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I

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. 49. JANUARY 1892.

I.—*A new Species of* Munna *from New Zealand.* By Charles Chilton, M.A., B.Sc.

[Plates I. & II.]

The genus *Munna* was established in 1839 by Kröyer; but as yet only a comparatively small number of species appear to be known. Beddard, writing in 1886, says that only five species were then known, all of them being inhabitants of the shallow water off the coasts of Great Britain, Norway, North America, &c.* He adds two species, *M. maculata* and *M. pallida*, both obtained from shallow water off Kerguelen Land during the 'Challenger' Expedition. Each of his species is remarkable for some point: *M. pallida* has the eyes without the appreciable stalks found in other species, and in *M. maculata* the male has the same form of body as the female and is not narrowed and elongated as in some of the other species of the genus.

I am now able to add another species, found between tide-marks on the coasts of New Zealand. As in *M. maculata*, the male has the same form of body as the female; the species appears to differ from the others hitherto described in having the first pair of thoracic appendages of the male very large

* Report of the 'Challenger' Isopoda, part ii. p. 24.

and of a peculiar shape. As I have an abundance of specimens, I am able to describe the species in greater detail than has been done for some of the others, and also to give pretty fully the peculiar characters of each sex.

Most of my specimens are from Port Chalmers in Otago Harbour. They were taken during low tide on the surface of stones and boulders under a mass of decaying *Boltenias* that had been washed up on the beach. They were found in great numbers and of all sizes, many of the females bearing eggs or young. I have not taken them in the same locality either before or since, although I have several times hunted over the same spot. Possibly some of them had been washed up with the *Boltenias* and had afterwards increased on the beach, though, if so, they must have increased very rapidly, as the *Boltenias* had evidently not been there for more than a few days. The specimens of the *Munna* were so numerous on all the stones near that it scarcely seems possible that they could all have been washed up with the *Boltenias*. They walked about on the stones somewhat slowly but with perfect ease, and seemed quite at home out of the water. The excessively long hind legs and the very long antennæ, which they carried bent back over the body, gave them a very spider-like appearance.

I have since taken a single specimen on sea-weed in a rock-pool in Port Chalmers, and another from a rock-pool at Brighton, on the east coast of Otago.

The new species now to be described agrees closely with the characters of the genus as they are given by the various authors. According to Beddard the affinities of *Munna* are with *Pleurogonium* and its immediate allies, though it also approaches *Jæra*, *Janira*, &c. in having biunguiculate thoracic appendages *. This affinity with the latter genera is fully confirmed by an examination of the mouth-parts and pleopoda of the present species, as a comparison of them with those of *Ianthe speciosa* as described by Bovallius † shows that they closely conform to the Asellidan type. Bovallius, however, does not include *Munna* in his "Notes on the Family Asellidæ" ‡.

I shall first give a short specific diagnosis of the species, and afterwards describe some of its parts in greater detail.

Munna neozelanica, sp. n. (Plates I. & II. figs. 1–15.)

Male.—Body narrow-elliptical, length about two and a half

* Report on the 'Challenger' Isopoda, part ii. p. 24.

† Bihang till K. Svenska Vet.-Akad. Handlingar, Band 6, no. 4.

‡ *L. c.* Band 11, no. 15.

times the greatest breadth. Head not broader than the first segment of pereion, deeply notched on each side for the bases of the antennæ, produced anteriorly between the antennæ; front margin straight, with rounded upper lip attached. The lateral portion behind the insertion of the antennæ with the anterior angle somewhat acute, the posterior angle rounded, somewhat produced, and bearing the moderately-sized eyes. First four segments of the pereion subequal in length, gradually increasing in width up to the fourth, which is the widest; next three segments subequal and slightly shorter than the preceding, curving slightly backwards at the sides. All the segments having the lateral margins straight or slightly rounded. Pleon as long as the four preceding segments of the thorax, pear-shaped, narrowing posteriorly, extremity rounded.

Antennules with the first two joints stout, others slender, reaching a little beyond the end of the third joint of the antennæ. Antennæ considerably longer than the body. First pair of legs very large and strong and of peculiar shape, the ischios being very thick and strong and hollowed anteriorly to receive the distal part of the limb when bent back; carpus expanding distally, mallet-shaped at the end; propodos small and rounded. Succeeding legs of usual shape, the last three pairs longer than the others, about as long as the body.

Female with the body of the same shape as in the male; differs from the male in the first pair of appendages of the pereion, which are short and imperfectly subchelate; carpus broader than the propodos, having the inner edge armed with six strong spiniform setæ.

Colour brownish, more or less closely covered with darker dots and stellate markings.

Length of body of largest specimens about 3 millim.

Hab. Port Chalmers and Brighton, New Zealand, between tide-marks.

Remarks.—In the shape of the body and in the fact that the male and the female have the body of the same form, this species appears to resemble *M. maculata*, Beddard, but the form of the first pair of legs is evidently very different; it also differs in the antennules and in other points. It seems to be quite different from *M. pallida*, Beddard.

Detailed Description.

The *head* (Pl. I. figs. 1 and 3) is broad, about twice as broad as long, and longer than the two succeeding segments of the pereion; on each side it is deeply notched for the insertion of the antennæ; it is produced in front between the antennæ and has the front margin, to which the upper lip is attached, straight, with the lateral angles well rounded. The lateral portion behind the bases of the antennæ has the anterior angle somewhat acute and the posterior angle produced and rounded and bearing the large eyes, which are thus somewhat pedunculated, though apparently not so much so as in some other species of the genus.

The *pereion* (Plate I. fig. 1) has the first segment a little broader than the head, rather shorter than the second, the second, third, and fourth subequal in length, widening slightly up to the fourth segment, which is the widest; the fifth, sixth, and seventh segments are progressively shorter and curve backwards at the sides into rounded lobes, which are somewhat gaping laterally.

The *pleon* (Plate I. fig. 1) is much narrower than the pereion, somewhat conical or pear-shaped, rapidly narrowing posteriorly, with the extremity rounded. It usually projects slightly upwards, and the uropoda are barely visible in a dorsal view.

The *antennules* (inner antennæ) (Plate I. figs. 2 and 3) reach somewhat beyond the end of the third joint of the peduncle of the outer antennæ. The first or basal joint is the broadest, being about two thirds as broad as long; the second joint is about as long as the first, but only half as broad at the base; it expands considerably towards the distal end and bears a few fine setæ scattered over the surface; the next two joints are subequal, small, the two together being less than half the length of the second joint; each is nearly as broad as long, they are followed by a long slender joint as long as the second and third together; at the extremity of this are two very small joints provided with long "olfactory filaments."

In the possession of the long slender joint at the end of the antennules this species resembles *Munna Whiteana*, Spence Bate and Westwood *. It is evidently, however, subject to some variation, for I have one specimen in which the right antennule is of the normal shape, as already described, but the left one has the long fifth joint only about two thirds as long as that on the right, while the following joint is much larger than usual, being about one half the length of the fifth joint; both of these bear "olfactory filaments," so that doubtless the long fifth joint should be looked upon as a modified portion of the flagellum.

* 'British Sessile-eyed Crustacea,' ii. p. 329.

The *antennæ* (Plate I. figs. 1 and 3) are very long, when fully developed being considerably longer than the body; in small specimens they are shorter in proportion to the body. They present nothing remarkable in their character. The first three joints are subequal, short, the fourth and fifth subequal, very long, slender; the flagellum slender, about as long as the whole peduncle. The antennæ are often bent sharply backwards at the end of the third joint, so that the fourth joint is directed backwards, while the fifth and the flagellum are directed forwards again. There is no trace of the rudimentary exopodite found in *Janira*, *Ianthe*, and *Stenetrium*.

The *upper lip* (Plate I. figs. 4 *a* and 4 *b*) is attached to the front margin of the head and is directed forwards and partly downwards. It is nearly semicircular, slightly convex above; in the centre the front margin curves over underneath, so that when viewed from above the lip appears slightly emarginate in the centre. When viewed from below it is seen that the middle portion of the front bears many short setæ, those on each side being directed inwards.

The *mandibles* (Plate I. figs. 5 *a* and 5 *b*) are similar to those of *Ianthe*. The right mandible has only one cutting-edge, ending in four distinct sharp teeth, next to which come five large pectinated setæ, arranged in an oblique line across the end of the mandible. The seta nearest the end is the broadest and the most pectinated, being quite comb-shaped; the others are longer, but gradually decrease in breadth and in the number and size of the pectinations, the fifth having only a few pectinations towards the end. The molar tubercle is long, rather slender, and has the end obliquely truncate and bearing two or three rather long setæ in addition to the usual short thick-set setæ which form the grinding-organ at the end.

The left mandible is similar, but has two cutting-edges, the end one with five teeth and the inner with four; then follow four or five pectinated setæ, as in the right.

The palp (fig. 5 *b*), which is the same on each side, consists of three joints, the second being the longest and about half as long again as the first; towards its distal end it bears two stout serrated setæ; the third joint is somewhat shorter than the first and bears five or six stout setæ on one side towards the distal end; these are placed at right angles to the joint and are curved and serrated on the concave edge; they increase regularly in length distally, the last one being nearly as long as the joint itself. The third joint is usually bent at right angles to the second.

The *lower lip* (Plate I. fig. 6) consists of two portions almost completely separated; I have never been able to dissect out the two parts together. Each is subtriangular in outline, the inner margin nearly straight, the outer strongly curved and somewhat sinuous, the distal extremity being acute. The distal half of the inner margin is fringed with short setæ which gradually increase in length distally, the longest being placed at the extremity; the outer margin is free from setæ.

The *first maxilla* is of the usual shape and consists of two lobes, the outer longer than the inner, slender, narrowing towards the extremity, and bearing at the end about ten broad comb-like setæ; the inner lobe is only about half as long as the outer, broadest at the base, bearing at its extremity four or five long curved setæ, plumose towards the end, and also two or three finer simple setæ.

The *second maxilla* is also of the usual shape, consisting of a broad basal portion bearing three subequal plates, the inner forming a prolongation of the base, the outer two being articulated to it. The two outer plates are similar and subequal, oblong, each bearing at the end four long setæ, the three outer very finely pectinated on the inner margin, the inner one shorter than the others and coarsely pectinated, the pectinations being at right angles to the seta. The inner plate bears at its extremity eight to ten setæ of various sizes, some stout and pectinated, others fine; there are also some fine slender setæ or hairs on the inner margin.

The *maxillipedes* (Plate I. fig. 7) are well developed and broad and appear to form a sort of operculum to protect the mouth-parts. The basal joint (*coxos*) is short, transverse, and bears the elliptical *epipodite* and the large *basos*. The margin of the epipodite is quite free from setæ and quite entire except for a short distance towards the end on the outer side, where it is finely crenate. The basos is very large and forms much the largest part of the whole appendage; its inner margin is straight and it is produced distally into a flat plate nearly as large as the basos proper; the extremity of this plate bears numerous short pectinated setæ. On the inner margin are four stout setæ, slightly hooked or enlarged at the end so as to fit into those on the other side and hold the two halves of the maxillipedes together. The "palp" (*endopodite*) has the ischios short transverse, the meros is much larger and expands distally, and has both margins, but especially the inner one, fringed with long setæ; the *carpus* is much broader than long, the inner margin rounded and densely covered with setæ, a few being placed also at the outer distal angle; the *propodos* is narrow and about as long as the carpus is broad; it expands slightly distally, curves inwards, and bears long setæ on both margins; the *dactylos* is less than half as long as the propodos, and ends in two long stout setæ.

The *legs of the first pair* (Plates I. and II. figs. 8 *a*, 8 *b*, 8 *c*, 8 *d*) are very different in shape in the two sexes. It will be convenient to describe those of the female first, as they are the more normal in shape. The *basos* (see fig. 8 *a*) is subrectangular and about twice as long as broad, the *ischios* is about as long as the basos but slightly narrower, the *meros* is triangular, expanding distally, the antero-distal angle slightly produced and bearing a single stout seta, a few setæ being also present on the posterior margin; the *carpus* is also triangular, but is larger and broader and has the postero-distal angle produced, the distal end of the joint being straight but oblique; there are a few fine setæ on the anterior margin and the posterior margin is supplied with about six stout spiniform setæ and a few fine scattered hairs; the *propodos* is considerably narrower than the carpus, but of about the same length, the anterior margin is convex and bears several fine setæ, there are usually a few also on the posterior margin and at the end, the largest being situated at the rounded postero-distal angle; the *dactylos* with the claws is as long as the posterior margin of the propodos, it bears a few fine setæ, and ends in two distinct claws, the outer one fully twice as large as the inner.

From the figure and description given it would appear that the first pair of legs in the female in this species is not very dissimilar from that of *Munna Kröyeri*, Goodsir, as drawn and described by Bate and Westwood, though they state that only the male of that species is known, and their figure would therefore presumably apply to the male.

In the *male* the first pair of legs are very large and peculiar in shape. The first joint (fig. 8 *d*), which might at first sight be taken for the *coxos* (epimeron), but is really the *basos*, is very short and small, and from it arises a very large *ischios*. This joint is large and subrectangular, not quite twice as long as broad, and the whole joint is filled with a very powerful muscle, which moves the next joint and with it the remainder of the limb. In front the ischios is deeply grooved and receives the distal portion of the limb when bent back; at the base it is the inner portion of the ischios that is produced forwards, while at the distal end the outer portion is produced forwards and downwards to form the groove, so that when the end of the limb is bent back upon the ischios it is protected and held in its place both on the inside and the outside. The *meros* is flat or hollow above and expands a little distally, its articulation with the ischios is concealed in a view from the outer side by the prolongation of the outer portion of the ischios. The *carpus* is nearly as wide at the base as the preceding joint, but expands distally and has the end shaped something like a mallet, being produced both above and below, the lower portion finely crenate—the exact form will be learnt from the figure more easily than from any verbal description. The *propodos* is attached to the upper distal corner of the carpus; it is nearly circular in shape, and bears a small dactylos which ends in two claws as in the other legs. The whole limb is, in fully developed males, quite free from setæ; the ischios and meros are rather thick through from side to side, but the carpus and propodos are thinner and plate-like.

The whole leg is most striking in appearance and quite unlike anything else that I have seen among the Isopoda. It most probably forms a grasping-organ of some kind, though it is not easy to see exactly how it is used, and while grasping-organs are usually formed by means of the terminal joints (propodos and dactylos) in other species, in this case these are small and more or less rudimentary.

In young males the first pair of limbs is much more like those of the female and quite different from those of the fully developed male. One stage in the development is shown in figure 8 *b* of Plate II. The basos is of fair size, though not so long in proportion to the other joints as in the female; the ischios is much larger and already shows signs of its future great expansion; the remainder of the limb is practically the same as in the female, except that there are fewer spiniform setæ on the carpus. A more advanced stage is shown in figure 8 *c* of Plate II. The ischios is more enlarged, the meros more elongated and more like that of the adult male, the carpus has begun to take its peculiar mallet shape, the propodos is becoming more rounded, and the setæ have almost disappeared from the whole limb.

It will thus be seen that in this species, as in many other cases, the young male resembles the female, and that the peculiar characters of the adult male are acquired by a gradual development *.

* See Darwin's 'Descent of Man,' p. 232 (second edition).

The *legs of the second pair* (Plate II. fig. 9) are about two thirds the length of the body and are normal in shape. The *coxos* (epimeron) is short, transverse, and clearly separated off from its segment; the *basos* is narrow oblong, slightly constricted proximally, margins free from setæ; the *ischios* is similar in shape but not quite so long; the *meros* is shorter than the ischios, narrow at the base, and has the antero-distal angle somewhat produced and bearing a seta; there are also two or three fine setæ on the posterior margin towards the distal end; the *carpus* is slightly longer than the ischios and meros together and is rather more than four times as long as broad, it bears one or two rather stout setæ on each margin towards the distal end; the *propodos* is considerably longer than the carpus, but is much narrower, being not quite half the width; on the posterior margin towards the distal end is a row of about twelve short stout setæ, and on the anterior margin a fringe of finer hairs, those at the base of the dactylos being the longest; the *dactylos* is of the usual shape and bears two distinct claws.

The *third and fourth pairs of legs* are quite similar to the second, and are of about the same size.

The *legs of the fifth pair* (see Plate II. fig. 10) are similar in general form to the preceding, but are considerably longer. The *basos* and *ischios* are subequal in length and longer than the *meros*, which, however, is more elongated than in the preceding legs; all three joints have the upper (anterior) margin fringed with a number of fine hairs; the *carpus* is rather broad and is as long as the ischios and meros together, and in addition to a few stiff setæ at the distal end has, *in the male*, the whole upper surface of the joint densely covered with long, irregular, woolly hairs, which are usually clogged with dirt, diatoms, and other extraneous matter; the *propodos* is very long and slender, being longer than the meros and carpus together; the whole upper surface is fringed with irregular fine hairs and the lower margin bears a number of stiff setæ; but these are smaller and do not form such a distinct row as those described on the second pair of legs; the dactylos is like that of the second pair of legs, but more elongated.

In *the female* the fifth pair of legs is similar to those in the male, but the carpus does not bear the irregular woolly hairs, and consequently the stiff setæ present are more distinctly seen.

The *sixth and seventh pairs of legs* are quite similar to the fifth and of about the same size.

The appendages of the pleon are of small size in accordance with the size of the pleon itself, and they are rather difficult to dissect out satisfactorily; but, so far as I have made them out, they present a fairly close general resemblance to those of *Ianthe speciosa* as described by Bovallius.

In *the male* the *first pair of appendages* (Plate II. figs. 11 *b* and 11 *c*) are modified to form an accessory male organ. They consist of two more or less oblong plates fitting closely against one another along the median line; they are widest at the base, where the outer margins are strongly convex; towards the middle they narrow considerably, widening again slightly towards the distal end; the extremity of each part is curved and bordered with about eight short setæ. On the underside the surface of the plates is quite flat and the lateral margins are entire (fig. 11 *b*). On the upper surface near the middle there is on each side a thin plate projecting upwards, so that a kind of groove is formed between them, the top of it being no doubt closed by the next pair of pleopoda fitting on to it above. Towards the end the surface is raised on each side into two ridges which converge towards each other as they reach the outer distal angle, thus forming a duct on each side, which reaches from nearly the centre of the joint to the outer angles (fig. 11 *c*). The whole apparatus probably serves to pass on the spermatozoa from the genital openings in the seventh segment of the pereion to the "penial filament" of the second pair of pleopoda. On the under surface the two halves of the organ are separated along their whole length, but on the upper surface they are joined together from the base until the beginning of the ducts, only the distal portions therefore being completely separated.

The *second pleopoda* (Plate II. fig. 12) have the main portion subtriangular, the inner edge nearly straight, outer edge curved and bearing a few short setæ towards the subacute extremity. This portion, which both Bovallius and Beddard consider the "protopodite," contains a very powerful muscle, which reaches to the "penial filament" and no doubt acts as an extensor muscle for it. This filament appears to consist of two joints, one directed backwards towards the base of the appendage and the other when at rest lying alongside it, directed in the opposite direction, slightly curved, and ending in a long, very acute extremity, apparently grooved on the concave side. Beddard considers this "penial filament" to be the "endopodite," a small soft appendage which arises from near its base he considers as the "exopodite."

The *third pleopoda* (Pl. II. fig. 13) consist of a basal portion, the *protopodite*, which bears an inner, flat, rectangular, branchial plate, the *endopodite*, which narrows slightly towards the distal end and bears at its extremity three long, delicately plumose setæ; the outer part of the appendage, the *exopodite*, is not separated at the base from the protopodite; it consists of two joints, the first rectangular, bulging a little distally on the inner side, the second subtriangular, bearing a few small setæ at the extremity and three longer ones on the outer margin; the outer margin of both joints is also closely fringed with very fine short setæ.

The *fourth and fifth pleopoda* I have not been able to separate out quite satisfactorily, but they appear to consist of rounded branchial plates with margins quite free from setæ. Among the other parts I found the appendage represented in figure 14 of Plate II. This I believe to be the exopodite of the fourth pair of pleopoda; it is somewhat similar to the exopodite of the third pair, but narrower and more delicate; the basal portion is long and curves slightly outwards, the whole of its outer margin is finely crenated and fringed with very delicate setæ, which project radially outwards at each crenation; the second joint is subtriangular, joined to the first by an oblique articulation; it has the outer margin fringed with fine setæ and bears at the end two very long, delicately plumose setæ longer than the joint itself.

In *the female* the first pair of pleopoda (fig. 11 *a*) have been modified to form an oval operculum, which is only slightly longer than the greatest breadth; it consists of a single piece without any suture or other mark showing the different parts of which it is composed; the extremity, which is nearly straight, bears six or seven very small fine setæ.

The other pleopoda of the female, with the exception of course of the second, appear quite similar to those of the male.

The *uropoda* (Plate II. fig. 15) are very small, conical, and bear a few small setæ. They are the same in both sexes.

Sexual differences.—In no point do we find so much variety as in the characters by which the female differs from the male among the Crustacea. These differences are found sometimes in one part of the body and sometimes in another, and the parts affected are often different in closely allied species. In the present species the female differs from the male in the following points:—(1) In the character of the first pair of legs; (2) in the absence of the woolly hairs found on the carpus of the fifth, sixth, and seventh pairs of legs in the male; (3) in the special modifications of the pleopoda.

EXPLANATION OF PLATES I. & II.

[All the figures refer to *Munna neozelanica*.]

Fig. 1. Dorsal view (taken from a rather small female), showing some of the appendages only. × 19.
Fig. 2. Antennule, × 52.
Fig. 3. Lateral portion of the head, showing the eyes and the insertion of the antennules and antennæ (from a smaller specimen), × 52.
Fig. 4. Upper lip, with front part of the head. *a*, from above, × 22; *b*, from below, × 52.
Fig. 5. Mandibles: *a*, extremity of right mandible, × 125; *b*, palp of mandible, × 90.
Fig. 6. Lower lip, × 52.
Fig. 7. Maxillipede, × 52.
Fig. 8. First pair of legs: *a*, of female, × 52; *b*, of a young immature male, × 52; *c*, of a young male, more developed, × 52; *d*, of fully developed male, × 23.
Fig. 9. Second pair of legs (of male), × 23.
Fig. 10. Fifth pair of legs (of male), × 23.
Fig. 11. First pleopoda: *a*, of female, forming an operculum, × 23; *b*, of male, forming male organ, from below, × 52; *c*, extremity of the same, from above, showing ducts &c., × 52.
Fig. 12. Second pleopoda of male, × 52.
Fig. 13. Third pleopoda, × 52.
Fig. 14. Exopodite of fourth pleopoda (?), × 52.
Fig. 15. Uropoda, × 90.

II.—*Note upon the Encystment of* Æolosoma. By Frank E. Beddard, M.A., F.R.S.E.

The observations to be recorded in the present note were made upon material kindly supplied to me by Mr. O. H. Latter, Science Master at Charterhouse. Knowing my interest in this group of Worms, Mr. Latter was so good as to forward me three tubes containing decaying plants from an aquarium, among which were a large number of specimens of one of the species of *Æolosoma* with *red* oil-globules in the integument. Two or three individuals were found in every sample of the water from these tubes examined with the microscope; they were of varying sizes, some being twice or even thrice the bulk of others: reproduction by gemmation was not going on with any vigour—a fact possibly due to the commencement of the cold weather; nor, on the other hand, were there any indications whatever of sexual maturity. With the cessation of the asexual method of reproduction one would perhaps expect to meet with some indication of the acquirement of sexual organs; but no such indication was observable in any of the individuals which I submitted to examination. The sexual organs of *Æolosoma Ehrenbergii* have been described by d'Udekem *, Maggi †, and, later, by Štolc ‡. Štolc's paper is fuller; there is no statement in d'Udekem's paper of the time of year at which sexual propagation takes place. Maggi speaks of autumn without particularizing the exact month. It is quite evident, however, that Maggi saw sexually mature individuals (see fig. 9, tav. ii. of his memoir).

Fig. 1.

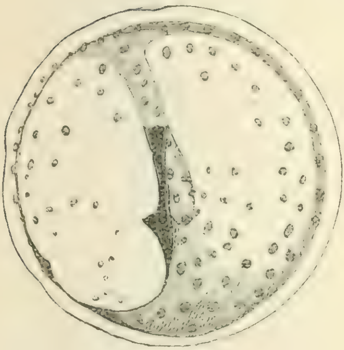

Fig. 2.

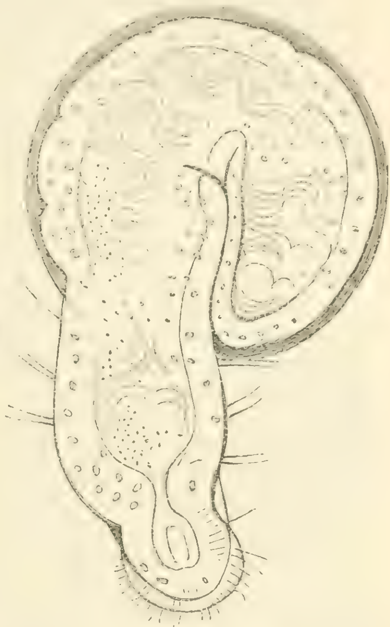

Fig. 1.—*Æolosoma* within the cyst.
Fig. 2.—The worm making its way out of the ruptured cyst.

In spite of the absence of any trace of genital organs in the *Æolosoma* the water contained numerous peculiar bodies (woodcut, fig. 1) which I believed at first to be developing embryos; I may, indeed, very possibly be mistaken in believing as I do now that they are *not* developing embryos.

* "Notice sur les organes génitaux des *Æolosoma* et des *Chætogaster*," Bull. Acad. Roy. Belg. t. xii. (2e sér.) p. 469.

† "Intorno al genere *Æolosoma*," Mem. Soc. Ital. Sci. Nat. vol. i.

‡ "O pohlavnick organech rodu *Æolosoma* a jejich poměru ku organum exkrečnim," SB. Böhm. Ges. 1889, p. 183.

The only author who has seen, described, and figured the developing embryo of *Æolosoma* is Maggi *. "The egg," he remarks (*ibid.* p. 15), "up to the complete formation of the embryo is always covered by a very resistant membrane, which may be compared to an egg-shell." The ovum when deposited has no longer a spherical form, but is oblong, formed of an outer membrane (the "egg-shell"), with an inner vitelline membrane, which surrounds the granular contents. As the embryo develops out of the ovum the red oil-globules appear, and at a comparatively early stage. The embryo can and does move freely about in the cavity of the shell. When hatched the setæ are only just visible. The figures illustrating this description (tav. ii. fig. 11, A–F) show a progressive increase in size of the whole ovum, which is, when fully mature, very minute. The drawing of the embryo just before hatching measures a little more than 1 inch in length, and is magnified 700 times.

Maggi speaks of the whole structure as an egg. Vejdovsky †, however, says "Nach Maggi sind die abgesetzten *Cocons* von *Æolosoma* elliptisch, durchsichtig, und die Embryonalentwicklung, &c." He regards them as cocoons, and the resistant membrane figured and described by Maggi as the chitinous wall of the cocoon. It is rather surprising that Maggi did not arrive at the same conclusion, since he correctly described the clitellum, which is known to be the organ concerned with the formation of the cocoon. Possibly, however, the difference in shape which the supposed cocoon of *Æolosoma* exhibits as compared with those of other Oligochæta, led Maggi to the view that the membrane in question does not represent a cocoon. In all Oligochæta, so far as is known at present without a single exception, the cocoon, which varies in form, is invariably prolonged at either end into a longer or shorter process, particularly long in *Criodrilus*. Otherwise the cysts of *Æolosoma* might well be supposed to be cocoons, even though they contain, according to Maggi, but a single embryo; for the Enchytræidæ and Naidomorpha, the nearest allies of *Æolosoma*, deposit only one ovum in each capsule. This fact was first discovered by the industrious investigator Jules d'Udekem ‡, and afterwards confirmed by Vejdovsky § and Štolc ‖. In the figure of the cocoon of

* Unless there is any statement made in Štolc's paper.

† 'System und Morph. d. Oligochaeten,' p. 19.

‡ "Nouvelle Classification des Annélides sétigères abranches," Bull. Acad. Roy. Belg. t. xxii.

§ 'Monographie d. Enchytraeiden.'

‖ "Příspevky ku Studiu Naidomorph.," SB. Böhm. Ges. 1887.

Enchytræus given by d'Udekem (on p. 9 of separate copy of his memoir already quoted) the two processes at either end of the cocoon are extremely rudimentary. In another memoir * published about this same time, dealing principally with the embryology of *Lumbricus*, a figure is also given of the cocoon of *Enchytræus galba*—it is evidently from the same drawing as that which furnished the figure already referred to. The cocoon and contents are thus (on p. 49) described :—"Il n'y en a jamais qu'un seul [œuf] dans une capsule; celle-ci est sensiblement sphérique et enveloppe complètement l'œuf; seulement il y a deux points opposés où on rencontre une légère protubérance."

With these illustrations and descriptions before him one could not be blamed for regarding the structures figured by Maggi as cocoons, from the drawings of which the "protuberances" had been omitted, since their slight development rendered them inconspicuous, and therefore easily passed over. The only difficulty in the way of making this comparison would be the increase of size in the cocoon—a fact not readily intelligible on the hypothesis of its being a cocoon.

In every drop of water which I examined from the source already mentioned there were not only specimens of *Æolosoma Ehrenbergii* crawling about, but very numerous round capsules, containing what looked at first like developing embryos of *Æolosoma.*

These capsules seemed to be occasionally attached to fragments of weeds &c. ; but I fancy that they were merely lying upon these bodies, and had no real connexion with them. In any case there was no observable means of attachment, and they were as commonly found lying freely in the water at the bottom of the vessel in which they were placed.

Each capsule contained a single *Æolosoma*, which appeared to be always bent once upon itself, the tail lying close to the head. The capsules were nearly invariably *perfectly spherical*, but sometimes more irregular in form or oval; otherwise they recall Maggi's figure (fig. 11, F), where the "embryo" is represented as being coiled in a position very similar to that which I found. These capsules are quite visible to the naked eye, their average size being about that of *Volvox globator*. They are in every case perfectly motionless—that is to say, there was no motion of translation ; the worms inside were, however, in active movement — not crawling about within the cysts, but showing active contractions of the body and movement of the alimentary canal, the

* "Développement du Lombric terrestre," Mém. cour. et Mém. d. sav., etc., Acad. Roy. Belg. t. xxvii.

contents of which were driven hither and thither by peristaltic waves of contraction; these movements were generally though not always to be seen; they appeared to be sometimes increased by warming the slide. I did not observe any movement of the cilia on the under surface of the prostomium.

The capsules were of various sizes, some being quite twice as large as others; but although there was a difference of size there was no ascertainable difference in shape between the larger and smaller capsules, nor, in fact, any difference of structure correlated with the difference of size. The capsules bore not a little resemblance when examined with a lens to the "fruit" of *Chara*, on account of their orange colour; this colour is due to the innumerable orange oil-drops of the contained worms. Occasionally the worms within the capsules appeared of a faint pinkish colour; this coloration recalls Prof. Lankester's * observations upon the blood of *Æolosoma*. He remarks that the blood in the vessels is of a pinkish colour; the pink colour which I observed was not limited to the blood-vessels, but pervaded the body generally; it is, I think, due to a diffusion of the integumental pigment liberated through the disintegration of some of the epidermic oil-globules. The pink colour was notably increased by pressing upon the cover-glass with sufficient energy to injure the integument and rupture the vesicles containing the pigment.

The capsules consist (see figs. 1 & 2) of a thin layer, which varies in thickness in different individuals; it is perfectly colourless and transparent; it had no tinge of yellow like the cocoons of Oligochæta in general. When the capsule was ruptured by forcibly pressing upon the cover-glass with a needle the contents were pressed out, leaving the cyst intact. The cyst was then seen to be a complete hollow thin-walled sphere; the elasticity of the walls was shown by the fact that if, during the process of rupturing, the cyst-walls were pressed inwards at any point, they recovered their form immediately that the pressure was removed.

The worm always completely filled the cyst, its epidermis being in close contact with the membrane. Occasionally I found empty cysts, which were split across as shown in the figure (fig. 2), to allow the egress of the worm.

What is the nature of these cysts? Are they cocoons? It is difficult to answer this question quite positively. But before attempting to do so I may quote a later remark of Prof. Vejdovsky † upon the subject. In a general summary of our

* "A Contribution to the Knowledge of the Lower Annelids," Trans. Linn. Soc. vol. xxvi. p. 642.

† 'Entwicklungsgeschichtliche Untersuchungen,' Heft i. p. 46.

knowledge of the cocoons of the Oligochæta he observes with regard to *Æolosoma*, "Auf die Schilderung der vermeintlichen Cocons von *Æolosoma* wie sie seinerzeit Maggi gegeben hat, verzichte ich einzugehen, da es hier durchaus unklar bleibt, ob er thatsächlich Cocons, oder encystirte Würmer gesehen hat." I am not certain whether Prof. Vejdovsky is speaking here of his own knowledge or is merely arguing from Maggi's figures; be that as it may, I believe that Vejdovsky's suggestion of encystment is the right one, and I had come to that conclusion before making myself acquainted with the paragraph quoted above, while getting together the literature of the subject. All the facts that I have been able to bring forward in this paper tend, as it appears to me, to show that we have here a unique case among the Oligochæta of encystment. I believe I am right in saying that no freshwater Annelid has hitherto been discovered to possess this power of temporary encystment. I shall now endeavour to show that *Æolosoma* does encyst itself.

On the hypothesis that the cysts in question are cocoons we have to dispose of a good many preliminary difficulties. In the *first* place their form—absolutely spherical and without processes at either end—is unique among the Oligochæta; *Æolosoma* of course may be an exception, but there is not, I think, evidence at present that it is. *Secondly*, there is the difference of size; no doubt there are infinite variations in the size of the cocoons of various species of Oligochæta, but I have not found such a great difference as I have recorded here among the cysts of *Æolosoma*. This very fact seems to indicate that Maggi's figures, to which I have already referred, represent cysts (of various sizes) and not developing ova; the figures of the contained embryos which he gives are not sufficiently detailed to enable one to be absolutely certain that they are not disintegrating worms rather than developing embryos. The difference in shape between the structures figured by Maggi and those which I have observed may be possibly put down to specific differences. *Thirdly*, all the cysts which I examined — amounting to forty or fifty — contained fully grown worms, immature certainly (as regards absence of sexual organs), but quite as large as those swimming about in the same water. This may be merely a coincidence, but in that case it will be a very remarkable one; all that we know of the development of the Oligochæta shows that the time varies somewhat in individuals, one growing faster than another. Besides this we have further to assume that all the cocoons, each furnished with its one ovum, were fabricated either upon the same day or at the exact intervals that would allow of the embryos simultaneously reaching their full term of development. This supposition is rather too much to believe. *Fourthly*, the supposed cocoons possess no apparatus of fixation; this is not a positive bar to believing them to be cocoons, for some worms have not any such mechanism, but in others the cocoon is enveloped in a gelatinous layer which causes it to adhere firmly to the surface upon which it falls. *Fifthly*, and, if my observations are correct, this is an absolute and final objection to regarding the cysts of *Æolosoma* as cocoons. I treated a number of these bodies with streng potash; the first effect of this reagent was to change the colour of the pigment to a splendid violet, which rapidly disappeared. This fact I have already recorded in this Journal*. The second effect was to colour bright green the contents (be it noted that there *were* contents) of the alimentary canal. *Æolosoma* is a vegetable feeder, and potash produces a precisely similar effect upon the colouring substances of various algæ. The natural inference is that the supposed embryos had been feeding upon such algæ; clearly therefore they cannot be embryos at all, as algæ could not gain access to the interior of the cysts. They must have fed upon these algæ and then encysted themselves. It is perhaps unnecessary to state that the worms within the cysts had setæ precisely similar to those crawling about outside. I mention this fact, however, more particularly since Maggi did not find setæ upon the worms within the cysts described by him. The setæ might, however, be passed over; they are extremely delicate, and the position of the worm in the cyst —coiled upon itself—is not by any means a favourable one for allowing these structures to be seen.

Considering all these facts it seems to me necessary to arrive at the conclusion that *Æolosoma can temporarily encyst itself*, after the fashion of some of the lower organisms. It should be noted that the alimentary tracts of the free-swimming individuals did not for the most part contain much food; and I saw but little evidence of active feeding on the part of the worms in the shape of the very characteristic pellets of dung evacuated by these Annelids. This cessation of feeding may be preliminary to encystment; the torpor caused by the approach of winter may have brought about a general cessation of activity, which culminates in encystment for a period

* "Notes upon certain Species of *Æolosoma*," Ann. & Mag. Nat. Hist. Oct. 1889.

when food is not so abundant. The apparent rarity of sexual propagation, which might possibly lead to the formation of cocoons so small as to be readily carried about by the wind, may have something to do with this encystment. The cysts are small enough to travel very easily, and the wide distribution of the species may have been thus brought about.

III.—*Notes on Longicorn Coleoptera of the Group* Cerambycinæ, *with Descriptions of new Genera and Species.* By CHARLES J. GAHAN, M.A., Assistant in the Zoological Department, British Museum.

[Concluded from vol. vii. p. 34.]

IN my two papers on this group of Longicornia which have already appeared I have dealt with African, Indo-Malayan, and Australian species. The present contribution is confined to South-American species of the group.

Hammaticherus macrus, Bates.

Mr. Bates's clear description of this species leaves no room for doubt that it is identical with the *Hammaticherus bellator* of Dejean's collection. It is very doubtful, however, whether Serville's description could possibly have been drawn up from the same species; if it is to be accepted as accurate we must regard the *H. bellator* of Serville as a species allied to but quite distinct from *H. macrus*, Bates (= *H. bellator*, Dej.). It may be remarked that in the latter species the anterior cotyloid cavities are distinctly open behind, while in all the other species known to me they are completely or almost completely closed in behind.

Hammaticherus consobrinus, sp. n.

Plocæderus consobrinus, Dej. Cat.

Fulvo sat dense pubescens; prothorace supra transversim regulariterque plicato, lateraliter in medio modice tuberculato; elytris fulvescentibus, apicibus truncatis, utrisque bispinosis; articulis antennarum a tertio ad decimum apice intus spinosis, articulis tertio quartoque spinis recurvis.

Long. 26, lat. 8 mm.

Hab. Cayenne (*Lacordaire*).

Almost entirely covered with a close but short tawny pubescence. Antennæ (♀) a little longer than the body, with the joints from the third to the tenth spined at their inner apex, with the spines of the third and fourth joints long and recurved, that of the fifth almost at right angles to the joint, those of the following joints gradually becoming shorter and directed more forwards, until in the tenth the spine is little more than a sharp angulate process of the joint. Prothorax crossed above by about nine tolerably regular transverse ridges, exclusive of the raised anterior and posterior margins; furnished at the middle of each side with a rather feeble tubercle. Elytra each truncate and bispinose at the apex. Prosternal process feebly tubercled.

This species is to be distinguished by the structure of its antennæ from every known species of the genus. In colour and general appearance it most nearly resembles a variety of *H. plicatus*, Oliv., which is characterized by the absence of the dark bands from the margins of the elytra.

Hammaticherus Lacordairei, sp. n.

Plocæderus Lacordairei, Dej. Cat.

H. bato similis, sed differt capite supra inter oculos distincte carinato; antennis (♂) articulis tertio quartoque solis spinosis, ceteris inermibus; prothorace supra minus regulariter plicato.

Hab. Argentine: Buenos Ayres, Salta.

Brownish black, with a yellowish-grey or greenish-grey pubescence. Prothorax with a conical tubercle on the middle of each side, with a callosity (stronger in the male) between this tubercle and the anterior margin; crossed above by about ten ridges in addition to the raised anterior and posterior margins. Elytra pitchy brown, with a faint yellowish-grey pubescence; apices truncate, each bispinose. Legs greenish grey; tarsi reddish tawny.

♂. Antennæ more than twice as long as the body; third and fourth joints spined at the apex, with the spines turned strongly backwards; fifth joint very feebly dentate near the apex, the remaining joints unarmed.

♀. Prothorax less regularly wrinkled above. Antennæ a little longer than the body, with the third to fifth joints each armed with a recurved spine at the apex, the sixth to tenth joints denticulate at the apex.

I have little doubt, considering the very close agreement in colour, that the two specimens here described belong to the same species. The male specimen is from Salta, the female from Buenos Ayres.

The species is evidently very nearly allied to *H. batus*, Linn. The colour of the elytra is almost the same, but the pubescence has a slight greenish or yellowish tinge. The ridges of the prothorax are more numerous and a little less regularly transverse. The fifth joint of the male antennæ is without a distinct spine. The head is more distinctly carinate between the upper lobes of the eyes.

Hammaticherus punctulatus, sp. n.

Nigro-fuscus, cinereo-pubescens; prothoraco supra transversim sat regulariterque plicato, plicis prope medium sinuatis, lateribus utrisque tuberculis duobus—uno medio, altero obtusiore paullo pone marginem anticam; elytris elongatis, rufo-brunneis, cinereo leviter pubescentibus, subtiliter punctulatis, apicibus truncatis utrisque valde bispinosis; antennis (♂) quam corpore duplo longioribus, articulis tertio ad quintum spinosis, spinis valde recurvis, articulo quinto tertio æquali.

Long. 37–41, lat. 10–12 mm.

Hab. Brazil.

Blackish brown, with a pale greyish pubescence, with the emargination of the eyes covered with a bright golden pubescence. Prothorax crossed above by about eleven transverse ridges in addition to the raised anterior and posterior borders; the sides each with two tubercles—one at the middle, the other, distinct though obtuse, a little behind the anterior margin. Elytra elongate, feebly and somewhat sparsely punctulate, reddish brown, with a faint greyish pubescence, each truncate and bispinose at the apex.

This species may be distinguished from *H. batus*, Linn., and its allies by the punctuation of its elytra, by the second distinct tubercle on each side of the prothorax, and by having the fifth joint of its antennæ equal in length to the third.

In *H. batus* and *H. mexicanus* the fifth joint of the antennæ is a little shorter than the third; the prothorax has a slight thickening of the ridges, or callosity, on each side near the anterior margin; the elytra are almost destitute of punctuation beyond the excessively minute pits from which the hairs of the pubescence spring.

In *H. punctulatus* the stridulating surface of the mesonotum is less finely striated than in allied species; but I do not yet know whether this character may be relied on as a specific distinction.

H. carthagenæ (Guér., MS.), a variety of *H. batus*, Linn., with brown or reddish-brown elytra, which is found in Colombia and Panama, has a strong resemblance to the present species.

Hammaticherus lasiocerus, sp. n.

Plocæderus lasiocerus, Dej. Cat.

Piceo-ferrugineus, fulvo-griseo-pubescens; capitis fronte antennisque griseo-villosis; prothorace lateraliter valde tuberculato, supra transversim sat regulariterque plicato; elytris fulvo-testaceis, opacis, griseo-pubescentibus; apicibus truncatis, utrisque bispinosis; antennarum articulo tertio quam quarto fere duplo longiore, articulis tertio quartoque apice spina valde recurva armatis, ceteris inermibus.
♂. Long. 33, lat. 9½ mm.

