little longer than the anterior or middle; femora linear; middle tibiæ emarginate.

Pro- and mesosterna simple. Metasternum moderately elongate.

This genus is allied to *Trachystola*, of which it has the general form, but from which it may be readily distinguished by the short third joint of its antennæ, by the peculiar tuberculation of its thorax, and the less prominent median projection at the base of each elytron.

Æthalodes verrucosus, n. sp. (Pl. XVI. fig. 1.)

Niger, squamositate fusca indutus; antennis concoloribus; prothorace lateribus acute spinoso, dorso quinque tuberculis; elytris seriato-granulatis, apicibus rotundatis.

Long. 23–28 mm., lat. 10–11 mm.

Hab. North China.

Black, covered (excepting the tubercles of the thorax and the summits of the granules of the elytra) with a dark brown squamosity. Head impunctate. Prothorax acutely spined at the sides, with five tubercles on the disk, of which one (median), much larger than the others, is emarginate behind and somewhat heart-shaped; two are placed one on each side in front of this, while the remaining two, quite small and, at first sight, scarcely noticeable, lie one on each side of and close to the large median tubercle, whose free lateral borders overlap and partly conceal them.

Elytra with four rows of larger and five of smaller granules on each, and in addition a short row of smaller granules on the outer margin of each extending about one third of its length from the base. The sutural row of smaller granules appears double at the base, owing to the presence of a few granules of larger size on each side of the scutellum, and extending in a curve on to the median process of the base.

Epepeotes uncinatus, n. sp. (Pl. XVI. fig. 2.)

Niger, viridi-griseo pubescens; capite et prothorace supra albo trivittatis, vitta media prothoracis angusta, evanida; elytris albo bivittatis, nigro maculatis, apicibus truncatis.
Long. 14–28 mm., lat. $4\frac{3}{4}$–9 mm.

Hab. North India.

Black, with a greyish-green pubescence, which is darker on the head and prothorax. Head with three white vittæ on the vertex and one behind the lower lobe of each eye. Thorax with three white vittæ above, the middle one narrow and faint, and in some specimens almost entirely absent; a white vitta on each side just above the coxa, continued on to the sides of the breast. The lateral vittæ on the dorsal side of the thorax are continued on to the elytra through their entire length as two more or less distinct white bands; in some specimens these bands appear as nothing more than lighter portions of the pubescence, passing gradually into the darker shades on each side.

Elytra with numerous small black spots, apices truncate, the angles not produced. Abdomen with a single row of white spots on each side. Legs and first joint of antennæ coloured like the rest of the body; the remaining joints of the antennæ in the male fuscous, in the female dark grey, with their apices fuscous. Mesosternum feebly tubercled.

This very distinct species bears, in the British-Museum collection, the manuscript name which I have adopted.

Though an apparently common species, I have been unable to find any description of it.

Epepeotes albomaculatus, n. sp.

E. punctulato affinis, sed differt maculis elytrorum majoribus et paucioribus, vitta media thoracis brevi, abdomine quatuor seriebus maculorum.

Long. 25–30 mm.

Hab. North India.

In colour and general appearance this species much resembles *E. punctulatus*, Westw.; it is, however, a little larger, the median vitta of the thorax stops short behind at about one third of its length; the white spots on the elytra are much larger and fewer in number; they vary in size, the largest being at the middle of each elytron. The elytra are quite smooth behind and without any trace of carinæ, their apices are transversely truncate, with all the angles very slightly produced. Each of the first four abdominal segments has two white spots, the fifth one spot, on each side. The three specimens are apparently all females.

The species (*E. punctulatus*) referred to above is, I believe, synonymous with *E.* (*Monohammus*) *guttatus*, Guér., which is placed in the Munich Catalogue in the genus *Euoplia*. A specimen of the former in the British-Museum collection is Dejean's *Monohammus guttatus*, and a second specimen of Chevrolat's collection is ticketed *guttata*, Guér. To the genus *Epepeotes* must also be added the *Monohammus lateralis*, Guér. *Epepeotes meridianus*, Pasc., is probably synonymous with it.

Pelargoderus flavicornis, n. sp. (Pl. XVI. fig. 3.)

♂. Niger, griseo pubescens, fusco mixtus; antennis corpore paulo longioribus, articulis primo et secundo nigris, cæteris flavis, apicibus fusco-ferrugineis; prothorace lateribus modice tuberculato; quoque elytro pone medium macula magna, nigra, nitida; apicibus subrotundatis.

Long. 26 mm., lat. 9 mm.

Hab. Nias Island.

Black, with a short greyish pubescence mixed with fuscous. Antennæ in the male a little longer than the body, the scape and second joint black, the remaining joints rather thick, flavous at the base and dark ferruginous at the tips. Thorax with fairly well-marked lateral spines. Elytra with a large black shining spot on each behind the middle; apices slightly obliquely truncate or almost rounded. Legs greyish pubescent; anterior tibiæ in the male somewhat twisted, feebly dentate along their lower border, with a distinct tooth near their tarsal end. The first two joints of the anterior tarsus in the same sex somewhat laterally expanded. Mesosternum with a small conical tubercle.

This species is very distinct, almost generically so, by reason of the shortness and greater thickness of its antennæ. In no other species of *Pelargoderus* are the antennæ in the male less than twice the length of the body. The greater size of the spots on its elytra and the lighter colour of its antennæ are also marks which will easily differentiate it from other species.

Monohammus rivulosus (Pasc. MS.), n. sp.

Omnino pubescens, punctis dispersis nonnullis elytrorum exceptis; capite, prothorace, cruribus et corpore subtus griseis; elytris brunneis albo vittatis; antennis griseis, articulis a tertio apicibus fuscis.

Long. 18–26 mm., lat. 6–9 mm.

Hab. North India (Assam) and Laos.

Head, thorax, the underside of the body, and the legs dark grey and somewhat glossy. Antennæ grey, with the tips of the third to the last joint dark brown. The elytra are of a light brown colour, streaked with dull white; one broad streak sets out from the shoulders, and, after passing obliquely inwards, runs close to and parallel with the suture for the rest of its distance; posteriorly a very narrow stripe of brown divides it into two; in addition to these there are two narrow stripes of white posteriorly, all uniting towards the apex, and a short white streak below the shoulder. The elytra are minutely punctured and have also some large, widely scattered, shallow punctures, which give them a somewhat spotted appearance. The apices are rounded.

Monohammus ciliatus, n. sp.

Æneo-niger, sparse ochraceo-pubescens, prothorace brevi, lateribus fortiter spinosis, spinis recurvis; elytris punctulatis, ad basin minute granulatis, apicibus rotundatis, angulis suturalibus leviter productis; antennis fuscis, subtus ciliatis.

Long. 27 mm., lat. 9 mm.

Hab. China.

Black, with an ochraceous pubescence entirely covering the head, legs, and underside of the body, but limited to more or less confluent spots on the thorax and elytra. The head deeply and triangularly concave between the antennal tubercles, and longitudinally sulcate. Thorax much broader than long, the lateral spines very long and directed somewhat backwards, very closely and finely punctured on the disk, the latter with a slight median lobe or swelling near its base just in front of and faintly projecting over the posterior transverse groove. Elytra very finely granulate at the base, the granules replaced behind by very close and somewhat fine punctures, which extend almost to the apex; the latter rounded, with the sutural angles very slightly produced. The last two joints of the antennæ are broken off in the two specimens under observation; the remaining nine are together about as long as the body, the scape and second joint are covered with an ochreous pubescence, the other joints show a trace of pubescence above, and all are fringed with hairs beneath. Both specimens are, I believe, females.

The ciliate antennæ and the rather short prothorax, with its long and recurved lateral spines, are characters which make the species doubtfully a *Monohammus*.

Haplohammus speciosus, n. sp.

Pube olivaceo-aurea velutina tectus; capitis fronte sparse et minute punctulata; prothorace haud levi, antice et postice transverse bisulcato; elytris minute subseriatim punctulatis, apicibus subrotundatis.

Long. 15–23 mm., lat. 5–8 mm.

Hab. China and Hong Kong.

Completely covered with a dense, golden-olive, velvety pubescence, with shades varying in different lights. The pubescence is as bright on the under as on the upper side of the body, is less bright on the legs, and is rather dull on the front of the head and on the basal joint of the antennæ. A narrow median impressed line along the face and occiput. Cicatrice of scape pubescent, its margin not quite complete. Bases of third to eleventh antennal joints yellowish brown, clothed with a faint grey pubescence (denser in the female), the apices fuscous ferruginous. The prothorax appears slightly uneven on the disk; but this is chiefly due to the ruffled-looking pubescence; it has four transverse grooves, two anteriorly, of which one is very close to the anterior border, and two posteriorly; a faint median lobe or process abuts slightly on the anterior of the two latter grooves. A few punctures on each side of the middle of the disk. Elytra smooth, minutely and somewhat seriately punctured, the punctures visible only on the basal half. Apices somewhat angular, almost rounded. Anterior femora, especially in the male, stouter than the posterior pairs.

The only described species with which the present one might be confused are *M. permutans* and *M. vicinus* of Pascoe, yet from these it is very distinct. In each of these two species the legs are varied with brown, the prothorax above is more punctured, and the transverse grooves are scarcely distinct, while the elytra are coarsely enough granulate at the base, with small black granules. They are, taken altogether, much coarser-looking species.

Haplohammus socius, n. sp.

H. specioso simillimus, sed differt colore pallidiore, capitis fronte impunctata, prothorace paulo longiore, leviore.

Long. 19–21 mm., lat. 6–7 mm.

Hab. China.

Very like the last species, but with a paler and somewhat silvery pubescence. The front of the head impunctate; the prothorax somewhat longer than in *speciosus*, more even on the disk, with an appearance of a faint longitudinal median ridge, the transverse grooves less distinct, but still quite apparent.

Dihammus spinipennis, n. sp.

Griseo-fusco pubescens; antennis concoloribus, ♂ longissimis, scapo minute et sparse nigro-maculato; prothorace supra inæquali, minute granuloso, subtus plicato; elytris ad humeros rectis, apicibus truncatis, angulis externis valde spinosis.

Long. 32–34 mm., lat. 11–12 mm.

Hab. New Caledonia.

Brownish grey; the antennal tubercles in front, the scape of the antennæ, the underside of the body, and the legs with minute scattered black spots, due to punctures, from each of which springs a short white bristle. Head with its sides and vertex darker than its front. Prothorax somewhat uneven on the disk, with numerous very small black granules on each side and extending on to the lateral spines. Scutellum pale, with a narrow black line in the middle. Elytra straight at the shoulders, minutely punctured throughout, apices truncate, with the outer angles strongly spined, the sutural angles not produced. The anterior tibiæ in the male slightly toothed near their tarsal end. First joint of anterior tarsus in the male long, and produced on its outer side into a spur. Smaller than *longicornis*, Thoms., and distinguished, *inter alia*, by the long spines to the elytra.

Cyriocrates Waterhousei, n. sp. (Pl. XVI. fig. 4.)

Niger, squamosa pubescentia viridi-cærulea; prothorace supra æquali, macula longitudinali nigra subdepressa media; elytris ad basin granulis parvis, nigris, maculorum nigrorum tribus seriebus transversis; antennis ♀ corpore paulo brevioribus, articulis basalibus viridi-cæruleis, cæteris nigris.

Long. 27 mm., lat. 11 mm.

Hab. Nias Island.

Excepting a longitudinal black spot on the thorax and three (or four) series of spots on the elytra, the body is entirely covered with a bluish-green squamous pubescence, somewhat iridescent on parts. Head, including the labrum and base of the mandibles, entirely bluish green, with a very faint longitudinal median line on the face and vertex. Antennæ in the female a little shorter than the body; the scape, second joint, and bases of the third and fourth joints blue, the rest black.

Prothorax with strong and sharp lateral spines; the disk smooth.

Elytra with some small black granules at the base, with three transverse, somewhat anteriorly curved bands, each made up of eight quadrate black spots. (In a second specimen there is a fourth indefinite band, which may have been due to rubbing.) From each of the minute and scattered punctures of the elytra there springs a short black hair; these hairs, of which there are a few also on the prothorax, are only visible when looked at sideways.

Legs coloured like the rest of the body; the middle tibiæ, fringed, like the posterior, with black hairs on their lower outer border, are but very faintly emarginate.

In colour and markings resembles *Monohammus Bowringi*, White, but is otherwise very distinct.

I have named this fine species after my colleague, Mr. C. O. Waterhouse, to whose help and guidance I owe much.

Aristobia angustifrons, n. sp.

Pallide griseo-pubescens, nigro maculata et plagiata; oculorum lobis inferioribus grossissimis, approximatis; antennis nigro-annulatis, articulis primo, tertio et quarto apice villosis; prothorace supra

vix inæquali, maculis nigris parvis plurimis, lateribus spinis longis, acutis; elytris nigro plagiatis, apicibus emarginatis.
Long. 37 mm., lat. 13 mm.

Hab. Siam.

Clothed with a pale grey pubescence, having spots and patches of black. Head with very large eyes, and consequently a narrow front; vertex longitudinally sulcate. Scape of the antennæ faintly grey at the base, the apex black and with a small tuft of black hairs; the second and bases of the following joints pale grey, their apices black; third joint at its apex with a tuft of black hairs almost entirely surrounding it, the fourth also slightly villose at its extremity. Head and thorax above thickly dotted with small black spots. Elytra granulate at the base; a black patch covering the shoulders and extending inwards almost as far as the scutellum, the latter dark grey; four velvety black spots or patches along the margin of each elytron, the largest at the middle, and four spots on each along the suture. The body underneath grey, each of the first four abdominal segments with a black nitid spot in the middle and two smaller spots on each side. The femora ringed with black at the ends, pale grey in the middle. Tibiæ with a small black patch near the tarsal end; the tarsi black, slightly mixed with grey.

By its very large and approximate eyes this species differs from most species of the genus; in this, as in some other respects, it seems to come close to *A. Voetii*, Thoms.

Cœlosterna (*Lamia*) *pulchellator*, Westwood, which appears in the Munich Catalogue under *Batocera*, has been referred by Ritsema to the genus *Psaromaia*, while it is redescribed and figured by Aurivillius as *Euoplia argenteo-maculata* ('Entomologisk Tidskrift,' 1887). Its true affinity is with the species *C. javana* and *C. plagiata*.

Monohammus carissimus, Pasc., is a *Cœlosterna*, for which *C. tessellata*, White, is a synonym.

Cœlosterna imitator, White, is a *Cyriocrates*, and closely enough allied to *C. Horsfieldi*, Hope.

Rhaphidopsis (*Eutœnia*) *elegans*, Waterh., is a *Cœlosterna*.

Cœlosterna trifasciella, White, is the type of the following genus.

Eutæniopsis, n. g.

Head broadly concave between the antennal tubercles; front rectangular, broader than long. Inferior lobes of the eyes rather small, reaching not more than halfway to the base of the mandibles. Antennæ in the male a little longer than the body, in the female somewhat shorter; scape stout, thickest in the middle, with a broad and completely margined cicatrice at the apex; third joint longer than the scape, the fourth and following joints gradually decreasing in length and thickness.

Prothorax subtransverse, somewhat swollen in the middle, narrower behind than in front of the lateral median spines.

Elytra rather narrow, oblique at the shoulders, with their sides parallel and apices rounded.

Legs with the femora rather thick in the middle; the middle tibiæ entire; the claws of the tarsi broadly divergent.

The sternal processes are simple, the mesosternal narrowly truncate behind and not pointed. The anterior coxal cavities incompletely closed in behind.

Owing to its distinct and completely margined cicatrice this genus must be placed in the *Monohammus*-group, in which it may come after *Cœlosterna*. From the latter genus it is easily distinguished by its narrower form, its smaller eyes, and broader front, its elytra oblique at the shoulders, and its anterior coxal cavities open behind.

Type *E. trifasciella*, White (Proc. Zool. Soc. 1850, p. 13, pl. xiii. fig. 1).

A somewhat variable species from China, Hong Kong, N. India, and Penang.

Thomson apparently confounded this species with his *Eutænia Javetii*. In his description of *Eutænia* he gives *Javetii* as the type; but subsequently *trifasciata*, White, is given as the type, and *Javetii* as a synonym. I have no doubt that *trifasciata* was written in error for *trifasciella*, and I feel almost as certain that Thomson was wrong in his identification of that species. At any rate his description of *Eutænia* is quite inapplicable to *trifasciella*, White.

Haplothrix, n. g.

Of the somewhat elongated form and general appearance of the genus *Goes*.

Head as in *Monohammus*; antennæ (male) more than half as long again as the body; scape rather long and slender, with a narrow and completely margined cicatrice; the third joint a little longer than the scape, the fourth to tenth decreasing in length, the eleventh nearly twice as long as the tenth.

Prothorax rather small, laterally spined.

Legs of equal length; the femora sublinear; middle tibiæ without the slightest trace of tubercle or notch.

Sternal processes simple and rather narrow; the anterior coxal cavities distinctly open behind *.

This last character, in conjunction with the entire median tibiæ and the rather narrow sternal processes, will sufficiently distinguish the genus amongst the group of the Monohammids; there is only one other genus of the group (*Eutæniopsis*, described in the present paper) in which the anterior coxal cavities are open behind; from this genus it is very distinct.

May be placed after *Mecynippus* and *Goes*.

Haplothrix simplex, n. sp. (Pl. XVI. figs. 5 & 5 *a*.)

Omnino dense brunneo-griseo pubescens; antennis concoloribus, scapi cicatrice pubescente; prothorace supra æquali, spinis lateralibus ad basin angustis; elytris elongatis, lateribus subparallelis, apicibus rotundatis; segmento abdominis quinto (♂) ad apicem media fovea.

Long. 26 mm., lat. 8 mm.

Hab. Siam.

The whole of the body, the legs, and antennæ covered with a unicolorous, dense, drab-grey pubescence. The head impunctate. The prothorax smooth above, the lateral spines rather narrow at the base; the elytra very minutely punctured, the punctures scarcely visible through the pubescence. The legs all very similar in size and form. The last segment of the abdomen in the male is slightly emarginate at the apex, and has, just in front of this emargination, a deep and somewhat transverse depression.

Pharsalia alboplagiata, n. sp.

P. vinosa affinis, sed major; prothorace omnino ochraceo, impunctato, antice et postice transverse sulcato; elytris lateribus ante medium

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* In the treatment of the Lamiidæ this character of the coxal cavities, so useful in other families, has been hitherto neglected. Lacordaire, indeed, in his introductory account of the family, states that the anterior coxal cavities are constantly closed behind. I have shown that there are exceptions to this rule in the *Monohammus*-group. In the *Batocera*-group of Lacordaire the character is of greater importance, for by means of it the genera may conveniently be subdivided into two groups, in one of which the coxal cavities are open behind, in the other closed. The former includes *Batocera* and all the genera which most closely resemble *Batocera* in their organization, viz. *Apriona*, *Megacriodes*, and *Rosenbergia*.

albo-plagiatis, apicibus rotundatis; antennis fuscis, tenuiter griseo-pubescentibus.
Long. 21 mm., lat. 7 mm.

Hab. Borneo.

Head with an ochraceous-grey pubescence and with a faint longitudinal raised line on the front. Prothorax with a short transverse depression on the middle of the disk. Elytra without basal crests, roughly punctured at the base, the punctures becoming smaller as they pass backwards; the basal part, especially around the scutellum, and the scutellum itself with an ochreous pubescence; a large white, somewhat broken patch on each side in front of the middle; towards the apex the pubescence is again ochreous. The whole of the underside of the body, except along the middle of the abdomen, ochraceous. The legs entirely ochraceous grey.

Excepting *vicina*, Pasc., this is the only described species of the genus in which the elytra are without basal crests.

Pharsalia pulchra, n. sp.

P. mortali affinis; prothorace supra flavo-variegato, scutello flavescente; elytris nigro-velutinis, flavo maculatis et fasciatis.
Long. 23½ mm., lat. 9 mm.

Hab. Siam.

Closely allied to *Pharsalia* (*Zygocera*) *mortalis*, Thoms., with which it agrees very well in its structural details. It is, however, distinct enough by the colour and pattern of its markings. At the base of the elytra is a flavous band well intermingled with black; just in front of the middle is a tolerably broad transverse flavous band, which is interrupted and mingled with black near the suture. Towards the apex there are three or four irregular flavous spots on each elytron, and some smaller spots in front of them near the suture. The markings on the head are similar to those of *mortalis*.

Pharsalia (*Zygocera*) *mortalis*, Thoms.

This species occurs twice in the Munich Catalogue, once under the genus *Callipyrga* and again as *Cereopsius saga* (Dejean's Cat.). Recently (Notes Leyd. Mus. vol. ix. 1887) it has been fully described and referred to its true genus by Van de Poll under the name *albomaculata*.

Rosenbergia exigua, n. sp.

♀. Parva, nigra, pube grisea tecta; antennis corpore paulo longioribus, scapo apice leviter ruguloso; elytris griseis ochraceo mixtis, granulis maculisque parvis, nigris, nitidis, numerosis; apicibus truncatis, angulis productis.

Long. 32 mm., lat. 10 mm.

Hab. New Guinea.

Pubescence dull leaden grey on the head and thorax, light grey on the underside of the body, somewhat darker on the legs, and a light grey mixed with ochreous on the elytra. Head somewhat large; eyes large and subapproximate; a median impressed line on the face and vertex. Superior lobes of the eyes margined behind on the vertex with minute black dots. Antennæ with the scape rather stout, somewhat rugose towards the apex, as in species of *Apriona*; first to third joints and base of fourth grey, the rest sooty brown. Prothorax with two transverse wrinkles in front of the middle, the lateral spines scarcely directed upwards and not constricted at the base. Elytra with a very small transversely directed tooth at each shoulder, with numerous small, black, scarcely raised granules near the base; posteriorly these granules are replaced by spots which extend almost to the apex. The latter transversely truncate, with the angles produced into short spines, the outer spines very slightly longer than the sutural.

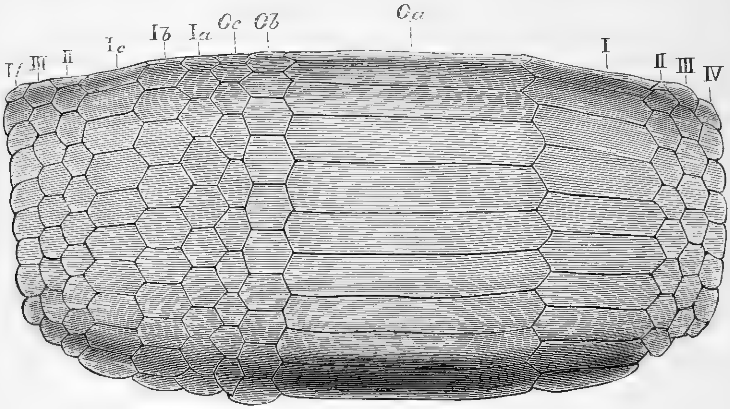
Much smaller and otherwise distinct from any of the species of the genus hitherto described.

EXPLANATION OF PLATE XVI. Figs. 1–5.

Fig. 1. *Æthalodes verrucosus.*
Fig. 2. *Epepeotes uncinatus.*
Fig. 3. *Pelargoderus flavicornis.*
Fig. 4. *Cyriocrates Waterhousei.*
Figs. 5 & 5 *a*. *Haplothrix simplex.*

XXXIV.—*Note on an Abnormal Specimen of the Dentition of* Rhinoptera. By A. Smith Woodward, F.G.S., F.Z.S.

Mr. William Davies has recently presented to the Zoological Department of the British Museum a remarkably abnormal example of the dentition of the Selachian genus *Rhinoptera*, which seems worthy of a brief notice, from the explanation it may some time afford of such a relic possibly to be met with among the fossil species. Having in this respect a bearing upon certain palæontological studies, of which the results will shortly appear, Dr. Günther has kindly given me the opportunity of examining the specimen, and its main peculiarities are shown in the accompanying woodcut. It is evidently referable to the Brazilian species *R. Jussieui*, and probably represents an adult individual.



The largest series of teeth (O *a*) is neither symmetrical nor centrally placed, one extremity of each tooth being bevelled at a much more acute angle than the other. Flanking this series there are four rows on one side and no less than eight on the opposite, there being thus a marked departure from the usual symmetry observed in the dentition of the genus. The four rows of lateral teeth are evidently normal, the innermost (I) exhibiting the ordinary transverse elongation—slightly more than three times as long as broad—and the three outer (II, III, IV) being more or less irregularly diamond-shaped. On the other side the largest teeth are those of the fifth row (I *c*), which have on an average a breadth equal to once and a half their length. Outside this series are three rows of irregularly diamond-shaped teeth (II, III, IV) of nearly the same character as those of the opposite side, though slightly narrower. Between the same series and the largest mesial teeth are four rows, the components of the first (O *b*), third (I *a*), and fourth (I *b*) being almost symmetrical and as broad as long, while those of the second row (O *c*) are longer than broad and have the outer angle much more acute and produced than the inner.

In interpreting the malformation just described, I venture to follow a suggestion of Dr. Günther, and regard the bilateral symmetry of the dentition as merely obscured by a partial subdivision of two of its elements. The three outer rows of teeth on each side (II, III, IV) are normal and approximately symmetrical. The first lateral row of one side must thus have become subdivided; and as the large mesial teeth are decidedly unsymmetrical and do not quite occupy the middle part of the dentition, their extremities on the abnormal side also seem to have been detached. Indeed, it will be noticed that if the first two of the abnormal lateral rows (O *b*, O *c*) could be connected with the very broad teeth, the latter would be precisely median; and the manner in which the length of the teeth of the second of these series varies with the differences in the length of the broad teeth seems to prove that the homology denoted by the lettering is correct. The three rows marked I *a*, I *b*, I *c*, taken together are exactly equal in breadth to the first row of the opposite side, and may thus be regarded as its equivalent.

No specimen hitherto described appears to exhibit malformation equal to that of this unique dentition; but it may be added that Sir Richard Owen * has already noted the subdivision into two parts of the first lateral series of teeth in the East-Indian *Rhinoptera javanica.*

XXXV.—*On he Genus* Theatops. By R. I. Pocock, Assistant, Natural-History Museum.

[Plate XVI. figs. 6–10.]

Whilst reading in the 'Entomologia Americana,' vol. iii. no. 4, a paper entitled "The Scolopendridæ of the United States," by Lucien M. Underwood, Ph D., my attention was attracted on page 65 by a footnote which suggested to me the advisability of publishing the present paper. This footnote I quote verbatim :—

"The genus *Theatops* has had a strange history, and after all its vicissitudes may as well be consigned to oblivion. It was first described by Say (1821) as *Cryptops postica*, from Georgia and East Florida. Newport in 1844 established the

* 'Odontography,' p. 46, pl. xxv. fig. 2.

genus *Theatops* on type specimens sent by Say to Leach and deposited by him in the British Museum. Newport says 'it approaches *Cryptops*, but differs from that genus in the distinctness of the ocelli and in the possession of labial teeth.' Gervais, in the fourth volume of 'Aptères,' 1847, reunites it to *Cryptops*, and yet adds: 'On devra très-probablement la réunir aux véritables Scolopendres.' Wood, in 1862, and later, in 1865, quotes Newport's description, stating that he never saw a specimen of it. Latzel (1880), in the first part of his 'Myriopoden der Oesterreichisch-Ungarischen Monarchie,' makes it a probable synonym of *Scolopendra*; while Kohlrausch (1881) enumerates it as a valid species of *Theatops* in his 'Gattungen und Arten der Scolopendriden.' It thus appears that Say and Newport are all who saw specimens, and their statements are opposed to each other in regard to the position of the eyes. It will probably never appear again; at least it is not necessary to include it in future lists."

In the above-quoted passage the only inaccuracy with regard to matter of fact occurs in the statement referring to the number of specimens sent by Say to Dr. Leach. There appears to have been but one, for apart from the fact of there being but one at the present moment preserved in the British (Natural-History) Museum, Newport says his "description is taken from a specimen."

With this exception Dr. Underwood is correct in all that he asserts with reference to the past history of *Theatops*; but the object that I have at present in view is to prevent the fulfilment of his prophecy concerning the future probably in store for this genus by showing that, so far from being consigned to oblivion by exclusion from future lists, the name *Theatops* of Dr. Newport must not only be included, but must, in addition, take in these lists the place that has hitherto been assigned to the name *Opisthemega* of Dr. Wood.

With the object, then, of settling once and for all the question concerning the systematic position of "*Theatops postica*," about which, as Dr. Underwood clearly shows, so much diversity of opinion exists, I have reprinted word for word the two descriptions to which all this diversity of opinion is traceable, and have described the type specimen of this form as accurately as is under the circumstances possible.

Say (Journ. Acad. Nat. Sci. Philad. vol. ii. pp. 111, 112, 1821), in the following words, describes the species under discussion:—

"CRYPTOPS (Leach).

"Anterior margin of labium not denticulated; eyes obsolete; posterior pair of feet longest, basal joint unarmed.

"*Cryptops postica.*

"Terminal segment of the body longest; posterior feet very short and robust.

"Inhabits Georgia and E. Florida.

"Body rufous, paler beneath, punctured; segments with two impressed longitudinal lines above and a deeply impressed one beneath; ultimate segment longer than the two preceding ones conjunctly, with two obsolete impressed abbreviate lines at the base and an intermediate more distinct continued one. Posterior feet remarkably robust, hardly longer than the ultimate segment; nail remarkably robust, as long as the two preceding joints conjunctly.

"A very remarkable species, distinguished at once from all others by the very thick and short posterior pair of feet, the nails of which cross each other and are much used by the animal in its defence."

Of this species one specimen was, according to Newport, sent by Say to Dr. Leach, and by him it was placed in the British Museum.

In 1844, Newport examined this specimen, and published in the Trans. Linn. Soc. xix. p. 409, the following description of it:—

"Genus THEATOPS, Newp.

"*Ocelli* distincti. *Antennæ* breves, subulatæ, 17-articulatæ. *Segmentum cephalicum* truncatum subimbricatum; margine labiali denticulato. *Pedum postremorum* articulo magno, obconico, abbreviato. *Pedum* paria 21. *Appendices anales laterales* obtusæ.

"This genus is perfectly distinct in the form of the head and the short antennæ from the true *Scolopendræ*, in the structure of the respiratory organs from the *Heterostominæ*, and in the number of legs from *Scolopendropsis*; while it approaches *Cryptops*, but differs also from that genus in the distinctness of the ocelli and in the possession of labial teeth.

"1. *Theatops postica.*

"Aurantiaca, ocellis inconspicuis lateralibus, dentibus 8 minutis, segmento postremo maximo elongato quadrato lateribus rotundato medio profunde sulcato margine posteriore transverso, pedibus postremis brevibus crassis rotundatis attenuatis; articulo basali brevissimo conico. Long. unc. $\frac{8}{10}$.

"*Hab.* In Georgiâ Floridáque Orientali (v. in Mus. Brit.).

"The mandibles are short, thick, and have a distinct basal tooth; the dental plates are elongated and widely separated; the teeth eight, minute but distinct. The basal joint of the posterior pair of legs much shorter than the second, which is twice as long as the succeeding joints. The lateral anal appendages deeply punctured. Preanal scale flat, with a median longitudinal sulcus and scattered punctures, with the margin straight."

It will be noticed at once from a perusal of these two descriptions (1) that the statements of Say and Newport concerning the labial teeth are absolutely contradictory; (2) that Newport can scarcely be called consistent in applying to the same features two words so different in meaning as "distinct" and "inconspicuous;" and (3) that although the latter author asserts that *Theatops* approaches *Cryptops*, yet, to judge from his description of it, the former genus is more nearly allied to other genera of Scolopendridæ (e. g. *Cormocephalus*) than it is to *Cryptops*.

In our treatment of this genus there are two obvious alternatives before us—to conclude (1) that the specimen described by Say was different from the specimen described by Newport, or (2) that one of or both these authors gave erroneous descriptions of the same specimen.

Now, in addition to the discrepancies existing between the two descriptions, it may be urged in favour of the first alternative that the only evidence to show that the specimen in the British Museum is Say's type is Newport's assertion to that effect, and the presence upon the pin transfixing this specimen of a ticket upon which is written in Dr. Leach's handwriting "*Cryptops posticus*, Say, N. America."

Each naturalist must form his own opinion as to the value of this evidence, and small blame can be attached to one who trusting to the accuracy of Say as a describer prefers to regard the "*posticus*" of that author as a species of the genus *Cryptops*. But if this be so the type specimen has disappeared, and no American collector has, so far as I know, come across a form agreeing with the description of it.

Taking, then, these last facts into consideration it will certainly greatly simplify matters if the second alternative be adopted. In support of this it can be shown (1) that Say's description applies well to Newport's specimen in almost every point; (2) that the only point in which it does not apply is his statement about the absence of the labial teeth; (3) that Newport's words with regard to the eyes are ambiguous and misleading, and have been wrongly interpreted by subsequent authors.

Therefore all that is required for the adoption of this second alternative (*i. e.* that Newport redescribed Say's type) is the assumption that Say overlooked the labial teeth.

This may well have been so; for it seems quite likely that he was so accustomed to associate the absence of eyes with the absence of labial teeth that, noting in this case the absence of the former, he without examination took for granted the absence of the latter.

For the sake of convenience therefore I shall assume that Say and Newport described the same specimen.

Whatever conclusion, however, be arrived at with regard to this point, the truth of the following statement is beyond all question:—The genus *Theatops* (Newp.) was recharacterized in 1862 and again in 1865 (Trans. Amer. Phil. Soc. xiii. p. 169) by Dr. Wood and named *Opisthemega*.

That this is so may be demonstrated by comparing the description of *Opisthemega* taken by Dr. Meinert (Proc. Amer. Phil. Soc. xxiii. p. 207) from Dr. Wood's own specimens with the following description, which I have taken from the type specimen of the genus *Theatops*, which has been preserved in the British Museum ever since the days of Newport.

Genus Theatops, Newport.

1844. *Theatops*, Newport, Trans. Linn. Soc. xix. p. 410.
1862. *Opisthemega*, Wood, Journ. Acad. Nat. Sci. Philad. v. p. 35.

Capitis lamina laminam dorsi primam partim protegente.
Lamina basali partim manifesta.
Oculis nullis vel evanidis.
Antennis ad basim incrassatis, ad apicem attenuatis; articulis proximis glabris, reliquis breviter hirsutis.
Pedum maxillarium sterno integro, in laminas denticulatas antice producto; articulo proximo dente basali instructo.
Tarsis tibiisque plerumque calcare armatis; tarsis plerumque articulo unico constantibus.
Segmento anali segmentis præcedentibus majore.
Pleuris analibus truncatis; maxima ex parte protectis.
Pedibus analibus maximis, valde incrassatis, articulis quinque constantibus; ungue magno, arcuato armatis.
Segmento corporis septimo spiraculis haud instructo.
Spiraculis utrinque novem.

The possession of but one dried specimen has rendered it impossible for me to give as complete a generic description as is desirable. The characters presented by the mouth-parts I have been unable to determine, and owing to damage to many of the limbs I have been unable in every instance to note the entirety of their tarsi and their spine-armature.

Yet, in spite of these deficiencies, it must, I think, be admitted by every one, from a comparison of those characters that are given, that the descriptions of *Theatops* and *Opisthemega* have been founded upon specimens which are generically identical.

That Dr. Wood suspected the likelihood of this is evident from his question, "Is it possible that Mr. Newport is mistaken as to the possession of eyes?"

Undoubtedly most of the mistakes that have been made with regard to *Theatops* are referable to Newport's unlucky expressions "ocelli distincti" and "ocellis inconspicuis lateralibus." For in addition to the doubt raised by the difference of meaning between the two adjectives "distinct" and "inconspicuous," it will be noticed that the sentence "ocellis inconspicuis lateralibus" might mean one of two things, either "inconspicuous eyes on each side" or "an inconspicuous eye on each side."

From the facts of the case it is only fair to presume that Newport meant the latter. But most authors seemed to think that he meant the former; and being familiar with the four distinct ocelli upon each side of the head in *Scolopendra,* they very naturally imagined that Newport was referring to similar structures when using the word "ocelli" in connexion with *Theatops.*

Now, although it is certain that in *Theatops* no distinct ocelli such as are found in *Scolopendra* are to be observed, yet there is upon each side of the head of the type specimen of the former genus a distinct and well-defined area, which occupies the position corresponding with the position of the eyes in *Scolopendra.*

This area appears as a somewhat oval whitish patch, differing only in colour from the substance composing the rest of the head-plate. Upon the patch of the left side of the head immediately behind the joint of the antenna there is to be noticed a small brown spot, darker than the substance of the head-plate. No corresponding spot occurs upon the right side.

No doubt these two whitish patches, which are probably rudimentary eyes, are the features to which Newport applied the words *ocelli distincti* and *ocellis inconspicuis lateralibus.*

Assuming this to be the case, his statements become intelligible, for when examined with a lens of low power the head appears to be furnished upon each side with a single ocellus.

Although Dr. Wood in his descriptions of *Opisthemega postica* and of *Op. spinicauda* makes no mention of the presence in these species of any eye-structures resembling those described above, yet Dr. Meinert, when characterizing the genus *Opisthemega*, remarks: "Oculi nulli vel evanidi." But since the latter author omits to state in which of the species described by him the eyes are "evanidi," it is fair to presume that he attaches no specific value to the features presented by these organs.

It is certainly to be regretted that a genus composed of species in which the eyes are either absent or rudimentary should be known by a name so inappropriate as *Theatops*. Yet the law of priority compels its adoption, and one's regret is perhaps to a certain extent lessened by the satisfaction derived from abolishing a name so ill-formed and so ill-sounding as *Opisthemega*.

Theatops postica (Say).

1821. *Cryptops postica* Say, Journ. Acad. Nat. Sci. Philad. ii. pp. 111, 112.
1844. *Theatops postica*, Newport, Trans. Linn. Soc. xix. p. 411.
1862. *Opisthemega postica*, Wood, Journ. Acad. Nat. Sci. Philad. v. p. 35.
1886. *Opisthemega crassipes*, Meinert, Proc. Amer. Phil. Soc. xxiii. p. 209.

Dorsal plates ochraceous; head-plate castaneous; antennæ, ventral plates, and legs testaceous.

Head, body-segments, and anal legs strongly punctured.

Antennæ consisting of 17 segments.

Distal segments of the antennæ more or less moniliform and covered with short hairs. Basal segments bare.

Prosternal plates of the maxillary sternum almost in contact; each armed with three small obtuse teeth. Basal tooth small, obtuse and simple.

Dorsal plates, except the first and last, bisulcate; the first marked in front with a median longitudinal sulcus, which behind bifurcates and marks off with the posterior margin of the dorsal plate a triangular area. Dorsal plates, except the last, with simple margins.

Head-plate without sulci.

Ventral plates marked with a central longitudinal depression, the last elongated, with converging lateral margins, rounded posterior angles, and a slightly concave posterior margin.

The dorsal plate of the anal segment quadrate, with straight margins, raised lateral borders, and a conspicuous median longitudinal sulcus. On each side the dorsal plate descends so as to form the lateral portion of the segment and so as to be separated by but a narrow space from the ventral plate.

The pleuræ of the anal segment appearing in the narrow space between the dorsal and ventral plates, extending behind slightly beyond the margin of the ventral plate, but not beyond the margin of the dorsal plate; not armed with spines; thickly punctured.

Tibiæ and tarsi of most of the legs armed below with a strong spur; claws of legs mostly armed.

Anal legs very thick, punctured, without spines, in contact; the inner surface of the three proximal segments flattened; the upper inner margin of the proximal segment raised.

Claw of anal leg unarmed.

Length about 20 millim.

I have had no opportunity of examining the type specimen either of *Op. postica*, Wood, or of *Op. crassipes*, Meinert. But the descriptions of these two species are so much alike and are so applicable to *Theatops postica*, Newport, that I have without hesitation regarded the three specific names as being referable to but one form.

Dr. Meinert suggests that *Op. spinicauda*, Wood, may be synonymous with *Th. postica*, Newport; but if the figure and description of the former species are to be trusted, the two must still be considered distinct.

EXPLANATION OF PLATE XVI. Figs. 6–10.

Fig. 6. Anterior portion of the body of *Theatops postica* (Say), seen from above.
Fig. 7. Head of ditto, seen from below.
Fig. 8. Anal segment of ditto, seen from above.
Fig. 9. The same, seen from below.
Fig. 10. The same, seen from the side.

XXXVI.—*Descriptions of new Species of Oriental Homoptera belonging to the Family* Cicadidæ. By W. L. Distant.

As I am now engaged in identifying such species belonging to other collections as are kindly submitted to me for the furtherance of my intended Monograph, it becomes necessary to publish these descriptions in order to prevent the unsatisfactory course of distributing MS. names only. The species will be all subsequently figured.

Huechys suffusa, n. sp.

Head and thorax above black; front of the head and two large spots on mesonotum red; abdomen red; eyes brownish ochraceous. Head and thorax beneath black, the face and abdomen beneath red. Tegmina pale opaque blackish, the apical area broadly dull opaque greyish, with the margins of the lower apical area blackish; wings pale dull greyish hyaline, the venation darker.

Rostrum somewhat mutilated, but apparently reaching the intermediate coxæ; face large and moderately compressed.

Long. excl. tegm. 21 millim., exp. tegm. 52 millim.

Hab. Java. Coll. Dist.

Gæana delinenda, n. sp.

Huechys octonotata, Walk. (nec Westw.), List Hom. i. p. 253. n. 10 (1850).

Body above brownish ochraceous. Head with the apex of front and a transverse fascia in front of eyes, including area of ocelli, black. Pronotum with a central hourglass-shaped fascia and two large oblique spots on each side black. Mesonotum with a central fascia (somewhat similar to that on pronotum) and a large spot on each lateral margin black; basal cruciform elevation blackish, its anterior angles ochraceous. Abdomen with the posterior segmental margins blackish. Body beneath and legs brownish ochraceous, disk of face and a spot before eyes blackish. Tegmina pale brownish ochraceous; wings brown, with about basal third red.

Long. excl. tegm. 19 millim., exp. tegm. 47 millim.

Hab. Cochin (coll. Dist.), Silhet (Brit. Mus.).

By a strange oversight Walker placed this species in the British-Museum collection under the name of *Huechys octonotata*, Westw., and actually redescribed that species under the name of *H. picta* (Ins. Saund. Hom. p. 28).

Dundubia ærata, n. sp.

Body above resembling *D. mannifera*, Linn., but much larger; beneath with the opercula small, narrow, concavely sinuated towards the middle, their apices obtusely rounded and reaching the third abdominal segment (rostrum mutilated).

Tegmina and wings pale hyaline, their apical areas (especially those of tegmina) suffused with bronzy brown.

Long. excl. tegm. 50 millim., exp. tegm. 120 millim.

Hab. Borneo, Elopura (*Pryer*). Coll. Dist.

Dundubia tavoyana, n. sp.

Above resembling in size, general hue, and markings *D. tripurasura*, Dist., but differing remarkably from that species by the size and shape of the opercula, which have their apices somewhat acutely pointed and reaching the penultimate abdominal segment, their lateral margins being concave near base, convex about centre, and somewhat profoundly concave towards the apices; their colour is also pale olivaceous green.

Long. excl. tegm. 30 millim., exp. tegm. 80 millim.

Hab. Tavoy. Calc. Mus.

Dundubia similis, n. sp.

Above very closely resembling *D. radha*, Dist., the thoracic markings similar, but the colour more olivaceous green. It differs from *D. radha*, however, by the shape and length of the opercula, which do not extend beyond the third abdominal segment, and have their apices somewhat obtusely rounded.

Long. excl. tegm. 50 millim., exp. tegm. 122 millim.

Hab. Sikkim. Coll. Dist.

Cosmopsaltria nigra, n. sp.

♂. Body above and beneath with the legs blackish; eyes and ocelli dark fuscous brown. Tegmina and wings smoky hyaline, the venation fuscous, the tegmina with the transverse veins at the bases of the second and third apical areas, and the apices of the longitudinal veins to apical areas, infuscated.

The rostrum about reaches the apices of the posterior coxæ; the opercula are concavely sinuated a little before centre, their apices convexly rounded and almost reaching apex of fourth abdominal segment.

Long. excl. tegm. 44 millim., exp. tegm. 110 millim.

Hab. Philippine Islands.

This species was erroneously identified by Walker as *Dundubia spinosa*, Fabr. (the type of which is contained in the Banksian collection), and remains under that name in the National Collection. The habitat is derived from one of those specimens, my own being without a locality.

Cosmopsaltria umbrata, n. sp.

♂. Head and thorax above obscure olivaceous. Head with the lateral margins to front, the area of the ocelli, and some irregular spots on each lateral area of the vertex black; eyes ochraceous. Pronotum with two irregular central black fasciæ, ampliated at base and apex, and two at each lateral margin, the posterior margin with its edge narrowly black and a black spot near lateral angles. Mesonotum with two central blackish obconical spots, between which a narrow black fascia extends to base, and a black spot in front of each anterior angle of the basal cruciform elevation. Abdomen above largely suffused with dull black shadings. Body beneath olivaceous; a central fascia to face, anterior margin between face and eyes, inner margins and apices of femora, and the tibiæ more or less blackish. Opercula olivaceous, their apices and a spot near base blackish. Abdomen beneath olivaceous, largely suffused with black shadings. Tegmina and wings pale hyaline, the venation fuscous; tegmina with the base and costal membrane fuscous, the transverse veins at the bases of the second, third, fifth, and seventh apical areas and the apices of the longitudinal veins of apical areas infuscated.

The rostrum has the apex pitchy and just passing the posterior coxæ; the opercula are somewhat narrowed, concavely sinuated on each side near base, and narrowed towards apices, which are obtusely angulated and reach the fourth abdominal segment.

Long. excl. tegm. 46 millim , exp. tegm. 120 millim.

Hab. Sikkim. Coll. Dist.

Cosmopsaltria lauta, n. sp.

♂. Head and thorax above ochraceous, with the following black markings :—Head with a central fascia to front, vertex with a central double fascia and a sinuated fascia behind each eye; pronotum with a central double fascia united at base, a large sublateral spot on each side, and a spot beneath on basal margin; mesonotum with a central longitudinal fascia, on each side of which is a short and somewhat oblique fascia, followed by a small spot on anterior margin and a broad, sublateral, irregular fascia, and a spot in front of each anterior angle of the basal cruciform elevation. Abdomen purplish red, the posterior segmental margins ochraceous, excepting those near apex, which are piceous, and with a central discal piceous spot near base. Head beneath with the anterior margin black and a central piceous spot near apex of face. Opercula ochraceous, with apices and inner margins broadly black; apex of abdomen beneath black. Tegmina and wings pale hyaline, the venation more or less fuscous; tegmina with the costal membrane castaneous, the transverse veins at the bases of the second and third apical areas infuscated.

The face is convex, with a central longitudinal incision, which neither reaches base nor apex. The opercula are long and broad, concavely sinuated on their outer margins near base, their apices obtusely rounded and about reaching the apical abdominal segment. Rostrum *mutilated.*

Long. excl. tegm. 35 millim., exp. tegm. 102 millim.

Hab. Pontianak (West Coast, Borneo). Brussels Mus.

Cosmopsaltria minahasæ, n. sp.

♂. Body above pale obscure olivaceous, more or less covered with pale ochraceous pile. Head with the front anteriorly striated and with two apical, black, central spots; vertex with some scattered black spots, the ocelli reddish. Pronotum with a central, longitudinal, ochraceous fascia, bordered with black and with an irregularly rounded black linear spot near each lateral margin. Mesonotum with seven black spots, three central and two near each lateral margin, and a black spot in front of anterior angles of cruciform elevation. Tympana with grey pilosity; abdomen above also much shaded with greyish pile. Body beneath greyish, with an olivaceous tinge; apical portion of the face black; apices of the femora and tibiæ and the tarsi dark fuscous; apical abdominal segment infuscated, anal appendage with a central fuscous fascia. Tegmina and wings pale hyaline, venation brownish, ochraceous at the base of upper ulnar area, and the transverse veins at the bases of the second and third apical areas broadly infuscated.

The opercula are pale olivaceous, somewhat gradually narrowing towards apices, which are obtusely angulated and reaching the apex of the fourth abdominal segment; rostrum reaching the second abdominal segment, its apex fuscous.

Long. excl. tegm. 35 millim., exp. tegm. 100 millim.

Hab. Celebes, Menado (coll. Dist.), Ceram (Brit. Mus.).

A specimen of this species from Ceram was identified by

Mr. Walker as *Dundubia doryca*, Boisd., and still remains under that name in the National Collection.

Cosmopsaltria silhetana, n. sp.

Body above shining brownish olivaceous. Head with two central black spots on front and with an irregular black fascia across vertex, widening at area of ocelli, and the posterior margin of the eyes black. Pronotum with two central black fasciæ, the oblique incisures black, the basal margin greenish. Mesonotum with the following black markings:—a central longitudinal fascia, on each side of which is a slightly oblique obconical spot; these are each followed by a very much smaller spot, and again by a short, broad, irregular spot, all starting from anterior margin; two long discal spots and a small rounded spot in front of each anterior angle of basal cruciform elevation. Abdomen above with the disk much shaded with dark shining fuscous; posterior segmental margins greenish. Body beneath very pale olivaceous, with a greyish tinge; face with the apex and a central fascia black; apex of rostrum, apices of the tibiæ, anterior tarsi, and bases and apices of intermediate and posterior tibiæ fuscous. Tegmina and wings pale hyaline, venation brownish; costal membrane and base of upper ulnar area ochraceous; transverse veins at bases of second and third apical areas infuscated.

The rostrum reaches the apex of the posterior coxæ; the opercula gradually narrow towards apices, which are obtusely angulated and reach the fourth abdominal segment.

Long. excl. tegm. 28 millim., exp. tegm. 72 millim.

Hab. Silhet. Coll. Dist.

Cosmopsaltria jacoona, n. sp.

Allied to *C. oopaga*, Dist., and very similar above in colour and markings. Differs from that species by the size and shape of the opercula, which are longer—reaching the penultimate abdominal segment—narrower, and with their apices somewhat angularly rounded.

Long. excl. tegm. 37 millim., exp. tegm. 98 millim.

Hab. Johore. Calc. Mus.

Pomponia solitaria, n. sp.

Body above ochraceous. Head with the eyes dark fuscous; front with two central black spots on anterior margin and two small rounded black spots at base; vertex with the area of the ocelli—which are red—a curved line before each eye, and a spot near each anterior lateral angle, black. Pronotum with two central black lines, united at base, and a black spot on each lateral margin. Mesonotum with the following black markings, viz. three central lines, the central one extending across disk, followed by a shorter line on each side, and again by an irregular line which reaches nearly across disk, and a black spot in front of each anterior angle of basal cruciform elevation. Tegmina and wings pale hyaline, the first with the costal membrane and venation ochraceous, the transverse veins at bases of second and third apical areas infuscated; venation of wings generally ochraceous.

The rostrum reaches the apices of the posterior coxæ; the opercula are small, not reaching the apex of the basal segment of the abdomen.

Long. excl. tegm. 28 millim., exp. tegm. 75 millim.

Hab. Andaman Islands, Narkondam. Calc. Mus.

Pomponia obnubila, n. sp.

Allied to *P. maculaticollis*, Motsch., but differing from that species by the darker and more obscure hue of the body, the distinctly pale fuscous tegmina and wings, and by the length of the rostrum, which considerably passes the posterior coxæ and terminates on the overlapping opercula.

The head is also much narrower than in *P. maculaticollis*, and the opercula are unicolorous and more convex posteriorly.

Long. excl. tegm. 30 millim., exp. tegm. 110 millim.

Hab. Simla. Calc. Mus.

Cryptotympana Limborgi, n. sp.

Cryptotympana recta, Dist. (nec Walk.), J. A. S. Beng. vol. xlviii. p. 40, pl. xi. fig. 4 (1879).

♂. Body above olivaceous brown. Head with the lateral striations to front and a transverse fascia between the eyes black. Pronotum with two central, oblique, discal, black fasciæ; the posterior margin olivaceous, with its inner border and the anterior margin narrowly black. Mesonotum with two central, obconical, black fasciæ on anterior margin, between which is a very narrow and indistinct dark line; on each side of the obconical spots is a smaller spot and a short oblique, discal, black fasciate line on each side near base. Abdominal segmental margins and inner area of tympana blackish; abdomen laterally clothed with greyish pile. Body beneath olivaceous brown; anterior tibiæ and tarsi, apices of intermediate and posterior tibiæ and the tarsi blackish. Opercula olivaceous, with their inner margins blackish; abdomen beneath dark castaneous, the lateral margins broadly covered with ochraceous pile. Tegmina and wings pale hyaline, their bases blackish, the venation ochraceous or fuscous; tegmina with the costal membrane olivaceous, the apical costal margin blackish; transverse veins at the bases of second and third apical areas infuscated.

The opercula are short and suboval, their inner margins straight at base and then obliquely deflected to apices, which do not extend beyond the basal abdominal segment; their outer margins are slightly oblique and convexly deflected at apices. Rostrum mutilated.

Long. excl. tegm. 32 millim., exp. tegm. 95 millim.

Hab. Tenasserim (*Limborg*). Calc. Mus.

When describing the Rhynchota collected by Mr. Ossian Limborg in Upper Tenasserim the typical female *Cryptotympana recta*, Walk., was alone known to me, and I then opined that the specimen here described as a new species might prove to be the male of *C. recta*. I now possess the male of that species, and find the Tenasserim specimen to represent a very distinct and undescribed species.

Cicada elopurina, n. sp.

♀. Body above castaneous. Head with a fascia across front, a spot near base of antennæ, the area of the ocelli, and a spot behind the eyes black. Pronotum with two central black fasciæ, the posterior margin more or less olivaceous. Mesonotum with two central, incurved, black spots starting from anterior margin, between which is a black fascia crossing the whole of disk; beyond the central incurved spots is a small spot on each side and a sublateral and somewhat indistinct black fascia; a black spot in front of each anterior angle of the basal cruciform elevation. Abdomen above with the posterior segmental margins black. Body beneath thickly clothed with greyish pile; face with a central black fascia. Tegmina and wings pale hyaline, the venation very dark olivaceous or brown; tegmina with the costal membrane olivaceous.

♀. Long. excl. tegm. 28 millim., exp. tegm. 82 millim.

Hab. Borneo, Elopura (*Pryer*). Coll. Dist.

Cicada pontianaka, n. sp.

Head and thorax above dark ochraceous. Head with the front laterally striated with black; vertex with the area of the ocelli and the lateral areas black. Pronotum with two short, central, black fasciæ at base, which widen anteriorly to behind the eyes; the posterior margin olivaceous. Mesonotum with two central obconical spots, between which is a central spot widened at base and a curved spot on each lateral area, all black. Abdomen above dark castaneous, shaded with pitchy suffusions and sparingly and palely pilose. Body beneath ochraceous; femora and tibiæ tinged with castaneous, excluding apices of femora and bases of tibiæ; opercula pale castaneous, the margins palely pilose. Abdomen beneath dark castaneous, the margins palely pilose. Tegmina and wings pale hyaline, the venation dark brownish; tegmina with the apical area shaded with bronzy reflections; the costal membrane castaneous, excepting apical half, which is black; base greenish, transverse veins at bases of second and third apical areas narrowly infuscated.

The face is somewhat flat and deeply transversely striate, excepting a central, longitudinal, levigate line; the rostrum is *mutilated*; the opercula do not extend beyond the basal abdominal segment, have their lateral margins somewhat straight, their inner margins very slightly overlapping, and their apices somewhat broadly rounded.

Long. excl. tegm. 32 millim., exp. tegm. 97 millim.

Hab. Pontianak (West Coast, Borneo). Brussels Mus.

XXXVII.—*Shell-growth in Cephalopoda* (*Siphonopoda*). By F. A. Bather, B.A., F.G.S., of the British Museum (Natural History).

Introduction.

Up to 1886 the formation of the shell in Cephalopoda was explained by a hypothesis, either of simple lime-secretion (2) or of lime-deposition in cellular membranes thrown off from the mantle of which they were once a constituent (1 and 3); in that year Dr. Riefstahl proposed a hypothesis of growth by intussusception (8) similar to that previously proposed by Müller for Lamellibranchs (7). Riefstahl's conclusions, based on *Sepia*, were extended by him through *Belemnites* to

Ammonites, and so, by analogy, on to *Nautilus*; the induction was blindly followed in a leader by "Naturforscher" (9). At the beginning of this year Dr. v. Lendenfeld tried to convict Riefstahl of similar blindness, and himself falls into the ditch (12). With the drift, however, of his "Bemerkung" I am glad to agree, since it is a repetition, though incomplete, of two lines previously written by me. As the note containing those lines (10) gives both abstract and criticisms of Riefstahl's results, I beg my kind readers to glance at it before continuing their present perusal.

In this paper I wish :—I. to make a personal explanation respecting the parallelism of v. Lendenfeld's work with mine; II. to criticize his methods of work and argument; III. to refute Riefstahl's conclusions; IV. to propound a theory of shell-growth that shall harmonize with the facts of phylogeny no less than with those of ontogeny.

I. Personal Statement.

Von Lendenfeld says that Moseley was the first English biologist to observe Riefstahl's paper, and that he consulted Lankester, with whom v. Lendenfeld then was. My introduction to the subject also came from Prof. Moseley, who allowed me to study it in his laboratory at Oxford; and there my work was done in the spring of 1887. Moseley at first inclined to Riefstahl's conclusions; unhappily his sad illness prevented subsequent discussion. The young Nautilus-shell examined by v. Lendenfeld was seen by me at the British Museum for the first time in July 1887; it of course confirmed my previous conclusions. I never knew that anyone intended to figure it. The editors of the Geol. Mag. had my MS. by the end of July 1887, about which time I heard that v. Lendenfeld had been working on this point. The latter had, I believe, left England when my note appeared, so that he probably did not see it; and I must apologize to him for being delayed by ignorance of his address in sending him a copy.

This explanation was needed to show that, though v. Lendenfeld and myself received inspiration from the same source, our work was independent; it will also be seen that our methods of work were not quite the same.

II. Criticism of v. Lendenfeld.

In the first place, it appears that v. Lendenfeld only examined a single young Nautilus-shell; he, however, speaks of young *shells*, as though basing an induction with regard to all on the evidence of this one. The intussusceptionist might therefore contend that the shell in question was abnormal, and would support his contention by the fact that in shells of *Nautilus* and *Ammonites* a single shallow chamber occasionally intervenes, far back in the shell, between two of normal size.

Even from a single shell, however, v. Lendenfeld might have adduced confirmatory evidence had he grasped the full significance of this specimen. His figure of the young shell (12, t. ix. fig. 2) shows the last-formed septum partially destroyed; the destruction was due to its extreme tenuity; the portion left forms a rim round the shell-wall and is much thinner than the corresponding part of the preceding septa. This septum was in fact only half formed when the animal was killed. In other young specimens I had observed rims of similar nature, but much narrower and thinner, as though the remnants of septa in the very earliest stage of formation. Such sutural rims show, whenever they occur, that the new septum was from the beginning formed at the normal distance from the penultimate septum. Moreover, in every young Nautilus-shell examined by me (two in the Oxford Museum, one in the British Museum, and two in my own collection), and in the rare young Ammonites * that I found sufficiently preserved, the interval between the last two septa is greater than the preceding intervals in a constant proportion. All these facts seemed to me conclusive; but v. Lendenfeld's single argument from a single specimen proves nothing.

Still he does happen to have hit on a typical example; and his figure, though rather obscure, illustrates more points in my paper (10) than in his own. Taking with gratitude a favourable view of these figures, I may point out that they are both reduced by one third from the original specimens and that these are exhibited in the shell-gallery of the Natural-History Museum.

III. Refutation of Riefstahl.

Von Lendenfeld avowedly refrains from criticizing the main part of Riefstahl's paper, nor does he question the intussusception-hypothesis as applied to the sepion. Mere comparison with *Nautilus* would not have justified such action,

* In the examination of fossils I received much help from Messrs. E. T. Newton and H. A. Allen, of the Geological Survey, for which I tender my hearty thanks.

as I will now prove. True that in old age the septa of *Nautilus* gradually approximate; further, it should seem proven that the septa are directly formed by the animal (*sc.* by secretion of some sort), and that there is no subsequent growth of the intraseptal zone of shell-wall. What, then, does this approximation of septa mean? Primarily it is caused by diminution of body-growth; this renders it less necessary for the mollusk to move into a wider portion of its shell; it therefore advances more slowly. Nevertheless the formation of septa does not slacken; they are formed at the same intervals of time as usual; the intervals of space between such septa are therefore less than those between septa formed when the animal was more rapidly growing. None can suppose that the formation of septa at these shorter distances is intended to benefit the aged animal, as though, compelled to advance, it were unable to do so without support; the very closeness of the septa proves the contrary. Thus, in many fossil specimens of Ammonoidea and Nautiloidea, the last-formed septa are very closely pressed together. More forcible is the evidence of a recent adult Nautilus-shell belonging to Prof. Moseley; here the last septum is twice as thick as that preceding; indeed, a line down the middle shows that it is really formed of two septa. It must have been a very feeble *Nautilus* that could not advance a single millimetre without a wall to lean its back against. We must therefore conclude that this pathological approximation of septa in the chambered shell of a senescent, or, more rarely, of a middle-aged Cephalopod is due to the continued activity of the secretory function after the relaxation of the other functions.

So far secretion of the shell is probable but not proven; further discussion will be found in the sequel. Riefstahl's total negation is based chiefly on the compression of the last-formed membranes in the sepion. We have therefore to prove that the approximation of septa in *Nautilus* is not homologous with the apparently similar compression of membranes in *Sepia*. The argument follows two lines—(α) Phylogenetic, (β) Ontogenetic.

(α) Granted that abnormal approximation of septa is due to the persistence of septal formation when the other wheels of life run down or are thrown for the time out of gear, we shall see that this feature has for the evolutionist a wider meaning. The characters of old age, produced as they are by failure of powers, are often curiously simulated by the symptoms of a disease that is not "specific," but due to overwork of the organism. Thus the geratological * character of approaching

* *Geratology*, the science of old age: Hyatt.

septa sometimes occurs as a purely pathological episode in middle age. Further, these normal signs of a period when powers are weakened outwardly repeat those of a period when powers have not yet acquired strength. Old age "is second childishness." But there is an old age of the Phylum as well as of the Individual; it is brought about by an acceleration of development and by an absorption into the mature form of senile characters inherited from its ancestors. Hence the laws that govern the life of the Individual govern that of the Phylum. Phylogenetic old age repeats the characters of phylogenetic youth. The gradual coiling of the Ammonoidea, followed by a converse uncoiling, is a well-known instance. Another instance is afforded by the character now under consideration.

Hyatt (5, p. 328) has pointed out that the most antique Cephalopoda known to us are certain North-American species of *Endoceras*, *Piloceras*, and allied genera; in these forms the septa are very close to one another throughout. From this fact, as well as from a consideration of septa in certain other molluscan shells and the tabulæ in Cœlenterate skeletons, we may infer that when first the Cephalopod shell became chambered the septa were close together. In the three main lines of descent from such an ancestor the septa came to lie further apart. In the Nautiloidea, which seem to have been the last to specialize, the septa are still far apart, but approach in old age. The Ammonoidea differed at an earlier stage from the parent stem; so early as the *Goniatites* the septa are far apart in proportion to the diameter of the whorl; senile characters gradually appear, and among them this one, the approximation of the septa; it is gradually absorbed into the mature forms, and in the retrograde Cretaceous species all of the septa are again closer together. The straight forms in which the protoconch is protected by a sheath (*Aulacoceras*, *Belemnites*, &c.) form another genetic series parallel with the Ammonoidea, for which I propose the name Coleoidea *. The same process takes place here, along two lines, as described in IV.; at the end of one of these comes *Sepia*, and it is clear that the closely pressed lamellæ of the "pad" † are nothing else than septa in which this retrogression, started by phylogenesis, has been enhanced by natural selection on account of its adding strength to the now internal shell. It is therefore the general approximation of all septa in *Sepia* that is homo-

* Κολεός, sheath, εἶδος, form. See further (14).

† "Pad" = German *Wulst*; suggested as shorter and less misleading than "spongioid tissue."

logous with the approximation of the later septa in the senescent *Nautilus*.

(β) The compression of the anterior membranes in *Sepia* is different; its meaning we will now consider. I have previously (10) pointed out that the septa approach one another postero-ventrally, so that, in a vertical section of a small portion of the shell, the last-formed appear closer than those underlying. Further, I do not deny that in senescent shells the last-formed septa may be closer than those preceding: the laws of geratology do not lapse when their action has been extended. But these two appearances have been confused by Riefstahl with another of very different nature. Riefstahl states that membranes of chitin * continue from the middle plate over the last-formed septa; he implies that sinuous partitions do not exist in these membranes. These membranes are visible; but, as I pointed out (10), the partitions pass through them and are seen on the surface (fig. 1, p. 305). This observation was corroborated by Dr. Appellöf, whose paper, read on Sept. 14, 1887, was received in England just two months later (11). He describes this structure as a mass of chitinous membranes, traversed by partitions from the first. In this the following changes take place:—cracks appear between the membranes, at right angles to the partitions; these cracks widen, so that the membranes above and below are pressed together, and in them calcification begins; they finally form the septa; the intermediate membranes are further separated by cracks, and form the "free-stretched membranes." Since the partitions extend completely across the space these membranes appear fastened to them. On Riefstahl's hypothesis the free-stretched membranes should pass through the partition-walls; that they do so I could never see (fig. 2). My sections, unreconcilable with Riefstahl's view, fully confirm that of Appellöf: they bear out the suggestion of the latter that the membranes are pressed together, not separated, by calcification, so as to form septa; the nacre lies on either side of these compressed membranes, not between them. The structure just described bears no resemblance to approximated septa, and the changes are to be explained in a different manner.

The approximation of septa in *Nautilus* is therefore proved to be not homologous with the coherence of the last-formed membranes in *Sepia*. Riefstahl's argument for intussusceptional growth in *Nautilus* based thereon consequently falls to the ground.

* "Conchyolin" is the term he employs; it may be more correct, but "chitin" is simpler and more usual.

We have next to consider how far the intussusception hypothesis holds good for the sepion. I have already noted some opposed facts; but, setting aside for a time arguments derived from a cross-examination of the shell itself, I proceed to call witnesses of a different character. Riefstahl seems not to have investigated the epithelium that lines the shell-sac; to this I paid special attention—indeed one can hardly imagine a man dismissing the secretion-hypothesis without examining the structure which, above all others, was calculated to yield valid external evidence. This mistake was not made by Appellöf; he has studied both soft and hard parts together, and his description, so far as I can follow it without figures, seems to agree with my sections and drawings, while in our explanation of the appearance we substantially agree. Dr. Appellöf promises a more detailed account of his investigations. For the present purpose a short description will suffice. The whole shell-sac is lined by a simple columnar epithelium of variable character. Over those parts of the shell that have long been formed the epithelial cells are flattened out so as to almost form a pavement-epithelium. Towards those parts of the shell in course of formation the cells become more columnar. There is a distinction between the cells overlying the dorsal plate and those overlying the inner plate and the last septum. The former line the mantle, by which all, including Riefstahl, allow that the membranes of the dorsal plate [=sheath or guard] are deposited. Their appearance is shown in fig. 3. The cells that line the anterior part of the shell-sac on the ventral side (*i. e.* over the visceral hump) are very peculiar. I have been unable to demonstrate a cell-wall; the nuclei stain clearly with borax-carmine, and the chromatin element in each is much convoluted, producing the appearance of several nucleoli. Towards the sutural margin of the anterior septum the nuclei become elongate, and seem to tail off by their proximal or ventral ends into the underlying connective tissue (fig. 4). The appearance is in fact somewhat that of a syncytium formed by cells migrated from the connective tissue; the nuclei form a single layer, and have their long axes parallel to one another, but slightly inclined to the surface in antero-dorsal direction. Above, *i. e.* dorsal to, the nuclei is a clear cytoplasm, and above this again a distinct layer continuous along the surface, and separated in places from the cytoplasm by a dark line. Over the region where the septum joins the inner plate the cells are extraordinarily elongate and their nuclei correspondingly dragged out (fig. 5). The cells show a greater degree of separation in this part, but the superficial layer is still continuous; it shows a corresponding increase in thickness; its distinction from the upper part of the cell is not, however,

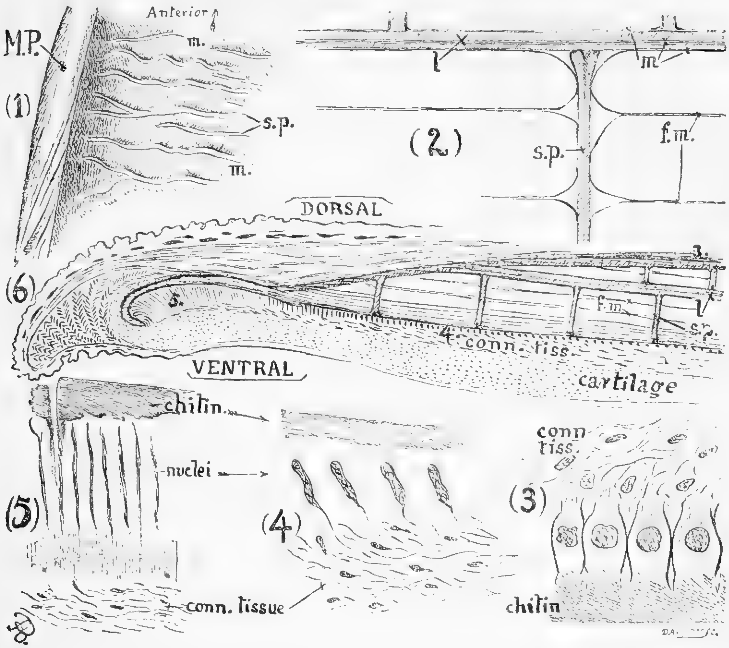


Fig. 1.—Sinuous partitions (*s.p.*) appearing near margin of shell through membranes (*m.*). M.P. is the edge of the middle plate folded over. (Seen with 1-inch objective, reflected light.)

Fig. 2.—Shows relation of free-stretched membranes (*f.m.*) to a sinuous partition (*s.p.*), which is cut at right angles. Its ventral end is enlarged and abuts on a lamella or septum (*l.*) composed of membranes (*m.*) and arragonite. (Stained borax-carmine, and examined by polarized light, seen with Zeiss D objective.)

Fig. 3.—Cells lining mantle, from 3 in fig. 6. (Stained hæmatoxylin.)

Fig. 4.—Cells from 4 in fig. 6.

Fig. 5.—Cells from 5 in fig. 6.

[Figs. 4 and 5, drawn as stained with borax-carmine, were also studied with hæmatoxylin and methyl-green. Figs. 3, 4, 5, as seen by transmitted light under $\frac{1}{8}$-inch objective of Swift.]

Fig. 6.—Sagittal section of anterior portion of shell enclosed in shell-sac; shows relations of figs. 2, 3, 4, and 5. The calcified portion is shaded with diagonal lines, as in fig. 2. (Seen with 1-inch objective.)

N.B.—The orientation of figs. 3, 4, 5, 6 is the same; fig. 2 is reversed. All the figures are drawn to nature except the shell-part of fig. 6, which is supplied from very many sections and drawings.

quite so clear. Where the edge of the shell is reached these remarkable cells suddenly stop. The conclusion that these cells are connected with secretion is inevitable; in fact the distal layer seems to be nothing more than chitin in course of deposition; as its connexion with the cell is lessened it splits into membranes. The suggestion of Appellöf that the upper portions of the [rapidly growing] cells coalesce and are thrown off as a chitinous membrane seems to explain their peculiar character, and agrees with what we know of chitin-formation elsewhere.

Therefore the external evidence of the soft parts corroborates the internal evidence of the shell. The intussusception-hypothesis does not explain the growth of the shell in *Sepia* any more than in *Nautilus*.

IV. Proposed Explanation.

Any theory must of course explain the facts for all the specialized forms, e. g. *Nautilus*, *Ammonites*, *Belemnites*, *Sepia*, *Spirula*, *Loligo*. But, since ontogeny is parallel to phylogeny, we shall expect our theory to be borne out by the facts of palæontology, and possibly to illustrate the methods by which the evolution of the group was accomplished. The latter point I deal with more fully elsewhere (14).

In the shells of all Cephalopoda chitinous membranes are first secreted; these form a framework in which lime can be deposited, and on their arrangement depends the structure of the shell. The membranes of the outer portion must be distinguished from those of the inner portion; the lime also differs in physical character according to the portion in which it is deposited (13). The membranes of the inner portion are secreted by the visceral hump, and in them is formed the True Shell (shell of *Nautilus* and *Orthoceras*; conch of *Ammonites*; phragmocone of *Belemnites*; middle plate, inner plate, and lamellæ of *Sepia*; conch of *Spirula*; gladius of *Loligo*, in part). Riefstahl postulates for *Sepia*, as F. Müller has done for Lamellibranchs (7), a primal mass of homogeneous chitin, from which, as it grows by intussusception, these membranes are repeatedly detached. There is none such; but on the surface of the cells that coat the visceral hump a layer of chitin is, by concrescence of their distal portions, continually formed, and from it the membranes are, as it were, exfoliated. Secretion and exfoliation, beginning in the anterior region of the shell-wall, proceed backwards to the suture; thence, centripetally over the septum, to the posterior margin of the septal neck; a membrane of the septum is therefore one with a membrane of the shell-wall, and each complete membrane is typically shaped like a funnel. Lime, derived from sea-water, is deposited as arragonite upon and between these membranes soon after their secretion; by this more purely physical process nacre is produced. The structure of this nacre is like that of the Lamellibranch shell in all essential points (6); and if, *pace* F. Müller, the present explanation be extended to the shells of all Mollusca, we shall merely be returning to the views of Dr. W. B. Carpenter (1 and 3), with this difference—the membranes are not cellular and do not of themselves retain vitality. The membranes of the outer portion are secreted by the mantle-lobes, and in them is formed the Sheath (cap of *Orth. truncatum*, Barr.; guard of *Aulacoceras* and *Belemnites*; mucro and shagreen-layers of *Sepia*; disc of attachment and ligament in *Spirula*; outer portion in pen of Teuthidæ and gladius of *Loligo*). These membranes may be rendered entirely or partially spathose by the deposition of lime in them as calcite. These latter facts have been disputed by no recent worker.

The foregoing explanation accounts very simply for observed structures in recent forms if in applying it we remember two principles:—(i.) that secretion of chitin may persist after advance of the body in the shell has slackened; (ii.) that extent of calcification varies inversely as rate of secretion. Where secretion of chitin is slow in proportion to the growth in length the septa are well separated from one another, and each is calcified soon after the membranes forming it have been deposited; there is no subsequent growth or movement of the septum (e. g. *Nautilus*). When, in accelerated development, the septa have come close together, calcification cannot keep pace with secretion, and the numerous overlying membranes prevent further deposition of lime in those subjacent (e. g. *Sepia*). Remember that calcification is always a slow process compared with secretion, and cannot, like it, be hurried. The growth of the sheath being correlated with that of the shell, we shall expect to find that, in forms where the anterior extension of the shell takes place slowly, the sheath-membranes remain calcified (e. g. *Belemnites*), but that in forms where the shell-wall is rapidly prolonged the sheath-membranes cover one another too quickly to permit of calcification (e. g. *Coccoteuthis*). Remember that these membranes shrink into a very thin space when not kept apart by lime (cf. *Belemnoteuthis*).

Examining extinct forms by the light of these principles, it is easy to see how the various differentiations arose. Nautiloidea and Ammonoidea considered, let us study the Coleoidea. At the beginning of the Mesozoic Era these split into two branches. In one branch the anterior extension of the dorsal region of the shell-wall was rapid; the septal and sheath-membranes were numerous or only partially calcified, and their edges appeared as lines of growth on the shell-wall; for this branch Fischer has kept the name *Chondrophora* (4), meaning by *χόνδρος* not cartilage, but chitin; among its earliest examples are *Coccoteuthis* and *Geoteuthis* of the Solenhofen slate. In the other branch the shell grew more slowly and the membranes were still fully calcified; since it is both opposite and parallel to *Chondrophora*, I propose for it the corresponding name *Osteophora* *, which is no more misleading and has the merit of being Greek. This branch consists of the *Phragmophora* and *Sepiophora* of Fischer; but these names merely describe stages in one series, not divergent groups. Not till the Tertiary era did phylogenetic retrogression influence this branch. Then the septa gradually became more closely set, and their membranes, as well as those of the sheath, less calcified. Naturally the extreme form thus produced, viz. *Sepia*, simulates the earlier *Chondrophora*; but it is still well calcified, and its genetic history is different. The evidence of fossils emphasizes the distinction: in *Osteophora* the part preserved is the calcified portion of the sheath (guard and mucro); in *Chondrophora* we only find the semicalcified chitinous laminæ. *Sepia* is *not* yet known in the Solenhofen slate, though the ghost of this ancient belief still shrieks to be laid. Fit places are found in this scheme for *Spirula* and *Loligo*, as I show elsewhere (14).

Since, however, the sepion has been chosen as battle-ground, it is as well to summarize here conclusions respecting it. Secretion of chitin is rapid in proportion to growth; more membranes are deposited than can be calcified; some of these remain free-stretched, the others are seen in the septa. At its antero-dorsal margin each membrane is rapidly covered by a fresh one; the edges, which thus remain uncalcified, form the middle plate; this was represented in the Belemnite by an *epicuticula* of the phragmocone. In the sheath-membranes, deposited by the mantle, calcification takes place with more or less completeness at different stages, according to the varying rapidity of secretion. As it is the youngest portion of the inner shell that most resembles the Belemnite-phragmocone (14), so is it that part of the outer plate covering the young portion which most

* Keferstein, in Bronn's 'Klassen u. Ordnungen,' thus distinguished recent forms, and spoke of *Decapoda calciphora* (p. 1438); but he did not recognize their true affinities. As my grouping is not quite the same as his, I seize the opportunity of rejecting his barbarous epithet.

resembles the Belemnite-guard. Here too, then, the sign of lineage is to be found in the young shell.

Conclusion.

The views here put forward—suggested by the macroscopic and microscopic structure of the *Sepia*-animal and shell—are confirmed by comparison with other shells; explained by the life of individuals, they illustrate the history of the race. The views are these:—The whole of the true shell and the whole of the sheath are formed first in chitinous membranes, secreted by the visceral hump and by the mantle respectively; these become calcified by the deposition in their interstices of arragonite and calcite respectively; there is no intussusception, except of lime, and that is probably a physical process. Secretion of chitin continues after growth ceases, and may be accelerated in phylogeny. The rate at which lime is deposited is independent of the animal; hence extent of calcification varies inversely as rapidity of chitin secretion.

In obedience to these principles and to others long since established the results which we see have been and are being produced by agencies already known.

Papers and Works referred to.

1. W. B. Carpenter.—"On the Microscopic Structure of Shells," 14th Rep. Brit. Assoc., York, p. 1 (1844).
2. Edwards and Wood.—"The Eocene Cephalopoda and Univalves," Palæontogr. Soc. 1848–77.
3. S. P. Woodward.—'Manual of the Mollusca,' ed. 4, 1880.
4. P. Fischer.—'Manuel de Conchyliologie,' &c., 1883.
5. Hyatt.—"Fossil Cephalopoda in the Museum of Comp. Zool.;" Proc. Amer. Assoc. xxxii. Minneapolis, p. 323 (1883).
6. v. Gümbel.—"Ueber die Beschaffenheit der Mollusken-Schalen," Zeitschr. deutsch. geol. Gesellsch. xxxvi. p. 386 (1884).
7. F. Müller.—"Schalenbildung bei Lamellibranchiaten," Zool. Beiträge, Breslau, p. 206 (1885).
8. Riefstahl.—"Die Sepien-Schale u. ihre Beziehungen zu den Belemniten," Palæontographica, Bd. xxxii., 1886.
9. Anon.—"Bemerkungen über Cephalopoden-Schalen," Der Naturforscher, Jahrg. xx. No. 18, p. 153 (April 30, 1887).
10. Bather.—"The Growth of Cephalopod Shells," Geol. Mag. dec. iii. vol. iv. p. 446 (October 1887).

11. APPELLÖF.—"Om skalets bildning hos *Sepia officinalis*, L.," Kongl. Svenska Vetensk.-Akad. Förhandl. xliv. No. 7, p. 495. (Communicated Sept. 14, published Oct. or Nov.? 1887.)

12. V. LENDENFELD.—"Bemerkung zu Riefstahl's Wachsthumstheorie der Cephalopoden-Schalen," Zool. Jahrb. Abth. für Syst. Geogr. u. Biol. &c., iii. Bd. 2 Heft (Jena, 15th Jan., 1888).

13. CORNISH AND KENDALL.—"Mineral Constitution of Calcareous Organisms," Geol. Mag. dec. iii. vol. v. p. 66 [Cephalopoda, p. 71], Feb. 1888.

14. BATHER.—"The Evolution of the Cephalopoda." Read March 2, 1888, at Geol. Assoc. and to be published shortly.

BIBLIOGRAPHICAL NOTICES.

A Catalogue of the Moths of India. Compiled by E. C. COTES and Colonel C. SWINHOE. Part I. Sphinges; Part II. Bombyces. Printed by order of the Trustees of the Indian Museum. Calcutta, 1887.

THIS Catalogue, of which the first two parts have reached this country, is a very valuable addition to the literature of the Heterocerous Lepidoptera of India, and will be extremely useful to scientific workers and collectors both at home and in India. Colonel Swinhoe, during his recent visit to England, spared no pains or trouble in his endeavours to name his specimens from such of the types as were available for the purpose. The first part of the Catalogue is devoted to the Sphingidæ, of which 187 species are recorded from various parts of India and Ceylon. Judging from this, the collection in the Calcutta Museum must be a very poor one, only 81 species being represented in it; so that no attempt could be made to investigate the value of the many very closely allied forms that have been named without any regard to variation or geographical distribution. Take, for instance, the genera *Macroglossa*, *Pergesa*, and *Triptogon*. On page 2 under *Hemaris hylas* is included *Macroglossa Kingi*, McLeay, from Australia. This is, however, a most distinct species, and one that could not in any case be confounded with *H. hylas*.

In Part II. of the Catalogue, which contains the Bombyces, 1436 species are included, of which only 308 are represented in the Calcutta Museum. In this section the arrangement of the various families is somewhat erratic. For example, the Notodontidæ are placed between the Bombycidæ and the Drepanulidæ, and the Saturniidæ are arranged almost at the end of the Bombyces, next to the Cossidæ. Among the Agaristidæ we note that *Eusemia opheltes* from North Burma (P. Z. S. 1885, p. 518) is omitted. In the family Chalcosiidæ the authors have placed a species in the genus *Dioptis*; but that genus, so far as we are aware, is entirely confined to the New World. It was raised to the rank of a family by the late Mr. Walker under the name of Dioptidæ. *Phalæna perdica*, Cramer, the species called *Dioptis perdica* by the authors, belongs to the family Euschemidæ and to the genus *Bursada*, Walker. The genus *Epicopeia*, we may remark, does not belong to the Chalcosiidæ, but is a Laparid. Nine species are recorded, but some of them are of very doubtful value. In the genus *Amesia*, *Amesia hyala*, from Darjeeling (P. Z. S. 1885, p. 518) is not included. These are some of the minor faults of the work; but by far the most serious is the omission of any reference to the authorities for the genera, many of which are brought under our notice for the first time.

The Catalogue is fairly well got up; but a slight want of care in correcting the proofs is evident. For instance, on page 211 the heading is printed "Ælasiocampid" instead of "Lasiocampidæ." Not a word of preface is given nor any intimation of the authors' intention or otherwise to continue the Catalogue; but it is to be hoped that they will do so, and, as far as possible, make the work complete.

Catalogue des Crustacés Malacostracés recueillis dans la Baie de Concarneau. Par Jules Bonnier. 8vo. Paris: Octave Doin, 1887.

We have received from M. Jules Bonnier a copy of his Catalogue of the Malacostracous Crustacea of Concarneau, published originally in the 'Bulletin Scientifique du Département du Nord,' but issued in a separate form under the above title. The work is one which must interest every student of the Crustacea, and is of special value to British carcinologists, as it furnishes a copious synonymy of the numerous species observed by the author, and at the same time indicates the distribution of the species, especially along the French coast of the Channel, as far as the station at Wimereux, the chief scene of the author's official labours. The list includes 192 species, of which 73 are Podophthalma.

Besides giving a very full synonymy of all these forms, M. Bonnier generally appends to the notice of each species some brief notes as to its mode of occurrence and comparative rarity in different places, sometimes enlarged by a few words upon the natural history of the species, and especially, as might be expected from so earnest a student of the parasitic Crustacea, a most valuable series of notes upon the occurrence of the latter. The Catalogue is furnished with a short introduction and a bibliographical index, which add considerably to its value as a work of reference.

MISCELLANEOUS.

A new Foraminifer. By M. J. Kunstler.

The organism of which the following is a description comes from the basin of Arcachon. The enumeration of its characters will show clearly that it is a new form of the most remarkable kind as regards its characters, its development, and its zoological affinities.

In the normal adult state it appears in the form of isolated, ovoid, elongated shells, from 1 to 2 millim. in length, monaxial and perforated by a mouth at one of their poles. The study of this envelope elucidates the question, hitherto so obscure, of the development of the test in the Rhizopoda. In the young state it is thin, purely chitinous, with an alveolar structure, which is often very distinct. It thickens by the division of its areolæ into two and then into several layers; the two peripheral layers, internal and external, persist in the chitinous state, while the intermediate areolæ become charged with calcareous matter, which thus forms a series of globules, often arranged in regular rows. The internal layer is the primary fundamental membrane of authors. The preceding statements demonstrate the falsity of the theory of the growth of the test of Rhizopoda by apposition, as well as several other hypotheses characterizing the present state of science; growth takes place throughout the thickness of the test, as if the whole envelope were living. The protoplasmic body contained in the shell, which presents all sorts of tints, from brownish yellow to bright rose-colour, is surrounded by a delicate membrane of cuticular aspect. It presents an areolar structure, which is fine in the peripheral region, with larger meshes in the interior protoplasm. It is far from always filling the whole shell; often there is only a small dense mass, from which issue anastomosing bands running towards the mouth, where an accumulation of clear substances is formed. There are all passages between these different states and a number of others which it would take too long to enumerate here.

From the buccal protoplasmic accumulations issue fine transparent pseudopodia of variable number, which serve for the prehension of the creatures destined to the nourishment of these organisms. In cases where the pseudopodia are all retracted we may see, at the buccal pole, a most remarkable arrangement, unique, at present, in the group of Foraminifera. There is here an excavation of no great regularity, at the bottom of which is the entrance of a tube analogous in its aspect to the œsophageal tube of many Infusoria.

The number and aspect of the nuclei are very variable. Often not very abundant, pale and large, they are in other cases small, refractive, and in larger number. The appearance of these nuclear corpuscles coincides with the commencement of reproduction.

The reproductive phenomena appear to be produced as follows:—In the peripheral region, around each nucleus, by a sort of gemmation, the group of dense protoplasm becomes surrounded by a chitinous layer, and in this way are formed a number of small embryos, which, during growth, divide abundantly, and, after attaining certain dimensions, issue through the mouth. A free young organism is provided with a chitinous shell perforated by a pore and containing a small external nucleus. This embryonic chamber soon produces, by gemmation, a small elongated chamber, which becomes spirally twisted around it; this first chamber produces a second by the same process, and so on. Thus is produced a small rolled-up organism, analogous to a *Miliola*. This rolling-up soon becomes irregular, like a ball, and finally the new chambers erect themselves, become ramified in various ways, and form a dendritic mass. In the further course of the development the different shells constituting these masses become detached from each other, increase in size, multiply in various ways which cannot be described here, and, after having attained certain dimensions, propagate again by embryos which recommence the same cycles.

A great number of other new facts further characterize this organism, such as frequent moultings, the formation of multiple septa at the expense of the inner membrane of the shell, &c.

From what precedes it seems that hitherto the adult form may have been misunderstood in certain Foraminifera. In fact the descriptions are only of twisted forms, or at least forms in which all the chambers are in continuity. Now I have just shown that this was an embryonic stage in the organism here under consideration. It seems to me very improbable that this alone presents these phenomena to the exclusion of all other species. The deficiency of observations upon the mode of reproduction of the latter confirms my opinion.—*Comptes Rendus*, March 12, 1888, p. 769.

A new Freshwater Sponge. By Henry Mills.

Heteromeyenia radiospiculata, n. sp.

Sponge massive; specimen $3 \times 2\frac{1}{2} \times 2$ inches in thickness; texture close, compact; surface nodular; statoblasts or gemmulæ uniformly globular; diameter ·02 parts of an inch; crust thick, charged with two distinct forms of birotulate spicula, the inner ends of both resting on the chitinous coat of the statoblast.

Foraminal opening small, slightly prolonged, not funnel-shaped.

Skeleton-spicula generally smooth, a few sparsely microspined; curved, moderately sharp-pointed; length varying from ·012 to ·014 parts of an inch; long birotulates vary in length from ·007 to ·009 parts of an inch. From thirty to sixty of these project irregularly from each statoblast, reaching out beyond the shorter birotulates, one fourth or more the diameter of the statoblast, and terminating in rotulæ, consisting of numerous, strong, recurved hooks, some of which are turned inward pointing directly to the shaft. Shaft more or less spined, slightly curved, larger in the middle; width of rotulæ ·0012.

Shorter birotulates large, symmetrical, with irregularly dentate rotulæ; rotulæ boletiform; shafts straight, strongly spined, spines at right angles to shaft tapering to a point.

Length of short birotulate ·003 inch. Width of rotulæ ·001. Dermal or flesh-spicula numerous throughout, small, hexradiate-stellate; with rays or arms of various extent proceeding in all directions from a common centre; centre without form or other character, except that which is incident to the junction of the many spines which make up the spiculum. Average extent of stellate spicula measured from the ends of opposite rays ·001. Rays sometimes of uniform thickness, occasionally enlarged at the ends with microspines, curved inward.

There are also many small spicula with one or two long arms, forming an axis from which proceed other rays or arms perpendicular to the axial rays. These are all microspined, sometimes with blunt terminus and sometimes tapering slightly.

The two kinds of birotulate spicula found in the statoblast of this sponge, as already described, bring it into the genus *Heteromeyenia*, Potts. But for this feature it must be classed at least as a remarkable form of *Meyenia plumosa*, Carter. Forty years ago Mr. Carter, of England, found his specimen of the last-named sponge in the water-tanks of Bombay, India. This he described in 1849. No other specimen or variety of it was found again till three or four years ago, when Dr. Palmer found a variety of it on the banks of the Colorado River. This was described by Mr. Potts, who named it *Meyenia plumosa*, variety *Palmeri*. See his description in his monograph of the freshwater sponges.

As the term used to designate the generic character of this entirely new form is technically expressive of one of its peculiarities, I have thought it best to use a specific term which is also expressive of the stelliform spicula, which, among all the freshwater sponges, so far as I know, are only found in this and the two allies above named. It will therefore be known as *Heteromeyenia radiospiculata*.

This sponge was found in the Ohio River, twelve miles from Cincinnati, by my friend Mr. George B. Twitchell, in September 1887, and sent to me in November, same year. I acknowledge my indebtedness to Mr. Twitchell for several other specimens found also in the Ohio River. Among them are *Carterius tubisperma*, Mills, a fine specimen of *Tubella pennsylvania*, Potts, and *Spongilla lacustris*, Auct.—*The Microscope*, no. 2, February 1888, p. 52 (Detroit).

On Parasitic Castration in the Eucyphotes of the Genera Palæmon *and* Hippolyte. By M. A. Giard.

In 1837 Rathke noticed the curious fact that the Palæmons infested by *Bopyri* belonged exclusively to the female sex:—"*Mirabile dictu Bopyri omnia quæ vidi exempla—vidi autem eorum plures centurias—solummodo in Palæmonibus feminis repereram, licet in manus meas non pauciores horum animalium mares quam feminæ incidissent*" *. All subsequent authors down to the most recent one, P. Fraisse, have only confirmed Rathke's observation.

Guided by my previous discoveries as to the effects of parasitic castration in Decapod Crustacea infested by Rhizocephala, I last

* 'De Bopyro et Nereide,' p. 18.

year put forward the hypothesis that the fact noticed by Rathke was no doubt correct only *in appearance*, and that if no male Palæmons are found to harbour *Bopyri* this is because the atrophy of the testes in the infested males produces as a consequence an arrest of development of the external sexual characters *. I have since been able to verify the correctness of this supposition both in our European prawns infested by *Bopyri* and in *Palæmon ornatus* of the Brussels Museum infested by *Probopyrus ascendens*. The large size of the last species renders the proof more easy. Besides the position of the genital apertures there are, in the Palæmons, a certain number of secondary sexual characters which have been well indicated by Grobben and J. V. Boas, namely:—

1. The males are smaller than the females.
2. The thoracic chelæ are generally longer in the males.
3. The inner ramus of the first pair of abdominal feet is much more developed in the male than in the female and differently fringed.
4. The second abdominal foot bears on the inside of the inner ramus, between this and the retinaculum (*appendix interna*, Boas), a styloid copulatory appendage furnished with stiff setæ (*appendix masculina*, Boas).
5. The branch of the first antenna which bears the olfactory setæ is larger in the male than in the female, and this absolutely and not only relatively to the size of the body; the olfactory setæ are also more numerous.

We may add to the preceding characters a peculiarity indicated by E. von Martens, and which is of very great practical value, namely that in the females the free space between the bases of the fifth thoracic feet is much larger than in the males.

The characters derived from the size and from the form of the chelæ are of relative value. If we compare suitably selected series of individuals it is easy to find males of smaller size and with shorter chelæ than certain females. It is therefore not surprising to find that these characters disappear completely in the castrated males. But with the exception of the distinctions derived from the position of the genital apertures and the distance of the feet of the fifth thoracic pair it is easy to ascertain that the other sexual characters also become attenuated, or even disappear, in the infested males. The inner ramus of the first abdominal foot is, perhaps, a little larger than in the female, but at any rate much smaller than in the normal male. On the second pair the *appendix masculina* is generally wanting. In one word, the general aspect is so profoundly modified that, without careful examination, the infested male would certainly be determined as a female. Even the amount of separation of the coxæ of the fifth pair of thoracic feet and the

* Bull. Soc. Sci. de la France et de la Belgique, 1887, p. 12 *et seqq.*; translated in 'Annals,' ser. 5, vol. xix. pp. 325–345.

form of the sternal portion of the corresponding segment approach the arrangements existing in the other sex.

However, it must be remarked that in the case of the Palæmons, as in the other previously studied cases of parasitic castration, there is a very singular want of uniformity in the phenomena observed. Thus a specimen of the male *Palæmon serratus* of the shores of the Channel, infested by *Bopyrus squillarum*, has very distinctly retained the attributes of its sex, and even presents only a slight reduction of the *appendix masculina*. Perhaps this diversity in the extent of the modifications observed is to be ascribed to the more or less early period of infestation. Moreover, these modifications are not indelible, so far as I may judge from experiments made at the Laboratory at Wimereux upon male *Paguri* castrated by *Phryxus paguri*; when subsequently freed from their parasites the characters of the male sex gradually reappeared at the successive moults.

The numerous species of *Hippolyte* which abound in the arctic seas are often infested by Bopyrians confounded by authors under the collective names of *Gyge hippolytes*, Kröyer, and *Phryxus abdominalis*, Kröyer. Hitherto I have not been able to study a sufficient number of these parasites; but a careful examination of the synonymy leads me to think that they exert the same action upon the *Hippolyte* as the *Bopyri* upon the *Palæmon*. In fact, among the numerous species of *Hippolyte* established by Kröyer and the zoologists of the early part of the present century, some have since been recognized as being only the two sexes of the same specific type. Kingsley, G. O. Sars, &c. have shown that *Hippolyte borealis*, Kr., is the male of *H. polaris*, Sab., and that *H. Phippsii*, Kr., is the male of *H. turgida*, Kr. Now if we run over the lists of the habitat of *Phryxus abdominalis* and *Gyge hippolytes*, we find with surprise that these parasites have constantly been indicated upon *Hippolyte polaris* and *H. turgida*, never on the male forms *H. borealis* and *H. Phippsii*. In a recent and very careful work upon the Crustacea of the west coast of Greenland, H. J. Hansen, after having indicated the presence of *Phryxus abdominalis* upon *Pandalus Montagui* and four different species of *Hippolyte*, adds that of the comparatively large number of individuals of this Bopyrian observed by him not one was attached to a male host. Lastly, there is a curious fact to be noted. Kröyer, whose works are generally so precise and exact, says, in his monograph of the genus *Hippolyte*, that the female genital aperture is situated in these Carides at the same point as that of the males, that is to say, at the base of the coxæ of the posterior feet. Is it not probable that Kröyer made this erroneous observation upon infested males which he took for females? This is a point to which I would call the attention of the Scandinavian zoologists. There are interesting investigations to be pursued upon a series of phenomena which are still very little known.—*Comptes Rendus*, February 13, 1888, p. 502.

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[SIXTH SERIES.]

No. 5. MAY 1888.

XXXVIII.—*On a new Physophore,* Plœophysa, *and its Relationships to other Siphonophores.* By J. WALTER FEWKES *.

[Plate XVII.]

ONE of the most interesting Siphonophores collected by the United-States Fish-Commission steamer 'Albatross' in the Gulf-stream is a new genus, *Plœophysa*, which has most interesting morphological affinities with known genera of these animals. This Medusa, notwithstanding its very interesting relationships, has never been described. The structure of the genus is so exceptional and its anatomy throws so much light on the morphology of other little-known Physophores that a description of it seems worthy of special publication.

Plœophysa was picked out of a bottle of "surface skimmings" obtained by the 'Albatross' during her cruise of 1886 †. Two fine specimens were found, both of which exhibit the characteristic features here described and figured.

* Communicated by the Author, by permission of G. Brown Goode, U.S. Fish Commissioner.

† The bottle in which *Plœophysa* was found had not been examined when my Reports on the Medusæ collected by the 'Albatross' were written.

The most exceptional peculiarity in the genus is the structure of an organ called the hood, elsewhere unknown among Physophores in this form, although represented by organs which have already been described in other little-known genera. This homology of these structures, however, is here pointed out for the first time. A diagnosis of the genus *Plœophysa*, of which only the single species *P. Agassizii* is known, is given in the following pages. The account closes with a discussion of its affinities and its relationships to certain other Physophores.

I. *Description of* Plœophysa Agassizii, *gen. et sp. nov.*

Plœophysa, gen. nov.

Float large, conspicuous, partially covered by a hood-shaped body, which is (or appears to be) bound by muscular bands to a globular enlargement of the polyp-stem.

No nectocalyces, no hydrophyllia. Polyp-stem globular, bearing numerous, long, flexible tasters, without (?) filaments. Polypites situated below the crown of tasters. Polygastric. Tentacles with tentacular knobs formed of a sacculus, two terminal filaments, and a terminal vesicle. Rudimentary involucrum at the base of the sacculus. Sexual clusters in botryoidal bunches at the base of the tasters. Monœcious.

Diameter of the float in a horizontal direction 5 millim. Whole diameter with contracted tasters (hydrocysts) 12–15 millim. Colourless * in alcohol, with the exception of the pigment-zone about the apex of the float.

Plœophysa Agassizii, sp. nov. (Pl. XVII.)

Float.—The float (*f*) is large and hemispherical, with a pigment-zone at the apex, as in *Athorybia.* The lower hemisphere of the float is inflated and passes directly into a globular enlargement of the polyp-stem known as the polyp-sac. Size 2 millim. in horizontal diameter.

Hood.—On one side of the float there rises a structure called the hood (*h*). This organ arches over the float in alcoholic specimens and appears to be a continuation of the polyp-sac. Its outer walls are papillose, and the whole structure appears to be glandular. It is connected with the polyp-

* A universal characteristic of all specimens of Physophores which have been in alcohol for a length of time.

sac by thin bands (*m*), which embrace the lower part of the float. It is not possible for me to say that the arching of the hood over the float, figured in my drawings, is not due to contraction *. The hood may thus be more prominent in live specimens than in alcoholic.

Nectocalyces and Nectostem †.—There are no nectocalyces in the two specimens studied. It is possible that the hood (*h*) may be a homologue of the nectostem and the minute papillæ rudimentary nectocalyces. The structure of *Pleurophysa* would seem to indicate this interpretation.

Polyp-sac.—The enlargement below the float is known as the polyp-sac. It is an inflated or globular structure, and bears on its sides many highly flexible organs (*ts*), forming a mass of filamentous bodies with members projecting at all angles. Looking at the float from one side it will be seen that on the same side of the float as the hood (left hand) there is a cluster of sexual bodies (*s*) larger than the others. The position of these bodies is important morphologically.

Tasters.—The whole side of the polyp-sac below the float is concealed by the tasters (*ts*). No filaments were observed on them; but in one or two instances bodies which may be the filaments of the tasters were observed coiled at their bases. It is possible that no filaments exist and that these tasters are like the nectotasters of *Apolemia.*

Polypites.—The polypites (*pt*) are contracted to globular bodies and lie on the underside (opposite the float) of the polyp-sac. Ordinarily in contraction in alcohol they bear at their distal end a small button-shaped structure, formed by the reflexed lips of the mouth. There are several polypites, while each of these structures has longitudinal rows of "liver-cells" on its inner walls.

Tentacles and Tentacular Knobs.—The tentacles (*ta*) arise from the bases of the polypites. The tentacular knobs were easily seen in the alcoholic specimens and consist of a sacculus, a rudimentary involucrum, two terminal filaments, and a terminal vesicle.

The terminal filaments are short, stumpy (in alcohol), and

* The description which Hæckel gives of the aurophore of his Auronectæ is so short—his paper is a preliminary one ("System der Siphonophoren")—that I am unable to say whether my "hood" of *Plœophysa* is not an aurophore. *Plœophysa*, however, does not belong to the Auronectæ, Hæckel, as no nectocalyces are developed in my genus. There are other structural differences between *Plœophysa* and the Auronectæ, Hæckel.

† The stem on which the nectocalyces are carried may be called the nectostem; that which bears the polyp is called the polyp-stem. Tasters which arise from the nectostem as in *Apolemia* may be called nectotasters.

resemble those of *Athorybia* * *rosacea*, Köll. The sacculus is uncoiled, curved, and armed with powerful nematocysts. The involucrum is rudimentary.

Gonophores.—Clusters of male and female gonophores are found at the base of the hydrocysts. Monœcious. An exceptionally large cluster of female gonophores is found at the point *s*.

Summary of Exceptional Features in Plœophysa.

1. Existence of the hood (*h*).
2. Portion of the stem (axis) which ordinarily bears polypites (polyp-stem) is reduced to a globular sac. The nectostem, or the part of the stem which generally bears nectocalyces, is modified into a hood (*h*).
3. Nectocalyces and hydrophyllia are wanting.

II. *Conclusions in regard to the Affinities of* Plœophysa.

1. It is the type of a new family, for which the name Plœophysidæ is suggested.

The affinities of *Plœophysa* are somewhat difficult to make out. As in the families to which *Physalia*, *Velella*, and *Rhizophysa* respectively belong, nectocalyces and hydrophyllia are wanting. The tentacular knobs are unlike those of any of these families. There is, however, a remote likeness of the tentacular knobs of *Plœophysa* to those of *Rhizophysa gracilis*, Fewkes †; but in this genus the stem is elongated and not globular, as in *Plœophysa*. While the tentacular knobs somewhat resemble those of *Athorybia rosacea*, unlike any of the Anthophysidæ the Plœophysidæ are destitute of hydrophyllia or covering-scales.

The absence of nectocalyces separates *Plœophysa* from the order Auronectæ of Hæckel ‡, although it is not impossible that the hood is homologous with the aurophore of the last-mentioned writer.

With the Angelidæ, a family which includes *Angela* and *Angelopsis*, *Plœophysa* has close resemblances, but differs from it in the character of the hood.

* The *Athorybia* with two kinds of tentacular knobs described by me as *Athorybia formosa* is referred by Hæckel to *Anthophysa*, Mert. I accept his suggestion that it is not an *Athorybia*, but find it different from *Anthophysa*. It is probably a new genus, *Diplorybia*, Fewkes.

† Bull. Mus. Comp. Zool. vol. ix. no. 7, p. 270, pl. vi. fig. 5.

‡ Of the three genera of this order *Stephalia* is without tentacular knobs; while *Auralia* and *Rhodalia*, according to Hæckel, have knobs like *Forskalia*.

III. *Homology of the Hood of* Plœophysa.

The homologue of the hood is to be found among other Physophores in the nectostem of which it is an outgrowth. It assumes in certain genera a variety of shapes. In *Rhizophysa gracilis*, Fewkes, in which, as in all Rhizophysidæ, the polyp-stem is very long, the hood appears as a small transparent hernia-like bud with air-bubbles at the base of the float, as figured in my paper on the jellyfishes of Tortugas *. In *Pleurophysa* the nectostem does not bear nectocalyces; but instead of bells it carries small buds or tubercles on one side. In this genus the hood has been elongated into a nectostem, but does not yet bear nectocalyces. In *Haliphyta* we have the same condition as in *Pleurophysa* as far as the modified hood is concerned †. It can readily be seen that in these two genera the hood has assumed the shape of a nectostem, which, in genera like *Agalma*, bears nectocalyces ‡. It seems, then, that we have in the so-called nectostem of *Pleurophysa* and *Haliphyta* an indication of the homology of the hood of *Plœophysa*.

In the Rhizophysidæ, as before recorded, the nectostem is ordinarily reduced to nothing or wanting. The hood, however, may be represented in the structure at the base of the float of *R. gracilis*. In *Pterophysa*, a giant genus over twenty feet in length, a differentiation of the nectostem from the polyp-stem has begun to take place, and in the allied *Bathyphysa abyssorum* (Studer) Hæckel, both nectostem and polyp-stem are well differentiated.

In *Pterophysa* § we find at the base of the float, in about the same position as the bud already mentioned on the float of *Rhizophysa gracilis*, a cluster of taster-like bodies homologous with the so-called tasters (*ts*) of *Plœophysa*. These bodies indicate the position of the nectostem and are homologous with similar bodies, called nectotasters, found on the

* *Loc. cit.*

† The great difference between these two genera is the absence of hydrophyllia in *Pleurophysa* and the character of the polypites.

‡ I was at first led to suppose that nectocalyces once existed on the nectostem of *Haliphyta* and that the small knobs indicated their former attachment. That opinion is now abandoned, and I now think they were never there. I am confident of this so far as *Pleurophysa* is concerned.

§ My figure of *Pterophysa*, drawn from a beautiful specimen over *twenty feet* long, shows no nectocalyces or hydrophyllia. In none of the specimens which I have studied are there any signs of nectocalyces or covering-scales, nor of the attachment of these structures. Moreover, a long nectostem does not exist. I cannot therefore follow Hæckel when he refers my *Pterophysa* to the Forskalidæ.

nectostem of *Apolemia uvaria*. The filiform bodies (*ts*) of *Plœophysa* are thought to be homologous with nectotasters in *Apolemia* and *Pterophysa*.

Cambridge, Mass., U.S.A.,
February 1888.

EXPLANATION OF PLATE XVII.

f. Float.
h. Hood.
m. Connexion of the hood with the polyp-sac.
pt. Polypite (artificially extended; in nature probably even more extended).
pt'. Polypite as it appears in alcoholic specimens.
s. Gonophores. A large cluster of male and female bells.
ta. Tentacle (artificially extended as in nature; in alcohol all the tentacles are retracted to the body of the polypite).
ts. Taster or hydrocyst.

[The figures are drawn from an alcoholic specimen.]

Fig. 1. *Plœophysa Agassizii* (lateral view).
Fig. 2. The same (viewed from above).

XXXIX.—*Contribution to the Knowledge of Snakes of Tropical Africa*. By Dr. A. Günther, F.R.S., Keeper of the Zoological Department, British Museum.

[Plates XVIII. & XIX.]

I. *Descriptive Notes.*

Rhinocalamus, g. n. (Calamariid).

Body elongate, cylindrical, of uniform thickness throughout; head small, not distinct from neck, narrow and tapering; tail rather short, obtuse; eye very small; cleft of mouth narrow, with feeble jaws; scales smooth, in seventeen rows; subcaudals paired. Rostral shield wedge-shaped; two pairs of frontals, the posterior replacing a loreal and anteocular; nasal single, but with a groove below the narrow nostril. Maxillary armed with a few comparatively strong teeth, the two hindmost of which are enlarged and grooved.

Rhinocalamus dimidiatus, sp. n. (Pl. XIX. fig. C.)

The scutellation of the head of this singular snake consists first of a large and broad rostral shield, which in front is compressed into a horizontal edge. Then follow two pairs of frontals, the anterior of which are transversely narrow; the posterior large, in contact with the third labial and forming the front margin of the orbit. Vertical broad, subquadrangular, with an obtuse angle in front and an acute one behind; occipitals rather narrow and elongate, forming a suture with the fifth labial. Upper labials six, of which the first two are small, situated below the nasal; the third and fourth enter the orbit, the fifth is the largest and succeeded by a sixth very small one. The supraciliary is very small and the single postocular minute. One large temporal occupies the hinder part of the temple. The first pair of lower labials form a suture together in the median line, and are succeeded by a single pair of small and narrow chin-shields; the fourth lower labial exceeds the others considerably in extent. Ventral shields 204; anal divided; subcaudals 26.

The upper parts of this snake are uniform black, the lower parts and the three outer series of scales white.

The largest of three specimens is $15\frac{1}{2}$ inches long, the tail measuring $1\frac{1}{2}$ inch.

Three specimens were obtained at Mpwapwa.

The figure of the head is twice the natural size.

Calamelaps miolepis, sp. n.

In the pholidosis of the head this species agrees entirely with *Calamelaps unicolor*, and, like that species, it is of a uniform deep black colour; but the scales are arranged in twenty-one series instead of seventeen. Ventral scutes 205; subcaudals 18; anal bifid.

One specimen, 16 inches long, was obtained at Cape Maclear on Lake Nyassa.

Elapomorphus acanthias, Kröy.

This species is not always ornamented with longitudinal bands. The British Museum possesses two specimens from Old Calabar, one of which has the body uniform black, with yellowish abdomen, and the other nearly so, although in certain lights the bands may be seen. In all the head is of a lighter colour than the trunk, marbled with brown.

Ventral and subcaudal scutes 210 + 18.

Elapomorphus cœcutiens, sp. n. (Pl. XIX. fig. B.)

This species is distinguished from its African congeners by the remarkably small size of the eye, and especially from *Elapomorphus gabonicus* by the elongate first lower labials, which form a suture in the median line behind the mentale. Head short, broad and depressed. Upper labials seven, of which the third and fourth enter the orbit; præocular one; postocular one, rarely two. Temporals 1 + 1, the anterior in contact with the postocular. Scales in fifteen rows. Ventral scutes 231; subcaudals 17 or 18; anal bifid. The orbit is but little larger than the depression of the nasal aperture. Upper and lateral parts uniform dark slate-coloured, lower parts white.

Two specimens from the Cameroon Mountains (altitude 2000 feet), the larger being 20 inches long.

Uriechis capensis, Smith.

This species is distinguished by the very large mentale, which separates widely the two anterior labials from each other. Specimens from Zanzibar agree entirely with Jan's figure, the fifth labial being in contact with the occipital; but a specimen from Nyassa has the body uniform black, the nuchal white and black bands being present as in the typical form. This latter specimen has also a longer tail, with 58 subcaudals (and 151 abdominal scutes). The Zanzibar specimens vary somewhat in these numbers, viz. 138–153 ventral and 41–46 subcaudal scutes.

Uriechis lunulatus, Ptrs.

Although closely allied to *Uriechis capensis*, this species may be readily distinguished by the much smaller and shorter mentale, which allows the lower labials of the first pair to meet each other in the median line, but without forming so long and distinct a suture as in *Uriechis concolor*. The head is rather broad and depressed. The anteocular about as deep as long. Seven upper labials, of which the third and fourth enter the orbit; the fifth only forms a suture with the occipital; one postocular. Temporals 1 + 2, the anterior not meeting the postocular. Scales in fifteen rows.

One specimen, 13 inches long, is light olive-coloured, each scale with a brown edge; the neck is ornamented by a broad black cross bar, which at a distance of seven scales is succeeded by a similar but narrower band; a series of about ten black cross bars follow, becoming narrower and shorter behind; lower parts whitish. 154 ventral and 59 subcaudal scutes.—Lake Nyassa.

A second specimen is 15 inches long. The ground-colour is the same as in the first, but of the black cross bands only the two anterior are indistinctly visible; lower parts uniform whitish. Ventral scutes 155; subcaudals 51.—Lake Tanganyika.

Uriechis concolor, Fischer.

A specimen from Lado, sent by Emin Pasha, agrees perfectly with the description given by Fischer. Besides the black coloration, the length of the suture formed by the first lower labials behind the mentale is characteristic. Ventral scutes 148; subcaudals 54. Fischer's specimen came from the foot of Kilima-ndjaro.

Uriechis Jacksonii, sp. n. (Pl. XIX. fig. E.)

This species also is very closely allied to *Uriechis capensis*. Scales in fifteen rows. Ventral scutes 150; subcaudals 39. Head rather narrow, depressed. Præocular short, two postoculars. Temporals 1+2, the anterior in contact with the postoculars; seven upper labials, of which the third and fourth enter the orbit, and none of which are in contact with the occipitals. Mentale short, the lower labials of the first pair forming a suture together in the median line. Light olive-coloured, the upper part of the head and of the neck and also the labials below the eye black; a pair of white spots behind the occiput. A narrow black line runs along the vertebral series of scales. Lower parts uniform whitish.

A single young specimen, $7\frac{1}{2}$ inches long, was discovered by F. J. Jackson, Esq., at the foot of Kilima-ndjaro.

The figure of the head is twice the natural size.

Grayia triangularis, Hall.

A young specimen from the Congo has the whole of the lower parts uniform black. Another young specimen from the Gaboon differs still more from the type in its coloration, the light cross bands being absent, appearing as irregular whitish longitudinal lines on the side of the body. The upper parts are nearly uniform greyish brown, each scale having a darker centre. Lower parts black.

Ahætulla Emini, sp. n.

Ventral shields without keels, 151; anal bifid; upper labials nine, the fourth, fifth, and sixth entering the orbit; one anteocular, two postoculars; six of the lower labials are in contact with the chin-shields; loreal not twice as long as broad; temporal shields 1+2. Scales smooth, in 15 rows. Head of moderate size, not elongate or depressed; body and tail moderately slender. Uniform green; skin between the scales black, each scale with a white spot on the basal half of its outer margin.

One specimen was obtained from Monbuttu by Emin Pasha; it is 29 inches long, the head measuring $\frac{3}{4}$ inch and the tail 10 inches.

Ahætulla shirana, sp. n.