Hab. Brazil.

This species somewhat closely resembles *H. plicatus*, Oliv., but the prothorax is more pubescent and its plication somewhat less regular towards the middle, and the elytra are without dark margins. It may be distinguished from this and from every other species in the genus by the yellowish-grey villosity covering the antennæ and the front of the head, by the long third joint of the antennæ, and by the spines of the antennæ, which are confined to the third and fourth joints, and which are rather short and directed very much backwards.

Hammaticherus murinus, sp. n.

Plocæderus murinus, Dej., MS.

Parvus; fuscus, omnino denseque murino-pubescens; prothorace supra leviter interrupteque plicato; elytris punctulatis sat dense pubescentibus, apicibus truncatis utrisque bispinosis; antennis (♂) corpore sesquilongioribus, articulis quinto ad decimum apice spinoso-dentatis; antennis (♀) corpore vix longioribus.
Long. 17, lat. 5 mm.

Hab. Corrientes.

This species may be recognized by the rather close mouse-grey pubescence, which entirely covers it. The rugæ of the prothorax are feebler than in other species of the genus, and do not seem to exceed eight or nine in number. The dense and very fine punctuation of the elytra is scarcely visible under the rather close pubescence. The joints of the antennæ from the third to the tenth are dentate at the inner apex, the third and fourth very feebly so, the fifth and some of the following almost spinose.

Hammaticherus luridipennis (Chevr., MS.), sp. n.

Ferrugineus, corpore subtus griseo subtiliter pubescente; antennis

rufescentibus, articulis a quinto apice intus angulato-productis, haud spinosis, scapo apice carinato; prothorace supra transversim regulariterque rugato; elytris fulvo-testaceis, glabris, nitidis, dense punctulatis; apicibus truncatis, angulis externis spinosis; pedibus rufescentibus, dense punctatis, femoribus posticis apice nigris.
Long. 19, lat. 4 mm.

Hab. French Guiana.

This species belongs to the group—including *P. glabricollis*, Bates, and *P. pactor*, Lameere—in which the third and fourth joints of the antennæ are unarmed, and in which the succeeding joints up to the tenth are angulately or spinosely produced at the inner apex. The species can be easily enough recognized by its distinct coloration. The punctures of the elytra are exceedingly minute at and beyond the middle, but are somewhat stronger towards the base. The legs are densely and somewhat strongly punctured. The scape of the antennæ bears a distinct carina at the apex. The pro- and mesosternal processes are tubercled.

Criodion fulvopilosum, sp. n.

Criodion flavopilosum, Buq., Dej. Cat.

Castaneum, fulvo vel griseo-fulvo omnino denseque pilosum; prothorace supra tuberculato sparsissime punctato, lateribus tuberosis, inæqualibus, basi apiceque constrictis; elytris apice subtruncatis, sutura breviter spinosis; femoribus intermediis posticisque apice breviter unidentatis; antennis corpore paullo brevioribus (♂), medium elytrorum vix excedentibus (♀).
Long. 40–60, lat. 11–17 mm.

Hab. Brazil.

Clothed entirely with a dense tawny or greyish tawny pubescence, which is thicker and somewhat silky on the underside of the body. Head with a broad, obtuse, and feebly raised carina on the vertex between the antennary tubercles. Eyes moderately large, the lower lobes each forming a triangle, whose obtusely pointed anterior termination is but little sunk beneath the projecting margin of the antennary condyle. Prothorax transverse, constricted at the base and apex; the anterior margin of the pronotum slightly projecting and rounded in the middle; the disk with about five obtuse tubercles. Elytra (which are apt to be rubbed bare of their pubescence in places) with the apices truncate for a short distance from the suture, and briefly spined at the suture. Intermediate and posterior femora each with a short spine or tooth at the posterior distal extremity. Tibiæ each with a spine at their outer termination. Antennæ in the male reaching to within a short distance of the apex of the elytra, in the female surpassing but little the middle of the elytra, with the third joint in both sexes but little longer than the scape.

Criodion cinereum, Oliv.

Prionus cinereus, Oliv. Ent. iv. 66, p. 35, pl. xiii. fig. 55 (♀).
Criodion placidum, Dej.

Castaneum, griseo sat dense pubescens; prothorace supra leviter tuberculato, valde subrugoseque punctato, lateribus inæqualibus; elytris rufo-castaneis, fulvo-griseo sat dense pubescentibus, apicibus rotundatis et ad suturam brevissime spinosis; femoribus intermediis posticisque apice unidentatis; antennis quam corpore paullo (♂) vel multo (♀) brevioribus.

Hab. Cayenne.

I have here characterized the *C. placidum* of Dejean; but I have no doubt that this is the species described and figured by Olivier under the name *Prionus cinereus*. It may be distinguished from *C. fulvopilosum* not only by a difference in colour, but by its less distinctly tubercled and more strongly and much more thickly punctured prothorax.

Criodion antennatum, sp. n.

Castaneum, cinereo sat dense pubescens; prothorace parum transverso; basi apiceque constricto, lateribus tuberosis, subinæqualibus, fortiter sat denseque punctatis, disco leviter tuberculato, sparsim punctato; elytris apicibus rotundatis, sutura breviter mucronatis; femoribus intermediis posticisque apice breviter unidentatis; tibiis apice extus breviter spinosis; antennis utroque sexu articulis duodecim distinctis.

Long. 49, lat. 12 mm.

Hab. Venezuela.

Clothed almost entirely with a rather dense ashy-grey pubescence. Prothorax slightly transverse, constricted at the base and apex, somewhat swollen and uneven along the sides, the latter strongly and rather thickly punctured, the disk with three feeble tubercles or callosities and with some strong punctures. Elytra each rounded at the apex, briefly mucronate at the suture. Antennæ about equal in length to the body in the male, much shorter in the female; the third joint longer than the first and second taken together, and more than half as long again as the fourth, the latter shorter than any of the succeeding joints, the twelfth excepted; this joint in the male is about half as long as the eleventh, in the female it is much shorter.

This species has some resemblance to *C. cinereum*, but can be easily distinguished from any of the allied species by the distinct twelfth joint to its antennæ.

Criodion Dejeani, sp. n.

Criodion holosericeum, Dej. Cat.

Fulvo vel griseo sat dense tomentosum; prothorace subquadrato, basi apiceque constricto, supra leviter rugoso, lateraliter nonnihil inæquali; elytris pube cinerea decumbente sat dense obtectis, apicibus late et recte truncatis, utrisque bispinosis; antennis (♂) corpore paullo longioribus, subtus pilis fulvis dense fimbriatis. Long. 28–38, lat. $7\frac{1}{2}$–$9\frac{1}{2}$ mm.

Hab. Brazil.

Head with rather strong mandibles; with the cheeks prominent and somewhat bluntly pointed, widely separated below, with a distinct transverse groove on the underside of the head between them. Eyes rather small, the lower lobes transverse, somewhat pointed in front. Prothorax subquadrate, constricted at the base and apex, slightly rugose above, somewhat uneven at the sides, covered with a thick greyish or fulvous pubescence. Elytra with a rather dense ashy-grey decumbent pubescence; the apices broadly truncate, each with two spines, of which the outer is stronger than the sutural one. Body underneath and legs with a fulvous-grey pubescence. Tibiæ each armed with a spine at its outer distal termination; intermediate femora unispinose at the apex; apex of the posterior femora spinose behind, dentate or sharply angulate in front. Antennæ (♂) a little longer than the body, thickly fringed with tawny hairs underneath.

The name *holosericeum* seems particularly inappropriate to the present species. I can see nothing in the three specimens before me that could have suggested silkiness; their pubescence, in its present state at least, is entirely devoid of gloss.

Criodion tuberculatum, sp. n.

Criodion tuberculatum (Chevr., MS.).

♂. Fuscum, griseo-pubescens; prothorace subquadrato, dorso plagis nonnullis paullo elevatis, intervallis sulcatis separatis; elytris pube brevi grisea dense obtectis, apicibus late recteque truncatis,

utrisque bispinosis; antennis corpore paullo longioribus, subtus pilis fulvis dense fimbriatis.
Long. 28 et 38, lat, $7\frac{1}{2}$–$9\frac{1}{2}$ mm.

Hab. Peru, Sarayacu; and (?) Cayenne.

Head with strong mandibles and prominent cheeks. Disk of the prothorax with about seven slightly raised plagæ or flattened tubercles, which are separated from one another by narrow sulcate intervals; the medio-basal plaga is somewhat rhomboidal in form, with its longer diameter in the middle line; the two in front of its anterior angle are small and scarcely separated from each other; the two on either side of the median plaga are broad. The sides of the prothorax are somewhat uneven. The elytra have a dense greyish pubescence. The intermediate femora are unispinose, the posterior bispinose at the distal extremity. The tibiæ are each spined at their outer termination. The antennæ, a little longer than the body, are fringed with fulvous hairs underneath.

This species, in the sculpture of its prothorax and in its general appearance, somewhat resembles *C. rhinoceros*, Bates. But the latter species is characterized by the remarkable horn-like processes which come off from the anterior side of the mandibles. In the larger of the two specimens which I have included in the present species there is a slight elevation or ridge on the anterior side of the mandibles.

Criodion testaceum, sp. n.

Criodion testaceum, Dej. Cat.

Rufo-testaceum, elytris fulvis: capite prothoraceque fulvo-griseo dense pubescentibus; prothorace subquadrato, fortiter sparsimque punctato; elytris haud nitidis, pilis minutis sparsim munitis, apicibus truncatis, utrisque bispinosis; corpore subtus sparsim pubescente; femoribus intermediis apice unidentatis, posticis bidentatis; tibiis apice extus spinosis; antennis quam corpore paullo longioribus, fulvo sparsim pilosis.
(♀?) Long. 32, lat. 9 mm.

Hab. Brazil.

From its general appearance, and especially from the rather close approximation of the antennal tubercles, this species might be considered to belong to the genus *Sphallenum*; but as its intermediate cotyloid cavities are not closed externally, the species could not be placed in *Sphallenum* without breaking through the limitation which Mr. Bates has imposed upon the latter genus.

Criodion quadrimaculatum, sp. n.

Fuscum; capite prothoraceque griseo-pubescentibus; prothoracis dorso lateribusque rugoso-punctatis, illo medio carina brevi paullo elevata; elytris testaceo-fulvis, subopacis, sparsim setosis, utris μυο marginibus externis maculisque duabus (una sub humerum oblonga parum nitida marginem attingente, altera discoidali rotundata paullo pone medium) fuscis; apicibus truncatis, utrisque bispinosis; corpore subtus griseo-pubescente; antennis quam corpore sesqui-longioribus.

♂. Long. 38, lat. 10 mm.

Hab. Brazil.

Dark brown, with a greyish pubescence. Prothorax strongly and somewhat rugosely punctured; the sides nearly parallel; the disk with a short feeble carina in the middle. Elytra fulvous, opaque, sparsely punctulate, with very short yellowish setæ springing from the punctures, with the extreme lateral and apical margins and two spots on each dark brown; of these spots one (oblong) is placed under the shoulder in contiguity with the outer margin, the other (rounded) is situated on the disk a little behind the middle; apices of the elytra truncate, each with two moderate-sized spines. Intermediate femora unidentate; posterior bidentate at their distal extremity. Tibiæ spined at their outer termination. Intermediate cotyloid cavities open externally.

This species seems nearly enough related to the preceding one, and for similar reasons must be placed in *Criodion*.

Criodion Sommeri, sp. n.

Criodion Sommeri (Dej. Cat.).

Nigro-fuscum; capite prothoraceque griseo-fulvo pubescentibus; prothoracis dorso lateribusque rugoso-punctatis, medio disco tuberculo glabro plano antice in carinam prolongato; elytris fulvo-testaceis, pilis fulvis erectis dispersis, maculis septem fuscis—una elongata utrinque sub humerum, una communi subcordata pone scutellum, duabus utrinque pone medium obliquiter dispositis; marginibus externis suturaque angustim infuscatis; apicibus truncatis, ad suturam breviter spinosis; corpore subtus fulvo-villosis; pedibus fuscis, fulvo sparsim setosis, femoribus utrisque macula dorsali rufo-testacea; antennis sparsim pilosis, quam corpore sesquilongioribus.

♂. Long. 41, lat. 12 mm.

Hab. Brazil.

Disk of the prothorax with a flat medio-basal tubercle somewhat rhomboidal in shape and prolonged at its anterior angle into a sharp carina, which extends almost up to the anterior border; with two very small transverse tubercles, one on either side of the carina, on the anterior part of the disk; with a broad and very feebly raised tubercle on each side near the base; the sides of the prothorax thickly and rugosely, the disk less thickly, punctured. The elongate spot placed just below the shoulder of each elytron does not touch the outer margin. Of the two spots, placed obliquely behind the middle of each elytron, the anterior and outermost is small, the posterior and inner rather large. Intermediate femora unidentate, the posterior bidentate at the apex. Tibiæ spined at their outer termination. Intermediate cotyloid cavities open on the outside.

This species must have some resemblance in the style of marking of the elytra to *C. sexmaculatum*, Buq., and to *C. Chabrillaci*, Thoms.; but from other described characters of those species I am led to believe that the present species is quite distinct.

Sphallenum literatum, sp. n.

Criodion z-littera, Chevr., MS.

Fuscum, griseo-pubescens; prothorace grosse, dense subrugoseque punctato, lateribus leviter rotundatis: disco trituberculato, tuberculis parvis, glabris, nitidis: elytris fuscis, opacis, sparsim albosetosis; utrisque maculis duabus testaceis (una ante medium literæ *z* simulante, altera prope apicem rotundata): apicibus obliquiter truncatis, sutura minus productis et breviter spinosis, angulis externis modice spinosis: antennis corpore sesquilongioribus.

♂. Long. 32, lat. $7\frac{1}{2}$ mm.

Hab. Brazil.

Head, thorax, underside of body, legs, and antennæ with a not very thick coarse pubescence. Prothorax very strongly and thickly punctured, slightly rounded at the sides, narrowed towards the base and apex; its greatest width scarcely greater than its length along the median dorsal line; the disk with three feeble, glabrous, shining tubercles. Elytra dark brown, dull, furnished with minute white setæ, and with some longer white setæ arranged somewhat in longitudinal rows. The four posterior femora are each unidentate at their apex; the tibiæ are each feebly spined at their outer distal extremity. The little projecting process of the antero-lateral part of the mesosternum is very distinct, though it does not completely cut off the epimeron from the intermediate cotyloid cavity.

Sphallenum spadiceum, sp. n.

Criodion spadiceum, Dej.
Criodion cylindricum, Dej.

Fuscum, fulvo-griseo-tomentosum; prothorace subquadrato, supra obsolete bituberculato, sparsim punctato; scutello dense tomentoso; elytris fuscis, fulvo sparsissime setosis, setis decumbentibus; apicibus truncatis, utrisque bispinosis; femoribus apice obtuse angulatis, haud dentatis: tibiis apice extus vix spinosis; antennis fulvo-griseo-tomentosis et sparsim ciliatis, quam corpore sesquilongioribus (♂), vel paullo brevioribus (♀).
Long. 33–36, lat. $8\frac{1}{2}$–$9\frac{1}{2}$ mm.

Hab. Brazil.

The femora in this species are slightly and obtusely angulate on each side at the apex; the tibiæ have each a very short blunt spine at their outer termination. The intermediate cotyloid cavities are closed in on the outside by an antero-lateral process or tubercle coming off from the metasternum. Owing to the absence of spines or teeth from the apical angles of the femora, and their great reduction on the tibiæ, this species ought perhaps to be placed in *Xestia*. It may be looked upon as an intermediate form, whose characters on the whole, it seems to me, bring it into closer relation with *Sphallenum* than with *Xestia*.

Xestia denticornis (Chevr., MS.), sp. n.

Xestia spinipennis, Dej. Cat., nec Serville.

Nigro-fusca, elytris castaneis, opacis; capite (postice excepto) antennisque vix punctatis; prothorace grosse sparsimque punctato, dorso punctis in rugis parum transversis positis; scutello fulvo-pubescente: elytris coriaceis, minutissime punctulatis: apicibus truncatis, utrisque longe bispinosis; corpore subtus pedibusque sparsim fulvo-griseo-pilosis; antennis (♂) quam corpore paullo longioribus, articulis a quarto ad decimum apice intus denticulato-productis, articulo undecimo medio angulato.
Long. 25–35, lat. 6–9 mm. (♂ ♀).

Hab. Brazil.

This species appears to be somewhat allied to *X. brevipennis*, Bates, from which it may be distinguished by the almost complete absence of large punctures from the front part of the head, including the antennal tubers. The antennæ of the male are slightly longer than the body, those of the female much shorter; the third joint in the male is but little longer than the fourth; in the female the third joint is about half as long again as the fourth. The femora are somewhat gradually thickened from the base up to beyond the middle, and not abruptly thickened, or clavate, between the middle and apex as in some other species of the genus.

In *X. brevipennis* the antennæ of the male are, according to Mr. Bates's description, much shorter than the body. This character will afford a further means of distinguishing *brevipennis* from *denticornis*. It is necessary to add, however, that the females of some of the species of the present genus might easily (without recourse to dissection) be mistaken for males.

Xestia spinipennis, Serv.

Prothorax transversely and almost regularly wrinkled above, irregularly rugose at the sides, slightly narrowed anteriorly. Elytra highly polished, very minutely punctulate, and of a reddish chestnut-colour. Femora somewhat abruptly thickened between the middle and the apex. Third joint of the antennæ in the female—the only sex known to me—twice as long as the fourth; the scape thickly and somewhat rugosely punctured. The head also strongly enough but not very thickly punctured.

These supplementary characters of *X. spinipennis*, Serv., I have drawn up from a female example (from Serville's collection) which in Chevrolat's writing has been labelled *type*. It will be well also to direct attention to the fact that the species—under the name of *X. spinipennis*, Serv.—with which Mr. Bates has made comparisons in describing some of his species was not the true *spinipennis* of Serville, but probably *X. denticornis* (the *X. spinipennis* of most collections), which is quite a different species.

Xestia vittata, Thoms.

The specimens answering to the description of this species vary considerably in size.

I can find no characters by which to distinguish a specimen from Dejean's collection—ticketed *X. confusa*, Dej.—from examples of *vittata*, Thoms. The antennæ are eleven-jointed, as in the latter species.

There is, however, one specimen in the British-Museum collection which (in almost every other respect agreeing with *confusa*, Dej.) has twelve distinct joints to the antennæ. It was no doubt a specimen similar to this which was

under Lacordaire's observation when he wrote the note*
referring to *X. confusa.* If the complete division of the eleventh joint of the antennæ is to be taken by itself as a sufficient specific difference, the latter species may conveniently be called *X. confusa*, Lacord.

Xestia longipennis (Chevr., MS.), sp. n.

Castanea; prothorace supra transversim sat regulariterque plicato, lateribus irregulariter rugosis; elytris elongatis, castaneis, subopacis, vitta lata longitudinali utrinque rufo-castanea; apicibus truncatis utrisque longe bispinosis; femoribus ultra medium modice clavatis; antennis (♀) quam corpore multo brevioribus, articulis a septimo ad decimum apice intus angulato-productis, articulo tertio quam quarto duplo longiore.

♀. Long. 35, lat. $8\frac{1}{2}$ mm.

Hab. Brazil.

Very closely allied to *X. vittata*, Thoms., from which it differs by the more regular transverse rugation of the upperside of the prothorax and by the relatively greater length of the elytra.

Xestia globulicollis, sp. n.

Criodion globulicolle (Chevr., MS.).

Rufo-brunnea; capite antennarumque basi sat dense punctatis; prothorace grosse denseque et subrugose punctato, dorso medio plaga parva lævi; lateribus rotundatis, antice et postice leviter constrictis; elytris minute punctulatis, subopacis, apicibus externe rotundatis, prope suturam breviter truncatis, et ad suturam brevissime mucronatis; antennis (♂) articulis a sexto apice intus angulatis, haud dentatis.

♂. Long. 18, lat. $4\frac{1}{2}$ mm.

Hab. Brazil.

This species is of a dull reddish-brown colour above; the elytra somewhat paler in tint. The abdomen, the middle of the hind breast, and the femora are reddish testaceous and nitid. The prothorax is strongly, closely, and somewhat rugosely punctured, with a small smooth space on the middle of the disk; the sides are distinctly rounded in the middle. The elytra are coriaceous, very feebly punctulate, each of the minute punctures or pits bearing an exceedingly minute whitish seta. The first nine joints of the antennæ together surpass by a little the middle of the elytra (the remaining joints

* 'Genera des Coléoptères,' viii. p. 271 (2).

are wanting); the joints from the sixth are somewhat angular at the inner apex. The abdomen is rather broadly truncate at the apex, with a dense fringe of fulvous hairs coming from between the dorsal and ventral segments.

The following species appearing under *Criodion* in the Munich Catalogue will be better placed in *Xestia*. Their tibiæ are unarmed at the outer apex, their femora are simple, and their intermediate cotyloid cavities are either partly or wholly closed in on the outside.

X. annulipes, Buq.

X. bivittata, Buq. (=*suturalis*, Perty (*Stenochorus*), Delect. An. p. 90, pl. xviii. fig. 5).

X. corvina, Germ.

X. dorsalis, Thoms.

X. pictipes, Newm.

The same remarks will, perhaps, apply to other species.

IV.—*On some Japanese Species of* Paromalus. By George Lewis, F.L.S.

The Micro-Coleoptera of China, like those of our Indian possessions, are almost wholly unknown; no Chinese species of *Paromalus* has been described, and the only example known to me is one I captured in a rotten stem of a decaying *Celtis* in Hong Kong in the winter of 1880. It remains therefore a matter of speculation whether any or all of the species here recorded from Japan occur or not on the adjacent continent, although it is exceedingly probable some of them do. Two at least of the species have a wide distribution, as they are well-known European insects, and their names are, I believe, also in the lists of the Siberian Coleoptera.

List of Species.

Paromalus complanatus, *Panz.*
—— mendicus.
—— viaticus.
—— fujisanus.
—— vernalis.

Paromalus tardipes.
—— parallelepipedus, *Herbst.*
—— omineus.
—— musculus, *Mars.*
—— montivagus.

Paromalus complanatus, Panz.

Hab. Japan. This species occurs throughout the Archipelago, but it is commonest in Yezo.

Paromalus mendicus, sp. n.

P. biarculo simillimis at paulo minor; elytris propygidioque distincte punctulatis; mesosterno stria transversali nulla.
L. 2–2½ mill.

Oblong-oval, rather flat, black; antennæ and legs reddish; the head distinctly but not densely punctured, stria complete, well-marked, and angulate over the eyes; the thorax visibly punctured behind the anterior angles, less so laterally, and nearly smooth on the disk, scutellar spot very small and placed a little away from the edge, stria interrupted behind the neck; the elytra much more distinctly punctured except on the area behind the scutellum and a very narrow margin along the suture, one short basal stria, somewhat straight but ill-defined; the propygidium clearly and rather closely punctured; the pygidium nearly smooth, in the male there are obscure and ill-defined marks but no vermicular sculpture; the prosternum is a little broader than in *P. biarculus*, Mars., bistriate, striæ strong, feebly sinuous at the sides, and widening outwards a little in front and joining posteriorly; the mesosternum feebly and sparsely punctulate, without a transverse stria, lateral furrow deep and common to it and the metasternum; the suture is clearly seen between the meso- and metasterna; anterior tibiæ 4-dentate.

This species differs from *P. biarculus* in having the elytra distinctly punctured, by the absence of the mesosternal transverse stria, and by the want in the male of vermicular sculpture on the pygidium.

Hab. Japan. I found this insect at Kashiwagi and in several places in Higo.

Paromalus viaticus, sp. n.

Oblongo-ovalis, depressiusculus, niger, nitidus, supra punctulatus; mesosterno stria transversali nulla; metasterno leviter et sparse punctulato; propygidio pygidioque sublævibus.
L. 1½ mill.

Oblong-oval, somewhat depressed, black, legs reddish; the head evenly punctured, a little prominent and obtusely angulate over the eyes, stria strong laterally, arched anteriorly, sinuous before the eyes, forehead flattish; the thorax bisinuate behind the head, punctured finely behind the neck and on the disk, punctures much larger at the sides and along the base, no scutellar fovea; the elytra are punctured like the sides of the thorax, sutural margin narrowly smooth, suture feebly raised before the apex to the middle of the dorsum, epipleural stria continues round the sutural angle, dorsal striæ indistinct; the propygidium evenly, not closely punctured; pygidium in the female evenly punctulate, in the male punctulate except at the apex, which is transversely rough and very densely punctured; the prosternum, lobe sparsely but distinctly punctate, keel bistriate, stria feebly sinuous, bent at both ends, but not connected at either; the mesosternum without a transverse stria, suture apparent and, like the metasternum, sparsely and finely punctured, especially in the median area; anterior tibiæ 4-dentate.

Hab. Japan. Taken at Nikko, Oyama, Kashiwagi, Nara, Kumamoto, and Yuyama, chiefly in the warmer districts of the islands.

Paromalus fujisanus, sp. n.

Oblongo-ovatus, convexiusculus, niger, nitidus, supra punctatus; prosterno striis parallelis postice junctis; pronoto ante scutellum foveolato; mesosternum stria transversali biangulata; pedibus piceis.

L. 2 mill.

Oblong-oval, rather convex, black, shining, punctured above; the head rather broad, impressed in front, stria complete, surface clearly and evenly, not thickly punctured; the thorax, stria complete and strong at the sides, very fine behind the head, wholly punctured, with a distinct scutellar fovea visible amongst the punctures, anterior angles rather depressed, anterior margin impressed behind the eyes; the elytra punctured like the thorax except in the sutural area before the apex, where the punctures are oblong, epipleural stria continues along the apex and turns round the sutural angle, one oblique obsolete stria; the propygidium sparsely and evenly punctulate; the pygidium in the male has a raised exterior margin, and within the margin the whole surface is evenly vermiculate in sculpture, in the female the pygidium is immarginate, irregularly and sparsely punctured at the base, nearly smooth at the apex; the prosternum bistriate, striæ parallel at the sides, bent inwards at either end, keel with a few punctures very irregularly set, anterior lobe somewhat straight on the anterior edge and sparsely punctured;

the mesosternum, transverse stria middle part nearly straight, arcuate on each side, not angulate, suture not apparent, surface sparsely punctulate; the metasternum with large punctures between the intermediate and posterior coxæ, punctures gradually becoming finer on the median area and especially behind the mesosternum; anterior tibiæ 4-dentate.

This species must be placed next to *P. bistriatus*, Er., from America.

Hab. Japan. I obtained a considerable number of specimens at Kiga, Hakone, Subashiri, and Nikko.

Paromalus vernalis, sp. n.

Oblongo-ovalis, convexiusculus, niger, nitidus, supra punctatus; prosterno haud striato; mesosterno, stria transversali in medio arcuato, utrinque biangulato.

L. $1\frac{1}{2}$ mill.

Oblong-oval, rather convex, black, legs pitchy; the head evenly punctured, stria complete, forehead flattish; the thorax, anterior angles depressed, somewhat obtuse, somewhat thickly punctured, stria strong at the sides and behind the anterior angles, fine behind the neck, punctures behind the neck small, those at the sides and in front of the scutellum somewhat oblong; the elytra are punctured like the thorax, suture very feebly raised in the dorsal region, sutural margin narrow, smooth, one stria short and oblique, the epipleural stria does not reach the sutural angle; the propygidium is transversely punctured; the pygidium in the male has a transverse furrow near the base, and behind it is another (which is sometimes broken at the sides), which is formed to enclose a semicircular lobe, the course of the furrow not being always well defined; in the female the pygidium is faintly and sparsely punctulate; the prosternum without stria, punctures scattered and feeble, the whole surface microscopically strigose; the mesosternum, stria arcuate in the middle, angles acute, median part wider than the appendages, suture invisible; the metasternum similarly punctate, punctures large and not closely set, subocellate in front of the hind coxæ; the lateral striæ on the first segment of the abdomen are nearly parallel to each other; anterior tibiæ 4-dentate.

This species also is of the *P. bistriatus* group.

Hab. Japan. Obtained at Nara, Oyayama, and Yuyama.

Paromalus tardipes, sp. n.

Ovalis, depressiusculus, brunneus, nitidus, punctatus; fronte impressa stria interrupta; pronoto basi tenuiter bistriato.

L. $1\frac{1}{2}$–2 mill.

Oval, rather depressed, brown, shining; the head anteriorly impressed, punctate, punctures rather large but not closely set, stria strong and somewhat carinate, feebly sinuous over the eyes, anteriorly ceasing behind the mandibles; the thorax, anterior angles obtuse and depressed, strongly punctate, punctures oblong, with some inclined to be acicular, evenly, not closely set, stria laterally a little elevated, fine and complete behind the head, two short striæ before the base at a point parallel to the usual position of the fourth elytral stria, the striæ are faint but easily seen, and they are a good specific character in this difficult genus; the elytra wholly punctured somewhat like the thorax, but more distinctly, the punctures towards and at the apex are round, not oval or acicular like some in front; the propygidium is punctured like the apices of the elytra; the pygidium in the male is punctured like the propygidium at the base, but at the apex there are transverse furrows which are confluent with the punctures; in the female the pygidium is sparsely and finely punctulate; the prosternum bistriate, striæ nearly straight laterally, bent, but not quite joining at either end, a few irregular punctures on the keel, anterior lobe punctate and strigose; the mesosternum very sparsely punctured, lateral furrow strong, transverse stria with the middle portion very wide and straight, arcuate at the sides, suture not apparent; the metasternum, anterior half lightly punctulate, posteriorly and the first segment of the abdomen with much larger punctures, all are more or less elongate or acicular; the other abdominal segments are smooth, with a row of punctures on their posterior edges; anterior tibiæ 4-dentate, tarsi rather short.

Hab. Japan. Single specimens taken at Miyanoshita, Kiga, Kashiwagi, and Nara.

Paromalus parallelepipedus, Herbst.

Hab. Japan. Apparently scarce; five examples only were taken at Sapporo, Miyanoshita, Nikko, and Nishimura.

Paromalus omineus, sp. n.

Oblongo-ovalis, parum convexus, lateribus vix parallelis, brunneus, nitidus; fronte stria integra; metasterno utrinque subocellato-punctato; pedibus flavis.

L. $1\frac{1}{2}$ mill.

Oblong-oval, rather convex, brown, shining, antennæ and legs flavous; the head clearly and somewhat sparsely punctulate, stria elevated over the eyes, fine and complete in front, forehead rather flat; the thorax, anterior angles depressed, little acute, stria not interrupted, but very fine behind the neck, not closely punctate, punctures somewhat ocellate, especially before the bases of the elytra; the elytra are punctured like the thorax, subocellate at the sides, finer behind the scutellum and on the dorsal area, striæ obsolete; the propygidium clearly, not densely punctulate in both sexes; the pygidium similarly punctured, and in the male a few scratches or obscure furrows are visible at the apex; the prosternum without striæ, finely strigose under the microscope; the mesosternum with a few punctures, transverse stria very slightly bent in the middle portion, rather widely arched on each side, median portion narrowest; meso- and metasternal suture invisible, both plates punctate, not closely, but at the sides the punctures are subocellate; anterior tibiæ 4-dentate.

This species is like a small example of *P. parallelepipedus*. The colour, and especially the shape of the mesosternal stria, with the median portion much less wide than the appendages, will distinguish it.

Hab. Japan. Two examples taken on Ominesan.

Paromalus musculus, Mars.

Hab. Japan. Taken at Nara, on the main island, and in several places in Kiushiu.

This species is peculiar in occurring under stones in the shady forests, while most of the species of the genus are subcortical.

Paromalus montivagus, sp. n.

Ovalis, convexiusculus, niger, supra punctulatus; pedibus rufo-brunneis; elytris striis obsoletis; pygidio sublævi vel grosse vermiculato; mesosterno marginato.

L. $2\frac{1}{4}$–$2\frac{1}{2}$ mill.

Oval, convex, black, punctulate above, with a strigose surface-sculpture visible under the microscope; the head lightly impressed in front, somewhat prominent over the eyes, stria complete, strong above the eyes, fine anteriorly; the thorax bisinuous behind the neck, anterior angles obtuse and depressed, stria complete, and on the edge before the scutellum is a row of ten or twelve large punctures; the elytra, punctuation larger and more dense than that of the thorax except on the dorsal area behind the scutellum, the striæ are obsolete and in their place the punctures are rugose and confluent; a narrow margin at the suture is smooth, the epipleural stria is fine and passes round the apex, and terminates after passing the angle at the suture; the propygidium is punctulate like the thorax; the pygidium impunctate in the female and microscopically strigose, in the male it is narrowly smooth at the base, with a coarse vermicular sculpture at the apex; the prosternum bistriate, striæ indistinctly joined at the base, where the margin is a little broad; the mesosternum short and transverse, marginal stria nearly complete, being a little broken in the middle only, transverse stria widely sinuous, suture invisible; the metasternum, lateral stria oblique, punctuation sparse; the anterior femora conspicuously grooved like those figured for *Phelister Simoni*, Lew. (Ann. & Mag. Nat. Hist. 1889, vol. iv. p. 46); the anterior tibiæ 5–6-dentate, posterior without spines. The minute strigosity is more apparent on the sternal plates than on the upper surface.

The facies of this species is like a very large *Abræus*, and it is the only species noticed in this paper with an anterior marginal stria to the mesosternum.

Hab. Japan. I took several specimens at different places bordering the great plain of Fujisan in May 1880. It frequents old beeches.

V.—*Descriptions of two new Genera of Scorpions, with Notes upon some Species of* Palamnæus. By R. I. Pocock, of the Natural-History Museum.

[Plate III. B.]

Having been occupied of late in the identification of the oriental species of *Scorpio* and *Palamnæus*, I soon made the discovery that there has been considerable confusion respecting the Indian and Burmese species of the latter genus.

Their history may be briefly told as follows.

The type of the genus, *P. spinifer* (Hempr. & Ehrb.), was originally described as from India. This species, however, has not been identified since it was established, apparently because it was described and figured as having nineteen or twenty pectinal teeth—this number being considerably larger than any presented by the species described by Dr. Thorell.

In 1877 Dr. Thorell characterized from Singapore a species named *P. Petersii*; this form apparently only differs from *spinifer* in the number of the pectinal teeth, and I have little doubt the two are synonymous.

But to complicate the matter still further Dr. Thorell subsequently referred to *P. Petersii* a number of specimens obtained by Sig. Fea and Comotto in Burma, which specimens had been previously identified by Mons. Simon as *P. bengalensis* (C. Koch). But both these identifications are, I think, erroneous; for, in the first place, *bengalensis* of C. Koch is a true *Scorpio*, as is shown by examples in this Museum, and, in the second place, the Burmese specimens above referred to seem to be different from the type of *Petersii* that Thorell described from Singapore.

The first assertion needs no justification; the second is based upon the following facts.

Whilst collecting in various parts of Burma Mr. E. W. Oates obtained literally many hundred examples of a species of *Palamnæus*, which is undoubtedly the Burmese form that Dr. Thorell identified as *P. Petersii*. But amongst those collected at Rangoon there are three examples which are at once to be recognized from the rest. These are of larger size, with the inner border of the hand beset with spiniform tubercles; the vesicle is clear ferruginous, and the chelæ or palpi of the male have almost the same form as in the female. In the others, on the contrary, the size is smaller, the inner border of the hand is thickly granular and not spicular, the vesicle is generally of about the same tint, though sometimes a little paler than the rest of the tail, and the chelæ of the male are more slender and longer than in the female, the manus being especially narrow. Of this latter kind the British Museum has those quantities of specimens that were generously presented by Mr. Oates, and, in addition, one example obtained by Sig. Comotto at Minhla—an example, by the way, that was kindly given to the Museum by the Marquis G. Doria, and which is one of those above referred to as having been identified as *Petersii* by Dr. Thorell. But of the former kind, in addition to those just mentioned from Rangoon, the Museum has very many examples from India, East Indies, Bengal, Mergui, Perak, Penang, Singapore, and Billiton Island. This species is, I think, *spinifer* (Ehrb.) and *Petersii* of Thorell.

There is nothing in Ehrenberg's figure and description to refute this view. On the contrary, it is clearly shown that the inner border of the hand is armed with spiniform tubercles and that the vesicle is ferruginous. The specimen, moreover, came from India, whence this Museum also has examples. Furthermore, the Museum, as already stated, has specimens from Singapore, the place where the *type* of *P. Petersii* was obtained—a coincidence which suggests at once the likelihood of specific identity between the scorpions. And this idea as to their identity is amply borne out by Dr. Thorell's description of *Petersii*; for the vesicle is described as ferruginous, and of the hand it is said "*ipso latere interiore granulis acuminatis fortibus obsito.*" But if we turn to what is said of the Burmese specimens that were referred to *Petersii* we read, "*manus intus sat dense granulosa est, granulis sat parvis et parum acuminatis,*" and again, "*color caudæ niger, vesica interdum paullo clariore.*" Thus the figure of *spinifer* and the description of *Petersii* appear to apply to the larger and more widely distributed East-Indian form. The smaller Burmese species is consequently without a name. I propose therefore to call it *P. Thorellii.*

As regards the number of the pectinal teeth, which seems to have been a stumbling-block in the way of the identification of *P. spinifer*, it may be said that the Museum series shows them to vary from 14 to 18 in *spinifer* and from 14 to 19 in *Thorellii*. So that the existence of 19 in the type of *spinifer* and of 16 in the type of *Petersii* cannot be used as an argument for the separation of the two.

The known synonymy of these will be as follows:—

Palamnæus spinifer (Hempr. & Ehrb.).

Heterometrus spinifer, Hempr. & Ehrb. Symb. Phys. Scorpiones, p. 3, pl. i. fig. 2 (1829).

Palamnæus Petersii, Thorell, Ann. & Mag. Nat. Hist. (ser. 4) vol. xvii. p. 13 (1876); Actes Soc. Ital. Sci. Nat. xix. pp. 214–217 (syn. excl.) (1877).

Palamnæus Thorelli, sp. n.

Palamnæus bengalensis, Simon, Ann. Mus. Genov. xx. pp. 360–362 (1884); not *Buthus bengalensis*, C. Koch, Die Arach. ix. p. 3, fig. 696 (1842).

Palamnæus Petersii, Thorell, Ann. Mus. Genov. (2) vii. pp. 588–590 (1889); not *Petersii*, Thorell, 1876.

The average size of *P. spinifer* is perhaps about 125 millim., although I have measured many varying from 135 to 140. *P. Thorellii*, on the contrary, is much less, seldom being more, and generally less, than 115 millim.

The appended tables of measurements will serve to show how the sexes of the two species may be recognized. From it may be seen, in addition, that the average length of the tail in the female is greater in *P. spinifer* than in *P. Thorellii.*

For in the former the tail is more than three and a half times the length of the cephalothorax, while in the latter it is less. This circumstance strengthens the evidence of identity between *P. spinifer* and *P. Petersii*; for the figure of *P. spinifer* shows that the tail (judging from the sketch of the lateral view of it) is a little over three and a half times the length of the cephalothorax.

Mons. Simon has recorded a species which he considers to be *Petersii* from Bintang. The males of his specimens, however, are not like those that I here call *spinifer*, inasmuch as they are declared to be like *longimanus*, Herbst. This opens the interesting question of possible dimorphism in the males.

Now three male examples have been described without their females being known. These are *longimanus* of Herbst, *longimanus* of C. Koch (which is not the same specimen at least as Herbst's type), and *angustimanus* of Thorell. I give a table to show the dimensions of these specimens, together with those of two examples in the British Museum which I provisionally refer to *angustimanus*. A glance shows that the two examples named *longimanus* have the hand-back very short and the movable dactylus long, the difference between the two being 7·5 and 8 millim. respectively, whereas in the others the difference is ·5, 2, and 2·5 millim. But this great interval is almost entirely bridged over by some of the male specimens of *spinifer*. Thus in no. 5 the difference in length between the dactylus and the hand-back is 3, in no. 1 it is 3·5, in nos. 2 and 6 it is 4, in no. 4 it is 4·5, and in no. 3 it is 6—the amount of variation being considerable.

I am consequently disposed to think that at least *longimanus* of C. Koch may be a form of the male of *spinifer*, and I hold the same opinion with regard to the two males in this collection that I have named *angustimanus*. *P. costimanus* of C. Koch is also, I think, probably synonymous with *spinifer*.

It is worthy of note in connexion with this subject that the slenderness of the hand appears to be correlated with the longitudinal wrinkling of the upper surface. Consequently the presence of strong costæ on the hands of these males that have just been discussed need not point to specific distinction between them and *spinifer*, in which the costæ are less manifest.

Table of Measurements in millimetres of P. spinifer.

No.	Sex.	Length of cephalo-thorax.	Length of first two tail-segments.	Length of tail.	Length of humerus.	Length of brachium.	Length of hand-back.	Length of movable dactylus.	Width of hand.	Total length of body.	Locality.
1	♂	19·2	17	72·5	18·7	19	19	22·5	16	134·5	Perak.
2	”	19	17	73	18·2	19	18·2	22	14	137	Singapore.
3	”	19	17	74	17	17	16	22	14·3	135	E. Indies.
4	”	18·5	17	72	17	18	16·5	21	16	129·5	Mergui.
5	”	18	15·5	64·5	16·5	17	17	20	14	118·5	E. Indies.
6	”	16·5	15	62·5	14·5	15	14·5	18·5	12·5	112·5	Rangoon.
7	♀	19	16·5	70	15	16	17	21	14	139	E. Indies.
8	”	19	16	68	15	16	17·5	20	15·5	120	E. Indies.
9	”	18	16	69	15	16	16	20	14	128	Rangoon.
10	”	17·75	....	64	14·25	14·5	15·33	19	13·33	124	Singapore (Thorell's type of *Petersii*).
11	”	17	14	61	14	15	15	18	11·5	119	Billiton Island.
12	”	16	13·3	59	13·8	14	14	18	11	113·5	Singapore.

No.	Sex.	Length of cephalo-thorax.	Length of first two tail-segments.	Length of tail.	Length of humerus.	Length of bra-chium.	Length of hand-back.	Length of movable dactylus.	Width of hand.	Total length of body.	Locality.
1	♂	16·5	14	57·5	15·5	16	15	17	9	101	Burma.
2	"	13·5	12	50	15	15·5	14	15·5	7·5	86	"
3	♀	18·5	14	62	14·5	15	15	18·5	12·5	115	"
4	"	18	15	61·5	14·5	15	15	18·5	13	125·5*	"
5	"	15·5	13·5	53·5	....	....	....	....	....	105·5	"
6	"	14·5	12	50	....	....	....	....	....	95	"

* Distended with embryos.

Measurements in millimetres of certain Male Examples of which the Females are as yet unknown.

Length of cephalo-thorax.	Length of humerus.	Length of bra-chium.	Length of hand-back.	Length of movable dactylus.	Width of hand.	Total length of body.	
19	23	23	17	25	12·5	128	*P. longimanus* of C. Koch.
19	23	24	22	24	11·5	113·5	*P. angustimanus* (in Mus. Brit.). Loc.?
18	22·5	23	17·5	25	10	108	*P. longimanus* of Herbst.
16·75	21	21·25	20	20·5	10	117	*P. angustimanus* of Thorell.