Ventral shields slightly keeled, 157; anal bifid; upper labials nine, the fourth, fifth, and sixth entering the orbit; one anteocular, two postoculars; six of the lower labials are in contact with the chin-shields; loreal not twice as long as deep; temporal shields 1+2+2. Scales smooth, in 15 series. Head of moderate size, not depressed or elongate; body and tail moderately slender. Green; skin between the scales black; each scale with a white spot on the basal half of its outer margin. The back of the anterior half of the trunk is crossed by narrow, closely set, rather irregular, black cross bars, which become narrower behind and disappear altogether in the middle of the length of the trunk.

One specimen was obtained at the Blantyre Mission Station on the Shire River. It is 18 inches long, the head measuring $\frac{7}{12}$ inch and the tail 6 inches.

Ahætulla Bocagii, sp. n.

Ventral shields keeled, 196; anal bifid; upper labials nine, the fifth and sixth entering the orbit; one anteocular, two postoculars; six of the lower labials are in contact with the chin-shields; loreal elongate, at least twice as long as deep; temporal shields 2+2+2. Scales smooth, in 15 series. Head rather small, not elongate; body and tail very slender. Uniform green; skin between the scales black, each scale with a whitish spot.

One adult specimen was obtained by Lieut. Cameron in Angola; it is 35 inches long, the head measuring $\frac{5}{6}$ inch, and the tail 11 inches.

Ahætulla gracillima, sp. n.

Ventral shields without lateral keels, 180; anal bifid; upper labials nine, the fourth, fifth, and sixth entering the orbit; one anteocular, two postoculars; six of the lower labials are in contact with the chin-shields; loreal not twice as long as deep; temporal shields 1+1. Scales smooth, in 15 series. Head remarkably small, not depressed or elongate; body and tail very slender, especially the neck. Uniform green; scales without whitish spot.

One specimen was obtained in a collection from the Lower Congo; it is 27 inches long, the head being ½ inch long, and the tail measuring 10 inches.

Rhagerrhis oxyrhynchus.

The synonymy of this species stands as follows:—

Psammophis oxyrhynchus, Reinh. Dansk. Vid. Selsk. Afh. 1843, p. 244, tab. i. figs. 10–12. (V. sc. 169–178. Coast of Guinea.)
Ramphiophis rostratus, Peters, Berl. MB. 1854, p. 624, and Reise n. Mossamb. Amphib. 1882, p. 124, tab. xix. fig. 1. (V. sc. 160–179. Mossambique.)
Rhagerrhis unguiculata, Günth. Ann. & Mag. Nat. Hist. 1868, i. p. 422, taf. xix. fig. G. (V. sc. 176. Zanzibar.)
Cœlopeltis oxyrhynchus, Jan, Iconogr. livr. xxxiv. pl. i. fig. 1.
Cœlopeltis porrectus, Jan, Iconogr. livr. xxxiv. pl. ii. fig. 1.

Rhagerrhis rubropunctatus.

Dipsina rubropunctata, Fischer, Afrik. Reptil. &c., Hamb. 1884, p. 7, taf. i. fig. 3.

Kilima-ndjaro. V. sc. 230.

Psammophis acutus, sp. n. (Pl. XIX. fig. D.)

This species is distinguished by its singularly short and convex head, terminating in a sharply conical snout. The rostral shield has a tetragonal form, the upper side forming a part of the upper surface of the snout. The occipital shields are small, shorter than the vertical; the single præocular touches the vertical; two postoculars; loreal square; eight upper labials, of which the first is very small, the fourth and fifth entering the orbit; temporals 2+3+4. Scales in 17 rows; ventrals 185; anal divided; subcaudals 59 pairs. General shape of the body similar to that of *Psammophis sibilans*. A brown lateral band forms the boundary between the ground-colour of the back and that of the lower parts. The ground-colour of the back is light, with a brownish tinge; a vertebral line of a darker colour occupies only the median series of scales, but is more dilated on the neck and the crown of the head. The lateral band is deep brown, with a black and white edge, occupying the third and fourth and the two halves of the adjoining series of scales; it commences in the nasal region, passes through the eye, and is continued nearly to the end of the tail. The outermost series of scales and the abdomen are yellowish white.

A single specimen from Pungo Andongo is 36 inches long, the tail measuring $6\frac{1}{2}$ inches.

Simocephalus nyassæ, sp. n.

Scales in 15 rows, all strongly keeled, and the majority with shorter secondary keels; dorsal scales large, bicarinate. Ventral scutes strongly keeled on the sides, 178. One ante- and one postocular; seven upper labials, the third and fourth entering the orbit; temporals 1+2+3, the anterior separated from the anteocular by the occipital and fifth labial, which are in contact with each other. Snout very broad and much depressed. Uniform brownish black above, lighter beneath.

A single specimen, 17 inches long, from Lake Nyassa. The tail measures 4 inches.

Boodon geometricus, Boie.

This name, which frequently occurs in treatises on African snakes, has been applied to specimens of *Boodon* with 21, generally 23, and sometimes 25 series of scales, and with two yellow lines on each side of the head, of which one may or may not be continued along the side of the body.

From a revision of the specimens in the British Museum and a comparison of the descriptions by various authors I have come to the conclusion that several well-marked species have been confounded under that name, at any rate by myself in the 'Catalogue of Colubrine Snakes;' that neither the specimen in the Paris Museum from Péron's collection, which was described by Duméril and Bibron, nor the one figured by Jan, nor the snake figured by Andrew Smith, are the species named and figured by Boie and Schlegel *. Jan's figure was probably taken from a specimen from the Seychelle Islands, and Smith's snake is, as Boulenger has already stated, in fact, *Boodon lineatus*.

The type of the species is in the Leyden Museum and described by Schlegel. His description does not agree with any of the species distinguished here; possibly it may apply

* Peters and Bocage seem to have assumed that the type named by Boie is in, or at least identical with the specimens of, the Paris Museum (Jorn. Sc. Lisb. xliv. 1887, p. 199).

to my *Boodon mentalis*; but this has 25, and not 21 or 23 scales, as Schlegel says. In short, the true *Boodon geometricus* is unknown to me.

The following table may assist in the discrimination of these species:—

I. Two pairs of chin-shields, the shields of the posterior pair in contact with each other.

A. Scales in 23 rows.

1. One anteocular.

a. The anteocular reaches to the upper surface of the head; abdomen yellowish along the middle, slate-coloured on the side .... West Africa (Old Calabar and Ashantee): *B. ventralis.*

b. The anteocular does not reach to the upper surface of the head; abdomen uniform dusky brown. Seychelle Islands: *B. seychellensis.*

2. Two anteoculars .... East Africa (Lake Tanganyika and Mombas): *B. bipræocularis.*

B. Scales in 25 rows; lower parts uniform whitish. Fernando Po: *B. poensis.*

II. The chin-shields of the posterior pair are separated from each other by the anterior pair, and do not meet in the median line; scales in 25 rows .... Damara Land: *B. mentalis.*

Boodon ventralis, sp. n. (Pl. XVIII. fig. A.)

Scales in 23 rows. Head moderately depressed; snout not very broad; eye small. One præocular, which may or may not reach the vertical; two postoculars. Loreal longer than deep; eight low upper labials, the fourth and fifth entering the orbit. Temporals 1 + 2 + 3. Two pairs of chin-shields, the posterior pair about two thirds of the anterior. Ventral scutes 205 or 207. Upper parts of a uniform slate-colour, which colour extends on the abdomen, covering on each side about one third of the ventral scutes, the middle third only of the abdomen being of a yellowish-white colour; lower part of the tail light slate-colour. Head with two narrow well-defined yellow lines on each side, the two supraorbital lines converging on the rostral shield.

This is a West-African species and readily recognized by the coloration of the abdomen. I have seen six specimens, three being from Old Calabar and two from Ashantee. The largest is 32 inches long, the tail measuring 5 inches. One specimen had swallowed a rat.

Boodon seychellensis, sp. n. (Pl. XVIII. fig. C.)

Scales in 23 rows. Head short and depressed; snout broad and truncated; eye small. One præocular, which does not reach to the upper surface of the head; two postoculars. Loreal small, rather longer than deep. Upper labials eight, but the third is sometimes split into two; the fourth and fifth and sometimes the third enter the orbit; all the upper labials are high. Temporals 1+2+3. Two pairs of chin-shields, the posterior pair about two thirds the size of the anterior. Ventral scutes 195 to 210. Upper parts brownish grey, with a more or less indistinct dark line running along the median line of the back and along the middle of the side of the body. Head with the two bands on each side very distinct and edged with black; the lower is broken up into spots, the upper and lower lips being largely marbled with dark and light brown. An oblique light band runs from the eye to the angle of the mouth. Lower parts brown, each scute with a lighter posterior edge.

I have seen three specimens of this species. They were brought by Dr. Perceval Wright from the Seychelles. The largest is 36 inches long, the tail measuring 5½. It had swallowed a young chicken.

Boodon bipræocularis, sp. n. (Pl. XVIII. fig. B.)

Scales in 23 rows. Head and snout rather broad and depressed; eye small. Two præ- and two postoculars; the upper præocular reaches to or nearly to the vertical. Upper labials low, eight in number, the fourth and fifth entering the orbit. Two pairs of chin-shields, the posterior pair about half the size of the anterior. Loreal not much longer than deep. Ventral scutes 192. Upper parts uniform brown, lower whitish. The old example shows indistinct traces of the light labial band, but the supraocular band has entirely disappeared. In the young specimen both bands are conspicuous, narrow, the upper confluent on the præfrontals.

Of this species I have examined two specimens—one from Lake Tanganyika, 23 inches long, the tail measuring 6 inches; the second specimen is young and comes from Rabai Hills, Mombas.

Boodon poensis, sp. n.

Scales in 25 rows. Head scarcely depressed, of moderate width; eye rather small; one præocular, which extends to the upper surface of the head, but does not reach the vertical; two postoculars. Loreal not much longer than deep; eight low upper labials, of which the fourth and fifth enter the orbit; temporals rather irregular; two pairs of chin-shields, of which the posterior is only half the size of the anterior. Ventral scutes 214. Upper parts and sides uniform brown, lower parts whitish. Of the lateral lines of the head only the anterior portions of the supraorbital lines are distinct; they converge on the anterior frontals.

I have seen only one specimen of this species; it came from Fernando Po. It is young, 12 inches long, the tail measuring 1½ inch.

Boodon mentalis, sp. n. (Pl. XIX. fig. A.)

Scales in 25 rows. Head much depressed, broad, as is also the snout; eye large. One præocular, which is in contact with the vertical; two narrow postoculars. Loreal longer than deep; eight low upper labials, of which the third, fourth, and fifth enter the orbit. Temporals $1+2+4$. Two pairs of chin-shields; the shields of the posterior pair are very narrow and entirely separated from each other by the anterior. Ventral scutes 214. Upper parts light olive-coloured, sides and lower parts white; a very indistinct yellowish band runs along the side of the anterior part of the trunk. Two yellow lines on each side of the head, the supraorbital converging on the rostral shield; the infraorbital is rather irregular, straight, and not oblique, and covers the greater part of the lower labial shields.

I have seen only one specimen of this species; it is young, 13 inches long, the tail measuring 2 inches. It came from Damara Land.

Causus Jacksonii, sp. n.

Scales in 23 rows, only those of the upper series on the hinder part of the body are keeled. The rostral shield is turned upwards, with a slightly swollen upper edge as in *Causus rostratus*, in which, however, the shield is still more prominent. In other respects the scutellation is very much as in the other two species. The anterior frontals are a little longer than the posterior, and the area of the vertical shield considerably surpasses that of the occipital. Nostril between the two nasals and the anterior frontal. Loreal square; orbit surrounded by a ring of small and narrow scutes. Six upper labials; temporals $2+3$, the two anterior being the largest. Ventral scutes 146.

The coloration of the adult is uniform greenish olive, the abdomen being whitish. A very young specimen has the back crossed by numerous narrow curved bands, the convexity being directed backwards. The neck and occiput are ornamented by the outlines of the arrow-shaped spot which is observed in the two other species, but which in this species is lost in the adult.

We possess three specimens of this species; one came from Lake Tanganyika and the two others were found by Mr. F. J. Jackson at Lamu on the east coast. The largest is 18 inches long, the tail measuring $1\frac{1}{2}$ inch.

Elapsoidea nigra, sp. n.

Uniform black, lower jaw and anterior ventrals whitish. Scales in 13 rows. Body moderately stout. Ventrals 153; subcaudals in a double series, in 16 pairs; two pairs of frontal shields, one præ- and two postoculars; seven upper labials, of which the third and fourth enter the orbit. Temporals $1+2+2$. Anterior chin-shields in contact with four labials.

A single specimen, 16 inches long, the tail measuring $1\frac{1}{4}$ inch, was obtained at Ushambola.

Atractaspis microlepidota, Gthr.

A specimen of this species was obtained on the shores of Lake Tanganyika. It has 35 and 37 series of scales and 245 ventral scutes.

II. *The Snakes of the Lake-districts of Central Africa and their Relation to those of other Districts of Tropical Africa.*

The difficulties attending the carriage in Central Africa of natural-history collections, and especially of specimens preserved in spirits, have proved a great obstacle to the progress of our knowledge of the Central-African fauna. Speke and Grant had to be satisfied with bringing home one small snake and the head of another, and some of their successors were even less fortunate. It is only within the last few years that small collections containing snakes have reached Europe. Especially through the mediation of Sir J. Kirk many specimens collected at mission-stations in the interior have been sent to the British Museum; and finally the German traveller Hr. Bohndorff, Mr. F. J. Jackson, and Emin Pasha added to the same collection series of specimens, numerically, indeed, not very large, but all of great interest.

The species enumerated in the following list were obtained at Lado, at Monbuttu, and Semmio (district of the head-waters of the Congo), at the great Central-African lakes southwards to Lake Nyassa, at the foot of Kilima-ndjaro, in the Mpwapwa Mountains, and on the highland of Ugogo. In separate columns an asterisk (*) indicates the occurrence of a species in the littoral areas of tropical West and East Africa.

List of the Species of Snakes known to inhabit Districts of Central Africa †.

	West Africa.	Central Lake-districts.	Zanzibar District.	Mozambique District.
1. Typhlops Schlegelii, *Bianc.*	*	Tanganyika.	*	*
2. *Rhinocalamus dimidiatus*, Gthr.	..	Mpwapwa.		
3. Calamelaps *miolepis*, Gthr.	..	Nyassa.		
4. Uriechis lunulatus, *Ptrs.*	..	Lado, Tanganyika, Nyassa.	..	*
5. —— *concolor*, Fisch.	..	Lado, Kilima-ndjaro.		
6. —— *Jacksonii*, Gthr.	..	Kilima-ndjaro.		
7. —— capensis, *Smith*	..	Nyassa.	*	*
8. Ablabes Hildebrandtii, *Ptrs.*‡..	..	Kilima-ndjaro.	Mombaza	
9. Coronella nototænia, *Gthr.*	..	Nyassa.	..	*
10. —— olivacea, *Ptrs.*	Gaboon	Lado, Kilima-ndjaro.	..	*
11. —— semiornata, *Ptrs.*	..	Tanganyika.	*	*
12. —— *inornata*, Fisch.	..	Kilima-ndjaro.		
13. Neusterophis atratus, *Ptrs.*	*	Monbuttu.		
14. Grayia *Diardi*, Dollo §	..	Tanganyika.		
15. Scaphiophis albopunctatus, *Ptrs.*	*	Semmio.		

† A few species which I have not seen and about the determination of which I entertain doubts are omitted from this list. The principal contributions to our knowledge of this part of the Central-African fauna are the two following:—

1884. Fischer, J. G. "Ueber die von Hrn. Dr. G. A. Fischer im Massai-Gebiete .... gesammelten Reptilien, Amphibien, und Fische." JB. Hamb. wiss. Anst. i. pp. 3–32, pls. i. & ii.

1886. Dollo, L. "Note sur les Reptiles et Batraciens recueillis par M. le Capitaine Storms dans la région du Tanganyika." Bull. Mus. Belg. iv. p. 151.

‡ This snake shows such a remarkable agreement in many points with the following that a direct comparison of the typical specimens would be very desirable.

§ Not seen by myself.

	West Africa.	Central Lake-districts.	Zanzibar District.	Mozambique District.
16. Bothrophthalmus melanozostus, *Schl.*	*	Semmio.		
17. Psammophis sibilans, *L.*	*	Lado, Monbuttu, Kilima-ndjaro, Nyassa.	*	*
18. —— biseriatus, *Ptrs.*	..	Kilima-ndjaro.	*	
19. Rhagerrhis oxyrhynchus, *Rnhrdt.*	..	Mpwapwa, Tanganyika.	*	*
20. —— *rubropunctatus*, Fisch.	..	Kilima-ndjaro.		
21. Amphiophis angolensis, *Boc.*	*	Nyassa.		
22. Dasypeltis scabra, *L.*	*	Monbuttu, Kilima-ndjaro.	*	*
23. —— palmarum, *Leach*	*	Kilima-ndjaro.		
24. Bucephalus capensis, *Smith*	*	Nyanza, Mpwapwa, Tanganyika.	*	*
25. Ahætulla Kirkii, *Gthr.*	..	Tanganyika.	*	
26. —— punctata, *Ptrs.*	..	Kilima-ndjaro.	*	*
27. —— Emini, *Gthr.*	..	Monbuttu.		
28. Dryophis Kirtlandii, *Hallow.*	*	Kilima-ndjaro, Mpwapwa.		
29. Chamætortus aulicus, *Gthr.*	..	Tanganyika.	..	*
30. Leptodira rufescens, *Gm.*	*	Kilima-ndjaro.	..	*
31. —— semiannulata, *Gthr.*	Loanda	Tanganyika.	*	
32. Simocephalus *nyassæ*, Gthr.	..	Nyassa.		
33. Lycophidium Horstockii, *Schl.*	*	Kilima-ndjaro.		
34. Boodon lineatus, *D. B.*	*	Mpwapwa, Kilima-ndjaro.	*	*
35. —— unicolor, *Boie*	*	Semmio.		
36. —— bipræocularis, Gthr.	..	Tanganyika.	Rabai	
37. Python sebæ, *Gm.*	*	Upper Nile.	*	*
38. Naja nigricollis, *Rnhrdt.*	*	Kilima-ndjaro.	..	*
39. *Boulengerina Stormsi*, Dollo	..	Tanganyika.		
40. Causus rostratus, Gthr.	..	Ugogo.	Rabai	
41. —— Jacksonii, *Gthr.*	..	Tanganyika.	Lamu	
42. Dendraspis intermedius, *Gthr.*	..	Kilima-ndjaro, Nyanza, Tanganyika.	..	*
43. Atractaspis Bibronii, *Smith*	*	Monbuttu.		
44. —— aterrima, *Gthr.*	Lagos	Monbuttu.		
45. —— microlepidota, *Gthr.*	*	Tanganyika.		
46. Clotho arietans, *Merr.*	*	Kilima-ndjaro, Tanganyika.	*	*

An analysis of this list shows that out of forty-six species known from these central parts eleven are generally spread over Tropical Africa, viz. *Typhlops Schlegelii*, *Coronella olivacea*, *Psammophis sibilans*, *Dasypeltis scabra*, *Bucephalus capensis*, *Leptodira rufescens*, *Leptodira semiannulata*, *Boodon lineatus*, *Python sebæ*, *Naja nigricollis*, and *Clotho arietans*.

Of the remaining thirty-five species only eleven have not been found in the littoral areas of either West or East Africa, and must be considered at present to be peculiar to Central Africa.

Leaving out of consideration the species common to tropical Africa generally, we know :—

1. From Lado and Lake Nyanza three species, two of which are also found in the East-African littoral.

2. From Monbuttu and Semmio seven species, of which not less than six are West-African; therefore this portion of the fauna of the upper waters of the Congo is probably continuous along the course of this river to the west coast.

3. From Kilima-ndjaro eleven species, of which three occur also on the west and four on the east coast.

4. From Mpwapwa and Ugogo four species, of which one is known also from the west and two from the east coast.

5. From the shores of Lake Tanganyika eleven species, of which one only has been found also on the west coast, whilst eight occur in the eastern littoral. However, it should be remembered that probably most of these species were collected on or near the eastern shores of the lake.

6. From Lake Nyassa six species, of which one only is West- and three others East-African.

XL.—*Description of* Scolopendra valida, *Lucas, with Notes on allied Species.* By R. I. Pocock, Assistant, Natural-History Museum.

This species of *Scolopendra* appears to be but little known, and its history up to the present time may be told in a very few words.

Between 1836 and 1844 it was first described by Lucas from the Canary Islands. In 1844 one of the specimens from which Lucas drew up his description was presented to the British Museum by M. Barker Webb, and was recharacterized by Newport in the Trans. Linn. Soc. for the following year. Since then no new account of the species has been printed. In 1881 Dr. Kohlrausch, trusting to the descriptions given by Newport and Lucas and to the figure published by the latter author, was led to believe that the nearest ally to this form must be *Sc. morsitans* of Linnæus. But even a superficial examination of a specimen shows that it may at once be distinguished from the above-mentioned species by the possession of certain characters which exist conjunctly only, I believe, in some few neotropical forms.

That a species from North Africa possesses characters which seem to point to relationship between it and some species from South America is of itself a fact of sufficient interest to deserve special mention; but it is perhaps scarcely of a greater interest than certain others connected with the range of *Sc. valida*, so far as is at present known, in its own distributional area.

As stated above, it was first discovered in the Canary Islands, and hitherto its existence has not to my knowledge been reported elsewhere. But in addition to specimens brought from Gran Canaria by the Rev. A. E. Eaton the British (Natural History) Museum possesses specimens from Bushire, on the Persian Gulf, in the same degree of N. latitude as the Canary Islands, and a long series of forms from Socotra, an island some 1200 English miles to the south of Bushire.

It will thus be seen that it occurs in two places situated near the eastern and western extremities of the Mediterranean district of the Palæarctic Region and in an island in the north-eastern portion of the Ethiopian Region.

Whether or not it will be found in localities between those already pointed out, it were premature to surmise. Suffice it to say that although many species of *Scolopendra* from North Africa are known, nothing resembling *Sc. valida*, Lucas, has ever been recorded as taken.

The specimens from which the following description has been taken have been preserved in spirits of wine.

Scolopendra valida, Lucas.

1836–44. *Scolopendra valida*, Lucas, in Webb & Berthelot, Hist. nat. des Iles Canaries, ii. Entomol. p. 49, tab. vii. fig. 14.
1845. *Scolopendra valida*, Newport, Trans. Linn. Soc. xix. p. 402.

Colour.—Varying much with size, smaller specimens (30–60 millim.) being mostly testaceous, with the hinder portion of the body slightly darker. Two specimens (90 millim.) from Socotra testaceous; others of the same length from Gran Canaria and Socotra with olivaceous anterior and ochraceous posterior tergites. Three specimens from Bushire (85–114 millim.) with head-plate, proximal segments of antennæ, and distal segments of anal legs olivaceous, the rest of the body testaceous or ochraceous. Two specimens from Socotra

120–130 millim.) with anterior tergites olivaceous, posterior ochraceous, proximal segments of antennæ and distal segments of anal legs nearly black, legs pale green, head-plate and first tergite olivaceo-castaneous. One specimen (190 millim.), also from Socotra, exhibits coloration of the two last, but has the legs nearly black.

Antennæ consisting of from 19–27 segments, the number in some instances being different on the two sides; varying in length from a little less than one third the length of the body to a little less than one fifth. Three or four basal segments bare, the rest clothed thickly with short hair; segments more moniliform in the smaller specimens.

Head-plate very constant in shape, the width in nearly every case being equal to the length. In the larger forms equal to about three fourths the width of the anal tergite, in the smaller the two plates are approximately equal in width. Faintly punctured and always marked throughout its length by two faint anteriorly diverging sulci.

Plates of maxillary prosternite either in contact or slightly separated; each plate furnished with teeth which exhibit various grades of concrescence. In the smaller forms these teeth are mostly four in number, small, distinct, and tolerably sharp. In the larger forms the external tooth remains separate, but the three internal begin to coalesce until, in the largest specimens examined, each plate appears to be furnished with but two teeth—a larger internal, which is more or less obscurely divisible into two or three parts, and a smaller external.

Basal tooth always bidentate, though sometimes in small specimens obscurely so.

Tergites, except the first and last, always bisulcate, except the five, six, or seven first marginate. The first tergite sometimes showing very faint signs of the two sulci, but always deeply grooved transversely in its anterior half. The anal tergite never with a central longitudinal sulcus.

Sternites, except the last and the first (? always), bisulcate; the last sometimes with a faintly-marked median longitudinal depression; lateral margins slightly converging posteriorly, the angles always rounded, and the posterior margin straight or very slightly convex.

Anal pleuræ finely punctured, more or less truncate; in larger forms furnished with a short process; process usually armed with three spines, but the number of spines varying from two to six, and in some cases differing upon the two sides. A spine always present on the posterior external margin of each pleura midway between the anal tergite and the process.

Proximal tarsal segment of all the legs, except those of the anal somite, always armed with a spur.

Claws of all the legs always armed with two spurs.

Femora of all the legs, except those of the nineteenth, twentieth, and twenty-first somites, unarmed. Femora of legs of the nineteenth somite always armed above at the apex with one or two spines. Femora of legs of the twentieth somite always armed above at the apex with two or three spines, which in larger forms are borne upon a longer process. An accessory spine may be present upon the middle of the upper surface of the femur.

Femora of anal somite furnished mostly with about 15 or 18 spines arranged in longitudinal series typically as follows:—3 . 2 on the upper surface, 3 on the upper inner margin, 2 on the inner surface, 2 . 3 . 2 on the lower surface; but since each series is liable to variation either in the number or position of any or all of its constituent spines, it follows that so many modifications of this typical arrangement are possible that it rarely happens that two individuals are exactly alike, or that one individual presents the same arrangement of spines upon the femora of the right and left sides. Femoral process conspicuous, armed with from two to six spines, but for the most part with five—two larger at the apex, three smaller nearer the base. Length of anal legs varying from one fourth to one seventh of the length of the body. Thickness of the femur or of the patella varying from one third to one half of its length. The patella not armed with spines.

Length of	largest	specimen from	Gran Canaria	109	millim.
"	"	"	Bushire	113	"
"	"	"	Socotra	190	"

To redescribe the forms most nearly allied to *Sc. valida*, Lucas, were waste of time and space, since excellent descriptions of them may be found in the papers of Dr. Meinert, Dr. Kohlrausch, and von Porath, to which references are given.

Scolopendra prasina, C. Koch.

1863. *Scolopendra prasina*, C. Koch, Die Myriopoden, ii. p. 23, fig. 146.
1876. *Scolopendra nitida*, Porath, Sv. Vet. Akad. Handl. Bih. iv. no. 7, p. 8.

1881. *Scolopendra prasina,* Kohlrausch, Arch. f. Naturg. 47, p. 122.
1886. *Scolopendra prasina,* Meinert, Proc. Amer. Phil. Soc. xxiii. p. 192.

I have not seen the type specimen of *Sc. nitida* of von Porath, yet, owing to the fulness of the description of it, I cannot doubt but that it is identical with *Sc. prasina* of C. Koch.

Scolopendra viridicornis, Newport.

1844. *Scolopendra viridicornis,* Newport, Ann. & Mag. Nat. Hist. xiii. p. 97. no. 12.
1844. *Scolopendra punctidens,* id. ibid. no. 20.
1844. *Scolopendra variegata,* id. ibid. no. 21.
1844. *Scolopendra cristata,* id. ibid. p. 98. no. 23.
1876. *Scolopendra cristata,* Porath, Sv. Vet. Akad. Handl. Bih. iv. no. 7, p. 6.
1881. *Scolopendra cristata,* Kohlrausch, Arch. f. Naturg. 47, p. 117.
1886. *Scolopendra cristata,* Meinert, Proc. Amer. Phil. Soc. xxiii. p. 192.

Owing to the inadequacy of Mr. Newport's descriptions, upon which Dr. Kohlrausch was wholly dependent, it was not possible for him to discover the above-given synonymy. This, from an examination of the type specimens, I have without difficulty succeeded in doing.

Scolopendra gigas, Leach.

1814. *Scolopendra gigas,* Leach, Trans. Linn. Soc. xi. p. 383.
1845. *Scolopendra gigas,* Newport, Trans. Linn. Soc. xix. p. 399.
1845. *Scolopendra gigantea,* id. ibid. p. 400.
1876. *Scolopendra gigantea,* Porath, Sv. Vet. Akad. Handl. Bih. iv. no. 7, p. 5.
1881. *Scolopendra gigas,* Kohlrausch, Arch. f. Naturg. 47, p. 119.
1886. *Scolopendra gigas,* Meinert, Proc. Amer. Phil. Soc. xxiii. p. 191.

Not to overburden the text with names I have refrained from repeating many synonyms, which may be found in the last three of the above-cited works. I have thought it desirable merely to confirm by an examination of type specimens the conclusion arrived at by von Porath, from descriptions alone, as to the identity existing between *Sc. gigas* of Leach and *Sc. gigantea* of Newport. Whether or not the former be synonymous with *Sc. gigantea* of Linnæus it is quite impossible to say, since the description of the latter and the figure from which it was taken, agree in one particular alone, namely, that they are generally applicable to all *Scolopendræ,* but particularly applicable to none.

The following table will serve to show how *Sc. valida*, Lucas, may be distinguished from the allied South-American species, which agree with it in possessing spines upon the femora of the nineteenth and twentieth pairs of legs and a deep transverse furrow upon the first dorsal plate:—

A. Sternites smooth, not bisulcated; patellæ of anal legs armed with spines .... *prasina*, C. Koch. S. Amer.

B. Sternites bisulcated.

- a. Last tergite with a median longitudinal crest.............................. *viridicornis*, Newp. S. Amer.
- b. Last tergite without a median longitudinal crest.
  - *a*. Femora of all the legs armed; patella of anal leg armed .... *gigas*, Leach. S. Amer.
  - *b*. Femora of nineteenth and twentieth pairs of legs armed; patella of anal leg unarmed .... *valida*, Lucas. N. Afr.

XLI.—*On the Survival of* Spongillæ *after the Development of Swarm-larvæ*. By M. Weltner *.

The assertion made by Laurent (1844) that our freshwater sponges perish after the development of swarm-larvæ was disputed by Lieberkühn (1857). Marshall (1884) supposes that there is an alternation of generations in *Spongilla lacustris*. From the gemmulæ which live through the winter there originate in the spring male and female *Spongillæ* which fertilize one another. The males die after the development of the semen; the females, after the coming forth of the larvæ, become neuters and perish in the autumn with formation of gemmules. The offspring of the male and female specimens remain neuters in the first year and likewise break up into gemmules in the autumn.

Götte (1886), on the contrary, is of opinion that reproduction universally causes the death not only of the *Spongillæ*, but of sponges in general. The parts affected by the repro-

* Translated from a separate copy of the paper in the 'Sitzungsberichte der Gesellschaft naturforschender Freunde zu Berlin,' February 21, 1888, pp. 18–22, communicated by H. J. Carter, F.R.S.

duction first perish, so that a successive dying-off is observed. Hence it happens that we find sponges containing larvæ or gemmules the exterior of which may appear quite healthy, while the inner parts are already in course of breaking down by the development of the germ-materials, or already quite destroyed. Götte further explains those cases in which, in spring and summer, we find perfectly developed gemmules, together with ova or semen, by the supposition that in them the germ-formation taking place in the preceding autumn was prematurely interrupted, and the sponge hybernated with the gemmules sticking in its soft parts.

At a former meeting (21st December, 1886) I noticed the freshwater sponges living in the Spree and in the Tegelsee, and stated that *Ephydatia fluviatilis* living in the Tegelsee never forms gemmules there, but is perennial. This sponge is therefore a favourable object for deciding the question as to the duration of the life of this species and testing the correctness of the opinion of Laurent and Götte of the death of the *Spongillæ* through sexual reproduction.

During the last three winters I have kept large and small (*i. e.* down to 1 centim.) specimens of the above-mentioned species from October to March, May and June, in aquaria, some standing in heated, others in unwarmed rooms. A part of them, and especially all the larger specimens, have always perished in course of time. In many of the smaller ones, however, the original size became considerably diminished, as in the case of the larger specimens; here also the outer membrane became closely applied to the sponge-body or disappeared altogether; here also the points of the bundles of spicules projected more or less; but the efferent canal only disappeared in a part of them. The others almost constantly showed an osculum upon each sponge; the presence of an external membrane closely applied to it was ascertained under the microscope, and the current of water flowing through the *Spongilla* was demonstrated. These little sponges lived longest, but they also perished in May and June.

The dying off of the *Spongillæ* observed in the aquarium appears, however, to occur by no means so frequently in nature. Every one who has kept freshwater sponges in aquaria knows how difficult it is to keep even small specimens alive for a few months. On the other hand this is easily done (see Lieberkühn and Götte), as I have also observed, with young *Spongillæ* reared from larvæ. It was only after many attempts that I succeeded in realizing, at least approximately, the conditions which are necessary for the prosperity of larger specimens. My failures in past years in attempting to keep perennial freshwater sponges from the autumn to the middle of the summer I ascribe chiefly to want of nourishment. We know almost nothing of the food of the *Spongillæ*.

On the 16th October of last year I again obtained six large specimens of *Ephydatia fluviatilis* from the Tegelsee. The smallest of these sponges measured $5\frac{1}{2}$ centim. in length, the largest 10 centim.; the thickness of these crusts was $2\frac{1}{2}$ millim. in the smallest and nearly 5 millim. in the largest specimen. All the six were examined for ova, segmentation-stages, and larvæ in the most different parts of their bodies (at this season there is no longer any semen). Four were neuters, and will be no further referred to. The two others were female, and, as I expressly note, completely filled with segmentation-stages and larvæ. These two specimens were placed in large aquaria containing 3–4 litres of water *, into which I had previously put sand and *Elodeæ*. The glass vessels were disturbed as little as possible and stood in an unwarmed room of the Zoological Museum. During the whole time the water was only once changed, and this quite at the commencement. From these two sponges larvæ swarmed uninterruptedly from the 16th October onwards; the last free-swimming larvæ were observed on the 30th October. One of these *Spongillæ* constantly showed three large excurrent tubes and began in December gradually to diminish in volume; the derm and oscula first disappeared and the points of the spicules projected freely. On the 2nd January the temperature of the water in this vessel, which stood close to the window, had fallen below 32° F., and when the vessel was turned for observation the water all at once became solidified in large leaves down to the sponge, which was in the middle. Both aquaria were then brought into a place situated between two warmed chambers. The sponge just described did not, however, recover; it is now much reduced, nearly the whole skeleton lies bare, in two places the derm stands off in the form of large closed bladders, and in the upper part of the sponge there is only a minute osculum.

The other of the two larva-bearing *Spongillæ* constantly changed the number and position of its oscular tubes during the first month of its residence in the aquarium; from the 16th November onwards, when a passing frost occurred, it showed only a few oscula, and from the 10th December the number and position of the two excurrent tubes remained

* The water was derived from the local water-supply, which receives its water from the Tegelsee.

constant until the 1st February. On this and the following day the window of the room was left open at night, the temperature of the water had fallen in the morning nearly to 32° F., and the two oscular tubes had completely disappeared on the morning of the third day. But within a day, the window having been again closed, the oscula reappeared at the same place and again showed the same size. Besides these the sponge has now a third excurrent orifice. This *Spongilla* has also become smaller since it was brought from Tegel; it measured originally 10 centim. in length and nearly 5 millim. in the thickness of its crust; its length is now only 9 centim., with a thickness of $2\frac{1}{2}$ millim. At one place the spicular web, deprived of its soft parts, lies upon the parenchyma of the sponge; on all the rest of the surface we can indeed with the lens see the points of the spicules projecting, but almost everywhere the outer membrane may be seen closely applied to the sponge. In other respects the *Spongilla* presents a perfectly fresh appearance and emits from all the three oscular apertures a quick current of water. Upon the alteration of the soft-body of *Ephydatia fluviatilis* after the time of reproduction and until its recurrence in the following year I shall report in another place. Only this may be stated, that, in opposition to the statements of Lieberkühn and Metschnikoff, neither the dermis nor the excurrent tubes, nor the flagellate chambers and canals, completely disappear in the perennial sponges of the Tegelsee.

From this experiment in keeping alive a decidedly female *Spongilla* for nearly four months after the issue of the last larva it certainly follows that the notion of Laurent and Götte as to the death of the *Spongillæ* in consequence of sexual reproduction is not correct in all cases. On the other hand, I agree perfectly with Götte that in *Ephydatia fluviatilis* "there can be no question of a decided seasonal difference, or of a true alternation of generations," such as occurs, according to Marshall, in *Spongilla lacustris*.

XLII.—*Descriptions of new Reptiles and Batrachians obtained by Mr. H. O. Forbes in New Guinea.* By G. A. Boulenger.

Lygosoma Forbesii.

Section *Homolepida.* Body rather elongate, limbs short;

the distance between the end of the snout and the fore limb is contained once and a half in the distance between axilla and groin. Snout very short, obtusely acuminate. Lower eyelid scaly. Nostril pierced in a single nasal; no supranasal; præfrontal much broader than long, forming a suture with the rostral and with the frontal; latter shield as long as the distinct frontoparietals, not larger than the interparietal; parietals forming a median suture posteriorly; four pairs of enlarged nuchals; first upper labial largest, fourth below the centre of the eye. Ear-opening circular, a little smaller than the eye-opening, without projecting lobules. Twenty-six smooth scales round the middle of the body, those of the two vertebral series transversely enlarged. A pair of enlarged præanals. Limbs widely separated when adpressed; hind limb as long as the distance between the commissure of the mouth and the fore limb. Digits very short; fourth toe longer than third; subdigital lamellæ smooth, ten under the fourth toe. Tail thick. Brown above, closely spotted with black on the back and lineolated on the sides; yellowish inferiorly, throat with small black spots.

	millim.
Total length (tail reproduced)	88
Head	9
Width of head	5·5
Body	32
Fore limb	6
Hind limb	9

Camp of Sogere, in interior, 1750 feet above sea. A single specimen.

Typhlops inornatus.

Body moderately elongate, of subequal diameter throughout. Snout depressed, rounded. Nasal completely divided by a suture, which touches the second labial; a præocular, larger than the ocular; latter shield not touching any of the labials; eye just distinguishable, under the ocular; rostral rounded posteriorly, its length, as seen from above, nearly equal to its width; three scales on a transverse line between the oculars. Twenty scales round the middle of the body. Tail a little longer than broad at the base, ending in a spine. Uniform black; borders of mouth and end of tail yellowish.

Total length 170 millim.; diameter of body 4; length of tail 5.

Camp of Sogere. A single specimen.

Rana macroscelis.

Allied to *Rana Guppyi.* Vomerine teeth in two short oblique series on a level with the hinder edge of the choanæ, which are large. Head large, subtriangular; canthus rostralis distinct; loreal region deeply concave; eye large; interorbital space narrower than the upper eyelid; tympanum very distinct, circular, two thirds or three fifths the diameter of the eye. Fingers moderate, the tips dilated into small but very distinct disks, first extending beyond second; toes webbed to the disks, which are small; subarticular tubercles large, elliptic; a single, feebly prominent, elliptic metatarsal tubercle. The hind limb being stretched forwards along the body, the tibio-tarsal articulation reaches the tip of the snout. Upper surfaces minutely warty or granulate, the granules largest on the sides of the head; a short glandular fold above the tympanum. Dark olive-brown above, with some light spots around the upper lip and along the canthi rostrales; lower parts whitish, throat largely spotted or marbled with black.

From snout to vent 140 millim.

Camp of Sogere. Several female specimens.

CALLULOPS, g. n. (*Engystomatidarum*).

Pupil erect. Tongue oblong, entire, slightly free behind and on the sides. Palatine bones forming an acute ridge across the palate, armed with a series of small teeth. A cutaneous denticulated ridge across the palate, in front of the œsophagus. Tympanum distinct. Fingers and toes free, tips swollen into small disks. Outer metatarsals united. Distal phalanges simple. No precoracoids; no omosternum; sternum cartilaginous. Diapophyses of sacral vertebra feebly dilated.

Intermediate between *Callula* and *Xenobatrachus.*

Callulops Doriæ.

Head rather small, much broader than long, convex on the frontal and occipital region; eyes small; no canthus rostralis; interorbital space much broader than the upper eyelid; tympanum much larger than the eye. First and second fingers equal; toes moderately elongate; inner metatarsal tubercle indistinct; tibia two fifths the length of head and body. The tibio-tarsal articulation reaches the shoulder. Skin smooth, thick and leathery on the back. Brown (coloration badly preserved); groin and sides of hind limb yellowish, with a wide-meshed blackish network.

From snout to vent 75 millim.

A single female specimen. Milne Gulf.

Named in honour of the Marquis Giacomo Doria, who has so largely contributed to our knowledge of Papuasian herpetology.

XLIII.—*On the Characters of the Chelonian Families* Pelomedusidæ *and* Chelydidæ. By G. A. Boulenger.

There is probably not in the whole classification of Reptiles a more natural division than that of the typical Chelonians (*i. e.* excluding the Athecæ and Trionychoidea) into Cryptodira and Pleurodira. In addition to the two well-known characters, viz. the lateral bending of the neck and the anchylosis of the pelvis, the latter group differs in the following points:—

The mandible articulates with the skull by a condyle fitting into a concavity of the quadrate; the outer border of the tympanic cavity is completely encircled by the quadrate; the pterygoids are extremely broad throughout and form wing-like lateral expansions; the cervical vertebræ have strong transverse processes, and their cup-and-ball articulations are single throughout.

The existing Pleurodira may be divided into three families:—1. Pelomedusidæ (=Pelomedusidæ+Peltocephalidæ, Gray); 2. Chelydidæ (=Chelydidæ+Hydraspididæ, Gray); 3. Carettochelydidæ *. The latter family, characterized by the absence of dermal shields on the shell and the paddle-shaped limbs, is at present known from external characters only, but is apparently closely related to the Chelydidæ. Considering how widely the first two families differ, it is surprising that their recognition should have been delayed

* [I have asked Mr. Boulenger, who for some time past has been engaged in the study and arrangement of Chelonians, to publish this note in the 'Annals,' in order to preclude any misapprehension as to the authorship of this division of the Pleurodira. This division has been adopted in the article "Tortoise" of the 'Encyclopædia Britannica,' which bears the signature A. C. G. usually affixed by the publishers to my articles, but which, in fact, is the joint production of Mr. Boulenger and myself. More especially he supplied me in manuscript with the systematic synopsis as inserted in the article.—A. Günther.]

so long. Baur *, it is true, has recently expressed the correct view; but the characters pointed out by him are by no means the only ones which separate the two families, as may be seen from the following diagnoses:—

Pelomedusidæ.

Plastral bones eleven, mesoplastrals being present. A bony temporal arch; quadrato-jugal present; præfrontals in contact; no nasals; palatines in contact; dentary single. Second cervical vertebra biconvex. *Neck completely retractile within the shell.*

Africa, Madagascar, South America.

A. No bony temporal roof; mesoplastra extending right across the plastron: *Sternothærus.*

B. No bony temporal roof; mesoplastra small and lateral: *Pelomedusa.*

C. A bony temporal roof, the quadrato-jugal forming a suture with the parietal; mesoplastra small and lateral: *Podocnemis* (=*Dumerilia*) and *Peltocephalus.*

Chelydidæ.

Plastral bones nine. No bony temporal arch, the quadrato-jugal being absent; præfrontals separated throughout; nasals present, except in *Chelys*; palatines separated by the vomer; dentary bones distinct †. Fifth and eighth cervical vertebræ biconvex. *Neck bending under the margin of the carapace, always exposed.*

South America, Australia, and Papuasia.

A. Neck longer than the dorsal vertebral column: *Chelys, Hydromedusa, Chelodina.*

B. Neck shorter than the dorsal vertebral column: *Hydraspis, Platemys, Elseya, Chelymys.*

It will be observed that, owing to the structure of the Pelomedusidæ, the term Cryptodiran, as opposed to that of Pleurodiran, no longer expresses a distinguishing character. The Pelomedusidæ are in fact "Cryptodiran," and the Chelydidæ "Phanerodiran." The term "Orthodira" as opposed to that of Pleurodira would convey the correct idea. But I do not suggest such an alteration, for it seems to me the names of higher groups should, whenever practicable, be retained in virtue of the law of priority, like those of genera and species.

* Zool. Anz. 1887, p. 101.

† The symphysial suture disappears in adult specimens of *Elseya* and *Chelymys*, but is perfectly distinct in younger specimens of these genera.

XLIV.—*Some Observations on the Coleopterous Family* Bostrichidæ. By Charles O. Waterhouse.

Having recently had occasion to examine some species of Bostrichidæ, I have noticed a few points to which I think it advisable to call attention.

First, I observe that all the authors whom I have consulted who venture an opinion on the sexes in the genus *Apate* have reversed the sexes, not unnaturally supposing that the examples with fulvous hair on the forehead were males. The males have very little hair on the head; the pronotum has a recurved acute tooth at the anterior angle, and the apical segment of the abdomen is rounded. The female has much more hair on the head; the anterior tooth on the pronotum is not prominent, and the apical segment of the abdomen is broadly truncate, fringed with fulvous hair and with a line of hair just before the margin.

Apate terebrans, Pallas, is therefore the female of *A. muricatus*, F. The reverse has been suggested.

Von Harold suggests (Mitth. d. Münchn. ent. Ver. i. p. 119) that *Apate Francisca* required a new generic name, because *Apate* is founded on "*muricatus*," which is also the type of *Sinoxylon*. But *Apate* is founded on *muricatus*, Fabr., and not on *muricatus*, Linné, the latter being the type of *Sinoxylon*. It is true that Duftschmidt in describing *Sinoxylon* gives a reference to Fabricius (as well as to Linné) in naming *muricatus* as his type; but he gives three lines as the length of the species, which proves that he had the Linnean insect before him.

It is to be regretted that some recent authors have endeavoured to reestablish *Ligniperda*, Pallas (1772), which is founded on wood-boring species generally, belonging to different families. If any species can be said to be the type of his genus it is *capucinus*, which is the type of *Bostrichus*, Geoff. (1762).

Dinoderus substriatus, Steph. (nec Payk.), 1830.

Stephens, in his characters for the genus *Dinoderus*, mentions only five small joints following the two larger basal joints of the antennæ. He overlooks the joint next to the club, and on examining his type I am not surprised at his doing so, for (from the position of the antennæ and the pubescence) it is difficult to see. His type has, however, six joints to the funiculus.

This species appears to be found all over the world. Specimens are in the British Museum from the following localities :—St. Helena, Madeira, Sierra Leone, Bangalore, Ceylon, Penang, Siam, Hong Kong, Java, Celebes, New Guinea, Dorey, Philippine Islands, Brazil, Santarem.

The specimen from Madeira is the type of *Rhizopertha bifoveolata*, Wollaston, so named on account of the two approximate foveæ at the base of the thorax which are so characteristic of the species. I think there can be no doubt that it is *Apate minuta*, Fabr., from New Zealand, but most unfortunately the type is no longer to be found in the Banksian collection *. From Dr. Horn's description of *D. brevis* (Proc. Amer. Phil. Soc. 1877, xvii. p. 550) it is evident that it is closely allied to *minuta*, and may even be the same species.

Xylopertha, Guérin, 1845.

Guérin (Bull. Soc. Ent. Fr. 1845, p. xvii) mentions four types for this genus :—*Apate minuta*, F., *truncata*, Dej., *longicornis*, F., and *sinuata*, F. As *minuta*, according to the foregoing note, is *Dinoderus*, Steph., and *longicornis* has now the genus *Tetrapriocera*, Horn, for its reception, it would be best, in my opinion, to retain the name *Xylopertha* for *truncata* and *sinuata* &c.

Apate substriata, Payk.

I propose the generic name *Stephanopachys* for this species, which is too well known to require description, being the *Dinoderus* of many authors, but not of Stephens.

Rhizopertha rufa, Hope.

I think it very doubtful whether this species should be separated from *R. pusilla*. Typical examples, however, in the British Museum collection are not in sufficiently good condition to enable me to say positively.

It may be useful to point out that *Bostrichus mutilatus*, Walker, is a *Xylopertha* and must be transferred from under *Tomicus* in Gemminger and Harold's Catalogue, p. 2691.

* I have just received a letter from M. Fleutiaux of Paris (who sent me a specimen under the name of *minuta*, F., to compare with the type), in which he informs me that it is *Rhizopertha sicula*, Baudi, and *Xylopertha foveicollis*, Allard.

It is a very common species, having a wide range in the Malay Archipelago. The elytra are a trifle less strongly punctured than in a species which we have under the name *Apate lifuana*, Montr.; but the two insects are scarcely distinct, and both bear the name "*religiosa*, Dej."

Sinoxylon fumatum, *nitidipenne*, and *pubescens*, Murray, should be placed in *Xylopertha*.

Cænophrada, n. gen.

General characters of *Bostrichus*. Antennæ composed of ten joints; first joint elongate, the second one third shorter (but nearly twice as long as broad), the third to eighth joints becoming wider, compressed; the third scarcely as long as broad, the fourth a little longer than broad, narrowed at its base, the fifth, sixth, and seventh short and broad; the eighth joint a little longer than the sixth and seventh together and a little broader at its apex; the ninth shorter than the eighth and narrower, the tenth still narrower, elliptical. The eighth, ninth, and tenth form an elongate club, which, however, is not abrupt, owing to the width of the previous joints.

Quite distinct from all the genera of Bostrichidæ by the compressed and relatively broad antennæ.

Cænophrada anobioides, n. sp.

Elongata, nigra, convexa; thorace subrotundato, antice sat angustato, scabroso, fulvo piloso; elytris parallelis, confertim fortiter subseriatim punctatis, ad apicem oblique declivis, parte decliva tuberculis depressis rotundatis confertim dispositis ornata.

Long. $15\frac{1}{2}$ millim.

This species has the general appearance of *Bostrichus jesuitus*, Fabr. The sculpture of the elytra is very similar, but not so coarse, the punctures are still more irregular in form, the interstices more rugulose, narrower, and marked with fine punctures. The apical declivity is rather less abrupt, and instead of being punctured is covered with round, shining, flattened tubercles, which are placed close together. The thorax a little narrower than the elytra, distinctly narrowed in front, more rounded at the posterior angles. The sculpture is nearly the same, but not quite so rough in front, and there are only three prominent teeth visible from above on each side in front.

Hab. N. India (*Col. Buckley*). Brit. Mus.

XLV.—*On* Trachinus draco *and* T. vipera. By Francis Day, C.I.E., F.L.S., &c.

On referring to a few among the many ichthyologists who have written upon these two species of British weever-fishes or *Trachinus* one cannot help observing some differences of opinion. Willughby and Ray ('Historia Piscium,' 1686) recorded the "viver" or "weever," *Draco marinus* (p. 288, t. S 10. fig. 1), which showed D. 5 | 29, and the "otterpike," *Draco marinus species altera* (p. 289, t. S 10. fig. 2), having D. 6 | 19. Although one was termed the "weever" and the other the "otterpike," names by which the two British forms are to this day distinguished by our fishermen, still an error existed in the figures, as was pointed out by De la Roche in the 'Annales du Muséum d'Histoire Naturelle,' xiii. 1809. This latter author observed that the first figure in the 'Historia Piscium' was doubtless *Trachinus draco*, but that the second was *T. lineatus*, Bloch-Schneider, 1801, p. 55, tab. 10. But Cuvier and Valenciennes, in their 'Histoire Naturelle des Poissons,' observed that De la Roche had also been in error respecting this second figure, as it neither represented the "otterpike" of Britain nor *T. lineatus* of Schneider; in fact it was an unnamed form, so was termed *T. radiatus*, Cuv. & Val. Thus, although two British forms of this genus were recognized and described by Willughby and Ray, only one was figured.

Ray ('Synopsis Methodica Piscium,' 1713) gave the "weever," page 91, and the "otterpike," page 92, which last, he observed, he had not seen. Pennant ('British Zoology,' 1776) correctly figured and described both forms, the "great weever," page 171, plate xxix., showing D. 4 | 29, and the "common weever," page 169, plate xxviii., with D. 5 | 23; but De la Roche erroneously observed they belonged to one species. In Gmelin's 'Linnæus,' 1788, p. 1157, only one species of this genus was recognized, and that under the designation of *Trachinus draco*. Donovan ('British Fishes') figured the "lesser weever," and his example had D. 5 | 25; but following Gmelin he termed it *D. draco*, while Turton ('British Fauna,' 1807) appears to have compiled his description from Pennant's "common weever" and Donovan's account and figure. Fleming ('History of British Animals,' 1828, pp. 213, 214) described two forms, *T. draco*, "common weaver," D. 5 | 25, and *T. major*, "greater weaver," D. 5 | 32. Cuvier and Valenciennes ('Histoire Naturelle des Poissons,' iii. 1829) had *T. draco*, D. 6 | 30, A. 1 | 31, and *T. vipera*,

D. 6 | 24, A. 25. In the first we are told that on part of the head and gill-covers are small scales, but none on the preopercular margins; also that two very striking characters by which these two species may be readily distinguished are the number of soft rays in the second dorsal fin, and that the cheeks of the lesser weever are almost scaleless.

Yarrell ('British Fishes,' ed. i. 1836) gave, vol. i. p. 20, the "great weever," *Trachinus draco*, with a good figure, and respecting the fins says D. 6 | 30; and at p. 25, the "lesser weever," *T. vipera*, D. 5–6 | 24, observing "from an examination of many specimens it is probable that it very seldom exceeds 5 inches in length." Jenyns ('Manual of British Vertebrate Animals,' 1835) added little to the foregoing, but gave the dorsal rays of the "great weever" at 6 | 31, and of the "lesser weever" at 6 | 23–24. Parnell ('Fishes of the Firth of Forth') observed that *T. vipera* was distinguished from *T. draco* by having no spine before the eyes and by the second dorsal fin being composed of twenty-four rays, whereas in the "greater weever" there exists a strong hooked spine before each eye and thirty rays in the second dorsal fin. White ('List of British Fish in the British Museum,' 1851) made no alteration. Günther ('Catalogue of Fishes,' 1860, vol. ii. p. 233) gave *Trachinus draco* with D. 6 | 29–31, and at p. 236 *T. vipera* with D. 6 | 21–23; while in his 'Introduction to the Study of Fishes,' 1880, p. 464, he remarked "On the British coasts two species occur, *T. draco*, the greater weever, attaining to a length of 12 inches, and *T. vipera*, the lesser weever, which grows only to half that size." Couch ('Fishes of the British Islands,' vol. ii. 1877) observed that the smaller species was not known to naturalists until the early part of the present century, for before that time it had generally been confounded with the greater weever both in its form and habits; that it rarely exceeds the length of 4 or 5 inches and is proportionally deeper in the body than the greater weever. M'Intosh ('Marine Fauna of St. Andrews,' 1875, p. 173) stated that *T. draco* was frequent on the West Sands after storms, and *T. vipera* not uncommon in the same locality, and brought in by the fishermen. In my 'British Fishes,' 1880–81, I gave the two forms as distinct, and figured both, remarking that *T. draco* had D. 5–6 | 29–31, and *T. vipera* D. 6 | 21–24, while the first had "two small spines at the anterior-superior angle of the orbit," but that in the latter there are "no spines above the orbit." Since then Ogilby recorded his disbelief of the fact that *T. draco* had been taken in Ireland, where, however, *T. vipera* is not rare.

In the Ann. & Mag. Nat. Hist. May 1886, p. 441, Prof.

M'Intosh considered that "it is possible that the one is only a young stage of the other and that certain distinctions, such as the absence of spines above the orbit in the smaller form and its greater depth in proportion to its length, disappear with age." At p. 526 of the same volume I made some remarks, which I now propose supplementing, as Mr. Dunn has procured for me two specimens of the "greater weever," *Trachinus draco*, measuring 5·1 and 7·0 inches respectively in length. In my 'British and Irish Fishes,' pl. xxxi., I figured a specimen life-size of the "lesser weever" which measured $4\frac{1}{2}$ inches in length, which I took from a shrimp-net at Weston-super-Mare, and I have seen others nearly an inch longer, while Ogilby has recorded one $6\frac{1}{8}$ inches long from Portrush, in the vicinity of Antrim, while he likewise asserted that the "larger weever" was absent from the Irish coasts.

There is no need to refer again to the greater depth of the smaller species and how it has a lesser number of rays and no spines near the orbit, except for the purpose of remarking upon the two specimens of the *Trachinus draco* recently received. In the first, 7 inches long, the spines at the anterior-superior angle of the orbit were as distinct as in any of the larger specimens which I have seen, while those in the example 5 inches in length had them as prominent as in the larger fish. If, then, *Trachinus vipera* has been observed at $4\frac{1}{2}$, $5\frac{1}{2}$, and $6\frac{1}{8}$ inches in length with no spines near the orbit, while they are well developed in specimens of *Trachinus draco* at 5·1 and 7·0 inches respectively in length, such is a pretty convincing proof that this armature is not consequent upon the augmented size or increased age of the fish. As to fin-rays, both these small examples of *T. draco* had D. 6 | 29, A. 31–32, the first of this latter fin being a spine; but I have never seen a *T. vipera* with more than twenty-four soft rays in the dorsal fin or twenty-six in the anal. The form of the body of these small examples of *T. draco* was not nearly so deep as seen in *T. vipera*. I think we may safely conclude that Linnæus was in error when he included the two forms as one species, and that Fleming, Cuvier and Valenciennes, Yarrell, Jenyns, Parnell, White, Günther, Couch, and others were quite correct in considering that we possess two distinct species; viz. *T. draco*, D. 5–6 | 29–31, and *T. vipera*, D. 6 | 21–24, the first with orbital spines, the second without them.

Cheltenham,
April 6, 1888.