Cheloctonus, gen. nov.
(Pl. III. B. fig. 1.)

Cephalothorax with its median eyes near the middle, the lateral eyes, three in number, on the very edge, as in *Hormurus.*

Sternum pentagonal, a little wider than long, narrower at its posterior angles.

Stigmata elongate.

Tail as in *Opisthacanthus*, rather stouter than in *Hormurus.*

Palp.—Humerus as in *Heterometrus maurus*, very convex above, the anterior border reduced to a minimum; manus intermediate in form between that of, e. g., *Opisthacanthus* and of, e. g., *Scorpio*, but rather resembling that of *Iurus* or *Urodacus* in having the "hand-back" double, *i. e.* divided longitudinally by the keel which is found on the hand-back in scorpions of this group; the lower half of this area is not, however, limited below by a keel, and the keel that defines the upper half is weaker than in *Opisthacanthus.*

Cheliceræ as in *Opisthacanthus*, *Hormurus*, and *Palamnæus,* i. e. with the terminal fangs of the movable dactylus subequal in length, the inferior being the longer.

Tail, *tarsi*, *stigmata*, and *pectines* as in *Opisthacanthus.*

This genus is very interesting on account of its annectent qualities. On the whole, however, it certainly belongs to the *Opisthacanthus* group, although in the form of its palpi it approaches *Heterometrus.*

Cheloctonus Jonesii, sp. n.

Colour olivaceo-piceus above, palpi darker; legs, cheliceræ, and caudal vesicle ferruginous; pectines and genital operculum testaceous.

Cephalothorax a little wider than long, a little longer than the first two caudal segments, convex from side to side, the sides being considerably sloped, the frontal lobes rounded, the middle of the anterior border with an evenly rounded excision, weakly granular, the median sulcus dividing the ocular tubercle and stopping almost immediately behind it; the tubercle low, situated just in front of the middle of the upper surface, the eyes separated by a space about equalling a diameter; the lateral eyes small, subequal, the two anterior contiguous, the posterior separated by a space equal to its own diameter.

Tergites finely and closely granular, sulcate as in *Opisthacanthus.*

Sternites entirely smooth, very finely and closely punctured, the sulci uniting in front and resembling the imprint of a horseshoe; the last rugose, bearing vestiges of four finely granular, posteriorly converging keels.

Tail about three and a quarter times the length of the cephalothorax, narrowed posteriorly, the segments longer than they are thick, distinctly sulcate above, the sides of the upper surface rounded and very finely granular and not keeled, the lower surface distinctly carinate, the keels being normal in number, finely granular, and marked by setiferous pores; the fifth segment nearly flat above, the posterior third of its lower surface without keels; the *vesicle* large, pyriform, entirely smooth, aculeus short and abruptly curved.

Palpi robust; *humerus* coarsely granular above, mostly smooth behind and below, strongly granular in front; *brachium* rugose and subgranular above and behind, and subcostate behind, smooth in front and below except for the keel which separates the anterior and inferior surfaces: *manus* very stout, rugose, and reticulated and convex above, the pattern passing into tubercles internally and externally; the superior moiety of the hand-back forming a large obtuse angle with the upper surface, beset with small tubercles, defined above by a weak keel which anteriorly breaks up into the general pattern of the upper surface, the inferior moiety entirely smooth and polished, the antero-inferior surface granular; very wide, the length of the back being much less than the greatest width and only about equal to the width at the base of the dactyli; the height equal to about three fourths the length of the hand-back; the movable dactylus considerably longer than the hand-back and a little longer than the width of the hand, rugose, carinate, with a lobe which fits into a shallow excavation on the internal edge of the immovable dactylus, the external edge of this dactylus very short, about equal to half the length of the movable dactylus.

Legs very finely granular externally, the lower edge of the femora of the first three pairs more granular.

Pectines short, furnished with six to seven teeth; the genital operculum cleft, about twice as wide as long.

Measurements in millimetres.—Total length 75; cephalothorax, length 11, width 11·5; length of tail 35, of first segment 4·5, of second 5, of third 5·2, of fourth 6, of fifth 7·5, of vesicle and aculeus 7·3, of aculeus 2; width of first 4, of fifth 2·6; humerus, length 7, width 4, height 4; brachium, length 8, width 4·5, height 5; manus, length behind 8, width 9·2, height 6; length of movable dactylus 9·5, of immovable (along free border) 5.

A single male specimen from the Murchison Range in the Transvaal, collected and presented to the British Museum by Mr. C. R. Jones, with whose name I have very great pleasure in associating this remarkable new form.

HETEROCHARMUS, gen. nov.
(Pl. III. B. figs. 2, 2*a*, 2*b*.)

? *Charmus*, Karsch, Mitth. Munch. Ent. Ver. 1878, pp. 101, 104, 105.

Cephalothorax without keels; the ocular tubercle in the anterior half; the frontal region horizontal, not sloped downwards from the tubercle to the anterior margin; three lateral eyes.

Tergites with a single median keel.

Sternum small, pentagonal, wider than long, about equal in length to the genital operculum.

Pectines normal.

Stigmata elongate.

Cheliceræ with movable dactylus bifid at the apex, the two fangs equal in length, with three teeth on the upper edge and two on the under; immovable dactylus with two teeth above (the posterior bifid) and two subequal teeth below.

Chelæ with the external series of teeth formed by the enlargement of the three posterior teeth of the median rows, the internal series formed by single enlarged teeth, separated from the apices of the median rows and constituting with the teeth of the external series short oblique rows.

Tail somewhat powerful; no spine beneath the aculeus.

Legs of third and fourth pairs with tibial spur.

Claws free.

In its broad pentagonal sternum this genus departs widely from what is normal in the Buthidæ, and its inclusion in this family will necessitate the abandonment of the definition "sternum subtriangulum." Nevertheless I think it should be referred to this group, for in the sum of its characters it is unmistakably Buthoid.

In the dentition of the cheliceræ, the form of the palpi, with their slender unkeeled hands and long dactyli, the arrangement of the denticles on these dactyli, the spurs on the tibiæ of the posterior legs, the keeling of the trunk, &c., it agrees closely with many genera of this family. It only differs in fact in the form of the sternum. Of all the genera of Buthidæ it certainly comes nearest to *Butheolus* of Simon (*Orthodactylus*, Karsch); but although the sternum in *Butheolus* is more pentagonal (? always) than in the others, it is not so markedly wide as in *Heterocharmus*. In *Butheolus*, again, the cephalothorax has its frontal portion sloped, while in this new genus it is horizontal. Nevertheless the two are undoubtedly very closely allied.

If, again, *Heterocharmus* be compared with the known genera of other families, the only one with which it presents any affinity is *Charmus* of Karsch, a genus which this author referred to the Iurini. But between these the affinity appears to be very great, so far, indeed, as can be judged from the somewhat meagre description that Karsch has given. In fact no generic differences are to be discovered. But I find it hard to believe that any author familiar with scorpions should have placed a species congeneric with the one now before me in close proximity with such forms as *Iurus*, *Scorpiops*, &c. It is almost incredible that the Buthoid characters above mentioned can have been wholly overlooked. I consequently feel compelled to assume that some differences which do not appear in the description do in reality exist between *Charmus* and *Heterocharmus*.

Heterocharmus cinctipes, sp. n.

Colour.—Trunk above and tail fuscous, the former obscurely variegated with fulvous; vesicle ferruginous; ventral surface pale; palpi testaceous, brachium with a fuscous band, manus infuscate; legs fuscous, with testaceous joints.

Cephalothorax convex, about as wide as long, nearly as long as the first two caudal segments, weakly but closely granular throughout, the anterior margin nearly straight, the frontal region lightly depressed in the middle, the shallow depression extending over the ocular tubercle to the hinder margin; the ocular tubercle prominent, the eyes large and separated by a space about equal to a diameter.

Tergites granular, more coarsely but less closely so than is the cephalothorax, the first without the median keel, the last more thickly granular, without distinct keels, but lobate on the upper surface.

Sternites smooth and shining, the last beset posteriorly with coarse sharp granules.

Tail excavated above, the first three segments coarsely and thickly granular below and at the sides, the granulation obscuring the keels, the inferior median keels, however, marked by stronger and sharper granules, the upper surface much more feebly granular, the keels very feeble on the first but defined by larger granules; the keels absent on the third, which has its margins rounded and the position of the superior and supero-lateral keels marked by a larger granule posteriorly; the fourth segment without keels and almost without granules, but roughened by close-set coarse punctures, finely granular only in the excavation of the upper surface; the fifth segment also without keels, but marked with coarse, close-set, sometimes anastomosing punctures, granular on the posterior third of its lower surface, and finely so in the posterior portion of the superior excavation, the anal border lobate at the sides, granular beneath; the vesicle moderately large, coarsely punctured beneath, the aculeus strong and curved. Tail and vesicle thickly and irregularly hairy beneath.

Palpi slender; *humerus* very weakly granular along the feebly developed keels; *brachium* without keels, very slightly granular in front, the rest smooth; *manus* rounded, narrower than the brachium, without keels and without granules, the length of the "hand-back" much greater than the width of the hand; dactyli long, curved, and slender, the length of the movable dactylus nearly twice as great as the length of the hand.

Legs with weakly granular femora, coxæ quite smooth.

Pectines not projecting to the end of the fourth coxæ, furnished with fourteen similar teeth.

Measurements in millimetres.—Total length 30, length of cephalothorax 2·5, of tail 11·5, of first two segments 2·8, of fourth 2, of fifth 3; width of the first 1·6, of the fifth 1·4, of the vesicle 1; length of humerus 2·3, of brachium 2·5, of hand-back 1·2, of movable dactylus 2·5; width of hand ·8.

A single specimen probably from India or Ceylon, but without special locality. It was found in a bottle in Count Keyserling's collection together with a young example of *Scorpio Swammerdami*—a species which is undoubtedly Indian and Ceylonese.

The only known species with which this can be confounded is *Charmus laneus* of Karsch. But it certainly differs in colour, in having the last abdominal sternite coarsely and not "subtiliter" granular, the tail certainly carinate in part, and the fourth segment punctured and not granular.

EXPLANATION OF PLATE III. B.

Fig. 1. *Cheloctonus Jonesii*, g. et sp. n. Nat. size.
Fig. 2. *Heterocharmus cinctipes*, g. et sp. n. × 2.
Fig. 2 *a*. The same. Sternum and genital operculum.
Fig. 2 *b*. The same. Dentition of dactylus of palp.

VI.—*Description of a new Trap-door Spider from Ceylon.* By R. I. Pocock, of the British (Natural History) Museum.

[Plate III. A.]

Œcophlœus cinctipes, gen. et sp. n. (Pl. III. A.)

Colour.—Cephalothorax castaneous, variegated with black; ocular area black; mandibles castaneous; sternum, labium, coxæ, and femora clear ochraceous, the patella, tibia, and proximal tarsal segment with a fuscous band round the distal extremity; abdomen fuscous, variegated above and below with testaceous bands and spots.

Cephalothorax longer than wide, its lateral margins convex, anterior margin straight, truncate, its posterior margin lightly concave. The fovea transverse or perhaps very lightly concave backwards. The area of the upper surface behind the fovea sloped at an angle of 45 degrees, the area in front of it very lightly convex longitudinally. No ocular tubercle; the area of the eyes much wider than long and following the convexity of the cephalic portion; the median and the anterior lateral eyes forming a strongly procurved series, the median and posterior lateral forming a recurved series; the median eyes the largest and the highest, a horizontal line drawn from the base of each would touch but not cut the anterior lateral; the anterior laterals separated by a space which is about equal to twice the diameter of a median eye, the distance between the anterior and posterior lateral about equal to a diameter of a median eye, and that between the median eyes is a little less than a diameter of each; the fourth pair of eyes are small, closely in contact with and on the same level as the posterior lateral, and are separated from the median of each side by a space about equal to their own diameter.

Mandibles of moderate size, the anterior surface evenly curved from the base to the fang, smooth above, hairy in front, but not armed with teeth, fringed below with long reddish hairs, and armed internally with a row of denticles.

Maxillæ simply coxiform, fringed with reddish hairs along the anterior border, and having the anterior distal angle furnished with a few black spiniform teeth.

Palpi completely pediform, clothed with long hairs, the patella and tibia with the lower surface furnished laterally beneath with a few setiform spines, the tarsal segment scopulate, the hairs being thick at the sides, but scanty on the middle of the lower surface, terminated by a single, curved, inferiorly dentate tooth.

Legs.—The first, second, and third pairs subequal in length, the third being slightly the shortest, the fourth longer than the rest almost by its two terminal segments; clothed with hairs but not armed with spines, there being at most a few spiniform setæ scattered here and there. The first and second pair with the two distal segments furnished with thick undivided scopulæ; the third pair with the scopulæ very much reduced in size, but with two terminal tufts of hair at the base of the claws; the fourth with similar terminal tufts and with the scopula almost absent. Two simple strongly curved claws terminating each leg.

Labium united to the sternum, quadrate, wider than long, its anterior border straight and armed with a row of black spiniform teeth.

Sternum longer than wide, ovate.

Abdomen ovate; the superior spinners the longest, a very little shorter than the patella of the third pair of legs, the segments markedly decreasing in size from the base to the apex, the apical segment very short and conical; the inferior spinners composed of a single segment, which is about half the length of the basal segment of the superior spinners.

Measurements in millimetres.—Total length 15·5; length of cephalothorax 6·5, width 5·5; distance of fovea from anterior border 4; length of abdomen 9; length of palp 11, of first leg 14·5, of second 14·5, of third 14·3, of fourth 19; width of sternum 2·5, length 3·5; length of superior spinner 2.

Two female specimens in the Museum collection from Ceylon. The first, which has been selected as the type, was taken by Mr. E. E. Green at Punduloya; the second was obtained by Mr. Holdsworth.

The nest of this spider, which Mr. Green brought with the specimen, was found on the trunk of a tree. There are two doors set close together, with their hinges in contact, and consequently opening back to back. These doors, more or less irregularly circular in shape, are thin and laminate, and consist of small coherent lamelliform particles, which appear to be pieces of the epidermis of the leaf of some flowering plant*. The area immediately surrounding the doors is covered with the same leafy flakes; so that, when closed, the doors become almost invisible. The nest itself consists, not of an elongate silk-lined tube, as is usual in this group, but simply of a shallow excavation on the surface of the tree-trunk.

EXPLANATION OF PLATE III. A.

Fig. 1. *Œcophlœus cinctipes*, g. et sp. n. Dorsal view, nat. size.
Fig. 2. Nest, showing the two doors.

VII.—*Suggested Terms in Crinoid Morphology.* By F. A. Bather, M.A.

It is to be feared that the title of this paper will bring a smile to the lips of those who think, not without some show of reason, that students of Crinoid morphology spend more time in quarrelling as to what terms they are to use than in finding out fresh facts that should warrant any departure from the language of the text-books. It is not long since there appeared in this Magazine several notes on the Anatomical Nomenclature of Echinoderms from the pen of the leader whose loss we so deeply lament—P. H. Carpenter †. The object of that paper, however, was to give greater *precision* to the nomenclature of Echinoderm morphology rather than to propose any great novelty. The object of the present paper is different: it is to propose certain changes in the terminology of the various parts of a Crinoid, partly because it is hoped that these changes will facilitate the drawing up of descriptions and give greater clearness to our ideas, partly because it is believed that they are necessitated by recent advances in Crinoid morphology.

Every scientific paper should be its own apology; at the same time some reply may be offered to two different classes of objectors.

Those who have an innate objection to all change may be answered by the following quotations from a recent article by Prof. T. Jeffery Parker ‡:—"I think it may be taken as

* I am indebted to my colleagues of the Botanical Department of the Natural-History Museum for this information respecting the nature of the substance of which these doors are composed.

† Ann. & Mag. Nat. Hist. ser. 6, vol. vi. pp. 1–23, July 1890.

‡ "Suggestions for securing greater Uniformity of Nomenclature in Biology," 'Nature,' vol. xlv. p. 68, Nov. 19, 1891.

axiomatic that whenever the bounds of knowledge are extended, either by the investigation of new problems or by the re-examination of old ones with the aid of improved methods and extended views, an elaboration of nomenclature is inevitable. Indeed, the introduction of an extended terminology, either because of the discovery of new facts or of the more accurate grouping of old ones, is a distinct gain; it emphasizes an actual advance in knowledge." "In morphological nomenclature suitability is of far more importance than priority, and the most respectable and time-honoured terminology should never be allowed to stand in the way of one by which homologies, mutual relations, &c., are adequately expressed."

To those who deem it hardly fitting that one who has so recently entered on the field of Echinoderm morphology should be already running atilt at terms that have long held the ground, no other reply is needed than that the proposed terms were arrived at after considerable discussion with Dr. P. H. Carpenter, and that nearly all received his definite approval. Without his encouragement this paper would not have been written, and it has only been the sudden removal of his kindly help that has prevented its earlier completion.

Super-radials and Infer-radials.

Many of the Monocyclic genera of Crinoidea Inadunata are remarkable for the transverse bisection of some or all of the radial plates of the dorsal cup. To these radially situated plates themselves the term "Radials" is restricted, but it is convenient to have some short term to express their upper and lower halves. For these therefore I propose the terms "Super-radials" and "Infer-radials," which may be represented symbolically by R^s and R^i. Instead of saying "the lower half of the left anterior radial," we shall now be able to say "the left anterior inferradial" (l. ant. R^i). The plate for which the term Radianal (R') has been adopted is of course the right posterior inferradial (r. post. R^i); while the right posterior radial, being the upper half of the same plate, is morphologically the right posterior superradial (r. post. R^s).

Arm-ossicles.

In July 1890 the following terminology was proposed for the various series of arm-ossicles by P. H. Carpenter * :—

* *Op. cit.* p. 11.

Brachials = all arm-ossicles, or, in other words, all ossicles situated in the direction of the rays, distal to the radial (*s. str.*) and belonging to the abactinal system.
Costals = the first order of brachials, *i. e.* all brachials from the radial up to and including the first axillary.
Distichals = the second order of brachials.
Palmars = the third order of brachials.
First Postpalmars = the fourth order of brachials.
Second Postpalmars = the fifth order of brachials; and so on.
Free Brachials = all brachials after the last axillary, whichever that axillary may be.

Through the kindness of Dr. Carpenter I had already been able to put forward the above terminology * and to announce that it would be used in my papers on British Fossil Crinoids. Wachsmuth and Springer had also privately expressed their intention of accepting it. The latter authors, however, have already found it necessary to modify it slightly †. "To the most of this terminology," they say, "we entirely agreed, but in some particulars it does not quite meet the requirement in dealing with the greater complexity and variety of construction found in the Palæozoic forms." Instead of applying the term *Free Brachials* to brachials after the last axillary only, they use it in a different and extended sense, applying it to all brachials that are free from the calyx, as are all the arm-ossicles in the Inadunata. The term is thus opposed to *Fixed Brachials*, by which is meant those arm-ossicles incorporated in the calyx, such as are often found in the Camerata.

In the same place Wachsmuth and Springer have supplemented the above terminology, as follows:—

"*Interradials*, all plates interradially disposed in the calyx.
"*Interbrachials*, a general term for all plates between the rays above the radials.
"*Interdistichals*, the plates between the first divisions of the ray.
"*Interpalmars*, those between the second divisions of the ray.
"*Interambulacrals*, the plates between the ambulacra."

In applying to Palæozoic Crinoids the terminology to which I stood committed, I soon stumbled on certain difficulties. This was especially the case in the attempt to work out and

* "Brit. Foss. Crin., II.," Ann. & Mag. Nat. Hist. (6) vol. v. p. 313, April 1890.

† "The Perisomic Plates of the Crinoids," Proc. Acad. Nat. Sci. Philadelphia, vol. for 1890, p. 374: Feb. 1891.

to formulate the laws of arm-branching in the various families or genera. The difficulties are of two kinds, subjective and objective. We will take them in that order.

The subjective difficulties are due chiefly to the cumbrous, illogical, and, for the most part, meaningless nature of the terms adopted. This is not a censure of any one in particular, for no one man could ever have invented such a disconnected lot of names for similar and connected objects. The terminology has grown up bit by bit, unsubjected to the stern laws of *natural* selection. It is by no means easy for the student, or even for the describer of new species, to carry all these names in his head. It is on the face of it absurd to begin a fresh series of numbers at the postpalmars, as though there were some morphological change; moreover, the interpretation to the mind of such a phrase as "the second postpalmars" involves an arithmetical calculation before one realizes that the ossicles alluded to are brachials of the fifth order. Then, in speaking of a particular ossicle, one can hardly say "the second third postpalmar," so one is obliged to indulge in some such cumbrous circumlocution as "the second ossicle in the third postpalmar series." The symbols too that are employed in specific formulæ—c, d, p, p', p^{ii}, b, &c.—hardly convey their meaning at a glance, while they certainly do not lend themselves to the expression of statements referring to more than one order of brachials at a time. It is of course possible that these difficulties are not obvious to highly trained intellects, and it is true that they hardly present themselves in the study of most recent Crinoids.

There is, however, a more serious objection, at least to one of the terms. It was J. S. Miller who invented the now resuscitated term "costals," and it is true that he used it to denote the second radials, where he did not call them arm-plates. But, as can be seen from the table that was given by Carpenter (*op. cit.* p. 16), he also applied the term to the first radials, the basals, and the infrabasals. It would no doubt have been legitimate to restrict the term to one or other of the plates to which it was applied by Miller; but unfortunately this had already been done. As Carpenter himself pointed out, Prof. Lovén has "proposed to specialize this name as denoting the primary interradial plates of the Echinoderm apical system, *i. e.* the genitals of Urchins and the basals of Crinoids." It may be true that Prof. Lovén's proposal "has not been generally accepted by Echinologists;" at the same time there are others who have applied the term "costals" to interradially disposed plates, notably Prof. James Hall, who has thus denoted the basals of various species in the 'Palæontology of New York,' vol. i. (1848). It seems to me therefore that the use of the term "costals" in the sense now proposed cannot be justified, and I regret that I ever agreed to use it.

The objective difficulties in the way of the proposed terminology are due to the more correct views that are now held with regard to the homologies of pinnules. As was fully explained in the section on the Arms in "British Fossil Crinoids," Part II. (p. 374), pinnules are nothing more than armlets that have become small, ceased to branch, and are regularly placed on alternate sides of successive ossicles. An armlet itself is merely one branch of a dichotomous arm reduced in size. Consequently, from a morphological standpoint, a pinnule, however small, is the homologue of a whole dichotom (as we may conveniently call such a branch), while the ossicle that supports a pinnule is simply an axillary, and this without going beyond the strict conception of that term as recently laid down by Carpenter (*op. cit.* p. 19).

If now we turn to such a genus as *Botryocrinus*, and compare two of its species, such as *B. ramosus* and *B. decadactylus* *, and if we name the successive orders of brachials after the methods hitherto followed, we shall come to these conclusions—that

in *B. ramosus*		in *B. decadactylus*
the costals are homologous		with the costals;
the distichals	„	with the first two distichals;
the distichal axillary	„	with the second distichal;
the palmars	„	with the third distichal and the first pinnule, or, if this pinnule is branched, with the proximal portion thereof;
the first postpalmars	„	with the fourth distichal, the second pinnule, and the branches of the first pinnule if it be branched;
the second postpalmars	„	with the fifth distichal and third pinnule;

and so on. Which conclusions appear a sufficient *reductio ad absurdum* of our present methods. Those methods were only legitimate so long as pinnules were considered to be structures distinct from arm-branches and present or not according to some unrecognized or, at the best, empirical system.

From the foregoing review of the circumstances it appears that a terminology is required that shall fulfil the following conditions. Homologous parts must receive the same name. Parts serially homologous must receive names of a similar nature. When specialization and differentiation have taken

* Brit. Foss. Crin., V., Ann. & Mag. Nat. Hist. ser. 6, vol. vii. pp. 394 and 398.

place, there should be some means of expressing the facts in a simple manner. *Ceteris paribus*, the names employed should at once convey to the mind the idea denoted by them, and should involve as little change as possible from terms that previous naturalists have been accustomed to use. It will also be advantageous if the system of terminology is capable of extension both along its own lines and to parallel structures, and if it can be readily expressed by intelligible symbols such as can be utilized in formulæ.

It is believed that the system about to be detailed does fulfil these conditions as far as possible, and since not one of those conditions has been adequately fulfilled by previous systems, it may claim to be their superior in these respects at least.

Examination of the Carpenter-Wachsmuth system brings to light one term, and one only, that has a meaning, viz. the Müllerian term "distichals." At first, therefore, it seemed natural to suggest that the successive orders of brachials should be designated *monostichals*, *distichals*, *tetrastichals*, *octastichals*, and so on. This plan would inform us how many corresponding branches there ought to be at the level alluded to; but as this number would only be complete in a regularly dichotomous arm, such information would in many cases be merely misleading. Another objection to the system, so far as Palæozoic forms were concerned, lay in the words "so on." For instance, such a term as "eikosinoctokaihekatostichals" would not commend itself to the gentlemen who are so anxious to eliminate Greek from the education of a man of science, and even a mathematician might take some time in discovering that "128 stichals" signified the fifth postpalmars.

This suggestion may therefore be set aside for the present.

Instead, recourse may be had to the Latin language and to the method of simple enumeration. The term "Brachialia" may be simply combined with the Latin ordinal numbers. Since, however, this plan would produce rather lengthy words, even in their anglicized form, it seems advisable to shorten "brachialia" to "brachs." The terms thus formed are easily represented symbolically by the respective Roman numerals preceding "Br," *e. g.* IV Br., while the actual ossicle alluded to may be represented by an arabic numeral placed below the line after "Br," *e. g.* IV Br_2. When it is desired to indicate the fact that the ossicle alluded to is an axillary, the suffix "axil" may be combined with the appropriate numeral; while in the symbols "ax" will supplant "Br" (see Table, p. 57).

Table of Proposed Terms and Signs.

For Simple Arms.		Terms in use.		For Compound Arms.		Other Radial Plates.	
Primibrachs	I Br	Costals	*c*	Monostichals (First Order)	1 St	Infer-radial	R^i
First primibrach	I Br_1	First costal		First monostichal	1 St_1	Super-radial	R^s
Second primibrach	I Br_2	Second costal		Second monostichal	1 St_2	Radianal	R'
Primaxil	I ax	Axillary costal		Monaxil (First Mainaxil)	1 Ax	Inter-secundibrachs	i II Br
Secundibrachs	II Br	Distichals	*d*	Distichals (Second Order)	2 St	Inter-tertiobrachs	i III Br
Secundaxil	II ax	Axillary distichal		Distaxil (Second Mainaxil)	2 Ax	Primambulacs	I Amb
Tertiobrachs	III Br	Palmars	*p*	Tetrastichals (Third Order)	4 St	Inter-primambulacs	i I Amb
Tertiaxil	III ax	Axillary palmar		Tetraxil (Third Mainaxil)	3 Ax	Secundambulacs	II Amb
Quartibrachs	IV Br	First post-palmars	*pp*	Octastichals (Fourth Order)	8 St	&c.	&c.
Quartaxil	IV ax	Axillary first post-palmars		Octaxil (Fourth Mainaxil)	4 Ax		
Quintibrachs	V Br	Second post-palmars	pp^{ii}	(Fifth Order)	16 St		
Sextibrachs	VI Br	Third post-palmars	pp^{iii}	(Sixth Order)	32 St	Interradial Plates	IR
Septimibrachs	VII Br	Fourth post-palmars	pp^{iv}	[Higher Greek terms are too cumbrous and are rarely needed.]		Interbrachials	*ibr*
Octavibrachs	VIII Br	Fifth post-palmars	pp^{v}	[These are not needed.]		First interbrachials	ibr_1
Nonibrachs	IX Br	Sixth post-palmars	pp^{vi}			&c.	&c.
Decimibrachs	X Br	Seventh post-palmars	pp^{vii}			Interambulacrals	*iamb*
						Deltoids	Δ
						Anal *x*	*x*
						"Third anal"	*rt*
						Corresponding plate on left	*lt*
finials	*f*	Free brachials (P. H. C.)	*b*	Finials	*F*	Fixed Brachials	$\overline{Br}$
						e. g. $\overline{\text{I–III Br}}_2$	
						Cirrals	C
						Radicals	$\sqrt{\quad}$

N.B.—A sign between brackets, thus (II Br_4), denotes *variability*; while II Br? denotes *ignorance* of number. II Br4+ indicates that 4 are known, but that more existed, i. e. *incompleteness*.

This system has the advantage of at once conveying to the mind, in the simplest possible manner, the desired ideas. It is obviously capable of indefinite extension; but, since very few arms branch as many as twelve times, it does not involve words of any great length. It is true that "primibrachs" is longer than "costals;" but then "the fourth sextibrach" is far shorter than "the fourth brachial of the third post-palmar series" or even than "the fourth ossicle after the fifth axillary," which latter is a periphrasis proposed to me by Mr. Wachsmuth. Besides, the system is merely a more convenient rendering of terms that have been, and are still, employed by authors of repute, including Wachsmuth and Springer. In a letter dated August 5th, 1891, Mr. Wachsmuth writes: "The terminology of the brachials which you propose is almost the same which I proposed to Carpenter when we discussed the question two years ago, with the exception that I called the costals 'primary brachials,' the distichals 'secondary brachials.' At first we thought these terms were excellent, but, using them in some of our descriptions, we found them extremely cumbreus, and this induced us to accept Carpenter's terms." He adds, however, "we occasionally use primary and secondary brachials in place of costals and distichals as a change." The alteration involved in adopting the proposed system is therefore of the smallest possible kind, while the terms have all the 'excellence' without the 'cumbrousness' of those still used occasionally by Wachsmuth and Springer.

A still greater advantage of the new system is that it can be extended to all parallel structures. The general term at present applied to the covering-plates of the ventral grooves is "ambulacralia." This word may be conveniently shortened in composition, and the various series denoted as "primambulacs" &c. A similar nomenclature can be applied to cirrus-ossicles or "cirrals," and to root-ossicles or "radicals," in cases where these branch.

The supplementary plates that occur in some Camerata between the secundibrachs and tertiobrachs of a single ray have been called "Interdistichals" and "Interpalmars." The change to "Intersecundibrachs" and "Intertertiobrachs" is hardly euphonious; but there is rarely occasion to use these terms. The corresponding plates of the ventral surface should of course be known as "Intersecundambulacs" and "Intertertambulacs:" these plates have hitherto had no distinctive names, and some may think that it was better so.

As yet we have only considered the proposed system in its application to simple or non-pinnulate arms, when those are free from the radials upward. Let us now consider it with reference to pinnulate arms.

First in cases where these are free. Strictly speaking the first ossicle that bears a pinnule is homologous with the primaxil, and the next one bearing a pinnule with the secundaxil. But however philosophical this may be, it is clear that, after all, practical people do need some name that shall include all the pinnuliferous ossicles of any one series or order. In supplying this want we may adopt one of two courses. Either we may retain the present system with its illogical names, or we may evolve a new system that shall answer the requirements of a morphological terminology as laid down on p. 55. There can be little doubt that the former course will recommend itself to those who have to deal only with recent Crinoids, the vast majority of which belong to the genera *Antedon* and *Actinometra* (*Comaster*), for the species of which genera formulæ have been constructed by F. J. Bell * and P. H. Carpenter †. When, however, we consider fossil pinnulate genera, especially in the Camerata, the second course would appear to be accompanied by fewer difficulties.

For descriptive purposes, then, I would propose a terminology congruous with the Müllerian term "distichals." The objections to this that were stated above do not apply in the case of pinnulate genera, for in them the branching is almost always quite regular and does not take place so many times: except in formulæ, it would rarely be necessary to speak of any brachials higher than the octastichals. As a rule the monostichals correspond to the primibrachs, and there is no reason why the latter term should not be employed. In *Metacrinus* and *Calamocrinus*, however, pinnules are borne by the brachials of the first order. In that case the two terms do not apply to the same things, and the word "monostichals" must be adopted.

In cases where some of the proximal series of brachials enter into the dorsal cup, these may be called by Wachsmuth and Springer's term "Fixed brachials" or "*brachialia fixa*;" while those outside the limits of the cup will be "Free brachials" or "*brachialia libera*." In formulæ and symbols it would have been natural to have expressed the difference between the two by enclosing the fixed brachials in brackets. Brackets, however, have already been employed by Bell and Carpenter, with far less obvious significance, to denote uncer-

* "An attempt to apply a method of Formulation to the species of the Comatulidæ &c.,' Proc. Zool. Soc. Lond. 1882, pp. 530-536.

† 'Challenger' Zoology, vol. xxvi. part lx., Report on the Comatulæ, pp. 43 *et sqq.*, 1888.

tainty of occurrence; instead, therefore, it will be necessary to use a brace, or even a simple rule, placed above the symbols of those brachials that are included in the cup. Thus $\overline{\mathrm{II\ Br}}$ would indicate the secundibrachs, while conveying the additional information that they were fixed.

In cases where some only of the free brachial series bear pinnules, it would be well to apply the Latin terminology to those brachials without pinnules, whether free or fixed, and the Greek to those with pinnules. Thus, $\overline{\mathrm{I–II\ Br}}$. III Br . 8 St, indicates that both primibrachs and secundibrachs are fixed, that the tertiobrachs are free but do not bear pinnules, that the next series of arm-ossicles are free and bear pinnules, and that there are eight free arms to a ray. The best way of representing the number of ossicles in each series will be discussed presently.

If the term "Free brachials" be used in the sense here ascribed to it, it can no longer be applied to the distal unbranched ends of the arms. If it is really necessary to have a special term for these ossicles, the word "finials" may be appropriately conveyed from architectural terminology. The word "terminals" already has its special use in Echinoderm morphology. The symbol for finials may be *f* when they do not bear pinnules, and *F* when they do. In all formulæ the last or right-hand term of the brachial series should always be understood as applying to the finials, so that there will rarely be any need to use the special symbol *f*. For the same reason it seems unnecessary to have different terms to express pinnulate and non-pinnulate finials, although, strictly speaking, non-pinnulate finials are homologous only with the last pinnule borne by the finials of a pinnulate arm.

Another difficulty arises with regard to the word "axillary." As has been pointed out, each pinnuliferous brachial is morphologically an axillary. Consequently, if the morphological terminology be followed, supposing that the ossicle on which a pinnulate arm first branches be the primaxil, then the two ossicles that this supports are the secundaxils; and if there are six distichals the sixth will be the septimaxil. The septimaxil then, in this case, is the same as the distichal axillary. It will therefore be convenient to distinguish those axillaries on which a pinnulate arm itself branches as "mainaxils;" and instead of alluding to them individually as "monostichal axillary," "distichal axillary," and so on, they may be spoken of as "first mainaxil," "second mainaxil," and so on; or they might possibly be called "monaxil," "distaxil," tetraxil," "octaxil," &c. In the symbols, the mainaxils may be distinguished from the simple axillaries by being represented by "Ax" instead of "ax," and by the use of Arabic instead of Roman numerals.

We are now in a position to express in the formulæ the number of brachials in any series. To say that the Quartaxil is the fifth ossicle of its series is obviously the same thing as saying that there are five quartibrachs; while to say that the third mainaxil (or Tetraxil) is the fourth ossicle of its series is obviously the same thing as saying that there are four tetrastichals. These facts may be expressed symbolically thus—IV ax_5, and 3 Ax_4; which symbols come to mean just the same as IV Br–5 and 4 St–4, or as IV Br_5 = IV ax, and 4 St_4 = 3 Ax. Applying this method to the formulæ we get such results as these:—

Thenarocrinus callipygus.

$$\mathrm{I\,ax}_3 \,.\, \mathrm{II\,ax}_{(4)} \,.\, \mathrm{III\,ax}_{4\text{-}10} \,.\, \mathrm{IV\text{–}VIII\,ax}_{6\text{-}18} \,.\, f_?,$$

which being interpreted is, Primibrachs 3, Secundibrachs 4 as a rule, Tertiobrachs from 4 to 10, Quartibrachs, Quintibrachs, Sextibrachs, Septimibrachs, and Octavibrachs from 6 to 18, number of finials uncertain. It also conveys the information that the arms branch eight times, that they are non-pinnulate, and that none of the brachials enter into the dorsal cup.

Botryocrinus pinnulatus.

$$\mathrm{I\,ax}_4 \,.\, 2\ \mathrm{St}\text{–}35+,$$

which indicates that there are four primibrachs, which are free, that there are two arms to each ray, which do not branch again but which bear pinnules, and that the number of ossicles in each of these arms is uncertain, but exceeded 35.

Botryocrinus decadactylus.

$$\mathrm{I\,ax}_{(3\text{-}4)} \,.\, (\mathrm{II\,ax}_2\ \&\ \mathrm{III\,Br}) \,.\,.\, 2\ \mathrm{St}.$$

The facts expressed by this are somewhat more complicated. Primibrachs are usually 3 or 4, but may be more or less; they are free. It is clear from the symbol 2 St that the arm bifurcates on the primaxil; but the signs in brackets that precede 2 St show that the earlier ossicles of this distichal series do not all bear pinnules, there being first a simple secundibrach, then a secundibrach bearing either a pinnule or armlet, then a simple ossicle which is morphologically a tertiobrach, and then the series of pinnuliferous distichals of which the number is uncertain.

Batocrinus Lovei (the formula for all rays except anterior).

$$\overline{\mathrm{I\ ax}_2\,.\,\mathrm{II\ ax}_2\,.\,\mathrm{III\ Br}{-}2}\,.\,4\ \mathrm{St},$$

$$\text{or, more shortly, }\overline{\mathrm{I{-}III\ Br}_2}\,.\,4\ \mathrm{St}.$$

This is quite clear, the only point to notice being that in the third order of brachials two are fixed, the rest free and pinnuliferous. The corresponding formula for *Batocrinus Christyi* is $\mathrm{I{-}III\ ax}_2\,.\,8\ \mathrm{St}$.

Gilbertsocrinus tuberculosus.

$$\overline{\mathrm{I\ ax}_2\,.\,\mathrm{II\ ax}_3}\,.\,\mathrm{III\ ax}_{4-5}\,.\,8\ \mathrm{St}.$$

In this case the tertiobrachs are free but bear no pinnules, and there are 8 pinnulate arms to each ray.

One cannot hope to express quite as much in a formula as Mr. Puff got into a shake of Lord Burleigh's head; it is hoped nevertheless that the above examples will show how, by a more rational terminology, with its appropriate symbols, the attempt to apply a system of formulation to Palæozoic Crinoids may have some chance of success. There are of course more complicated plans of arm-branching than those here alluded to; they will demand more complicated formulæ no doubt, but it should be possible to use the same terminology and symbols in all but the most exceptional cases.

Interradial Plates.—Interbrachials.

The term "Interradials" is applied by Wachsmuth and Springer to "all plates interradially disposed in the calyx." These include Basals, Interradials (*s. str.*), Interambulacrals, and Orals. Now, since all these plates are truly *interradial*, and since all morphologists will wish to retain this wide use of the word, it seems a pity to endeavour to restrict it to those interradially situated plates alone that occur in the dorsal cup and that are above the level of the basals. There is a term "Interbrachials," which Wachsmuth and Springer have proposed "for all plates between the rays above the radials," thus, by implication, still further limiting the meaning of Interradials (*s. str.*) to the one plate in each interradius that may occur between the radials themselves. But morphologically these latter plates do not differ from the Interbrachials (W. & Sp.) in the same way as radials differ from brachials; consequently the difference of name is misleading.

Why should not all interradial plates below the free arms, except of course the basals, be called Interbrachials, each row being distinguished as first, second, third, &c.? Thus the plates to which the term "Interradial" is now often wrongly restricted would be called "the first Interbrachials," or, when they alone existed in the dorsal cup, simply "the Interbrachials" (*ibr*).

It would be convenient still to distinguish the corresponding plates of the ventral surface as "Interambulacrals" (*iamb*).

Interradial Plates.—Deltoids.

In the genus *Euspirocrinus* there occur on the oral surface four cordiform or subtriangular plates. One of these is situated in each interradius, except the posterior interradius, and abuts on the upturned portions of the radials, *i. e.* on the radial processes. These four plates meet one another laterally, beneath the ambulacra, except in the posterior interradius. In the posterior interradius there is a larger plate of somewhat similar shape, which has an irregular surface. This plate bears to the peristome the same relation as do the four cordiform plates; it also partly supports the ambulacra; it does not, however, bear the same relation to the radials, as it is separated from them by a varying number of plates connected with the anal tube. One or more of these latter plates, on either side of the anal tube, meet the adjacent cordiform plate beneath the ambulacrum.

The four cordiform plates are also met with in *Gissocrinus*, *Cyathocrinus*, *Carabocrinus*, *Streptocrinus*, and other Inadunate genera. The posterior plate with an irregular surface is usually conspicuous in the same genera. The homologies of these plates with plates occurring in the tegmen of other Crinoids are still in dispute; it is therefore advisable to give to them some names that shall not have too great morphological significance.

The posterior plate appears to have been perforated by one or more pores, being in some cases quite cribriform *, and it is probable that it subserved the functions of a madreporite, whatever those functions may be. It will therefore be convenient to apply to this plate the term "Madreporite," which term, it should be remembered, has no strict morphological significance, since the position of the madreporite in other Echinoderms is by no means constant.

The four cordiform plates have often been regarded as orals,

* Wachsmuth and Springer, "Perisomic Plates," *loc. cit.* p. 358.

a view which in recent times has been advocated by M. Neumayr ('Stämme des Thierreichs'). Most recent writers, however, among whom P. H. Carpenter may be mentioned, have considered them as Interradials, though whether homologous with Interbrachials or with Interambulacrals was left a little uncertain. The most recent and most original view is that of Wachsmuth and Springer *, who treat them as partly, if not altogether, Subambulacral, a view which can hardly be defended †. The latter authors have, however, suggested that these plates correspond to the deltoids of the Blastoidea (*ibid.*). P. H. Carpenter, in a letter to me, dated 25th September, 1891, said: "They are unquestionably homologous with the deltoids of *Stephanocrinus* and the Blastoids." It is not likely that any one will disagree with this statement, however much opinions may differ as to the homologies of the Blastoid deltoids themselves. Consequently we may temporarily extend to the four cordiform, interradially situated plates of the tegmen, in *Euspirocrinus* and the Cyathocrinidæ, the term "Deltoids," which may be fittingly symbolized by the Greek delta, Δ.

We can hardly doubt that a homologue of the deltoids exists in the posterior interradius; but whether this be represented by the madreporite or by two of the small plates at the base of the anal tube is a question not yet settled. It is therefore inadvisable at present to extend the term deltoid to any plate or plates in the posterior interradius.

Interradial Plates.—Anals x and t.

It may be as well to take this opportunity of stating that the term "anal x" will be applied for the present in my papers to the single anal plate that enters into the composition of the dorsal cup in such genera as *Cyathocrinus*, and to the homologue of that plate in other genera. This is the plate for which the term "Brachianal" was proposed in "British Fossil Crinoids," II. p. 330; that term, however, lays too much stress on an inference that has not met with general acceptance.