XLVI.—*Note on the Early Mesozoic Ganoid,* Belonorhynchus, *and on the supposed Liassic Genus* Amblyurus. By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

I. Belonorhynchus, Bronn.

Thirty years ago Dr. H. G. Bronn * described a remarkable fossil fish, presumably "Ganoid," from the Upper Trias of Raibl, Carinthia, assigning to it the generic name of *Belonorhynchus*, in allusion to the length of its *Belone*-like snout. Eight years later Prof. Rudolph Kner † had the opportunity of examining fifty other well-preserved specimens from the same locality; and the character of the genus and its type species, *B. striolatus*, are thus defined with considerable accuracy and completeness. The head has an enormously produced snout, its total length being nearly equal to that of the whole of the body behind; it is superficially ornamented with transverse rugæ; the lower jaw is as long as the upper; and there are large widely-spaced teeth, with smaller ones intervening. Both pairs of fins are present, comparatively small, and the pelvics are placed far behind; the single dorsal and anal fins are nearly equal in size, opposite, and very remote; and the caudal fin is symmetrical, slightly forked. The body is slender and destitute of ordinary scales, but ridged both dorsally and ventrally by a single series of much elongated, distally pointed, overlapping scutes, which become especially long and needle-shaped upon the tail, beyond the dorsal and anal fins; the lateral line is also supported on each side by a row of broad scutes.

The head of this fish is so similar to that of *Belonostomus* that Bronn (*loc. cit.* p. 12) was originally led to suspect that the Liassic species *B. acutus* and *B. Anningiæ*, named by Agassiz ‡ upon the evidence of the head alone, might truly belong to *Belonorhynchus*. Zittel § has recently remarked that the first of these certainly does belong to the latter genus, though without publishing the evidence; and I am now able

* H. G. Bronn, "Beiträge zur triasischen Fauna und Flora der bituminösen Schiefer von Raibl," Neues Jahrb. 1858, pp. 7–12, pl. i. figs. 1–10.

† R. Kner, "Die Fische der bituminösen Schiefer von Raibl in Kärnthen," SB. Akad. Wiss. Wien, math.-naturw. Cl. liii. pt. 1 (1866), pp. 189–196, pl. vi.

‡ L. Agassiz, Rech. Poiss. Foss. vol. ii. pt. 2, pp. 142, 143, pl. xlvii *a.* figs. 3, 4.

§ K. A. von Zittel, Handb. der Palæont. vol. iii. (1887), p. 222.

to add that the undescribed *B. Anningiæ* must also be placed here, this being specifically undistinguishable from *B. acutus* so far as can yet be determined. The fact is of interest, as considerably curtailing the known range of the genus *Belonostomus,* of which no satisfactory specimens have hitherto been discovered below the lithographic stone of Bavaria and France *.

Conclusive proof of the generic identity of the so-called *Belonostomus Anningiæ* with *Belonorhynchus* is afforded by more than one specimen in the British Museum, but only a single fossil (no. P. 3790) gives much clue to the proportions of its trunk and the characters of some of the scutes. Whereas in the typical *B. striolatus* the head is about equal to the rest of the body in length, in *B. Anningiæ* it is not more than half as large in proportion; and the snout of the latter is destitute of the superficial transverse striations characteristic of the former. The dorsal scutes, however, upon the middle of the trunk are equally narrow and pointed, and apparently of corresponding form and size.

This discovery will eventually lead to a more complete elucidation of the characters of *Belonorhynchus*, for the Liassic species being considerably larger than the Triassic and its remains occurring in a more satisfactory matrix it will doubtless throw considerable light upon the structure of the skull when exhaustively studied. At present, however, it must suffice to remark that there appears to be a very close resemblance between the skull and mandible and dentition of this genus and the corresponding parts of *Belonostomus*; and one fossil lately described † is very suggestive of a large mandibular presymphysial bone, exactly similar to that discovered by Otto Reis ‡ in the Solenhofen *Belonostomus*.

The Liassic specimens and a few additional examples of *B. striolatus* from Raibl also seem to determine definitely

* Agassiz (*tom. cit.* pt. 2, p. 143) named a species from the Stonesfield Slate *B. leptosteus*, and Phillips (Geol. Oxford, 1871, p. 180, diagr. xl. fig. 4) figured under this name a portion of mandible which might pertain either to *Belonostomus* or *Belonorhynchus*. The evidence is very uncertain, and some of the supposed fragments of *Belonostomus* from Stonesfield, so labelled in collections, doubtless belong to a species of *Aspidorhynchus*, of which Phillips figured a mandibular ramus under the name of "*Pholidophorus minor* ?, Agass." (*op. cit.* p. 180, diagr. xl. figs. 5, 6), and of which there are satisfactory specimens in the British Museum.

† Smith Woodward, "On the Mandible of *Belonostomus cinctus*, &c.," Quart. Journ. Geol. Soc. vol. xliv. (1888), p. 147, pl. vii. fig. 14.

‡ O. Reis, "Ueber *Belonostomus, Aspidorhynchus,* und ihre Beziehungen zum lebenden *Lepidosteus*," SB. math.-phys. Cl. bay. Akad. Wiss. 1887, p. 169, pl. i. fig. 4.

that in *Belonorhynchus* the notochord was persistent. Kner * suspected that there were complete vertebral centra in the anterior portion of the trunk and small triangular calcifications in the sheath of the notochord more posteriorly; but the small bodies must doubtless be regarded as the expanded proximal portions of the neural and hæmal arches, quite similar to those of many other early Ganoids. It may be added, moreover, that Bronn's description of the fin-rays as transversely jointed is correct, though subsequently questioned by Kner, the fossils being often deceptive owing to the circumstances of preservation.

With regard to the systematic position of the genus, Kner institutes many comparisons with the living *Fistularia*, and Lütken † has suggested that it is probably related to the Cretaceous *Dercetis*. The characters of the skull, however, together with the disposition of the fins and the primitive nature of the vertebral axis, appear to indicate much more affinity with *Belonostomus* and its allies, as originally recognized by Bronn; and the genus may therefore be referred to a nearly related family, the Belonorhynchidæ, characterized as follows:—Body long and slender; snout much elongated and pointed. Notochord persistent, the bases of the arches expanded. Paired fins moderately developed; dorsal and anal fins large, nearly equal and opposite, very remote; caudal symmetrical; fulcra minute or absent. No continuous squamation, but a median longitudinal series of dorsal and ventral scutes, and a single lateral series on each side supporting the lateral line.

II. AMBLYURUS, Agassiz.

While referring to Liassic Ganoids it may be well to place on record a correction which was made some years ago by Mr. William Davies in the British Museum, but does not appear to have been hitherto published. Whatever be the nature of the head-fragment associated by Agassiz with the genus *Amblyurus*, there can be no doubt that the type specimens of the single species, *Amblyurus macrostomus* ‡, are really *vertically crushed* specimens of *Dapedius*; and the name thus falls into the synonymy of this well-known Lower Liassic fish.

* R. Kner, *loc. cit.* p. 192, pl. vi. figs. *b*, *c*.

† C. F. Lütken, "Professor Kner's Classification of the Ganoids," Geol. Mag. vol. v. (1868), p. 432.

‡ L. Agassiz, *tom. cit.* pt. 1, p. 220, pl. xxv *e*.

XLVII.—*Short Life-histories of nine Australian Lepidoptera.* By A. Sidney Olliff, Assistant Zoologist, Australian Museum, Sydney.

[Plate XX.]

The following pages contain notes and descriptions of larvæ observed in the immediate neighbourhood of Sydney, drawn up with the view of supplying some little information about the early stages of such species as I have succeeded in rearing during the past year. As few collectors in Australia have turned their attention to the earlier stages of the Lepidoptera, any resident entomologist with time and inclination for the work would have an almost untrodden field in this direction. Of the ten larvæ which I have reared, as far as I am aware only one, namely *Brunia replana*, has previously been observed, although my larva-collecting scarcely extended beyond the limits of a single garden at Double Bay, one of the innumerable indentations of Port Jackson.

Papilionidæ.

Papilio sarpedon, Linn., var. *choredon*, Feld.
(Pl. XX. fig. 1.)

The larva when very young is of a velvety black colour, with numerous spines, somewhat resembling those of many Nymphalidæ. On the shoulders two much larger spines fringed with hairs, and two at the anal extremity pure white. As the larvæ increase in size they lose the whole of the spines with the exception of two on each side of the first three segments * and the two at the tail, the colour of the insect now being of a dull sap-green above, merging into a bluish ashy hue on the sides; on the third segment, between and connecting the two spines, is a bright yellow band. These colours, although decreasing in intensity and becoming finely speckled with white, are continued until the insect is full-grown. The spines, however, become smaller and the lateral band of yellowish white in the region of the stigmata much more distinct. The adult larva is robust anteriorly, gradually tapering to the tail, in length about $1\frac{3}{4}$ inch, and possesses retractile tentacula.

* In this and the following descriptions the head is considered separately and the segments are counted antero-posteriorly from one to twelve.

The pupa is attached by the tail and a central band, about $1\frac{1}{4}$ inch in length and throughout of a pale green, finely speckled with darker. Over the head there is a projection or process of considerable length, from which emanate four conspicuous brown lines, which proceed two on each side until they meet at the tail.

This species is common in open sunny places, such as gardens and waste grounds where flowering-plants occur. Its food is the camphor-laurel, on which the parent insect deposits the eggs singly.

Owing probably to the copious rains which have fallen during the past summer and the consequent luxuriant vegetation *Papilio sarpedon* and many other butterflies have been unusually abundant. One conspicuous species, *Delias argenthona*, never before observed by the Sydney collectors, has been comparatively common. It will be interesting to see if the species has permanently established itself; in Queensland it is one of the most abundant of the Pierinæ, but hitherto, I believe, the Clarence River has been the southernmost limit of its range.

Papilio Macleayanus, Leach.
(Pl. XX. figs. 2–2 *c*.)

The young larva of this species, which I found in April feeding on the tender shoots of the orange, is whitish in colour, with the sides velvety brown; the head, second, third, eleventh, and twelfth segments black; each segment except the first and last provided with small, black, bifid bristles; the first, second, third, and last segments with large black tubercles. At the first moult the larva loses the bifid bristles and the tubercles assume the appearance of black spines, the anal one white at the base and bifid; the larva is now of a delicate green colour, somewhat speckled, with the head yellowish green, the anterior segments pale yellow, and the tail reddish. After the second moult, which took place in about a week from the time of hatching, it became perceptibly larger and more brightly coloured; the head turning yellowish green and the anterior spines, together with the space between them, reddish black. It is in this stage I believe, but on this point I am not quite sure, that the retractile tentacula are first perceptible; they are long, soft, and greenish in colour. At the third moult the ground-colour is much yellower and the green more pronounced, with two distinct rows of white spots on each side, the spines less conspicuous, and the anal horn yellow, tipped with black, and no longer bifid. Fourth change:—Colour similar but brighter, the spines on the first and second segments almost obsolete, and the line connecting the dorsal row of white spots greatly intensified.

This larva is very sluggish in its habits, but it is extremely sensitive, shooting out its tentacula at the slightest alarm.

Like the larva the pupa varies much in general colour; sometimes it is bright emerald-green and sometimes bluish white.

The butterfly, which is by no means common, made its appearance in August.

Papilio erectheus, Don.

This larva I found on a young orange-tree. When young it is marked with alternate patches of glossy brown and white, the brown predominating, and the body covered with conspicuous spines. As the larva increases in size its markings change; when adult it settles into a dull green, with large irregular patches of brown, strongly edged with white, generally three on each side. The spines now appear small, not having increased in the same proportion as the insect. The underside of the abdomen is dull white, except the first four segments, which are brown. The larva, which attains a length of $3\frac{1}{2}$ inches, is furnished with the dorsal tentacula usually found in the Papilionidæ, and is very sluggish.

Pupa light green in colour, delicately speckled with black and occasionally with silver; a bifid projection at the head. Length varying from $1\frac{3}{4}$ to $2\frac{1}{4}$ inches.

This is the commonest *Papilio* and the largest butterfly found in Sydney, where it occurs throughout the summer, occasionally in such numbers as to cause considerable destruction in orange-orchards. It also feeds on *Xanthoxylum.*

Acræidæ.

Acræa Andromacha, Fabr.

The larva when adult measures $1\frac{1}{2}$ inch and is of a yellowish-brown colour throughout; each segment bears a whorl of six black tubercles, each emitting a long branched spine.

Pupa about an inch in length, suspended by the tail; the thorax and abdomen cream-coloured, the latter with five longitudinal rows of yellowish spots edged with deep black;

the wing-cases slightly brown, with black markings, and somewhat angulated.

Extremely abundant on the hybrid passion-vine (*Tacsonia Mortii*) in gardens at Darling Point. My specimens took wing in March.

Hesperidæ.

Apaustus agraulia, Hew. (Pl. XX. figs. 3-3 *b*.)

Larva pale green, darker at the sides, considerably narrowed posteriorly; the head dark brown, with a white V-shaped marking in front; the lateral line very indistinct. Length of adult 11 lines.

Pupa grey, semitransparent.

Fed on couch-grass, at the roots of which it pupated during March. The butterfly appeared early in April.

Hypsidæ.

Hypsa nesophora, Meyr. (Pl. XX. figs. 4 & 4 *a*.)

Larva dark brown, somewhat shining, clothed with long bristly grey hairs; two conspicuous white spots on the sides, one between the fourth and fifth, the other between the ninth and tenth segments. Legs reddish, feet dark brown. Adult nearly 2 inches in length.

Pupa dark brownish red.

Fed on native fig, the larva living gregariously under a loosely made web. Turned to a pupa in April, but the moth did not emerge until December.

Œcophoridæ.

Philobota bimaculana, Don.
(Pl. XX. figs. 6–6 *b*.)

Larva about 7½ lines in length, bluish white, sparingly clothed with fine grey hairs; the head and a moderately large spot on each side of the second, third, and last segments dark brown; a row of small brown spots on each side of the dorsal surface extending from the fourth segment to the anal extremity.

Pupa reddish brown, the abdomen bright red.

Fed on *Eucalyptus*; living within a shelter formed by spinning the leaves together. Changed to a pupa in January, the moth taking wing on the 15th of the following month.

I believe this is the first record of the early stages of this extensive Australian genus.

Depressariidæ.

Gonionota pyrobola, Meyr. (Pl. XX. figs. 7 & 7 *a*.)

Larva about an inch in length, delicate bluish green in colour, the second segment more robust than the others; the head dark brown, having on each side an oblong patch of dull white. It lives at the end of the leaf in a tube, which it ingeniously constructs by cutting the leaf on each side from the outer margins to nearly the middle and rolling the upper portion on itself and securing it firmly with silk threads. Before entering the pupa state it leaves this habitation and attaches itself to the back of a leaf or small twig by the tail.

Pupa naked, dark bluish green, finely speckled with red; the shoulders prominent and angular; a rounded protuberance on the upper part of the front of the abdomen formed by the tips of the wings; two pointed processes above the eyes, projecting forwards, the tail truncated.

A single specimen of this remarkable species reared from a nearly full-grown larva found on *Ægiceras fragrans* in September last. The moth, which is nocturnal, emerged in January.

Hyponomeutidæ.

Encœmia caminœa, Meyr. (Pl. XX. figs. 5 & 5 *a*.)

The larva of this species is of the form locally known as a "saddle-back." In colour it is white with traces of red, the sides yellow, with four longitudinal dark reddish-brown markings, two at the anterior and two at the posterior extremity, and a row of small brown spots parallel to each lateral margin. Length 7 lines.

Pupa yellow. Attached to the underside of a leaf on its food-plant.

A female specimen bred in April from larvæ found on a low-growing *Eucalyptus* in a garden at Double Bay.

EXPLANATION OF PLATE XX.

Fig. 1. Larva of *Papilio sarpedon.*

Fig. 2. Larva of *Papilio Macleayanus.* 2 *a*. Ditto, after third moult. 2 *b*. Ditto, with tentacula protruded. 2 *c*. Pupa.

Fig. 3. Larva of *Apaustus agraulia*. 3 *a*. Ditto, with covering formed of leaves. 3 *b*. Pupa.
Fig. 4. Larva of *Hypsa nesophora*. 4 *a*. Pupa.
Fig. 5. Larva of *Encemia caminœa*. 5 *a*. Pupa.
Fig. 6. Larva of *Philobota bimaculana*. 6 *a*. Ditto, with covering formed of leaves. 6 *b*. Pupa.
Fig. 7. Larva of *Gonionota pyrobola*. 7 *a*. Pupa.

XLVIII.—*On a new Mode of Life among Medusæ.* By J. Walter Fewkes *.

Several pamphlets and one or two books have been written on the influence of parasitism in the modification of animal structure. Perhaps nowhere do we find this mode of life better illustrated than among certain of the Crustacea, where the anatomical structure is so masked by their parasitic habits that for a long time in the history of research it was impossible to recognize their zoological affinities, and it was only when the immature stages in the growth were studied and larval conditions, unaffected by parasitism, had been investigated, that the true relationships of the group could be discovered.

What we find in the so-called Lernean worms exists wherever parasitism is found among animals. It may, in fact, be concluded that ordinarily in parasites there is a degradation in structure, or at all events such a modification as to lead to important changes in anatomy and external form.

It would seem that among the lowest animals we ought to find a larger number of parasitic genera than among the higher. While there is little doubt that there is more variety in lower animals, I am not so confident that this mode of life has led to as great modifications in structure here as might be expected. While we cannot ascribe to parasitism the many variations in animal structure which occur, and it is impossible to give this mode of life a primary importance in theories of origin of species as has been attempted, it is no doubt true that many variations in structure have been derived either directly or by heredity from parasitic ancestors.

Nowhere among lower animals is there more likelihood

* From the 'Proceedings of the Boston Society of Natural History,' vol. xxiii. Communicated by the Author.

that we should find parasitic conditions than among the Medusæ. Reflect for a moment that the young of a majority of these animals live attached to submarine objects, and it seems easy to see how, by changing its habitat, a parasitic attachment to another animal might easily take place. Considering the probabilities, however, although the number of genera which might be mentioned as living upon other animals is large, the number of recorded instances of those which have suffered a modification in structure by their attachment is very small.

Every one who has taken a hand in the most fascinating part of the study of marine zoology, viz. dredging in the ocean, knows how often ascidians, brachiopods, large mollusks, and other animals are brought up with attached hydroids growing upon them. These hydroids, in one sense, are not parasitic, as they draw no nourishment from their hosts, nor are they at all modified by their mode of life. For instance, *Hydractinia* from a *Natica*-shell inhabited by a hermit-crab is not unlike *Hydractinia* from the underside of a floating bell-buoy. *Obelia* from the stalk of *Boltenia* is specifically the same as *Obelia* on a submerged log. In these and similar instances, for they are numerous and varied in nature, there is no resultant modification either of host or parasite, as the attachment is in no way vital or intimate.

There are, however, among the Medusæ certain recorded cases of parasitism where there is a vital connexion, so to speak, where there is a parasitism or even commensalism of such an intimate character that not only the structure of the parasite but also even that of the host itself is modified. It is a study of these cases which has a most interesting morphological importance, for it affords in some instances at least a means of estimating the modifications of structure which may result in Medusæ from parasitic habits. They introduce into the discussion of the theory of evolution a series of facts which may well be carefully considered by those who regard selection as an all-important factor in the modification of animal structure.

It is not my purpose, however, to enter into a discussion of this subject, upon which so much has already been said by abler naturalists than myself. I have simply introduced it in preparation for the consideration of new observations bearing upon the question among the jellyfishes. Let me, as an introduction, mention a few instances of modification of Medusan genera by the mode of life called parasitism.

One of the best known instances of parasitism among Medusæ is that of *Cunina*, which lives parasitic in the stomach of another Medusa, *Geryonia*. We undoubtedly have in this case a modification of the parasite by its peculiar mode of life in the host, although a reciprocal effect on the host is not recognizable.

Less known than *Cunina*, although quite as interesting, is the case of *Mnestra parasita,* a Hydromedusa which lives parasitic on the pelagic mollusk *Phyllirhoë*. We find here a modification in the structure of *Mnestra* by the attachment, although we know but little of the nature of that modification, while of the growth of the Medusa we know nothing.

A most interesting instance of parasitism and consequent modification among Medusæ is found in the problematical organism *Polypodium*. This undoubted hydroid is found parasitic in the ova of the sturgeon while in the body of the fish. We have in *Polypodium*, as described by Ussow, a hydroid-like animal, which develops and drops buds which can be directly compared with Medusæ. These are not the only instances of parasitic Medusæ thus far recorded, but they are typical and useful for comparisons. None of them are as valuable as they might be in estimating the amount of change in anatomy which has resulted, since we are either ignorant of their whole life-history or of that of related adults with simple development.

It is with the greatest pleasure that I am able to add to the above-mentioned instances of parasitism among Medusæ another of most extraordinary character. This instance is peculiarly adapted for the study of the effect of parasitism in modifying the Medusan structure, as its close allies are well known and comparisons with them can be easily made. This instance is, I believe, unique and the first recorded example of a Hydroid living attached to the outside of a fish and modified in structure by its life. It may thus properly be called a new mode of life among Medusæ.

In the pelagic fishing which has been carried on for the last ten years at the Newport Marine Laboratory we have taken several specimens of the well-known fish *Scriola zonata*, Cuv. This fish is a close ally of the ordinary "pilot-fish," and is often seen in calm weather swimming near the surface of the sea. Three of these fishes were found in company last summer, and upon the side, near the anal fin, of one of these, curious appendages were noticed which had never been observed before. On capturing the fish and making a superficial examination of the attachment I was reminded of an attached fungus growth. Every one is familiar with the growth on fishes of the fungus *Saprolegnia*, and the resemblance seemed so great, except in colour, between the supposed fungus of *Seriola* and *Saprolegnia*, that at first I regarded the former as a fungoid growth. The colour of the supposed fungus of *Seriola* was, however, reddish and yellow; and, although I have since learned that superficial fungoid growths of this colour sometimes exist on fishes, at the time when *Seriola* was captured I was ignorant of this fact; the red colour led me to doubt its fungoid affinities. A glance at the supposed fungus through a small lens easily dispelled my error and showed me that I had a new and unique case of a parasitic Hydroid. It is to the peculiarities in structure of this animal and the Medusa which was raised from it that I wish to call attention in the present paper.

As the genus of Hydroids which shows this curious mode of life is new, it will be necessary to assign it a name, and I suggest that of *Hydrichthys mirus*, as expressing one phase at least of the curious life which it leads *.

The majority of genera of Hydromedusæ have ordinarily two stages of growth, one of which is called the Hydroid and the other the Medusa-stage. The latter is a Medusiform zooid of the former. Let us consider each of these stages in *Hydrichthys*.

Hydroid.—The Hydroid of *Hydrichthys* consists of sexual and asexual individuals, both of which arise from a flat plate of branching tubes which is fastened to the sides of the body of the fish. The sexual individuals may be called the gonosomes, the asexual the filiform bodies.

The gonosomes consist of a simple contractile, highly sensitive axis, upon the sides of which are borne lateral branches with terminal clusters resembling minute grape-like bodies. These grape-like bodies are Medusæ in all stages of growth. The filiform individuals are simple flask-shaped bodies, without tentacles and with terminal mouths †.

No circle of tentacles about a mouth-opening was detected either in the gonosomes or the filiform bodies. This is a significant want, since, with the exception of *Protohydra*, *Microhydra*, and the secondary zooids of certain Alcyonians, tentacles of some kind are found near a mouth or in relation to the oral opening of most of the fixed Hydroids or polyps.

Medusa.—The gonophore of *Hydrichthys* has a *Sarsia*-like bell and manubrium, four radial tubes, four tentacles without appendages, as already elsewhere described by me ‡.

In the light of what we know of the affinities of the Medusa

* An accurate diagnosis with figures will be found in my paper "On certain Medusæ from New England," Bull. Mus. Comp. Zool. xiii. no. 7.
† Somewhat like the spiral zooids in *Perigonimus* except this particular.
‡ Bull. Mus. Comp. Zool. xiii. no. 7.

of *Hydrichthys* it is interesting for us to consider those of the attached Hydroid. If our problem was to determine the relationship of *Hydrichthys* from a study of the Medusa alone, we could easily conclude that it is a near relative of *Sarsia*. Such a conclusion is, I believe, one which can be easily defended. When, however, we come to compare the Hydroid of *Sarsia* and the Hydroid of *Hydrichthys* we find the greatest differences between the two. These differences are so important that they have affected the whole structure; for a comparison of the two reveals the effect of the peculiar mode of life in *Hydrichthys*. The typical structure, or schema, of the Tubularian Hydroid, as *Coryne*, is a slender axis which may be naked or encased in a chitinous tube, an enlargement at the free end, and a terminal mouth-opening. This mouth-opening or the walls of the enlargement bear tentacles in rows, irregular or otherwise. Somewhere among these tentacles, or elsewhere on the stem, arise buds which may or may not develop into Medusæ. The widest variations from such a schematic type may be noticed among Hydroids. Our purpose here is to compare *Hydrichthys* with the so-called schema.

In the case of the gonosome of *Hydrichthys* I suppose that the stem of the schema remains, that the terminal mouth-opening is present, but that the enlargement of the axis has disappeared. From the sides of the axis arise lateral branches, as in some Hydroids, and the Medusa-buds have been crowded to the distal ends of these branches. Tentacles have disappeared on account of the parasitic nature of the life of the Hydroid. It is from this fact that we find in *Hydrichthys* the schema of the ordinary Tubularian Hydroid reduced to a simple sexual body or gonosome.

In the homology of the "filiform bodies" of *Hydrichthys* the reduction, as compared with the schema of a Hydroid, has gone still further, on account of the parasitic life, and nothing remains but a simple axis, without appendages of any kind.

If I am right in this homology of the two kinds of individuals in the *Hydrichthys*-colony, it would seem as if there ought to be a meaning for their simple structure as compared with the typical Hydroid. The relation of the Medusa to that of *Sarsia*-like genera would imply degeneration, not phylogenetic simplicity. Cannot we find in parasitism a cause for such a degradation?

Is the conclusion legitimate that these great differences between *Hydrichthys* and the fixed Hydroid closely related to it are the result of its peculiar mode of life? I believe it is. I believe that the modification in the Hydroid *Hydrichthys*, the loss of tentacles, the polymorphism, and the increase in prominence of the sexual bodies, are exactly what we should expect to find *à priori* if a degradation had taken place in its structure.

There is one other point to which I wish to call attention before closing my communication. The existence of a polymorphism, such as we find in *Hydrichthys*, is exceptional among fixed Hydroids of the Tubularian group. Something similar exists in *Hydractinia* and *Perigonimus* and one or two other genera; but this kind of polymorphism is not common among fixed Hydromedusæ. A similar polymorphism exists, however, in *Velella*, a floating Hydroid well known to all naturalists. In *Velella* we have the basal plate with anastomosing tubes of *Hydrichthys* modified into a complicated float. The gonosomes are the same in both genera, the filiform bodies of *Hydrichthys* are represented by the single central polyp, so-called, in *Velella*. The Medusæ of the two closely resemble each other. There are only two kinds of individuals in both genera.

Strangely enough, after I had reasoned out this likeness between *Velella* and *Hydrichthys* on morphological grounds, my memory went back to a strange story I had once heard from an Italian fisherman of the origin of *Velella* from the common mackerel. This story or a similar one long ago found its way into the books.

According to Marcel de Serres, the Mediterranean fishermen suppose that *Velella* originates as a bud from the head of the mackerel; and Pagenstecher goes on to explain this error, after quoting its source, from the fact that young *Velellæ* are often found in the nets with the fishes, and it is easy to suppose, as their colour is similar, that one budded from the other. While we accept without question this explanation and the want of foundation of the fishermen's yarns, it is a strange coincidence that a possible relative of *Velella* should be found attached to the body of a fish. It is well for us to inquire, in the light of phylogeny, whether *Velella*, if it has not itself originated from Hydroids on the fish by budding, has not been directly derived from one which is so intimately related to *Hydrichthys*, which is attached to the body of a fish, that an unskilled observer might be easily deceived.

Hydrichthys is, in point of fact, the nearest known ally of *Velella* among fixed Hydroids, and their morphological likenesses have already been pointed out. It would be premature to suppose, however, that *Velella* has derived its peculiar anatomy from its descent from a form like the parasitic

Hydrichthys, rather than that *Hydrichthys* is a parasitic descendant of *Velella*; while the acceptance of the last-mentioned theory would lead us to regard fixed Hydroids like *Coryne* as likewise descendants of parasitic forms with which they have few resemblances. Indeed, we know next to nothing of the egg and early growth of either *Hydrichthys* or *Velella*. We have at all events found in *Hydrichthys* a near ally of *Velella* as far as the Hydroid is concerned, whatever may be the story told by the early history of both.

There is also another point long since known to those familiar with the literature of the Hydromedusæ, which is beautifully illustrated by *Hydrichthys*. Several naturalists have mentioned or called attention to the resemblance of the Medusæ of Hydroids of very different form. We may have Medusæ so nearly related as to be placed in the same genus, but their Hydroids would otherwise be placed in different genera. In *Hydrichthys* we have an illustration of this principle. The Medusa is similar to *Sarsia*, but there is only a remote likeness between the attached Hydroid *Hydrichthys* and *Coryne* the Hydroid of *Sarsia*. If a special student of the Hydroids was called upon to identify the parasitic Hydroid, he would consider its zoological distance from *Coryne* very considerable; but a study of the Medusa would lead him to a very different opinion of its zoological position.

Do these facts of a difference in the form of the Hydroids of allied Medusiform gonophores, or *vice versâ*, as sometimes happens, the diversity of Medusæ derived from similar Hydroids, mean anything morphologically? The question is an interesting one, and admits of several interpretations, which, however, it is not my purpose to consider at present. There is one thing which has a bearing on the subject, which I wish in closing to say in this connexion, viz.: *the true affinities of the majority of genera of Campanularian or Tubularian Hydroids, or of Leptomedusæ and Anthomedusæ derived from the same, cannot be definitely made out until both Hydroid and Medusa are studied together.*

XLIX.—*Notice of a remarkable Ophiurid from Brazil.* By F. Jeffrey Bell, M.A.

Among the specimens recently collected at Itamaraca, a few miles from Pernambuco, by Mr. Ramage, and forwarded to the British Museum, are three examples of a remarkable Ophiurid, to which I should like to direct the attention of naturalists who may be collecting in Brazilian or West-Indian waters. The form is, in the first place, remarkable for the extraordinary length of the arms in proportion to the diameter of the disk, for while the latter measures about 4 millim., the arms are no less than 150 millim. long.; the proportion of arm to disk is therefore as 1 : 37·5, or more than twice that of *Ophiothrix longipeda*, which Mr. Lyman gives as 1 : 18.

It is, unfortunately, impossible to be certain of the genus to which this very long-armed form is to be referred, for from all three examples the covering of the disk has been lost, and this loss has, in a very curious way, affected also the dorsal surfaces of the most proximal arm-joints. The loss of this upper surface would, if it were natural (and the close similarity between the specimens leads one to imagine that it is so), be more or less fatal to the animal in inverse proportion to the quantity of carbonate of lime which, in the form of covering-plates, ordinarily protects the disk. On the assumption that that quantity is small, or that the greater part of the disk is naked, the species now under consideration appears to be allied to the genera *Ophionema* and *Ophionephthys* of Dr. Lütken. In these genera the arms are likewise long, though by no means so extraordinarily long as in the Brazilian form, and they are both represented in the West-Indian seas. Naturalists who have the opportunity of observing this long-armed form in life should direct particular attention to this loss of the disk, with a view to answering such questions as whether the loss is in any way associated with the act of reproduction, whether the disk becomes restored, and, if so, whether the restoration is effected rapidly.

As it is convenient to have a name for our object, the species may be provisionally placed in the genus *Ophionephthys* * and be called *O. sesquipedalis*. The following description will probably serve the collector as a means of identifying it :—

Disk very small; arms narrow, exceedingly long, and probably, when complete, as much as forty times the diameter of the disk; three short arm-spines, one tentacle-scale. Upper arm-plates very regularly oblong, the proximal and distal edges quite straight, about three times as wide as long.

* If it should be found that this is its proper place it will be necessary to so far amend the diagnosis of that genus as to diminish to two the number of the mouth-papillæ and to three the number of the arm-spines.

Arm-spines subequal. Under arm-plates very regular, rather wider than long.

The upper arm-plates are of a dark colour with a lighter proximal margin; the spines and the lower plates are much paler.

Hab. Itamaraca, Brazil.

L.—*Descriptions of new Species of Oriental* Cicadidæ. By W. L. Distant.

Leptopsaltria picturata, n. sp.

♂. Body above brownish ochraceous; head, excluding base, much suffused with piceous, the ocelli red, the eyes castaneous. Pronotum with a central, longitudinal, fuscous fascia, the margins of which are black, ampliated anteriorly and notched and narrowed posteriorly; and an oblique piceous fascia near each lateral margin. Mesonotum with a central, longitudinal, linear fascia, on each side of which is a curved, linear, discal fascia extending to anterior margin; a broad fascia on each lateral area, and a spot at each anterior angle of the cruciform basal elevation, piceous. Abdomen sparingly greyly pilose, with a double discal series and a more continuous series of piceous spots on each lateral margin; base of anal segment also piceous. Body beneath ochraceous; bases of anterior femora, bases and apices of the tibiæ, apices of the tarsi, abdominal tubercles, and anal segment of the abdomen piceous; anal appendage luteous. Tegmina and wings pale hyaline, the venation fuscous; the tegmina with a small costal ochraceous and fuscous spot at base of the upper ulnar area, and the transverse veins at the bases of the first, second, and third apical areas infuscated.

The rostrum has the apex piceous and just passing the posterior coxæ, and the face is depressed and somewhat flattened.

Long. excl. tegm. 15 millim., exp. tegm. 44 millim.

Hab. Nilgiri Hills, northern slopes, 5000 feet (*Hampson*). Coll. Dist.

Leptopsaltria andamanensis, n. sp.

♂. Body above reddish ochraceous, ocelli reddish. Pronotum with the centre of the anterior margin and the whole of the posterior margin (widest at centre) blackish. Mesonotum with two linear, blackish, obconical spots at anterior margin and a greenish fascia near each lateral margin. Abdomen with the segmental margins darker. Body beneath ochraceous, the abdominal tubercles blackish. Legs *mutilated.*

Tegmina and wings pale hyaline, the venation fuscous. Tegmina with the costal membrane brownish ochraceous, a small costal fuscous and ochraceous spot at base of upper ulnar area, the transverse veins at the bases of second, third, and fifth apical areas infuscated, and a series of small fuscous marginal spots situated on the apices of the longitudinal veins of apical areas.

The rostrum has the apex piceous and just passing the posterior coxæ.

Long. excl. tegm. 21 millim., exp. tegm. 58 millim.

Hab. Andaman Islands (*J. Wood-Mason*). Calc. Mus.

Cosmopsaltria Pigafettæ, n. sp.

♂. Body above brownish ochraceous; head with the whole frontal margin and a transverse fascia between the eyes black. Pronotum with two central, longitudinal, linear fasciæ, on each side of which are two or three oblique, short, linear spots, and a broader fascia on each lateral margin black. Mesonotum with five linear fasciæ; the central crossing disk, on each side of this a shorter and curved fascia, and a broken fascia on each lateral area, black. Abdomen pilose, with some black spots at base. Body beneath brownish ochraceous; face with a central black fascia, not reaching anterior margin, and a transverse series of black linear spots on each lateral margin; some scattered spots on head, apex of the rostrum, some femoral streaks, the tarsi, and a transverse fascia at base of abdomen black. Wings pale hyaline, the venation greenish or fuscous, the first with a small ochraceous costal spot at base of upper ulnar area, the transverse veins at bases of second, third, fifth, and seventh apical areas infuscated, and a marginal series of small fuscous spots, situate on the apices of the longitudinal veins to apical areas.

The rostrum reaches the posterior coxæ; the opercula are ovate and extend to the third abdominal segment.

Long. excl. tegm. 26 millim., exp. tegm. 84 millim.

Hab. Ternate (coll. Dist.), Bouro (Brussels Mus.).

This species is allied to *C. impar*, Walk.

Pomponia collina, n. sp.

♂. Body above ochraceous brown; head with the margin of the front and the vertex much suffused with blackish. Pronotum with two central longitudinal fasciæ, which are most widely separated at anterior margin; on each side of disk is a curved linear spot, and a large, oblique, semioval, linear spot on each lateral area, black. Mesonotum with five black fasciæ; the central crossing disk and widened anteriorly and posteriorly, one on each side of this short and curved, and one on each lateral area crossing the whole of disk, and a spot in front of the anterior angles of basal cruciform elevation black. Abdomen with the segmental margins somewhat broadly black. Body beneath ochraceous; head, excluding face, blackish; bases of tibiæ, the tarsi, and basal segment of abdomen fuscous; apical segment of abdomen somewhat infuscated.

Tegmina and wings pale hyaline, the venation fuscous or ochraceous; the first with the costal membrane ochraceous.

The face is moderately tumid and not centrally and longitudinally sulcated; the rostrum reaches the posterior coxæ; the opercula are small, wide apart, and somewhat angulated.

Long. excl. tegm. 16–17 millim., exp. tegm. 47–54 millim.

Hab. N. Khasia Hills. Calc. Mus.

Pomponia Ransonneti, n. sp.

♂. Head and thorax above ochraceous; head with two converging black lines in front, and the anterior area of vertex (enclosing ocelli), the hinder margin of eyes, and a small spot at same region black. Pronotum with a broad, central, double, longitudinal fascia, on each side of which are two curved linear spots and a large oblique, semioval, linear spot on each lateral area black. Mesonotum with a central longitudinal fascia broadening at base into a large crescentic spot in front of basal cruciform elevation, on each side of this fascia, starting from anterior margin, is a short curved fascia followed by a spot and again by a long, broad, and slightly curved fascia and a small oblique spot on each lateral margin black. Anterior angles of basal cruciform elevation black. Abdomen above brownish ochraceous, pilose, the segmental margins narrowly piceous. Head beneath, sternum, and legs ochraceous; an oval fascia on face, a transverse spot on each side, posterior margin of head, a transverse spot on mesosternum, apices of the femora, and bases of the tibiæ black. Abdomen beneath brownish ochraceous, its base and apex piceous.

Tegmina and wings pale hyaline, with a pale creamy bluish reflexion, venation castaneous or fuscous; tegmina with a small ochraceous costal spot at base of upper ulnar area, transverse veins at bases of second, third, fifth, and seventh apical areas infuscated, and a marginal series of fuscous spots situated on the longitudinal veins of apical areas.

The rostrum reaches the posterior coxæ; the opercula are small and widely separated.

Long. excl. tegm. 22 millim., exp. tegm. 59 millim.

Hab. Ceylon, Colombo. Calc. Mus.

Tibicen amussitatus, n. sp.

♀. Head and thorax above dull ochraceous; head with two central oblique spots on front and a spot at base of each antenna black; vertex with a large oblique spot before each eye and with two central longitudinal lines, enclosing the ocelli and continued across and to posterior margin of pronotum, black; two black curved lines on each lateral area of pronotum. Mesonotum with a central longitudinal line, on each side of which at anterior margin is a short, somewhat oblique line, a linear fascia across each lateral area and a spot in front of each anterior angle of basal cruciform elevation, all black. Abdomen above castaneous, with a central black spot at base, and a series of marginal black spots widening to apex. Body beneath and legs ochraceous; the abdomen darker, with some apical black spots.

Tegmina and wings pale hyaline, their bases narrowly ochraceous, the venation ochraceous. Tegmina with some faint fuscous submarginal spots situate on the longitudinal veins of the apical areas.

The pronotum is large and subquadrate; the face is moderately globose, with a wide, central, longitudinal sulcation and strong transverse lateral striations; the rostrum about or almost reaches the posterior coxæ.

Long. excl. tegm., ♀ 12 millim., exp. tegm. 35 millim.

Hab. Darjiling. Stockholm Mus.

Tibicen Acberi, n. sp.

♂. Head black, the ocelli red, eyes brownish ochraceous. Pronotum black, with a central longitudinal fascia and the hind margin yellow, and two large discal reddish spots. Mesonotum black, with two faint yellowish central fasciæ extending a short distance from anterior margin. Abdomen black, the lateral areas and apex more or less reddish. Face, sternum, and femora yellow; central longitudinal fascia to face, head beneath (excluding face), apices of femora, the tibiæ and tarsi black. Abdomen beneath dull reddish.

Tegmina and wings pale hyaline, the venation blackish or olivaceous; costal membrane to tegmina olivaceous.

The face is moderately broad and strongly striated laterally; the rostrum has the apex pitchy and about reaching the intermediate coxæ. The opercula are yellowish, short, and broad, obliquely rounded, and not meeting at centre.

Long. excl. tegm., ♂ 25 millim., exp. tegm. 72 millim.

Hab. Cashmere Valley, 6300 feet (*Leech*). Coll. Dist.

Tibicen reticulatus, n. sp.

♀. Head black; apex of front, anterior lateral margins of vertex, and a narrow, central, longitudinal line dull reddish; eyes brownish ochraceous. Pronotum black, the margins and two large contiguous spots on each side of disk dull reddish. Mesonotum black, the margins, the basal cruciform elevation, and two irregular subobconical spots on anterior margin dull reddish. Abdomen black. Body beneath and legs black, somewhat greyishly pilose; margins of the face, under surfaces and apices of femora, tibiæ and tarsi, excluding bases and extreme apices, spots and markings on sternum and abdominal segmental margins dull reddish.

Tegmina and wings pale hyaline, the venation blackish, their bases narrowly reddish, outwardly shaded with black; costal membrane to tegmina dull reddish.

The face is laterally much compressed and moderately striated; the rostrum about reaches the intermediate coxæ; the legs are robust, and the anterior femora have a strong spine both at base and apex. The tegmina in the specimen described have a small additional cell at base of second apical area, caused by the presence of a short abnormal transverse vein.

Long. excl. tegm., ♀ 29 millim., exp. tegm. 70 millim.

Hab. Gilgit. Calc. Mus.

Tibicen casyapæ, n. sp.

♀. Head black, margins of front, ocelli, and a small central basal spot dull reddish; eyes ochraceous. Pronotum dull reddish, the margins and two central longitudinal lines black. Mesonotum black; two central "antler"-shaped fasciæ, the lateral margins, and the basal cruciform elevation dull reddish, the anterior angles of the last black. Abdomen above black. Body beneath black, somewhat greyishly pilose; face red, its central longitudinal sulcation black; rostrum black; legs reddish, the femora streaked with black beneath.

Tegmina and wings pale hyaline, their bases dull reddish, the venation blackish; the costal membrane of tegmina ochraceous.

The face is large, but laterally compressed and strongly striated, with a profound central longitudinal sulcation. The rostrum about reaches the intermediate coxæ; the legs are robust and the anterior femora have a strong spine beneath at apex and a similar spine near base.

Long. excl. tegm., ♀ 35 millim., exp. tegm. 90 millim.

Hab. Cashmere Valley, 6300 feet (*Leech*). Coll. Dist.

Cicadetta continuata, n. sp.

♀. Head and thorax above dull blackish, sparingly covered with short grey pilosity. Head with the anterior margin, the ocelli, and a central, linear, longitudinal fascia continued across the pronotum, where it is widened, dull ochraceous, the pronotal margins of the same colour. Mesonotum with two longitudinal discal fasciæ, the lateral margins and basal cruciform elevation dull ochraceous, the last with its centre blackish. Abdomen above pale castaneous, greyishly pilose, the posterior segmental margins paler in hue and with an obscure, central, narrow, longitudinal, blackish fascia. Body beneath and legs dull reddish ochraceous; head beneath and the discal area of face blackish.

Tegmina and wings pale hyaline, their bases narrowly reddish ochraceous, the venation more or less olivaceous. The rostrum about reaches the intermediate coxæ, and the face is very broad and tumid.

Long. excl. tegm., ♀ 15–18 millim., exp. tegm. 38–45 millim.

Hab. Quetta. Calc. Mus.

Cicadetta literata, n. sp.

♀. Head and pronotum dull blackish, somewhat palely pilose, both crossed by a narrow, obscure, longitudinal, ochraceous line; ocelli red, eyes black and shining. Pronotum shining black, with the lateral margins and a large, discal, " letter H "-shaped spot ochraceous. Abdomen above dull blackish, the posterior segmental margins narrowly and obscurely dull reddish. Body beneath ochraceous, the sternum much shaded with dull blackish. Abdomen with a central longitudinal row of blackish spots; legs ochraceous, femora and tibiæ streaked with blackish.

Tegmina and wings pale hyaline, the venation olivaceous or fuscous.

The rostrum does not extend beyond the intermediate coxæ and the face is laterally coarsely striated.

Long. excl. tegm., ♀ 12 millim., exp. tegm. 37 millim.

Hab. Cashmere Valley, 6300 feet (*Leech*). Coll. Dist.

LI.—*Remarks on Shell-growth in Cephalopoda.* By Prof. J. F. Blake, M.A., F.G.S.

The structure of the "shell" of a Sepia is so unlike that of the Nautilus that any serious attempt to work out their homologies must be heartily welcomed by all who are interested in Cephalopoda. The Sepia is much the harder of the two to understand, and well deserves the study that has recently been bestowed upon it by Riefstahl * and Bather †. Unfortunately these descriptions of the soft parts within it do not agree, though the difference is not on a point of very great importance.

It does not appear, however, that these studies throw much light on the question from a geological point of view. That is to say, we get no nearer understanding how a Nautilus- or Ammonite- or Belemnite-shell is actually formed. When I was writing the Introduction to my 'British Fossil Cephalopoda,' some six years ago, I examined the structure of the Sepia with a view to obtaining light from it, and got as far as the above-named writers have in the knowledge of the hard parts, yet found no means of homologizing them with those of a Nautilus or Belemnite with any approach to conviction. Nor do I find that these writers have anything definite to add, but help themselves along by theory, even without testing it by available facts. I wish to deprecate this method in the interests both of the subject and the workers. In the first place, it is not *inductive* science; and in the second the author of a supposed genealogy will find it very awkward when further knowledge—and that not hard to acquire—shows the facts to be dead against him. But most of all it is to be deprecated for the damage it does to the credibility of what are meant to be stated as facts by such writers, as we never can tell whether what they say is from autopsy or from mental conception.

* Palæontographica, Bd. xxxii. 1886.

† 'Annals,' April 1888, p. 298. See also Geol. Mag. 1887, p. 446.

Whether the successive layers of the spongioid-tissue or "pad" of the Sepion is formed by intussusception, as Riefstahl says, or by successive formation of chitinous membranes by the epithelium of the shell-sac, as Bather says, is, after all, only a matter of argument, in which the latter seems to me to have the best of it. If we are to get any further, we must have some *evidence* of the homology between these layers and the parts of any other Cephalopod. It is *assumed* that these layers correspond to the septa of a Nautilus or of the phragmocone of a Belemnite. But do they? They have no siphuncle, and they are not even perforated. Yet a siphuncle and neck are present in Nautilus, Ammonite, Belemnite, and Spirula, and, what is more remarkable, though the Nautilus commences with a cap and the other three have a well-marked nucleus, nothing of this sort has yet been discovered in Sepia. I specially looked for it, but could find no representative of such a structure. On the other hand, if Mr. Bather had availed himself of my observations of the shell of Nautilus, of which he seems to be ignorant, or had made observations for himself, he could not have written as he does, nor could M. Riefstahl have supposed for a moment that the Nautilus-shell grows by intussusception between the septa. On page 17 *et seq.* of my work I give a very detailed description of the structure of this shell.

I there show that the shell proper is composed of three layers: the outer, a porcellaneous one, is formed of large radiating crystalline particles set in a dark ground-mass, which, if they show any orientation, are perpendicular to the surface; and this layer is not at all divisible into laminæ. It shows lines of growth on the surface, and these pass marginally, and not superficially, into any fractures that may have taken place in the growing edge of the shell. These characters leave little doubt that this layer is formed by secretion at its bounding edge. Very different is the middle layer. It has, as Hyatt pointed out, an imbricated structure, a structure which might very well suggest the pad of the Sepion as its homologue. This imbrication is in truth excessively fine, as about a thousand fine laminæ may be counted in its thickness; the outcropping edges of these, being about 20,000 to the inch, diffract the light and give rise to the nacreous lustre, when the innermost layer is absent or worn away. The direction of these laminæ is outwards in the direction of the aperture of the shell. Their obliquity is very slight, so that in tracing them from their commencement inside to their termination against the outer layer of the shell, they pass more than one septum, and must therefore have been formed previously to the septa they pass. They are sprinkled more or less closely by minute dark spots, with irregular radiations, like the lacunæ of a bone, which may have a formative function. Again, some of these laminæ start from the inside of the body-chamber remote from the last septum, as indeed it is obvious they must do, as the nacreous surface formed by them is not confined to the camerated portion of the shell. We may conclude from this that they are formed by the *surface* of the front part of the body-covering or mantle, and would be formed whether there were any septa or not. They are also formed successively, and as they are not devoid of animal substance, we may perhaps say they are at first "chitinous" membranes subsequently calcified, and that they do not grow by intussusception. The third layer is a thin amorphous substance covering the whole of the interior of the shell. It is excessively thin, and though quite invisible, if present, in the earliest chambers, is well marked in the later portion of the shell, especially where the septa abut on the shell-wall. It is here seen *between the septum and the shell*, completely separating the two structures. It is thus seen that the statement by Mr. Bather ('Annals,' p. 306)—that "secretion and exfoliation, beginning in the anterior region of the shell-wall, proceed backwards to the suture; thence, centripetally over the septum, to the posterior margin of the septal neck; a membrane of the septum is therefore one with a membrane of the shell-wall, and each complete membrane is typically shaped like a funnel,"—either is entirely imaginary, or my observation, which I have just verified again, is erroneous.

The structure of the septum is different from that of the shell, though it is on the same type as the nacreous layer. It is composed of a large number of equally fine laminæ, also speckled with lacunæ; but the laminæ do not crop out on the surface, but are parallel to it; there is therefore no diffraction of light, but a peculiar pearly lustre, due to the minute floating specks, just as in a pearl, or at least as in an artificial pearl whose lustre is similar to that of a natural one. It thus differs from the nacreous layer, just as pearls do from mother-of-pearl. I judge this to have been formed in the same way, by secretion from the surface of the body-covering in contact with it.

These observations do not lend much countenance to the idea that the laminæ in the pad of the Sepia are homologous with the septa of a Nautilus, nor, therefore, with those of the phragmocone of the Belemnite. If one might venture a guess, in the absence of more precise proof, it would appear rather that the imbricating laminæ of the pad of the Sepia may be homologous with the imbricating laminæ of the nacreous or middle layer of the Nautilus, but far more loosely aggregated, and thus that the Sepia, instead of being a closed tube, like the Nautilus or Belemnite, is an open or boat-like structure; and this would account for the absence of any cap or nucleus in the former—those structures being essentially related to the formation of a closed tube—and their homologues would be sought in the open spoon-like commencement of the Sepia, which is clothed round by the mucro. In this view the outer layer of the Nautilus-shell would be represented by the middle layer of the Sepia, a correlation less difficult on account of its excessive thinness in Ammonites and Belemnites; and hence the guard of a Belemnite and the shagreen-layer of Sepia are adventitious superadded structures, unrepresented in *Spirula* and probably in *Loligo*.

If there is any truth in this, then the approximation or otherwise of the septa of the Nautilus will have little to do with the question; moreover, if it has, the observations of Mr. Bather are too partial to be of value, either in relation to the living Nautilus or its extinct congeners. One would suppose from his statement that in a Nautilus the earlier septa are approximate, the middle ones far apart, and the later ones approximate again, and he derives a confirmation from this of the theory, which is doubtless often true, that the characters of senility resemble those of youth. As to this I may quote the following passage from p. 30 of my work:—" Starting from the first septum, we do not find them at distances constantly proportional to the diameter. If they were, there would always be the same number in each whorl. In an example, however, of *Nautilus pompilius* the first whorl has eight chambers, the next sixteen, and the last *half* whorl seven. The same want of regularity is found in other Nautiloids. As a rule the earlier septa are more remote, and the middle ones only retain for some distance their proportionality. The last two or three septa of the adult very commonly differ in distance from the rest. In some rare cases they are more remote, but they are usually closer, and the commonest case is that in which the last one is at half the usual distance."

Again, as to the history of any genus. I should like Mr. Bather to look at the septa of *Goniatites sagittarius* of the Devonian, so crowded one can scarcely count them—yet it is not the earliest *Goniatites* by far, nor yet the last—and then see if he can maintain the statement that " so early as the *Goniatites* the septa are far apart in proportion to the diameter of the whorl." In fact the distance of the septa seems to be an adaptive character, related to the breadth of the whorl, almost all coiled Cephalopods which have wide whorls having approximate septa and *vice versâ.*

Although therefore a new student of the Cephalopoda is to be welcomed, as there is plenty of work to do, it would be better that such a one should take up the story where others have left it than go over the old ground with preconceived theories and less careful observations. Nothing, in fact, in the present communication is new; though it may be little known, it was all in print six years ago.

I am not at all sure, however, that the suggestion to divide the Cephalopods into three primary groups, Ammonoidea, Nautiloidea, and Coleoidea, instead of into two, the Tetrabranchiata and the Dibranchiata, is not a good one. We really do not know that the Ammonites were tetrabranchiate, and by the old subdivision we assume they were. But is Coleoidea a good name? No doubt Sepia and Belemnites have a "sheath," but has Spirula, or Loligo, or Octopus? How would Belemnoidea do? The zoologists might not like it; but then it is more natural to name children after their parents than *vice versâ.* And from its relation to terms already in use and its congruity with the other two every one would know what was meant.

BIBLIOGRAPHICAL NOTICE.

Transactions of the Cumberland and Westmorland Association for the Advancement of Literature and Science. No. xii. 1886–87. 8vo. Carlisle: G. and T. Coward, 1887.

In this part of the 'Transactions' of the local societies of Cumberland and Westmorland the contributions of purely literary and antiquarian interest and those dealing with scientific subjects are exactly in equal numbers. Of the former, although they are of considerable general interest, we need say nothing here; of the latter, one is the "Zoological Record for Cumberland, 1886," by the Rev. H. A. Macpherson and W. Duckworth, and the other bears the title of "Our Summer Visitors," by Mr. Tom Duckworth, and is in continuation of previous communications by the same writer. The former is a record of the occurrence and breeding of certain species of birds in the district, to which are added notes on the habits of several of the species and on some of the Mammalia of Cumberland. In the latter we have a series of notes upon several of the birds which visit the district in the summer—the Ring Ouzel, the Wheatear, the Nightjar, the Landrail, and the Common Sandpiper.

The most important article in the book is the concluding one, by the Editor, Mr. J. G. Goodchild, and is on "Ice-work in Edenside and some of the adjoining parts of North-western England," in which the author brings together the results of his investigations upon the glacial phenomena of the region in question. Some of these results have already been indicated by Mr. Goodchild in papers published in the 'Quarterly Journal of the Geological Society' and elsewhere; but he has done good service by summarizing his observations upon such an interesting district in this convenient form.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

February 8, 1888.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "On some Remains of *Squatina Cranei*, sp. nov., and the Mandible of *Belonostomus cinctus*, from the Chalk of Sussex, preserved in the Collection of Henry Willett, Esq., F.G.S., Brighton Museum." By A. Smith Woodward, Esq., F.G.S.

The remains referable to *Squatina* consist of a crushed skull, with the mandibular and hyoid arches, and an associated fragment of the pectoral fin with dermal tubercles. The fish was probably about 30 inches long. There are some difficulties in the way of interpretation, but the form and relative proportions of the cranium, &c., appear to be similar to those of the living representative of the genus. The dentition is not completely preserved; the teeth near the symphysis of the mandible are relatively high and slender, while the opposing teeth are small. The great relative size of the spinous dermal tubercles serves to distinguish it from species of *Squatina* already known. The anterior lower teeth are also more slender than in the existing *S. angelus*.

No specimen of *Belonostomus* has hitherto revealed the precise characters of the dentition or the relations of the bones. This deficiency is now supplied. The two rami occupy only one half the entire length of the jaw, the anterior half being formed by the elongated presymphysial bone, which is provided with a powerful prehensile dentition. The character of the teeth was described by the Author: the large median teeth end abruptly at the posterior extremity of the presymphysial element, but the small lateral teeth are continued backwards upon the rami of the jaw, increasing in size and becoming relatively shorter. Further details were given, and the evidence shows that the original specimens described by Agassiz, as portions of the mandibular rami of *Belonostomus cinctus*, are really fragments of the presymphysial bone of this species. Some of the relations of *Belonostomus* and *Aspidorhynchus* were pointed out.

2. "On the History and Characters of the Genus *Septastræa*, D'Orbigny (1849), and the Identity of its Type Species with that of *Glyphastræa*, Duncan (1887)." By George Jennings Hinde, Ph.D., F.G.S.

D'Orbigny founded the genus *Septastræa* on the characters of a coral from the Miocene strata of Virginia, which was named *S. subramosa*, but no specific description was given. In the same year (1849), Edwards & Haime accepted the genus as valid, but placed *S. subramosa* as a synonym of *Astræa ramosa*, Defrance—an apparently *recent* species of coral which had previously only been informally described by Defrance. They also included in the genus *S. Forbesi*, the original specimen of which was from the Miocene of Maryland, and at that time in the collection of the Geological Survey in London. Later on, in 1852, D'Orbigny claimed that *S. Forbesi* was but a synonym of his *S. subramosa*. There is good reason for regarding this as correct, but owing to the fact that D'Orbigny's name *subramosa* was merely nominal and without description, the later name of *S. Forbesi*, Edwards & Haime, must be allowed to stand for the type of the genus *Septastræa*.