Once more, however, it is necessary to point out that neither the rejection of the term Brachianal, nor even the rejection of the inference that the anal x was primitively derived from a brachial, affect the main contentions of the paper referred to. I still believe, for reasons given in that

* *Op. cit.* pp. 358–360.

† See review of this paper in Geol. Mag. dec. iii. vol. viii. p. 222, May 1891.

paper, that the anal x descended into the cup from above; and I believe that the lowest, median, posterior plate of the ventral tube is always this same plate, whether it be right above the radials, as in *Iocrinus* and *Merocrinus*, resting on the radials, as in *Heterocrinus* and *Castocrinus*, between the radials but not in line with them, as in *Homocrinus* and *Dendrocrinus*, in line with the radials, as in *Botryocrinus* and *Cyathocrinus*, or rising above the radials again, as in the later Decadocrinidæ and in the larval *Antedon*. In this view I have the misfortune to differ from Messrs. Wachsmuth and Springer, who apply the term "anal x" to the lowest plate of the tube only when it is partly or entirely within the limits of the dorsal cup. They "apply the term 'anal plate' only to those taking part in the dorsal cup. All others are plates of the anal tube or the ventral sac." That this is not, in *their* opinion, a mere difference of terminology is shown by the arguments that they have based on this supposed difference. If, however, we consider such a form as *Botryocrinus*, we shall see that the anal x is of exactly the same shape and provided with the same axial ridges as the plate that rests immediately on it: there is no visible difference between them, and whatever the one is that we should suppose the other must naturally be. It is merely for convenience, and to distinguish it from the other plates of the cup, that we call one of them "anal x."

In exactly the same way, the third anal plate that enters to a greater or less extent into the dorsal cup in such genera as *Dendrocrinus*, *Poteriocrinus*, and *Decadocrinus* would appear to be merely the small plate that in *Botryocrinus, Cyathocrinus*, and such forms, is seen on the right of anal x, resting partly on it and partly on the right posterior radial, and corresponding to a similar plate on the left. In other words, calling these two plates rt and lt respectively, rt is outside the cup in *Cyathocrinus* but partly inside it in *Poteriocrinus*. Messrs. Wachsmuth and Springer, however, in their paper on the Perisomic Plates (p. 385) have advanced the view, apparently for the first time, that in the Poteriocrinites "a new plate was introduced beneath the other, a sort of third anal." That is to say, in their opinion the third anal of *Poteriocrinus* is a fresh development without any homologue in the Cyathocrinidæ and Botryocrinites. But surely the constancy in shape and position of the anal cup-plates x and rt is hardly consistent with the idea that they are merely supplementary plates developed to suit the needs of those particular genera in which they appear. It seems more in accordance with the principles that have hitherto governed

Crinoid morphology to regard their resemblances as due to homogeny rather than to homoplasy.

Imperforate Articulation.

Reference to "British Fossil Crinoids," II. p. 314, will show that there is some difficulty in distinguishing between those forms of joint that are there called "Loose suture" and "Muscular articulation." There are among Inadunate Crinoids many instances of arm-joints in which there is a well-defined fulcral ridge, combined with muscular and ligamental depressions, but in which the axial canal does not happen to be separated from the ventral groove by stereom and so does not perforate the fulcral ridge. It might be advisable to distinguish these joints as "Imperforate articulation," and to call the muscular articulation in which "the articular ridge, whether vertical or transverse, is always perforate," "Perforate articulation."

It is unfortunately necessary to explain that the word "joint" is used here and throughout my papers in its ordinary English and anatomical sense, and not in that restricted and different sense which is usually ascribed to it by crinoidologists and cooks.

VIII.—*On the Oviposition and Embryonic Development of the Crocodile.* By Dr. A. Voeltzkow, of Majunga, Madagascar *.

THE Madagascar Crocodile, *Crocodilus niloticus*, Laur. (*madagascariensis*, Grandid.), is not only one of the commonest reptiles, but perhaps the commonest Vertebrate of the island. It is found in large numbers wherever there is water, in every pool and stream. The natives distinguish two species, one (*Cr. niloticus*) with a longer, and another with a shorter head and greater length of body; the latter is said to occur only in the large rivers in the primeval forest, and the natives are extraordinarily afraid of it, as it is stated to be very savage; it is probably identical with *Cr. robustus*, Vaill., Grandid. I

* Translated from the 'Mathematische und Naturwissenschaftliche Mittheilungen aus den Sitzungsberichten der Königlich Preussischen Akademie der Wissenschaften zu Berlin,' Heft ii., 1891, pp. [115] 51–56 [120].

have not yet succeeded in securing a specimen of this second species; my remarks therefore refer exclusively to *Cr. niloticus*, Laur. (*madagascariensis*, Grandid.).

This animal is met with in all sizes, especially numerous on the sandbanks of the Betsiboka River, where, in the space of an hour, in rowing down the river, a hundred and more may be readily observed. The largest which I have yet measured was 13 feet in length, though individuals of considerably larger size occur.

Oviposition commences in the latter days of August, and continues until towards the end of September*, after which I found that the eggs all contained embryos. Altogether rather more than one thousand eggs were submitted to examination, derived from about thirty-five batches. In a few cases the number of eggs in the batch could not be exactly determined. The number of eggs in a batch varies between twenty and thirty.

The nest consists of a pit excavated in the earth to the depth of about a foot and a half to two feet, with partially steep walls. At the bottom of the pit the walls are undermined, and here the eggs are placed. The floor of the pit is raised slightly in the middle, so that the eggs, as they are laid by the female, roll by themselves into the hollowed-out places. Very rarely one or two eggs are found lying in the middle of the pit, which may well be taken as proving that the mother does not herself push the eggs into the hollows with her feet, for in that case no eggs would ever be found in the centre of the pit. After the eggs are laid the pit is filled in, and no sign of it can be detected from above. The old crocodile sleeps upon the nest, and this enables the natives to find the eggs, since they follow the tracks of the animal from the water.

The shape of the eggs is extremely variable, and not even those of the same batch resemble each other completely; many are elliptical, others cylindrical with rounded ends; two eggs were pointed at one end. In size they vary from $5\frac{1}{2}$ to 9 centim. in length and from 4 to 5 centim. in breadth. The shell is white, thick, and hard, sometimes coarsely granular, sometimes smooth.

Almost all the nests were dug in the dry white sand, a few in ground rich in humus, but in such a way that they could not be reached by damp. I must lay especial emphasis on the latter point, since freshly-laid eggs are peculiarly sensitive to wet. More than half the eggs which were

* Oviposition does not appear to take place at the same time in all localities, since Keller mentions the month of January for Nossi-Bé.

placed in pits in my courtyard perished through getting mouldy, in spite of the fact that only a very small degree of moisture could afterwards be detected in the sand. The fresh egg is altogether one of the most sensitive objects with which I am acquainted. A slight increase of temperature also killed the young embryos to a certainty if the eggs were not covered with a sufficient depth of sand. Older eggs, on the contrary, are all the more capable of resistance, and may half dry up, and lie for days uncovered upon the table, without causing the destruction of the embryo.

The Sakalava people told me that when the young are ready to emerge the female scrapes the sand out of the pit; I had no reason to doubt this statement, as I had myself seen numerous pits from which the sand had been removed and which contained the broken egg-shells. This gave rise to the question as to how the mother knows that the eggs are sufficiently developed and that it is time to scrape out the pit. The solution of the riddle was very simple.

In the workroom of my house there stand a few boxes filled with sand containing crocodile eggs, in order that I may have the latter always before my eyes and eventually be able to see the young animals emerge. One day I heard sounds emanating from one of these boxes, and came to the conclusion that a young crocodile had actually hatched and, being buried in the sand, was stifling, and so making these noises. On digging out the sand I discovered the surprising fact that the sounds actually came from the uninjured eggs. The noises are so loud that if the eggs are exposed they may be heard quite distinctly in the adjoining room. If the eggs are covered with sand, as they are in their natural state, therefore to the depth of about 2 feet, the sounds are somewhat deadened, but still distinctly discernible without difficulty at the distance of the length of a room. The cries of the young animals in the egg can be aroused at any time by walking with a heavy tread past the spot where the eggs are lying, or knocking at the box containing the eggs, or taking the egg in the hand and shaking it slightly; every disturbance causes the young animals inside to utter sounds.

Since, as mentioned above, the mother animal sleeps upon the nest, it will in its movements or in its wanderings to and fro between the water and the nest shake the ground, and cause those young animals in the eggs which are sufficiently far developed to emit sounds. The female then scrapes the sand out of the pit, and after some time the young emerge. From eggs of this kind, which were exhumed and kept uncovered, the young emerged in three days.

The fact that sounds are produced by the young in the egg was unknown to anybody here. The natives laughed at me when I spoke about it, until by listening they were convinced of their mistake. The sounds are produced with the mouth closed, apparently by powerful contraction of the ventral muscles, much as we make a noise when hiccoughing. The sound, too, is similar.

When the young animals have emerged the old crocodile goes with them to the water. My taxidermist, a thoroughly trustworthy man, who has previously travelled with Dr. Fischer, told me that a short time before he had seen a large crocodile with a tribe of about twenty young ones travelling over a stretch of sand to the water. He stated that the old one was remarkably savage. That the just-hatched young are able, without help from the mother, to break through the superincumbent layer of sand I believe that I am entitled, according to the experiments which I have made, to deny as emphatically as possible. Of the eggs which were covered with a layer of sand about $1\frac{1}{2}$ to 2 feet in depth it is true that a few showed feeble attempts on the part of the young to escape, in that the shell was broken at one point, while sometimes the young animals had protruded the tip of the snout; but they had invariably perished, probably from want of air. The eggs which were only lightly covered with sand presented no difficulties to the young in escaping.

The process of hatching is preceded by a change in the position of the embryo, with partial destruction of the embryonic membranes, so that the tip of the snout of the young animal now comes into contact with one end of the egg; at any rate this was the position of all embryos which were ready to emerge. The piercing of the egg-shell is effected by the mechanical operation of the egg-tooth, which is also found in young birds. The rudiments of this tooth may be detected at a very early stage, at the period at which the young crocodiles begin to assume their definite shape, therefore when the embryos are about one and a half to two months old. In the just-hatched young it appears as a tooth about $\frac{1}{2}$ to $\frac{3}{4}$ millim. in length, terminating in two points; the movements of the animal cause it to act precisely like a gimlet. In crocodiles a fortnight old it was still distinctly recognizable. On the perforation of the egg the embryonic fluid escapes and produces a softening of the adjacent parts of the shell, and the young animal forces itself backwards through the narrow cleft. A specimen which was watched from the moment it pierced the egg-shell took about two hours to completely emerge. As the animal forces itself through the narrow hole the embryonic membranes are torn off at the edges of the opening and are left behind in the egg.

The just-hatched young are of considerable size, and it is afterwards difficult to understand how they could have found room in the egg. For instance, an egg 8 centim. in length by 5 centim. in breadth produced a young crocodile of 28 centim. These young animals are very savage from the first; they snap at the finger if one attempts to pick them up, &c. They frequently make a noise, especially when they are hungry. This fact had long been known to me. The note is not so high as that produced by the young in the egg. It sounds pretty much like the cry of our fire-bellied toad (*Bombinator igneus*), but is somewhat louder; it is repeated six or seven times, followed by a pause. Some young crocodiles which I have been observing for about a fortnight in a pool I have not heard to utter any cries during the last day or two. Besides this the animals make a spitting noise if they are irritated, *e. g.* when they are held up by the tail.

Hatching is not directly dependent upon the setting in of the rainy season, and is not occasioned by the increased moisture of the ground, since the greater number of pits contained empty egg-shells about a fortnight before the occurrence of the first fall of rain. Development in the egg takes about three months. It was in the middle of November that I received information that the first newly-hatched young had been observed.

The newly laid egg exhibits the following characteristics.

As has been remarked above, the form and size of the egg are variable, and it possesses a hard and coarsely granulated shell. Immediately beneath this lies the thick and tough shell-membrane, which is so resistant that the egg retains its form after the removal of the shell. This shell-membrane consists of two layers, a thicker external and a more delicate internal one. It is possible with a little care to peel off the external layer in large pieces. S. F. Clarke * states that the shell-membrane of the alligator is attached to the shell in a ring-shaped zone in the direction of the smaller diameter, and that even from outside the egg appears to be encircled by a readily distinguishable white zone. Nothing of this is to be seen in the perfectly fresh eggs of the crocodile. Crocodile eggs which presented this appearance underwent no further development.

The albumen is of about the same consistency as jelly, sometimes has a greenish lustre, and is so tough that, after care-

* S. F. Clarke, "The Nest and Eggs of the Alligator, *Alligator lucius*, Cuv.," Zool. Anzeiger, 1888, no. 290, p. 568.

fully removing the shell-membrane, the entire egg may be taken in the hand, rolled about, examined from every side, and even allowed to slide from one hand into the other without collapsing. The yolk is globular and so large that it reaches almost to the long sides of the shell-membrane. The colour is somewhat brighter than in the case of the fowl. The vitelline membrane is very delicate, but so tough that it is possible with a little practice to remove the albumen entirely, until finally only the yolk is retained in the hand; the yolk then naturally assumes the shape of a round flat cake.

I must agree with S. F. Clarke in stating that the egg of the crocodile is the tenderest and most difficult object to manipulate imaginable, since the conditions which have just been described apply to perfectly fresh eggs only; subsequently it is only extremely seldom that the egg can be prepared without injury. I adopted the expedient of first removing one half of the egg-shell and then half of the shell-membrane, which I succeeded in doing without damaging the albumen; then, turning the egg gently, I searched for the embryo; if I discovered it I opened the albumen and yolk by a quick cut with the scissors, and then allowed the embryo to slide slowly into a watch-glass; the whole was then lifted up, and further manipulated under a dissecting-microscope. In spite of every precaution all my trouble was often thrown away.

It is stated by S. F. Clarke that it is possible to determine the position of the embryo from without by the fact that at one spot the above-mentioned ring-shaped white zone is expanded. This statement is not applicable to *Crocodilus niloticus*, since an expansion of the zone is found even in bad eggs, in which the embryo has perished. Eggs which develop normally exhibit no trace of change in their external appearance until the escape of the young animal, but appear pure white.

It would be premature at the present moment to attempt to give a review of the entire course of the embryonic development, since my investigations are not yet concluded and will need a supplementary examination next year, for unfortunately perfectly new-laid eggs have not come to hand so plentifully as might have been wished.

The youngest embryos observed, about six days old, were dumbbell-shaped and 3 millim. in length; the amnion was not yet closed. The object is unfortunately so delicate that I have not yet succeeded in examining these stages under the microscope, and I was obliged to confine myself to preserving these as well as the perhaps even younger stages *in toto*.

So far as I have yet been able to determine, the development of the crocodile closely resembles that of the bird. A noticeable feature is the tail, which is of great length at a very early stage, and is at first rolled up in a spiral form, and afterwards, when the embryo is more strongly bent, twisted round the neck.

That the rudiment of the egg-tooth appears very early has already been mentioned.

Rudiments of the genital protuberance are already to be seen in embryos which are about 10 millim. long (measured in the bent position). A rod-shaped structure may then be observed between the posterior legs; it is about 1 millim. in length and protrudes from the cloaca, with the anterior wall of which it is fused. It at first lies parallel to the median line of the abdomen, is subsequently erected, and finally completely retracted within the opening of the cloaca. It is not until the embryos are almost full-grown, after about two and a half months, that the genital protuberance begins to disappear altogether, and is then only to be seen by separating the lips of the cloaca.

IX.—*On newly-discovered East-African Chameleons, with Remarks on some other Reptiles described by Dr. Steindachner.* By G. A. Boulenger.

Judging from the number of descriptions recently published* it would seem that the Chameleon fauna of East Africa is likely soon to rank next to that of Madagascar with regard to variety of species. I have, however, no doubt that the list of species has to be reduced by three, of which two have just been described by Dr. Steindachner and the third by Mr. Stejneger. On comparing the descriptions and figures of *Chamæleon Höhnelii* and *leikipiensis* with the late J. G. Fischer's account of *Ch. bitæniatus* and the specimens in the British Museum, I cannot come to any other conclusion but that they all belong to one and the same species, Dr. Steindachner's specimens being fully-developed males. The

* *Chamæleon sphærophol is* (Victoria Nyanza) and *Fischeri* (Usagara?), Reichenow, Zool. Anz. 1887, pp. 370 and 371; *Ch. Roperi* (Kilifi), Boulenger, P. Z. S. 1890, p. 85, pl. viii. fig. 4; *Ch. Hohnelii* (Leikipia, west of Kenia, 6000 feet), *leikipiensis* (Leikipia), and *tavetensis* (Taveta, foot of Kilimandjaro), Steindachner, Anz. Ak. Wien, 1891, pp. 141 and 142, and Sitzb. C. 1891, pp. 307, 309, 310, pl. i.; *Ch. Abbotti* (Kilimandjaro), Stejneger, Bull. U. S. Nat. Mus. xiv. 1891, p. 353; *Rhampholeon Robecchii* (Somaliland), Boulenger, Ann. Mus. Genova (2) xii. 1891, p. 11, pl. i. fig. 3.

difference between them is no greater than between individuals of the South-African *Ch. pumilus.*

The third species described by Steindachner, *Ch. tavetensis*, is the same as Stejneger's *Ch. Abbotti.* The library of the Natural-History Museum having received a copy of the latter author's paper on Sept. 2, and the number of the Vienna 'Anzeiger' containing Dr. Steindachner's diagnosis on June 22, I regard *Ch. tavetensis* as having priority, and it is under that name that I shall describe a female specimen which has recently been presented to the British Museum by Mr. Keith Anstruther, who obtained it at Taveta on the 30th June last.

Chamæleon tavetensis, Stdr., ♀.

Casque feebly raised posteriorly, with a mere indication of a parietal crest; the distance between the commissure of the mouth and the extremity of the casque equals the distance between the former point and the nostril; canthus rostralis with a series of conical tubercles; the rostral appendages replaced by a slight swelling in front of the nostril. Body covered with subequal, rather large, flat granules, some of which may be regarded as slightly enlarged "tubercles;" no crests. Tail longer than head and body. Olive-grey; a pair of white lines along the middle of the posterior part of the belly.

	millim.
Total length	185
From end of snout to extremity of mandible	18
" " " casque	21
Greatest width of head	12
Depth of skull (mandible included)	13
Body	70
Tibia	14
Tail	115

Chamæleon Fischeri, Reichenow, which is only known to me from the description, differs from *Ch. tavetensis* in the much more strongly compressed rostral appendages and the presence of a crest on the anterior part of the back.

Before concluding I have a few remarks to make on some other Reptiles described by Dr. Steindachner in the same paper.

1. *Tetragonosoma effrene*, Cant.—Dr. Steindachner, who has overlooked Stoliczka's description (Journ. As. Soc. Beng. xxxix. 1870, p. 203, pl. xi. fig. 3), is mistaken in believing the *Lycodon* described by me as *L. atro-*

purpureus, Cant., to be the same as *L. effrenis*; the latter has three labials in contact with the eye, the former only two. The type of *Lycodon ophiteoides*, Blkr., is preserved in the British Museum.

2. *Simotes Meyerinkii*, Steind., is, I suggest, only a variety of *S. octolineatus*, Schn.

3. *Chalcides Simonyi*, Steind., from Fuertaventura, I regard as a variety of *C. viridanus*, and as there is a *C. viridanus*, var. *Simonyi*, either of the names will have to be changed. My reason for not accepting *C. Simonyi* as a valid species, although some of its characters do not fit into the diagnosis I have given of *C. viridanus* (Cat. Liz. iii. p. 402) is that a female specimen from Grand Canary, preserved in the British Museum, falling, as regards coloration, into Steindachner's var. *bistriata*, *β*, and with 36 scales round the middle of the body, agrees precisely in its proportions with *C. Simonyi*, as may be seen from the following measurements:—

	millim.
From snout to vent	87
From snout to fore limb	25
Head (to ear-opening)	13
Width of head	10
Fore limb	15
Hind limb	22
Tail (reproduced)	78

4. *Molge Luschani*, Steind.—I have no doubt this is a *Salamandra*. There seems to be less difference between *Salamandra Luschani* and *S. caucasica* than between the latter and *S. maculosa*.

X.—*Description of a new Snake from Nubia.* By G. A. Boulenger.

Gongylophis Muelleri.

Rostral large and broad, with angular horizontal edge; upper surface of snout and crown with small smooth shields, the largest of which is an azygous shield behind and wedged in between the internasals, which form a short suture behind the rostral; five shields from eye to eye across the forehead; nine or ten scales round the eye, which is separated from the labials by a single series of scales; nine upper labials. Scales perfectly smooth, in 41 to 45 rows. Ventrals 181–187; anal small, entire; subcaudals 16–19. Tail pointed, ending in a curved, claw-like, horny scute, as I have described in *Eryx Jayakari*. Cream-colour, above with a dorsal series of large dark-brown blotches, some of which alternate and are confluent into a zigzag band; a lateral series of smaller dark brown spots, alternating with the dorsals.

Total length 370 millim.; tail 30.

Two examples of this species from Sennar, obtained by the Italian traveller Marno, were noticed by Dr. F. Müller in his Catalogue of the Reptiles in the Basle Museum (Verh. nat. Ges. Basel, vi. 1878, p. 650), and provisionally referred to *Eryx jaculus*. Through the kindness of Dr. Müller I have now received one of the two specimens, and feel no hesitation in pronouncing it to belong to a new species, with which it gives me great pleasure to connect the name of my friend the distinguished herpetologist.

This now brings the number of *Eryces* (*Eryx* and *Gongylophis*) to eight, which may be easily distinguished by means of the following synopsis:—

I. A mental groove: *Eryx*, Daud.

A. Eyes latero-superior, separated from each other by six or more longitudinal series of scales; tail obtuse or obtusely pointed.

a. Anal shield small; ventrals and subcaudals narrow.

54–65 scales across the middle of the body; ventrals 194–210 .... *E. Johnii*, Russ.

40–50 scales across the middle of the body; ventrals 165–200 .... *E. jaculus*, L.

36 scales across the middle of the body; ventrals 184 .... *E. elegans*, Gray.

b. Anal shield large; ventrals and subcaudals broad, the former occupying at least one fourth the circumference of the body .. *E. sennariensis*, Jan.

B. Eyes entirely on the upper surface of the head, separated from each other by four longitudinal series of scales; tail pointed, ending in a curved, claw-like, horny scute. *E. Jayakari*, Blgr.

II. No mental groove: *Gongylophis*, Wagl.

A. Scales keeled, at least on the hind part of the body; tail ending in a conical scute.

8–10 keeled scales from eye to eye across the forehead; rostral without angular edge; scales in 40–49 rows .... *G. conicus*, Schn.

12–15 smooth scales from eye to eye across the forehead; rostral with angular horizontal edge; scales in 47–53 rows	*G. thebaicus*, Reuss.
B. Scales smooth, in 41–45 rows; tail ending in a curved, claw-like scute; 5 smooth scales from eye to eye across the forehead.	*G. Muelleri*, Blgr.

XI.—*Descriptions of Three new* Gerbilles *in the British Museum Collection.* By OLDFIELD THOMAS.

Gerbillus calurus, sp. n.

Size medium. Ears rather large, laid forward they reach 1 millim. in front of the anterior canthus of the eye. Mammæ, as usual, 2—2=8. Palms naked, with the usual five pads, the two large basal ones subequal in size. Soles quite naked, the proximal halves smooth and shining, the distal halves very coarsely granulated and bearing six large and prominent pads. Tail considerably longer than the head and body, even without its terminal tuft of hairs; coarsely scaly, the rings of scales averaging about fourteen to the centimetre; thickly clothed all round with long coarse hairs 13 to 18 millim. in length from within an inch of its base to its tip, the whole tail being as bushy as in many Myoxidæ; its colour apparently has been a dark rich brown or black throughout its length, except at its tip, where the terminal half-inch is white or yellow.

Colour of the body apparently as usual in the genus, yellowish or rufous above and whitish below, but, like the colours of the tail, they must be taken with great reservation, as the only specimen is in a very bad condition and has been at least fifty years in spirit.

Skull with a long, slender muzzle, narrow interorbital region, large bullæ, whose posterior portion is much swollen and appears in an upper view of the skull, and projects posteriorly just beyond the level of the occipital bone.

Upper incisors bevelled, with a single deep groove. Molars of the type so worn that the three laminæ of $\underline{m^1}$ are connected by two central bridges; these two bridges are, however, not directly in front of one another, the anterior being at a markedly more internal level than the posterior. As far, however, as can be judged in the present state of wear, the teeth are decidedly those of *Gerbillus* (*s. s.*), and not of the *Meriones* section of the group. Laminæ as usual 3—2—1 both above and below; the last molar nearly circular in each case.

Dimensions of the type (an adult female in spirit):—Head and body 113 millim.; tail, without hairs, 152; hind foot 31; ear (above crown) 15.

Skull: basal length 31; greatest length, from tip of nasals to occiput, 37; greatest breadth, at anterior edge of auditory meatus, 19·6; zygomatic breadth 19·2; nasals, length 14·5, greatest breadth 3·4; interorbital breadth 5·7; interparietal, length 4, breadth 8·7; least distance between posterior portions of bullæ across occiput 7·9; length of anterior zygoma-root 5·5; palate, length 19·4, diastema 9·5, palatal foramina 6·8; length of upper molar series 5; greatest diameter of bullæ 14·5; greatest vertical height of brain-case and bulla combined 13·8.

Hab. Unknown.

The type specimen of this species has been in the Museum at least since 1837, and probably considerably longer, for about that date it was entered by Dr. Gray in the first manuscript list of the then Museum collection of rodents in spirit; and even then its history seems to have been already forgotten, as it is merely entered as "22. a. *Sciurus*," the localities, donors, &c. being in other cases entered in the same list. It is noteworthy that so distinct a species has never turned up since.

G. calurus is a most striking and remarkable species, differing from every other member of the group by its evenly bushy tail, which more resembles that of one of the larger Myoxidæ or smaller Sciuridæ than that of a Gerbille. This last resemblance is curiously exemplified by Dr. Gray's entry of the specimen already referred to. In addition only some three or four other species, and these quite small ones, half the size of *G. calurus*, have six posterior foot-pads. They are all African, and there is every probability that *G. calurus* also comes from that continent, as the Asiatic species all have palms and soles of quite a different character.

Gerbillus gracilis, sp. n.

Size rather small, form slender and graceful. Ears large, rounded, laid forward they reach to the anterior canthus of the eye. Palms and soles as in *G. indicus*, *leucogaster*, *afer*, and others, viz. naked, the palms granulated and with five pads, the soles smooth posteriorly, granulated anteriorly, and with four small pads. Tail slender, thinly hairy, but little pencilled terminally.

General colour above bright rich rufous, darker along the centre of the back, clearer and richer on the sides. Under surface from nose and cheeks to anus, forearms all round, hands and feet, white, the line of demarcation sharply marked.

Tail brown above, dull yellow on the sides and below; the lengthening of the upper brown hairs forming the usual crest and pencil commencing on the proximal third of the tail.

Skull narrow, but with rather a stout muzzle; its general form more Murine than Meriones-like, as the posterior part is narrow, and no part of the bullæ show in a vertical view of the skull. These latter are small, oval, and have their mastoid portion scarcely swollen at all.

Teeth: upper incisors very much bevelled, with a single deep groove. Molars markedly Gerbilline in the strictest sense, their laminæ low, separate from each other, and evidently each originally composed of two cusps, with the usual exceptions of the anterior lamina of the first and the posterior of the last molar.

Dimensions of the type (an adult male in spirit):—Head and body 92 millim.; tail 134; hind foot 29; ear 15·5.

Skull: basal length 25·5; greatest length from tip of nasals to occiput 32; zygomatic breadth 15·7; breadth at anterior edge of auditory meatus 14·9; nasals, length 12·4, greatest breadth 3·2; interorbital breadth 5·9; interparietal, length 4·4, breadth 8·5; length of anterior zygoma-root 5·1; palate, length 16·2, diastema 7·7, palatal foramina 5·0; length of upper molar series 5·1; greatest diameter of bulla 10; vertical height of brain-case and bulla combined 12·2.

Hab. Gambia.

Type specimen (85. 2. 2. 1) collected and presented to the Museum by Sir C. A. Moloney.

This pretty little species appears to be most nearly allied to *G. leucogaster*, Peters, which is found from Mozambique across to Angola, and to the Algerian *G. garamantis*, Lataste. The former of these, however, is considerably larger than *G. gracilis*, while the latter, besides being much smaller, has five instead of only four hind foot-pads.

Gerbillus Emini, sp. n.

Size slightly larger than in *G. gracilis*, markedly smaller than in the large species and larger than in the small ones described by Sundevall, Heuglin, and others from the same region.

Colour above a soft brownish fulvous, finely grizzled with black, paler on the sides. Lower surface, hands, and feet, as usual, pure white.

Tail longer than the head and body, brown above, pencilled with black terminally, orange-rufous on the sides and below. Palms and soles with the essential characters of those of *G. gracilis*, *leucogaster*, &c., *i. e.* naked, with five anterior and four posterior pads, but distinguished from all the species of this group by the fact that a band (about 4 millim. broad) of fine hairs passes across the soles at about the level of the base of the hallux. Skin of soles black.

Skull very much as in *G. gracilis*. Bullæ small, egg-shaped, their posterior part scarcely swollen.

Teeth: upper incisors much bevelled, each with one deep groove. Molars with the low, distinct, directly transverse laminæ characteristic of this group of Gerbilles.

Dimensions of the type (an adult specimen in skin):—Head and body 140 millim.; tail 155; hind foot 29.

Skull: basal length 30; greatest length 35; tympanic breadth 16·5; nasals, length 14, breadth 3·7; interorbital breadth 6; interparietal, length 4, breadth 8·5; palate, length 18·5, diastema 10, palatal foramen 6·1; length of upper molar series 5·2; greatest diameter of bullæ 10·4; vertical height of brain-case and bullæ combined 13·5.

Hab. Wadelai.

Type (87. 12. 1. 50) collected and presented by Dr. Emin Pasha.

A second specimen, collected at the same time and place, agrees in every respect with the type.

These two specimens were presented to the Museum with Emin Pasha's first collection (see P. Z. S. 1888, p. 10, no. 24). Turning out now to be new, it is only just that they should receive the name of their distinguished discoverer.

XII.—*The Mesozoon* Salinella. By Johannes Frenzel *.

It is a well-known fact that between unicellular and multicellular animals there hitherto stretched a gulf which was wider than that between the vegetable and animal kingdoms, for indeed the two latter, in spite of the advances which we have made in knowledge, are even to-day hardly separable from one another. The unicellular animals, usually comprised under the name Protozoa, and embracing besides many doubtful forms of the Protista, not only consist, as their name

* Translated from the 'Biologisches Centralblatt,' xi. Bd. no. 19 (October 15, 1891), pp. 577–581.

already implies, of a *single cell* which unites in itself all the various functions of an animal organism, but also assume quite a peculiar position in many other respects, especially with regard to development. In the systematic arrangement of the group we are even obliged, hard though it will be for every modern zoologist, to allow ourselves to be swayed by *physiological* considerations, since here the purely *morphological* and *embryological* foundations are insufficient; and we are even forced to exclude them, at any rate in general, from Häckel's fundamental principle of biogenesis, which is equally unsatisfactory.

The multicellular animals, on the other hand, are not mere aggregates of cells, such as, moreover, are not unknown among the Protista, but they permit us to distinguish, albeit frequently with difficulty, a structure consisting of *three layers*, in that in the simplest case they possess an *external* layer of cells, which provides for sensory perceptions &c., next a *median* supporting tissue, and finally an *internal* one, which discharges the function of nutrition, since it clothes a cavity which is known as the gastral chamber, alimentary canal, &c.

There is yet another by no means unimportant difference between unicellular and multicellular animals to which unfortunately far too little attention is paid, perhaps in consequence of the fact that it arises in the first place from physiological conditions only.

For if we disregard forms which exhibit holophytic nutrition, and therefore live like a lower form of plant, and further neglect the intestinal parasites, which in many cases, but not always, are able to absorb that which has already been digested by other animals, we find that the Protozoon cell receives its food *into itself*, digests it in its *interior*, and absorbs what is suitable. This is a so-called *intra-cellular* digestion, which in Metazoa, on the contrary, is only met with in isolated and exceptional cases; for in the latter *extra-cellular* digestion prevails, which is accomplished on the principle of "one for all and all for one," since all the participating cells to a certain extent throw their digestive ferments into a common pot, in which digestion proceeds, exactly as cooking is done in a kitchen for a large number of persons. It follows that *solid*, in part absolutely indigestible bodies, are no longer taken up by the cells, as we found to be the case in Protozoa, but only *fluid* substances in the shape of peptone, sugar, fat, &c. In consequence of this, those morphologically specially constructed organs for the acquisition of food, such as we meet with in the Protozoa in the form of pseudopodia, flagella, cilia, &c., are no longer necessary. We may rather regard absorption in the Metazoa as a purely *chemical* process, emanating from the living cells.

Now, should we desire to construct a multicellular animal from a number of Protozoa, *e. g.* from Ciliate Infusoria, we should consequently soon be confronted with a great physiological difficulty. We could indeed easily imitate the simplest Metazoon type, and so arrange the cells that they should surround a cavity possessing an incurrent opening. But how would nutrition proceed? The group of Protozoa would at all events obtain their food from the common cavity, but it would be directly introduced into the interior of the separate individuals, there digested, and so forth. It follows that in this construction of ours we should not get beyond a simple Protozoon colony, and should still be a long way from obtaining a typical Metazoon. For although among the Metazoa there are forms which possess intracellular digestion, we must nevertheless not forget that it is only the *endoderm* cells which can be concerned therein. But yet all the other tissues must be similarly nourished, and this is effected by their receiving already digested matters from the intestinal cells. Were we able therefore still to regard the latter at all events as Protozoon cells, this view would be absolutely inadmissible for the former, the cells of the mesoderm and ectoderm, and they must absorb in a manner similar to that of the intestinal cells which possess the power of extracellular digestion.

From the foregoing considerations it is not difficult to see that the multilamellar character of the Metazoa in itself entails the decisive difference which separates them from the Protozoa, and, further, that the multicellular character, as such, is insufficient to bridge over the deep gulf between the two principal groups of the animal kingdom.

It is well known that the title Mesozoa has already been bestowed upon organisms which it must be confessed are strange enough, and which rendered the justification of the term not improbable. But the position of the Orthonectids and Dicyemids is nevertheless an extremely doubtful one, and points more to an affinity with the worms. The genus *Trichoplax*, moreover, has been with good reason assigned to the Metazoa by Fr. Schulze; for although its conditions of nutrition may be regarded as being still very obscure, nevertheless it has not been possible to determine that its digestive processes are intracellular.

It thus came to pass that the group Mesozoa once more disappeared from the scene. I therefore consider that I am entitled to regard the chance as a lucky one which enabled me to discover, in a solution of salt obtained from a salt-pit in the province of Cordova, in the Argentine Republic, a microscopic animal, which, being a combination of a number of cells to form a single organism, cannot be regarded as a Protozoon; while, on the other hand, since it exhibits only a single layer of cells, it cannot be termed a Metazoon, although the digestive processes follow the Metazoon type.

It follows that we are here confronted with the first and only example of a connecting-link between Protozoa and Metazoa.

Salinella, as I have named this new animal, is a multicellular organism in which the elementary organisms of which it is composed have so completely renounced their independence, that there has been developed an animal possessing a mid-gut as it were, an animal the intestinal epithelium of which is composed of typical mid-gut cells. Whether, nevertheless, there was in this case originally a colony of Infusoria, which have gradually become transformed, is a question which it is absolutely impossible to decide in any way whatever; for unfortunately one of the most material aids to demonstration, *i. e.* a knowledge of the development, is so far wanting. I have so far only met with larvæ, which are certainly *unicellular*, and moreover have an *intracellular* digestion, exactly like a true Ciliate. The external structure of these larvæ is, however, of so peculiar a character, in the possession of ventral cilia, dorsal setæ, &c., that we are bound at once to recognize their connexion with *Salinella*, and are inclined to conclude that development is thoroughly direct. This nevertheless leaves a difficulty of considerable importance to be surmounted, in that the transition from the *single cell with intracellular* digestion to the *adult animal with extracellular digestion* is enigmatical and completely unexplained.

Were we to attempt to construct our *Salinella* from an aggregate of Ciliate Infusoria, we should obtain, as we already know, merely a *Protozoon colony*. It would then be further necessary to induce the individual elementary organisms to close their mouths, empty their digestive ferments into the common cavity of the intestine, and absorb the digested matter. This would, however, constitute a highly complicated developmental process, to which there scarcely exists anything analogous.

As a matter of fact moreover Nature appears to have followed a different path; for an observation, which unfortunately could not be further continued in consequence of an unlucky accident, points to the fact that within the larval cell, by means of a kind of endogenous cell-formation upon the body-wall, new and much smaller cells arise, leaving a cavity in the interior which probably subsequently becomes the intestinal canal. This process is ushered in by a splitting of the nucleus into two, which is indeed to be regarded as an indirect division, but which differs materially from mitosis. Further segments are subsequently produced, which then pass to the periphery of the larval cell. What afterwards happens I was unfortunately unable to observe. Probably, however, as already stated, a cell is formed round each of those nuclei —ventral cells on the ciliated ventral side of the larva, dorsal cells on the dorsal side, which is beset with setæ, and so on. Simultaneously an oral opening must be developed at the anterior pole and an anal opening posteriorly, and likewise a coating of cilia on the inner side of the young cells. With this the fully-developed animal would then be constituted, and the original digestive cavity of the unicellular larva, which, indeed, is filled with endoplasm and is not hollow, would have passed into the alimentary canal, which for its part is now free from such contents.

It appears to me that this last circumstance becomes of quite critical importance; for were the intestine also to contain a (digestive) plasma, this must be of a cellular nature, and must, since particles of food are taken in, digest by the *intracellular* method. But then a multilamellar structure also would be already in existence.

I have already published a preliminary communication upon the structure of *Salinella**, and have recently sent to the press a detailed paper upon the subject. I may be permitted to refer the reader to the latter for particulars, since here it was only intended specially to indicate the closeness of the relations between *Salinella* and the Metazoa from the point of view of physiology, and to show that it must not be regarded offhand as having arisen from a Protozoon colony, although its larval form indeed looks just like a Ciliated Infusorian; for it is precisely the further development of this larva, incomplete though my study of it was, which proves that it does not develop into the perfect animal by means of ordinary division, much as a colony is formed from a single Choanoflagellate, but by a far more complicated process, which we may most fitly term endogenous cell-formation.

In conclusion, it is for the present pretty much a matter of indifference whether we assign *Salinella* to the Protozoa or to the Metazoa, or introduce it between the two as a Mesozoon, where its position will be quite as disconnected as that

* Zool. Anzeiger, 1891, no. 367, p. 230 *et seqq.* See p. 109.

of *Amphioxus* in the series of higher animals. Nevertheless, that it constitutes an actual transition between the two great groups of the animal kingdom can be asserted of it equally as little as of an Orthonectid or of *Trichoplax*; for indeed we have here isolated links before us for which we cannot find a place in our system, beautifully and ingeniously constructed though it is, and which tend to prove how little Nature is amenable to a dogmatic treatment on our part, a treatment which unfortunately appears to take the upper hand too much in the biological sciences, and which would gladly exclude everything which does not fit into its narrow frames.

XIII.—*Descriptions of Seven new Species of Terrestrial Mollusca from South Africa.* By James Cosmo Melvill, M.A., F.L.S., and John Henry Ponsonby, F.Z.S.

[Plates IV. & VI.]

1. *Helix* (*Pella*) *trichosteiroma*, sp. n. (Pl. IV. fig. 9.)

H. testa angustissime sed profunde umbilicata, corneo-fusca, convexiuscula, sublævi, longitudinaliter oblique tenuistriata, undique lirulis spiralibus minutissime decussata: anfractibus quinque, ultimo in medio carinato, carina capillis brevibus accincta; apertura lunari-ovata; peristomate simplici ad marginem columellarem reflexo.

Long. 5·50, lat. 7·50 mill.

Hab. Port Elizabeth, S. Africa.

Judging from the description of *Helix petrobia* (Benson), recorded from High Constantia, Cape of Good Hope, but of which we have not been able to examine the type, the species under discussion would seem to differ chiefly in the acutely angled keel, fringed with regular, short, epidermal hairs, also in the form being more convex, colour dull brown, with no fulvous tinge, and other minor distinctions.

2. *Helix* (*Pella*) *epetrima*, sp. n. (Pl. IV. fig. 3.)

H. testa anguste umbilicata, depressa, tenui, cornea, subpellucida, undique confertim striatula, striis obliquis regularibus, spira depresso-convexa; anfractibus quatuor, convexiusculis, ad suturas impressis, ultimo anfractu rapide accrescente; apertura lunati,

peristomate simplici, acuto, ad marginem columellarem breviter triangulatim reflexo.
Long. 3, lat. 4·50 mill.

Hab. Somerset District, S. Africa.

Allied to *H. bisculpta* (Benson), from which this little species differs in its whorls being more discoid, greater depression of spire, and smaller size; the system of sculpture, so far as the closely ranged longitudinal striæ are concerned, though apparently identical, is found upon examination with a strong lens to be far more clearly and finely developed in *H. bisculpta*, the striæ in that species looking like finely cut serrations round the edge of the periphery, while in *H. epetrima* they are barely perceptible and the edge of the shell looks ragged in comparison.

3. *Helix* (*Pella*) *lygæa*, sp. n. (Pl. IV. fig. 7.)

H. testa profunde sed anguste umbilicata, cornea, tenui; spira depresso-conoidea; anfractibus sex (ultimo acuti-carinato), undique confertim regulariter obliquistriatis; apertura lunari; peristomate simplici, ad basin reflexo, et ad marginem columellarem laminam triangularem formante.
Long. 7, lat. 12 mill.

Hab. Natal (*Lightfoot*).

A conspicuous species, but one which we have not seen in good live condition. It is of the same horny and striated character of whorl as the last two species, much resembling *H. lens* (Fér.) in miniature, but the outer lip is not so strongly expanded nor developed as in that species.

4. *Stenogyra cacuminata*, sp. n. (Pl. VI. fig. 2.)

S. testa acute turrita, gracili, pellucida, albo-cornea, undique lævissima, nitida; anfractibus decem, ultimis quinque fere uniformibus, ad apicem sensim gradatulis, apice quasi-papillari; apertura ovata; peristomate simplici, acuto.
Long. 21, lat. 5 mill.

Hab. Bedford (*Farquhar*).

A remarkably delicate, shining, pellucid shell, differing from all the species of the genus hitherto described, though its characters are simple enough.

5. *Ennea thelodonta*, sp. n. (Pl. VI. fig. 4.)

E. testa subrimata, breviter cylindriformi, obtusa, albo-cornea, nitida, tenuissime et regulariter obliquistriata; anfractibus sex, prope apicem obtusatis, infra cylindraceis; apertura ovato-oblonga, labro reflexo, albo-nitente, quadriplicato, plica parietali magna acinaciformi, producta valide intrante, plica labiali nitida, magna, interdum haud æque bidentata, basali simplici, minore, interna subtus marginem columellarem mammæformi.

Long. 4, lat. 2 mill.

Hab. Noord Hock (*Langley*) and Monk's Kloof.

An extremely beautiful small species, of horny-white colour, bluntly cylindrical; mouth ovate-oblong, slightly produced, the lip shining white, thick, much reflexed, with four plaits; of these the parietal and labial are very large, shining white, the basal smaller and simple, the internal tooth below the columellar margin being shining white and roundly nipple-shaped. This species seems widely distributed and variable; we have been able to examine a considerable number of individuals.

6. *Ennea munita*, sp. n. (Pl. VI. fig. 5.)

E. testa subrimata, brevi, cylindriformi, minuta, obtusa, tenui, corneo-fuscescente, ad suturas impressa, confertim regulariter argute striata; anfractibus sex, ad apicem duobus brevibus, compressulis, tribus uniformibus, ventricosis, ultimo ad basin producto; apertura oblonga, auriculæformi, constrictissima, labro crasso, albo-nitente, subreflexo, extus scrobiculato, triplicato, plica parietali magna valide intrante, labiali magna crassa, interdum bifurcata, basali minore, margine columellari intus dentato, multum incrassato.

Long. 3·50, lat. 1·50 mill.

Hab. Griqualand East (*E. R. Sykes*).

A smaller species even than the last, to which it possesses many points of similarity, but the nearly closed, very narrowly auricular mouth, with shining white and unusually thickened subreflexed lip, and prominent plicæ amply distinguish it.

7. *Ennea dolichoskia*, sp. n. (Pl. VI. fig. 6.)

E. testa oblongata, cylindracea, pellucide ochracea, subnitente, undique confertim obliquistriata; anfractibus septem, duobus ad apicem brevissimis, tertio et sequentibus lente accrescentibus, ultimo ad basin prolongato; apertura parva, labro albo-nitido, crassiusculo, quadriplicato, plica parietali conspicua, multum intrante, labiali prominente, basali simplici, minore, quarta interna subtus marginem columellarem variabili, interdum mammæformi.

Long. 5, lat. 2 mill.

Hab. Near Port Elizabeth (*Langley*).

A very similar shell to *E. thelodonta*, differing in being composed of more whorls, namely seven, as against six, greater attenuation of build, and feebler development of lip, though the various plicæ are arranged as those of the above-mentioned species. It is never difficult, however, to distinguish them.

XIV.—*Descriptions of Seventeen new Terrestrial Mollusks from South or Central Africa, in the Collection of Edgar L. Layard, Esq.* By JAMES COSMO MELVILL, M.A., F.L.S., and JOHN HENRY PONSONBY, F.Z.S.

[Plates IV.–VI.]

THE seventeen species which form the subject of the present paper are from the collection of Mr. Edgar L. Layard, who has most kindly placed them at our disposal for description.

1. *Nanina hypochlora*, sp. n. (Pl. IV. fig. 8.)

N. testa imperforata, effusa, pallide stramineo-cornea, vitrea, lævi, nitida; anfractibus quinque, planato-depressis, ultimo rapide accrescente; apertura ovata; peristomate simplici, tenui.
Long. 4·50, lat. 12 mill.

Hab. Cape of Good Hope (*Edgar L. Layard*).

A plain, smooth, shining, and delicate little species, somewhat flattened, the last whorl much the largest, lip thin, aperture ovate.

Though of simple character it does not appear to have been previously noticed or described. Two specimens, precisely similar.

2. *Helix* (*Pella*) *rhysodes*, sp. n. (Pl. IV. fig. 2.)

H. testa profunde sed anguste umbilicata, tenui, depresso-convexa, corneo-fuscescente, ad apicem planato-depressa; anfractibus quinque, apud suturas compressis, undique longitudinaliter liris albulis irregularibus oblique cinctis, ultimo anfractu ad medium vix angulato; apertura lunari-ovata; peristomate simplici, tenui, ad marginem columellarem reflexo.
Long. 4, lat. 6 mill.

Hab. "S. Africa" (*E. L. Layard*).

Unfortunately Mr. Layard has no record of the precise habitat of this little species, of which there are three specimens, two being hardly full-grown, and consequently smaller than that selected for the type. It falls under the "*bisculpta*" section of *Pella*, considered typical in Tryon's Manual, while it is there mentioned that the name "*Sheldonia*" has been employed by Ancey (1887) for such species as *natalensis*, *Trotteriana*, and *cotyledonis*.

H. rhysodes is thin, horny, fuscous, five-whorled, with white oblique liræ longitudinally crossing, somewhat irregularly, there being here and there small spaces left quite clear and free; and the shell presents a wrinkled appearance in consequence. The umbilicus is deep, but narrow; mouth lunar-ovate, lip a little reflexed at the columellar margin.

3. *Helix* (*Pella*) *tuguriolum*, sp. n. (Pl. V. fig. 5.)

H. testa obtecte umbilicata, tenui, albo-cornea, subplanata, infra ventricosa; anfractibus quinque, longitudinaliter indistinctissime striatis, transversim tenuiter et minute concentrico-decussatis; apertura lunari-ovata; peristomate simplici, ad marginem columellarem paullo reflexo.

Long. 6 (sp. majoris), lat. 8·50 mill.

Hab. "S. Africa" (*E. L. Layard*).

Three specimens, of which two are perfect. A plain, smoothish, horny shell, bearing indistinct lines of longitudinal ribbing (when closely examined with a lens), very minutely decussated by spiral striæ. Allied to *H. Lovéni* (Krauss), represented by only a poor specimen in the National Collection, South Kensington, from which this species seems to differ chiefly in the absence of any keel at the periphery, and likewise in there being no sign of epidermis, which in *H. Lovéni* adheres to the ribs and renders them more conspicuous.

4. *Helix* (*Pella*) *crateina*, sp. n. (Pl. V. fig. 3.)

H. testa profunde sed anguste umbilicata, lenticulari, depresso-conica; anfractibus quinque, cinereis, undique confertim costulis lamellosis regularibus oblique cinctis, flammisque rufis longitudinaliter decoratis, ad suturas quasi-crenulatis, anfractu ultimo apud peripheriam serri-carinato; apertura subquadrata; peristomate simplici, ad marginem columellarem paullum reflexo.

Long. 2·25, lat. 3 mill.

Hab. Bredasdorp, in sand under stones; and Cape Point (*E. L. Layard*).

A most elegant and beautiful little shell, found, as noticed above, by Mr. Layard in two localities; we have taken the

Bredasdorp specimen as the type. Though minute, the sculpture is most elaborate, with fine oblique lirulæ extending over the entire surface. The umbilicus is deep, though narrow, last whorl serrately keeled, aperture somewhat square, lip simple.

We provisionally place this species under *Pella* on account of its similarity of texture to *H. bisculpta* (Benson) and allies; but there can be no doubt but that in some respects it approaches the subgenus *Martensia* (Semper).

5. *Helix* (*Pella*) *bathycale*, sp. n. (Pl. V. fig. 4.)

H. testa minuta, profundissime umbilicata, tenui, corneo-virente, planorbiformi, apice fere immerso; anfractibus sex, convexis, ad suturas impressis, liris regularibus longitudinaliter undique cinctis, anfractu ultimo rapide accrescente, infra effusa; peristomate tenui, simplici; apertura lunari.

Long. 1·50, lat. 2·50 mill.

Hab. Under dead leaves in the bush, Craigie Burn, Somerset East, S. Africa (*Miss Mary Layard Bowker*).

Another very lovely species, though minute, and conspicuous for its flattened upper whorls as well as its deep perspective umbilicus, the whole surface of the greenish-horny shell being decorated with fine longitudinal regular liræ.

Five specimens.

6. *Helix* (*Trochozonites*) *dioryx*, sp. n. (Pl. V. fig. 2.)

H. testa conico-pyramidali, obtecte umbilicata, ad basin planato-convexa, trochiformi, opaca, albo-grisea, scrupulosa, epidermide brunnea tecta; anfractibus septem, infra suturas canaliculatis, costulis rugulosis regulariter oblique dispositis, ultimo ad peripheriam carinato; apertura quadrata; peristomate tenui, simplici, apud marginem columellarem paullum reflexo.

Long. 7, lat. 6 mill.

Hab. On sand-dunes, Robbe Bay, S. Africa (*E. L. Layard*).

Allied to *H. Folini* (Morelet), from W. Africa. The shell is pyramidal, with conical apex, seven-whorled, the whorls being very deeply transversely channelled just below the sutures and covered with a brownish epidermis. There are rough wrinkled liræ or riblets at regular distances longitudinally crossing the whorls, the mouth being simple, with slight columellar marginal reflexion.

7. *Buliminus Layardi*, sp. n. (Pl. V. fig. 11.)

B. testa imperforata, solidiuscula, lævi, ovato-pyramidali, apice obtuso; anfractibus octo, subventricosis, et ad suturas compressis, flammis brunneis hic illic longitudinaliter depictis; apertura oblonga, fauce pallida; peristomate subexpanso, solidiusculo, ad marginem columellarem late reflexo.
Long. 12, lat. 6 mill.

Hab Kobis (*E. L. Layard*).

This seems to us to differ from *B. Burchelli* (Gray) in the smaller size, want of umbilication, greater reflexion of columella, less ventricose whorls, and more vivid painting. Mr. Layard remarks that one of his three specimens shows a rather solid epiphragm *in situ*, which would seem to indicate æstivation at one period of the year.

8. *Buliminus quisqualis*, sp. n. (Pl. V. fig. 10.)

B. testa ovato-oblonga, obtecte umbilicata, candide nitente, pellucida, spiræ suturis subimpressis, apice obtuso; anfractibus sex, ventricosulis; apertura parva, oblonga, labro simplici, paullo ad basin marginis columellaris reflexo.
Long. 7·25, lat. 3·50 mill.

Hab. Moçambie (*E. L. Layard*).

A small white, subpellucid, little species, with somewhat of the aspect of a *Stenogyra*.

9. *Buliminus lamoensis*, sp. n. (Pl. V. fig. 12.)

B. testa oblongo-turrita, obtecte umbilicata, cornea, subopaca, apice obtuso; anfractibus octo longitudinaliter confertim crasse obliquistriatis; apertura fere oblonga, labro simplici.
Long. 12, lat. 4·50 mill.

Hab. Lamo, E. Africa (*E. L. Layard*).

Very like a *Stenogyra*, being a simply formed, somewhat plain, turreted shell.

10. *Stenogyra Chapmani*, sp. n. (Pl. VI. fig. 3.)

S. testa gracillima, tenui, candida, aciculari, elongato-turrita; anfractibus novem, ad suturas gradatulis, binis ad apicem effusis, longitudinaliter oblique striatis, ultimo oblongo, recto, columella truncata; apertura oblongo-ovata; peristomate simplici, tenui.
Long. 9·50, lat. 2·25 mill.

Hab. Ovampo-land, collected by the late Mr. Chapman (*E. L. Layard*).

An extremely pretty though very small shell, of which the three specimens in Mr. Layard's collection are all more or less imperfect. They bear a decided superficial resemblance to certain marine forms of the genus *Chemnitzia*, the shell being very delicate, white, eight- or nine-whorled, the whorls gradated at the sutures and longitudinally finely ribbed with raised striæ.

11. *Cionella ovampoensis*, sp. n. (Pl. VI. fig. 1.)

C. testa parva, aciculari, candida, tenuissima, apice obtuso; anfractibus quatuor, ultimo producto, columella ad basin truncata; apertura oblonga, labro simplici.

Long. 3, lat. 1 mill.

Hab. Ovampo-land (*E. L. Layard*).

A very elegant, pure white, four-whorled shell, with very obtuse apex, a little recalling the *Cæcilianella acicula* (Müll.) of Europe and the British Isles.

12. *Pupa elizabethensis*, sp. n. (Pl. V. fig. 13.)

P. testa minuta, aperte rimata, vitrea, albo-nitente, breviter cylindrica; anfractibus septem, lævibus subventricosis, minutissime sub lente striatulis; apertura rotundata, plicis duabus intrantibus munita, altera parietali, altera columellari valde intrante; peristomate paullum reflexo.

Long. 3, lat. 1·20 mill.

Hab. Port Elizabeth (*Miss Glanville*).

This little *Pupa* is a shining, white, smooth species; with a strong magnifier the slightly ventricose whorls are found to be closely and finely striated; the mouth is furnished with two teeth-plaits, both deep-seated and extending far back, one parietal, the other behind the columellar margin; the lip is also slightly reflexed.

Four specimens.

13. *Pupa ovampoensis*, sp. n. (Pl. VI. fig. 11.)

P. testa rimata, prolongato-cylindrica, alba, tenui; anfractibus quinque, ventricosis; apertura subquadrata; peristomate effuso, dentibus duobus munito, altero parietali, altero subtus marginem columellarem intrante.

Long. 2, lat. 1 mill.

Hab. Ovampo-land (*E. L. Layard*).

A very neat though minute species, with conspicuously swollen whorls; the effuse lip furnished with two deeply-seated plaited teeth, one parietal, the other columellar.

14. *Ennea Bowkeræ*, sp. n. (Pl. VI. fig. 9.)

E. testa minuta, rimata, cylindrica, albescente, subpellucida; anfractibus septem, longitudinaliter undique confertim oblique tenuistriatis, anfractu ultimo extus scrobiculato; apertura callosa, trigono-ovata; peristomate tribus dentibus munito, altero valido parietali, altero incrassato labiali, tertio minore basali, subtusque marginem columellarem ad imam faucem plica interna aditum fere claudente.

Long. 3, lat. 1·25 mill.

Hab. East London (*Miss Mary L. Bowker*).

A very small shell, but very wonderful in its symmetry, and complicated as regards its orifice. It is seven-whorled, cylindrical, the whorls being uniformly densely striated; mouth somewhat triangular, furnished with three teeth, of which, firstly, a large and projecting parietal tooth is conspicuous, and also another on the inner thickened edge of the outer lip; a smaller and simple basal one completes the prominences of the peristome, but a large callous plait below the columellar margin almost serves to close the throat completely.

Four specimens, but only one in good condition.

15. *Ennea Mariæ*, sp. n. (Pl. VI. fig. 12.)

E. testa rimata, breviter cylindriformi, vitrea, lævi; anfractibus sex, ad apicem obtusissimis, lævibus, linea transversim infra suturas circumambiente; apertura trigono-ovata; peristomate dentibus quatuor instructo, uno parietali, secundo labiali bifurcato, tertio minuto basali, quarto ad marginem columellarem et intra valde ad imam faucem penetrante.

Long. 2·75, lat. 1 mill.

Hab. Under decayed leaves, Craigie Burn, Somerset East, S. Africa (*Miss Mary L. Bowker*).

A very pretty little shining cylindrical species, quite plain and smooth, save for a transverse, compressed, sulcated line encircling the whorls a little below the sutures and running parallel with them. The mouth is furnished with four teeth, one parietal, one on the inner edge of the thickened outer lip, a very small one at the base, and a fourth at the columellar margin, which joins on to a large internal plait which well nigh closes the throat below.

Four specimens, all in good condition and precisely similar.

We have much pleasure in associating the name of Mr. Layard's god-daughter, Miss Mary Layard Bowker, with both this and the preceding species, both having been discovered by her, and, as far as we can ascertain, found by her alone.

16. *Ennea aperostoma*, sp. n. (Pl. VI. fig. 10.)

E. testa parum rimata, cylindrica, albo-cinerea, pellucente; anfractibus septem, ad apicem compressulis, obtusis apud suturas impressis, striis obliquis undique longitudinaliter instructis; apertura ovato-auriformi; peristomate crassiusculo, triplicato, plica parietali columellarique utraque prolongata, valida, profunde intrante, labro intus tridentato.
Long. 8·75, lat. 3·50 mill.

Hab. Natal (*E. L. Layard*).

Allied to *E. Wahlbergi* (Pfr.). There are three specimens on the tablet in Mr. Layard's collection, of which we have taken that with the whorls delicately obliquely striated as the type. The other two are quite smooth, and we would designate these as var. *lissophanes*, which seems in other respects to agree with the type. This species is at once distinguished from any others of the genus described in this or our former paper ('Annals,' Sept. 1891) by the comparatively open character of the mouth. This is ovately auriform; the parietal plait is well developed; the columellar tooth is broad, flat, and enters deeply into the shell; there is a small tooth at the base and the outer lip is furnished with a raised callus from which spring two teeth, the lower one small, the upper one larger and entering more deeply.

17. *Ennea scrobiculata*, sp. n. (Pl. VI. fig. 8.)

E. testa rimata, breviter cylindrica, albo-cinerea, subdiaphana; anfractibus novem, tribus ad apicem gradatim decrescentibus, quatuor his proximis fere uniformibus, duobus ultimis majoribus, omnibus striis obliquis confertim longitudinaliter decoratis, anfractu ultimo extus multum scrobiculato et prolongato; apertura trigona; peristomate incrassato, plica parietali magna, columellari valde intrante et ad imam faucem fere omnino aditum claudente, dente labiali patulo.
Long. 5·75, lat. 2 mill.

Hab. Natal (*E. L. Layard*).

This shell is queried by Mr. Layard as appertaining to *E. Kraussi* (Pfr.). It is an extremely interesting little species, owing to the attenuated constriction behind the outer lip; the mouth is well furnished with plicæ and teeth large in proportion to the orifice, so that the inner throat of the shell at some little distance down appears almost closed.

Three specimens, of which two are in good condition.

We take this opportunity of correcting two errors that have appeared. In our paper in Ann. & Mag. Nat. Hist. for Sept. 1891 the dimensions of *Cyclostoma transvaalense* should have been long. 12, lat. 11½ mill. In the same paper it will be noticed that there is a discrepancy between the number of teeth in *Vertigo thaumasta* as stated in the Latin and the English text. The former is correct, for it will be seen on reference to the plate that the shell has *three* teeth.

EXPLANATION OF THE PLATES.

Plate IV.

Fig. 1. *Helix viridescens* †.
Fig. 2. —— *rhysodes.*
Fig. 3. —— *epetrima.*
Fig. 4. —— *Crawfordi* *.
Fig. 5. —— *pretoriensis* *.
Fig. 6. —— *hottentota* †.
Fig. 7. *Helix lygæa.*
Fig. 8. —— *hypochlora.*
Fig. 9. —— *trichosteiroma.*
Fig. 10. —— *gypsina* †.
Fig. 11. —— *porphyrostoma* †.
Fig. 12. —— *namaquensis* †.

Plate V.

Fig. 1. *Helix liricostata* †.
Fig. 2. —— *dioryx.*
Fig. 3. —— *erateina.*
Fig. 4. —— *bathycœle.*
Fig. 5. —— *tuguriolum.*
Fig. 6. *Cyclostoma transvaalense* †.
Fig. 7. *Pisidium Langleyanum* †.
Fig. 8. *Vitrina cingulata* *.
Fig. 9. —— *zonamydra* *.
Fig. 10. *Buliminus quisqualis.*
Fig. 11. —— *Layardi.*
Fig. 12. —— *lamoensis.*
Fig. 13. *Pupa elizabethensis.*

Plate VI.

Fig. 1. *Cionella ovampoensis.*
Fig. 2. *Stenogyra cacuminata.*
Fig. 3. —— *Chapmani.*
Fig. 4. *Ennea thelodonta.*
Fig. 5. —— *munita.*
Fig. 6. —— *dolichoskia.*
Fig. 7. *Vertigo thaumasta* †.
Fig. 8. *Ennea scrobiculata.*
Fig. 9. —— *Bowkeræ.*
Fig. 10. —— *aperostoma.*
Fig. 11. *Pupa ovampoensis.*
Fig. 12. *Ennea Mariæ.*

* Described in the 'Annals' for Dec. 1890.
† Ditto for Sept. 1891.

XV.—*On the Skeleton of a Chimæroid Fish* (Ischyodus) *from the Oxford Clay of Christian Malford, Wiltshire.* By A. Smith Woodward, F.G.S.

Of the later Jurassic Chimæroid fishes several skeletons have been discovered in a good state of preservation in the Bavarian Lithographic Stone (Lower Kimmeridgian) *. In

* *Ischyodus avitus*: *Chimæra* (*Ganodus*) *avita*, H. von Meyer, Palæontogr. vol. x. (1862), p. 87, pl. xii.—*Ischyodus Quenstedti*, A. Wagner, Abh.

Britain, however, such fossils have hitherto remained unknown, and Chimæroid fishes have been recorded solely on the evidence of detached teeth and spines. At last a single specimen, comparable in many respects with the Bavarian material, is forthcoming for discussion; and this forms the subject of the following notes. The writer observed the fossil during a recent visit to the Northampton Museum, and is indebted to the kindness of Mr. T. J. George, F.G.S., Curator, and the Committee of the Museum, for the opportunity of making a detailed study of the characters of the specimen.

The fossil is displayed on a small slab of hard clay from the Oxfordian series of Christian Malford, near Chippenham, Wiltshire, and was evidently obtained from the same horizon as that already well known to yield species of *Lepidotus*, *Aspidorhynchus*, and *Leptolepis* *. The skeleton is apparently that of a laterally-compressed fish, being shown in side-view; and the cartilages seem to have been very slightly calcified. The total length of the original fish probably did not exceed 0·32 m., and its maximum depth would be about 0·045.

The rostrum is unfortunately wanting and the cartilages of the head are too much crushed and obscured for determination. Moreover the dentition is too imperfectly displayed to decide whether the species is truly referable to *Ischyodus* or to *Ganodus*; but as the latter genus has never been obtained above the Lower Oolites, the specimen may be most probably assigned to *Ischyodus*. The left palatine and vomerine dental plates are shown from the external aspect, the latter of the quadrate shape characterizing these plates in *Ischyodus*. The greater part of the left mandibular plate is also exposed from the outer face, showing the deeply sinuous oral border; and the corresponding element on the right side projects in front, showing the very narrow symphysis. The individual being a male, a large rostral spine occurs on the top of the head, with a cluster of scattered dermal hooklets below. The base of this spine forms a triangular expansion, with a faint median crest on the inferior attached face; and the proximal

math.-phys. Cl. k. bay. Akad. Wiss. vol. ix. (1862), p. 286, pl. i. fig. 1, and J. Riess, Palæontogr. vol. xxxiv. (1887), p. 6, pl. i. figs. 1–5, pl. ii. figs. 1–7.—*Chimæropsis paradoxa*, K. A. von Zittel, Handb. Palæont. vol. iii. (1887), p. 114, fig. 126, and J. Riess, *loc. cit.* p. 21, pl. ii. figs. 9–11, pl. iii. figs. 1–10.

* Sir P. Egerton, "On some new Species of Fossil Fish from the Oxford Clay at Christian Malford," Quart. Journ. Geol. Soc. vol. i. (1845), pp. 229–232.

end of the comparatively slender exserted portion is laterally compressed, though apparently expanding again at the distal end, where it is much broken. The denticles originally clustered upon this spine are very slender, pointed, sigmoidally bent, and fixed upon expanded bases.

The vertebral column consists, as usual, of a closely arranged series of delicate calcified rings, of which five in the abdominal region occupy a length of 0·0035 and measure 0·004 in vertical diameter.

Of the appendicular skeleton both the pectoral and pelvic arches are too imperfectly preserved for description; but the elongated claspers are faintly shown, and these do not appear to have been provided with dermal hooklets or spines. A single denticle resting upon the pelvic cartilage may well have been displaced from the group on the head.

The dorsal fin-spine, which measures 0·057 in length, is remarkably slender and only slightly arched. The small supporting cartilage is conspicuous at its base. In form and proportions, and even in the restricted anterior area of the superficial striations, it agrees precisely with the small spines from the Stonesfield Slate described as *Leptacanthus semistriatus* *, and, if found at a Lower Oolitic horizon, would be thus named without hesitation. In Elasmobranch and Chimæroid fishes, however, the characters of the dorsal fin-spines are often unreliable and insufficient for specific, or even generic, determinations.

No traces of calcified rings in the "lateral line" system or of dermal tubercles are exhibited; but the absence at least of the former is probably due to their loss in the extrication of the fossil from the matrix.

In conclusion, the Oxfordian fossil now described tends further to confirm the reference of the *Ischyodus*-like fishes to the existing family of Chimæridæ, and a peculiar form of "*Leptacanthus*," already assumed on theoretical grounds to pertain to *Ganodus* †, is definitely proved to be at least Chimæroid. The impossibility of observing the oral surface of the dental plates prevents, as already remarked, any satisfactory determination; but the external aspect of the dentition so closely resembles that of the well-known Upper-Jurassic species *Ischyodus Egertoni* ‡ that, until further evidence is discovered, the Christian Malford fossil may be provisionally quoted as an immature example of that form.

* L. Agassiz, Rech. Poiss. Foss. vol. iii. (1837), p. 28, pl. vii. figs. 3–8.
† Woodward and Sherborn, Cat. Brit. Foss. Vertebrata (1890), p. 114.
‡ L. Agassiz, *tom. cit.* p. 340, pl. xl. *c.* figs. 1–10.

XVI.—*Descriptions of new Species of* Eratina *from Tropical South America.* By Herbert Druce, F.L.S. &c.

Lately having had occasion to arrange the genus *Eratina* and allied groups for the 'Biologia,' I find that I have a large number of undescribed species in my collection from various localities in tropical South America, many of them from Ecuador collected by the late Mr. Buckley, to which are added those received from other collectors during the past few years. The species have all been compared with the types in the National Museum and those in the Saunders collection now in the Oxford Museum.

I believe it will be necessary to divide the genus at some future time when more material is available for examination; but at present many of the species are so rare that it is impossible to do so.

Eratina artemisia, sp. n.

Male.—Primaries dark brown, the basal half the palest; a curved white band crosses the wing beyond the middle very similar in shape to one crossing the primaries in *E. undulata*, but considerably wider: secondaries dusky white, broadly bordered with blackish brown, the fringe black, with four white spots on the outer side and one on the inner margin just above the anal angle. The underside of the primaries pale yellowish brown, with the line crossing the wing much more extended, reaching from the costal margin to the inner margin close to the anal angle; a large silky white patch extends from the base nearly to the white line; a small white line at the end of the cell and a round white spot in the cell nearer the base: secondaries greyish white, irrorated with yellowish-brown scales, the outer margin broadly bordered with yellowish brown; the fringes as above. The head, antennæ, thorax, and abdomen dark brown, the latter banded with fine white lines, the anal tuft yellow; the legs, underside of the thorax, and abdomen greyish white.

Female.—Primaries very like those of the male, but shaded with reddish brown on each side of the white line and broadly on the inner margin: the secondaries differ from those of the male in being almost uniformly dusky brown, with a very faint, zigzag, greyish-white line extending from the costal margin to the inner margin. The underside is very similar to the male, but considerably more red in colour.

Expanse, ♂ $1\frac{3}{4}$, ♀ 2 inches.

Hab. Ecuador, Intij, Sarayacu, Chiguinda (*Buckley, Mus. Druce*).

This species is allied to *E. goniuris*, Feld. & Rog.

Eratina mecyra, sp. n.

Male.—Primaries blackish brown, crossed beyond the middle by a semihyaline yellowish-white band that does not reach the costal or inner margin; the fringe brownish black: secondaries brownish black, darkest round the outer margin; a narrow yellowish-white line extends from near the apex of the costal margin almost to the anal angle; the fringe alternately yellowish white and brown. The underside of the primaries reddish brown, streaked with yellow and reddish brown at the base, the yellowish-white band more distinct than above, and a submarginal white line extending from near the apex to the anal angle: secondaries white, streaked with red and yellow, the outer margin dark brown, the fringe the same as above. The head, thorax, and abdomen above dark brown, the latter white on the underside and banded with very narrow yellow lines; the antennæ brown and the legs greyish brown.

Expanse $1\frac{3}{4}$ inch.

Hab. Colombia, Antioquia, Frontino (*Salmon, Mus. Druce*).

Eratina rhesa, sp. n.

Male.—Primaries dark brown, partly crossed beyond the middle by a whitish hyaline band, which becomes wider as it extends to the inner margin, the fringe alternately brown and white: secondaries brown, palest at the base and along the inner margin; a large red spot on the inner margin slightly above the anal angle; the fringe alternately brown and white. Underside: primaries reddish brown, thickly irrorated with yellow scales; the white hyaline band crossing the wing beyond the middle is more distinct, and a waved, submarginal, yellow line extends from the costal margin near the apex to the anal angle: secondaries brown, streaked with yellow and white. The head, thorax, and abdomen dark brown, the collar yellow, the anus reddish brown; antennæ and legs greyish brown.

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

Hab. Bolivia (*Buckley, Mus. Druce*).

Eratina medama, sp. n.

Male.—Primaries dark brown, slightly greyish at the base; a wide yellowish hyaline band crosses the wing beyond the middle from the costal margin almost to the anal angle, but not reaching it, the band is widest just above the anal angle; the fringe alternately brown and white: secondaries dark brown, crossed about the middle from the costal margin to the anal angle by a straight, rather wide, yellowish hyaline line, below which on the anal angle is a red spot; the fringes alternately brown and white. Underside: primaries reddish brown, with the band crossing the wing considerably wider than on the upperside; a submarginal yellowish-white waved line extends from the costal margin near the apex to inner margin, where it almost joins the inner band; the base of the wing is streaked with yellowish white: secondaries reddish brown, the veins mostly yellowish white from the base to about the middle; a rather wide central pale yellow band, bordered on the outer side with deep red, crosses the middle of the wing from near the costal margin to the anal angle; a large orange-coloured spot close to the anal angle; the fringe of the primaries brown, that of the secondaries alternately brown and white. The head, thorax, antennæ, and legs dark brown; the abdomen brown, banded with fine white lines.

Expanse 2 inches.

Hab. Ecuador, Intij (*Buckley*, *Mus. Druce*).

This species is allied to *E. mecyra* from Colombia, but the secondaries are considerably broader and not tailed as in that insect.

Eratina aroma, sp. n.

Male.—Primaries dark brownish black, partly crossed about the middle with a semihyaline band; the fringe alternately brown and white: secondaries brownish black, crossed about the middle by a wide pale primrose-coloured band; a bright red spot close to the anal angle; the fringe alternately white and black. Underside: primaries dark reddish brown, palest on the outer margin; a rather wide submarginal yellowish line extends from the costal margin near the apex to the anal angle; the semihyaline band is more distinct, reaching the costal and inner margins; the base of the wing is streaked with white: secondaries reddish brown, with the veins near the base white, the red spot close to the anal angle considerably larger than above. The head, thorax, and abdomen dark brown, the abdomen banded with fine yellowish-white lines, the anal tuft yellow; the legs, underside of the thorax, and abdomen dark greyish white; antennæ dark brown.

Expanse 2 inches.

Hab. Bolivia (*Buckley, Mus. Druce*).

A very distinct species; in form it resembles *E. medama* from Ecuador.

Eratina Hewitsoni, sp. n.

Male.—Primaries black, partly crossed at the end of the cell by a curved whitish hyaline band that becomes lobed nearest the outer margin; the inner margin streaked with creamy white, the fringe dark brown: secondaries creamy white, shaded with black close to the base; the outer margin from the apex to the anal angle broadly banded with black; the fringe dark brown, with two white spots on the outer margin. Underside of the primaries rich reddish brown, the veins near the base yellow; a streak at the end of the cell and two streaks extending from the base pure white; the hyaline band is more distinct than on the upperside, reaching the costal margin; a submarginal dark yellow waved line extends from the costal margin near the apex to the anal angle; the fringe alternately white and reddish brown: secondaries creamy white, the base and outer margin reddish brown, the veins near the base yellow; a bright yellow submarginal line extends from the apex to the anal angle. The head and thorax dark brown; the abdomen pale yellowish brown, banded with fine black lines, the anal tuft yellow; antennæ black; the underside of the thorax, abdomen, and legs greyish white.

Expanse $1\frac{3}{4}$ inch.

Hab. Ecuador, Sarayacu (*Buckley, Mus. Druce*).

Eratina artemis, sp. n.

Female.—Primaries brownish black, palest near the base; a rather broad yellowish-white band partly crosses the wing beyond the cell, but does not reach either margin; the fringe brown: secondaries black, with a large creamy-white spot in centre, the outer edge of which is in the form of a short broad tail, the fringe black and white. Underside: primaries deep reddish brown, becoming black on the inner margin; the veins near the base pale yellow; the white band crosses the wing from the costal margin to the inner margin near the anal angle; two fine submarginal, waved, yellow lines extend from near the apex almost to the anal angle: secondaries, the middle part of the wing creamy white, the base, outer and inner margins deep reddish brown, the veins all yellow; two fine dark yellow submarginal lines extend from the apex round the outer margin to the anal angle; the fringe black and white. The head, antennæ, thorax, and abdomen black, the abdomen banded with fine yellow lines; the legs and the underside of the abdomen greyish white.

Expanse $1\frac{3}{4}$ inch.

Hab. Colombia (*Staudinger*, *Mus. Druce*).

This species is allied to *E. Hewitsoni* from Ecuador, but differs very considerably on the underside and in the shape of the white markings on both wings.

Eratina Buckleyi, sp. n.

Male.—Primaries deep black; a pale primrose-yellow, rather broad, elongated spot beyond the cell, the veins near the base pale yellow; the fringe black: secondaries deep black, elongated into a broad tail on the outer margin; a large round pale primrose-yellow spot about the middle of the wing, not bordered with black on the inner margin; the fringe black, excepting a small spot on the outer margin and the point of the tail pale yellow. Underside of both wings dark brownish red, the markings the same as above; the veins at the base of both wings pale yellow; the fringe on the outer margin of the secondaries alternately black and yellow. The head, thorax, abdomen, and antennæ black, the abdomen banded with pale yellow; the legs, underside of the thorax, and abdomen yellowish white.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Sarayacu (*Buckley*, *Mus. Druce*).

A beautiful little species, very distinct from any other known to me.

Eratina arocha, sp. n.

Male.—Primaries dark brown, with a curved hyaline streak partly crossing the wing at the end of the cell; the fringe alternately brown and white: secondaries red, the outer margin narrowly edged with brown; the fringe alternately red and white. Underside: both wings reddish brown, the secondaries with a yellowish tinge on the outer margin: primaries crossed beyond the middle with a greyish-white band: secondaries crossed from the costal margin near the apex to the anal angle by a very fine waved white line, edged on the outer side with dark red. The head, antennæ, thorax, abdomen, and legs dark brown, the abdomen banded with very fine yellowish lines.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Sarayacu, Chiguinda (*Buckley*, *Mus. Druce*).

The three male specimens before me do not show any variation; the female is unknown.

Eratina meduthina, sp. n.

Male.—Primaries dark brown, with two round hyaline spots beyond the middle, the first close to the costal margin, the second below, nearest the outer margin; the fringe brown: secondaries pale yellowish brown, the fringe the same colour. Underside: primaries and secondaries pale yellowish brown, primaries with the spots as above, secondaries crossed about the middle from the costal margin near the apex to the inner margin slightly above the anal angle by a very faint waved brown line. The head, thorax, abdomen, antennæ, and legs dark brown.

The female is almost identical with the male.

Expanse, ♂ ♀ 1 inch.

Hab. Ecuador, Chiguinda (*Buckley*, *Mus. Druce*).

This species is allied to *E. arocha*, from which it is at once distinguished by the two hyaline spots on the primaries and the very much paler colour of the secondaries, also by the very different underside.

Eratina bosora, sp. n.

Female.—Primaries dark brown, palest at the base, partly crossed from the costal margin beyond the middle by a band of four hyaline spots, the second and third spots the smallest, the fourth the largest, the fringe alternately brown and white; the costal margin is slightly reddish from the base to about the middle: secondaries dark brown from the base to about the middle, and broadly round the outer margin from the middle of the wing to anal angle bright red, the fringe reddish brown. Underside: primaries from the base to the band of spots blackish brown, the apical portion of the wing yellowish brown: secondaries pale brown, crossed from the costal margin to the anal angle with a rather wide band of the same colour, but considerably paler. The head, thorax, abdomen, antennæ, and legs dark brown.

Expanse 1 inch.

Hab. Interior of Colombia (*Wheeler*, *Mus. Druce*).

This species is allied to *E. arocha* from Ecuador.

Eratina capua, sp. n.

Female.—Primaries and secondaries deep black; a wide semihyaline whitish band crosses the wing beyond the middle, but does not reach either margin; the fringe black, excepting at the apex, where it is white: secondaries with a very fine submarginal white line, the fringe white. Underside: both wings very dark claret-colour, the markings as above, the veins of the secondaries white. The head, antennæ, thorax, abdomen, and legs black.

Expanse $1\frac{1}{4}$ inch.

Hab. South-east Brazil, St. Catharina (*Mus. Druce*).

This species is allied to *E. siliquata*, Guen.

Eratina masura, sp. n.

Female.—Primaries brown, greyish at the base, with a large elongated spot at the end of the cell: secondaries white, with the base and outer border broadly bordered with dark brown; the fringes of both wings alternately brown and white. Underside: primaries reddish brown, the veins at the base pale yellow; a wide white band crosses the wing beyond the middle from the costal margin to the anal angle, beyond which is a submarginal row of small yellow spots almost forming a waved line: secondaries white, the base and a large irregular-shaped spot at the anal angle reddish brown, the outer margin dark brown, with a submarginal yellow line extending from the apex to the anal angle; the fringe alternately brown and white. The head, antennæ, thorax, and abdomen dark brown, the abdomen banded with fine white lines; the legs greyish brown.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Chiguinda (*Buckley*, *Mus. Druce*).

A small species, not closely allied to any known to me.

Eratina media, sp. n.

Female.—Primaries black, with a rather wide, elongated, white spot at the end of the cell: secondaries black, with a large, central, white, round spot in the middle and extending to the inner margin; the fringes of both wings alternately white and black. Underside: primaries brownish black, the inner margin white from the base to near the anal angle; two bands partly cross the wing from the costal margin; the apex of the wing is irrorated with white scales: secondaries white, broadly bordered with dark brown, the base and the outer margin thickly irrorated with yellow scales. The head, thorax, and abdomen black; antennæ black; the underside of the abdomen and legs greyish brown.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Chiguinda (*Buckley, Mus. Druce*).

This species is allied to *E. masura*, but it is very differently marked on the upper- and undersides.

Eratina peloria, sp. n.

Female.—Primaries black, slightly greyish at the base and along the inner margin; a rather wide white band at the end of the cell, but not reaching either margin; the fringe brown and grey: secondaries greyish brown, with a slight greenish shade, the outer margin edged with black, the fringe alternately grey and brown. Underside: primaries reddish brown, the white band extends to the costal margin and almost to the anal angle; a white spot in the middle of the cell and several small yellow dots near the apex: secondaries pale yellow, the outer margins broadly bordered with dark brown; the marginal line yellow; a rather wide, zigzag, submarginal, white line extends from the apex to the anal angle; a white streak in the cell and three below the cell between the veins. The head, thorax, abdomen, antennæ, and legs dark brown.

Expanse $1\frac{1}{4}$ inch.

Hab. Interior of Colombia (*Wheeler, Mus. Druce*).

This species is very distinct from all others known to me.

Eratina Wheeleri, sp. n.

Female.—Primaries very dark brown, palest near the base; a very pale, almost white, band partly crosses the wing at the end of the cell, but does not reach either margin; the fringe alternately white and brown: secondaries dark brown, with a large oval-shaped, pale yellow, semihyaline spot below the cell; a reddish-brown spot at the anal angle; the veins at the base of the wing yellow; the fringe alternately yellow and brown. Underside: primaries dark reddish brown, the base to about the middle pale straw-colour, the veins near the base yellow, the band as above, but very much more distinct, and extending from the costal margin to the anal angle, where it becomes a fine line only; a pale yellow waved line partly crosses the wing near the apex: secondaries pale yellow, the base, inner and outer margin broadly bordered with dark brown; the veins all yellow; a bright red streak extends partly round the outer margin from the anal angle; the fringe alternately yellow and dark brown. The head, thorax, antennæ, and legs brown, the collar yellow; the abdomen dark brown, banded with yellow.

Expanse $1\frac{3}{4}$ inch.

Hab. Interior of Colombia (*Wheeler*); Antioquia (*Salmon, Mus. Druce*).

Eratina artabates, sp. n.

Male.—Primaries dark brown, greenish brown at the base, the veins white to about the middle of the wing; a narrow white band crosses the wing beyond the middle from the costal margin almost to the anal angle, but does not quite reach it; the fringe dark brown: secondaries greenish brown, the outer margin dark brown, the veins all white from the base to the inner side of the dark marginal brown band; a long red streak close to the anal angle; the fringe alternately white and brown. Underside: primaries reddish brown, the base and a wide band beyond the cell pale yellowish white; the veins at the base of the wing yellow; a waved submarginal yellow line extends from near the apex on the costal margin almost to the anal angle: secondaries reddish brown, all the veins and two bands crossing the wing pale yellowish white; a submarginal reddish line extends from the apex to the anal angle; the fringe alternately yellow and brown. The head, thorax, antennæ, and abdomen dark brown, the abdomen banded with fine yellow lines; the anus yellowish; the underside of the thorax and abdomen pale yellow; the legs dark brown.

Expanse $1\frac{3}{4}$ inch.

Hab. Bolivia (*Buckley, Mus. Druce*).

This species is allied to *E. lineata.*

Eratina faventia, sp. n.

Male.—Primaries dark brown, crossed about the middle by a pale primrose-coloured band, which becomes wide and lobe-shaped near the anal angle; on the costal margin it is quite narrow; a subapical yellow streak touching the costal margin: secondaries pale primrose-colour, the base dusky brown, the outer margin from the apex to the anal angle broadly bordered with dark brown, much dentated on the inner edge; the fringe alternately yellow and brown. Underside: primaries yellowish brown, the primrose-coloured band as above, and a submarginal pale yellow band: secondaries very similar to the upperside, but paler in colour, and with a row of brown spots crossing the middle of the wing. The head, antennæ, thorax, and abdomen dark brown, the abdomen banded with fine yellow lines; legs dark brown.

Female almost identical with the male.

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

Hab. Ecuador, Chiguinda (*Buckley*, *Mus. Druce*).

This species is allied to *E. Wheeleri* from Colombia.

Eratina Whitelyi, sp. n.

Male.—Primaries black, the veins at the base white; a spot at the end of the cell, a round spot below near the anal angle, and two small spots on the costal margin near the apex all white: secondaries deep black, with a large central, almost round, creamy white spot about the middle of the wing, which extends to the inner margin; the fringe alternately white and black. Underside very similar to the upperside, but considerably browner in colour, the veins at the bases of both wings white: primaries with a white band, which crosses from the costal margin to the outer margin near the apex: secondaries with two streaks and a round spot close to the anal angle both white. The head, thorax, abdomen, antennæ, and legs black, the abdomen banded with narrow white lines.

The female is identical with the male.

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

Hab. East Peru (*Whitely*, *Mus. Druce*).

Eratina necysia, sp. n.