In 1861 de Fromentel, and in 1867 Prof. Duncan included in *Septastræa* several species of Jurassic and Liassic corals, which, however, have no generic relationship to the type form of the genus from the Miocene Tertiary.

In 1887, Prof. Duncan read a paper before the Geological Society in which he adopted *Septastræa Forbesi*, E. & H., as the type of a new genus *Glyphastræa*, thus leaving in *Septastræa* those Liassic and Jurassic species placed therein by himself and de Fromentel. As this proceeding is contrary to recognized rules of nomenclature, the genus *Glyphastræa* will have to be abolished.

In the type form of *Septastræa*, now in the British Natural-History Museum, the walls of the corallites, though closely apposed, are quite distinct; the theca is formed by the extension of the septal laminæ; the walls and septa in the lower portion of the corallites are very thin, but the upper portion of the corallites are so infilled with compact stereoplasm that the calices are extremely shallow when mature. There is no true columella, only a pseudo-columella, formed by the union and partial involution of the inner septal margins. The increase is exclusively by marginal gemmation; fission does not occur. In some cases linear perforations between the septa are shown; these appear to be for the insertion of the mesenterial muscles.

The septa in *Septastræa* consist of a central layer, dark in microscopic sections, the primary layer of v. Koch, or centre of calcification of Bourne and Fowler, enclosed on both sides by layers of compact subcrystalline stereoplasm. In longitudinal fractures the septa frequently split in the centre of the dark or primary layer, and thus show that each half of the septum consists of a dark and light portion, and the median face of each septal lamina exhibits transverse growth-lines, not unlike those of an epitheca, beneath which are delicate longitudinal ridges and grooves. The thecal wall has a similar structure to that of the septal laminæ, of which it is an extension.

There is a close correspondence in the septal and thecal structure of *Septastræa* and that of the recent and fossil genus *Flabellum*, and in this genus also the septa occasionally split longitudinally and show the same growth-lines on their median faces.

Only two species are included in *Septastræa*, as now defined, viz. *S. Forbesi*, E. & H., and *S.* (*Columnaria?*) *sexradiata*, Lonsdale, sp.

February 29, 1888.—W. T. Blanford, LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"Appendix to Mr. A. T. Metcalfe's paper 'On Further Discoveries of Vertebrate Remains in the Triassic Strata of the South Coast of Devonshire, between Budleigh Salterton and Sidmouth.'" By H. J. Carter, Esq., F.R.S.

A microscopic examination of certain calcareous pellet-like bodies, containing plates possessing a bony structure, and referred to in Mr. Metcalfe's paper in the Society's Journal for May 1884, revealed the fact that the plates resembled the scales of the Bony Pike, and also the scales contained in certain Liassic coprolites which were identical in appearance with the Triassic pellets. The Author concluded that the latter were the coprolites of Triassic amphibians which fed upon the same kind of Ganoid fishes as the Ichthyosaurs of the Lias.

The Author had also examined microscopically the so-called "spine," No. 1, fig. 2, and the jawbone, No. 2, of Mr. Metcalfe's paper, and observed that there appeared to be no difference between the structure of the latter and that of reptilian bones, whilst its structure is different from that of the Lepidostean scale; with regard to the former, he stated that it was totally different from the spines of two species of *Hybodus* examined, and considered that there were no grounds for considering it a spine.

MISCELLANEOUS.

Note on the Nomenclature of three Genera of Fossil Mammalia. By R. Lydekker, B.A., F.G.S., &c.

In the 'Catalogue of Fossil Mammalia in the British Museum' I have adopted the name *Ælurogale* (*Ailurogale*), Filhol, for an extinct genus of Felidæ, and *Stylodon*, Owen, for one of the Mesozoic Polyprotodont Marsupials. The name *Ælurogale* is, however, preoccupied by Fitzinger (Sitzb. Ak. Wiss. Wien, 1869, p. 77), who applied it to *Felis planiceps*; and Dr. Trouessart (Bull. Soc. Angers, xv. 1885, Cat. of Mamm. p. 92) has proposed in substitution the name *Ælurictis* (*Ailurictis*), which must be adopted, unless it prove, as I have suggested in part v. of the 'Catalogue,' that Cope's *Nimravus* is not generically separable. The name *Stylodon*, I am informed by Dr. G. Baur, is preoccupied by H. Beck in 1838 for a genus of Gastropoda in the work entitled 'Index Molluscorum præsentis ævi, Mus. Christiani Frederici,' fasc. i., Hafniæ. Since, however, Prof. Marsh's genus *Stylacodon* is probably not distinct from Owen's *Stylodon*, I think that this name may be at least provisionally adopted for the English genus, and in any case the name of the family may be changed from Stylodontidæ to Stylacodontidæ.

Finally, I gather from Dr. Rojer's recently published 'List of Fossil Mammalia' that Dr. M. Schlosser proposes to substitute the name *Haplogale* for my genus *Æluropsis* (which I have placed in the Felidæ). This substitution appears to rest on the existence of the name *Ælurops* (*Ailurops*); but since the names *Æluropsis* and *Ælurops* are founded upon totally different Greek words, I consider that it is unnecessary.

On the Collection of Starfishes formed by the Cape-Horn Scientific Commission. By M. E. Perrier.

The collection of starfishes brought back by the scientific commission which remained in the region of Cape Horn during the years 1882 and 1883 includes no fewer than 553 specimens belonging to 38 species, of which 23 are new and 32 were wanting in the collections of the museum. This brings up to 57 the number of species of starfishes referred to the southern point of America. The examination of the numerous specimens which I have been able to observe in the collection of the museum shows great variability in each species in relation to the extreme diversity of conditions of existence presented to nearly sedentary animals by these coasts, which are so much broken up. It seems probable that of the species described a certain number will have to descend to the rank of simple varieties. Some among the 56 specimens of *Asterias sulcifera* which have been sent to me appear to approach *A. Brandti*, *A. obtusissima*, and *A. neglecta* of Jeffrey Bell. *A. antarctica*, Lütk., *A. rugispina*, S. Simpson, *A. spirabilis*, Bell, *Anasterias minuta*, Perrier, *Asteroderma papillosa*, Perr., may also be only terms of one and the same series; but even assuming that these reductions may become definitive, the number of forms too different to receive the same name is still remarkably large.

The correspondence between the arctic and antarctic faunas indicated by various authors is striking in the starfishes, as is shown by the two following lists, in which the corresponding species of each region bear the same number:—

Northern Species.—1. *Brisinga coronata*, O. Sars; 2. *Pedicellaster typicus*, Sars; 3. *Stichaster roseus*, O. F. Müll.; 4. *Cribrella oculata*, Linck; 5. *Lophaster furcifer*, Düb. & Kor.; 6. *Crossaster papposus*, Fab.; 7. *Pentagonaster granularis*, O. F. Müll.; 8. *Hippasteria plana*, Linck; 9. *Porania pulvillus*, O. F. Müll.; 10. *Goniopecten Christi*, Düb. & Kor.; 11. *Ctenodiscus corniculatus*, Linck; 12. *Pteraster militaris*, Müll. & Troschel.

Southern Species:—1. *Labidiaster radiosus*, Lovén; 2. *P. scaber*, Smith; 3. *S. auriantiacus*, Meyer; 4. *C. Pagenstecheri*, Studer, *C. Hyadesi*, E. Perrier, and *C. Studeri*, E. P.; 5. *L. Levinseni*, E. P.; 6. *C. australis*, E. P.; 7. *P. austro-granularis*, E. P.; 8. *H. magellanica*, E. P.; 9. *P. antarctica*, Smith; 10. *G. Fleuriaisi*, E. P.; 11. *C. australis*, Lütk.; 12. *P. Ingousi*, E. P., and *P. inermis*, E. P.

The naturalists of the 'Challenger' have noted the frequency of incubatory animal forms in the southern regions. I have ascertained this remarkable habit in *Diplasterias Lütkeni*, E. P., *D. Steineni*, Studer, and *Asterias spirabilis*, Bell. In these species the young are attached to the buccal membrane and to the stomachal membrane turned back by the mother by an *interradial ventral* peduncle, which corresponds to the preoral lobe of the larva (brachiolar arms of *Asterias* and *Cribrella*, larval organ of *Asterina*), a lobe at the expense of which, according to Barrois, the *median dorsal* peduncle of the Crinoids is also developed. I have made known the organization of the young of *Asterias spirabilis* in a preceding note, all the statements in which I maintain, notwithstanding the contrary assertions of M. Cuénot, which have been advanced without any examination of the type spoken of by me.

Labidiaster radiosus has presented a phenomenon hitherto absolutely unknown in the Echinodermata—the normal formation of new arms adding themselves to the old ones after the completion of the larval period. These new arms *bud forth* upon the margin of the disk, *behind* the dentary pieces of the arms, between which they are intercalated in such a way that their ambulacral groove does not reach the buccal membrane; they are distinguished by other very precise characters from broken arms in course of regeneration. Six of the fourteen specimens of *L. radiosus* that I have examined presented from one to six arms in course of development; the number of completely formed arms varied in these individuals from twenty-three to thirty-one; among the individuals (all of large size) in which the phenomenon was not observed the number of arms varied from thirty-nine to forty-two. The great number of arms in old individuals thus seems to be connected with this formation of intercalary arms. I have recognized some indications of an analogous formation in *Heliaster*. In connexion with this I will remark that, in *Brisinga mediterranea*, the nine arms are entirely formed before the close of the larval period; young examples of *Solaster* and *Acanthaster* did not present any arms in course of formation.

In order to classify the starfishes of the sea around Cape Horn I have had to form the new genera *Diplastinas*, *Asteroderma*, *Poraniopsis*, *Cribraster*, *Lebrunaster*, and *Asterodon*. In the genus *Diplastinas* I range *Asterias*-forms which have at least two rows of adambulacral spines; *Asteroderma* includes *Asteriæ* without any apparent spines or pedicellariæ, and in which the dorsal skeleton is almost deficient. The genus *Poraniopsis* presents characters exactly intermediate between those of *Echinaster* and *Porania*; the animals of this genus have the ventral surface differentiated from the dorsal surface and thick integuments, like the *Poraniæ*, while the very short arms are rounded and covered with spines. The *Cribrasteres* are *Cribrellæ* having paxilli upon the ventral surface; in *Lebrunaster* marginal plates begin to be differentiated. These animals form the passage towards the *Ganeriæ*, which themselves lead to the *Cycethræ*. The species of *Asterodon*, previously classed with the Goniasteridæ, are in reality Archasteridæ. They are characterized by their dentary plates, each having a hyaline spine laid down upon them with its point directed outwards; these two spines may unite and form only a single hyaline interradial spine, resembling the dentary plume of the sea-urchins. *Asterodon* has also at the angle of the arms an unpaired marginal plate, and the ventral spines often group themselves into multifid pedicellariæ, as in *Pectinaster*, E. P. To this genus must be referred *Astrogonium singulare*, Müll. & Tr., *A. meridionalis*, Smith, *Pentagonaster Belli*, Studer, *Calliderma Grayi*, Bell, and two new species, *Asterodon pedicellaris* and *granulosus*.—*Comptes Rendus*, March 12, 1888, p. 763.

On Nephromyces, *a new Genus of Fungi parasitic in the Kidney of the* Molgulidæ. By M. A. Giard.

In a fine memoir on *Cyclostoma elegans*, M. Garnault * has recently noticed the existence in this mollusk of a closed organ (*glande à concrétions* of Claparède) which contains at the same time uric products and symbiotic bacilli. Several years ago I observed phenomena of symbiosis of the same kind in the completely closed

* 'Recherches anatomiques et histologiques sur le *Cyclostoma elegans*,' pp. 49-60 (1887).

renal organ of Ascidians of the family Molgulidæ. But in the latter animals the symbiotic Fungi belong to a group much higher than the Schizomycetes. The older writers have described and imperfectly figured foreign bodies in the kidney of the Molgulidæ, calling them confervoid filaments, gregariniform bodies, &c., and supposing them to belong to *diverse creatures* *. In reality these productions must be referred to Fungi of the tribe Siphomycetes (*Sorokine*) and of the family Chytridineæ. The parasites of the various species of Molgulidæ belong to different species, but in the same species of Ascidia we generally find only one species of parasite in very various stages of evolution. I give these Fungi the generic name of *Nephromyces*. The most nearly allied genus seems to me to be *Catenaria*, Sorokine, the type species of which, *Catenaria anguillulæ*, is parasitic upon Nematoda. However, in *Nephromyces* the sporangia are always terminal.

I have particularly studied two species of *Nephromyces* having as their hosts two Molgulidæ which are very common at Wimereux:—1. *Nephromyces Molgularum*, parasitic upon *Molgula socialis*, Alder; and 2. *Nephromyces Sorokini*, a parasite of *Lithonephrya eugyranda*, Lac.-Duth.

Nephromyces Molgularum forms around the isolated concretions which fill the kidney of *Molgula socialis* a unicellular mycelium with very delicate filaments strongly felted together, the free extremities of which are terminated by spheroidal dilatations; notwithstanding their appearance, I have never seen these terminal swellings detach themselves from their support and behave like conidial spores.

This delicate, transparent mycelium produces a great number of much thicker tubes of irregularly cylindrical form, more or less contorted upon themselves, and filled with a finely granular opaque protoplasm which is strongly stained by picrocarmine. Side by side with these protoplasmic masses originate, in enormous quantity, zoosporangia of very varied forms, often bifurcated at their free extremity, and in these are developed a multitude of very active zoospores of excessively small size. The formation of the zoospores is preceded by a spumous appearance of the protoplasm, such as has been indicated in various Chytridineæ, and by the formation of thicker septa separating the sporangium from the rest of the mycelium. For a long time I had only a very imperfect notion of these zoospores, and I have been able to make anything of their study only by the aid of Zeiss's excellent apochromatic objectives. The zoospores are perfectly spherical, and furnished with a pretty long but very slender flagellum; they contain a strongly refractive granule towards the origin of the flagellum. It is probable that these active bodies introduce themselves into the branchiæ of the young *Molgulæ*, and penetrate by diapedesis into the renal organ, since neither by injections nor by sections has any opening been found into that organ.

* Lacaze-Duthiers, Arch. de Zool. expér. et gén. tome iii. pl. xi. (1874).

Towards the end of the summer the empty zoosporangia separated from the mycelium often encumber preparations; generally they present, at various parts of their wall, especially at the extremities, swellings formed by a layer of undifferentiated refractive protoplasm.

During the autumn months, in the *Molgulæ* produced in the spring, the mycelium presents a great quantity of zygospores. These reproductive bodies, which are much larger than the zoospores, originate isolatedly, but at very closely approximated points, where several (usually four or five) filaments of the mycelium conjugate. The zygospores have a finely granulated envelope, perhaps even slightly echinulate. During the winter, at the beginning of February, these zygospores germinate by emitting two equal filaments, terminating in points and slightly divergent, which give the spore in course of evolution the form of a pair of compasses. The two branches of these compasses open more and more, and the compass-stage gradually becomes converted into a fusiform stage, in which the spore is no longer visible except as a median swelling, which soon disappears completely.

Side by side with these various forms we find all the year round pretty long tubes, wider than the mycelium from which they separate readily, and rounded at the two extremities. Upon their walls these tubes present a fine plasmatic deposit arranged in two intercrossing spirals, or perhaps disseminated around vacuoles placed end to end throughout the length of the tube. The meaning of these parts completely escapes me.

Anurella roscovitana, Lac.-Duth., contains a *Nephromyces* (*N. roscovitanus*) nearly allied to *N. Molgularum*, but nevertheless quite distinct.

The species parasitic upon *Lithonephrya eugyranda*, and which I name *Nephromyces Sorokini*, is very distinctly characterized by the form of its regularly pyriform zoosporangia with two refractive masses, one at the apex, the other at the base, at the point where the sporangium is inserted upon the mycelium. In the *Lithonephryæ* the kidney is almost entirely filled by a single very voluminous concretion. A very limited space is left, therefore, for the symbiotic fungus, and hence the latter is much less abundant than its congeners parasitic upon the *Molgulæ*.

The arrangements of the laboratory at Wimereux have not permitted me hitherto to make experiments upon the culture of the Fungi of the genus *Nephromyces* in artificial media containing guanine or uric acid. I think, however, that such cultures may be possible, and that these Fungi are useful to the Tunicates which they infest by freeing them of the excreted products, which, without them, would rapidly choke up the kidney, which is destitute of any evacuatory duct.—*Comptes Rendus*, April 16, 1888, p. 1180.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 6. JUNE 1888.

LII.—*On the Reproductive Organs of* Phreoryctes. By Frank E. Beddard, M.A., Prosector to the Zoological Society of London.

[Plate XXIII.]

Among a number of earthworms which I have recently received from New Zealand was a single example of a small slender worm, which I refer, with some doubt, to the genus *Phreoryctes*. The specimen was in a very fair state of preservation, and I have therefore been able to investigate its structure by means of sections. The anterior region of the body, comprising the first twenty segments, was cut into a series of longitudinal sections; the posterior region was studied by means of transverse sections. Mr. W. Smith, of Ashburton, New Zealand, to whose kindness I am indebted for the worm, states that it was found in marshy soil coiled up with a number of others into a ball; its colour during life was a bright red. It is about 2 inches in length and very slender; its general proportions in fact agree very closely with Vejdovsky's figure of *Stylodrilus* ('System und Morphologie der Oligochaeten,' Taf. xi. fig. 9 *a*); its form is not nearly so elongated as that of either of the two species of *Phreoryctes* at present known.

With regard to external characters the genus *Phreoryctes* is distinguished by two peculiarities. Both Leydig ("Ueber *Phreoryctes Menkeanus*," Arch. für mikr. Anat. 1865) and Timm ("Beobachtungen über *Phreoryctes* &c.," Arb. a. d. Zool.-Zoot. Inst. Würzburg, Bd. vi. 1883) describe the setæ of *P. Menkeanus* as *disposed in four rows of a single seta each*. Vejdovsky ('System,' &c., p. 49) states of the second species, *P. filiformis*, "Die Borsten stehen in vier Reihen und je einzeln in jedem Borsten-follikel; doch in nicht seltenen Fällen erscheint auch neben der alten Borste eine fast völlig erwachsene Ersatzborste, so das es den Anschein hat, als ob das betreffende Borstenbündel aus zwei Borsten zusammengesetzt würde." It is therefore important to note that in my species *the setæ are invariably paired*; their shape moreover (Pl. XXIII. fig. 10) appears to be rather different from that of the seta figured by Vejdovsky ('System,' &c. pl. xii. fig. 6).

The second peculiarity of *Phreoryctes* is the incomplete division of the prostomium into two rings by a transverse furrow; I have found this to be the case in my species (Pl. XXIII. fig. 2), and this is one of the chief reasons which leads me to place my specimen in the genus *Phreoryctes*, with which, moreover, it has apparently other points in common to be referred to later.

The arrangement of the pairs of setæ with respect to each other can be understood from an inspection of Pl. XXIII. fig. 7, which represents a transverse section through one of the posterior segments; the two dorsal pairs are much nearer to each other than are the two ventral pairs or the dorsal and ventral pairs of one side.

There is a marked difference in size between the dorsal and ventral setæ, as is the case in *P. filiformis*, the dorsal being far stouter. This is, however, not the case in the anterior segments of the body.

The facts in the internal structure of the worm, to which I wish to direct attention in the present paper, concern the reproductive organs and their ducts (Pl. XXIII. fig. 3).

Our knowledge of these is at present extremely limited. Vejdovsky was unable to find any trace of the reproductive organs in *P. filiformis*. Leydig and Timm have, however, given some details with respect to *P. Menkeanus*. There are said to be four pairs of testes lying in segments ten, eleven, twelve, and thirteen (the ninth, tenth, eleventh, and twelfth setigerous segments); Vejdovsky suggests that these glands are probably ovaries and testes, and I am in a position to prove his supposition to be right, supposing of course that I am right in referring the present worm to the genus *Phreoryctes.*

Testes.—There are two pairs of these organs, situated in segments ten and eleven; they are attached to the anterior septa of their segment to the outside of the ventral pair of setæ. The testes are large bodies and occupy a very considerable portion of their segment; so far as their shape can be made out by sections they appear to be irregularly conical in form, the apex forming the point of attachment. In the possession of two pairs of testes and in the position of these organs *Phreoryctes* agrees with the majority of earthworms; the only ally of the Lumbriculidæ which has an identical arrangement is *Ocnerodrilus* (Eisen, Acta reg. Soc. Upsala, 1878), and Vejdovsky has already indicated some of the points of resemblance which this latter genus bears to the terricolous forms.

Vasa deferentia.—No sexual ducts have hitherto been recorded in *Phreoryctes*, neither vasa deferentia nor oviducts. Leydig and Timm suggest that the nephridia, which occupy the segments where they should be found, perform the functions of reproductive ducts. The occurrence, however, of nephridia in the generative segments is now known through the researches of Vejdovsky. Nephridia are present in these segments *before* the sexual ducts make their appearance; it is probably, as Vejdovsky suggests, this fact which misled Leydig and Timm into regarding the nephridia of the genital segments as fulfilling the office of vasa deferentia and oviducts. It would obviously be of the greatest possible interest if the suggestion of Leydig and Timm should prove to be correct; it cannot, however, be correct if my species is a *Phreoryctes*, for I have succeeded in finding both vasa deferentia and oviduct.

The vasa deferentia correspond in number to the testes, that is to say there are two pairs of them. The funnels are flattened disks (Pl. XXIII. fig. 6) closely applied to the septum; they are perfectly simple in form, not plicated; and as their epithelium is composed of rather small columnar ciliated cells they were not readily found. The funnels lie in segments ten and eleven just opposite to the attached end of the testes. From the inner corner of each funnel arises the vas deferens, which is a ciliated tube composed of a single layer of columnar cells. The vas deferens passes through the septum and opens on to the exterior a little to the outside of the ventral pair of setæ; the important fact to be noticed bout the vasa deferentia of this worm is that *all the four vasa deferentia open independently, and there are no atria.*

At the aperture of the vas deferens the cuticle of the epidermis was continued for a short distance up the tube.

There are thus four male pores situated a little to the outside of the ventral setæ and disposed in pairs, one pair to each of segments eleven and twelve. The structure and position of the male reproductive ducts is, so far as is known at present, unique among the Oligochæta. *Acanthodrilus* and *Moniligaster* are not really comparable in these particulars, as might be inferred from Vejdovsky's work upon the Oligochæta. In *Acanthodrilus* the vasa deferentia of each side unite and open upon the eighteenth segment independently of the two pairs of atria, which open on to the seventeenth and nineteenth segments respectively. In *Moniligaster* the supposed anterior pair of male reproductive pores are in all probability spermathecæ (Beddard, "On the Reproductive Organs of *Moniligaster*," Zool. Anz. Bd. x.). At the same time the simplicity of the efferent ducts in *Phreoryctes* suggests that they are in a primitive condition.

Ovaries.—There are two pairs of ovaries, a pair to each of segments twelve and thirteen. In position and general shape they are precisely like the testes. The number of ripe ova in each ovary is small, as in most of the lower Oligochæta. The presence of two pairs of ovaries is extremely unusual, and there is of course the possibility to be considered that it is abnormal in the present case. There are, however, as I shall point out further on, two pairs of oviducts; and this fact (coupled with the observations of Leydig and Timm) is confirmatory of the view that *two pairs of ovaries are characteristic of the genus* Phreoryctes.

Vejdovsky particularly states that the Oligochæta possess only one pair of ovaries, and believes that the supposed three pairs of ovaries of *Euclipidrilus* (Eisen, *loc. cit.*) are testes and seminal vesicles. Lankester ("The Sexual Form of *Ch. limnæi*," Q. J. M. S. 1869) notes that in *Chætogaster limnæi* there are occasionally two pairs of ovaries, but Vejdovsky finds himself unable to confirm this observation. In any case it is certain that a second pair of ovaries is occasionally met with in *Lumbricus* (Bergh, "Geschlechtsorgane der Regenwürmer," Zeitschr. f. wiss. Zool. 1886) and in *Perionyx* (Beddard, "Variations in *Perionyx*," Proc. Zool. Soc. 1886). The fact of there being two pairs of oviducts in *Lumbriculus* (Vejdovsky, 'System und Morph.' &c. p. 150, note) suggests that in that Annelid a second pair of ovaries may exist.

Oviducts.—*Phreoryctes* differs from all Oligochæta except *Lumbriculus* in the fact that *there are two pairs of oviducts opening on a line with the ventral pair of setæ between segments* *twelve and thirteen, and thirteen and fourteen.* I have myself recorded the occasional presence of two pairs of oviducts in *Perionyx* (*loc. cit.*), where, however, it is a very rare occurrence. It is I think a fair assumption that the one specimen of *Phreoryctes* at my disposal exhibits the normal characteristics of the genus.

The oviducal funnels resemble in every particular, except that they are a little smaller, the funnels of the vasa deferentia, and they occupy a corresponding position in segments twelve and thirteen. Each funnel is connected with a tube whose structure is identical with that of the vas deferens; this tube is, comparatively speaking, of some length, and passes closely adherent to the opposite side of the septum to that which bears the funnel to its point of opening, which is upon the intersegmental furrow.

The position of the oviducal pores, behind the male pores, agrees with that of Lumbriculidæ, as does also their position upon the intersegmental furrow.

The close agreement between the ducts as well as the glands of the male and female reproductive systems in *Phreoryctes* is more apparent than in any other Oligochæta; it is probably to be looked upon as an indication that the reproductive system of this Annelid is in an archaic condition. The ovaries and testes correspond *in number* as well as in their other particulars which *Phreoryctes* shares with the remaining genera of Oligochæta. The oviducts and vasa deferentia approximate more closely than in any other genus; they only just show indications of differentiation.

Spermathecæ.—There are two pairs of these organs; the anterior pair lie in segment seven, the second pair in segment eight; each spermatheca is a somewhat pyriform pouch lined with a columnar epithelium having a glandular appearance; the apertures of the spermathecæ are on the anterior border of their segment between the dorsal and ventral pairs of setæ. The spermathecæ are not furnished with diverticula of any kind. Leydig and Timm describe three pairs of spermathecæ in *P. Menkeanus* situated in segments seven, eight, and nine; these are said to be distinguished by their extraordinarily thick and muscular walls. They are certainly not so in my species.

It will be clear from the foregoing description that the worm belongs to a distinct species, for which I propose the name of *Phreoryctes Smithii* *, and it may ultimately prove to be a distinct generic type. In favour of this view is the

* Named after Mr. W. Smith, of Ashburton, New Zealand.

paired character of the setæ. There is, however, evidently a close agreement, if not identity, between the reproductive organs of this species and of *P. Menkeanus*, and in most other points of structure they agree; so that I am not disposed to create a new genus, at least for the present.

The facts which I have been able to record in this paper confirm the justice of separating *Phreoryctes* as the type of a distinct family, as has been done by Claus and Vejdovsky.

Vejdovsky's definitions may be thus amended:—

Fam. **Phreoryctidæ**, Claus.

Long slender worms, the body made up of numerous segments; prostomium divided into two by a furrow; setæ in four rows, a single seta or a pair of setæ to each row, ʃ-shaped, not bifid. Nephridia persistent in the segments behind those containing the reproductive organs, opening on to the exterior behind, or in front of, the ventral setæ. Testes in segments ten and eleven; ovaries in segments twelve and thirteen; four vasa deferentia opening on to segments eleven and twelve between dorsal and ventral setæ; four oviducts opening between segments twelve and thirteen, and thirteen and fourteen. Spermathecæ, two to three pairs in front of testes, in segments seven, eight (nine).

Genus Phreoryctes, Hoffmeister.

With the characters of the family.

Species:—

(1) *Phreoryctes Menkeanus*, Leydig.

Excessively slender, reaching to the length of 1 foot. Setæ in four rows of a single seta each; ventral setæ stouter than dorsal. Three pairs of spermathecæ in segments seven, eight, and nine. Nephridia opening in front of setæ.

(2) *Phreoryctes filiformis*, Vejdovsky.

Slender, but smaller than *P. Menkeanus*. Setæ in four rows of a single seta each, the dorsal setæ longer than the ventral. Nephridia open behind setæ.

(3) *Phreoryctes Smithii*, n. sp.

Much shorter than either *P. Menkeanus* or *P. filiformis*.

Setæ in four rows of pairs; dorsal setæ (in posterior region of body) much longer than ventral. Nephridiopores in front of ventral setæ. Two pairs of spermathecæ in segments seven and eight.

EXPLANATION OF PLATE XXIII.

Fig. 1. *Phreoryctes Smithii*, nat. size.
Fig. 2. Anterior segments from ventral aspect, magnified. *sp*, spermathecal pores, ♂ openings of vasa deferentia, ♀ openings of oviducts.
Fig. 3. Genital segments. *t*, testes; *o*, ovaries; *v.d*, vasa deferentia; *o.d*, oviducts; *sp*, spermathecæ; *s*, setæ; *n*, nerve-cord.
Fig. 4. Fragment of testis, highly magnified.
Fig. 5. Fragment of ovary, highly magnified.
Fig. 6. Section through funnel of vas deferens. *st*, septum; *f*, funnel; *v.d*, vas deferens.
Fig. 7. Section through one of posterior segments. *s*, setæ; *n*, nerve-cord; *al*, intestine; *d.v*, dorsal vessel; *v.v*, ventral vessel; *np*, nephridium.
Fig. 8. Surface view of the nephridiopore (*np*) and setæ (*s*).
Fig. 9. Spermatheca, transverse sections. *a*, near to external orifice; *b*, near distal end.
Fig. 10. Seta.

LIII.—*Notes on the Palæozoic Bivalved Entomostraca.*—No. XXV. *On some Silurian Ostracoda from Gothland* *. By Prof. T. Rupert Jones, F.R.S., F.G.S.

[Plates XXI. & XXII. †]

Prof. Gustav Lindström, of the State Museum, Stockholm, having confided to me in 1886 a fine series of Ostracoda from the Silurian rocks of Gothland for examination, I had much pleasure in 1887 in comparing them with such as are known from other countries and in determining what seemed to me to be their generic and specific alliances. Late researches among the British species, especially those collected by Messrs. J. Smith and G. R. Vine in Shropshire ‡, enabled me to arrive at conclusions more confidently than I could otherwise have done; and the results were given by me in the

* For No. XXIV. see Ann. & Mag. Nat. Hist. for June 1887.

† These Plates have been drawn with the aid of a grant from the Royal Society for illustrating the fossil Entomostraca.

‡ Ann. & Mag. Nat. Hist. for April 1886, May 1886, March 1887, and June 1887.

privately-printed 'Notes on some Silurian Ostracoda from Gothland,' 8vo, Stockholm, 1887.

These Scandinavian specimens have now been carefully figured in the accompanying Plates, and some figures and descriptions of other specimens from Gothland have been added, as well as further remarks on the alliances of the already known species.

Mr. C. D. Sherborn, F.G.S., has helped me in sketching and collating the specimens sent from Stockholm. Several exquisite drawings executed by Hr. C. Hedelin and forwarded by Dr. Lindström in 1886 have supplied the basis for some of my determinations of species.

I. Macrocypris, G. S. Brady, 1867.

(Ann. & Mag. Nat. Hist. ser. 5, vol. xix. 1887, p. 178.)

1. *Macrocypris Vinei*, Jones. (Pl. XXII. figs. 1 *a*, 1 *b*, 1 *c*, 2.)

Macrocypris Vinei, Jones, *op. cit.* p. 179, pl. iv. figs. 1–3, and woodcut, p. 179; Silur. Ostrac. Gothland, 1887, p. 6.

Careful drawings sent to me from Stockholm represent *Macrocypris Vinei*, Jones. The Swedish form, however (see figs. 1 *a*, *b*, *c*), is slightly longer, has a slightly less orbicular end-view, and is more gracefully curved on the postero-dorsal slope; otherwise fig. 2 of pl. iv. referred to above very closely matches the drawing sent from Stockholm.

One specimen (Pl. XXII. fig. 2) among those sent to me in 1886 also comes within the limits of form characteristic of *Macrocypris Vinei*.

This species occurs rather copiously in the shale at Fröjel * (of the Wenlock series).

Note.—*Cytheropsis siliqua*, Jones (Ann. & Mag. Nat. Hist. April 1858, p. 249, pl. x. fig. 6), is possibly figured in a reversed position, that is, with its dorsal edge downwards, and may really be a *Macrocypris* squeezed and broken. If so, being about 2 millim. in length, it would not be very different from the Scandinavian specimen (Pl. XXII. figs. 1 *a*, *b*, *c*), which is 2 millim. long; fig. 2 shows an individual $1\frac{1}{2}$ millim. long. Of the English specimens (*op. cit.* March 1887, pl. iv.) fig. 2 is $1\frac{1}{3}$ millim. and fig. 3 is $1\frac{3}{4}$ millim. in length.

* For the localities mentioned in this paper, as regards the Silurian Ostracoda of Gothland, see the geological map appended to Prof. Lindström's paper on the Silurian strata of that island, in the Neues Jahrb. für Mineral. &c. 1888, vol. i. pp. 147 &c. pl. v.

A group of Silurian *Macrocyprides*, such as *M. Vinei*, might at first sight be thought to be comparable with such a group of the Carboniferous *Bairdia subelongata* as described and figured in the Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 573, pl. xxx. figs. 1–11 and 16 (especially figs. 1 and 7); but however near an approach they may seem to make, the *Macrocyprides* have not the characteristic Bairdian outline of the postero-dorsal border. They also have the right valve larger than the left.

II. Pontocypris, G. O. Sars, 1865.

(Ann. & Mag. Nat. Hist. ser. 5, vol. xix. 1887, p. 182.)

1. *Pontocypris Mawii*, Jones.
(Pl. XXII. figs. 3 *a*, 3 *b*, 3 *c*.)

Pontocypris Mawii, Jones, *loc. cit.* pl. iv. figs. 4–6.

A few examples with *Bythocypris Hollii* came from the Fröjel shale. The specimen here figured differs slightly from the type in the convexity of the posterior third. The hinder border in fig. 3 *a* is not specially depressed, but being somewhat translucent shows the inner lamina.

III. Bythocypris, G. S. Brady, 1880.

(Ann. & Mag. Nat. Hist. ser. 5, vol. xix. 1887, p. 184.)

1. *Bythocypris symmetrica*, Jones.

Six specimens sent in 1886, showing slight modifications of outline, agree sufficiently well with *Bythocypris symmetrica*, Jones (*op. cit.* p. 186, pl. vii. figs. 3 and 4), for them to be referred to that species (Silur. Ostrac. Gothland, 1887, p. 6). From Fröjel.

2. *Bythocypris concinna*, Jones.

Bythocypris concinna, Jones, Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 186, pl. v. fig. 6; Silur. Ostrac. Gothland, 1887, p. 6.

Judging from the drawings sent from Stockholm, this species is represented in the Stockholm Collection. This is one of the most widely spread species, found in the uppermost strata of Œstergarn, Linde klint, and Hoburg; and in the shale of Stora Carlsö.

3. *Bythocypris Hollii*, Jones.

Bythocypris Hollii, Jones, Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 184, pl. v. figs. 1 and 2, and pl. vi. figs. 3 and 4; Sil. Ostrac. Gothland, 1887, p. 6.

This fine species is represented in the drawings sent to me by Prof. Lindström; and several examples were among the specimens obtained from the shale or marl of the brickyard at Fröjel and sent to me from Stockholm in 1886.

Note.—*Cytheropsis concinna*, Jones (Ann. & Mag. Nat. Hist. ser. 3, vol. i. 1858, pp. 249 and 254, pl. x. figs. 3 and 4), was referred, I now think erroneously, to the smooth *Primitiæ*, as *P. muta* (*op. cit.* vol. xvi. 1865, p. 425, and ser. 4, vol. iii. 1869, p. 222). It was probably figured in a reversed position; and if looked at in the other position it may be taken for a *Bythocypris*, approaching *B. testacella* (Ann. & Mag. Nat. Hist. March 1887, p. 186, pl. v. fig. 5) in shape, though rather larger, being 1½ millim. long, instead of a very little more than 1 millim. "*C. concinna*," figured and described by Dr. Kolmodin (Sverg. Silur. Ostrac. 1869, p. 21, pl. O. fig. 15), which is 1½ millim. long, may also be included in the same category, as a possible *Bythocypris*, if the convex border be regarded as dorsal instead of ventral.

IV. Klœdenia, Jones & Holl, 1886.

(Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. pp. 347 and 362.)

1. *Klœdenia apiculata*, sp. nov. (Pl. XXI. figs. 1–5.)

This Scandinavian *Klœdenia*, from the uppermost strata of Slite, in Gothland, is not far removed as to its general shape and features from *K. Wilckensiana* *. In some individuals of the new species the valves are much more oblong (figs. 3 and 4) and the dorsal angles are generally more acute. The front and hind lobes rise much higher, reaching beyond the dorsal border; and this formation suggests the name *apiculata*. The middle lobe, on the contrary, does not rise so high

* This also belongs to the Silurian rocks of Scandinavia, being found as well in place as in the drifted blocks of limestone in North Germany; Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. pp. 82 and 89, pl. v. figs. 17–19; figs. 20, 21, represent *K. plicata*, described at p. 90 as a variety, but sufficiently different as compared with the two other forms to be regarded as specifically distinct. See A. Krause, in Zeitschr. deutsch. geol. Ges. 1877, p. 35, pl. i. figs. 18 *a*, *b* (18 *b*, *K. plicata*), and G. Reuter, *op. cit.* 1885, p. 647, pl. xxvi. fig. 23, on the distribution of these *Klœdeniæ*.

towards the back edge, but huddles itself low down within the curve of the anterior lobe. The semilunar furrow, forming a narrow ridge or fold in the posterior region of *K. Wilckensiana*, is absent in *K. apiculata*. In an old individual of the latter (fig. 5) there is an uncertain appearance of a slight furrow within the anterior border, but it probably resulted from an accident. Figs. 1–5 show the gradations of form between the youngest (smallest) and the oldest individuals that have come to hand; and although no two are *exactly* alike, they all possess the same essential characters. Figs. 4 *a*, *b*, *c*, represent a valve having the antero-ventral region hypertrophied, as is usual among some species of *Beyrichiæ* and in *K. Wilckensiana* *. The specimens of *K. apiculata*, white and well preserved, are not rare in the uppermost Silurian strata at Slite, Gothland.

V. Beyrichia, M'Coy, 1846.

(Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. 1886, p. 345.)

1. *Beyrichia clavata*, Kolmodin. (Pl. XXI. figs. 6–9.)

Beyrichia clavata, Kolmodin, Bidrag till Kännedomen om Sverges Siluriska Ostracoder, Akad. Afhandl. &c., 1869, p. 18, pl. O. fig. 10; Jones, Silur. Ostrac. Gothland, 1887, p. 2.

This *Beyrichia* seems to be the same as Haidenhain's fig. 12, pl. i. (Zeitschr. deutsch. geol. Gesell. vol. xxi. 1869, p. 171), which he describes as *B. Klœdeni*; also fig. 11 in Angelin's unpublished "tab. A."

It differs from the ordinary *B. Klœdeni* in the relative position and size of its lobes. The gigot-lobe is broad and triangular and often compressed above and almost apiculate; the front lobe is very narrow and curved, and the middle lobe lies down close in the concavity of the latter. The surface has a minute and variable granulation. The marginal area is broad and hollow, and its ventral portion has a series of small, impressed, radiating marks, slighter in some specimens than in others, and the outer rim is strong.

This is an abundant species, and among about one hundred specimens sent to me from Stockholm the arrangement and relative size of the lobes are remarkably persistent among individuals from 1 to $2\frac{1}{2}$ millim. in length. It is plentiful in the shales of Eksta and Fröjel.

* Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. pp. 340–342.

Some individuals have the hypertrophied lobe (fig. 9) frequently seen in some species of *Beyrichia* (see Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. pp. 339–343). There are about twelve of these accompanying the others.

Several years ago I received specimens of Silurian *Beyrichiæ* found at Fröjel and Œstergarn, in Gothland, from Dr. Lindström, and amongst them *B. clavata* occurs, sometimes with the hypertrophied antero-ventral lobe.

Note.—The figure given of *Beyrichia Klœdeni*, M'Coy, in the Brit. Pal. Foss. Cambr. Mus. 1851, pl. 1 E. fig. 2, has a considerable resemblance to *B. clavata*, Kolm.; so also has Haswell's figure of *B. Klœdeni* (Silur. Formation Pentland Hills, 1865, pl. iii. fig. 12). In each case, however, I believe this resemblance is due to the inferior portraiture of the specimen. Having been favoured with an opportunity of studying M'Coy's type specimen, I find that it is a fairly good internal cast of an ordinary adult *B. Klœdeni*, with three lobes really having proportions and distances different from those in *B. clavata*.

2. *Beyrichia Klœdeni*, M'Coy, var. *granulata*, Jones.

Beyrichia Klœdeni, M'Coy, var. *granulata*, Jones, Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. 1886, p. 350, pl. xii. fig. 2; Silur. Ostrac. Gothland, 1887, p. 2.

Of this form, which is a good type of *B. Klœdeni*, except that it has a rough instead of a smooth surface, there was only one in the set sent in 1886, and I had one which Prof. Lindström gave me some years ago. Both have the hypertrophied lobe.

Except in the roughness of the surface and the want of tubercles on the margin these specimens closely match fig. 12 of Angelin's unpublished "tab. A."

Found at Œstergarn and Fröjel.

3. *Beyrichia Klœdeni*, M'Coy, var. *verruculosa*, nov.

Three specimens among those from Eksta and Fröjel are referable to *B. Klœdeni*, but are rather longer (3 millim. in length) than usual, and have a coarse granulation of somewhat scattered tubercles over the surface and on the thick free margins. The lobes are well formed and distinct, the middle lobe slightly united below with the other two. The fig. 13 in Angelin's unpublished "tab. A" is of the same kind, but its features are rather masked by the hypertrophy of its antero-ventral lobe. Fig. 21 of the same plate is possibly a larger (older) individual of the same variety.

Boll's *B. spinigera* (Archiv Ver. Fr. Naturges. Mecklenburg, 1862, p. 133, pl. i. fig. 7) is much like the variety under notice, but the middle lobe is quite distinct from the other two, and the margin has a different ornamentation. *B. nodulosa*, Boll (*l. c.* fig. 6), also belongs to the same category, but the lobes have different proportions and position. *B. protuberans*, Boll (*l. c.* fig. 6), is a weaker variety, tuberculate only on the hinder lobe, and deformed in front by the usual hypertrophied lobe.

4. *Beyrichia Klœdeni*, M'Coy, var. *antiquata*, Jones.

Beyrichia Klœdeni, M'Coy, var. *antiquata*, Jones, Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. 1855, p. 167, pl. vi. fig. 8; Palæoz. Biv. Entom., Geol. Assoc. 1869, p. 12, pl. xiv. fig. 7 (in both instances the sinistral valve is figured and is erroneously termed the dextral); Geol. Mag. 1881, p. 345, pl. x. fig. 11; Silur. Ostrac. Gothland, 1887, p. 2.

Some years ago I received this specimen from Prof. Lindström. It occurred in the shale of Œstergarn, Gothland.

Fig. 14 in Angelin's unpublished "tab. A" is evidently *B. Klœdeni*, var. *antiquata*.

5. *Beyrichia Klœdeni*, M'Coy, var. *tuberculata*, Salter.

(Geol. Mag. 1881, p. 345, pl. x. fig. 13; Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. 1886, p. 354, pl. xii. figs. 8, 9; Silur. Ostrac. Gothland, 1887, p. 3.)

This variety is shown by one of the drawings sent from Stockholm. A few specimens were found in the uppermost limestone of Linde klint. From the shale at Fröjel I have one specimen, sent some years ago.

B. Klœdeni, var. *tuberculata*, was first described and figured by Mr. J. W. Salter in 1848 (Mem. Geol. Survey, vol. ii. part 1, p. 352, pl. viii. figs. 14, 15) as "*B. tuberculata*, Klöden." Figs. 14 and 14*a* represent the outside of the valve, from the Wenlock Limestone at Lindells, Woolhope; figs. 15 and 15*a* show an internal cast from the Wenlock Shale, at Tynewydd, south of Llandovery.

In this variety the width of the ventral margin and the amount of tuberculation vary very much with individuals.

In Angelin's unpublished "tab. A," fig. 18 evidently represents this variety.

6. *Beyrichia Bolliana-umbonata*, Reuter.
(Pl. XXI. figs. 10 & 11.)

Some specimens under notice are probably identical with

Reuter's above-mentioned variety of his *B. Bolliana* (Zeitschr. deutsch. geol. Ges. vol. xxxvii. 1885, p. 646, pl. xxvi. fig. 21), although it has a finely granulated surface. I do not agree with Hr. Reuter's synonymy for this form (Silur. Ostrac. Gothland, 1887, p. 3).

The ventral margin differs in development with individuals. Two were sent to me by Prof. Lindström in 1886 from Fröjel.

7. *Beyrichia tuberculata* (Klöden) and varr. (Pl. XXI. figs. 12–17.)

For *B. tuberculata* (Klöden) see Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 347, pl. v. figs. 4–9 (figs. 10–11, var. *nuda*, is the same as *B. Kochii*, Boll). See also *op. cit.* April 1886, pp. 347–349, for synonyms, correcting as above.

7*. *Beyrichia tuberculata*, vera (senex). (Pl. XXI. fig. 12.)

In Pl. XXI. fig. 12 we have what I believe to be an old individual well developed, but unfortunately broken at its antero-dorsal region, where the middle lobe and the dorsal portion of the front lobe have been displaced inwards by pressure. Klöden's fig. 22 comes nearest among published figures to this specimen; but the lobes are more divided and the hinder lobe more distinctly sulcate in that figure, and our specimen is denticulate on the front margin and has a few prickles behind. Boll's fig. 1 *a* of *B. tuberculata* has the lobes still more distinct; the hinder lobe exhibits its three characteristic segments; the front lobe is distorted by hypertrophy; and the margin is broad and somewhat tuberculate in front. The Nova-Scotian specimen (Geol. Mag. 1881, pl. x. fig. 10) is another of these full-grown and coarse-featured individuals, retaining the essential characters, however much modified they may be by age.

7**. *Beyrichia tuberculata*, var. *spicata*, nov. (Pl. XXI. figs. 13, 14.)

Differing, it may be, by advanced growth only, fig. 13 shows isolated spikes or prickles on its lobes and sharp teeth both along the front border and on what remains of the hind margin. The lobes are distinct; the anterior lobe is modified by an enlargement of its lower moiety; the posterior lobe is broken, but shows some signs of its normal sulcation, and has a projection on its dorsal edge as in fig. 12.

In fig. 14 (a right valve) the prickles of the surface are more numerous; the hinder lobe shows no sulcation, as in the var. *antiquata* (Ann. & Mag. Nat. Hist. August 1855, p. 87, pl. v. fig. 12), and the upper moiety of the front valve is reduced to a narrow, curved, rugose ridge; the hind and front margins are denticulate.

7***. *Beyrichia tuberculata*, var. *foliosa*, nov.
(Pl. XXI. figs. 15–17.)

In figs. 15 and 16 the superficial isolated prickles are exaggerated into somewhat concentric rows of large and small spines, directed backwards on the posterior and forwards on the anterior part of the valve, and less regularly arranged tubercles occupy the inner slope of the hinder or gigot-lobe. The middle lobe is distinct, as in all the other specimens of these *Beyrichiæ*; but the hinder lobe is no longer rounded and divided crosswise, and the front lobe is also obsolete or shapeless and overgrown with tubercles.

Fig. 17 has a still more extreme variation in its concentric overlapping growths of leaf-like, coarsely denticulated expansions over the hinder lobe, which retains the dorsal projection, seen also in figs. 12–15. The middle lobe is distinct and smooth; the front lobe is smooth and low above, but prominent and partially tuberculate in its lower moiety.

The originals of figs. 12–17 are well-preserved white specimens from the Uppermost Silurian strata of Slite, Gothland.

VI. Leperditia, Rouault, 1851.

(Ann. & Mag. Nat. Hist. ser. 2, vol. xvii. 1856, p. 84, and ser. 5, vol. viii. 1881, p. 333 &c.; Proc. Geol. Assoc. vol. ix. 1886, p. 503.)

1. *Leperditia grandis*, Schrenck.
(Pl. XXII. figs. 11 *a*, 11 *b*.)

(Silur. Ostrac. Gothland, 1887, p. 3.)

This *Leperditia* is evidently a small individual of *L. grandis*, as described and figured by Fr. Schmidt in the Mém. Acad. Imp. Sci. St.-Pétersb. sér. 7, vol. xxi. 1873, p. 10, figs. 1–6 *a*. According to him it is the same as F. Römer's *L. gigantea*.

This right valve, figured in the drawings sent from Stockholm, shows distinctly at its ventral margin the two minute pits, which Fr. Schmidt describes as perforating the valve; here, however, they appear to be only shallow pits.

From the lowest limestone beds of Œstergarn.

VII. Thlipsura, Jones & Holl, 1869.

(Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 213.)

1. *Thlipsura v-scripta*, J. & H., var. *discreta*, Jones. (Pl. XXII. figs. 9 *a*, 9 *b*, 9 *c*, 10.)

Thlipsura v-scripta, J. & H., var. *discreta*, Jones, Silur. Ostrac. Gothland, 1887, p. 6.

This species was described and its British variety figured in 1869 by Jones & Holl (Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 214, pl. xv. fig. 3). See also *op. cit.* ser. 5, vol. xix. p. 403.

In the Swedish variety, of which about fifty specimens form part of the series sent to me in 1886, the front sulcus is oblique, being not quite perpendicular, and those on the hinder half of the valve keep slightly apart, not closing together to form the letter V completely. There is also a slight, curved, convex ridge within and parallel to the posterior margin; but it is not always well developed. Dr. Krause has figured this variety as *Primitia minuta* (Zeitschr. deutsch. geol. Ges. vol. xxix. p. 38, pl. i. fig. 19). Abundant in the shale of Fröjel.

VIII. Primitia, Jones & Holl, 1865.

(Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 415.)

1. *Primitia lævis*, Jones. (Pl. XXII. figs. 12 *a*, 12 *b*.)

Primitia lævis (parte), Jones, Silur. Ostrac. Gothland, 1887, p. 4.

This is a smooth, subtriangular, somewhat Leperditioid form, straight on the back, rounded at the ends, but one of them much higher (broader) than the other. It appears to be new. The only group to which I can refer it is that of the smooth *Primitiæ*, such as *P. matutina*, *semicircularis*, *obsoleta*, *ovata*, and *oblonga*, in pl. xiii. Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 423 &c. It is convex mainly in the postero-ventral region. Its contact-edges are bevelled inwards, except along the straight edge, which seems to be the back and hinge-line. It would more closely resemble *P. obsoleta*, J. & H., if it were shorter and less compressed anteriorly. Edge-view (fig. 12 *b*) narrow-ovate.

This may be provisionally known as *P. lævis.* Though the smooth *Primitiæ* pass by gradation into the sulcate forms, possibly a subgeneric term might be usefully applied to them.

So far as its outline is concerned *P. lævis* much resembles *Leperditia tyraica*, Fr. Schmidt; but its internal edges are not those of *Leperditia*, nor has it the special surface-characters of that genus.

Only two specimens (from the shale of Fröjel) were among those sent in 1886.

2. *Primitia stricta*, sp. nov.
(Pl. XXII. figs. 13 *a*, 13 *b*.)

Primitia lævis (parte), Jones, Silur. Ostrac. Gothland, 1887, p. 4.

More compressed than fig. 12, and with less height at the posterior third, this unique specimen is more oblong in outline, with parallel sides. Edge view (fig. 13 *b*) narrow oblong, but acute in front and rounded behind. From Fröjel, in 1886.

In shape this approximates to *Primitia variolata*, J. & H. (Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 418, pl. xiii. fig. 6); but it is not so evenly rounded at the ends and has neither the sulcus nor the punctation. It is smooth, like the little *P. matutina*, J. & H. (*loc. cit.* fig. 7), but differs from it in shape.

3. *Primitia valida*, J. & H.

Primitia valida, J. & H., Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. 1886, p. 409, pl. xiv. fig. 7, and vol. xix. p. 193, pl. vi. fig. 7; Silur. Ostrac. Gothland, 1887, p. 4.

In the Swedish specimens (of which twenty-four were sent in 1886) the reticulation of the surface is much more definite than in the British examples. There is also a distinct row of minute denticles along the ventral edge of each valve in many of the Swedish specimens.

From Fröjel.

4. *Primitia grandis*, Jones.
(Pl. XXII. figs. 14 *a*, 14 *b*, 14 *c*.)

Primitia grandis, Jones, Silur. Ostrac. Gothland, 1887, p. 4.

One of the drawings sent from Stockholm shows a beautiful, large, suboblong, reticulate *Primitia* without a sulcus. It is near *P. valida*, J. & H., and, indeed, in one of the varieties of that species the sulcus is obsolete, namely var. *breviata* (*op.*

cit. pl. xiv. fig. 8). The ventral margin of *P. grandis* has a delicate punctation, due apparently to the meshes of the ornamental network coming against the raised marginal rim.

From Fröjel.

5. *Primitia reticristata*, Jones.
(Pl. XXII. figs. 15 *a*, 15 *b*, 15 *c*.)

Primitia reticristata, Jones, Silur. Ostrac. Gothland, 1887, p. 5.

This is closely allied to *P. cristata*, J. & H. (Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. 1865, p. 420, pl. xiii. fig. 1). It differs, however, somewhat in outline, being more semicircular in its contour, and especially in having a beautifully reticulate surface.

About twelve specimens were among those sent in 1886.

From Fröjel.

6. *Primitia seminulum*, Jones.
(Pl. XXII. figs. 17 *a*, 17 *b*.)

Primitia seminulum, Jones, Silur. Ostrac. Gothland, 1887, p. 5.

This is a variety of *P. seminulum*, J. (Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 413 for references, pl. xiv. fig. 14). It is slightly modified, being rather longer than the British specimens. Three or four among the specimens sent in 1886.

From Fröjel.

IX. Primitiopsis, Jones, 1887.

Primitiopsis, Jones, Silur. Ostrac. Gothland, 1887, p. 5.

This is like *Primitia* externally, except that the anterior end has a specially smooth area, corresponding with an internal portion, which is partitioned off from the rest of the cavity by a cross wall.

1. *Primitiopsis planifrons*, Jones.
(Pl. XXII. figs. 18 *a*, 18 *b*, 18 *c*, 18 *d*.)

Primitiopsis planifrons, Jones, *op. cit.* p. 5, woodcuts.

Suboblong, with rounded ends; bearing a faint sulcus, together with the subcentral pit, which is normal in *Primitia*; also another slight furrow is observable in the anterior dorsal region. The convexity is greatest along the ventral region, as is usually the case with *Primitiæ* of the group to which

P. umbilicata, *P. valida*, and their allies belong; and the ventral convexity, overhanging the margin, hides the continuous row of denticles which borders each valve. The surface is reticulate except at the anterior end. The interior of each valve has a thin cross wall in the anterior region, dividing off about an eighth of the length of the valve from the rest of the interior. This constitutes the generic distinction. The narrow crescentic area of surface, corresponding to the separated portion of the interior, being destitute of ornament and therefore smooth, gives the specific name.

There are eight or nine individuals (from the soft shale-beds of Fröjel) among the specimens sent from Stockholm in 1886.

It is correct to take the *smooth* end of *Primitiopsis* for the *anterior*, because that end has its analogue in the structure of the recent *Chlamydotheca*, Saussure, although in this living form the partition of the anterior portion is not always so complete, and its outside not so distinctly differentiated from the rest of the surface, as in our Palæozoic specimens.

1*. *Primitiopsis planifrons*, var. *ventrosa*, Jones. (Pl. XXII. figs. 19 *a*, 19 *b*, 19 *c*.)

Primitiopsis planifrons, var. *ventrosa*, Jones, Silur. Ostrac. Gothland, 1887, p. 6.

This is closely allied to the last described, but is remarkable for the relative convexity of its ventral region, its less height, and increased dorsal hollow, making it narrow-oblong and subcylindrical in shape.

Only one specimen occurred among those sent in 1886, from Fröjel.

X. Entomis, Jones, 1861.

(Ann. & Mag. Nat. Hist. ser. 4, vol. xi. 1873, p. 413.)

1. *Entomis Lindstrœmi*, Jones. (Pl. XXII. figs. 16 *a*, 16 *b*.)

Entomis Lindstrœmi, Jones, Silur. Ostrac. Gothland, 1887, p. 3.

An *Entomis* closely related to others already known, but distinct from them all.

It is ovate-oblong; rounded at the ends unequally, elliptically curved below, and nearly straight above. The sulcus is straight and strong, a little in advance of the middle of the valve. The hinder moiety of the valve is fully convex, steep behind, and sloping forward into the sulcus; the front part is not so much swollen and slopes down to the anterior margin.

This form is near to *E. dimidiata*, Barrande (Syst. Sil. Boh. vol. i. Suppl. p. 513, pl. xxiv. figs. 7, 8, 9), but it is longer, more oblong, and not so convex. *E. pelagica*, Barr. (*ibid.* figs. 1–6), is a near ally, but it is too convex and has a tubercle. Among other allies are *E. tuberosa*, Jones, and *E. depressa*, Salter (Ann. & Mag. Nat. Hist. ser. 5, vol. xiv. pp. 391 and 394, pl. xv. figs. 1, 5, 6, 7, and figs. 2–3), but the relative convexities, conditions of sulcus, and other features distinguish them. *E. reniformis* (Kolmodin) and *E. Angelini*, Jones (*op. cit.*), are far too round and globose, and the sulcus differs also.

I may here remark that *Entomis Marstoniana* (*op. cit.* fig. 8) is possibly the same as Kolmodin's *E. reniformis* (Œfv. K. Vet.-Akad. Förhandl. vol. xxxvi. 1880, p. 135, pl. xix. fig. 2).