Female.—Primaries deep black, with a dark blue gloss; the cell, three spots beyond, and one elongated streak below the cell bluish hyaline white; three spots forming a short band close to the apex bluish hyaline white: secondaries bluish hyaline white, with the veins, the costal margin, and the outer margin deep black, glossed with dark blue. Underside: primaries the same as above, but with a reddish tinge: secondaries with the hyaline part as above, the dark parts being all of a rich lake-colour, the base of the wing chrome-yellow; a rather wide, marginal, silvery-white line extends from the apex to the anal angle. The head, thorax, antennæ, and abdomen bluish black; the collar white; the underside of the abdomen banded with white; the legs black.

Expanse $1\frac{3}{4}$ inch.

Hab. Colombia, interior (*Mus. Druce*).

A very distinct species allied to *E. pohlita*, Feld. & Rog.

Eratina hermæa, sp. n.

Female.—Primaries deep black, the veins at the base, a narrow streak at the end of the cell, and part of the inner margin creamy white; the fringe black: secondaries semi-hyaline white, broadly bordered with deep black from the apex to the anal angle. Underside: primaries brownish black, with a reddish shade, the veins from the base to the middle pale yellowish white, the streak as above, but extending to the costal margin: secondaries as above, with a rather wide, submarginal, dark red line which extends from the apex to the anal angle. The head, thorax, and abdomen black; the collar and tegulæ yellowish white; the abdomen banded with white; antennæ and legs black.

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

Hab. Ecuador, Chiguinda (*Buckley, Mus. Druce*).

Eratina tryphosa, sp. n.

Male.—Primaries: the costal margin, apex, and outer margin broadly bordered with dark brown, the inner portion of the wing white; a large yellow spot close to the apex; the fringe dark brown: secondaries white, the base and outer half of the wing dark brown; the fringe brown. Underside: primaries as above, with a second yellow spot close to the anal angle: secondaries as above, with a marginal greyish line, which extends from the apex to the anal angle; a large yellow spot at the anal angle. The head, thorax, abdomen, antennæ, and legs dark brown.

Expanse $1\frac{1}{4}$ inch.

Hab. Ecuador, Intij (*Buckley, Mus. Druce*).

This species is quite distinct from any known to me.

BIBLIOGRAPHICAL NOTICE.

Les Coquilles Marines des Côtes de France. Par Arnould Locard. F. B. Baillière et Fils: Paris, 1891.

This work forms a companion volume to the 'Prodrome de Malacologie Française, Catalogue général des Mollusques vivants de France, Mollusques marins,' by the same author, and each may be regarded as supplementary to the other.

The 'Prodrome' contains a classified list of the marine mollusks of France, with more or less complete synonymy of the species and full details respecting localities. It does not, however, include descriptions of the families, genera, or species, and is unillustrated. On the contrary, in the present volume we find short diagnoses of the various groups and species, and a woodcut of a typical species of each generic and sectional group, but no complete synonymy, merely a reference to the original descriptions and M. Locard's and a few other works. Precise habitats are not quoted, but only the particular sea in which the various forms occur, and the bathymetrical distribution is indicated by three zones, namely the littoral, the herbaceous (=laminarian), and the coralline.

The classification adopted is practically the same in both works, but we notice a few omissions and alterations. For example, no mention is made of the families Xenophoridæ and Siphonariidæ, both of which occur in the 'Prodrome.' The genus *Isocardia* is removed from the Cardiidæ to the Cyprinidæ, *Circe* and *Astarte* from the Cyprinidæ to the Astartidæ, *Galeomma* from Kelliidæ to Galeommidæ, *Spondylus* from Ostreidæ to Spondylidæ, and in the Brachiopoda *Megathyris*, *Cistella*, and *Thecidea* are placed in the family Megathyridæ instead of Terebratulidæ.

In the first hundred pages, which are a fair sample of the rest, we observe that half a dozen genera and about ten species occurring in the 'Prodrome' are here abandoned; at least eight species are placed in different genera, and in about a dozen instances the names of species have been changed. We also find about twenty *so-called new species* and at least twenty-five others not contained in the 'Prodrome'!

This excessive multiplication of species could not occur anywhere except in France—for that is the special function of the "Nouvelle école" in that country. By all serious conchologists this practice is strongly condemned, and no opportunity should be lost of loudly protesting against it. What is more ridiculous than the supposition that within the last five or six years M. Locard has discovered about a hundred and sixty species of Mollusca (one seventh of the total number in the book!) from the shores of France, which have escaped the attention of his compatriots and others for a hundred years?

This is the only work as yet published which contains descriptions (albeit they are too brief and inadequate) of all the known shells met with on the French coast. It consists of 384 pages of text and is illustrated with 348 fairly good woodcuts.

No reference whatever is made to the soft parts or animals, and the shell-bearing species only are treated of; consequently such groups as the Cephalopoda, Nudibranchiata, Pteropoda, Heteropoda, and a few others are entirely disregarded. These are serious omissions to scientific students, for whom, however, the work is probably less intended than for shell-collectors.

In conclusion, we cannot commend this volume as possessing any special scientific value, nor is it in any way comparable with the works of Forbes and Hanley and Jeffreys on the Mollusca of the British coasts.

MISCELLANEOUS.

A Multicellular Infusorian-like Animal.

By Prof. Johannes Frenzel, of Cordova (Argentine Republic).

After sending to the press a preliminary report upon my investigations into the microscopic fauna of this locality I discovered, on making a fresh examination of a small salt-water aquarium, a really remarkable microscopic creature, exhibiting indeed many relations to the Ciliata, but sharply separated from that group on the one hand by its multicellular character, and on the other by its well-differentiated alimentary cavity, without, however, being directly referable to the Cœlenterata, owing to the fact that only a *single* layer of cells is present.

For the investigation of the salt-pit fauna of this region I had procured a few litres of a solution containing about two per cent. of salts, obtained from a salt-pit in the south of the province of Cordova. It was some time before a few Flagellata &c. were developed among decaying matter, and these presented so few noteworthy characters that I abandoned my researches. On casually resuming my studies I found a number of little creatures, of which I would here give a brief description; the animals were met with at the bottom as well as upon the glass sides of the vessel, but not free-swimming.

The external form is that of a tube, somewhat pointed in front and behind, and slightly flattened dorso-ventrally, so that it may be termed bilateral. The ventral surface is flat, the dorsal, on the other hand, tolerably evenly arched, so that the transverse section is approximately semicircular.

The ventral surface is clothed with delicate cilia, by means of which the animal moves actively along, twisting about at the same time like a snake or worm. The dorsal and lateral regions, on the contrary, are not ciliated, but bear a sparser covering of short setæ. In front, nearer the ventral surface, we find an *oral opening*; posteriorly, exactly terminal in position, an anal aperture of smaller size. At the former opening longer and stouter cirri are placed, by the active movement of which particles of food are whirled into the mouth.

A well-developed cuticle or similar firm dermal layer is wanting; nevertheless, as in the Ciliata, the membrane of the cells, or limiting layer, is more strongly developed on the outer side, almost possessing a double contour, though it is always very delicate.

The wall of this tube-shaped organism is furnished by a *single* layer of tolerably large, almost cuboid cells, all of nearly equal size, leaving a cylindrical lumen, which is closely packed with foreign bodies, such as particles of sand, bacilli, diatoms, vegetable matter, &c. This is the *intestinal cavity*, which commences in front at the mouth and terminates posteriorly at the anus.

The cells are all more or less similar in structure, the difference consisting, as already stated, in the fact that those of the ventral side are ciliated on their free surfaces. In all cells the surface which is turned towards the lumen of the intestine is also delicately ciliated, whereby an active movement is imparted to the intestinal contents.

The oral opening, which is not quite terminal in position, is overtopped by one cell in front. The cirri, which I have previously mentioned, are borne upon this cell, as well as upon the others surrounding the mouth. These cells are therefore well differentiated from the remainder, so that altogether we have to distinguish three different kinds of cells.

The limits of each individual cell are distinctly visible, and almost in the centre of each there is a large roundish nucleus, containing several smaller nucleoli, which may usually be made out even in the living animal. The remainder of the contents of the cell are of a finely granular nature, though it is impossible to determine with certainty whether the nutritive contents of the intestine are received into the cells in solid form. I am inclined to believe that this is not the case. A few globules of fat, on the other hand, are discernible in most of the cells.

I frequently found these animals of different sizes. Growth simply results from the reduplication of cells by division, which takes place in such a way that the nucleus first becomes more homogeneous, since the nucleoli disappear from view. The nucleus, which has become elongated, then constricts, as does also the cell almost at the same time, whereupon complete division ensues, the nuclei first separating from one another and then assuming a rounded form. They subsequently become clear again and exhibit the nucleoli. Whether during this apparently direct division of the nucleus morphological changes take place in its interior it was impossible to determine in living specimens. Similarly it has not yet been possible to decide whether a true nuclear membrane is present, and, if so, how it behaves during the division. At all events, in observing the process no change can be detected at the margin of the nucleus.

Unfortunately I have not yet succeeded in killing the animals successfully, as on the addition of foreign matters they at once melt away exactly like Infusoria, since the cells separate from one another, assuming a spherical shape, and then flatten out after losing their cilia.

With regard to *reproduction*, two methods appear to exist. In the first place, in large individuals, a transverse division takes place, which vividly recalls the similar process in *Catenula* &c. The cells of the middle region usually first divide; a constriction of the animal then sets in at this spot at right angles to the longitudinal axis, while a new mouth is formed in the posterior division, since a few cells upon the ventral surface separate from one another and give rise to an opening, at the same time producing stronger cilia. Upon this the whole is constricted off, and the two animals are set free and swim away.

Besides this, however, we find *conjugation*, with subsequent encystment. Two individuals apply themselves together by their ventral surfaces, and discontinue the movement of their cilia. They then become shortened and rounded into a common spherical mass.

whereupon a cystic membrane is differentiated. As to what happens afterwards and in the interior I am sorry to say that I am unable as yet to give any account. Nevertheless it was still possible to see that the cavities of the intestines disappear, apparently owing to continued multiplication of cells, so that finally the entire contents of the cyst are composed of similar cells. I am inclined to believe that each of these cells represents a *young animal*, which, after being set free, roves about by aid of its cilia like one of the Ciliata, and by further division develops into the adult form; for I observed in the same salt-water small unicellular organisms, ciliated on the ventral surface only, yet bearing a few cirri in front. These are possibly the young forms (larvæ).—*Zoologischer Anzeiger*, xiv. Jahrg., no. 367 (13th July, 1891), pp. 230–233.

On the Growth of the Shell in Helix aspersa. By M. Moynier de Villepoix.

We know that the growth of the shell in pulmonate Gastropods takes place by the formation, at the edge of the test, of a soft and diaphanous zone, which speedily hardens. I have specially studied this formation in *Helix aspersa*, L.

The epidermis which gives rise to it is particularly interesting owing to the hyaline spherical globules, 10 μ to 12 μ in diameter, which cover its outer surface. Their nature is organic; they persist on the oldest shells, and I have reasons for thinking that it is to similar formations that we must attribute the markings which are to be found on almost all the shells of the genus *Helix*.

In animals in course of growth, the thickened border of the mantle is always applied against the peristome, and the free edge of the epidermis, folded inwards, buries itself, but without any connexion with the tissues, in a very narrow cleft which runs round the whole circumference of the collar. Immediately behind this cleft, we observe beneath the epidermis a white zone bounding the mantle in its entire breadth.

The deposition of calcareous matter takes place on the internal face of the epidermis, at some distance from its margin. The origin of these products can be understood by examining sagittal sections of the collar and mantle.

The white zone, or bandelet, is a gland composed of flask-shaped cells, with very long necks, and granular contents, which bury themselves deeply in the subjacent tissue. The action of acetic acid and oxalate of ammonia discloses the presence of calcareous matter in these cells.

Behind this bandelet the mantle is clothed with a columnar epithelium, containing pigment or colourless granulations.

Immediately in front of the bandelet the epithelium invaginates to form the groove in which is lodged the free extremity of the epidermis. The bottom of the groove is occupied by an irregular plexus of cells, which, in a sagittal section, present the appearance of epithelial cells cut obliquely and extending to a greater or less distance into the connective tissue. These cells contain transparent spherules, presenting all the characters of the globules of the epidermis.

There is thus formed in the connective tissue a series of regular glandular sacs, adhering one to another. On teasing out the tissues of the living animal it is seen that these gland-cells attain considerable dimensions, and that the globules are formed at the expense of their granular protoplasm. The globules originate and grow in vacuoles, which become successively hollowed out in the protoplasmic mass, so that finally the cells are nothing more than transparent masses formed by an agglomeration of little delicate-walled alveoli enclosing the globules. The latter, on being set free, probably by simple rupture, emerge at the bottom of the groove, where they attach themselves to the fine organic membrane secreted by the epithelium.

The calcareous and mucous glands are absent, as stated by Leydig*, in all the parts covered by the shell, and I was able to prove that the calcareous glands of the collar, conformably to the opinion of Semper, do not contribute in any way to the formation of the test.

The only elements which take part in the production of the latter are, commencing from in front:—(1) The pallial groove, where is formed the epidermis with the glandular sacs, which produce the globules, and the existence and function of which I believe I am the first to describe; (2) the bandelet, or pallial gland, on which appears to devolve the secretion of the calcareous matter; (3) the pallial epithelium following the bandelet, which provides the shell with its pigment and completes its calcification by the deposition of organo-calcareous layers, homologous to the layers of nacre in the Pelecypods.

I determined, moreover, that, *when the animal has attained its full size, the bandelet and the glands with globules have completely disappeared.*

It is only the epithelium of the mantle and of the pulmonary sac which retains its activity, for the purpose of contributing to the internal thickening of the test, and also of replacing the loss of portions of it, as is shown by the following experiment, which indicates the rapidity and activity of the secretion.

If we lay bare a portion of the surface of the pulmonary sac, by removing a fragment of the shell, it is possible even at the end of an hour and a half to two hours to detach an extremely delicate organic membrane, covering the whole surface, and strewn with rhombohedral and radiating crystals of carbonate of lime. If allowed to remain, this membrane thickens very rapidly, and finally closes up the opening with a solid calcareous wall.

In no case (contrary to the statement of C. Picard †) does the mucus produced by the collar or the mouth take part in this process of reparation.

As regards the activity of the pallial epithelium, it is such that, during two consecutive months, I was able to observe animals, which were deprived of food, reproducing every day the organo-calcareous membrane which I removed every morning.—*Comptes Rendus*, tome cxiii. no. 7 (August 17, 1891), pp. 317–319.

* Leydig, 'Die Hautdecke und Schale der Gastropoden.'

† Dr. C. Picard, 'Hist. des Moll. terr. et fluv. qui vivent dans le département de la Somme,' 1840.

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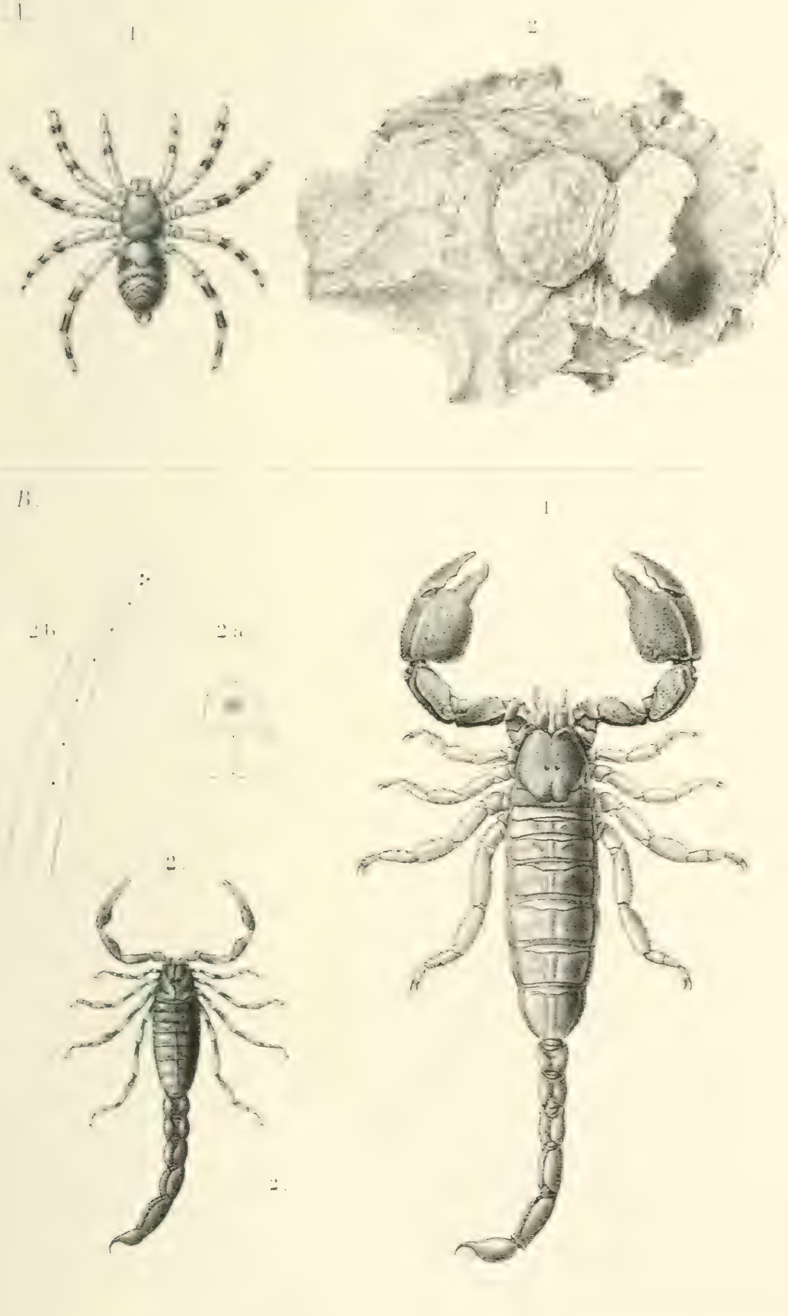
Mintern Bros. lith.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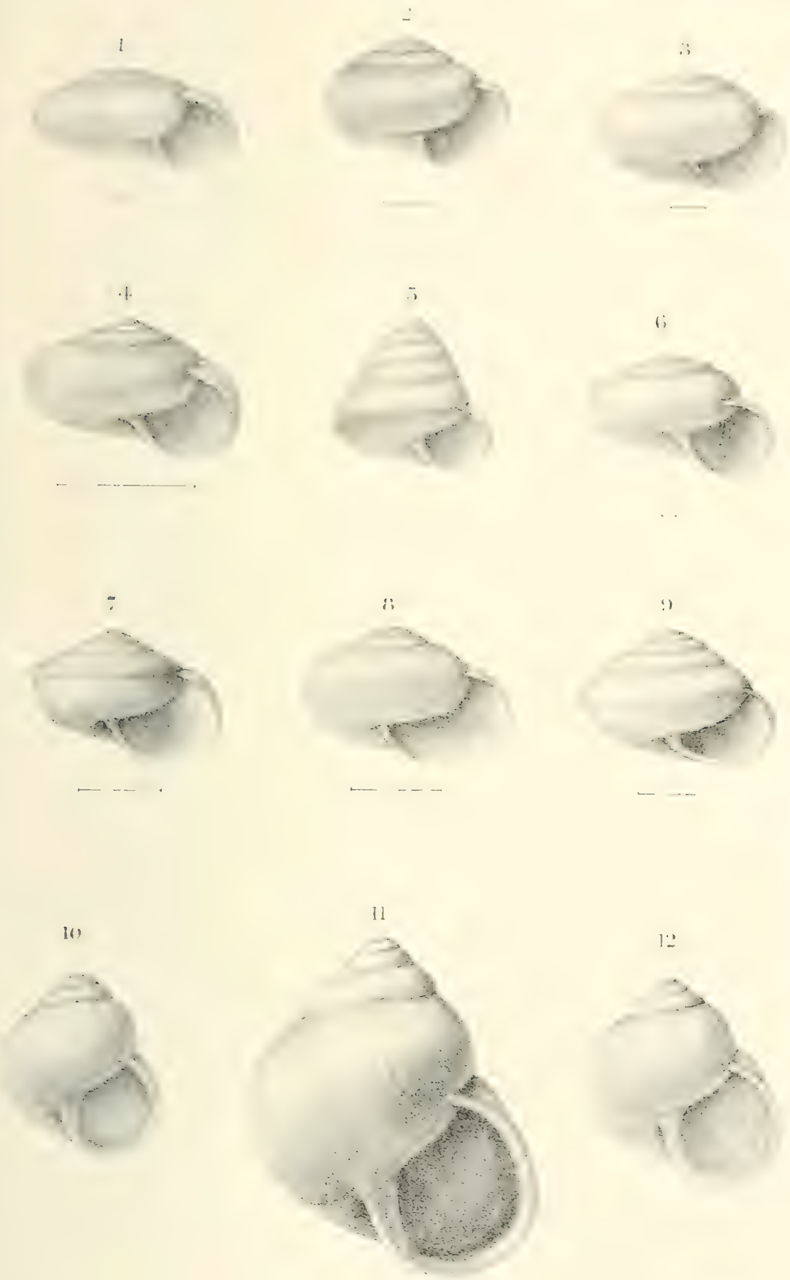

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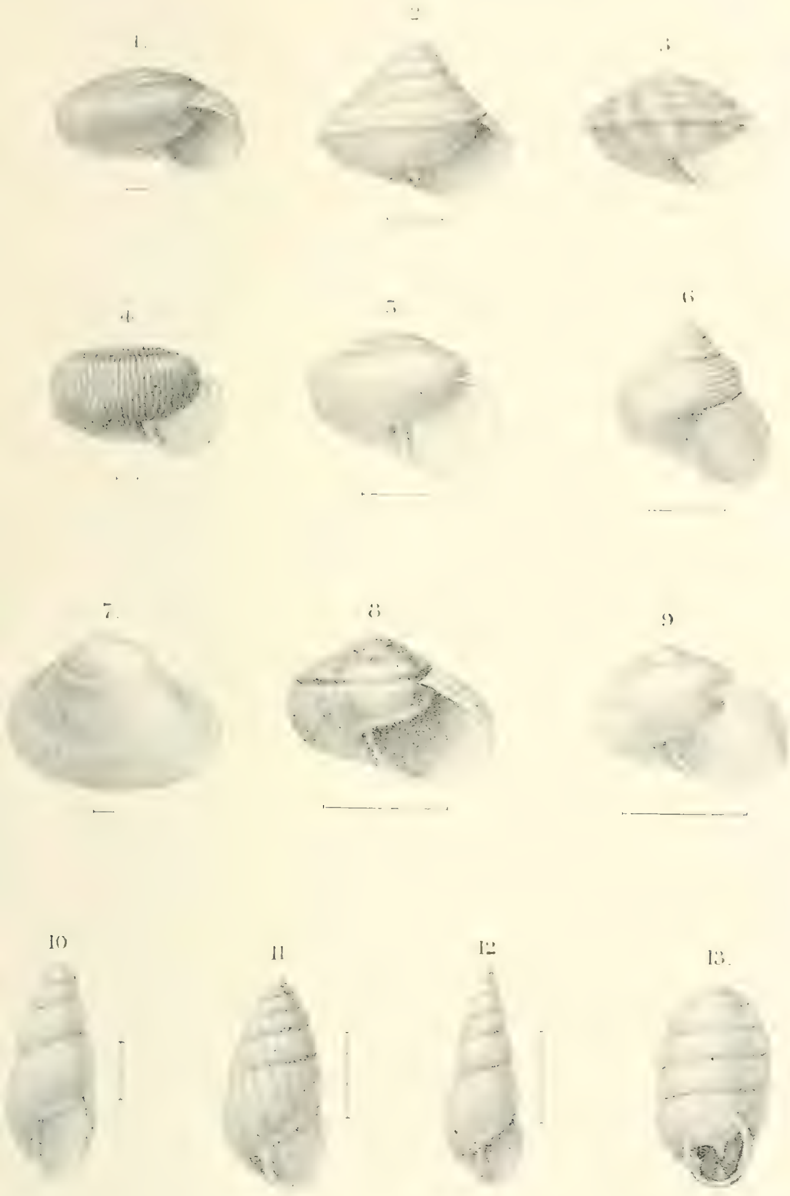

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THE ANNALS

AND

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[SIXTH SERIES.]

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XVII.—*The Earthworms of the Vienna Museum.*

By Frank E. Beddard, M.A., F.R.S.E.

[Plate VII.]

Prof. Claus has been so good as to let me examine the collection of earthworms preserved in the Vienna Museum, which includes the forms described by Schmarda in his 'Neue wirbellose Thiere' *, as well as a number of unnamed species from various localities.

Schmarda's species have been so long a mystery to the students of this group of Annelids, that I am very glad to be able to identify them.

"*Hypogæon heterostichon.*"

Schmarda's diagnosis of the species runs as follows:—

"Series setarum in dorso octo, binæ in antica parte convergentes, in postica divergentes."

Clearly, therefore, it should not be placed in the genus *Hypogæon* as defined by Savigny; for that genus has nine setæ per segment, the unpaired seta being dorsal in position. Such a character is quite sufficient to distinguish a genus, though no doubt the existence of this ninth seta requires further proof.

* 'Neue wirbellose Thiere &c.,' Leipsic, 1861, Bd. ii.

"*Hypogæon heterostichon*" is not a species of Perrier's genus *Titanus**, which Rosa has recently shown † to be identical with *Geoscolex* of F. S. Leuckart ‡, as might be inferred from Schmarda's diagnosis, but belongs to the genus *Anteus*. There are three or four specimens of this species in the collection from Ecuador and the Cordilleras.

It appears to differ from *Anteus gigas*, the only species of the genus at present known, and may be described as

(1) Anteus hetorostichon (Schm.). (Pl. VII. figs. 1 and 7).

Hypogæon heterostichon, Schmarda, Neue wirb. Thiere. Bd. i. Hälfte ii. p. 12.

The species is about 10 inches or so in length, with a diameter of 12 millim. anteriorly.

The colour (in spirit) is yellowish white anteriorly and bluish posteriorly; the blue colour is due to the thinness of the integument and the dark colour of the intestinal contents. There appears in fact to be no pigment in the skin at all. The setæ have precisely the arrangement which characterizes the other species, as is indeed set forth in Schmarda's diagnosis quoted above.

The *setæ* present the form which is illustrated in fig. 7; they are perhaps rather straighter (less curved) than in many other earthworms; fig. 7 *c* represents the free extremity of the seta more highly magnified; it is seen to be covered with faintly marked ridges. The genital setæ, which occur upon the clitellum, are rather more than twice as long as the ordinary setæ; the proportions are as indicated in figs. 7 *a* and *b*: *a* is of course a clitellar seta; the basal portion of this seta is curved, the rest of the shaft is nearly straight; at the free extremity the ridges are very strongly marked. The setæ appear to be precisely like those of *Anteus gigas* § and of *Rhinodrilus* ‖.

The nephridiopores, which commence upon the first setigerous segment, are placed as in the genus *Anteus*, in front of

* "Mémoires pour servir à l'histoire des Lombriciens terrestres," Nouv. Arch. Mus. t. viii. p. 57.

† "Sul *Geoscolex maximus*, Leuck.," Boll. Mus. Zool. Torino, vol. iii. no. 40.

‡ "*Geoscolex*, Leuck., ein neues Geschlecht von Ringwürmern," Zool. Bruchstücke, Heft ii.

§ "Descriptions of Earthworms.—VI. On *Antæus gigas*," Perrier, Notes Leyden Mus. vol. xiii. p. 77; Perrier, *loc. cit.* pl. i. figs. 10, 11.

‖ "On the Structure of a new Genus of Lumbricidæ (*Thamnodrilus Gulielmi*)," Proc. Zool. Soc. 1887, p. 154. This worm is really a *Rhinodrilus*.

the outermost seta of the dorsal couple; this is of course more apparent when the setæ diverge posteriorly.

The clitellum is developed in one specimen and occupied segments xv.–xxiii. There are two pairs of calciferous glands in segments xii. and xiii. These glands, as in *Urochæta*, stand out from the walls of the œsophagus instead of being attached to them along their whole length, as in most earthworms; they are subconical in form, the apex being directed away from the gut. A large branch arising from the dorsal vessel on each side supplies the anterior glands, entering them at the apex.

The principal difference, however, which this species shows from either of the other two species is in the sperm-sacs; instead of being represented by a single pair of long "tongue-shaped" organs, the sperm-sacs of *Anteus heterostichon* are two pairs of small bodies attached to the anterior septa of segments xi. and xii. They appear, in fact, to resemble those of *Anteus gigas*.

It is noteworthy that this species, like the other two, possesses no spermatheca; the absence of these structures seems to characterize the genus.

The nephridia fall into two series; up to the twelfth segment they have an exceedingly long muscular duct, which is shown by Horst in his figure * of the nephridium in *Anteus gigas*. I traced a delicate tube passing from this tuft of tubules forwards into the segment in front, where it doubtless ends in a funnel. Perrier's figure † of the nephridium and his description give an erroneous idea of the structure. The description runs as follows:—"Ces organes présentent d'ailleurs dans ces deux anneaux et dans les sept suivants qui font également partie de la ceinture un calibre plus considérable. Au lieu d'être pelotonnés comme chez la plupart des Lombrics, ils sont simplement un peu flexueux; leur calibre est suffisant pour qu'on puisse les injecter facilement par leur orifice extérieur, qui est lui-même fort apparent sur la ceinture. Chacun d'eux est terminé par une sorte de houppe formée par une série de replis membraneux implantés sur sa portion terminale libre. Cette houppe constitue le pavillon vibratil au milieu duquel s'ouvre le canal." This description implies that the convoluted tuft of tubules is really a large funnel.

Neither Perrier nor Horst noted that the posterior nephridia are different in structure from the anterior series. After the twelfth segment (in the present species) the nephridia still

* Notes Leyd. Mus. xiii. pl. vi. fig. 3. † *Loc. cit.* pl. i. fig. 14.

have a large terminal sac; but this lies along the transverse axes of the body in close contact with the septa and is furnished with a cæcum which lies on the distal side of the external pore.

Perrier has indeed remarked that the posterior nephridia of *Anteus gigas* are less in calibre than the anterior and are attached by a membrane not represented in the anterior series; but he says nothing of the cæcum (supposing it to exist in that species).

It is frequently the case in this family of earthworms (Geoscolecidæ) that the anterior nephridia differ in structure from the posterior. In *Rhinodrilus Gulielmi* * precisely the same differences exist as in the present species.

The present species of *Anteus*, like the other species of the genus and like so many other earthworms, has several specially thickened septa lying in the anterior region of the body. In *Anteus heterostichon* there are four of these immediately following the gizzard and separating segments vi./vii., vii./viii., viii./ix., ix./x.; behind these is another, thinner, septum which largely covers the septum in front, just as these cover each other successively in the way that Perrier has described.

Species of Anteus.

Is the above species really distinct from *Anteus gigas* described by Perrier, and more recently by Horst? I am convinced that it *is* distinct, and, moreover, I believe that Horst's species is not the same as either Perrier's or the one that I have just described.

The points of difference between *Anteus heterostichon* and *Anteus gigas* are of course to be found mainly in the divergence of the setæ posteriorly and in the commencement of the posterior set of nephridia in the thirteenth instead of the twentieth segment in the latter species. There can be no confusion as to these points, as Perrier's description is perfectly clear. With regard to the setæ he says (p. 52), "Les soies sont disposées, comme chez le Lombric ordinaire, en quatre rangées de paires, deux rangées sont franchement ventrales, deux latérales. Ces rangées sont constamment parallèles d'une extrémité à l'autre du corps, et les soies de chaque paire sont toujours très-rapprochées l'une de l'autre."

Dr. Horst considers that the species which he investigated is *Anteus gigas*. But in that form, as in *Anteus heterostichon*

* Beddard, *loc. cit.*, woodcuts figs. 5 and 6.

and in *Geoscolex maximus*, "the setæ in the posterior segments have also a tendency to separate."

The *clitellum* also is less extensive than in *Anteus gigas*, though this point is of less importance and mainly due to a difference in the state of maturity in the two specimens. Finally it comes from a different locality *.

The following is a definition of the three species. I reserve the generic definition until the next section.

1. *Anteus gigas*, Perrier.

Anteus gigas, Perrier, Nouv. Arch. Mus. t. viii. p. 50.

1 metre 16 centim. in length. Setæ strictly paired. Six strong infundibuliform septa following gizzard. Clitellum occupying segments xiii.–xxix. (?) Nephridia changing in structure in the twentieth segment.

Hab. Cayenne.

2. *Anteus Horsti*, Beddard.

Anteus gigas, Horst, Notes Leyd. Mus. vol. xiii. p. 77.

86 centim. in length. Colour (in spirit) bluish green, darker dorsally; clitellum brownish. Setæ paired, becoming separated slightly from each other posteriorly. Clitellum occupying segments xiv.–xxxii. Three pairs of calciferous glands; six strong septa following gizzard.

Hab. Brazil.

3. *Anteus heterostichon* (Schmarda).

Hypogæon heterostichon, Schmarda, Neue wirb. Thiere, Bd. i. Hälfte ii. p. 14.

25 centim. in length. Colour (in spirit) whitish brown, *i. e.* no pigment in skin or very little. Clitellum occupying segments xv.–xxiii. Setæ strictly paired anteriorly, widely divergent posteriorly. Two pairs of calciferous glands. Four strong septa following gizzard. Posterior nephridia from those of segment xiii. different in structure from anterior.

Hab. Ecuador and the Cordilleras.

Affinities of Genus Anteus.

Vaillant has recently proposed to unite the genera *Anteus*

* I do not mention the ornamented setæ, on the assumption that they also exist in *Anteus gigas*; and yet Perrier, who discovered these setæ in *Rhinodrilus*, says nothing about their existence in *Anteus*. Indeed he remarks on p. 145 of his memoir, when giving briefly the characters of the genera, that in *Anteus* the setæ are all alike, i. e. *not* modified upon the clitellum.

and *Microchæta* *, a proposition with which I cannot agree. No doubt there is a close affinity between *Anteus* and *Microchæta*; but the points of difference are numerous and, collectively at least, of considerable importance. Thus in *Microchæta* the setæ are not ornamented, even those of the clitellar segments; the nephridia differ from those of *Anteus*; the single calciferous gland is a dilatation of the œsophagus; the sperm-sacs are not at all like those of *Anteus*; and, finally, the spermatheca of *Microchæta* are a number of small sacs situated behind the segments which these structures usually occupy. Benham has suggested † that similar spermathecæ may have been overlooked by Perrier in *Anteus*; they do not, I am convinced, exist in that genus. With *Rhinodrilus*, however, *Anteus* shows such close resemblances that they amount, in my opinion, to generic identity.

Until the publication of Horst's paper upon *Anteus* and my own upon *Rhinodrilus Gulielmi* the two genera appeared to be very different. We now know that the ornamentation of the setæ and the difference between the ordinary setæ and the clitellar setæ are the same in both genera and that the nephridia have the same relations and structure (there being an anterior and posterior series differing by the presence or absence of a cæcum to the duct), and that the genitalia show no differences ‡. The clitellum in *Rhinodrilus Gulielmi* is nearly coextensive with that of *Anteus heterostichon*; indeed that species of *Rhinodrilus* and *Anteus heterostichon* link together the more divergent forms of either genus. The only points in which the two genera differ are:—

(1) The presence of a greater number of calciferous glands; and

(2) The presence of an elongated prostomium in *Rhinodrilus*.

As to the first point, it may be remarked that the number of pairs of calciferous pouches is not the same in all species of *Rhinodrilus*; there are six pairs in *Rhinodrilus Temkatei* and *Rhinodrilus Gulielmi*, eight pairs in *Rhinodrilus ecuadoriensis* ‖; we know nothing about these glands in *Rhinodrilus*

* "Annelés," in 'Suites à Buffon,' t. iii. p. 184.

† "An Attempt to Classify Earthworms," Quart. Journ. Micr. Sci. vol. xxxi. p. 265.

‡ Except perhaps in the presence or absence of spermathecæ. In *Anteus* spermathecæ have never been found; in *Rhinodrilus paradoxus* Perrier did not meet with them, but he examined only one individual; I found them to be occasionally wanting in *Rhinodrilus Gulielmi*.

‖ Benham, *loc. cit.* p. 253.

paradoxus. If the number of the glands were constantly the same the character would have more importance.

With regard to the prostomium, I quite agree with Perrier that the modifications of this alone are not sufficient to base generic characters upon. In view of the close resemblances in the clitellum, setæ, nephridia, and genitalia, between *Rhinodrilus Gulielmi* and *Anteus heterostichon*, and the considerable differences between the several species of each genus, it is difficult, I think, to maintain the two genera.

Anteus also shows resemblances to *Geoscolex* which nearly, if not quite, amount to generic identity.

The divergence of the setæ posteriorly which occurs in *Anteus heterostichon* is a new character in *Anteus*, but is one which characterizes *Geoscolex*—at least *Geoscolex maximus*; another character of *Geoscolex maximus*, which I shall refer to again in describing that species, is shared by *Anteus* and *Rhinodrilus*—that is, the ornamentation of the setæ; the clitellar setæ, it is true, are not different from the rest, but neither are they in *Anteus gigas* (?). *Geoscolex*, however, is distinguished by the long sperm-sacs, of which there is only one pair, by the muscular atrium, by the ventral nephridiopores, and the absence of any specialization in the nephridia of the anterior segments, and by the single pair of calciferous glands. In the meantime, therefore, I should prefer to retain the genus *Geoscolex* as distinct, but to merge *Anteus* and *Rhinodrilus* *.

(2) Geoscolex maximus, F. S. Leuckart.
(Pl. VII. figs. 2 and 8.)

Geoscolex maximus, F. S. Leuckart, Zool. Bruchstücke, Heft ii.
Titanus brasiliensis, Perrier, Nouv. Arch. Mus. t. viii. p. 57.

There is a single specimen of a worm which I refer to this species; it is labelled "*Lumbricus paucisetis*," and was collected near the river Patia, in Colombia.

The specimen measures 26½ inches in length by 18 millim.

* I may mention in connexion with the prostomium (so-called) of *Rhinodrilus* that I have recently investigated a species of *Diacheta* with a similar process, which proves to be an evaginable tube lying in a diverticulum of the buccal cavity just in front of and beneath the brain. Vaillant's account of the prostomium in *Rhinodrilus* agrees with my observations upon "*Thamnodrilus*" and upon the *Diacheta* just referred to. I do not think that the presence of this structure can be regarded as of generic importance in either case; the fact of its occurrence in species of two genera widely removed though certainly belonging to the same family is against regarding this "trompe" as of special importance for systematic purposes.

in diameter at the clitellum; it is of an intense brown colour, almost black, the intersegmental grooves being grey. Perrier does not mention the colour of his specimens.

The only points in the structure of the worm to which I wish to call particular attention are the calciferous glands, which were mistaken by Perrier for a part of the circulatory system; the structure lettered *cæ* in his figure * is really a calciferous gland † of a conical form; a blood-vessel arising from the dorsal vessel enters this gland at the apex, and looks very much as if it were simply continuous with it; however, in the specimen in the Vienna Museum the blood-vessel gives off a branch which ramifies over the surface of the gland before it enters its substance; this does away with the resemblance which the gland bears to a simple enlargement of the vascular trunk which supplies it. In the segment in front of this, *i. e.* the twelfth, is a large body which appears to be in connexion with the calciferous gland. This is really a dilated "heart," and there is another pair equally or nearly equally large in the next segment in front. The condition of this specimen did not permit of a conclusive settlement of this question; but I have been able to get some evidence in favour of this view of the anatomy of the parts.

A portion of the contents of the body lettered H in the drawing (Pl. VII. fig. 2) was extracted and teased in glycerine; it was evidently simply a blood-clot. On the other hand, a portion of the contents of the body, lettered *Ca*, which I take to be a calciferous gland, showed a series of elongated blood-clots which were surrounded by a layer of granular débris; these clots were highly suggestive of the coagulated contents of the blood-spaces which lie in the folds of the calciferous glands of other earthworms; the granular substance round the clots would be in this case the remains of the epithelium. As to the connexion between the calciferous glands of each side and the heart, which Perrier figures, it undoubtedly occurs, though perhaps it is more apparent than real. In the first place there is a septum between the two; they occur in different segments, both being attached to the septum would give an appearance of an actual connexion; there may, however, be a short branch from the heart to the calciferous gland.

The setæ of *Geoscolex* are said by Perrier to possess no interesting peculiarity. I understand by this that he regarded them as similar to those of *Lumbricus*. I find, however (see

* *Loc. cit.* pl. i. fig. 15.

† Dr. Benham informs me that he has come to the same conclusion.

fig. 8), that, as in *Anteus*, the distal extremity of each seta is ornamented by slight ridges with a jagged outline. The setæ present the same character on the clitellum and at the posterior extremity of the body. I may remark that it is not always easy to detect the ornamentation of the setæ. It is not sufficient to strip off a bit of the cuticle and then to examine under the microscope the cuticle and the setæ that have been accidentally detached in tearing it off. The cuticle itself in such a case frequently obscures the markings on the setæ.

The setæ must be picked out one by one; this is quite easy with a large species like *Geoscolex maximus*; when the body is opened the cavities where the setæ are planted are seen to be very large, and the setæ can be readily seized with the forceps and detached.

The nephridia open, as Perrier and Leuckart stated, in front of the ventral setæ; they have a large muscular vesicle.

In the anterior region of the body the nephridial duct passes straight from the tuft of tubules to the external pore; in the hinder region this duct is bent upon itself, but there is no cæcum such as is found in *Anteus*. The nephridia therefore show only the very slightest traces of the specialization into an anterior and a posterior series that is found in *Anteus*. The funnel, as in other earthworms, depends into the segment in front of the one in which the nephridium lies.

The sperm-sacs are long and were doubled upon themselves in the specimen which I examined. The vas deferens where it leaves the sperm-sac runs at first forwards and downwards side by side with the duct of a nephridium; it opens into a large muscular sac which occupies three or four segments and is constricted where it passes through the mesenteries. I did not notice the three bands figured by Perrier* attached to the atrium.

There are, as Perrier has stated, no spermathecæ.

(3) "*Perichæta leucocycla.*"

The collection contains a number of individuals labelled with this name. One smallish individual (no. 16) is evidently the type figured by Schmarda. Being quite immature, it is impossible to be absolutely certain whether it is really identical with a large individual measuring 37 inches in length, which has a similar label. So far as it was possible to form an opinion from the arrangement of the setæ (which show dorsal and ventral gaps) and from the general appearance of

* *Loc. cit.* pl. i. fig. 15.

the worm it is identical. "*Perichæta leucocycla*" is therefore the same species as *Megascolex cæruleus*, in spite of the differences of colour shown in Schmarda's figure and in Bourne's *.

The synonymy of the species will therefore stand thus:—

Megascolex cæruleus, Templeton, Ann. & Mag. Nat. Hist. 1845, p. 60.
Perichæta leucocycla, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 13.
Pleurochæta Moseleyi, Beddard, Trans. Roy. Soc. Edinb. vol. xxx. p. 481.
Megascolex Moseleyi, Vaillant, Annelés, Suites à Buffon, t. iii. p. 67.

"*Perichæta cingulata*," Schm.