Some six or eight specimens of *E. Lindstrœmi* were found in the uppermost limestone of Linde klint (cliff or hill) and Sandarfve kulle (top or hillock). Length nearly 4 millim.

2. *Entomis inæqualis*, Jones.
(Pl. XXII. figs. 20 *a*, 20 *b*, 20 *c*.)

Primitia inæqualis, Jones, Silur. Ostrac. Gothland, 1887, p. 5.

This is a peculiar and relatively large valve, having a Primitian character in its reticulate ornament and being Entomidian in its sulcation. This last feature is very strongly marked, and indeed, I think, exaggerated by pressure, making the two moieties of the valve very unequal in both size and convexity. One is much more swollen than the other and overhangs the ventral and part of the antero-ventral margin; this larger moiety extending forwards below, and thus lessening the area of the front moiety.

The sulcus reaches the ventral margin, as in *Entomidella* and *Bolbozoe**, but its extent and peculiar sigmoidal curve are most probably partly due to pressure. The hinge-line of the valve is straight within (that is, below the dorsal extensions of the two moieties of the valve); the front margin has a strong dorsal angle, is boldly curved below it, and edged with a raised rim and minute denticles. The postero-dorsal angle has been broken away.

The specimen is unique, among those sent from Stockholm in 1886, and, like most of these, was from Fröjel.

* See Ann. & Mag. Nat. Hist. December 1884, pp. 400 and 401.

XI. ÆCHMINA, Jones & Holl, 1869.

(Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 217.)

1. *Æchmina bovina*, Jones. (Pl. XXII. fig. 8.)

Æchmina bovina, Jones, Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 412, pl. xiii. fig. 6.

Some drawings sent from Stockholm, and of one of which fig. 8 is a copy, show a form identical with the British species from the Wenlock Shale, but more delicately toothed along the free margin. It is common in the shale of Fröjel, Gothland, also belonging to the Wenlock series.

XII. BURSULELLA *, Jones, 1887.

(Silur. Ostrac. Gothland, 1887, p. 7.)

This is a small, bivalved, probably Ostracodal form, with more or less triangular valves, which have one or two horn-like projections on the ventral edge of each valve.

1. *Bursulella triangularis*, Jones. (Pl. XXII. figs. 5, 6.)

Bursulella triangularis, Jones, Silur. Ostrac. Gothland, 1887, p. 7, woodcuts.

The upper and lower edges of the valves are straight, but the ventral edge is much shorter than the other, and a delicate spike projects from each of its angles. The corners of each valve are somewhat rounded and on the lower edge are marked inside with a series of shallow pits, making a slightly crenate contact-line. In outline this curious bivalve, which is probably an Ostracod, looks like a little subtriangular *purse* (hence the generic name), widest at the top, and ornamented below with two neat little projections.

It occurs in the Cephalopodan Limestone of Samsugn, in Othem, and the uppermost beds of Slite, some twenty specimens having been found.

2. *Bursulella semiluna*, Jones. (Pl. XXII. figs. 4 *a*, 4 *b*, 4 *c*.)

Bursulella semiluna, Jones, Silur. Ostrac. Gothland, 1887, p. 7.

Here the valves have a nearly semicircular ventral outline

* *Bursa*, a purse; *bursula*, a little purse; *bursulella*, a very little purse.

and a straight dorsal edge, with blunt angles. On each valve two short spikes project from the ventral edge. This is crenated within with small regular pits, making a neatly serrated junction; the pairs of spikes, opposite one to the other, close against each other when the valves are shut.

Seen sideways this fossil looks like a little halfmoon-shaped equal-ended boat, standing on its convex edge, with two pointed feet instead of a keel.

From the *Rhizophyllum*-beds of Lau, where it seems to be rare.

3. *Bursulella unicornis*, Jones. (Pl. XXII. fig. 7.)

Bursulella unicornis, Jones, Silur. Ostrac. Gothland, 1887, p. 7.

Valve triangular, with its dorsal corners rounded and its ventral border narrowing into a long subcylindrical spike. A few specimens have been found in the shale of Fröjel and the Cephalopodan Limestone of Samsugn and Slite.

Note.—My friend Professor Lindström has sent me for examination several small Entomostraca which he obtained lately from a red clay at Wisby, Gothland, belonging to the red marl-shales at the base of *Stricklandinia*-marls (equivalent to the Upper Llandovery) in Gothland. Among them there is a *Beyrichia Klœdeni* (with hypertrophied front lobe), *Polycope*, sp., *Leperditia*, small sp., *Bairdia* (?), *Pontocypris Mawii*, *P. Smithii*, *Bythocypris*, spp., *Cythere subquadrata* (?), and some probably undescribed species. These specimens are from the basement of the lowest known Silurian strata of Gothland.

Note.—Whilst this paper was in the press I received from Herr J. Kiesow, of Dantzic, a paper on some *Beyrichiæ* from Gothland, published in the Zeitschr. deutsch. geol. Ges. Jahrg. 1888.

EXPLANATION OF THE PLATES.

Plate XXI.

[All the figures are magnified 15 diameters.]

Fig. 1. *Klœdenia apiculata*, nov. *a*, right valve; *b*, edge view; *c*, end view.

Fig. 2. The same. Left valve.

Fig. 3. The same. Left valve.

Fig. 4. The same. *a*, left valve, with the antero-ventral lobe hypertrophied; *b*, edge view; *c*, end view.

Fig. 5. The same. Right valve, somewhat damaged.
Fig. 6. *Beyrichia clavata*, Kolmodin. Left valve.
Fig. 7. The same. Right valve.
Fig. 8. The same. Right valve.
Fig. 9. The same. Left valve; antero-ventral lobe hypertrophied; postero-dorsal angle broken.
Fig. 10. *Beyrichia Bolliana*, var. *umbonata*, Reuter. Left valve.
Fig. 11. The same. Right valve.
Fig. 12. *Beyrichia tuberculata* (Klöden). Old individual, damaged, the antero-dorsal portion having been crushed.
Fig. 13. *Beyrichia tuberculata*, var. *spicata*, nov., or possibly a very old individual of *B. tuberculata* (Klöden). Left valve, broken.
Fig. 14. *Beyrichia tuberculata*, var. *spicata*, nov. Right valve.
Fig. 15. *Beyrichia tuberculata*, var. *foliosa*, nov. Left valve.
Fig. 16. The same. Right valve.
Fig. 17. The same. Extreme variation; right valve.

Plate XXII.

[All the figures are magnified 15 diameters, excepting those marked otherwise.]

Fig. 1. *Macrocypris Vinei*, J. & H. *a*, carapace, showing the left valve; *b*, edge view; *c*, end view.
Fig. 2. The same. Right valve, shorter specimen.
Fig. 3. *Pontocypris Mawii*, J. & H. *a*, right valve; *b*, edge view of a valve; *c*, end view of carapace.
Fig. 4. *Bursulella semiluna*, J. *a*, side view of carapace; *b*, ventral edge; *c*, end view. Magnified 30 diam.
Fig. 5. *Bursulella triangularis*, J. Side view. Magnified 30 diam.
Fig. 6. The same. Interior of valve. Magnified 30 diam.
Fig. 7. *Bursulella unicornis*, J. Side view. Magnified 30 diam.
Fig. 8. *Æchmina bovina*, J. Side view. Magnified 30 diam.
Fig. 9. *Thlipsura v-scripta*, J. & H., var. *discreta*, J. *a*, side view of carapace, showing right valve; *b*, edge view.
Fig. 10. The same. Left valve.
Fig. 11. *Leperditia grandis*, Schrenck. *a*, right valve, small, nat. size; *b*, one of the marginal pits, magnified.
Fig. 12. *Primitia lævis*, J. *a*, left valve of carapace; *b*, edge view of carapace.
Fig. 13. *Primitia stricta*, J. *a* and *b* as above.
Fig. 14. *Primitia grandis*, J. *a*, carapace, showing left valve; *b*, ventral view; *c*, end view. Magnified 30 diam.
Fig. 15. *Primitia reticristata*, J. *a*, carapace, showing right valve; *b*, dorsal view; *c*, end view.
Fig. 16. *Entomis Lindstræmi*, J. *a*, left valve; *b*, dorsal edge. Magnified 5 diam.
Fig. 17. *Primitia seminulum*, J. *a*, right valve; *b*, dorsal view.
Fig. 18. *Primitiopsis planifrons*, J. *a*, left valve; *b*, dorsal view; *c*, edge view of carapace; *d*, interior of left valve.
Fig. 19. *Primitiopsis planifrons*, var. *ventrosa*, J. *a*, right valve; *b*, dorsal edge; *c*, end view of carapace.
Fig. 20. *Entomis inæqualis*, J. *a*, right valve, probably somewhat shortened by pressure; *b*, dorsal edge; *c*, front end.

LIV.—*On the Fructification and Affinities of* Archæopteris hibernica, *Forbes, sp.* By Robert Kidston, F.R.S.E., F.G.S.*

Under the name of *Cyclopteris hibernica*, *Archæopteris hibernica* was described by Forbes in 1852† from the Yellow Sandstones of the south of Ireland, where, at Kiltorkan and a few other localities, this fern is one of the most characteristic fossils.

In 1858‡ Mr. W. H. Baily, in describing the fructification of *Archæopteris hibernica*, Forbes, sp., said that "one of the fertile pinnules of a specimen showed the spores were aggregated into clusters or sori, and that the indusium or protecting cover had been but little broken up. A fertile pinnule from another specimen, however, appeared to be in a more advanced stage, losing in a great measure the aggregated character of the sori, and showing the protecting cases (which were granulated) to be much disturbed.

"Other specimens in the collection were alluded to, one of which, with a length of 16 inches, had twelve pinnules on each side of the rachis in full fructification without any appearance of leaflets, the spore-cases being scattered in all directions; another of the same length had about twenty pinnules on each side, the lower ones being in full fructification, which decreased gradually towards the upper portion of the frond, the leaflets taking its place."

At the same time Mr. Baily exhibited a diagram illustrating "what was considered to be the base of the stem or rhizoma, having a rounded expansion, apparently separating into scales which continued upwards, fragments of leaflets being attached to the stem at different intervals."

Schimper, in 1869§, figured and described *Cyclopteris hibernica*, Forbes, under the name of *Palæopteris hibernica*. In describing the fruiting pinnules he says: "These have undergone a complete metamorphosis and are transformed into groups in which all foliar expansion has entirely disappeared, and which show a principal rachis not at all represented in the sterile pinnules which are destitute of a medial nerve." He also describes the sporangia as clavate,

* Communicated by the Author, having been read before the Royal Physical Society of Edinburgh, April 18, 1888.

† Brit. Assoc. Report, 1852, p. 43.

‡ *Ibid.* 1858, p. 75.

§ Traité d. paléont. végét. vol. i. p. 475, pl. xxxvi.

costate ("soris (sporangiis?) costulatis"). He gives an enlarged drawing of the sporangia at pl. xxxvi. fig. 4.

More recently Mr. Carruthers redescribed the fruit of this fern *. Among other things he says:—"In some specimens in the British Museum all the lower pinnæ are entirely fertile. I am satisfied that the ovate-oblong sori are generally single, and not clustered, and are two-lipped, the slit passing one third of the way down the sorus. The vein is continued as a free receptacle in the centre of the cup or cyst, as in existing *Hymenophylleæ*, in which it is included, not reaching beyond the entire portion. In some specimens the receptacle is broad or thick, indicating the presence of something besides itself in the cup, and giving the appearance that would be produced if it were covered with sporangia; I cannot, however, detect any indication on the outer surface which might have been expected from the individual sporangia. The compression of the specimens in the rock, which has made the free receptacle appear like a vein on the wall of the cup, together with the highly altered condition of the rock in which the fossils are contained, account for the imperfect preservation of the minute structures.

"The interpretation which I have here given of the fructification of this interesting fossil exhibits so close a resemblance to what we find in the living genus *Hymenophyllum* that, were it not for the vegetative portions, I would without hesitation place it in that genus."

Crépin †, in 1874, figured and described some specimens of *Archæopteris* (*Palæopteris*) *hibernica*, var. *minor*, from Évieux, Belgium, of which he also figures the fruit, but does not describe it in detail.

As the generic name *Palæopteris*, adopted by Schimper for this and some allied ferns, had been previously employed by Geinitz ‡ for a fossil which he supposed to be a fern-stem (but which has been discovered to be the stem of *Cordaites*), Dawson §, in 1882, proposed the name *Archæopteris* for the plants placed in *Palæopteris*, Schimper (not Geinitz). Dawson's genus *Archæopteris* must therefore be employed for *Cyclopteris hibernica* and its generic associates, as *Palæopteris*,

* Geol. Mag. vol. ix. no. 2, Feb. 1872.

† "Description de quelques plantes fossiles de l'étage des psammites du Condroz (Devonien supérieur)," Bull. Acad. roy. d. Belgique, 2e sér. vol. xxxviii. no. 8, Aug. 1874.

‡ Vers. d. Steinkf. in Sachsen, p. 32; see also Grand'Eury, 'Flore carbon. du Départ. de la Loire,' pp. 241 and 243.

§ Foss. Plants of the Erian (Devonian) and Upper Silurian Formations of Canada, part ii. p. 98 (1882).

Schimper, is inadmissible, having been previously used by Geinitz for a different group of plants.

Among the Canadian species described by Dawson the point of chief interest to us is the figure and description of the fruit of *Archæopteris gaspiensis*, a very closely allied species, if really distinct from *Archæopteris hibernica*, Forbes, sp. His description of the fruit is as follows:—"Fertile pinnæ with about twelve pinnules, each having a long midrib with about seven pairs of crowded oblong spore-cases about 3 millim. in length, pointed or somewhat obtuse at top, straight at the sides, and apparently dehiscent at the apex. The midrib projects some distance beyond the spore-cases." It is further mentioned that *Archæopteris gaspiensis* "differs from *A. hibernica* in the arrangement and form of the spore-cases and in its shorter pinnæ, with fewer and less obtuse pinnules"*.

Since examining the specimens of *Archæopteris hibernica* in the British Museum I have doubted the accuracy of the description of the fruit of this fern as given by Schimper and Carruthers, but refrained from expressing any opinion till I had an opportunity of examining the specimens of this plant in the collections of the Science and Art Museum, Dublin, and of the Geological Survey of Ireland. I have now examined these specimens, and feel convinced that the description of the fruit as given by Schimper and Carruthers is inaccurate. I have entirely failed to observe the presence of a keel on the sporangia, as figured by Schimper, or the occurrence of a "slit passing one third of the way down the sorus," or any of the other Hymenophyllaceous characters mentioned by Mr. Carruthers. The sporangia (so far as my observations have gone, and I have examined minutely the specimens in the British Museum, as well as those in the two collections in Dublin, the finest of which are in the collection of the Geological Survey of Ireland) are narrow-oval, sessile, or very shortly stalked, as a rule pointed at both extremities, though occasionally blunt; they are usually developed singly, though occasionally in pairs, and are apparently produced on the upperside of the rachis-like vein of the very much metamorphosed pinnules, which in this case almost assume the structure of pinnæ, though their being only modified pinnules is proved by their position and by the occasional occurrence of a few sporangia on the margin of some of the foliage-pinnules, which, in the few such cases observed, had undergone but little reduction in the limb of the pinnule. A similar production of sporangia on the

* Dawson, *l. c.* p. 99.

incompletely modified foliage-pinnules is not uncommon in *Osmunda regalis*. The fruiting-pinnules end in several simple or divided thread-like filaments. The fruit appears to consist of *exannulate Marattiaceous sporangia*.

Another interesting point was observed on some of the specimens in the collection of the Geological Survey of Ireland. This had evidently been noticed by Mr. Baily, though its importance was not fully appreciated, and is referred to by him as a rounded expansion of the base of the stem, which apparently separated into scales. Mr. Carruthers, evidently referring to the same structure, says "The stipes were thick, of considerable length, and clothed with large scales, which formed a dense covering at the enlarged base" *.

The structures here alluded to are two large *stipules*, one on each side of the base of the rachis, and on some of the specimens in the collection of the Geological Survey of Ireland they are admirably shown. What has given rise to the statement that the base of the stipe was "clothed with large scales" is evidently the remains of large pinnules which are situated on the main rachis between the pinnæ, and are continued to almost the extreme basal termination of the rachis. Such pinnules, obliquely imbedded in the matrix and broken over, have been mistaken for scales. So far as my observations have gone, the rachis is entirely destitute of membranous scales.

The presence of the *stipules* at the base of the rachis of *Archæopteris hibernica*, altogether independently of the evidence afforded by the fruit, points strongly to its affinities being with the Marattiaceæ; and when to this is added the *Marattiaceous* structure of the fruit itself, there does not remain the slightest doubt in my mind that the true position of *Archæopteris hibernica* is in the Marattiaceæ.

In conclusion, I have to express my thanks to Dr. A. Geikie and Prof. Ball for all the facilities they kindly gave me for examining the specimens in the respective collections of the Geological Survey of Ireland and in the Science and Art Museum, Dublin.

LV.—*A List of Batrachians from the Province Santa Catharina, Brazil.* By G. A. Boulenger.

Two rather extensive collections of Frogs, formed in the Sierra do Catharina by Hr. Michaëlis, which I have recently

* Carruthers, *l. c.*

examined, afford information as to the little-known Batrachian fauna of the Province Santa Catharina. The principal interest resides in the comparison with the fauna of the contiguous province of Rio Grande do Sul, now fairly known, thanks to the exertions of Hensel, von Ihering, and Bischoff. It will be seen from the following list that the range of several forms recently discovered in the latter province extends to Santa Catharina.

1. *Engystoma ovale*, var. *bicolor*, Val.

2. *Engystoma leucostictum*, sp. n.

Snout obtuse, feebly projecting, not twice as long as the diameter of the eye. Fore limb much longer than its distance from the end of the snout. The tibio-tarsal articulation reaches the shoulder, the tarso-metatarsal the eye. Toes obtuse, with a rudiment of web; a single, very small, roundish, metatarsal tubercle. Dark brown above, with scattered, minute, white dots; limbs marbled with pink above; a fine interrupted white line along the hinder side of the thighs; lower surfaces white, spotted and marbled with dark brown.

From snout to vent 25 millim.

A single female specimen.

3. *Pseudis mantidactyla*, Cope.

4. *Elosia nasus*, Licht.

5. *Hylodes Gollmeri*, Ptrs. (*Guentheri*, Stdr.).

6. *Ceratophrys Boiei*, Wied.

7. *Paludicola Olfersii*, Mart.

8. *Paludicola biligonigera*, Cope.

9. *Leptodactylus Gaudichaudii*, D. & B.

10. *Eupemphix nana*, Blgr.

11. *Bufo arenarum*, Hens.

12. *Hyla faber*, Wied.

13. *Hyla marginata*, Blgr.

14. *Hyla pulchella*, D. & B.

15. *Hyla Bischoffii*, Blgr.

16. *Hyla bivittata*, Blgr.

17. *Hyla nasica*, Cope.

18. *Hyla senicula*, Burm.

19. *Hyla catharinæ*, sp. n.

Tongue circular, very slightly nicked and free behind. Vomerine teeth in two transverse groups close together between the rather large choanæ. Head much depressed, as long as broad; snout rounded, as long as the diameter of the orbit; canthus rostralis rather indistinct, curved; loreal region concave; interorbital space as broad as the upper eyelid; tympanum very distinct, half the diameter of the eye. An indistinct rudiment of web between the outer fingers; no projecting rudiment of pollex; toes two thirds webbed; disks smaller than the tympanum; subarticular tubercles moderate; no tarsal fold. The tibio-tarsal articulation reaches between the eye and the tip of the snout. Upper surfaces slightly warty; belly and lower surface of thighs granulate; no fold across the chest. Greyish or brown above, with symmetrical darker bands and marblings; a large, triangular, dark spot between the eyes, light-edged anteriorly; a Λ-shaped band on the sacral region; limbs with dark cross bands; groin white (in spirit), with black marblings; concealed surfaces of hind limbs barred black and white; lower surfaces whitish, with small blackish spots.

From snout to vent 42 millim.

Two female specimens.

20. *Hyla aurantiaca*, Daud.

21. *Phyllomedusa Iheringii*, Blgr.

LVI.—*On Butterflies of the Genus* Teracolus *obtained by Mr. H. G. Palliser at Khandesh in the Winter of* 1886–7. By Arthur G. Butler, F.L.S., F.Z.S., &c.

Amongst the butterflies collected by Mr. Palliser in the Khandesh district of Bombay, the species of *Teracolus* are the most interesting; and as this gentleman has very generously presented such as we required, including a unique pair of a new species, to the National Collection, I think I cannot do less than say a few words about them.

A series of *T. dynamene* included one or two examples of the form *T. carnifer*, which approaches *T. calais* of Arabia and Africa.

A series of *T. ochreipennis* (= *T. rorus*) were in the collection; they had been identified, I believe by my old friend M. De Nicéville, as *T. puellaris*.

T. fulvia of Wallace and a beautiful new species were both named *T. fausta*! I herewith append a description of the latter:—

Teracolus Palliseri, sp. n.

♂. About the size of *T. fausta*: primaries above with the pattern and coloration of *T. solaris* of Deesa; secondaries with the marginal spots even smaller than in *T. fausta*; head, collar, and tegulæ of an unusual rosy colour: under surface of a pale buffy ochreous tint; the apical area of primaries and the whole of secondaries (but especially the outer borders of the wings) washed with rose-colour; the ordinary markings arranged much as in *T. fulvia*, but the discocellular ocelloid spots narrower and smaller and the discal series smaller and redder than in that species. Expanse of wings 45 millim.

♀. Interno-median area of primaries and basal two thirds of secondaries milk-white, remainder of these wings suffused with pale salmon-colour; the black apical area of the primaries nearly as in the female of *T. fausta* or the male of *T. fulvia*, but the discocellular spot smaller even than in its own male; base of the wings sprinkled with grey scales as far as the middle of the cell; secondaries with the marginal spots rather smaller than in *T. fausta* ♀; head, collar, and tegulæ pink: under surface cream-coloured, the external borders dull pale pink; the discocellular spots small and oval; the discal spots as in the male of *T. fulvia*, but of a pinky brown or soft chocolate tint. Expanse of wings 43 millim.

West of Dhulia, Khandesh; December 1886.

The female of *T. fulvia*, which is a larger and more coarsely coloured species, is pure white, with very heavy black borders, as in the allied *T. tripunctatus*; it was in Mr. Palliser's collection, but only represented by one damaged example; the Museum does not at present possess it; but I hope this may not long be the case.

The Museum series of the *T. fausta* group is especially rich, and therefore it is the more satisfactory to be able to add two species, *T. fulvia* and *T. Palliseri* to our collection.

Of *T. fausta* (typical) we possess six examples from the Turco-Persian frontier, three from Kandahar, and one of doubtful locality; the "Zeller" collection added seven examples, in all of which the discocellular spot of primaries is replaced by a minute pale-centred ring, and the pattern of the underside is extremely pale; these specimens were received from Beirût and Bagdad, and may either represent a distinct local type or a seasonal form. Of *T. faustina*, owing to the generosity of Major Yerbury, we possess six examples; of *T. orientalis* the male type only; of *T. vi* eight specimens sent to us by Major Yerbury from Aden; of *T. solaris* four males, for three of which we were indebted to Col. Swinhoe; of *T. fulvia*, previously unrepresented in our series, we now have the male; of *T. trinotatus* we have three males and a female; and, lastly, we now have a pair of *T. Palliseri.* Every species of this group hitherto described is therefore represented.

Of the carmine-tipped group Mr. Palliser obtained two species, which he tells me are indiscriminately called *T. danae* in Bombay: one of these, which was represented only by a single male, is apparently a dwarfed example of that species; the other, of which there was a good series, is *T. sanguinalis*, and only differs from the Ceylonese types in being slightly larger.

Of the *T. etrida* group there were examples of *T. bimbura* and *T. pernotatus*, the latter less heavily bordered than usual; and of the *T. evanthe* group, *T. pseudevanthe* and *T. titea.*

LVII.—*Notice of an Abnormal Growth in a Species of* Haliotis. By EDGAR A. SMITH.

THE British Museum has recently acquired a specimen of *Haliotis* which is remarkable for having *two* rows of perforations in the shell instead of one. So far as I can ascertain this is the only instance recorded of such an abnormality. The shell in question is an example of the large Japanese species *H. gigantea*, and measures $5\frac{1}{2}$ inches in length and nearly $4\frac{1}{2}$ in width. It is well known that the perforations in the shells of *Haliotis* are caused by a slit in the mantle of the animal at the particular part immediately beneath them. Instead of perfecting the contour of the shell, in the course of growth an interruption or sinus in the margin is produced, which subsequently is formed into a complete raised perforation. The number of perforations which remain open indicates the extent of the mantle-slit, but *not* the number of the tentacular filaments along the margins.

In this example four of the holes of the outer or normal series are open, whilst of the inner series, which runs parallel with the other at a distance at the widest part of a little more than an inch, all are closed or filled up. From this I conjecture that the edge of the mantle at this particular point was accidentally notched in early life (or perhaps it may have been a peculiarity from birth) and that the notch was not deep.

The perforations in the shells of this genus are supposed to be for conveying water to the branchiæ and also, to some extent, for the extrusion of fæcal matter. This theory in all probability is correct, as the gills and anal opening are situated immediately beneath, and one fails to see what other purpose they can serve. There being neither gills nor anal opening under the abnormal series of holes, they had no special function to perform, and consequently the animal appears to have filled them up with nacre from within as soon as possible, so that not even the last-completed one is left unclosed.

The supposed abnormal slit or *peculiarity* in the mantle must have been present when the creature was very young, for the series of holes is noticeable to within an inch of the apex, where the shell is so eroded that traces of both this and the outer series become obliterated. The growth of this abnormal series seems to have been more slowly effected than that of the outer row, since, in the same period, which can be judged of by the lines of growth, twelve were produced in the latter to eight in the former.

In the figures of the European *Haliotis tuberculata* which appear in the works of Cuvier * and Fischer † it will be observed that a tentacle is protruded through each of the last six or seven perforations. Cuvier, however, only describes "trois ou quatre filets" on the edges of the mantle-slit, and therefore it is all the more remarkable that in the figure referred to seven are represented. In another figure on the same plate (figure 11) three only are shown (the actual number which exists), and these are drawn in the relative positions which they seem invariably to occupy.

I have carefully examined three specimens of *H. tuberculata* and examples of five other species from various parts of

* Anat. Mollusques, pl. i. fig. 9.

† Man. Conchyl. fig. 596 (from an unpublished cut by Deshayes).

the world, and find in every instance *only three* tentacles present, and *always similarly located.* One is at the posterior end of the slit at the junction of the two margins just over the anus, and I believe would be protruded from the last open perforation, or, in other words, that most remote from the lip of the shell. The second is situated well forward on the left margin of the slit, and doubtless would, when the animal was living, occupy the last-completed opening. The third is on the right margin somewhat further back, and, judging by the distance which separates it from the preceding tentacle, probably would be extruded through the second perforation.

Philippi, in his 'Handbuch der Conchyliologie' (p. 215), states that the animal thrusts through the holes the tentacular prolongations of the left side of the foot. This, however, is an impossibility, as the examination of any species at once shows, and possibly was merely a conclusion derived from the appearance of Cuvier's or some other figure.

LVIII.—*Professor Blake and Shell-growth in Cephalopoda.* By F. A. Bather, B.A.

In the 'Annals' for April (p. 298) a paper on shell-growth in Cephalopoda was published, in which I described certain facts that appeared inconsistent with the views of Dr. Riefstahl and others. From facts first published by Drs. Riefstahl and Appellöf, but verified and extended by my own observations, I ventured to draw a few conclusions and to suggest an explanation which was avowedly theoretical. Prof. Blake ('Annals,' May, p. 376) has been good enough to criticize my paper without delay. Unfortunately misconception on all sides necessitates a reply. His remarks dealing with questions of priority and trustworthiness must be kept distinct from those dealing with facts and the conclusions based thereon. I first reply to the former; for if a man is proved ignorant of previously published results and guilty of substituting fancy for fact, his credit as a scientific worker is destroyed.

There is no doubt that readers of Prof. Blake's article understood him to mean that, so far as facts were concerned, I had said nothing new. This they inferred from such sentences as "Nor do I find that these writers have anything definite to add," and from the last paragraph but one:—"Although therefore a new student of the Cephalopoda is to be welcomed . . . it would be better that such a one should take up the story where others have left it than go over the old ground with preconceived theories and less careful observations. Nothing, in fact, in the present communication is new; though it may be little known, it was all in print six years ago.

"I am not at all sure, however, that the suggestion &c."

In consequence of these sentences I wrote to Prof. Blake and asked for references to any papers in which the facts brought forward by Riefstahl and myself had been described. He replied with promptness, and kindly permits me to make use of his letter. He writes, "Nor do I say that what you have said was all in print six years ago, but what *I said.*" We must therefore presume that Prof. Blake admits the originality of my observations, despite the contrary impression produced by his paper.

What Prof. Blake does say is that the description of the structure of the Nautilus-shell contained in his Monograph is opposed to some of my conclusions, of which description, he adds, I "seem to be ignorant." Those who know his admirable work will understand the damaging nature of this innuendo. Reply is of course impossible; but, as I gather from Prof. Blake's letter that he infers my ignorance of his work from the fact that I do not refer to it in what he is pleased to call my "Bibliography," I may point out that a list of "Papers and Works referred to" in the course of an article need not be a bibliography. Clearly mine was not: I mentioned neither the great work of Barrande, nor the articles in 'Science Gossip' by Mr. H. E. Quilter, nor Prof. Seeley's suggestive paper in Quart. Journ. Sci. (1864, p. 760), nor— but I might fill pages with references to papers on this subject, with which Prof. Blake must be better acquainted than I am, but to which he has nowhere alluded.

Ignorance of Prof. Blake's writings, though it might handicap, could not disqualify my work. More serious is his constant uncertainty as to whether what I say is "from autopsy or mental conception." Much as I regret this, I can but state that when I refer to definite specimens, or when I give "figures drawn to nature," I hope for some credence; when, on the contrary, I propose an explanation and invariably speak of it as "a theory" or "a view," I do not mean to assert it as a fact.

I pass with relief to Prof. Blake's discussion of facts and arguments; and here I am glad to find so much agreement.

So far as Sepia is concerned, Prof. Blake tacitly admits not only the originality but the correctness of the observations made by Riefstahl and myself. Where I differ from Riefstahl as to the facts, and in the inferences based on those facts with regard to Sepia, he also gives me his support. This support is valuable, for Prof. Blake knew all that we have discovered about the hard parts six years ago. All students will regret that his observations were never published. Prof. Blake apparently accepts the view that successive chitinous membranes are given off by the body-surface and subsequently calcified (a view which I claimed to defend rather than originate), and he joins me in ascribing to this process the formation of nacreous layer and septum. This view differs from that advocated in Blake's Brit. Foss. Ceph. p. 19, lines 23–27; it gives me pleasure to suppose that Prof. Blake's change of opinion is partly due to my new facts and arguments.

Prof. Blake denies "that in a Nautilus *the earlier septa are approximate*, the middle ones far apart, and the later ones approximate again." It is hard to see how this meaning can be extracted from my sentence, viz. "In the Nautiloidea the septa are *still* [*i. e.* at the present day] *far apart*, but approach in old age"; and I have repeatedly verified the remarks on p. 30 of his Monograph. Although he there says nothing as to the relations of the septa in the young uncompleted shell, he need not suppose that I thought his observations "too partial to be of value"; there was simply no occasion to allude to them.

I proceeded to say that the Ammonoidea soon differed from the forms with approximate septa which Hyatt, Foord, and others regard as archaic:—"So early as the *Goniatites* the septa are far apart in proportion to the diameter of the whorl." Prof. Blake (who seems to place all Goniatites in one genus) reminds me that *G. sagittarius* of the Devonian has very close-set septa, and asks if I can then maintain my statement. Certainly! I did not say "in *all* Goniatites" or even "in *most* Goniatites." The septa in one species may be ever so crowded; this does not affect the septation in other species, in other genera, in other subfamilies. Prof. Blake cannot be guilty of so obvious a fallacy in logic; he merely misunderstood the statement.

Finally, Prof. Blake approves the suggestion to divide the Cephalopoda into three orders, dropping the old terms Tetrabranchiata and Dibranchiata.

These orders are:—(i.) NAUTILOIDEA, Cephalopoda in which the protoconch is not preserved, although coiling takes place:

(ii.) Ammonoidea, Cephalopoda in which the protoconch is preserved by shell-coiling and comes to be affected thereby: (iii.) Coleoidea, Cephalopoda in which the protoconch is typically preserved by an external sheath deposited by the mantle; the shell comes to be enveloped by the mantle, and may partly, even wholly, disappear. The name Coleoidea (κολεός, sheath) is congruous with the other two already in use.

The main points, then, have the very welcome support of Prof. Blake; there are, however, two which he has severely criticized:—(i.) the suggestion that the membranes of the septa are typically continuous with those of the shell-wall; (ii.) the theoretical assumption that the lamellæ of Sepia are homologous with the septa of a Belemnite-phragmocone.

(i.) A supposition on which no argument is based may well be described as "imaginary." But Prof. Blake's manner of controverting the hypothesis is open to much objection. He writes ('Annals,' p. 377), "if Mr. Bather had availed himself of my observations of the shell of Nautilus . . . . he could not have written as he does." Then follow two paragraphs which distinctly profess to be an abstract of p. 17 *et seq.* of Prof. Blake's Monograph. Whether the statements of Prof. Blake in the 'Annals' are in accordance with fact I do not for the moment inquire; it is enough to show that they do not harmonize with the statements of Prof. Blake in the Monograph. Prof. Blake ('Annals') states that the outcropping edges of the fine laminæ are 20,000 to the inch: this statement is not in the Monograph; on the contrary, from pl. ii. fig. 8 of that work it appears that Prof. Blake's "outcropping edges" are 4000 to the inch, 2800 in fig. 7, while in the earlier chambers they can be "seen under a low power," and are drawn in pl. ii. fig. 5 at about 450 to the inch. The slight curvature of the shell cannot explain the discrepancy. Next, Prof. Blake ('Annals') states that the obliquity of these laminæ "is very slight, so that in tracing them from their commencement inside to their termination against the outer layer of the shell, they pass more than one septum": this statement is not in the Monograph, nor can it be inferred from the figures; on the contrary, in pl. ii. fig. 1 oblique lines are seen to pass from the inside to the outside within the space between two septa. Lastly, Prof. Blake ('Annals') states that the shell is composed of three layers, and that "the third layer is a thin amorphous substance covering the whole of the interior of the shell . . . In the later portion of the shell . . . it is seen *between the septum and the shell*, completely separating the two structures": this statement is not in the Monograph; on the contrary, there will be found on p. 19 this description:—"Besides these two layers there is a third, lining the interior of the shell. This is of very small thickness, and consists of similar laminæ to the nacreous layer, &c." The word "amorphous" is usually taken to mean "without structure."

Prof. Blake's descriptions are clearly inconsistent with one another. He did not suppose that I had made observations for myself. I have done so. And I am bound to add that both of his descriptions are inconsistent with the facts. We must suppose that his statements of this year are intended to supersede those of 1882: let us consider them. He says, "The outcropping edges of" the fine laminæ are "about 20,000 to the inch." He says of these laminæ, "their obliquity is very slight, so that . . . they pass more than one septum." It is seen by measuring the distance from suture to suture in a Nautilus-shell that, to fulfil the latter condition, each lamina must be from 1 to 3 inches long. It is therefore obvious that, to fulfil the former condition, there must be from 20,000 to 60,000 such laminæ in the thickness of the nacreous layer. And yet, as Prof. Blake correctly says, "about 1000 fine laminæ may be counted in its thickness."

Prof. Blake's statement, on which he rests much of his subsequent argument, that iridescence is here caused by diffraction of light due to outcropping edges of laminæ (*i. e.* diffraction by a reflexion-grating), is based presumably on the theory of Brewster; reference to the original paper (Phil. Trans. 1814, p. 397) will show that this, though the ordinary reading of it, is both incorrect and incomplete. In his Monograph Prof. Blake brushes aside the contrary conclusions of Dr. W. B. Carpenter without a reference to the elaborate arguments of that most accurate observer (see Brit. Assoc. Rep. 1844, p. 11). I do not here commit myself to any view, but examination of sections and shell-surfaces has convinced me that the cause to which Prof. Blake ascribes the observed phenomena is absolutely insufficient. For example, in the most iridescent part of the shell the lines of outcrop are furthest apart, and iridescent surfaces are seen between them. To maintain his assertion Prof. Blake is compelled to say that the septa are not iridescent. Nautilus-shells are not rare; but I have never yet seen one that confirms this last statement.

Let us now consider "the third layer." This was not described as amorphous by Hyatt (Bull. Mus. Comp. Zool. iii. p. 105, 1872) or by Blake (Brit. Foss. Ceph. p. 19, 1882).

The latter, it is true, said: "In the acute angles made by the junction of the septa with the circumference of the shell is another deposit, less transparent than the nacreous layer, but showing very little structure." It seems as though Prof. Blake were now confusing this with the "third layer." But his Monograph distinctly leads one to understand that this deposit does *not* pass between the septum and the shell. He mentions also "a loose amorphous deposit" lining each septum on either side, apparently continuous with that filling the angles. The fact is that all these deposits are of the same essential structure as the nacreous layer and septa. The constituent membranes are less compressed in the angles, but they become compressed and pass between the septum and the previously formed portion of shell-wall. They are, however, united with the septal and shell membranes on either side by transverse chitinous connexions; these appear to be the walls of what Prof. Blake calls "lacunæ"; they pass right into the nacreous layer and into the septum. There is therefore organic connexion between the septum and shell-wall in Nautilus, just as Riefstahl first described in Sepia. I confess that in my explanation ('Annals,' p. 306) I expressed myself too definitely; the credit of pointing this out is due to Prof. Blake, but it will be understood that there was nothing in his previous description to conflict with my idea, and that his present statements are too incorrect to influence the same. The following alteration of my previous paper (*ib.* p. 306) is based on my own observations; the altered words are in italics:—"On the surface of the cells that coat the visceral hump a layer of chitin * is, by concrescence of their distal portions, continually formed, and from it the membranes are, as it were, exfoliated. Secretion begin*s* in the anterior region of the shell-wall, *and* proceed*s* backwards to the suture, thence centripetally over the septum to the posterior margin of the septal neck. *The chitin* of the septum is *essentially* one with *the chitin* of the shell-wall. *Probably before, but possibly in consequence of, calcification* † *this chitin splits into membranes* (*vide suprà*). Lime is deposited as arragonite upon and between these membranes soon after their secretion; nacre is produced by this more purely physical process, *not by direct secretion.*" I hope that this theoretical explanation will satisfy Prof. Blake, and I must thank him for affording me an opportunity of making the correction.

* *Chitin*, more correctly *conchiolin* (see footnote, p. 303).
† See Osborn, Stud. Biol. Lab. Johns Hopkins Univ. ii. p. 427 (1883).

(ii.) Some of my arguments depend, as Prof. Blake points out, on the homology of the lamellæ in the pad of Sepia with the septa in the Belemnite-phragmocone. This homology is doubted by Prof. Blake, who now suggests that the lamellæ of the pad are homologous with the calcified membranes of the nacreous layer in the shell-wall of Nautilus. His arguments are three. He claims first that his observations on shell-structure do not countenance my view: my readers will decide whether Prof. Blake's description is valid evidence one way or the other. He states secondly that the lamellæ of Sepia "have no siphuncle, and they are not even perforated:" now each later-formed lamella is like an elliptical figure with the posterior part cut away by another broader ellipse; the earlier lamellæ are of more circular outline, but are similarly incised; if this incision represents the siphuncular space, then from this form to the form of the septa in Belosepia is a mere step; even in the Belemnite the siphuncle is so external as hardly to be surrounded by the septum. Lastly, he states that there is no trace of a "cap" or of a protoconch in Sepia: the explanation of this was given by Prof. Lankester in his "Observations on the Development of Cephalopoda" (Q. J. M. S. xv. p. 37) in 1875, and to the arguments of that authority no opposition has hitherto been offered.

The view taken by me as to the homologies of the Sepion was first put forward by Voltz (Mém. Soc. Hist. Nat. de Strassbourg, i. p. 1) in 1830; I am not aware that his arguments have ever been refuted; the view is adopted by Prof. Gegenbaur in his well-known text-book; it has been confirmed by recent observations, and, though I arrived at it independently from a study of the facts, I had no wish to retell an old tale.

I accept with gratitude the support and welcome of Prof. Blake, and only regret that his article should necessitate a reply so full of controversy. For this I apologize to the readers of the 'Annals,' but would remind them of the Rabbinical proverb, "By the contention of students science is advanced."

LIX.—*Descriptions of two new Species of Indian* Soricidæ. By G. E. Dobson, M.A., F.R.S.

As Mr. W. T. Blanford is about to print his work on the mammals of British India, and is anxious to include every known species from that region, he has requested me to publish diagnoses of the following species, of which full descriptions are to be found in the manuscript of the still unpublished part iii. of my 'Monograph of the Insectivora.'

The following two species of *Crocidura* belong to the so-called subgenus *Pachyura*, having the dental formula

$$\frac{\text{nc. } 3\text{—}3, \text{ pm. } 3\text{—}3, \text{ m. } 3\text{—}3}{\text{mand. } 6\text{—}6} = 30 \text{ teeth.}$$

Crocidura leucogenys, sp. n.

Somewhat larger than *C. aranea*. The ears are short and clothed with a few short whitish hairs only; the tail is thick and fusiform, and clothed as in *C. murina*, numerous long, fine grey hairs arising out of the shorter fur; the feet compared with the size of the body are small and slender, thinly clothed with short greyish-brown hairs; a very large lateral gland, like that in *C. murina*, is found in the usual position.

The fur is short throughout; above light cinnamon-brown, with a reddish tinge intermixed with grey, the basal half of the hairs bluish; the sides of the head between the angles of the mouth and the ears, the chin, and part of the chest are dirty white, the remainder of the ventral surface greyish; the upper surface and sides of the tail are brown, the lower surface grey.

The skull and teeth closely resemble those of *C. murina* on a much reduced scale; they also resemble those of *C. Stoliczkana*, Anderson; but skulls of quite immature specimens of the latter species, although much smaller, have longer upper tooth-rows.

Length (of an adult male preserved in alcohol): head and body 75 millim., tail 47, ear 8, elbow to end of middle digit (without claw) 17, manus 7, pes 12; skull, occipital crest to front edge of premaxillary bone 19, greatest width of skull 9, length of upper tooth-row 7, length of lower tooth-row 8, length of mandible from condyle to tip of anterior tooth $12\frac{1}{2}$.

Hab. India (*Ajmir*).

Type an adult male collected by Sir O. B. St. John.

Crocidura Dayi, sp. n.

Smaller than *C. rubicunda*, but with a longer tail and nearly as large a foot. Fur and integument dark brown throughout, the ventral surface slightly paler, the basal three fourths of the fur on both surfaces dark bluish grey Tail long and clothed with very short hairs; in the single specimen there are scarcely any long fine hairs to be seen; feet slender and similarly thinly clothed. No trace of a lateral gland.

The skull differs conspicuously from that of *C. rubicunda* in its smaller size. The teeth differ in the shape of the first upper incisor as well as in the large size of the penultimate premolar. The first upper incisor has a large basal process provided with an internal basal cusp, the anterior principal cusp of this tooth is short and does not equal that of the second incisor in vertical extent; the third incisor is smaller and shorter than the anterior maxillary tooth; the small penultimate premolar is much larger than usual in the genus, being about three fourths the size of the third incisor in cross section at the base, and its cusp slightly exceeds in vertical extent the anterior basal cusp of the last premolar; the anterior mandibular tooth has two notches.

Length (of a skin): head and body 74 millim., tail 60, pes $15\frac{1}{2}$; skull, occipital crest to front edge of premaxillary bone $17\frac{1}{2}$, greatest width of skull 9, length of upper tooth-row 9, length of lower tooth-row $8\frac{1}{2}$, length of mandible from condyle to tip of anterior tooth 12.

Hab. Madras Presidency, India (exact locality unknown).

Collected and presented to the British Museum (Natural History) by Dep. Surgeon-General F. Day, C.I.E.

LX.—*Contribution to our Knowledge of the Fishes of the Yangtsze-Kiang.* By Dr. A. Günther, Keeper of the Zoological Department, British Museum.

Since I had the pleasure of reporting on a collection of Reptiles* made by Mr. A. E. Pratt at Kiu-Kiang, on the Yangtsze River, he has proceeded further inland, to Ichang, a distance of 1000 miles from the mouth of the river. He was fortunate enough to obtain there a specimen of the porpoise, the existence of which had been mentioned by several travellers (Blakiston, A. J. Little), and of which I especially desired

* See *antè*, p. 165. I regret not to be able to make use of the notes on Chinese fishes in 'La Pisciculture et la Pêche en Chine par P. Dabry de Thiersant,' as the figures as well as the accompanying notes are the work of persons not conversant with the rudiments of descriptive ichthyology, and as likely to lead to misconceptions as to assist in the determination of the species.

him to procure a specimen. This porpoise is not what, from the great distance from the sea, I expected it to be, but proves to be identical with, or closely allied to, *Delphinus* (*Neomeris*) *melas* of Schlegel. I still consider it probable that a species of *Platanista* may yet be found to inhabit the Yangtsze-Kiang, a river which would seem to be well adapted for the existence of this type of freshwater Cetacean.

The fishes sent by Mr. Pratt in the same consignment belong to the following species :—

CHONDROSTEI: *Acipenser*, sp. (two very young examples differing from the species hitherto known); *Psephurus gladius*, Martens (young).

ACANTHOPTERYGII: *Eleotris xanthi*, sp. n.; *Ophiocephalus argus*, Cant.; *Polyacanthus opercularis*, L.

SILURIDÆ: *Silurus asotus*, L.; *Macrones longirostris**, Gthr.; *Macrones crassilabris*, Gthr.; *Macrones tæniatus*, Gthr.; *Macrones Vachellii*, Rich. (A. 27); *Macrones macropterus*, Blkr.

CYPRINIDÆ: *Carassius auratus*, L.; (*Crossochilus monticola*, sp. n.); *Pseudogobio sinensis*, Kner; *Pseudogobio productus*, Ptrs.; *Pseudogobio maculatus*, sp. n.; *Rhinogobio cylindricus*, sp. n.; *Pseudorasbora parva*, Schleg.; *Xenocypris argentea*, Gthr.; *Ctenopharyngodon idellus*, C. V. (specimens 2 feet long); *Rhodeus sinensis*, Gthr.; *Ochetobius elongatus*, Kner; *Squaliobarbus curriculus*, Rich.; *Hypophthalmichthys molitrix*, C. V.; *Chanodichthys pekinensis*, Basil.; *Culter ilishæformis*, Blkr.; *Hemiculter leucisculus*, Kner; *Luciobrama typus*, Blkr.; *Homaloptera fimbriata*, sp. n.

COBITIDINA: *Misgurnus anguillicaudatus*, Cant.; *Misgurnus mizolepis*, sp. n.; *Nemachilus xanthi*, sp. n.

I subjoin some notes, chiefly descriptive of the new species.

Eleotris xanthi.

D. $6/\frac{1}{9}$. A. 1/7. L. lat. 33.

Præoperculum without spine. Twelve series of scales between the origin of the second dorsal fin and the anal. The scales on the neck, cheek, and opercles are small and do not extend on to the interorbital space. Scales finely ciliated. The height of the body is one fourth of the total length (without caudal), the length of the head two sevenths.

* This is not a Japanese species, as I was incorrectly informed when I described it.

Eye rather small, shorter than the snout, one fifth of the length of the head, and exceeding the width of the interorbital space. Head rather compressed and high behind, with broad snout, and with the lower jaw prominent. The maxillary extends to the vertical from the front margin of the orbit. Gill-membranes attached to the median line of the isthmus. Vertical fins lower than the body ; caudal fin rounded, equal in length to the pectorals, which are three fifths of the length of the head. Light-coloured, with broad, indistinct, darker cross bands on the sides. Dorsal and caudal fins indistinctly spotted with brown ; no spot at the base of the pectoral fin.

This species, of which there is only one specimen in the collection, $2\frac{1}{2}$ inches long, is allied to *Eleotris potamophila*, but readily distinguished from it by its narrow, scaleless, interorbital space. I do not know of any other species of this genus extending equally high up in fresh water.

Crossochilus monticola.

D. 11. A. 8. L. lat. 42. L. transv. 7/7.

Lips not fringed, the lower with a firm, sharp, horny cover ; four barbels, of which the lower are nearly as long as the eye and the upper minute. The height of the body is two sevenths and the length of the head two ninths of the total length (without caudal). Eye of moderate size, two ninths of the length of the head, two thirds of that of the snout, and rather more than half the width of the interorbital space, which is convex. Snout obtuse in front, with pits in which probably horny tubercles are secreted during the breeding-season. Mouth transverse, inferior. The origin of the dorsal fin occupies nearly the middle between the end of the snout and the root of the caudal ; root of the ventral fin opposite to the fourth, fifth, and sixth dorsal rays ; pectoral fin a little shorter than the head, reaching nearly to the origin of the dorsal fin. Four longitudinal series of scales between the lateral line and the root of the ventral fin. Caudal fin deeply cleft, as long as the head. Coloration uniform.

A single specimen, 7 inches long, was obtained by A. Henry, Esq., in a mountain-stream flowing into the Ichang gorge of the Yangtsze River.

Pseudogobio productus.

Pseudogobio productus, Peters, MB. Berl. Akad. 1880, p. 1035, fig. 6 (head).

D. 11. A. 9. V. 8. L. lat. 50. L. transv. 6/6.

The height of the body is one seventh of the total length (without caudal), the length of the head more than one fourth. Snout long and produced, with the upper profile concave, much longer than the diameter of the eye, which is one fourth of the length of the head. Mouth inferior, subsemicircular, of moderate width; jaws with broad lips, the inferior fringed in the middle; upper lip not fringed; barbel as long as the eye, compressed and rather stiff. Præorbital elongate, rhomboidal. The origin of the dorsal fin is midway between the end of the snout and the first anal ray; ventrals inserted below the hinder half of the dorsal. Caudal fin deeply forked. Pectoral fin inserted horizontally, as long as the head, but not extending to the ventral. Transparent greenish above, a narrow bluish band along the lateral line; abdomen silvery; fins not spotted.

Two specimens, of which the larger is 7 inches long, are in the collection.

Pseudogobio maculatus.

D. 10. A. 8. L. lat. 41. L. transv. 4/5.

Barbels none. Body rather compressed, its greatest depth being equal to the length of the head and one fourth of the total (without caudal); snout rather compressed, of moderate length, a little longer than the eye, the diameter of which is nearly one fourth of the length of the head. Interorbital space convex, as wide as the orbit. Mouth very small, subanterior; lower lip interrupted in the middle. The origin of the dorsal fin is nearer to the end of the snout than to the root of the caudal; ventrals inserted below the middle of the dorsal; caudal fin moderately forked; pectoral not quite so long as the head, extending to the origin of the dorsal fin, but not to the root of the ventral. Silvery, with large, irregular, deep black spots, each occupying one or more scales; anterior part of the dorsal fin and a band along each caudal lobe black.

Two specimens, the larger of which is 3 inches long, are in the collection.

This species would belong, on account of the absence of barbels, to Bleeker's genus *Sarcochilichthys.*

Rhinogobio cylindricus.

D. 11. A. 8. V. 8. L. lat. 48. L. transv. 6/7.

Body low, subcylindrical, its greatest depth being contained five and a half times in the total length (without caudal), the length of the head four times and a fourth. Head low, with the snout much elongate and pointed, the eye being rather nearer to the gill-opening than to the end of the snout; the projecting part of the snout is swollen, conical, the mouth being entirely at the lower side of the snout. Eye one fifth of the length of the head, less wide than the flat interorbital space. Upper lip swollen; lower very short, broadly interrupted in the middle; barbel very short, lying in a groove which extends forward to near the extremity ot the snout. Gill-membrane attached to the side of the isthmus. The origin of the dorsal fin is considerably nearer to the end of the snout than to the root of the caudal; ventrals inserted below the posterior half of the dorsal. Caudal deeply forked. The pectorals are much shorter than the head, and scarcely extend to the origin of the dorsal fin. The lower parts of the head and of the thoracic region entirely scaleless. Coloration transparent, without any spots.

One specimen, 4 inches long.

This species differs from *Rhinogobio typus* in having a much smaller eye and in having the lower parts of the thorax scaleless.

Hemiculter leucisculus, Kner.

This species is subject to variations with regard to the width of the third suborbital bone and the position of the ventral fins. In specimens from Ichang the third suborbital is broad enough to be in contact with the præopercular limb, whilst in specimens obtained in the lower parts of the river there is a more or less broad strip of soft skin intervening between suborbital and præoperculum. In the specimens from Ichang the root of the ventral is opposed to the first dorsal spine, whilst in the majority of our other specimens the whole of the ventral is in advance of the dorsal.

Homaloptera fimbriata.

D. 11. A. 7. P. 19. V. 11.

This species differs from the typical species of *Homaloptera* in the shape of its snout and in the arrangement of the barbels. The snout is flat and spatulate, considerably narrowed in front and nearly as long as broad; the mouth is surrounded with fringes, from which the barbels differ only by their greater size; the barbels and fringes of the upper jaw arranged in two concentric series, two pairs of barbels standing in the outer series; behind each angle of the mouth there is a third pair of barbels.

Scales minute and smooth, but there are a few larger ones along the median line of the back and along the lateral line. Origin of the anal fin rather nearer to the root of the caudal than to the occiput. Eyes very small, much nearer to the gill-opening than to the end of the snout; ventral fins opposite to the anterior half of the dorsal. Pectoral fins not extending to the ventrals. Body with broad, indistinct, dark cross bands; pectoral, ventral, and caudal fins with greyish spots.

One specimen, 4½ inches long.

Misgurnus mizolepis.

D. 7 or 8. A. 8 or 9. V. 6 or 7.

This species has larger scales than any other of the genus known to me; they are arranged in thirteen longitudinal rows between the dorsal fin and the lateral line and in ten between the lateral line and the ventral fin. Barbels ten, four belonging to the mandible; the inner pair of the mandibulary barbels are about half the length of the outer ones. Head and body compressed. The height of the body is nearly equal to the length of the head, which is contained six and a half times in the total (without caudal). Snout at least twice as long as the diameter of the eye, which is one sixth of the length of the head. Origin of the dorsal fin nearer to the root of the caudal than to the occiput, conspicuously in advance of the root of the ventral fin. Pectoral fin a little shorter than the head; caudal fin rounded, continued by a series of rudimentary rays to the anal fin, and a similar distance forward on the dorsal edge of the tail; these rudimentary rays render the free portion of the tail particularly deep. Greyish green, with a greyish line along each series of scales; lower parts whitish, finely mottled with brown.

Three specimens, of which the larger is 6½ inches long, were sent by Mr. Styan from Kiu-Kiang.

Nemachilus xanthi.

D. 12. A. 7. V. 8.

Scales minute, but conspicuous. Caudal fin deeply emarginate; the origin of the dorsal fin is midway between the end of the snout and the root of the caudal. The height of the body is considerably less than the length of the head, which is one fourth of the total (without caudal). Snout of moderate length, pointed, as long as the postorbital portion of the head; eye of moderate size. A skinny adipose lobe occupies the place of the enlarged axillary scales of the pectoral and ventral fins. Back crossed by fourteen narrow brownish bands; a small deep black spot at the end of the lateral line; each caudal lobe with four oblique blackish bands; each dorsal ray with one or two blackish specks.

One specimen, 4½ inches long.

LXI.—*On the so-called Eyes of* Tridacna *and the Occurrence of Pseudochlorophyll-corpuscles in the Vascular System of the Lamellibranchiata.* By J. Brock *.

Since the investigations of L. Vaillant *Tridacna* has usually been reckoned among the eye-bearing bivalve Mollusca. As the clam-shells, or at least their smaller species, are among the commonest inhabitants of the Indian coral-reefs, I had sufficient inducement, during my residence in the Indian Archipelago in the year 1886, to undertake a careful investigation of these supposed eyes. But owing to the abundance of the tasks which presented themselves on the spot I succeeded finally only in bringing with me to Europe some well-preserved material which has furnished the sole foundation of the following description.

As is well known, the margins of the mantle of the living species of *Tridacna* are splendidly coloured. The observation of the living animals in their natural position is one of the most charming spectacles which the coral-reefs, rich as they are in beautiful forms and brilliant colours, can present, and the enthusiastic descriptions of travellers (Quoy and Gaimard †, Cuming ‡, Vaillant §) are in this particular not in the least exaggerated, as I can affirm from my own experience.

The so-called eyes have no small share in producing this

* Translated by W. S. Dallas, F.L.S., from the 'Zeitschrift für wissenschaftliche Zoologie,' Band xlvi. pp. 270–287. The original memoir is illustrated with a plate (pl. xxii.).

† 'Voyage de l'Astrolabe,' Zoologie, par Quoy et Gaimard, tome iii. (1835), p. 488.

‡ Reeve, 'Conchologia Iconica,' part xiv., Monograph of *Tridacna.*

§ Ann. des Sc. Nat. sér. 3, tome iv. p. 73 (1865).

beauty. They stand out from the margin of the mantle, which is sometimes ultramarine blue, sometimes emerald-green *, as an irregular row of differently coloured points, sometimes black, sometimes brown †, so that an impression is produced as if Nature, in order to heighten the brilliant spectacle, had set differently coloured gems in the splendid material of which she forms the margins of the mantle. Even upon a superficial examination we easily see that these differently coloured spots adorn the summits of low, obtusely conical elevations, which Vaillant directly characterizes as "eye-tentacles" ("tentacules oculiformes," *l. c.* p. 83). How far this is correct a closer examination of their structure will show.