The collection contains two specimens, one of which is the type of Schmarda's species. This is sexually mature, so that I can describe its external characters more accurately than has been hitherto done. Vaillant † apparently confounded several species together under the name of *Perichæta cingulata*, as Perrier pointed out; but none of these species are really identical with Schmarda's. It is, in fact, not a true *Perichæta* at all.

I shall refer to it here as

(4) Megascolex cingulatus, Schm.
(Pl. VII. figs. 9–13.)

Perichæta cingulata, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 14,
Non *Perichæta cingulata*, Vaillant, Ann. Sci. Nat. 1868, p. 225.
Non *Megascolex cingulatus*, Vaillant, Annelés, p. 72.

I refer this worm to the genus *Megascolex* principally on account of the fact that the setæ are not arranged in a perfectly continuous circle round each segment, but are interrupted by dorsal and ventral gaps, as, for instance, in *Megascolex cæruleus*.

The clitellum consists of five segments, viz. xiii.–xvii.; setæ are present upon all these segments, but vary in their numbers on different segments. The first segment of the clitellum, the thirteenth, has a complete circle of setæ marked of course by the same dorsal and ventral gaps as are the rows of setæ upon the pre- and post-clitellar segments. The fourteenth, fifteenth, and sixteenth segments have each three setæ

* "On *Megascolex cæruleus*, Templeton, from Ceylon," &c., Quart. Journ. Micr. Sci. vol. xxxii. pl. vi.

† "Note sur l'Anatomie de deux espèces du genre *Perichæta*," &c. Ann. Sci. Nat. t. x. (1868) p. 225.

upon each side of a median gap. The eighteenth segment has five or six setæ upon each side of the median gap.

Dorsal pores are present, and commence, as in *Megascolex armatus*, between segments v./vi.

The oviducal pores, as in *Megascolex* generally, are double; each pore lies in front of the innermost seta of segment xiv.

The male pores are upon segment xviii. No setæ lie between them; they are placed in the line of the setæ. Each pore is surrounded by prominent lips, and there is a genital papilla in front of and behind each pore; the papillæ in question are upon the boundary-lines between segments xvii./xviii. and xviii./xix.

In Schmarda's figure of the species the clitellum is depicted as commencing with segment xv.; but in the text it is stated to commence after the thirteenth.

When the worm was opened by a median dorsal incision the intestine was partially cut into; otherwise the viscera were uninjured. Five of the intersegmental septa were specially thick and appeared of a brownish colour, the thin septa being bluish or colourless. The first thick septum follows immediately after the gizzard; in front of the gizzard lies the first recognizable septum, which is also rather thick; between this and the septum following the gizzard is a thin septum. The thick septa are bound by numerous isolated muscular strands, which show interference-colours. The number of them appeared to me to be unusually great for so small a worm; they were particularly abundant in the gizzard-segment and in those lying in front of the gizzard.

The alimentary tract presents the usual divisions; the first four segments were occupied by the buccal cavity, pharynx, and a part of the œsophagus. The buccal cavity was largely everted; the pharynx did not present the compact appearance which is usual in this organ; the muscular fibres forming its dorsal wall and connecting it with the parietes were greatly broken up into bundles running chiefly in a longitudinal direction; this was no doubt due to the protrusion of the buccal cavity and the consequent pushing forward of the pharynx; the fifth segment was entirely occupied by the œsophagus—the gizzard lying in the two following; the fifth segment is not bounded posteriorly by a distinct septum, but the sixth and seventh are separated by a septum. The forward position of the gizzard and the presence of a septum dividing the two segments in which it lies are characteristic of the genus *Megascolex*, at least these features are not met with in *Perichæta* (*s. s.*). The terminal section of the œsophagus is exceedingly narrow, and the large intestine suddenly begins in the fifteenth segment, its calibre being three or four times that of the œsophagus.

The dorsal blood-vessel is single. The cerebral ganglia lie opposite to the furrow separating the first from the second segment; they may possibly have been pushed forwards with the everted buccal cavity.

There is only a single pair of spermathecæ, which in compensation are very large; they occupy nearly the whole of the available space in segment ix., and indeed they materially encroach upon the cavity of segment viii., of course pushing the septum which divides the two segments in front of them. Each spermatheca (fig. 10) consists of a large thin-walled sac (*sp*) filled with hard coagulated yellowish matter; this communicates with the exterior by a duct which is very thick-walled and has a metallic yellow colour; connected with the duct is an equally thick-walled, somewhat oval diverticulum (*d*), which becomes constricted just before joining the spermathecal duct; at this point it is furnished with two subsidiary diverticula (*d'*); each of these small diverticula is really double and consists of two globular sacs (fig. 11, *d'*) opening by a common duct. These minute sacs, less than a pin's head in size, are opaque yellow and contain sperm. The spermathecal duct after it is joined by the wide diverticulum becomes somewhat dilated and opens on to the exterior just below the mesentery dividing its segment from the eighth. So far as I could make out there appeared to be some slight variation in the number of the small pouches belonging to the diverticula; but as the specimen is a unique one I am not in a position to give details the recording of which would have necessitated the destruction of the specimen. The *sperm-sacs* occupy segments x. and xi.; I am not quite certain whether they reach the twelfth segment. The *atria* have the lobate form so characteristic of the Perichætidæ, but they are nevertheless rather unusual in one point of structure: in all atria of this kind of which I am acquainted with from figures or description or from my own dissections the muscular duct which leads to the exterior comes off from about the middle of the glandular mass, and is generally comparatively short and curved into a horseshoe-shaped form; in *Megascolex cingulatus* the atria lie on either side of the gut, to which they are closely attached; more generally one finds the atria adherent to the ventral parietes. They are long and narrow, and extend from the eighteenth to the twenty-fourth segment; although long and narrow, they have not the tubular form found in the atria of *Acanthodrilus* and other genera; they are composed of numerous lobules of various sizes. The duct, however, comes off from the anterior end of the atrium in the eighteenth segment; it is rather long and coiled, and opens on to the exterior without any terminal dilatation. The structure of the atria is thus very interesting, inasmuch as they present us with characters intermediate between the "lobate" and "tubular" form of atrium. As both forms of atria are met with in the Perichætidæ, though the lobate is the more common type, the intermediate condition is required.

Close to the point where the atrium perforates the body-wall on its way to the exterior is a sac containing penial setæ. These setæ differ (see fig. 13) from those of *Megascolex armatus*, the only other species of the genus in which they have been hitherto figured. They are sharply bent at the extremity, which is beset for a short distance with minute denticulations.

Corresponding to the papillæ which I have referred to in describing the external characters are four round white glands.

"*Perichæta brachycycla*," Schm.

This is also a *Megascolex*; there is nothing but the colour to distinguish it from *Megascolex cingulatus*, since the clitellum was undeveloped, and since I have not been able to compare the internal organs. As there is the colour difference I shall for the present assume the distinctness of the species, and rename it

(5) **Megascolex brachycyclus** (Schm.).

Perichæta brachycycla, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 14.
Megascolex brachycyclus, Vaillant, Annelés, p. 88.

The characters upon which Schmarda relied to distinguish the species from the others described by him was the form of the setæ; it is now known that the form of the setæ cannot be relied upon for the discrimination of the species of *Perichæta*. This is certainly my own experience, and Prof. Bourne, who has examined a large number of species, remarks that, except in special cases, the shape of the setæ "is of little use for classificatory purposes."

The dorsal and ventral gaps in the circles of setæ are not perhaps so well marked as in *M. cingulatus*.

The first dorsal pore is, as in that species, between segments v./vi.

The oviducal pores are double.

The male pores are upon the eighteenth segment; in front of and behind each of them is a genital papilla; these lie, as in *Megascolex cingulatus*, upon the intersegmental grooves xvii./xviii. and xviii./xix., but appear to be rather different in position, in so far as they are not precisely above and below the genital pore, but both outside of it.

(6) Perichæta viridis, Schm.

Perichæta viridis, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 13.
Megascolex viridis, Vaillant, Annelés, p. 87.

Beyond stating that this species is a true *Perichæta* I have no further observations to offer about it. None of the specimens were mature, and no distinctive characters could therefore be drawn up.

(7) Pontoscolex arenicola, Schm.
(Pl. VII. figs. 3 and 6.)

Pontoscolex arenicola, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 11 (in part).
Pontoscolex arenicola, Vaillant, Annelés, p. 198 (in part).

Under the same name Schmarda has confounded two perfectly distinct species, which should perhaps be referred to two distinct genera. As I have no means of knowing which specimen served as the type of the species, I shall regard those individuals with a clitellum consisting of eight segments as representing the species *Pontoscolex arenicola*, the others I shall call *Diachæta littoralis*. They have all the same habitat, occurring upon the seashore in the neighbourhood of Kingston and Port Royal, in Jamaica.

I suggested myself* a short time since that *Pontoscolex* might prove to be *Pontodrilus*, which I have received from Bermuda, where it is also found upon the seashore. This supposition proves to be incorrect. The genus is in fact, as Schmarda's figure would lead one to believe, identical with *Urochæta*; one of the two species at least is referable, in my opinion, to that genus. The others, those with a more extensive clitellum, may perhaps be more suitably placed in Benham's genus *Diachæta*.

Schmarda's diagnosis of the genus is as follows:—

"Quatuordecim series setarum alternas binas. Clitellum. Maricolæ."

In the figure illustrating this species the clitellum appears to be shown in a very unusual position, *i. e.* nearer to the posterior than to the anterior extremity. It is true that it is

* "Abstract of some Investigations into the Structure of the Oligochæta," Ann. & Mag. Nat. Hist., Jan. 1891, p. 96.

not lettered as clitellum; but no other structure is shown in the drawing which could be supposed to be the clitellum. And Schmarda states in the text that the clitellum is usually situated behind. The structure which Schmarda has mistaken for a clitellum is really nothing of the kind; it is formed (fig. 3 *a*) by a group of segments of a somewhat tumid appearance which project beyond the general surface of the body, such as Fritz Müller first described* in *Urochæta corethrura*. This remarkable point of similarity first directed my attention to the probable identity of *Pontoscolex* and *Urochæta*.

The clitellum, as a matter of fact, is anterior in position. Schmarda noticed that this was the case with some specimens. The error into which he fell is to be accounted for by the fact that in the specimen figured, as in many of those collected by him, the clitellum was not developed. In those individuals in which it is developed it occupies eight segments commencing with xv. Its extent therefore is precisely that of *Urochæta*, or, as it must now undoubtedly be called, *Pontoscolex corethrurus*. Schmarda counts seven setæ only in each segment, which alternate in position in successive segments from the very first. This enumeration is inaccurate; there are undoubtedly eight setæ per segment on most of the segments; occasionally on some of the posterior segments of the body I could only find seven, but this is most probably merely due to the loss of one seta. As to the alternation, this only occurs in some of the specimens; perhaps as this fact is the first distinctive point mentioned in the description of the genus I should refer to that genus the individuals which I describe later as *Diachæta littoralis*. As, however, that fact is not referred to in the description of the *species*, and as the figure seems to me to be a little more like the individuals possessing a clitellum of eight segments, I think that the name "*arenicola*" should be applied to them.

In this species, then, the setæ do not alternate from the very beginning; upon the first few segments (I am not certain how many) they are strictly paired; the two setæ of each pair are quite close to each other. In this the species resembles *Pontoscolex corethrurus*. But, unlike what is found in that species, the setæ are ornamented, as in *Rhinodrilus*, with a series of curved ridges. In *Pontoscolex corethrurus* some of the setæ are ornamented, viz. those upon the clitellum; in *Pontoscolex arenicola* the clitellar are also ornamented, but they only differ from the setæ of the preclitellar

* "Description of a new Species of Earthworm," Ann. & Mag. Nat. Hist. vol. xx. 1857, p. 13. See also my own observations upon the same structure in the same journal for January 1891, p. 95.

segments in their greater size. The posterior setæ have the same irregular quincuncial arrangement which occurs in *Pontoscolex corethrurus*; many of them are large; they vary in fact in size, but are never ornamented.

With regard to internal structure this species shows certain differences from *Pontoscolex corethrurus*; but they are not, in my opinion, sufficient to separate the two forms generically. The material was not in a sufficiently good state of preservation to allow of anything like a complete account of even the macroscopic anatomy, and I did not think it worth while to attempt any section cutting.

The alimentary canal presents the same characters originally described by Perrier * in *Pontoscolex* (*Urochæta*) *corethrurus*. The large gizzard is situated anteriorly, though I have not been able to fix precisely the segment or segments which it occupies. On each side of the gizzard is a large coiled "glande à mucosité." Schmarda has mentioned the fact that the œsophagus is furnished with "4 braune birnförmige Organe," which I take to be the calciferous glands or "glands of Morren" as they are sometimes called. I count, however, six of them, *i. e.* three pairs, as in *Pontoscolex corethrurus*.

Behind the gizzard are four stout mesenteries.

Behind these again lie two pairs of hearts.

Of the genital organs only the spermathecæ and the sperm-sacs were visible. I only found two pairs of spermathecæ, which lie behind the gizzard in the segment bounded by the two last thick mesenteries. Their form (see fig. 6) is rather different from that of the spermathecæ in *Pontoscolex corethrurus*. Each consists of a reniform pouch connected with a long duct which leads to the exterior. The sperm-sacs are tongue-shaped organs, as in *Pontoscolex corethrurus*.

In the posterior region of the body the "pyriform vesicles" characteristic of *Pontoscolex* were present.

(8) **Diachæta littoralis**, sp. n.
(Pl. VII. figs. 4 and 5.)

Pontoscolex arenicola, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 11 (in part).

Pontoscolex arenicola, Vaillant, Annelés, p. 198 (in part).

This worm, like *Diachæta Thomasii* †, has eight setæ in each segment, which alternate in position upon successive segments from the very first; and, as in that species, the setæ

* "Études sur l'organisation des Lombriciens terrestres. Anatomie des *Urochæta*," Arch. Zool. Exp. t. iii. (1874) p. 331.

† Benham, "Studies on Earthworms, No. II.," Quart. Journ. Micr. Sci. vol. xxvii. p. 89.

upon a given segment are separated from each other by wide intervals.

The setæ upon the general body-surface are not ornamented, which is a further point of resemblance to *Diachæta Thomasii*; but they were in a few cases unmistakably bifid, as in *Pontoscolex corethrurus*. It is seldom that the free extremity of the setæ in either of these species shows the bifidity clearly; they are generally apparently too much worn, and a faintly marked notch, readily passed over, alone indicates the cleft. It is quite possible, therefore, that *Pontoscolex arenicola* and *Diachæta Thomasii* may really possess the same notched setæ which Perrier first described and figured for "*Urochæta corethrura*." The setæ upon the clitellar segments are larger than some of the others and are distinctly ornamented with a series of crescentic ridges limited to the distal part of the seta. This particular form of seta is very characteristic of the Geoscolecidæ, particularly upon the clitellum, and the fact that similar setæ occur in *Criodrilus* is a strong argument for regarding that genus as being related to this family. Benham makes no remark about the clitellar setæ of *Diachæta Thomasii*. I may mention that this peculiar ornamentation of the setæ in the Geoscolecidæ often requires some looking for; it is not always very strongly marked.

As in the last species, there is no prostomium.

The clitellum is extensive, occupying segments xvi.–xxxi. Schmarda has mentioned that the clitellum sometimes consists of fifteen rings, commencing with the fifteenth.

The nephridia are furnished with those peculiar cup-like bodies at their termination which Perrier first described in *Pontoscolex corethrurus* and regarded as sphincters for the closure of the nephridial pore.

The spermathecæ (figs. 4, 5) are exceedingly long thin sacs, hardly, if at all, dilated at the blind extremity, where the semen is stored. There are here again only two pairs; each measures about 5 millim. in length, which is half the circumference of the worm in the region where they occur.

The mucous gland, gizzard, and thick mesenteries appear to be as in the last species.

"*Hypogæon orthostichon*," Schmarda.

This species clearly belongs to the family Cryptodrilidæ, which comprises the majority of the Australian earthworms: it is not a characteristic family in New Zealand—at present

Rhododrilus minutus * is the only member of the family known from that country; but I have specimens of another (undescribed) species, and if Captain Hutton is right † in referring his *Lumbricus lævis* and *L. uliginosus* to Perrier's genus *Digaster*, we have a third Cryptodrilid genus in New Zealand. "*Hypogæon orthostichon*" is not referable to either *Rhododrilus* or *Cryptodrilus*. It seems nearest perhaps to Fletcher's ‡ *Notoscolex* (= *Megascolides*, M'Coy). I am not at all certain that it belongs to that genus, for the definition given by Fletcher is not at all satisfactory; indeed the discrimination of the genera of Cryptodrilidæ is unquestionably the most difficult part of the classification of the Oligochæta.

As I do not wish, pending a revision of the Cryptodrilidæ, to add unnecessarily a new generic name, I shall describe Schmarda's species as

(9) Megascolides orthostichon (Schm.).

Hypogæon orthostichon, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 12.

I do not attempt to give here anything more than the most obvious characters, as I could only dissect one specimen, which I have been careful to injure as little as possible.

The setæ are in eight equidistant rows.

The clitellum is a complete girdle, and occupies segments xiv.–xvii. inclusive.

The male pores are upon segment xviii.; there appear to be no genital papillæ developed in their neighbourhood or anywhere else upon the body; the male pores correspond in position to the ventralmost setæ.

The gizzard is in segment v.

The nephridia are apparently of the "diffuse" type; they were not at all obvious.

The sperm-sacs are in segments x., xi., xii.

The ovaries are in segment xiii. The receptacula ovorum are present and occupy the usual position in segment xiv.

The atria are short and tubular in form; the chief part of the atrium is a white glandular tube which communicates with the exterior by a very short muscular duct. There appear to be no penial setæ.

* "On the Oligochætous Fauna of New Zealand, with Preliminary Descriptions of new Species," P. Z. S. 1889, p. 380.

† "Synopsis of the Genera of Earthworms," New Zeal. Journ. Sci. vol. i. p. 586.

‡ "Notes on Australian Earthworms," Proc. Linn. Soc. N. S. W. 1886.

The spermathecæ are two pairs and lie in segments viii. and ix. Each has a small diverticulum, pyriform in shape, like the main pouch.

(10) **Perichæta vitiensis**, sp. n.

The collection contained a single specimen of a *Perichæta* bearing the label "*Hypogæon*, sp. aff. *Hyp. orthostichon*, Schm. Viti Ins." It measures 75 millim. and consists of about seventy segments. The colour of the preserved specimen is a brownish yellow, grey upon the clitellum. The setæ are borne upon a very distinct ridge upon the middle of each segment. The clitellum occupies segments xiv.–xvi., ending a little way in front of the posterior border of the sixteenth segment. There are no setæ upon the clitellum. The male pores are transversely elongated, somewhat curved, slits lying upon two glandular-looking areas upon the eighteenth segment; between the two pores are about six setæ. The two pores are 3 millim. apart. The dorsal pores begin between segments xi./xii. The spermathecal pores (one pair) lie between segments vii./viii. on a line with the male pores. The oviducal pore is single and median upon segment xiv.

The gizzard lies in segments ix., x., the septum dividing those segments being absent. From the septum which bounds the gizzard anteriorly a number of muscular bands are given off which are attached to the dorsal parietes. There is only one very clearly defined septum in front of this one; behind the gizzard are four rather thickened septa. The large intestine commences in the fifteenth segment, and there are a pair of cæca not quite in the usual position; they appear to belong to segment xxiv. The dorsal vessel is single, and from about the thirtieth segment there are well-developed septal glands arising from the posterior septum of the segments, and in many cases forming a continuous mass lying above the dorsal vessel.

The sperm-sacs are in segments xi., xii.; each sperm-sac sends up a narrow tubular process which approaches its fellow in the middle dorsal line; the arrangement in fact recalls that found in *Perichæta Vaillanti*, where, however, the processes become fused, thus forming an arch round the intestine. I found one pair of testes in segment xi. attached to the front wall of the segment. The funnels of the vasa deferentia, of which there are also only a single pair, open in the neighbourhood of the testes; the septum dividing segments x./xi. seems to be made up of two layers, between which the funnel lies; but as the specimen is a unique one, I am not able to settle the position of the funnel quite definitely, as it would be probably necessary to cut sections. The main fact, however, to which attention is called is the occurrence of only *one* pair of testes and one pair of funnels. I believe that in all *Perichætæ* hitherto described there are two pairs.

The atria are very compact and lie in segments xvii.–xix.: the horseshoe-shaped duct, which arises from the middle of the gland, is at first tolerably wide; just before the external opening it becomes exceedingly narrow and opens through a small globular sac on to the exterior.

The ovaries are in the thirteenth segment. The single pair of spermathecæ lie in the eighth segment; each has a single diverticulum, of a chalky-white colour owing to the contained sperm.

The only species of *Perichæta* with one pair of spermathecæ are *Perichæta elongata*, *P. quadragenaria*, and *P. sangirensis*; but *P. vitiensis* differs from all of these in the possession of but a single pair of testes and vas deferens funnels. Is it identical with Grube's *P. subquadrangulus*, which also comes from Viti? In this case, as with most of Grube's species, it is impossible to distinguish the species from his data.

(11) Acanthodrilus Schmardæ.

The single specimen of this species was found in fresh water at Rockhampton (? in Queensland).

It measures about 60 millim. in length by 5 millim. in breadth. The clitellum occupies segments xii.–xvii., and is undeveloped ventrally; the grooves between the clitellar segments are very evident; dorsal pores are present, but I could not ascertain where they commenced. Segments iii.–x. are annulate, the middle segments showing three annuli. On segments xvii. and xix. are the atrial pores, of which the anterior marks the ventral edge of the clitellum, and between segments viii./ix. a pair of spermathecal pores.

The worm being much contracted and the internal organs softened I am not able to say so much as I could wish about the anatomy of the worm. The notes that I am able to give, however, are quite sufficient to distinguish the species. The dorsal vessel is single; the nephridia are paired structures. A gizzard is present, but I am not certain which segment it occupies; after the gizzard come five thick mesenteries.

The only organs of which I am able to give an adequate account, and they are fortunately the most important, are the spermathecæ and the atria.

The atria are two pairs lying in segments xvii. and xix. respectively; the anterior pair are much the larger; both are coiled tubular glands and both are furnished with penial setæ. The anterior larger atria are furnished with five of these setæ, the posterior smaller pair have only two. This was only the case, however, on one side of the body; on the right side there were only two to each atrium. They are curved in form and show a transverse striation such as is usually found in large setæ up to nearly the free tip. The free extremity of the setæ is not ornamented in any way.

There are apparently two pairs of spermathecæ. In describing the external characters I have referred to the external aperture of the second pair, which are considerably the larger. Supposing that during copulation the worms lie in opposite directions, as is the case with *Lumbricus*, the larger pair of spermathecæ would correspond to the larger pair of atria. Whether the difference in size is a question of maturity or indicates a commencing disappearance of one pair of atria and of the spermathecæ corresponding to them I am unable to conjecture. The larger spermatheca showed a protuberance on the inner side near to its external aperture; this I suppose to be a diverticulum. Behind the second pair of spermathecæ is a pair of oval glands of the same appearance but smaller than the spermatheca. Between the two glands was a sac containing one or two copulatory setæ; these are smaller than the penial setæ and of a somewhat different form, but resemble them in being unornamented at the tip. Behind this pair of glands is another pair apparently also furnished with penial setæ; but I am not certain as to this point or as to whether they lie in the same segment or in the next. Structures similar to these have been described in other species of *Acanthodrilus*—for instance in *A. Layardi**.

There are now four or five *aquatic* Acanthodrilids known.

EXPLANATION OF PLATE VII.

Fig. 1. Posterior extremity of *Anteus heterostichon*, to show the divergence of the setæ. *s*, ventral, *s'*, dorsal setæ; *n*, nephridiopores; *a*, anus.

Fig. 2. Genital segments of *Geoscolex maximus*. *D.V.*, dorsal blood-vessel; H, "heart" connecting dorsal with ventral blood-vessel; *As*, œsophagus; *Ca*, calciferous gland; *V.S.*, sperm-sac bent upon itself; *V.d.*, vas deferens; *At.*, atrium. The organs of the left side only are shown.

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* F. E. Beddard, "Note on the Structure of a large Species of Earthworm from New Caledonia," P. Z. S. 1886, p. 173.

Fig. 3. Posterior end of body of *Pontoscolex arenicola*. *n*, nephridiopores; *A*, anus; *a*, "growing region" figured by Schmarda as clitellum.

Fig. 4. Extremity of spermatheca of *Diachæta littoralis*. *a*, large peritoneal cells.

Fig. 5. A spermatheca of the same species.

Fig. 6. A spermatheca of *Pontoscolex arenicola*. *sp.*, pouch communicating with exterior by long duct.

Fig. 7. Setæ of *Anteus heterostichon*. *a*, clitellar seta; 7 *d*, its free extremity more highly magnified; *b*, one of the ordinary setæ drawn to same scale as *a*; *c*, extremity of this seta more highly magnified.

Fig. 8. Setæ of *Geoscolex maximus*. *a*, a seta from one of the terminal segments of the body; *b*, free extremity of one of the clitellar setæ.

Fig. 9. Ventral aspect of clitellar and neighbouring segments of *Megascolex cingulatus*, for explanation of which see text. The segments are numbered.

Fig. 10. *Megascolex cingulatus*. Spermatheca. *Sp.*, the main pouch of the spermatheca; *d*, diverticulum; *d'*, diverticula of this; *o*, external orifice.

Fig. 11. The smaller diverticula of one side of the same, more highly magnified.

Fig. 12. "Prostate" of the same, showing the duct given off from the anterior end.

Fig. 13. Penial seta of the same. *a*, a seta; *b*, the free extremity, more highly magnified.

XVIII.—*The* Lysianassides *of the 'British Sessile-eyed Crustacea,' Bate and Westwood.* By Alfred O. Walker.

Having lately been enabled, by the courtesy of the British Museum authorities, to inspect the collection of Amphipoda presented by the late Mr. Spence Bate to that institution, I venture to lay the results, so far as the Lysianassidæ are concerned, before your readers.

The collection consists of one hundred and fourteen tubes, containing Amphipoda, Caprellida, and two species of *Praniza*. The specimens are in methylated spirits. All the names are in the handwriting of the late Mr. Spence Bate, and are those of species included in the 'Brit. Sess.-eyed Crust.;' but many of the species in that work are not to be found in the collection. Time and London fog did not permit me to examine more than the Lysianassidæ, and the two species afterwards noted. It must be understood that the examination had to be carried on without dissection; nevertheless in most cases I was able, by immersing the specimen in glycerine, to make out the details with sufficient accuracy. I take the specimens in the order and with the names given in the 'Brit. Sess.-eyed Crust.' The numbers are those on the tubes.

Lysianassa Costæ, M.-Edwards (12).

The tube contains four specimens in good condition. Of these one only—the largest—is *L. Costæ* ♀; of the others two are *L. longicornis*, Lucas, and the remaining one not a *Lysianassa*—perhaps *Orchomene pinguis*, Boeck. Owing to the kindness of Dr. Norman in lending me mounted specimens of *L. longicornis* from the Adriatic, I arrived at the conclusion that not only were the two specimens mentioned above that species, but also that the species described by me* as *L. ceratinus* is a female of it, as suggested at the time. The characteristic spine projecting from the lower margin of the last joint of the peduncle of the upper antennæ is absent in both the specimens I had then obtained; but I have since dredged a specimen in the Menai Straits which has it partially developed. It is probably not fully developed till the animal is full-grown.

Lysianassa Audouiniana, Bate (11).

A single specimen in bad condition. It is impossible to make out any details without dissection.

Lysianassa atlantica, M.-Edwards (13).

The tube contains two specimens, of which one appears to be *Callisoma Kröyeri*, Bruzelius, and the other to be that figured in the 'Brit. Sess.-eyed Crust.' It appears to have been partially dissected, as one of the first and both the second gnathopods are missing. The telson is not "simple" as described, but cleft to the base, without lateral spines, but with a terminal spine in a deep notch in each division. This character, while it would remove the species from the genus *Lysianassa* to (probably) *Socarnes*, Boeck, at the same time agrees sufficiently with M.-Edwards's description, which says "Abdomen terminé par une lame bilobée." The first gnathopod is much too long and slender for *Socarnes Vahlii*, Kröyer. The third pleon-segment has the hinder angle acute and shortly recurved, but without a sinus, as in *Ichnopus spinicornis*, Boeck. No spine was observed on the peduncle of the upper antennæ, but there are two on the lower side of the first joint of the flagellum.

* 'Proceedings of the Liverpool Biological Society,' vol. iii. Session 1888–89, p. 200, pl. x. figs. 1–8.

Lysianassa longicornis (10).

One specimen in good condition and unmutilated. This is certainly not Lucas's species. By immersion in glycerine the first gnathopods could be plainly seen, with the details of the hand and wrist clearly defined. The hand is subchelate and corresponds exactly with that of *Orchomene Batei*, G. O. Sars, when compared with Sars's figures in his beautiful work on the Norwegian Amphipoda and with Dr. Norman's mounted specimens. It is needless to add that it is entirely different from that figured in Bate and Westwood's plate. It is certain that the mouth-organs figured could not have been taken from the specimen in the tube, which is, as I have said, unmutilated; and it therefore seems probable that the authors dissected a true *L. longicornis*, Lucas, figuring its mouth-organs and gnathopod, while they figured the entire animal and the tail from the specimen in the tube, which I have no doubt is a male *Orchomene Batei*, as long since suggested by G. O. Sars *. At the same time Mr. Stebbing † was fully justified in questioning this in view of the form of the first gnathopod figured by Bate and Westwood.

Anonyx longicornis, Bate. Not in the collection.
= *Lepidepecreum longicornis.*

Anonyx Edwardsi (15).

The tube so labelled contains several specimens of *Orchomenella ciliata*, Sars, the largest of which does not exceed 4½ millim. in length, and no other species. The measurement given by Bate and Westwood is $\frac{5}{20}$ inch, but the two lines indicating the length given above the figure are respectively this length (or, say, 7½ millim.) and 20 millim. It is therefore tolerably certain that the specimens now in the tube are not the same as that described and figured. This has been referred by G. O. Sars to *Orchomene Batei* ♀, at which it may stand.

Anonyx obesus, Bate (16).

One specimen, the details of which could not be made out without dissection.

* 'Oversigt af Norges Crustaceer,' 1882, p. 81.
† 'Report on the 'Challenger' Amphipoda,' p. 460.

Anonyx denticulatus, Bate (14).

Two specimens. These agree with Sars's *Hippomedon denticulatus* (' Amphipoda of Norway,' p. 56, pl. xx.).

Anonyx Holbölli (17).

One specimen, which agrees with Sars's *Hoplonyx cicada*, Fabr.,=*Anonyx gulosus*, Kröyer. It is not *A. Holbölli* (Kr.), as shown by Lilljeborg in 1865, who then referred it to *A. gulosus*, Kr.

Anonyx minutus.	Not in	the	collection.
—— *plautus.*	"	"	"
—— *longipes.*	"	"	"

Mr. Stebbing has suggested * that *A. minutus* of the work in question is the young of *Orchomene serratus*, Boeck.

Anonyx plautus, Kröyer, is now *Onesimus plautus*, Kröyer, of Boeck and others.

Anonyx longipes, Bate, is *Tryphosa longipes*, Bate, of Boeck, and *Tryphosites longipes*, Bate, of G. O. Sars's new work.

Anonyx ampulla (18).

This was shown by Dr. Norman in 1868, in his ' Report on Shetland Crustacea,' to be the male of *Anonyx* (*Tryphosites*) *longipes*. There is only one specimen in the tube, which has (unlike Bate and Westwood's figure and description) the flagellum of the upper antennæ perfect and very long. It appears to agree in the main with Sars's figure and description, except that the upper flagellum contains about thirty-eight joints instead of thirty and the telson has six pairs of spines instead of three, the fourth from the body being the longest. This may, however, be abnormal, or the animal may be a very old male.

Callisoma crenata, Bate.

Several specimens.

This concludes the Lysianassidæ of Bate and Westwood's work. It only remains to add that among the species stated on the labels of the jars to have been " destroyed or injured

* Ann. & Mag. Nat. Hist. 1876, ser. 4, vol. xvii. p. 431.

by the action of the spirit" was *Gossea microdentopa*, Bate. I succeeded in extracting three specimens from a mass of fungus, and was rewarded by discovering that it was the same species as that described by Bate in the 'Catalogue of the Amphipoda in the British Museum' under the name of *Pherusa fucicola,* Leach, at p. 145, and again under *Gossea microdentopa* at p. 159. This therefore adds another to the list of synonyms given by me in Ann. & Mag. Nat. Hist. 1891, ser. 6, vol. vii. p. 421, under the name *Pherusa Jurinii*, M.-Edw. It will not, however, involve any alteration in the generic name *Apherusa* proposed by me (Ann. & Mag. Nat. Hist. 1891, vol. viii. p. 83), because a genus of Cœlenterata was named *Gossea* by Agassiz in the same year (1862) as Sp. Bate's was published. It is therefore obviously more convenient that Agassiz's genus should be retained.

Pherusa bicuspis.

This, as I have elsewhere* shown, is not *Amphithoë bicuspis*, Kröyer.

Nant-y-Glyn, Colwyn Bay,
December 9, 1891.

XIX.—*On the Occurrence of the Genus* Equisetum (E. Hemingwayi, *Kidston*) *in the Yorkshire Coal-measures.* By Robert Kidston, F.R.S.E., F.G.S.

Until the description of *Equisetum Monyi* from the Comentry Coal-field by MM. Renault and Zeiller †, there was no satisfactory record of the occurrence of the genus *Equisetum* in Palæozoic times ‡.

* 'Fauna of Liverpool Bay,' 2nd Report, p. 173; 'Proceedings of the Liverpool Biological Society,' vol. ii. p. 173.

† 'Comptes-rendus Acad. d. Sciences,' Paris, January 5, 1885. Also see Renault and Zeiller, "Études sur le terr. houill. d. Comentry: Flore fossile," part ii. p. 394, pl. lvii. fig. 7 (Bull. de la Soc. de l'industrie minérale, 3e sér. vol. iv. iie livr. 1890: St. Étienne).

‡ Several specimens from the Coal-measures have been described under the name of *Equisetites*, but none of these examples are sufficiently perfect to enable one to form any definite opinion as to their true systematic position.

Some have placed the *Equisetites mirabilis*, Sternb., in *Equisetum*. The *Equisetites lingulatus*, Germar, is another species whose systematic position is not satisfactorily determined.

The specimen described by these authors is a portion of a stem about 4 inches long and about $1\frac{1}{2}$ inch wide at the broadest part. It shows portions of thirteen nodes bearing the characteristic toothed sheath of *Equisetum*. The channelling on the stem is feebly shown, but each rib ends in a tooth.

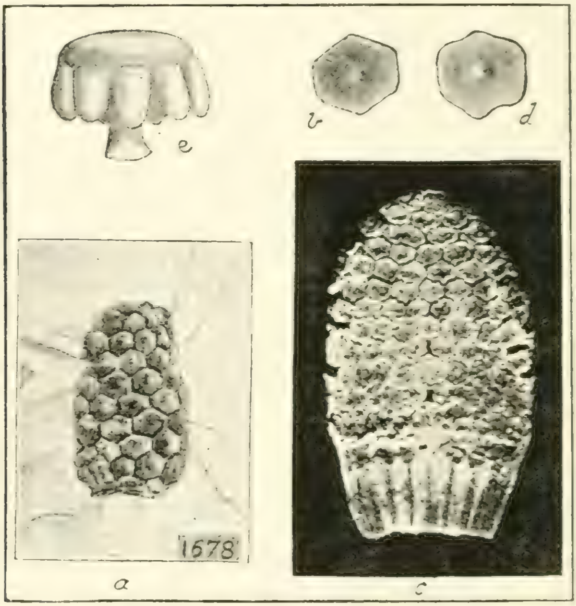
The specimens I now describe, and one of which is here figured, show the fructification of an *Equisetum*. They were collected by Mr. W. Hemingway, by whom they were communicated to me.

The first example of the fossil was received a couple of years ago, but the earlier specimens discovered were not well preserved and their true nature was not discerned. More recently I have received some fine specimens from Mr. Hemingway, which reveal the true character of the fossil.

The cones are about 1 inch long and a short distance above the base measure $\frac{6}{10}$ inch across. They are rounded at the base and have been attached to a thick stem, whose width can be ascertained by the concave fracture where the cone has separated from the stem. This "scar" shows that the top of the stem must have had a thickness of $\frac{3}{10}$ of an inch. From about a third above its base the cone gradually narrows upwards, and ends in a blunt apex about $\frac{4}{10}$ of an inch wide. The whole surface of the cone is covered with hexagonal plates whose diameter is from $\frac{2}{10}$ to $\frac{3}{20}$ of an inch. In the centre of these smooth plates is usually a slightly prominent point. There appear to be nine transverse rows of plates in the cone figured (woodcut fig. *a*).

On some of the other specimens the plates of the cone show three, seldom four, ridges running from the central point of the plate to the margin. These I believe to be due to shrinkage of the specimen before mineralization, and they do not occur on the specimen figured, which is the finest example I have seen.

For comparison I place beside the drawing of the fossil a figure of an immature cone of *Equisetum limosum*, Sm. (from which the sheath at the base has been removed), taken from a photograph of a herbarium specimen that has been compressed during drying. There is seen here in several of the plates the small central elevation, similar to what has been pointed out as occurring in the fossil (woodcut fig. *c*). Fig. *d* shows one of the peltate-shields of *Equisetum limosum* enlarged. Owing to the shrinkage of the cone in drying its hexagonal form is not so distinct as in the fresh state, but it exhibits the central point and the slight elevation of the margin of the peltate-shield. Fig. *b* gives one of the plates of the fossil, also enlarged, whose similar characters are observable. To return to fig. *d*, the central tubercle indicates the point at which the peltate-shield is attached to its stalk; hence there is a greater thickness of tissue at this part, and in drying the peripheral portions of the shield shrink more, and, being unsupported underneath, fall below the level of the centre, and thus the central tubercle is formed. One of the peltate-shields is shown in profile at fig. *e* *, which illustrates more fully their structure.



a. Equisetum Hemingwayi, Kidston. Nat. size.
b. Outer surface of one of the sporangiferous shields of *Equisetum Hemingwayi*. Enlarged.
c. Cone of *Equisetum limosum*, Sm. × $4\frac{1}{2}$; from a photomicrograph.
d. Outer surface of a sporangiferous shield of *Equisetum limosum*. Enlarged.
e. Sporangiferous shield of existing *Equisetum* seen in profile, to show central column and sporangia. Enlarged.

Now though the internal structure of the fossil cones is unknown, I think we are quite warranted in supposing that the central tubercle and slightly elevated margins of the plates

* From Maout and Decaisne, 'General System of Botany,' English ed. p. 904 (1873).

have been produced from similar causes. A comparison of figs. *d* and *b* almost demands this conclusion. Beyond evidence gained from an examination of the surface of the fossil there is none; but as all the characters exhibited on the outer surface of recent *Equisetum* occur on the fossils, I think I am quite justified in placing the Yorkshire specimens in the genus *Equisetum*.

It gives me pleasure to name this species after Mr. Hemingway, to whom I am much indebted for many interesting fossil plants from the Yorkshire Coal-field.

Before concluding these notes, I may add that the *Hippurites gigantea*, L. & H.*, from the Lower Coal-measures, Jarrow Colliery, of which the type is preserved in the Hutton Collection, and which MM. Renault and Zeiller thought might possibly belong to the genus *Equisetum*, is a portion of a stem of *Calamitina* (probably *Calamitina varians*, var. *insignis*, Weiss), and has no very close affinity with the genus *Equisetum*. I have examined the type, and the leaves appear to spring from the node, not as teeth of a sheath, as represented on their plate, but as free and independent organs placed close together †.

Equisetum Monyi, R. & Z., came from the Upper Coal-measures, whereas *Equisetum Hemingwayi* originates from the Middle Coal-measures.

Loc. Monckton Main Colliery, near Barnsley, and Woolley Colliery, Darton, near Barnsley, Yorkshire.

Hor. Shale over the Barnsley Thick Coal, Middle Coal-measures.

XX.—*Description of a new Frog from Burma.* By G. A. Boulenger.

[Plate IX.]

Rana Oatesii.

Vomerine teeth in two strong oblique series between the choanæ, their outer extremities nearly touching the anterior corners of the latter. Head depressed, longer than broad by the distance between end of snout and nostrils; snout long, pointed, and projecting; canthus rostralis obtuse; loreal

* 'Fossil Flora,' vol. ii. pl. cxiv.
† See Proc. Roy. Phys. Soc. vol. x. p. 370.

region concave; nostril much nearer to the end of the snout than to the eye; interorbital space as broad as the upper eyelid; tympanum very distinct, nearly as large as the eye. Fingers and toes rather slender, merely swollen at the ends; first finger extending distinctly beyond second; foot half as long as head and body; toes entirely webbed; subarticular tubercles rather feeble; inner metatarsal tubercle feebly prominent, oval, about one third the length of the inner toe; no outer tubercle. The tibio-tarsal articulation reaches halfway between the eye and the end of the snout. Skin finely granulate above; a prominent glandular lateral fold, about half as broad as the upper eyelid; another fold from the eye to the shoulder, followed by a prominent gland. Black above, uniform or marbled with pale brown, and with five whitish stripes, the middle extending from between the nostrils to above the vent, the upper pair running along the glandular lateral fold, the lower pair from the end of the snout along the upper lip, which is edged with brown, to the groin; sides of upper surface of snout and upper eyelids pale brown; limbs pale bronzy brown, with small black spots or marblings, which are confluent into longitudinal streaks on the sides of the tibiæ; hinder side of thighs black, spotted or marbled with white; lower parts white, uniform or spotted with brown. Male with a large, blackish, external vocal sac on each side below the mandible, extending from below the centre of the eye to the fore limb; a humeral gland.

From snout to vent, ♂ 80, ♀ 75 millim.

Several specimens were obtained near Toungoo by Mr. E. W. Oates.

This very handsome frog is most nearly allied to *R. humeralis*, Blgr., from which it differs in the longer head and the still more feebly developed digital expansions. The shorter hind limbs, the longer web between the toes, and the longer inner finger are characters which differentiate it at once from *R. macrodactyla*, Gthr., which has a somewhat similar coloration.

EXPLANATION OF PLATE IX.

Rana Oatesii, ♂, and side view of head and open mouth.

XXI.—*Note on* Toxotes microlepis, *Gthr.*, *and* Toxotes microlepis, *Blyth*. By G. A. Boulenger.

The important collection of reptiles and fishes recently made at Toungoo by Mr. E. W. Oates and presented by him to the British Museum, among which I found the new frog described above, contained several examples of a *Toxotes* which has appeared on all lists of Burmese fishes as *Toxotes microlepis*; Day * attributing the species to Blyth, Vinciguerra † to Günther. The fact is that two fishes were described independently and almost simultaneously by Günther ‡ from Siam and by Blyth § from Burma under the name of *T. microlepis*. Day assumed the two species to be identical, in which view he was followed by Bleeker ‖ and by Vinciguerra. Having compared the Burmese specimens with the Siamese types of *T. microlepis*, Gthr., I find them to be easily distinguishable both as regards structure and coloration. As Günther's name was published before Blyth's I propose to change the name of the Burmese species to *T. Blythii*. The diagnoses I have drawn up show the distinctive characters of the two species.