The considerable size which, as is well known, these animals attain, and the labour necessary for obtaining them (they have to be chiselled out of the blocks of madrepore ‡), at once placed a limit upon the amount of material brought away. My investigations have therefore been made exclusively upon three specimens; but as these furnished me with several hundred "eyes" for examination, the want of very young and of full-grown examples can alone be regarded as injurious to the completeness of the description. My largest specimen, which measured 18 centim. along the margin of the mantle, was killed in very dilute chromic acid (0·25 per cent.), then treated with gradually stronger alcohol; in the case of a second specimen of the same size the margin of the mantle was separated from the living animal and hardened successively in dilute osmic solution and then in alcohol; with a third small example I contented myself with hardening in alcohol. As will be seen hereafter these different methods of

* In *Tridacna crocea*, Lam., according to Quoy and Gaimard, ultramarine blue, in *T. elongata*, Lam., green, in *T. squamosa*, Lam., which was observed by me, most frequently also green, but with all shades towards blue very frequent, until the animals were pure blue. Moreover the metallic lustre of the colours is so strong that, as Vaillant correctly remarks (*l. c.* p. 73) only comparison with jewels can give even a tolerably good notion of them. The pigment, according to Vaillant (*l. c.* p. 86) is exclusively seated in the epithelium of the mantle. At any rate the coloration disappears immediately in alcohol without leaving any traces; it must also be remarked that nothing is to be found of a "spangle-layer," such as is so generally diffused in fishes with metallic lustre.

† Black in *T. elongata*, observed by Vaillant (which is confirmed by Möbius, 'Beiträge zur Meeresfauna d. Insel Mauritius u. d. Seychellen, Berlin, 1880, p. 322), yellowish green in *T. crocea* according to Quoy and Gaimard, as also from my personal recollections in *T. squamosa*. Unfortunately I cannot now make any definite statement upon this point, as I omitted making a coloured drawing.

‡ The mode of life of *T. squamosa* appears therefore to agree perfectly with that of *T. crocea*, as described by Quoy and Gaimard (*l. c.* p. 488).

preservation have supplemented each other very advantageously for the investigation.

Now, therefore, we may pass to the consideration of the "eye-tentacles." At the very first glance at the margin of the mantle of a *Tridacna* we observe a series of irregularly formed but generally obtusely conical tubercles or warts, which, at variable distances from the margin, upon the inner or branchial surface of the mantle, form a row nearly parallel with the margin of the mantle, and in my largest example, in which the mantle-margin is about 18 centim. long, I count on each side about fifty of these structures. Their distance from each other and from the margin of the mantle is no less irregular than their size and form. While the distance from the margin usually varies between 2 and 5 millim., we find individual warts much further inwards, even as far as 15 millim. The distance of the warts from each other is equally variable. While we sometimes find groups of six or eight together in a close series, a more irregular arrangement in small groups of two or three placed at variable distances apart is by far the most frequent condition.

The form of the larger elevations is generally that of a low hill, which, however, appears seated upon the surface of the mantle not straight, but obliquely, in such a manner that the apex looks towards the margin of the mantle. In the largest structures of this kind the long diameter (by which I mean that perpendicular to the mantle-margin) is usually somewhat greater than the transverse diameter (parallel to the margin), which it may exceed by about one third; in middle-sized tubercles the two diameters are nearly equal, and in small ones the proportion may be in favour of the transverse diameter. In the largest warts observed by me the diameters in question attained the lengths of 3 and 2 millim. As regards the form of all the warts, of whatever size, it is characteristic that their dorsal surface melts very gently and gradually into that of the inner surface of the mantle, while the ventral surface (that turned towards the mantle-margin) descends abruptly, and, indeed, below the level of the surface of the mantle, each wart being surrounded on its ventral side by a semicircular furrow, which stands in the same relation to it as the fosse of a fortress to the bastion. This fosse is very seldom faintly marked or quite effaced.

Between the series of large warts and the margin of the mantle there is a series of smaller structures of a peculiar kind, which are only just visible with the naked eye. Sometimes, but not frequently, the structures now to be described occur also between the larger warts or even beyond them;

but the great majority of them form a continuous series between the larger warts and the mantle-margin, and show exactly the same irregularity of arrangement as the larger warts themselves. At the first glance the two kinds of structures seem to have little to do with each other; frequently the smaller ones appear as mere scar-like shrinkings-in of the surface of the mantle without any perceptible elevation above the surface. But more advanced structures, in which these scar-like shrinkings already surround a slightly convex eminence, show us the transition towards typically constructed warts. These smaller structures are warts in course of development; the only thing remarkable in the process of development is the circumstance that the semicircular furrow which girdles the wart ventrally first sinks into the surface of the mantle, and only then the wart rises up above the inner mantle-surface from the dorsal declivity of this "fosse." This idea is also fully confirmed by the examination of series of transverse sections.

In general the smaller structures just described are so little remarkable in the vicinity of the mantle-margin, even in chromic-acid preparations, that during life the slight differences of relief caused by them will hardly appear at all. On the other hand, it would appear from Vaillant's description that during life these structures also are the seat of an intense pigmentation, and therefore must catch the eye very readily. With regard to them our author says (*l. c.* p. 83):—" In the periphery of the free margin of the mantle the green coloration forms an uninterrupted border, which is adorned with a series of very regularly arranged black spots; near them, but further inwards, there are large projecting tubercles also marked with a black spot; they are more numerous in the vicinity of the branchial aperture, and represent the eye-tentacles."

While there can be no doubt as to the identity of these latter structures (which, moreover, are described more in detail in another place, *l. c.* p. 135) with the larger warts described by me, the agreement of the younger structures with Vaillant's series of pigment-spots along the mantle-margin is a good deal more uncertain. In favour of this view we may cite the similarity of situation and arrangement, although so regular a position as Vaillant describes and figures (*l. c.* pl. viii. fig. 1) does not agree with my objects, and, further, the circumstance that the larger warts are most certainly pigmented. On this point, unfortunately, my personal recollections leave me completely in the lurch.

In order to ascertain the intimate structure of all these formations of the margin of the mantle, suitably selected portions of the margin were stained with alum-carmine and then divided in different directions into series of cross sections from 0·0125 to 0·01 millim. in thickness. The result was very surprising. From the scanty statements of Vaillant it might have been anticipated that the histological investigation would reveal a highly organized eye. "Notwithstanding the volume of these organs," says Vaillant (*l. c.* p. 135), "which in large individuals measure not less than 2–3 millim. at their base, I was unable, on account of the thickness and opacity of the tissues, which render dissections very difficult, in definitely finding in them the constituents which have been described in some other Mollusca, and especially in the species of *Pecten*. Near the apex of the tubercle there is a spot of dark pigment, which may be regarded as a choroid; and, further, in successful preparations, when such a wart is examined from the side, we see a convex transparent capsule, which might perhaps be assimilated to a cornea." These exceedingly cautious assertions, however, agree so little with the actual conditions that it is difficult to say what Vaillant really saw. For his excuse it may be indicated that his method of investigation must necessarily have exposed him to the most serious illusions.

Let us first of all examine the larger wart-like elevations which stand at a distance from the margin of the mantle. In these the first section in any direction teaches us the important fact that the warts themselves are not eyes or other special organs of any kind, inasmuch as their structure perfectly agrees with that of the mantle. But in the warts themselves there are in small numbers some very peculiarly constructed organs of microscopic minuteness, which perhaps might be eyes and which must here be somewhat closely examined in the first place.

The organs in question have the general form of a shallow flask with a broad belly and a short wide neck. They lie immediately beneath the epithelium and are so oriented that the belly is turned inwards and the neck outwards, so that their long axis is perpendicular to the epithelial surface. Even on the largest warts we do not find more than ten or twelve such organs; on smaller ones fewer in proportion to their size. With rare exceptions, in which we find individual organs on the extreme periphery of a wart, they throughout prefer the median regions; their favourite place is the surface of the wart turned towards the mantle-margin, which descends abruptly towards the crescentiform furrow. Here we find about 75 per cent. of their whole number, the remainder

30*

being pretty uniformly distributed over the most elevated part of the wart. Exceptionally a flask-shaped organ occurs on the outer declivity of the crescentiform furrow, therefore really outside the domain of the wart itself. The "flask-shaped organs," as we will name them for the present, usually stand in groups of two or three close together, but not unfrequently singly. Their size varies little. I found the greatest long diameter of a well-developed organ to be 0·2 millim., while the greatest transverse diameter amounted to 0·15 millim. This would be sufficient to enable them to be recognized under the lens even in a fresh torn preparation, that is to say, supposing them to be sufficiently differentiated from the surrounding tissue, which I greatly doubt.

The minute structure of a flask-shaped organ is comparatively simple. The whole is surrounded by a thin membrane, visible in sections as a strong contour, and which here and there contains imbedded fusiform nuclei. The chief contents consist of large cells, which in life are probably nearly round, but in my preparations irregularly polygonal, in consequence of the shrivelling, which cannot quite be avoided. These cells also possess a distinct membrane, recognizable as a thick contour; their protoplasm is quite free from granular inclusions, and in life probably perfectly transparent and strongly refractive. In my chromic-acid and osmium preparations it had acquired a finely reticular character, no doubt a phenomenon of coagulation; while in the alcoholic preparations a dully-lustrous fat-like substance had separated in large drops. The remarkably small, perfectly spherical nucleus is placed quite excentrically on a part of the membrane. The greatest diameter of these "transparent cells" is 15–25 μ, that of their nuclei 3–5 μ.

These transparent cells are surrounded, like a nut by its shell, by a somewhat differently constituted layer, which extends directly inwards from the external limiting membrane. This "external layer" is most perfectly developed at the bottom of the bellied part of the flask-shaped organ (which lies away from the surface of the mantle), and thence advances forwards, but without ever attaining the foremost part, that is to say, to keep up the comparison, the mouth of the flask. On the whole, this cell-layer is characterized by great irregularity. Not only do the individual cell-elements composing it often project irregularly into the cavity of the flask, but their arrangement is also sometimes interrupted; there occur in it larger and smaller gaps, into which the transparent cells penetrate and thus come into direct contact with the limiting membrane. In contrast to the transparent cells those of the outer layer appear very opaque, owing to their coarsely granular protoplasm; they are somewhat smaller (10–15 μ) than the transparent cells, show no recognizable membrane, and are polygonally pressed against one another. Their round nucleus, averaging 3–5 μ in diameter, is not placed excentrically, but more in the centre.

It is exceedingly remarkable and ought to be particularly noted that I have never seen a nerve passing to a flask-shaped organ.

With the anterior neck-like portion the organs frequently reach immediately under the epithelium, but just as often the thin layer of connective tissue, which forms the boundary between the tissue of the mantle and the epithelium, intervenes between them. The epithelium is the moderately thick, one-layered, vibratile cylinder-epithelium, with basal nuclei and thin, strongly refractive cuticle, which is sufficiently well known in the mantle of the Lamellibranchs. On the outer surface of the mantle (the shell-side) a great number of elongate, flask-shaped, unicellular mucus-glands open among the epithelium; these, when stained with alum-carmine, show very distinctly the framework-substance recently described by List * and myself in these elements.

The flask-shaped organs often project outwards more or less strongly, so as to push out the epithelium covering them in a conical form. This peculiarity is generally much better developed in those organs which we find upon the smaller (and probably younger) warts than in those which belong to older structures. With regard to their epithelial coat also a distinction may be set up. Throughout this is somewhat thinned over the flask-shaped organs, but in the younger much more than in the older ones. While in the latter the difference from the normal epithelium is but small and often scarcely perceptible, the epithelial covering over the younger structures is often reduced to a pavement-epithelium scarcely visible in profile.

We have just spoken of older and younger warts, and this gives the opportunity of going somewhat more into detail upon the relations of the two structures, which in description we have in the first place treated separately. If we examine the minute structure of one of the undeveloped structures near the margin of the mantle, which appear to the naked eye rather as scar-like indrawn depressions, it is soon seen that no principal differences from the larger warts exist in

* J. H. List, "Zur Kenntniss der Drüsen im Fusse von *Tethys fimbriata*, L.," Zeitschr. f. wiss. Zool. Bd. xlv. p. 281; and J. Brock, *ibid.* xliv. p. 333.

them. Here also we find flask-shaped organs in the typical position at the inner wall of the "fosse," or more rarely upon the still very low dome of the wart which is just swelling up. But their number is small, varying only from one to three; and moreover, as already stated, they project more strongly above the surface, and push out the much thinned epithelium of the mantle into a bump at this spot.

With respect to size and the details of the minute structure there is, however, absolutely no difference between them and the flask-shaped organs of the larger warts. If we examine more exactly the external relief of these younger structures it is not difficult to find evident incipient stages, in which only a deep narrow inversion of the epithelium of the mantle represents the first trace of the future "fosse," while within this the future tubercle is either not indicated at all or only by a broad, low, scarcely perceptible elevation. From these incipient stages up to typically developed warts all possible intermediate forms may be found, and hence there seems to us to be no doubt that the smaller structures near the margin of the mantle are developmental stages of the typical large warts. If this conclusion be correct, this development has certainly the remarkable peculiarity of showing that first of all the "fosse" surrounding the wart on the side towards the mantle-margin sinks in, and the wart only then begins to swell up above the surface of the mantle. If we add to this that our younger specimen of *Tridacna*, in which the mantle-margin measures only 13 centim. in length, shows only such younger organs towards the margin, and, indeed, in rather small numbers (in all about fifty were counted upon each mantle-margin), and, on the other hand, not a single distinctly projecting wart, we are not unjustified in coming to the conclusion that during the whole life of the animal new-formation of warts goes on continually, starting from the margin of the mantle *.

With regard to the formation of the flask-shaped organs we have unfortunately no direct observation. But from the circumstance that they occur typically developed in the youngest warts, it at least follows with some certainty that their formation precedes that of the warts. Therefore as the place where a new flask-shaped organ originates is not marked externally by change in relief of the surface of any kind, it is clear that only some very fortunate chance could throw any light upon the production of a flask-shaped organ in the adult

* The development of the warts sometimes attains such an extreme degree that they begin to be constricted off from the parent-surface and give origin to short-stalked clavate or mushroom-like structures.

animal. It may, however, be admitted that for a long time a new-formation of such organs must take place in the larger warts, for a comparison of the number of flask-shaped organs of the larger warts with the very much smaller number in younger structures leaves only the alternative between this supposition and the much more improbable one of a subsequent fusion of several smaller warts into one large one; but even here it is remarkable that I have never been able to observe a flask-shaped organ *in statu nascendi*. However, I will readily admit that I have not devoted much time to seeking for it, as in connexion with the chief interest which attaches to these mysterious organs, namely their function, no light is to be expected from developmental history.

Throughout, in all attempts to attribute any definite function to these organs, we find ourselves in a peculiarly unfavourable position. In the first place, because there are no available observations as to the behaviour of the living animal, as to undoubted sensorial perceptions, or the like, which might be brought into connexion with the flask-shaped organs. Further, because we know nothing definite as to the pigment, which, as we have seen, is undoubtedly present during life, and its arrangement relatively to the organs, a point which would have to be considered in the first line in every attempt at interpretation. And, finally, because we know even the histological elements which compose the flask-shaped organs only in the preserved state. We do not know whether the transparent cells are as strongly refractive during life as we suppose them to be from our preparations; we know nothing as to the constitution of the cells of the "external layer" during life. Thus any serious attempt at interpretation must for the present remain in suspense. Nevertheless we believe we shall not go wrong in decidedly rejecting any interpretation of our organs as eyes. The only things that might be adduced in favour of this interpretation is the resemblance of the "transparent cells" to the lenses of many Invertebrates, and above all the exceedingly favourable position of the organs for visual perception; but how many and important are the reasons against it! Above all, at any rate, the want of any large nerve-trunk running to the organ and of a perceptive layer, for we cannot expect even the boldest imagination to regard the "external layer" as a retina*.

* We know very well that precisely among the Mollusca "eyes" have frequently been described to which no large nerve-trunks could be proved to run; but in all these cases the interpretation, although assailable, is to a certain extent justified, if only because the organs in question agreed

A much more probable interpretation is that the flask-shaped organs are luminous organs. If the cells of the "external layer" have the faculty of shining, the "transparent cells" might perhaps act as prisms. This depends, however, very much on whether the distribution of the pigment, which we do not know, supports such an interpretation. Whether any luminosity really occurs during life is not known *, and, indeed, not at all probable, as from the abundance of the *Tridacnæ* in the whole Indo-Pacific region so remarkable a phenomenon could hardly have remained unobserved until now.

Perhaps my respected friend Dr. Sluiter, when these lines come under his notice, may be induced to make some observations upon the point in question. With the exception of some superficial and illusory resemblances there is no relation to the luminous organs of the Scopelidæ. The only organs

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closely in structure with undoubted eyes (*Patella*, see P. Fraisse, Zeitschr. f. wiss. Zool. Bd. xxxv. p. 468; moreover, as I now find, Hilger has recently demonstrated the nerve of the eye of *Patella*, see Morph. Jahrb. Bd. x. p. 358, 1884), or at least because physiological experiments proved the animal to be extraordinarily sensitive to light (as especially in the cases recently described by Sharp and Patten; see B. Sharp, "On the Visual Organs in Lamellibranchiata," Mitth. Zool. Stat. Neapel, Bd. v. p. 447, and W. Patten, "Eyes of Molluscs and Arthropods," *ibid.* Bd. vi. p. 542). But no special sensitiveness to light can be absolutely proved in *Tridacna*; indeed, *Tridacna* is so little sensitive that usually it is only upon direct contact that it retracts the margins of the mantle and closes its shell.

* I certainly thought that I was on the track of a conclusive observation when I read as follows in the treatise on the Invertebrata, edited by O. Schmidt, in Brehm's 'Thierleben' (ed. 2, Bd. x. p. 387):—"Besides many singular things, as, for example, that the Giant Clams (*Tridacna*) when they open at night diffuse a bright light or a lustre noticeable from a distance . . . besides these things our Dutchman (Rumph) cites some examples of the size and strength of *Tridacna gigas*," &c. But a comparison with the original showed that O. Schmidt had either read the passage in question hastily or misunderstood it. At p. 132 of his 'Amboinsche Rariteitkamer' (first Amsterdam edition of 1705) Rumphius says:—"They relate many singular things of a large Bia garu (*Tridacna gigas*) which is to be seen in a lagoon of the island Timor Laut, which on opening at night is said to emit a bright light or lustre, which may even be perceived from afar." Thus it is only a pleasant tale of the natives. It may be remarked *en passant* that Rumphius is well known to have been a German, born in Hanau, as, indeed, is to be read upon the title-page of his 'Rariteitkamer' and also under his portrait behind it, although "Totus Belga fide et calamo," as is added with an elegant compliment to his adopted country in the distichs in his honour placed under the latter. As, in my eyes, Rumph, although a dilettante, was a naturalist of the first rank, who far exceeded most of his contemporary professional naturalists not only in accuracy of observation, but also in critical acuteness, I would not let pass this opportunity of correcting an error which may easily receive the widest diffusion through so popular a work as Brehm's 'Thierleben.'

which show in their structure a decided resemblance to the flask-shaped organs, the so-called "eyes" on the tentacles of *Cardium* (see Patten's figure, *l. c.* Taf. xxxi. fig. 112), are unfortunately very doubtful as regards their function, although the opinion that they are luminous organs is by no means to be regarded as disproved *.

It is well known that the symbiosis of unicellular Algæ with Evertebrata of the most different classes discovered by Geza Entz and K. Brandt has never ceased to be a matter of the most lively interest. I believe, therefore, that I shall earn the thanks of many by adding to the known cases of this symbiosis a new one which may claim the greater interest as only one instance of the kind among the Mollusca is to be found in literature. The very first incision which I made through the mantle-margin of a *Tridacna* showed me, to my astonishment, all the available interstices of the tissue densely packed with "green cells" (pseudochlorophyll-corpuscles), and, as I found in the course of my investigation, this condition prevailed in all my specimens and in all parts of the mantle. It is true that the interest which would otherwise attach to this discovery was considerably weakened by the circumstance that it was made only on preserved animals. As the strict scientific proof that the colouring-matter of these green cells is chlorophyll can no longer be produced, readers of too critical a disposition may be inclined in regard to the new discovery to pass to the order of the day. In opposition to this I would point out that my only purpose here is to communicate briefly the observations made, which I am justified in doing, and, to a certain extent, obliged to do. When once attention is directed to these things the investigation of the questionable chlorophyll in fresh material will probably not have to be very long waited for.

The "chlorophyll-corpuscles" in question are certainly true cells, as, without exception, they possess an approximately central small nucleus with a distinct nuclear framework, which becomes very deeply coloured in the staining reagents employed (Grenacher's alum-carmine). In general the nucleus is spherical, but sometimes oblong or reniform,

* Carrière ('Die Sehorgane der Thiere,' Munich, 1885, p. 97) certainly observed no spontaneous luminosity when the outer light was excluded; but a function dependent upon nerve-influence, such as luminosity certainly is, need not occur at all times.

and not unfrequently, especially in alcoholic preparations, strikingly stelliform, to which Prof. Graf Solms called my attention. The increase by transverse division, which is frequently to be observed, may also be cited among the criteria of cell-nature. Further, they are spherical bodies of 6–8 μ in diameter (nucleus 2 μ), the contour of which appears so sharply and definitely that the assumption of a special (cellulose?) envelope * seems to be justified. From the numerous vacuoles which permeate it the protoplasm has a frothy character; usually a ring of larger vacuoles surrounds the nucleus, and between this and the membrane there are numerous smaller ones. But the most multifarious other arrangements also occur. The green colouring-matter, which is fixed by chromic acid but extracted by alcohol, is not generally diffused through the protoplasm, but localized in small round corpuscles (chlorophyll-bearers), which are distributed through the cell in variable numbers difficult to determine. However, their quantity suffices to cause the whole cell to appear of a lively green colour under low powers. Whether the green granules are situated in the vacuoles or in the protoplasm is difficult to decide from sections; but I regard the latter as far more probable.

Other points in the structure of the pseudochlorophyll-corpuscles I have been unable to make out clearly. In spirit-preparations, in which, as already stated, the green colouring-matter has been entirely extracted, the granules of the protoplasm, which bore the colouring-matter, have also become very indistinct, as their refractive power too nearly approaches that of the rest of the protoplasm. It is only where (in the microscopic image) they lie over a large vacuole that they are very distinctly visible. The vacuoles, however, in their form and distribution are, on the contrary, particularly clearly seen in spirit-preparations from which the colouring-matter has disappeared. The very fine, strongly refractive, almost dust-like granules which I sometimes found scattered through the protoplasm have remained quite inexplicable to me as regards their nature and significance; but I must mention that on treating sections of *Tridacna* hardened in osmium with iodized solution of iodide of potassium for a very different purpose (see p. 450), fine, dust-like, violet-blue granules made their appearance in many of the green cells, while in spirit-preparations chloride of zinc and iodine coloured the whole of the cell-contents deep blue-black. How these two results are to be reconciled, and whether the blue granules are iden-

* The test with chloride of zinc and iodine was not unequivocally successful.

tical with the above-mentioned granulations, I do not know; but at any rate it may be regarded as certain that the cell-contents contain starch.

The seat of the green cells is not determinable at the first glance. It is indeed quite clear that they never occur intracellularly, like the yellow cells of the Actiniæ for example. For this indeed the tissues of the Mollusca are much too small-celled. But whether they are in the interstices of the tissue or in the blood-passages is more difficult to decide without injections. Fortunately the numerous blood-corpuscles intermixed with them help us into the right road; we have to do only with blood-sinuses, as, moreover, the form and distribution of the spaces filled with the green cells would almost alone render certain. The injection effected by them is frequently so perfect as to give us a distinct picture of the lacunar system in the mantle; and of the subepithelial layer of the mantle-tissue we sometimes obtain representations which to some extent resemble those recently given by P. Schiemenz *. In this way we are taught that the flask-shaped organs must be surrounded by large blood-sinuses, as an enormous accumulation of green cells regularly occurs around them. On the other hand, in the larger vessels with distinct walls which are distributed in the mantle I have never met with green cells.

The only observation of the occurrence of pseudochlorophyll-corpuscles in Mollusca that literature has to show is due to K. Brandt and relates to *Elysia viridis* †. In this species they lie in the "system of contractile tubes in the mantle;" what Brandt means by this is somewhat obscure, but we may not be much mistaken in assuming that the vascular system is referred to. This would agree with *Tridacna*; but in other respects there is considerable difference in the green cells of *Elysia* according to Brandt's description and figures (*loc. cit.* figs. 90–93). They are much smaller and of much more irregular form than those of *Tridacna*, and the emerald-green colouring-matter is not localized in separate granules, but uniformly permeates the protoplasm.

As is well known Schmitz ‡ has recently adduced evidence

* Paulus Schiemenz, "Ueber die Wasseraufnahme bei Lamellibranchiaten und Gastropoden," II., Mitth. Zool. Stat. Neapel, Bd. vii. Heft 3, Taf. xvi. figs. 8, 9.

† K. Brandt, "Ueber die morphologische und physiologische Bedeutung des Chlorophylls bei Thieren," in Mitth. Zool. Stat. Neapel, Bd. iv. p. 243.

‡ F. Schmitz, "Die Chromatophoren der Algen," in Verh. naturh. Ver. preuss. Rheinl. und Westf., Jahrg. xl. (1883) p. 1.

that the old supposition that the chlorophyll is uniformly diffused in the protoplasm in the unicellular Algæ is erroneous; on the contrary, according to him all true Algæ have formed chlorophyll-bearers. We cannot abstain from mentioning this memoir at any rate in passing, as our own observations agree so well with it; moreover it is known that in the majority of the green corpuscles found in animals the chlorophyll is localized in special chlorophyll-bearers. The question whether the green cells of *Tridacna* are true unicellular Algæ or only developmental stages of them must be very superfluous when even the vegetable nature of these structures cannot be established with perfect certainty. Upon this point it may be noted here *en passant* that the latter opinion, put forward by Geza Entz, on account of which Brandt gave up his generic name *Zoochlorella*, has recently been disputed by Klebs * in the most decided manner. And it cannot be denied that of the diagnosis which Klebs (*loc. cit.* p. 332) gives for the genus *Pleurococcus* much is applicable to the green cells of *Tridacna*; but we need hardly say expressly that we will not therefore announce the latter as a new species of *Pleurococcus* †.

The place in which we find the green cells in *Tridacna* is unusual. The ordinary locality of the vegetable symbionts is in the tissue, *i. e.* the cells of the host; hitherto they have only rarely been found floating freely in the cavities of its body. If we interpret Brandt's expression correctly (see p. 447) *Elysia viridis* is also in the same case; in the Ephyræ of *Cotylorhiza*, Claus found chlorophylloid Algæ freely floating in the gastrovascular space ‡; Chun refers to yellow cells in the vessels of *Velella* §; and Silliman saw Algæ deposited in the intercellular spaces of the body-parenchyma in a North-American freshwater Turbellarian, *Mesostoma viviparum*,

* G. Klebs, "Ueber die Organisation einiger Flagellatengruppen und ihre Beziehungen zu Algen und Infusorien," in Unters. botan. Inst. Tübingen, Bd. i. p. 233.

† At any rate, as Prof. Graf Solms has likewise had the goodness to point out to me, the green cells of *Tridacna* are quite different from those of other classes of animals if only by the great number and spherical form of their chlorophyll-bearers. The green cells of *Hydra* have a single hood-like chlorophyll-bearer, and increase by tetrad-formation (see, for example, the figures given by Hamann, Zeitschr. f. wiss. Zool. Bd. xxxvii. Taf. xxvi. figs. 4–7), as also those of the Infusoria.

‡ C. Claus, "Die Ephyren von *Cotylorhiza* und *Rhizostoma* und ihre Entwicklung zu achtarmigen Medusen," in Arb. Zool. Inst. Univ. Wien, Bd. v.

§ C. Chun, "Ueber die geographische Verbreitung der pelagisch-lebenden Seethiere," in Zool. Anz. 1886, no. 215, p. 72.

Sill.* I am not acquainted with other cases of the same kind. But, at any rate, the Algal vegetation in the system of blood-lacunæ in the mantle of *Tridacna* proves that there can be no question of any "current" of blood in them worth mentioning. However, it cannot be denied that Algæ (always supposing them to be such) must yield a very valuable enrichment of any animal blood, as the oxygen which they develop under direct exposure to light must be immediately absorbed by the blood-plasma, and so benefit the animal to a great extent. That there can be no question of even a temporary or partial nourishment by the vegetable symbionts in the case of an animal so large and requiring so much nutriment as a *Tridacna* is a matter of course, even if this theory, set up by G. Entz and Brandt, were not to be regarded as already seriously shaken.

Some minor observations made in the course of the above investigation, but which have no other connexion therewith, may here find a place in conclusion. One of my observations relates to the blood-corpuscles. In my preparations I found these always fixed in a peculiar manner. The protoplasm had distinctly separated into two different constituents—a perfectly hyaline part in which the nucleus was always situated excentrically, and a "protoplasmatic" part, which showed a very marked fibrous coagulation. It was remarkable that in all three of my *Tridacnæ*, which had been treated with quite different reagents, namely chromic acid, alcohol, and osmium, the blood-corpuscles appeared altered in this manner, and, indeed, in each preparation the whole of them without exception, not only those of the deeper layers of tissue, but also those belonging to the subepithelial layers, which one would have supposed must have been killed and fixed almost instantaneously by the reagent employed. I am at present quite unable to offer any explanation of this peculiar phenomenon.

The following peculiarity of the blood of *Tridacna* may have more interest. I believe that the only known formed constituents are the ordinary amœboid blood-cells. But in *Tridacna* I succeeded in detecting, although very sparingly, a second very characteristic cell-element of the blood. These were rounded or oval, lobate, or otherwise irregularly formed

* Silliman, "Beobachtungen über die Süsswasserturbellarien Nordamerikas," in Zeitschr. f. wiss. Zool. Bd. xli. p. 62.

cells, the perfectly hyaline protoplasm of which is throughout so completely stuffed with strongly refractive granules of a fatty lustre that I could not even find a cell-nucleus. The granules of the contents, averaging 0·5–1 μ in diameter, are irregularly polygonal rather than rounded; in osmium they become brown rather more strongly than the protoplasm, and also acquire a deep colour in borax-carmine.

We find these "granule-cells," which usually attain twice or three times the size of the ordinary blood-cells, intermixed with these and the Algæ in the blood-lacunæ, where they generally lie close to the walls, often in recess-like depressions. If such a depression is seen from the side in a section peculiar images are produced, as though the cell lay free in the interlacunar tissue; and misled by this, I thought for a long time that I had to do with true wandering cells, but I gave up this notion on finding that the explanation above given is quite sufficient.

The frequency of the "granule-cells" is very variable. They are wanting in none of my three individuals of *Tridacna*; but while in the specimen treated with chromic acid and alcohol they always occur singly and so sparingly that I often had to examine several sections in order to find one, they occurred in the osmium-specimen in such abundance that every section showed at least half a dozen of them. The causes of this phenomenon are quite unknown to me.

In order to understand these peculiar cells it is most necessary to make out the chemical nature of their contained corpuscles. For reasons which are not far to seek I at first thought of glycogen; but I did not succeed in obtaining the characteristic glycogen-reaction with a solution of iodine and iodide of potassium prepared in accordance with Barfurth's prescription *. Whether this failure is to be ascribed to the hardening with osmium or to the processes of imbedding in paraffin may be decided by better chemists than myself—at any rate from the rarity of the "granule-cells" in my other two *Tridacnæ* I was limited to the osmium-specimen for this microchemical test.

The resemblance of the "granule-cells" to certain cells of the interstitial connective substance of the Pulmonata, which were discovered by Semper and reinvestigated and further described by me some years ago †, is very remarkable. The

* D. Barfurth, "Vergleichend-histochemische Untersuchungen über das Glycogen," in Arch. für mikr. Anat. Bd. xxv. p. 260.

† J. Brock, "Untersuchungen über die interstitiellen Bindesubstanzen der Mollusken," in Zeitschr. f. wiss. Zool. Bd. xxxix. p. 40 (1883).

reaction of the contained granules with osmic acid and basic colouring-matters agreed exactly in the two kinds of cells. In the Pulmonata also no evidence of glycogen was adduced, but that we have to do with glycogen or a similar body is at least probable since we know from Barfurth * that in the Pulmonata glycogen is at times accumulated in great quantity in the plasma-cells or Leydigian cells of the interstitial connective substance.

The much-discussed question of the intercellular spaces of the epithelium of the Mollusca has now, we believe, found its definitive solution in the recently published memoir by Schiemenz †. The intercellular spaces are not artificially produced, although their supposed stomata may be; they do not reach the surface of the epithelium, but terminate cæcally in sharp points between the epithelial cells. Although the existence of intercellular spaces has been placed beyond a doubt by means of injections (Schiemenz, Nalepa) and by the observation of fresh objects (Leydig &c.), the question deserved consideration how far intercellular spaces may be artificially produced by reagents causing hardening and shrivelling. Schiemenz has already raised this question when he brought forward this very objection to my observations of intercellular spaces in the epithelium of the pedal glands of the Pulmonata ‡. In this particular case Schiemenz's scruples were unfounded, for no one will doubt that intercellular spaces which regularly function as the efferent ducts of glands, and are often found filled with the secretion of the glands, are formed during life §. But as to the matter itself he is undoubtedly in the right. Of my three *Tridacnæ* the osmium and chromic-acid specimens showed a densely closed palissade-epithelium without the smallest interstices between the individual cells, while the spirit-specimen has the whole epithelium traversed by numerous large typical intercellular spaces. Only one of the two can represent the natural con-

* Barfurth, *loc. cit.* pp. 325 *et seqq.*

† Paulus Schiemenz, "Ueber die Wasseraufnahme bei Lamellibranchiaten und Gastropoden," II., in Mitth. Zool. Stat. Neapel, Bd. vii. Heft 3.

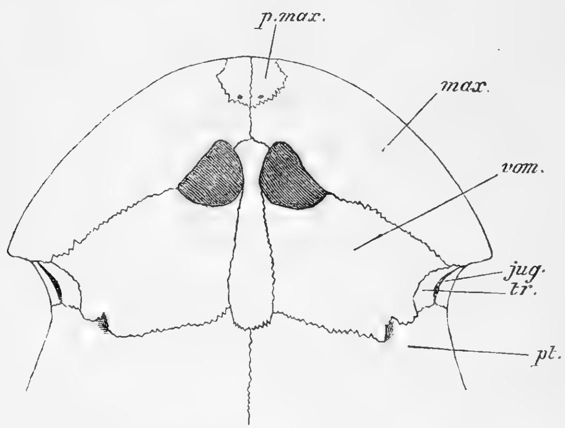
‡ Schiemenz, *loc. cit.* p. 428.

§ Although I have in the same place adduced the intercellular spaces of the epithelium of the pedal glands as evidence for the existence of such formations in general, this can no longer apply now that we know the true nature of the permanently closed typical intercellular passages. The two are quite different things, which must be kept apart.

dition, and from the prevalent opinions as to the value of the three reagents employed we must unanimously declare against the spirit-specimen and the intercellular spaces. Others also appear to have made similar observations. In a recent French memoir upon the histology of the Lamellibranchs * we find the epithelium everywhere represented as closed, only one figure shows, exactly like my spirit-specimen of *Tridacna*, the epithelium traversed by numerous " intercellular spaces."

LXII.—*On the Presence of Ossa transversa in a Chelonian.* By G. A. Boulenger.

The object of this note is to record the presence of transverse bones in the skull of *Hydraspis Hilairii*, Schw. The absence of that element had hitherto been regarded as characteristic of the order Chelonia.



Lower view of anterior part of skull.

As may be seen from the above figure, the bone (*tr.*) is intercalated between the pterygoid, the palatine, the maxillary, and the jugal; it is suturally united with the latter only anteriorly and posteriorly, its outer border being free.

* L. Roule, " Recherches histologiques sur les Mollusques lamellibranches," in Journ. Anat. et Physiol. tome xxiii. (1887), p. 31. The figure referred to is pl. v. fig. 8.

This discovery again shortens the gap between the Chelonians and the typical Reptilia. The group to which *Hydraspis* belongs is characterized by distinct nasals, separate dentary bones, and strong transverse processes to the cervical vertebræ, and is in those respects altogether of a more generalized type than the other Testudinata; however, as regards the shell and pelvis it stands apparently a step in advance, and the Pleurodira have for that reason been regarded, perhaps erroneously, as the most specialized type. Geologically, so far as the record goes and if Dr. Baur's recent views on certain Triassic Chelonians be correct, they are the oldest. The Wealden *Peltochelys Duchastelii*, the type specimen of which I was permitted to examine by my friend M. Dollo, is unquestionably closely related to *Hydraspis* and *Chelodina*. I have a suspicion that it will prove to be the young of *Plesiochelys*.

It is undeniable that all the discoveries that have been made of late give support to the view first expressed by Cope, nearly twenty years ago, on the affinities of those two groups, the *Chelonia* and the *Rhynchocephalia*, the systematic position of which has given rise to so much controversy.

BIBLIOGRAPHICAL NOTICES.

A Textbook of Biology. By J. R. Ainsworth Davis. London: Charles Griffin & Co., 1888.

Mr. Davis has designed this textbook in order to meet the requirements of the Intermediate Science and Preliminary Scientific Examinations of the London University. Such a work can never be one of a high class, for it must be limited by the conditions of the syllabus of a given body; in this case the body is not a teaching, but only an examining one.

Mr. Davis's book must therefore be tested solely by the syllabus to which it professes to afford an aid. The exposition of the simple facts of anatomy and physiology is generally accurate, but we do not think it is better done than in a number of other works, such as those of Huxley and Martin, or Marshall and Hurst. So far as the work is, as it claims to be, an introduction to theoretical biology, it is clear from the conditions imposed that it must be more or less unsatisfactory in correspondence with the powers and characteristics of the writer. For us the whole has too much the air of a crambook to justify us in recommending it from this point of view; we believe that the following explanation is the worst in the book, but the mental calibre of the writer may perhaps be judged from it. We find in the glossary, "Apodeme (απόδημος, absent from home), in the Crayfish.—One of the elements of the endophragmal system." Mr. Davis not only should have learnt that in Greek there is ε and η, but he should have learnt too that explanations should explain before he set to work on a glossary. The figures are partly original and partly borrowed: the latter vary in quality; the former are, without exception, the worst we have seen for a long time.

Proceedings of the Bristol Naturalists' Society, n. s. vol. v. (1886–87), pt. ii. pp. 95–206 : *Engineering Section*, pp. 1–94. Bristol, 1887.

This part of the Bristol Naturalists' Society's Proceedings opens with a paper on "Bristol Building Stones" by Prof. Lloyd Morgan; the various local rocks available for the purpose are described, the principal buildings constructed of them being mentioned, and particulars of their resistance given. In a second paper, "On the Origin of Mountain-Ranges," Prof. Morgan criticizes Mr. Mellard Reade's views, and offers some general suggestions on this difficult subject. Further geological information appears in the Engineering Section, Mr. Charles Richardson giving a valuable paper on the Severn Tunnel. Several interesting and useful sections are given as illustrations to the thirty pages of text; and the whole forms, with some notes by Prof. Morgan, an important contribution to local and applied geology.

In the Botanical Section Mr. J. W. White contributes some supplemental notes to the "Flora of the Bristol Coal-field," and Mr. C. Bucknall continues his valuable papers on the Fungi of the Bristol district, illustrating this portion of his work with four plates. Some interesting notes apropos of the tercentenary of the potato are contributed by Mr. G. F. Burder.

Local Zoology is taken in charge by Mr. H. J. Charbonnier, who catalogues the Reptilia, Amphibia, and Pisces observed by him in the district.

The local Meteorology is chronicled by Messrs. G. F. Burder and H. B. Jupp.

Many short papers and abstracts of papers also appear in this part ii., amongst which we may mention :—E. W. Phibbs, "Note on a Sacred War Trophy from Ecuador, consisting of a Human Scalp and Face;" W. P. Mendham, "The Deposition of Smoke and Dust by means of Electricity;" Prof. W. Ramsay, "On Colour Blindness;" Thomas Morgan, "Chilled Iron;" J. W. I. Harvey, "On the Method adopted to Compound a Pair of Ordinary Oscillating Paddle-wheel Engines;" and G. W. Sutcliffe, "Notes on Stationary Engines."

MISCELLANEOUS.

On the "Nursing"-habits of Dendrobates, *as observed by A. Kappler.* By G. A. Boulenger.

A short time ago Messrs. Cope and H. S. Smith * announced the startling discovery that a South-American frog, *Dendrobates braccatus*, Cope, carries its tadpoles on its back; these tadpoles differ in no respect from the normal type, and simply adhere (by the mouth ?) to the back of the parent. Mr. Smith observes that the tadpoles "were moist and glistening, as if they had just been taken from water, though the sun was shining hotly over them." It is a great

* Amer. Nat. 1887, p. 307.

pity that Mr. Cope, who describes the specimen on which the larvæ were found, should not have taken the trouble of ascertaining its sex, instead of contenting himself with the statement "The free tadpole is carried on the parent."

The explanation of this extraordinary mode of "nursing" is to be found in a contribution by Hr. Aug. Kappler * to the life-history of Reptiles and Batrachians in Dutch Guiana. We have here to do with a quite new mode of parental provision for the safe rearing of the brood, and I append a translation of Hr. Kappler's remarks:—

"*Dendrobates trivittatus*, Spix.

"During the rainy season the female oviposits in small puddles, where the eggs are hatched, after which the frog removes the young tadpoles to other (larger) puddles. This is accomplished, as I have myself several times witnessed, by the frog entering the water, when all the tadpoles gather round and suck on to the parent, which leaves on its journey with an investment of from twelve to eighteen young tadpoles, 6 or 7 millim. long. Whether it is the male or the female that undertakes the carriage is unknown to me."

It is to be hoped that Messrs. Smith and Kappler's interesting observations may be before long supplemented by fuller accounts. Naturalists in the tropics do not seem to be fully aware of the rich mine of investigation which the breeding-habits of Batrachians afford them. The more our knowledge advances the more we realize the immense amount of secondary modifications in the development of Batrachians, quite irrespective of their relationships. What is more remarkable than the similarity of the eggs and the nursing-habits of such widely remote forms as *Alytes*, *Ichthyophis*, *Desmognathus*, and *Amphiuma*?

It is, however, held by Mr. Ryder † that this similarity between *Ichthyophis* and *Amphiuma* is "a confirmation of Prof. Cope's conclusions as to the taxonomic relations of these two types, and a very interesting instance of the way in which embryological data may become available."

On the Formation of the Antherozoids of the Hepaticæ. By M. Leclerc du Sablon.

The antheridia of the Hepaticæ are formed by an aggregation of rounded or oval cells. The cells of the superficial layers remain sterile and form the envelope; the interior cells play a more important part—each of them forms a motile antherozoid, capable of fecundating the oosphere and converting it into an ovum.

How does a cell, formed of a nucleus surrounded by protoplasm and a membrane, become converted into a spiral filament endowed with motion? The authors who have studied the formation of the antherozoids have answered this question in very different ways. According to some the nucleus disappears, and it is the protoplasm that furnishes the spiral filament; according to others the protoplasm does not perform any essential part, and it is the nucleus that, by elongating and coiling itself, directly forms the antherozoid. At the close of my researches upon the Hepaticæ I shall propose a third

* Das Ausland, 1885, p. 858.

† Amer. Nat. 1888, p. 182.

solution, which appears to me to be more in accordance with the facts than the preceding.

As a first example I shall take *Metzgeria furcata*. The antheridia occur in involucra which are almost entirely closed and are situated themselves on the lower surface of the frond. When the mother-cells of the antherozoids have ceased dividing, the middle part of the membrane surrounding them soon dissolves; each cell is then completely free, only surrounded by a very delicate membrane, which will afterwards disappear. The nucleus, which was at first central, approaches the surface of the cell without changing in form or dimensions. At the same time all round the cell, following a great circle which touches the now excentric nucleus, a delicate thread of protoplasm is differentiated, becomes homogeneous and brilliant, and is coloured only with great difficulty by the ordinary reagents of the protoplasm and nucleus. This is the first indication of the formation of the antherozoid. It is to be observed that, at this period, the nucleus has not notably changed in form. We cannot therefore say that the nucleus alone forms the antherozoid by becoming elongate and slender. It is true that the nucleus has a point of contact with the filament; but by treatment with hæmatoxylin the colourless filament may be traced over the surface of the nucleus, now strongly stained violet.

This first phase of the formation of the antherozoid is of short duration, and appears to me to have hitherto escaped the notice of observers. In a rather more advanced state the different parts of the mother-cell retain the same relative positions; but the filament is thicker and more intimately united with the nucleus, the nucleus itself is smaller, and the protoplasm less dense. The filament therefore grows at the expense of the nucleus and protoplasm.

Still later the nucleus seems to have completely disappeared; its substance has been entirely employed in enlarging the antherozoid. The protoplasm also has almost completely disappeared; we see only a colourless space in the midst of the ring formed by the antherozoid. The direct observation of this stage of development led some authors to suppose that the nucleus disappeared and that the protoplasm then became condensed at the periphery of the cell to form the antherozoid. Soon afterwards the ring breaks, the filament elongates itself and becomes more slender, and gradually acquires the form of the adult antherozoid. It is only at this period that the two cilia appear at one of its extremities.

The antherozoids of the other Hepaticæ that I have studied (*Radula complanata*, *Frullania dilatata*, and *Alicularia scalaris*) are formed exactly in the same way as those of *Metzgeria furcata*. As these different species belong to groups pretty distinct from each other there is reason to suppose that the mode of formation of the antherozoids is very uniform in the family Hepaticæ. I hope, however, to extend my observations to a greater number of species and to publish figures which are necessary for the completion of such descriptions as those which I have just given.

The technical processes which I have employed in my observations are those which are ordinarily adopted in the investigation of the nucleus. To obtain good results, however, I have been obliged not to make use of materials hardened in alcohol; under such conditions, in fact, it becomes difficult to distinguish the protoplasm from the nucleus. In certain cases, at any rate, I think I may ascribe the mistakes of some authors to the use of materials hardened in alcohol. Treatment with hypochlorite of soda in very dilute solution has furnished good results.

To sum up: the antherozoids of the Hepaticæ are formed at the same time by the nucleus and the protoplasm of the mother-cell. The body of the antherozoid, therefore, not corresponding solely to the nucleus of the mother-cell, but to the nucleus and protoplasm together, there is not only a change of form of the elements of the cell, but there is at the same time a change of properties and of structure. The body of the antherozoid, which is more refractive and more homogeneous than the protoplasm or the nucleus, is also more difficult to stain with reagents, especially at the commencement of its formation. A complete transformation of the elements of the cell has taken place; we may therefore say that in becoming converted into an antherozoid the mother-cell has undergone a total renovation.—*Comptes Rendus*, March 19, 1888, p. 876.

On the Gemmules of some Marine Siliceous Sponges. By M. E. Topsent.

As in the Spongillæ, multiplication by means of gemmules is observed in adddition to sexual reproduction in many siliceous sponges common on the shores of the Channel and belonging to different families, such as *Chalina oculata*, *C. gracilenta*, *Cliona vastifica*, and *Suberites ficus*.

The asexual germs which originate in the deeper parts of these various sponges consist essentially (1) of rather large elements, darkened by a great accumulation in their protoplasm of large shining granules, which conceal the cell-nucleus; and (2) of a keratode envelope. In none of the marine species here in question do the gemmules attain the same degree of complication as those of the Spongillæ; their envelope is not pierced by a foramen, and the spicules with which it is often armed are not special ones.

The gemmules of *Chalina oculata* are, however, still rather complex. They are developed in small numbers (not more than thirty) in the lower region of the hard and apparently lifeless peduncle of this branching sponge. Attached to the yellowish fibres of the skeleton they appear as ovoid bodies of a milk-white colour, three or four times the size of the gemmules of *Spongilla fluviatilis* for example. Their keratodic envelope is supported throughout its whole extent by acerate spicules arranged parallel to each other; further, some horny fibrils, also containing spicules, intercross in the middle of the internal cellular mass.

Bowerbank, without knowing it, had discovered these gemmules in a very short piece of peduncle which he took for a new sponge (Shetland Islands) and named *Diplodemia vesicula*. From the description of this species and its *ovaries*, O. Schmidt in 1870 thought he recognized a fragment or a young form of a Chalinean. Now it seems no longer doubtful that the unique *Diplodemia* is the broken foot of a *Chalina oculata*.

Chalina gracilenta spreads over stones and shells, and its gemmules, always in considerable number, become organized directly against its support; they are rounded, whitish, and generally measure hardly more than 0·25 millim. in diameter; they are found disseminated or pressed against each other, and in the latter case the envelope of each of them remains independent of that of its neighbours; here again the capsule is armed with spicules, but no skeletal production traverses the cavity of the corpuscle, its small dimensions rendering quite unnecessary the formation of an internal framework.

It is also in contact with the support, that is to say adherent to the walls of the perforated galleries, that the gemmules of *Cliona vastifica* are developed. They vary much in form and dimensions, but they are distinguished at the first glance by the bright red colour of their cells. They have only an incomplete envelope to separate them from the mass of the sponge; the calcareous substance, riddled with little pits, upon which they are moulded, protects them on the other side. The capsule contains no spicules in its substance, but in general it is lined with a layer of these organites arranged tangentially to the mass and parallel to each other; generally also a few spicules are found scattered in the interior cellular mass. The three kinds of spicules of the sponge may be combined in these various positions, or one of them may occur to the exclusion of the others. More rarely the gemmules are absolutely devoid of spicules.

Lastly, what Carter called "the ovigerous layer of *Suberites domuncula*" is by the last evidence a layer of true gemmules. We know the part contributed by the English author to the knowledge of the gemmules of the Spongillæ, and yet in his note (Ann. & Mag. Nat. Hist. 1883, xii. p. 30) he has not made the least allusion to these asexual germs.

The gemmules of *Suberites domuncula* (of the Mediterranean) and those of its near relative, *S. ficus* (of the Channel), have the same structure and occupy the same position. They are reduced to the essential elements, a capsule and cells. Always in juxtaposition, they cover with a continuous layer the shell or stone to which the sponge is attached.

Carter very well describes these reproductive bodies; but having observed that their capsule became thinner in contact with the support, he regarded them as ova incapable of development until such time as, this support being destroyed, it becomes possible for the embryo to make a passage through the thin portion of the envelope. It is true that from what he says he had observed our *Suberites ficus* only on 6th January, 1870, and 4th September, 1877, at periods when the gemmules in repose appeared to him like ova all in the same stage of development; now these germs are formed at the end of summer and emit their contents in the spring by rupture of their capsule; and if Carter had had the opportunity of examining *Suberites* in May and June, he would have seen the capsules in position, but empty, and ruptured on their convex side.

At present *Cliona vastifica* is the only known sponge of which the gemmules do not all arrive at maturity in the spring; they may be found all the year round in its lobes, even at the time when sexual reproduction takes place.—*Comptes Rendus*, April 30, 1888, p. 1298.

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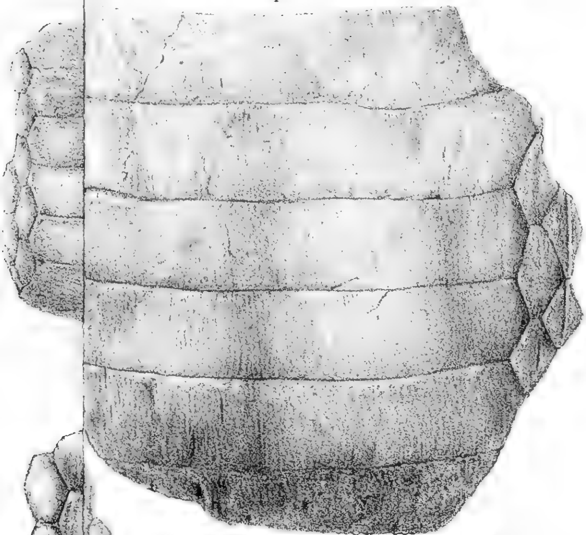

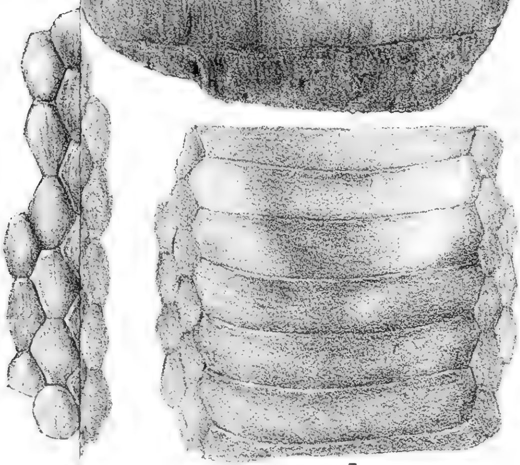

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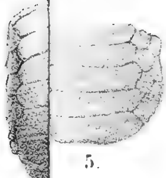

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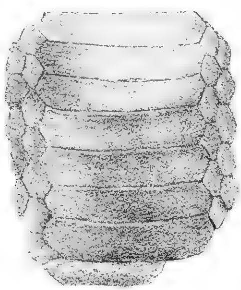

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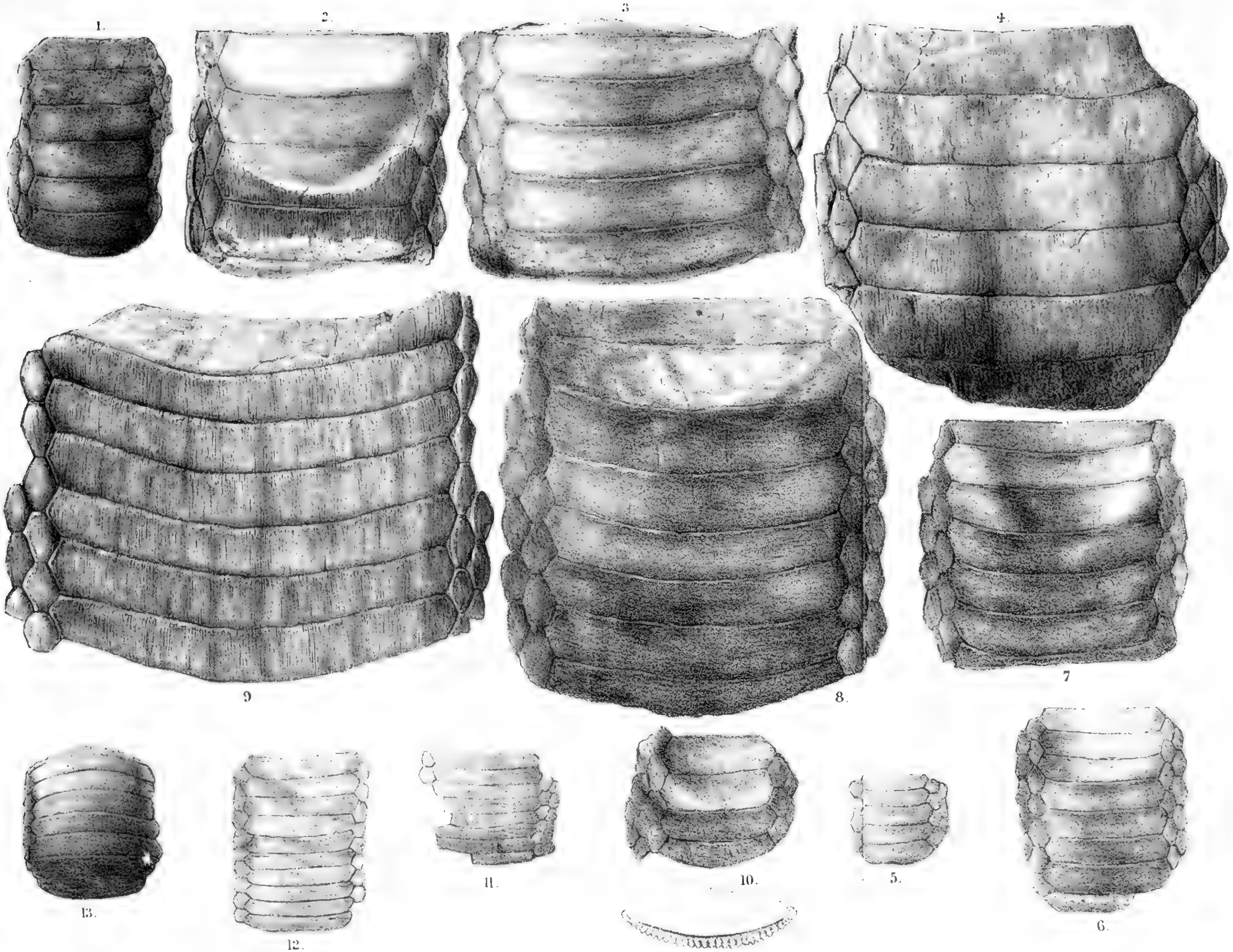

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DENTITION OF EOCENE SPECIES OF MYLIOBATIS

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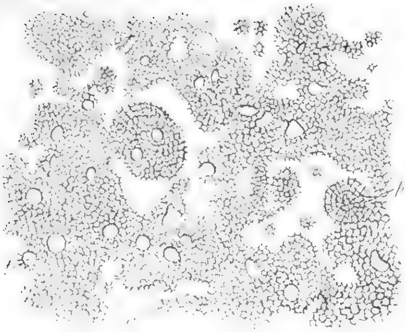

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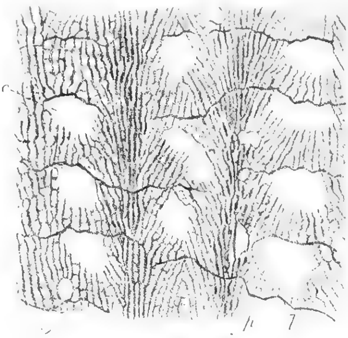

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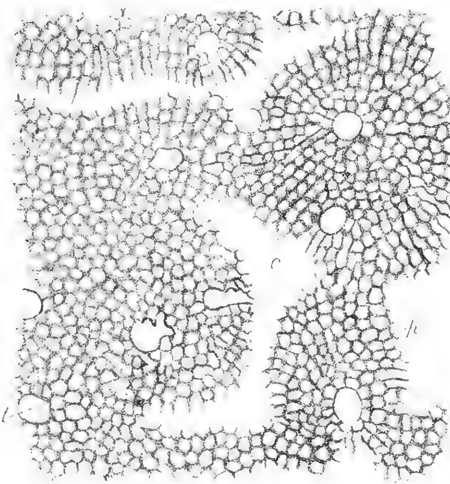

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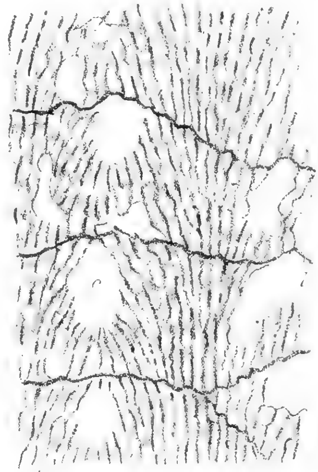

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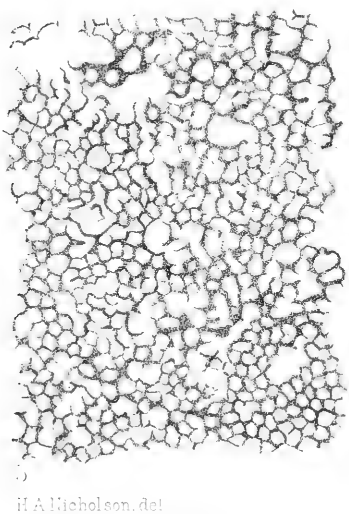

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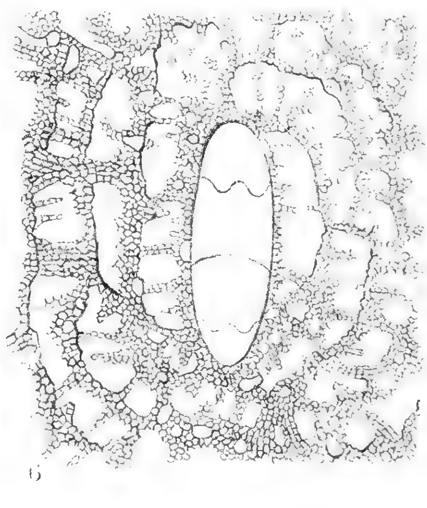

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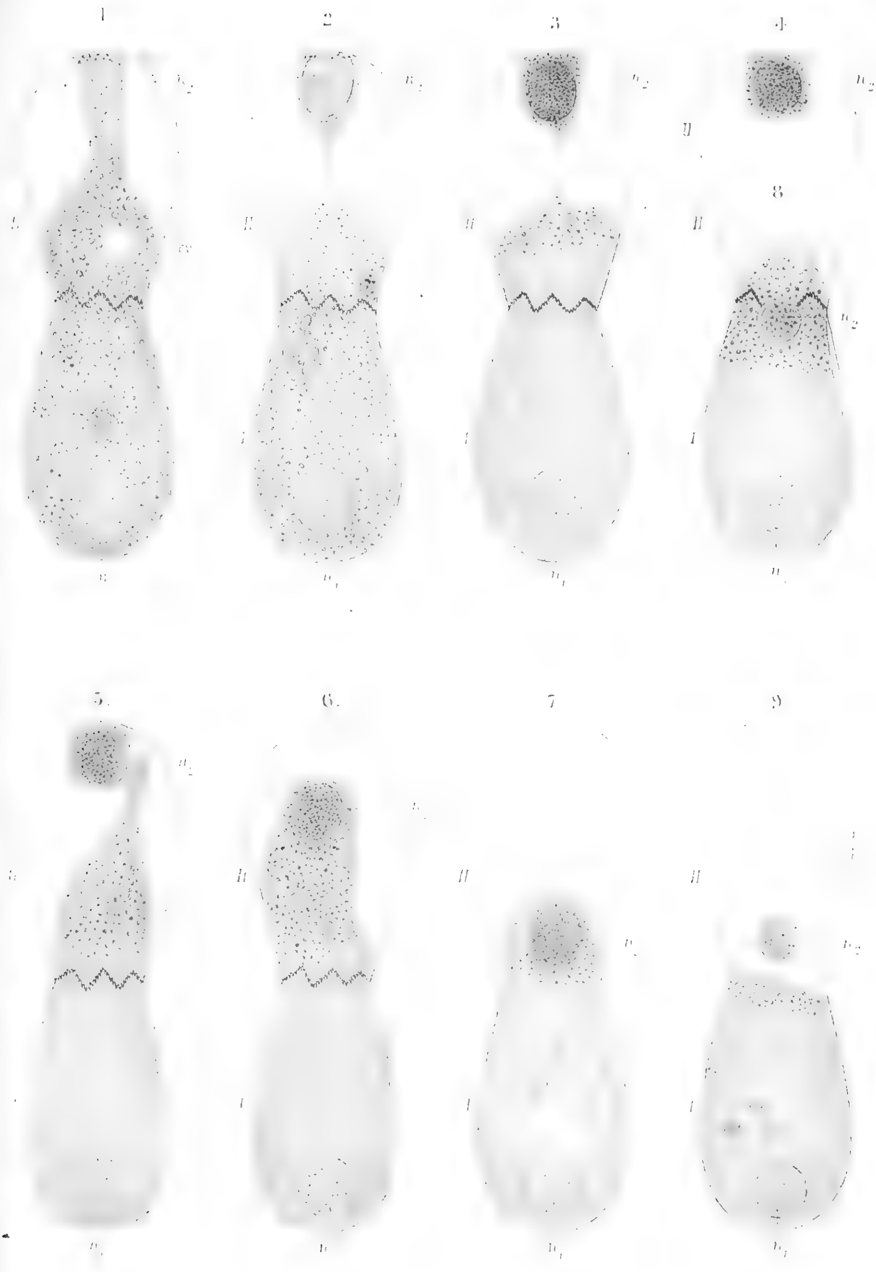

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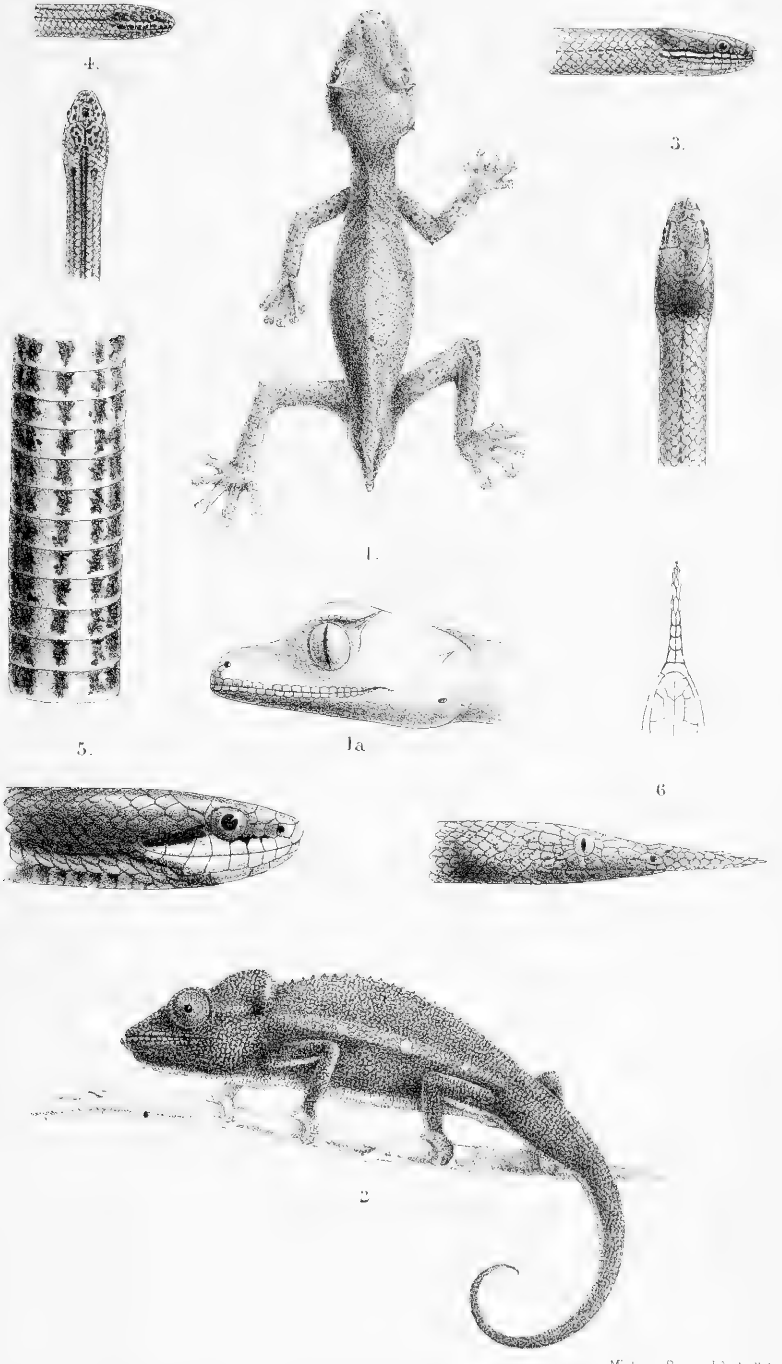

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4. C. microps. 5. Dromicus baroni. 6. Langaha intermedia.

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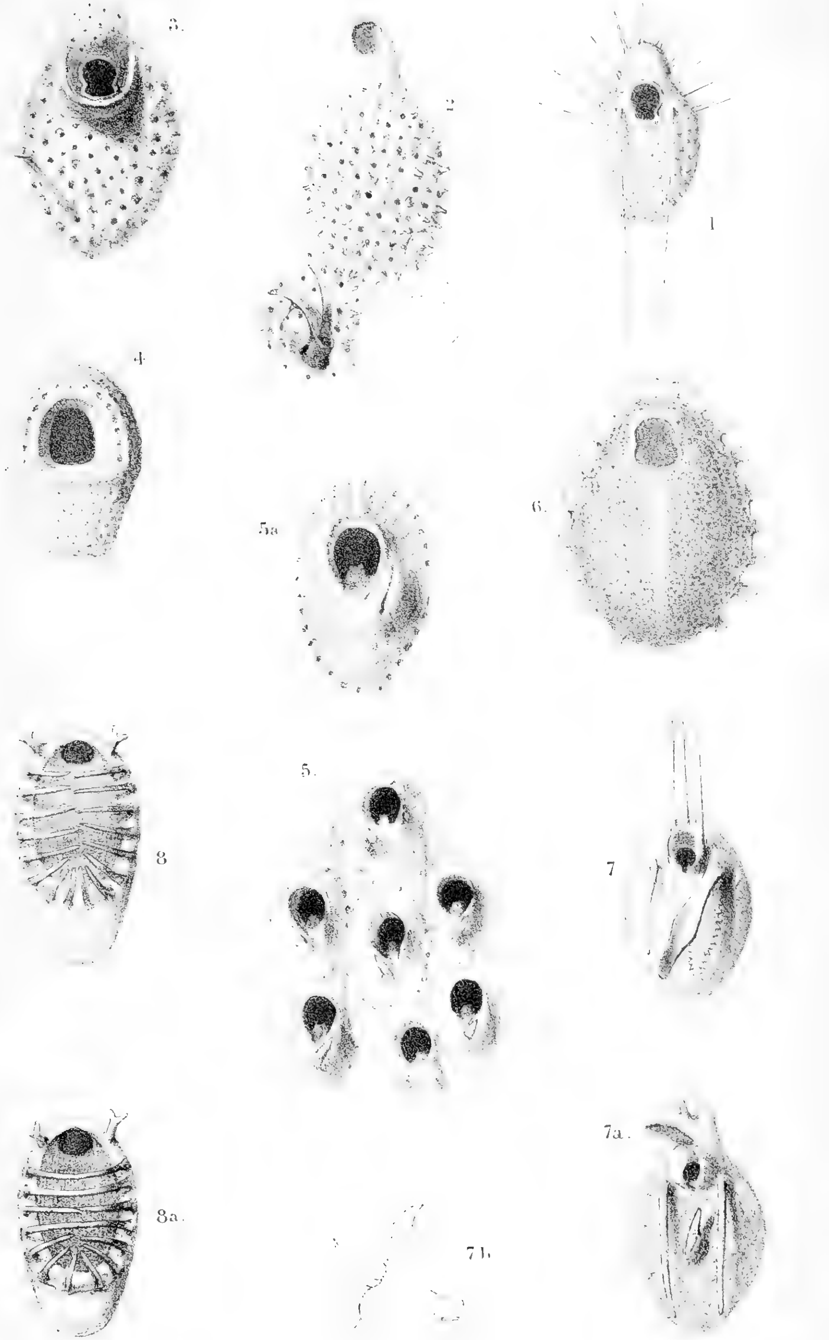

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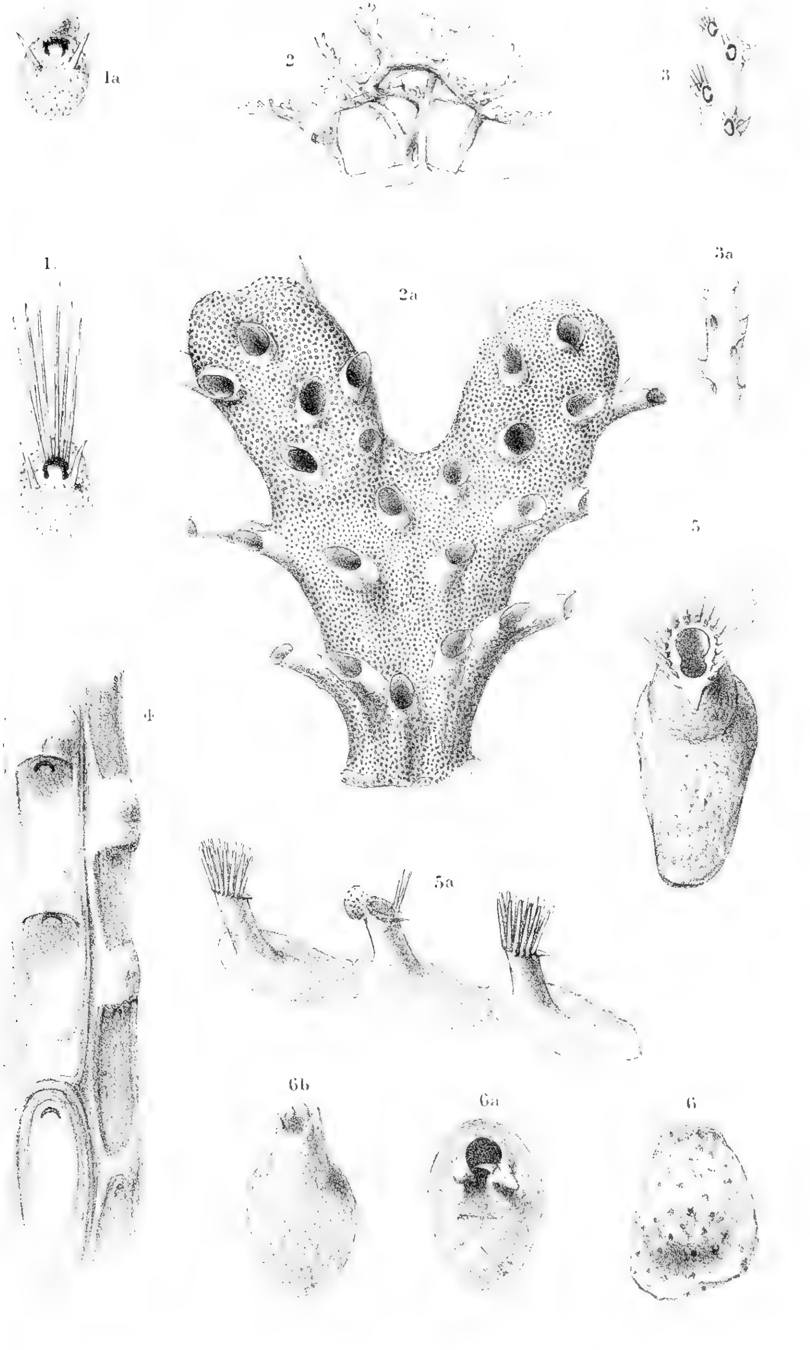

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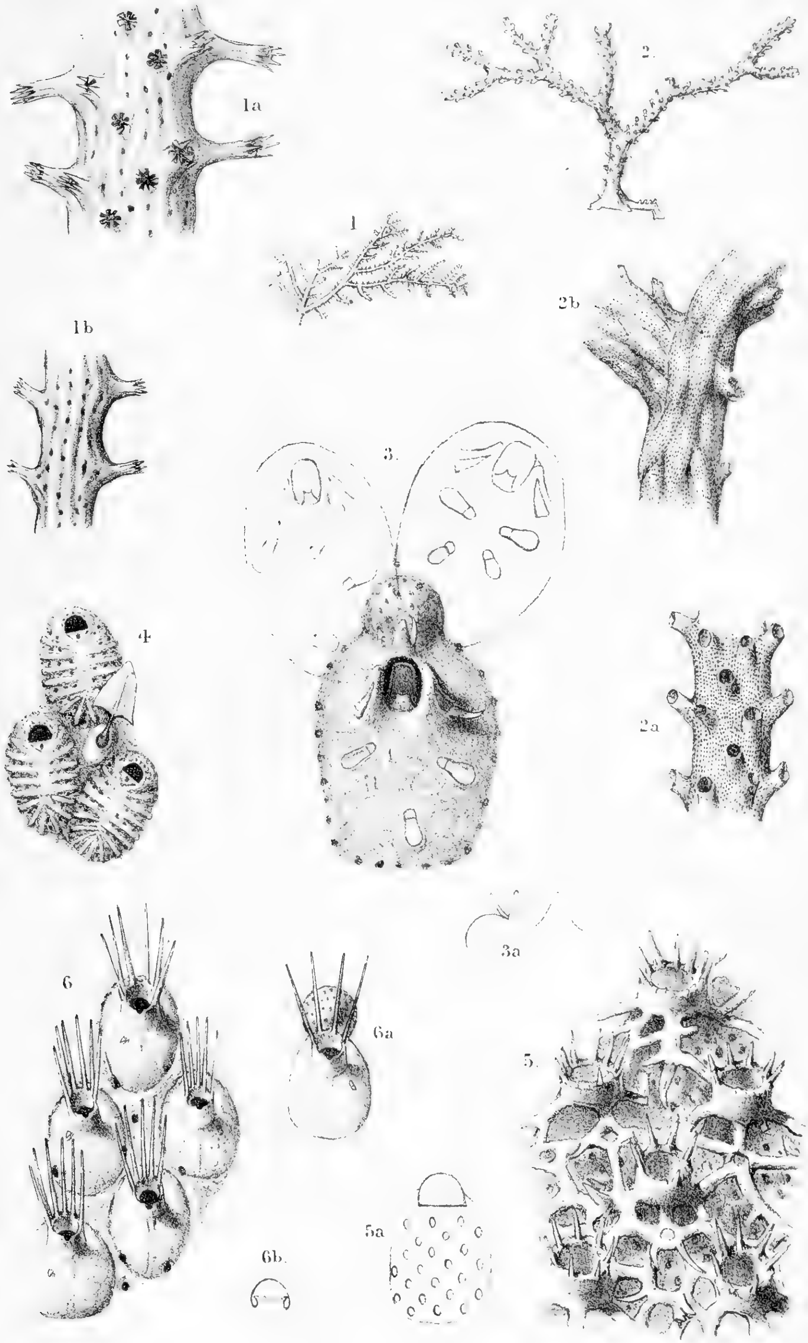

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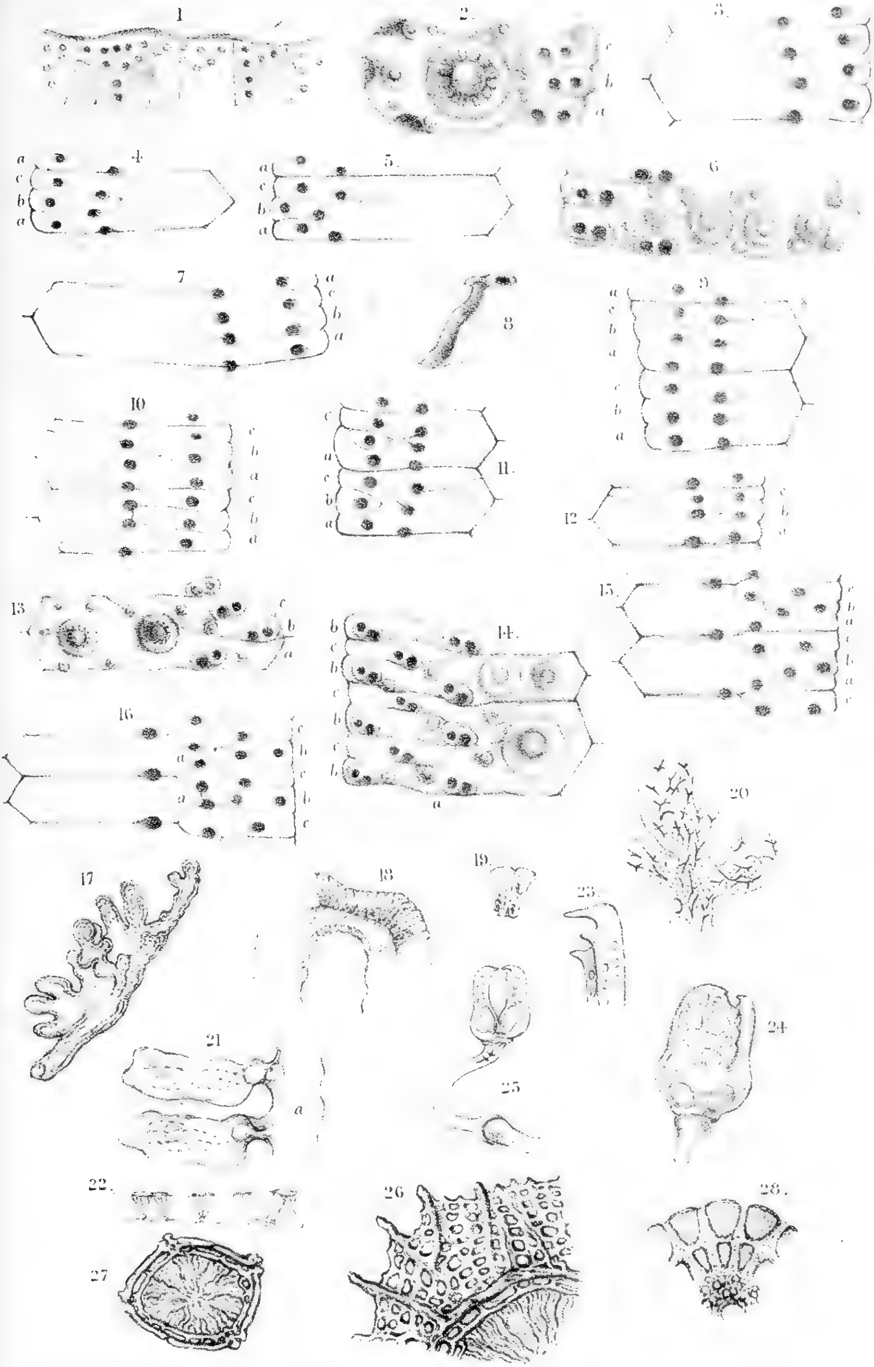

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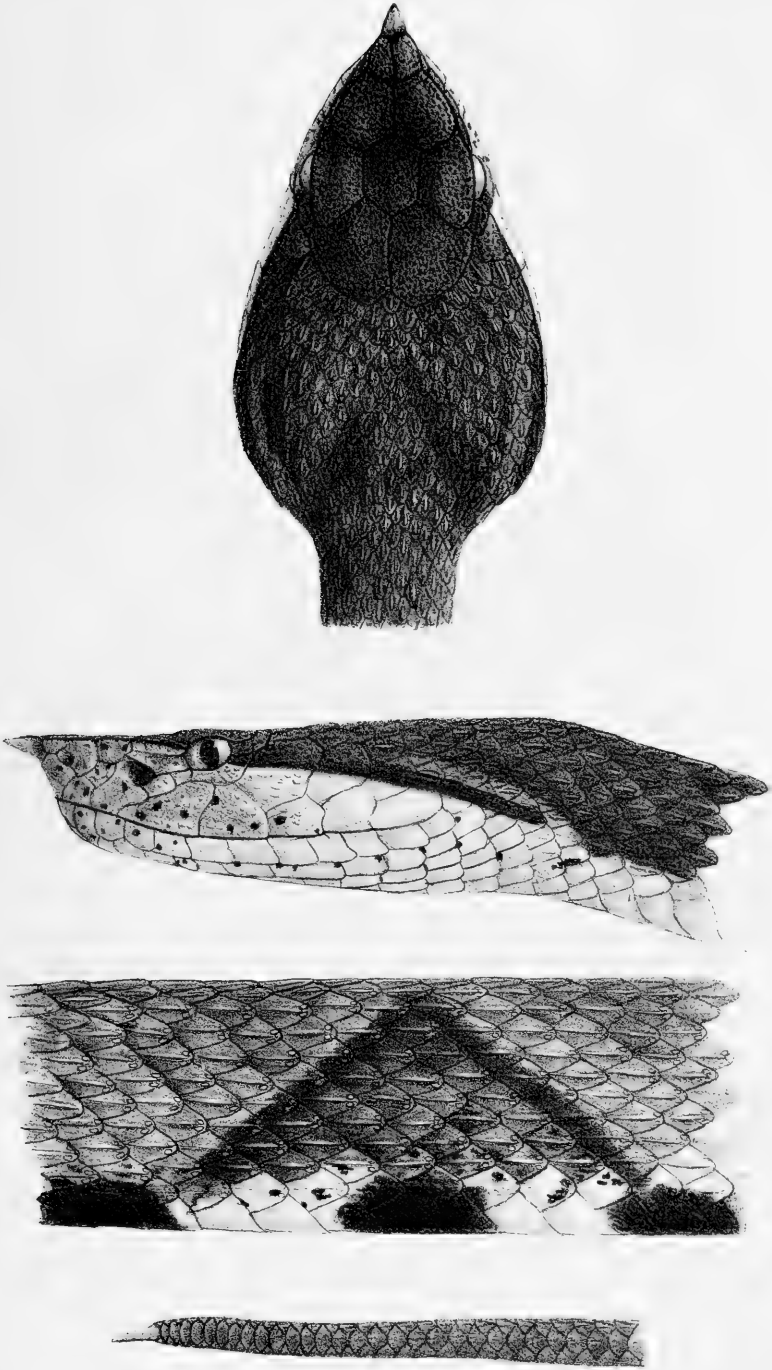

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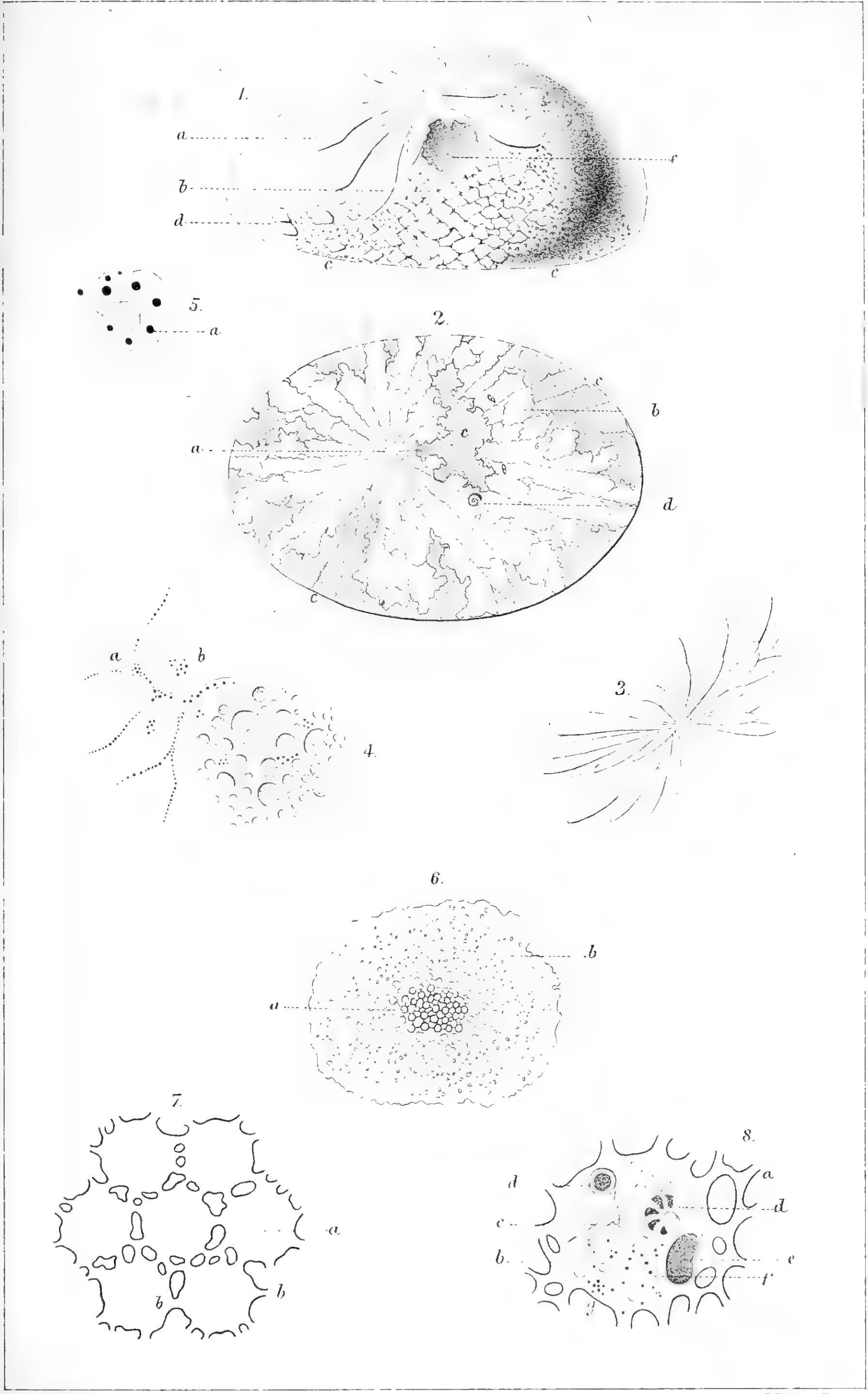

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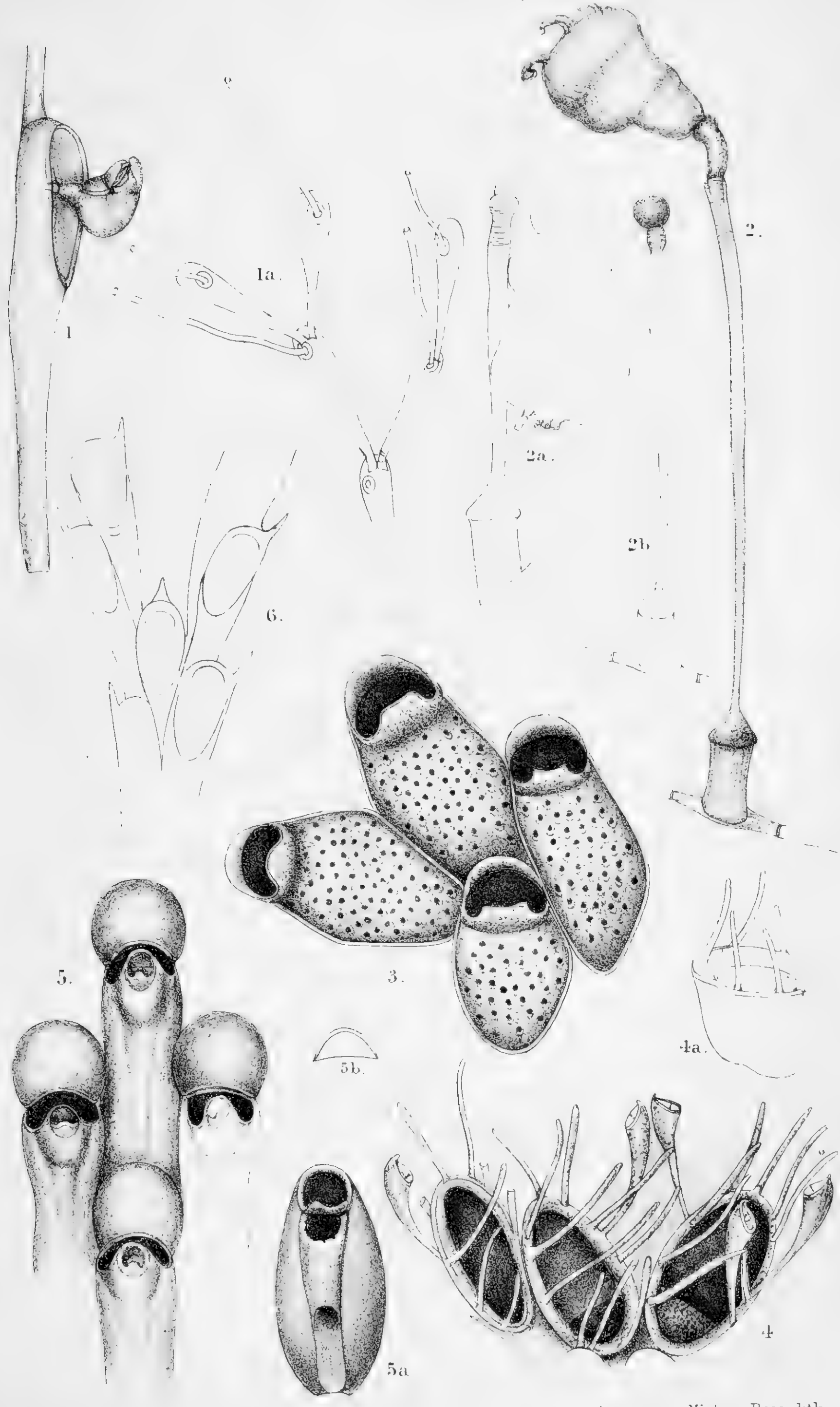

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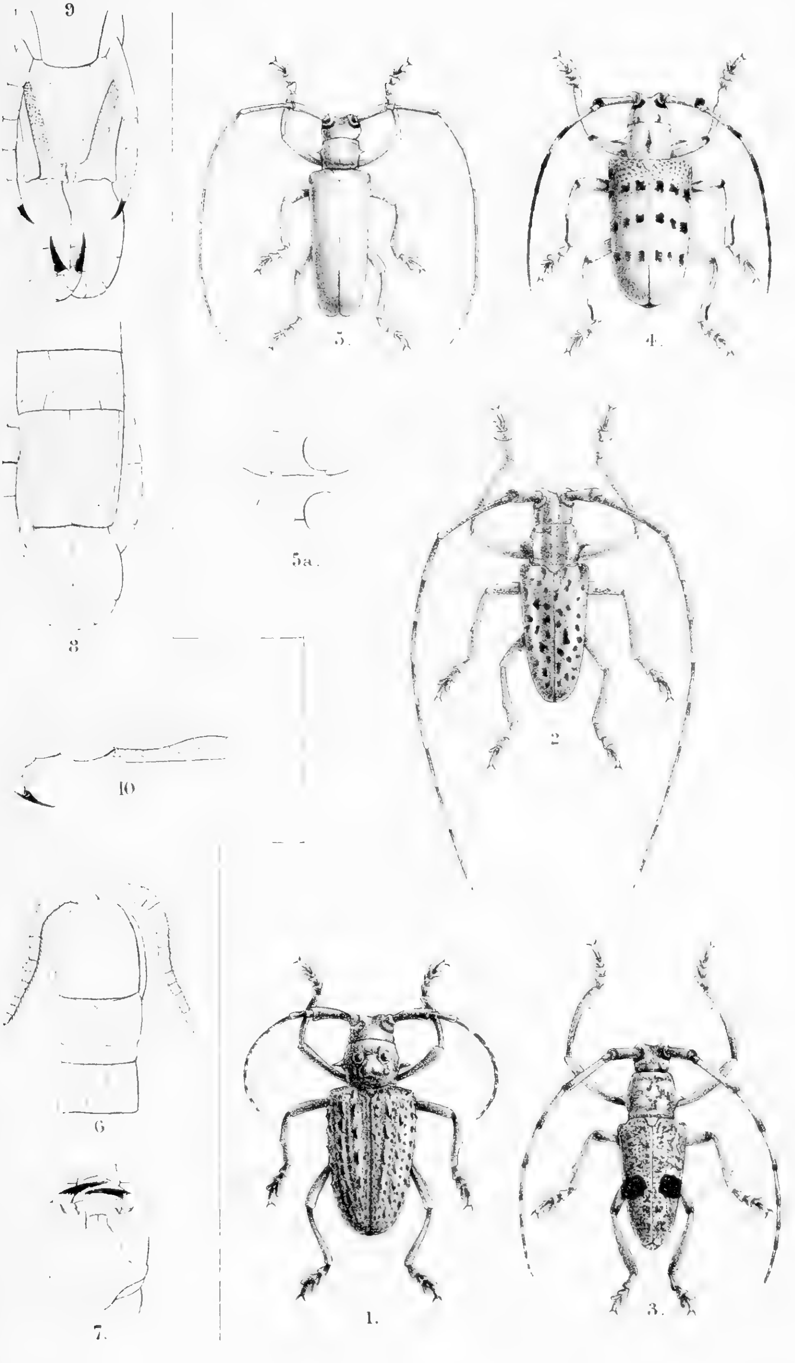

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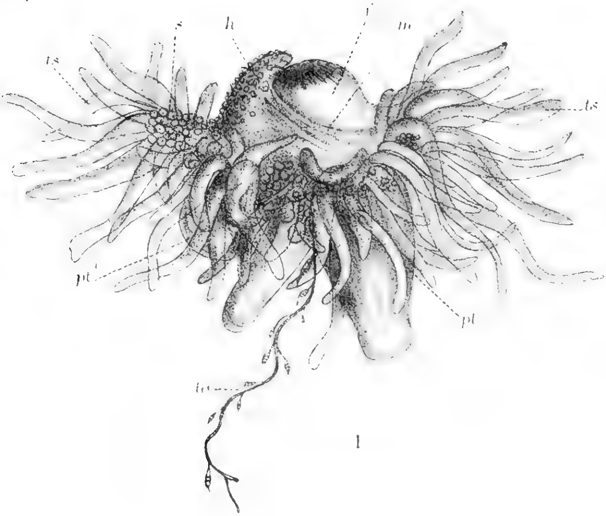

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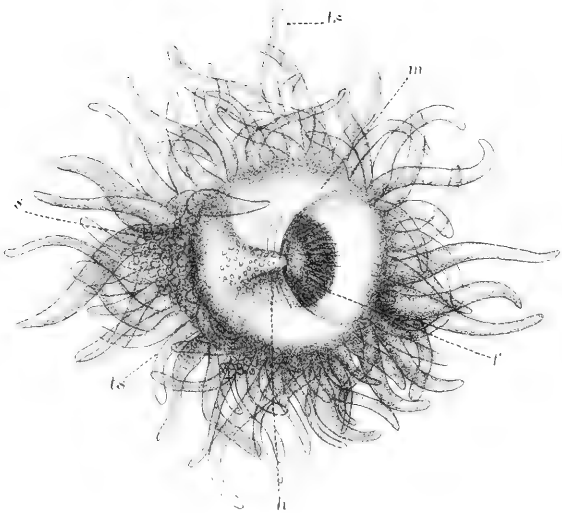

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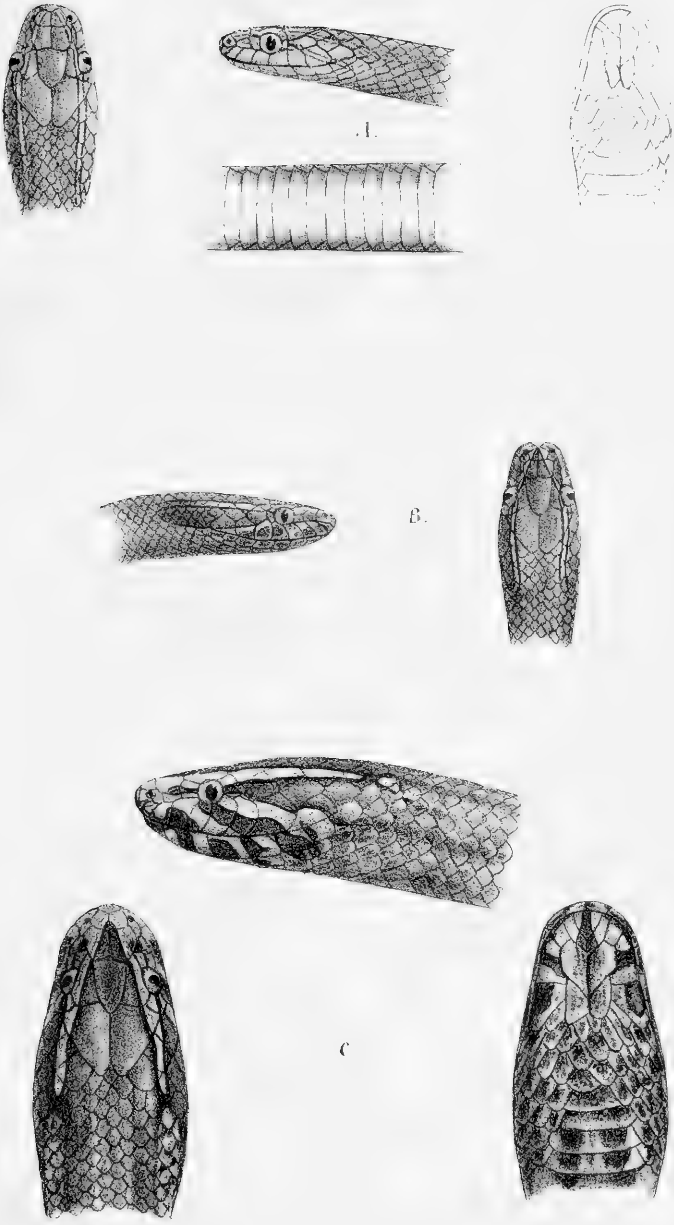

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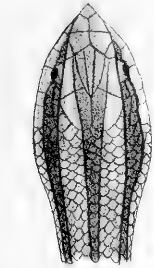

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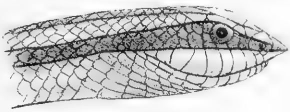

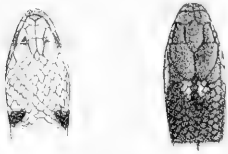

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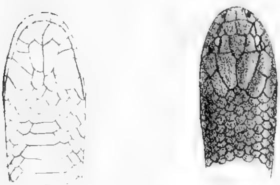

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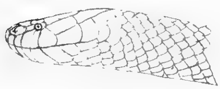

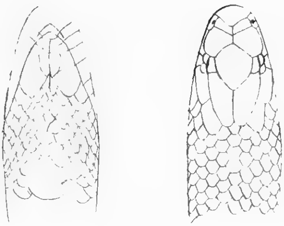

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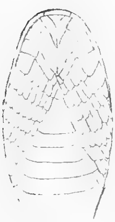

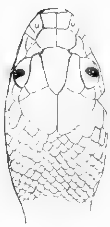

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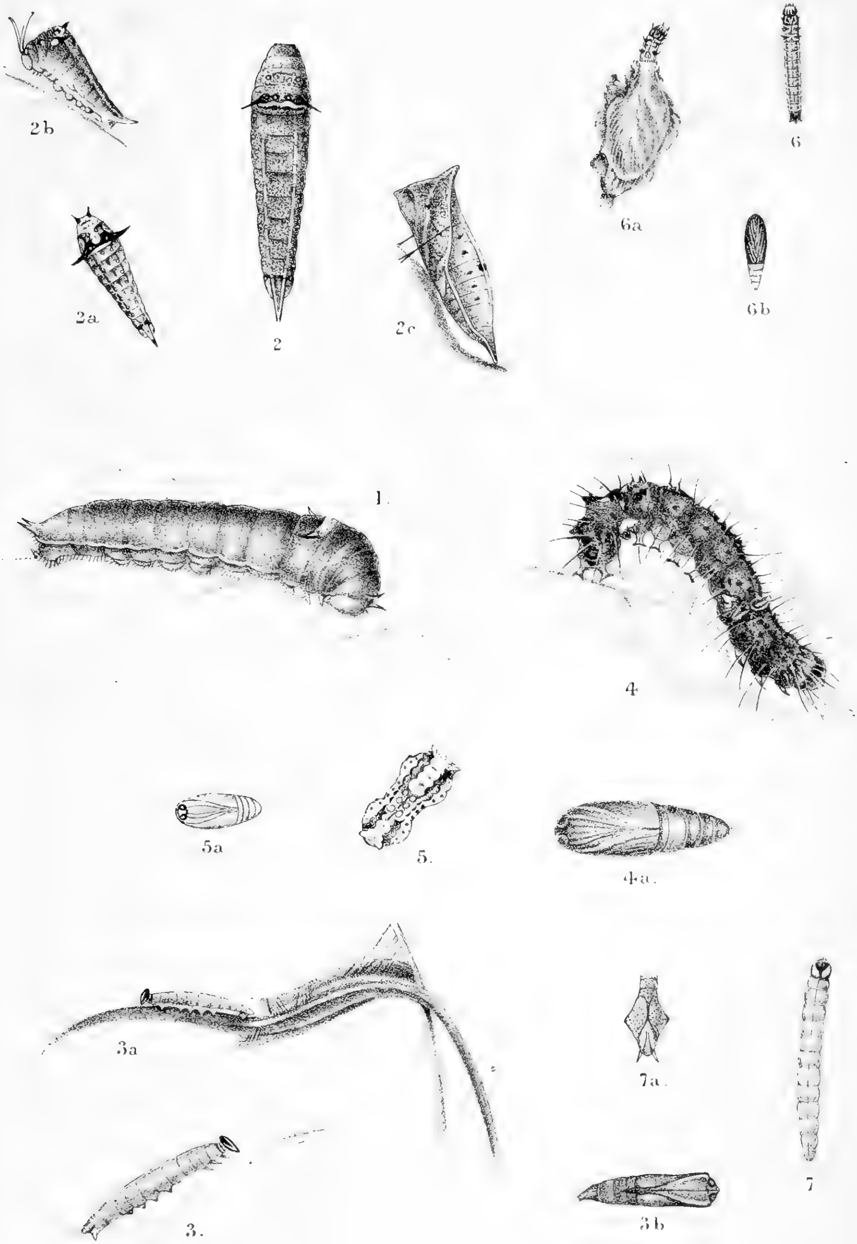

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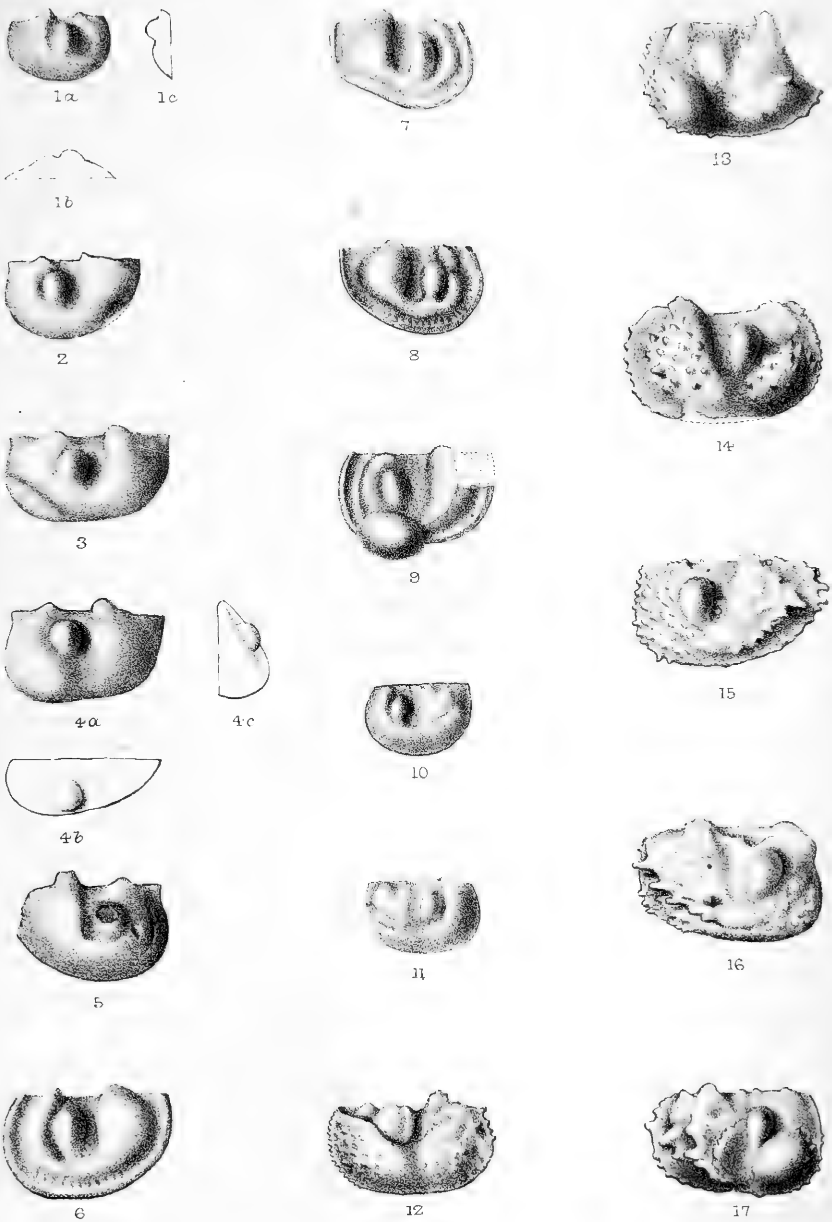

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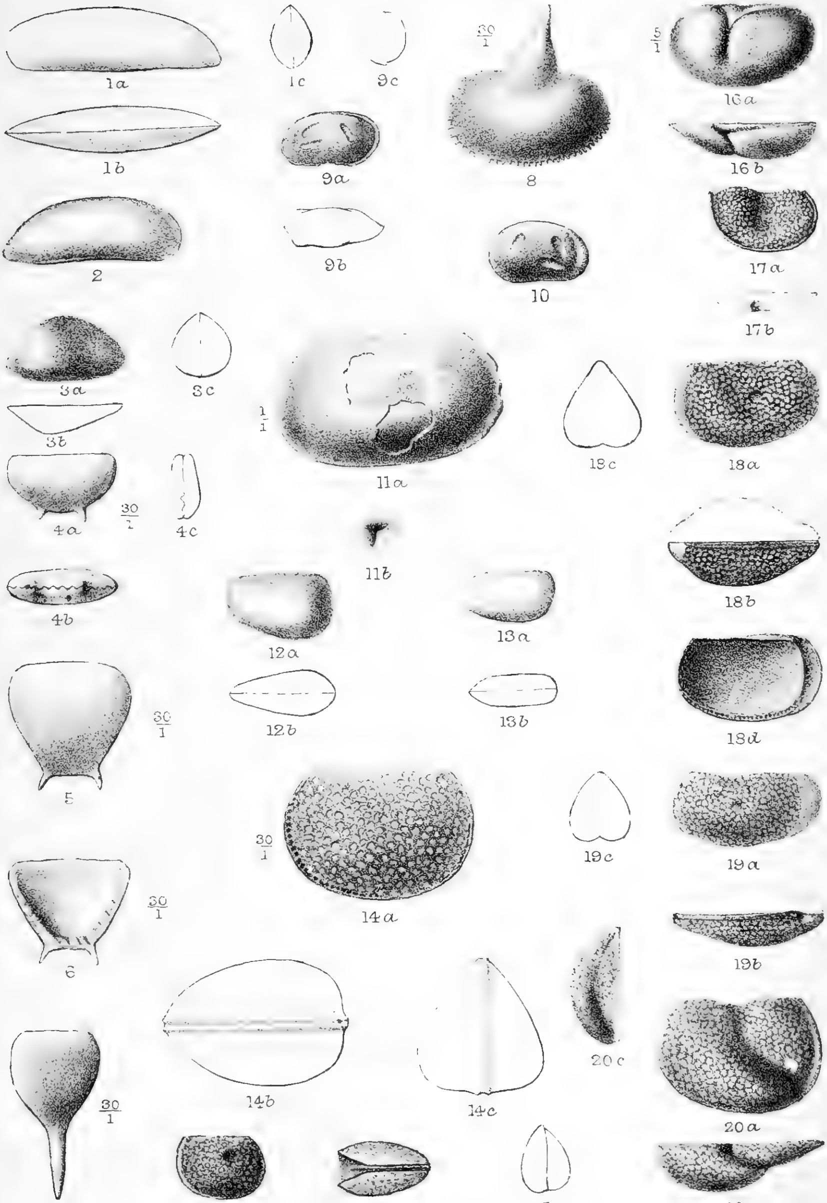
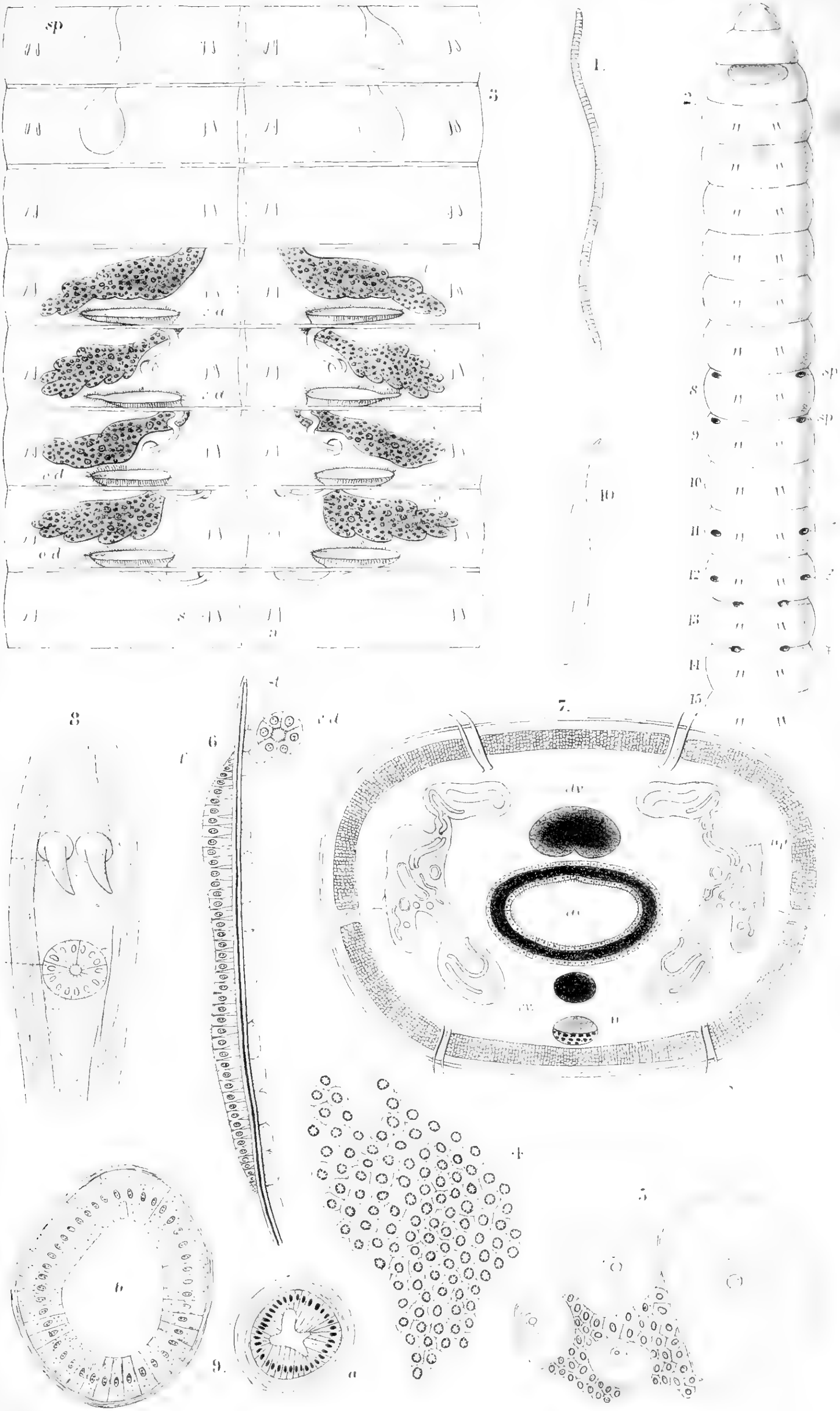
West, Newman & Co. imp.

Scandinavian Ostracoda.



E.C.Knight lith. West,Newman&Co.imp.

Scandinavian Ostracoda



F. E. B. del.
Mintern Bros. lith.