1. *Toxotes microlepis*, Gthr.

Depth of body one half total length (without caudal); fourth dorsal spine considerably longer than third; third anal spine but slightly longer than second dorsal, and shorter than the soft rays. Four black blotches or vertical bars on the upper part of the side.

2. *Toxotes Blythii.*

Toxotes microlepis, Blyth.

Depth of body not half total length (without caudal); fourth dorsal spine not or but slightly longer than third; third anal spine as long as third dorsal and nearly as long as the soft rays. Irregular black longitudinal blotches or stripes running along the body; a small black spot below the axilla.

* 'Fishes of India,' p. 117 (1875).
† Ann. Mus. Genova, (2) ix. 1890, p. 165.
‡ Cat. Fishes, ii. p. 68 (1860).
§ Journ. As. Soc. Beng. xxix. 1860, p. 142 (1861).
‖ Atl. Ichthyol. ix. p. 2.

Dimensions.

	T. microlepis.		*T. Blythii.*	
	Ad. millim.	Yg. millim.	Ad. millim.	Yg. millim.
Total length	150	80	163	78
„ „ (without caudal)	127	66	140	64
Depth of body	64	32	59	29
Length of head	44	26	48	26
Diametèr of eye	12	8	13	8
Length of 1st dorsal spine	9	5	9	$4\frac{1}{2}$
„ 2nd „ „	17	10	17	9
„ 3rd „ „	21	14	25	?
„ 4th „ „	26	16	26	13
„ 5th „ „	25	13	25	13
„ 1st anal „	13	6	13	6
„ 2nd „ „	17	9	19	10
„ 3rd „ „	18	11	25	14

XXII.—*On Strauch's* Triton longipes. By G. A. Boulenger.

In my revision of the newts, published in 1882*, I expressed the opinion that Strauch's *Triton longipes* † from Astrabad, N. Persia, should probably be considered a variety of *Molge cristata*, agreeing with var. *Karelinii*, Strauch, except in the more elongate digits. This view was endorsed shortly afterwards by Camerano ‡, who referred some Italian specimens (from the Gran Sasso) to subsp. *longipes*, not, however, without some hesitation. I am now in a position, thanks to the kindness of Dr. F. S. Monticelli, who sent me numerous specimens of *M. cristata* from near Naples, to state that *T. longipes* represents merely an individual variation of *Molge cristata*, var. *Karelinii*. Among the Naples specimens there is one, a male *post nuptias*, which is in every respect referable to *T. longipes*; its digits are extremely slender and elongate, all the fingers except the first extending beyond the snout when the fore limb is stretched forwards, and the longest toe reaching the elbow when the limbs are pressed against the body. As there exists in the same locality every passage between such a specimen and a normal *M. cristata*,

* Cat. Batr. Grad. s. Caud. 1882.

† Rev. Salam. Gatt., Mém. Ac. St. Pétersb. xvi. no. 4, 1870, p. 44.

‡ P. Z. S. 1884, p. 423, and Mon. Anf. Urod. Ital., Mem. Acc. Tor. (2) xxxvi. 1884.

var. *Karelinii*, it is clear that the form *longipes* cannot be upheld even as a subspecies. The measurements are here given of the specimen referable to *T. longipes* (*a*) and of a normal *M. cristata*, var. *Karelinii* (*b*), both males from Naples.

	a. millim.	*b.* millim.
Total length	108	108
From snout to cloaca	60	56
Head (skull)	14	14
Width of head	11	11
Fore limb	25	22
Third finger	8	6
Hind limb	28	22
Third toe	10	7
Tail	48	52

It must be borne in mind that the typical form also varies considerably as regards the elongation of the digits, and that Strauch's statement as to the proportions of the limbs in *M. cristata* applies only to females, which have the digits much shorter than in the males. It is quite clear, from the measurements given on p. 46 of his memoir, that the specimen from the Gov. Kursk, with which he compares the (male) type specimen of *T. longipes*, is a female; it need hardly be added that such a course, in a group of animals in which the secondary sexual characters are so highly developed, can only convey a fallacious impression, especially if no mention is made of the sexes of the specimens the measurements of which are tabulated.

XXIII.—*Note on the Gibbon of the Island of Hainan* (Hylobates hainanus, *sp. n.*). By OLDFIELD THOMAS.

IN his paper on the mammals of Hainan * Mr. Robert Swinhoe has given an account, mainly compiled from native authorities, of the Gibbon which inhabits that island; but no specimen appears hitherto to have been brought to Europe. The animal was referred by Mr. Swinhoe, with some doubt, to *Hylobates pileatus*, Gray, the Cambodgian species; but as he was unable to obtain a specimen, this reference has never been confirmed.

At length a specimen of this Gibbon has been presented to the British Museum by Mr. W. T. Lay, to whom it was

* Proc. Zool. Soc. 1870, p. 224.

brought alive from the island, and in whose care it lived for about four years in China.

The animal seems most closely to resemble *H. hoolock*, but differs from that, as from every other known species (except *H. syndactylus*), by the entire absence of the white superciliary streak, the animal being absolutely jet-black everywhere.

With the exception of the Siamang all the so-called species of *Hylobates* are so closely allied to each other and differ by characters of such slight importance that they seem to be really hardly worthy of specific distinction. Still for the present it seems better provisionally to recognize them as such, and unless they are all united it will be necessary to consider the Hainan form also as distinct, its differential characters being of very much the same value as in the cases of the other "species." I would therefore propose for it the name of *Hylobates hainanus*. At the same time I confess that I shall not be surprised to see this form reduced later to the rank of a subspecies.

Two species have, however, also been described as without the superciliary streak, namely *H. fuscus* * and *H. concolor* †. The former of these is distinguished from *H. hainanus* by its brown colour, apart from all question of locality, while the latter, based on a young specimen, and that an hermaphrodite, was a native of Borneo, and in all probability was the same as *H. Muelleri* ‡. Its youth and abnormality, however, render it impossible for this point to be settled with certainty, and in any case it can have nothing to do with the Hainan species.

H. hainanus appears to be of about the same size as *H. hoolock*, but the type, although nearly, is not quite adult. Its humerus measures 210 millim. in length, its ulna 250, and its femur 185.

XXIV.—*Diagnosis of a new Subspecies of Hare from the Corea.* By OLDFIELD THOMAS.

Lepus sinensis coreanus, subsp. n.

Size slightly larger and heavier than in the typical form.

Colour greyer throughout, the rufous tips to the hairs, especially on the rump and tail, being replaced by pale greyish fawn.

* Lewis, Bost. Journ. N. H. i. pt. 1, p. 32 (1834).

† Harlan, J. Ac. Philad. v. p. 229 (1827).

‡ See Anderson, Zool. Yunn. Exp., Mamm. p. 11 (1879).

Skull stouter and heavier. Nasals of more equal breadth throughout, not so markedly compressed and pointed anteriorly, nor so much bowed in profile. Frontal region broader, and the postorbital processes projecting much further out from the skull.

Dimensions.—Head and body (from skin) (c.) 450 millim., tail, with tuft, (c.) 60, ear from crown behind 83, hind foot 107.

Skull: greatest length, from occiput to gnathion, 83; nasals, greatest length 35, combined breadth anteriorly 15 (against 11·5 in a good Shanghai specimen of *L. s. typicus*), posteriorly 18·8 (against 19·2); least interorbital breadth 21 (against 18); least intertemporal breadth 12·2 (against 12·2); distance from the bottom of the postorbital notch to a point on the outer edge of the postorbital process level with it transversely 8 (against 5·4). Palate, length 34. Diastema 22. Breadth of palatal bridge 7. Antero-posterior diameter of bulla 10·5 (against 11·8).

Hab. Söul, the capital of Corea.

Type a skin obtained on Jan. 28, 1889, and presented to the Museum by Mr. Charles W. Campbell, of Her Majesty's Consular Service.

As the Museum at present possesses only summer skins of *L. sinensis typicus*, it is possible that the above differences in colour will prove to be only a seasonal character; but the skull differences are so marked and so constant in a series of S. Chinese skulls that I do not feel justified in allocating the Corean hare to the older-known form.

Should, however, the colour differences prove to be constant throughout the year it is possible that it will be found necessary to elevate *L. sinensis coreanus* to the rank of a distinct species.

XXV.—*Description of a new Species of* Meriones *from Palestine.* By Oldfield Thomas.

The Gerbille now described belongs to the group known as *Meriones*, a group which, in agreement with Brandt and Lataste, and differing from F. Cuvier, Blanford, and Büchner, I consider differs so essentially from *Gerbillus* as to merit its retention as a distinct genus.

I propose, in honour of its discoverer, to name the species

Meriones Tristrami, sp. n.

Size rather small, about equal to that of *M. meridianus*, Pall. Ears rather long and narrow, laid forward they reach beyond the middle of the eye. Fur long and soft. Colour above dull fulvous, grizzled with black, the general tone not unlike that of *M. Shawi*. Underside, hands, and feet white. Palms quite naked, granulated, with three small distal and two large proximal pads. Soles mainly hairy, but with a naked stripe running from the heel forwards to just past the tarso-metatarsal joint; distal part of sole cushioned, granulated, very thinly haired, with four minute pads at the bases of the digits and a rudiment of a fifth posterior internal pad just distinguishable. Tail grizzled yellow and brown above, with a small black terminal crest and pencil on its distal inch; uniformly yellow or white below.

Skull, for a *Meriones*, slender, narrow, and delicate, but little flattened and broadened across the parietal region. Bullæ very small for the genus, the neck of the auditory tube not dilated anteriorly towards the zygoma, as is the case in *M. meridianus* and other allied species.

Incisors slightly bevelled, each with a single groove. Molars of the most *Meriones*-like character, *i. e.* hypsodont, with lozenge-shaped laminæ connected with each other throughout.

Dimensions of the type (an adult male in spirit):—

Head and body 121 millim., tail 153, hind foot (without claw) 32, ear (above crown) 16.

Skull: greatest length (approximate) 37; length from bregma (junction of frontals with parietals) to nasal tip 25·5; zygomatic breadth 18·8; nasals, length 14·7, breadth 3·9; interorbital breadth 6·1; breadth across combined fronto-parietal sutures 12·5; (interparietal, length 5*, breadth 7·8*); length of ante-zygomatic plate 5·2; diastema 9·9; palatine foramina 6·8; bulla (greatest diameter 12·2 *), greatest diameter of tympanic portion 12·0, greatest breadth from lip of meatus at right angles to last measurement 8·7. Length of upper molar series 5·5.

A second specimen, a female, has the head and body 110, tail 126, and hind foot 29·5.

Hab. Palestine.

Type (B. M. 64. 8. 17. 35) from the Dead Sea; another specimen from Mount Carmel. Both collected by Canon H. B. Tristram.

* The measurements in brackets are taken from the smaller female specimen, owing to the imperfection of the skull of the type.

This appears to be the species referred with doubt by Canon Tristram * to "*Psammomys tamaracinus*, Kuhl," but is certainly not the true *Meriones tamaricinus*, Pall., a very much larger and heavier animal. Its nearest ally is perhaps *M. meridianus*, Pall.; but neither that nor any other species with which I am acquainted has such a narrow slender skull, so little broadened posteriorly. Its small and narrow bullæ also distinguish it from all its allies.

XXVI.—*The Polyzoa of the St. Lawrence: a Study of Arctic Forms.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plate VIII.]

[Continued from vol. iii. p. 433.]

Flustra solida, Stimpson. (Pl. VIII. figs. 1.)

Flustra solida, Stimpson, Marine Invertebrata Grand Manan, 1853; Hincks, "Polyzoa from Barents Sea," Ann. & Mag. Nat. Hist. 1880, ser. 5, vol. vi. p. 282, pl. xv. figs. 2, 3.

Eschara palmata, Sars, Beskriv. over nogle norske Polyzoer, 1862.

Escharella palmata, Smitt, Krit. Förteckn. öfver Skand. Hafs-Bryozoer, 1867.

Flustramorpha solida, Verrill, Proc. U.S. Nat. Mus. 1879.

This very interesting species occurs amongst the St.-Lawrence dredgings; it was obtained off Bear Head, Anticosti, at a depth of 120 fathoms. Besides the form described by Sars a small variety was met with which presents some notable peculiarities, to which I shall refer hereafter.

Zoarium erect, bilaminate, branched, attaining a height of about 3 inches, in the adult state composed of broad transversely separated segments, held together by epidermal tubular fibres, which traverse the surface of the zoarium and unite in their course downwards, so as to form cords of many strands, and ultimately give origin at the base to the fibrils by which the colony is attached to its site. *Zoœcia* linear-oblong, narrow, and usually of great length, inclosed by strongly marked boundary-lines and perforated round the sides, very moderately convex, surface smooth, commonly invested by an epidermal membrane, orifice broader than high, upper margin very slightly arched, sides nearly straight, lower margin decidedly curved outward, an articular process at each

* P. Z. S. 1866, p. 89.

extremity of the marginal curve, peristome not raised; immediately below the orifice an elongate linguiform *avicularium*, about a third of the cell in length, or sometimes (in the case of the dwarfer cells) about half the length, mandible pointing downwards. *Oœcium* broader than high, rounded above, and narrowing slightly towards the front, surface smooth and silvery, a number of roundish perforations and (in some cases) of narrow elongate fissures round the lower part of it, the central portion entire, or with a few scattered punctures.

Range. Spitzbergen; Greenland; Finmark; St. Lawrence; Barents Sea; Grand Manan.

The smaller form to which I have referred as occurring in the St. Lawrence is characterized by a very slender habit and by the narrowness of the segments which compose the zoarium. These differences might only indicate an earlier stage of growth, but there are others of more significance. There is a remarkable dissimilarity in the shape of the orifice. In the larger form (of which we have an admirable description from the elder Sars) it is subquadrangular ("rotundato-quadrangularis," Smitt), and the lower margin is occupied by a wide and shallow sinuation, stretching between the articular denticles (Pl. VIII. fig. 1 *b*). In the smaller form the orifice is rather taller than broad, the upper margin moderately arched, and the sides slightly curved, while in the centre of the interior margin there is a small but distinct rounded sinus (Pl. VIII. fig. 1 *a*). I was at first inclined to think that the latter might be a merely peristomial structure; but on detaching the opercula they were found to be furnished below with a projecting process corresponding exactly with the sinus. The orifice in this form is much more slender than in the other, and generally of a very different character. Notwithstanding these important differences it is difficult to believe that we are dealing with distinct species when we remember the remarkable similarity between the two forms in most of their characters. There is a difference, it is true, between the avicularia on the front wall, which produces an effect on the general aspect out of all proportion to its intrinsic importance. In the smaller form they are of very moderate size, and either circular or oval; in the other they are (prevailingly) large and linguiform. But such varieties of shape are too common amongst avicularian structures to have much systematic weight. Smitt long ago noticed the variability of the avicularium in his *Escharella palmata*, which was founded on the larger of the two forms with which I am dealing. His figures represent only a subquadrangular orifice. The

Eschara palmata of Sars seems to be referable to the same form *.

On a consideration of the whole question I can only suggest that probably we have to do with one of the species in which the orifice of the cells bearing the oœcium differs in structure from that of the ordinary cells. The larger specimens both from Barents Sea and the St. Lawrence were thickly covered with oœcia, and on these I have been unable to find an example of the orifice with the central sinus. On specimens of the smaller form from the St. Lawrence the *latter* was universally present. At the same time it must be admitted that the exclusive presence of one form of cell throughout fine and well-developed colonies affords a presumption against the explanation which I suggest. In similar cases the two classes of cell are always, so far as I know, mingled together. The alternative view would be that these forms are distinct species, which seems to be highly improbable.

Opinions have differed widely as to the precise systematic position of *Flustra solida*. Stimpson, who first described it, referred it to *Flustra*, to which it bears a certain amount of superficial resemblance; but there is no real affinity between the two. Sars ranked it in the old genus *Eschara*, simply on the ground of its zoarial habit, whilst Verrill placed it in the *Flustramorpha* of Gray, a genus since adopted by Busk for forms with a Microporellidan cell and an erect mode of growth. Such a genus can of course find no place in our later systems of classification †.

Smitt has discussed the affinities of this species in the light of the new views of which he has been so able an expositor, and assigns it a place in his genus *Escharella*, which (as finally limited) is identical with *Smittia* ‡. Undoubtedly there are points in which it agrees with the members of this genus, though the differences are by no means unimportant.

The orifice in such a species as *Smittia reticulata* before the development of the peristome bears the closest resemblance to that of *Flustra solida in its larger form*, the presence of a central denticle and of marginal spines being the only points of difference §. But Prof. Smitt had not met with the other form of orifice carrying a sinus on the lower margin, which

* In Stimpson's figure the avicularium is represented as small and suborbicular.

† Verrill makes the presence of "chitinous fibres strengthening the zoarium" the distinctive generic character. But this is common to many very dissimilar forms.

‡ 'British Marine Polyzoa,' vol. i. p. 341.

§ 'History of British Marine Polyzoa,' pl. xlviii. fig. 4.

indicates affinity with the Schizoporellidæ. Should further examination show that the orifice in *Flustra solida* is dimorphous, as it is in many of the Cheilostomata, and that the two forms which I have described are referable to one species, it will probably find a place in the above family. Unfortunately I have only had immature fragments of the so-called "smaller form," and though they have enabled me to ascertain with accuracy the structure of its cell-mouth, they do not furnish the means of determining with certainty the relation between the two forms.

A striking characteristic of *F. solida* is the epidermal covering of a uniform greyish tint which invests the surface of the zoœcia and occasionally of the oœcium also, though this is more usually free and retains its silvery lustre. The chitinous fibres which hold together the detached segments of the zoarium and also give origin to the organs of attachment are tubular extensions of the membranous covering of the cell * (Pl. VIII. fig. 1 *c*).

Monoporella spinulifera, Hincks, var. (Pl. VIII. fig. 3.)

Mucronella spinulifera, Hincks, "Polyzoa of the St. Lawrence," 'Annals,' May 1889, p. 431, pl. xxi. fig. 3.

This species was described and figured in the last part of this series of papers; but I have since met with a strongly marked variety (Pl. VIII. fig. 3), which should not be passed without notice.

Var. *præclara*.—*Zoœcia* much larger than in the common form, more convex and deeply divided; immediately below the orifice a large umbo, which frequently rises to a considerable height; oral denticle wanting.

The large size of the cell, the suboral umbo, and the absence of so distinctive a feature as the spinule on the lower margin materially affect the general appearance of the zoarium.

I have ranked this species in the genus *Mucronella*; but on reconsideration I am inclined to think that its affinities are rather with *Monoporella*.

Smitt has described and figured *M. spinulifera* † under the name *Discopora cruenta*, identifying it with the *Lepralia cruenta*, Norman, from which it differs essentially. He had

* See a paper by the author, "On new Hydroida and Polyzoa from Barents Sea," 'Annals' for October 1880, p. 282.

† "Kritisk Förteckning ofv. Skandinaviens Hafs-Bryozoer," Öfversigt af Kongl. Vetensk.-Akad. Förhandl. 1871.

previously ranked it as a form of *Microporella ciliata* ("*forma dura*") *. His figure of *Discopora cruenta* is a very good representation of the present species.

A peculiarity of the oœcium must not be omitted; the thick granular collar which incloses the orifice of the cell is carried up on each side, covering the lower part of the oœcium and concealing its oral arch. This is shown, though only partially, in the figure accompanying my last paper ('Annals,' ser. 6, vol. iii. pl. xxi. fig. 3).

The surface of the cells as calcification proceeds becomes granular and glistening; but in earlier stages it is thickly covered with minute pores, a line of somewhat larger size running round the margin.

Schizoporella cruenta, Norman (sp.). (Pl. VIII. fig. 5.)

Lepralia violacea, var. *cruenta*, Busk, B. M. Cat. pl. cx. fig. 1.

The figure of this species, taken from a St.-Lawrence specimen (Pl. VIII. fig. 5), shows a much more rugged condition of the surface than I have met with before. Even Busk's excellent figure, in which the two large nodules below the orifice are represented, gives no adequate idea of the extent to which these elevations of the surface may be developed. The suboral nodules seem to be almost always present on adult zoœcia; but in addition to these one is sometimes placed near the bottom of the cell, whilst the thickened upper margin of the peristome, which in its simplest condition is carried up into a central peak, is commonly broken up into two or more of the nodular prominences. At the same time the whole surface is furrowed and ridged and granulated.

The margin of the cell is occupied by a line of very large pores and a number are scattered over the front wall. The zoœcia near the margin of the colony are comparatively smooth and flattish and the nodules upon them merely rudimentary.

The figure of *S. cruenta* in my 'Hist. Brit. Mar. Polyzoa' was taken from a specimen in which calcification was not redundant, and does not present what must probably be considered the more usual aspect of the species.

A question may be raised as to the systematic position of this form. I have placed it in the genus *Schizoporella*, on the ground that "the orifice of the young cells is slightly

* "Kritisk Förteckn. &c.,' Œfversigt af Kongl. Vet.-Akad. Förhandl 1867, Bihang, p. 61, pl. xxiv. fig. 17.

sinuated in front," or, as the character is given in the diagnosis, "slightly channelled in front."

This character is not very strongly marked, and in the more highly calcified condition of the cell is often difficult to detect. On young zoœcia in the marginal region of the colony a shallow rounded sinus may be detected, though even amongst these cells not unfrequently occur in which the margin has all the appearance of being entire. In the case of older zoœcia, which are overlaid by a thick calcareous crust and the orifice is sunk in a comparatively deep shaft, the sinus will often be sought in vain.

It is right to add that Mr. S. O. Ridley, who obtained the species from Franz-Joseph Land, found the oral sinus "well marked in most, even old cells" *.

Lepralia pertusa, Esper. (Pl. VIII. fig. 7.)

There seems to have been a good deal of uncertainty about this species; I have therefore given a figure taken from a fine St.-Lawrence specimen in which the characters are well displayed. Smitt, in one of his later works †, identifies it with his *Escharella porifera* (a near ally, if not a mere variety, of *Smittia Landsborovii*), from which it is separated by important differences. Of Busk's figures one or two are referable to another species. Waters, in his 'Bryozoa of the Bay of Naples,' has recorded two varieties of *Lepralia pertusa*, both of which probably are quite distinct from Esper's species.

Schizoporella cincta, Hincks, var. (Pl. VIII. fig. 2.)

Lepralia cincta, 'Annals,' ser. 5, vol. xv. p. 254, pl. viii. fig. 6.

A variety of this New-Zealand species occurs amongst the St.-Lawrence dredgings which is distinguished by a peculiar condition of the cell-wall in the immediate neighbourhood of the avicularium. In the typical form a prominent umbo rises immediately below the orifice, bearing on its summit an elongate pointed avicularium, placed transversely. In the variety the umbo has disappeared or is reduced to a very slight and inconspicuous elevation forming part of a distinct area of the cell-wall, extending to a greater or less distance below the orifice, sometimes almost orbicular, sometimes elongate and stretching down about half the length of the cell. This area

* 'Annals' for June 1881, p. 449.

† Œfvers. Kongl. Vet.-Akad. Förhandl. 1878,—No. 7. Bryozoa from the Arctic Sea (Peninsula of Kola).

differs remarkably in appearance from the rest of the cell, which is of a brown colour and thickly covered with pores. It is smooth, dense, and of a whitish colour, showing very distinctly on the dark front wall. The avicularium lies across the upper part of it, immediately under the lower margin of the orifice, slanting slightly upwards. The whole structure probably represents the umbo of the normal form. Its effect on the general appearance of the cell is very striking.

The orifice in this species is wide and well arched above, but below the articular denticles, which are placed more than halfway down, it narrows off and terminates below in a curved line. The structure of the orifice would seem to connect it with the genus *Schizoporella* rather than *Lepralia*.

Membranipora armifera, Hincks. (Pl. VIII. fig. 4.)

Membranipora armifera, Hincks, "Contributions towards a General History of the Marine Polyzoa," 'Annals,' ser. 5, vol. vi. p. 82, pl. xi. fig. 5.

Some time since I described a species of *Membranipora* from the St. Lawrence under the above name; but it now appears that the specimen was immature on which the description was founded. Fortunately the occurrence of the perfect form enables me to revise and complete the diagnosis.

Zoœcia ovate, quincuncial, wholly membranous in front, margin rather wide, the inner border crenulate, two spines at the top, on each side (or sometimes on one only) a little below the upper margin an acute *avicularium*, placed obliquely on the top of a prominent bracket-like support, carinate in front, mandible directed downward, a tall and very stout articulated spine rising from the margin close to one or (occasionally) both of the lateral avicularia, immediately below the cell a large mounted avicularium. *Oœcium* rather large, much broader than high, surface smooth and entire, a prominent rib across it a little above the oral arch, and at the top a large elongate avicularium placed obliquely and stretching along one side of the cell above, mandible pointed.

Hab. On shell and stone, and incrusting *Flustra membranaceo-truncata*, Smitt.

Commonly only one of the lateral avicularia is present, and the large articulated spine takes the place of the other. In some cases both avicularia are present, each with an attendant spine. When the oœcium is developed it adheres to the avicularium at the base of the cell above, which appears as if it were a part of it.

This species is nearly allied to *M. unicornis*, Fleming.

Porella concinna, Busk (granular var.). (Pl. VIII. fig. 6.)

I have already referred to the variability of this species in superficial character. The figure represents a highly granular form, which I had supposed to be (probably) the *Lepralia Belli* of Sir J. W. Dawson *. The latter indeed is described as having a sinuated orifice, a character which does not belong to any variety of *P. concinna*. Still it seems more than probable, taking all things into consideration, that *L. Belli* is nothing more than a form of this variable species. Specimens are of common occurrence in which the cells are separated by a distinctly "sinuous furrow," which is one of the diagnostics of Sir W. Dawson's species.

Cellepora canaliculata, Busk.

Cellepora canaliculata, Busk, 'Challenger' Report, part i. p. 204, pl. xxx. fig. 5.

This species seems to be not uncommon. It forms small nodular masses, which incrust the stems of Hydroida. It was first obtained on the 'Challenger' voyage in the neighbourhood of Halifax, Nova Scotia, in 51 fathoms.

The *oœcium* was not observed. It is globose, of comparatively large size, much broader than high, rather prominent in front, oral arch wide and shallow, surface smooth, shining, entire.

Lagenipora spinulosa, Hincks.

Lagenipora spinulosa, Hincks, "Polyzoa of Queen Charlotte Islands," p. 31 (sep.) and 40: 'Annals,' ser. 5, vol. xiii. pl. iii. fig. 4, and pl. ix. fig. 4.

This very interesting form occurs abundantly. It has only been noticed previously amongst Dr. G. M. Dawson's dredgings from the Queen Charlotte Islands. It is probably an Arctic form. The St.-Lawrence specimens hitherto met with are all crustaceous in habit, overspreading the stems of Hydroida. The erect branching form obtained at the Queen Charlotte Islands has not occurred.

Smittia Landsborovii, Johnston.

There has been some confusion about this species, and the identification is not always to be trusted. Smitt has ranked

* 'Contributions to Canadian Natural History,' by W. S. M. D'Urban and Robert Bell; Polyzoa, p. 32. (Extracted from the Report of the Geological Survey for 1858: Montreal, 1860.)

two or three forms under it which must, I think, be accounted distinct *. Amongst the St.-Lawrence dredgings the true typical form is not by any means common; the species is represented chiefly by the variety *porifera* of Smitt. One specimen has occurred to me which, in addition to the ordinary characteristics of *S. Landsborovii*, is furnished with the large spatulate avicularia, which are rarely developed and always in connexion with the oœcium.

Myriozoum planum, Dawson.

Myriozoum crustaceum, Smitt, Krit. Förteckn., Œfversigt Kongl. Vet.-Akad. Förh. 1867, Bihang, p. 114.

This species was first described as *Lepralia plana* by Sir J. W. Dawson in 1858. His account of the species is contained in a paper on the Polyzoa of the Gulf of St. Lawrence, published in the Report of the (Canadian) Geological Survey for 1858. It was afterwards (1860) reprinted along with other papers on the fauna of Canada by Messrs. D'Urban and Robert Bell, under the title 'Contributions to Canadian Natural History.' This paper seems to have been entirely overlooked, and in 1867 Prof. Smitt described the present form under the name of *Myriozoum crustaceum*. Sir W. Dawson's diagnosis may not be as full and minute as we should now desire, but it indicates the general character of the species, and his name has as good a claim to be retained as those of a large proportion of the older writers.

EXPLANATION OF PLATE VIII.

Fig. 1. *Flustra solida*, Stimpson, with sinus. 1*a*. Outline of orifice of smaller form. 1*b*. Ditto of larger form. 1*c*. Showing the connexion between the epidermal covering of the cell and the tubular fibre.
Fig. 2. *Schizoporella cincta*, Hincks, var.
Fig. 3. *Monoporella spinulifera*, Hincks, var. *præclara*.
Fig. 4. *Membranipora armifera*, Hincks.
Fig. 5. *Schizoporella cruenta*, Norman.
Fig. 6. *Porella concinna*, Busk, granular variety.
Fig. 7. *Lepralia pertusa*, Esper.

XXVII.—*On the Development of* Dreissena polymorpha, *Pallas*. By Dr. Eugen Korschelt †.

The development of *Dreissena* is particularly interesting because, for reasons which will be discussed forthwith, we

* Brit. Mar. Polyzoa, p. 345.

† Translated from a separate impression from the 'Sitzungs-Berichte der Gesellschaft naturforschender Freunde,' no. 7, Jahrg. 1891, pp. 131–146. Communicated by the Author.

might in its case expect to find free-roving larvæ (in fresh water). Chiefly on this account I endeavoured during the summer of last year to elucidate the hitherto unknown reproduction and development of this mollusk. At that time my investigations were undertaken too late; but with the commencement of spring of the present year I recommenced my observations and persevered with them until I finally succeeded in deciding this question. I would remark at the outset that in the following pages I have no intention of giving a detailed account of the development of *Dreissena*. My observations were, as I have already hinted, directed chiefly towards the one point of the presence or absence of free-roving larvæ. Moreover they were really intended to partake of an orientating character, in order to determine the time and manner of the reproduction of *Dreissena*, and thereby to facilitate a subsequent minute investigation of the development, since this was not possible for me this year on account of other tasks which could not be postponed. Meanwhile it is already possible to determine the leading features of the development of *Dreissena*, so that a communication on the subject will not be unwelcome.

As a general rule development by means of free-roving larvæ provided with a velum is characteristic of the Lamellibranchs. Nevertheless an exception is formed by the freshwater mussels. As is frequently the case in freshwater forms, *e. g.* in the Annelids, Turbellarians, &c., these creatures adopt a direct development with the freshwater existence, and abandon the original method by means of free-roving larvæ. Thus we see that the freshwater mussels have already assumed the adult form on leaving the mother (*Cyclas*, *Pisidium*) or else pursue a course of development in which larvæ indeed appear, but which is at once recognizable as having undergone secondary modification and considerable adaptation to the present mode of life of the mussels (Unionidæ). *Cyclas* and *Pisidium* exercise a brooding-process, since they form a kind of brood-pouches within the gills, in which the eggs develop until the formation of the perfect animal is almost complete. Nevertheless these mussels pass through a stage in which the embryo is to be considered equivalent to the free-roving larva, which has been compared to the *Trochophora* of the Annelids. The velum of the larvæ of marine mussels is indicated by an area of cilia in the embryo of *Cyclas*; in this case therefore we may speak of a rudimentary velum *. Moreover it possesses a primitive kidney, the

* E. Ziegler, "Die Entwicklung von *Cyclas cornea*, Lam.," Zeitschr. f. wiss. Zool. 41 Bd., 1885.

excretory organ which is so important for the *Trochophora*-larva (E. Ziegler). With this we have the chief characteristics of the *Trochophora*, but this stage which repeats the *Trochophora* in a modified condition merely represents a transitory period of the embryonic development. In the case of the Unionidæ the typical form of the Lamellibranch larva receives even less expression. Here the velum is entirely wanting, and a tuft of cilia in the anal region is all we have to remind us of the free-roving larva *. The ova of the Unionidæ likewise develop in the gills, and the larvæ which are expelled from them, provided with shells and shell-hooks, have already reached a tolerably advanced stage of development—with the free-swimming larvæ of marine Lamellibranchs they have nothing in common. As is well known, they attach themselves to fishes, upon which they live parasitically for a time †. This mode of life at once bears witness to the extent of the adaptation which they have undergone, and which explains the striking transformation of their organization as also the various modifications of their early developmental stages ‡.

Since the development of the freshwater mussels which have been mentioned exhibits so greatly modified conditions, it seemed interesting to ascertain how *Dreissena* behaves in this respect. As a near ally of the common mussel *Dreissena* possesses more the character of a marine form, and we might therefore expect to meet with free-roving larvæ in its case, a most unusual phenomenon for freshwater mollusks. On the other hand, it appears to follow from the manner in which *Dreissena* is supposed to have entered our waters that it has long been accustomed to a freshwater existence, and thus perhaps an influence might also have been exerted upon the development. It appears that *Dreissena* has been derived from the region of the Euxine. It probably penetrated into our waters by continually travelling further up stream from the wide mouth of the Volga §. At any rate it was transported by connecting canals into those water-courses also

* C. Schierholz, "Ueber die Entwicklung der Unioniden," Denkschrift. k. Akad. Wiss. zu Wien, Math.-naturw. Cl. 45 Bd., 1889.

† M. Braun, "Postembryonale Entwicklung von Anodonta," Zool. Anz. 1 Jahrg., 1878.

Schierholz, *op. cit.*

F. Schmidt, "Beitrag zur Kenntniss der postembryonalen Entwicklung der Najaden," Arch. f. Naturgesch. 51 Jahrg., 1885.

‡ A. Goette, "Bemerkungen über die Embryonalentwicklung von *Anodonta piscinalis*," Zeitschr. f. wiss. Zool. 52 Bd., 1891.

§ E. von Martens, "Eine eingewanderte Muschel," Der Zoologische Garten, 6 Jahrg., 1865.

which open into the Baltic. Finally, and probably in a similar fashion, it also reached our rivers, and there wandered up stream, until at last it attained its present wide distribution *.

It has been reported from the Caspian Sea that *Dreissena* sometimes still occurs among marine mussels, though even here it confines itself to water which is less rich in salt, and is only found in the estuary of the Volga, which is probably largely impregnated with fresh water. Other truly marine mussels, such as *Cardium*, have been found in its vicinity in a dead state. In the Baltic it lives only within the bays, and it is interesting to note that here it seems to endure the strong salt water even less than a freshwater snail, *Neritina fluviatilis*, since the latter is found on the outer side of breakwaters, while *Dreissena* occurs only on the inside (E. von Martens). In a verbal communication Prof. von Martens is decidedly of the opinion that *Dreissena* now really lives in fresh water only.

Dreissena polymorpha is consequently to be regarded more as a freshwater mussel than as a marine form. We see that the question as to how it behaves with reference to its development is thereby brought still more closely home to us, for it would always be possible that a modification had set in in the mode of development. It is true that the small changes in the organization of the mussel itself do not support this theory. I was therefore able to search for the larvæ of *Dreissena* with some prospect of success. Since the mussel is of frequent occurrence near Berlin, and is even found in abundance in Lake Tegel, a successful treatment of the problem was rendered the more easy.

Although it appeared to me to be probable that reproduction took place in the spring, I nevertheless examined a considerable number of the mollusk in August of last year, and found them only moderately provided with sexual products or almost entirely destitute of them. However, the very small size of the ripe ova appeared to me even at that time to confirm the supposition of a free development.

This year from March onwards I watched the setting in of the breeding-season both in the case of the *Dreissena* of

* In the discussion on this point attention was drawn by Prof. Nehring to the fact that *Dreissena polymorpha* previously occurred in North Germany, and has been found in the Diluvium of East and West Prussia, as he informed the 'Gesellschaft' some years ago (Sitzungs-Ber. 1883, p. 68, "Ueber das fossile Vorkommen von *Cervus dama*, *Cyprinus carpio*, und *Dreissena polymorpha* in Norddeutschland"). It is supposed that *Dreissena* (probably owing to unfavourable climatic conditions) was driven away, and subsequently immigrated once more.

Lake Tegel as also in that of the mussels which are preserved under the most favourable possible conditions of existence in the reservoir of the garden of the Zoological Institute here. In the case of two of the latter, which had been obtained from Tegel only a short time before and placed in the reservoir, I observed as early as the middle of May the deposition of a large number of ova, which were found in each instance in a cohering mass near the mussel. These eggs did not develop, but soon perished. It was not until the middle of June that the deposition of ova was observed once more, and shortly after this the normal reproduction and development commenced. Whether it was merely retarded this year in consequence of the peculiarly low temperature of the spring, or whether it always takes place at this relatively late season, can only be determined by the observations of future years.

The very small ova of *Dreissena polymorpha* are deposited freely in the water; they are only surrounded by an extremely delicate envelope and are very scantily supplied with yolk. This very condition of the ova was evidence of the occurrence of free-roving larvæ. The method of oviposition is as follows. The mussel slightly opens the valves of its shell, and, quickly closing them again, a little ball of ova is extruded. This process is repeated several times and is readily observable in the aquarium by arranging the proper time. The balls of ova, which do not at once lose their cohesion, appear like little whitish lumps of mucus.

The unequal segmentation of the ova exhibits a great agreement with that of other mussels, as described by Lovén, Flemming, Rabl, Hatschek, Ziegler, Horst *, and others. The same is also true on the whole for the subsequent developmental stages, which will receive a detailed description at a later date, and will here be considered only in so far as they are necessary for the comprehension of the development of the larval form. These processes present a quite peculiarly close approximation to the conditions which obtain among the marine mussels, which is not to be wondered at for the very reason that they soon lead to the same result.

An expansion of the primitively narrow segmentation-

* W. Flemming, "Studien in der Entwicklungsgeschichte der Najaden," Sitzungs-Ber. Akad. Wiss. Wien, Math.-nat. Cl. 51 Bd., 1875.

C. Rabl, "Ueber die Entwicklungsgeschichte der Malermuschel," Jenaische Zeitschr. Naturw. 10 Bd., 1876.

R. Horst, "Embryogénie de l'huître (*Ostrea edulis*)," Tijdschrift Nederlandsche Dierkundige Vereenigung, Supplement, Deel i., 1883–84.

"On the Development of the European Oyster," Quart. Journ. Micr. Sc. vol. xxii., 1882.

cavity takes place, and with this the embryo which has arrived at the Gastrula-stage assumes a roundish oval shape. The rudiment of the intestine arises by the growing inwards from in front of an ectodermal invagination towards the endodermal portion (the subsequent mid-gut); this is the foregut, which afterwards unites with the endoderm. The hind-gut appears to arise in a similar way, though it was impossible to decide this with certainty. I have likewise been hitherto unable to determine satisfactorily the origin and further differentiation of the mesoderm. At an early period mesodermic cells may already be observed in the primary body-cavity, scattered about or collected together in groups, yet a doubt must be allowed to exist as to their relation to the mesodermic bands, which have been described for other mussels, and as to whether these bands are present in so definite a form.

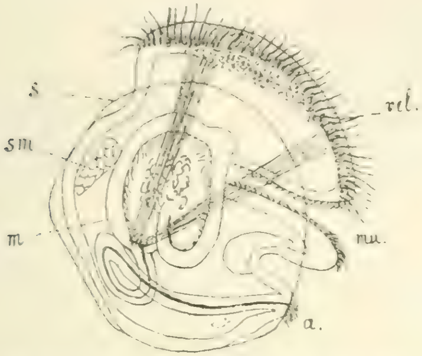
Before the development of the intestine has yet proceeded so far as has been indicated above there has appeared, in the shape of an invagination of the ectoderm, the rudiment of another organ of extreme importance for the development of the Lamellibranchs; this is the shell-gland. The embryo, or more correctly speaking the larva, assumes a broadly pear-shaped form. The widening of the anterior portion is especially pronounced: while even at an earlier period scattered cilia appeared at different parts of the body and caused it to rotate, they are now found packed more closely together on the thickened anterior portion, and here form a ciliated ring, which indicates the rudiment of the velum. This stage exhibits the greatest similarity to the marine larvæ (of *Modiolaria* and *Cardium*) which are figured in Lovén's paper*. We now have the *Trochophora*-larva of *Dreissena* before us, and it is an interesting point that this stage, which in the case of other freshwater mollusks (*Cyclas*, *Pisidium*, and Gastropods) is passed through in a more or less modified form within the egg-membrane, *i. e.* during the embryonic development, is preserved as a free-swimming stage in the case of *Dreissena*. The Annelids, too, which live in fresh water or upon the land (Oligochætes and Hirudineans), pass through this stage, as is well known, only in a modified condition within the cocoon, so that free-swimming Trochophora-larvæ were not known in fresh water.

Still essentially in the *Trochophora*-stage is also the somewhat older larva, in which the shell-membrane has con-

* S. Lovén, "Beiträge zur Kenntniss der Entwicklung der Mollusca acephala lamellibranchiata," aus den Abhandl. der k. Schwed. Akad. Wiss. für das Jahr 1848 im Auszuge übersetzt: Stockholm, 1879.

siderably increased in size, and already presents the appearance of the bivalve mussel-shell (fig. 1). This condition of the larva, apart from the processes which take place in the interior, continues for a long time. As it is peculiarly characteristic, and is useful for the discovery of the larva, a few sketches of it are given herewith.

Fig. 1.



Younger larva of *Dreissena*, with bivalve shell (*s*) and velum (*vel.*), seen from the side. *a*, anus; *m*, stomach; *mu*, mouth; *sm*, adductor muscle.

Before all things important and characteristic is, besides the shell, which is at first delicate and composed of a thin cuticular membrane, and subsequently somewhat stouter, the extensive velum.

The velum appears as, so to speak, a fleshy organ, which is beset with stout cilia at its margin. It possesses a peculiar pigmentation, which greatly increases with the age of the larva (figs. 1 and 2). Fig. 1 shows the velum as seen from the side in a younger larva, and the following figures exhibit it in older larvæ in different positions. From fig. 3, which represents an older larva seen from the side, it is evident what a considerable size the velum may assume.

The larva is usually observed as represented in fig. 2. It swims on the surface of the water, with the velum directed upwards. In front and behind we see the valves of the shell projecting beneath the expanded velum (figs. 2, 3). The ciliary movement is most readily comparable to the rotation of a circular saw, since only a certain number of the cilia are extended simultaneously, while the interjacent ones appear to be bent. Sometimes the whole of the cilia are stretched straight out. The motion of the larva is very rapid, and generally takes place in such a way that the deeply pigmented spot (*pi*), which is observable in fig. 2, is directed

Fig. 2.

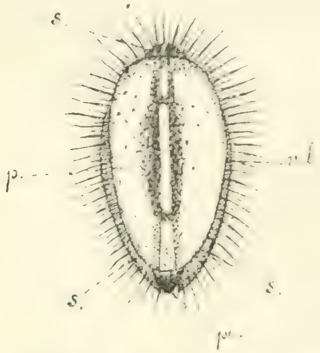


Fig. 3.

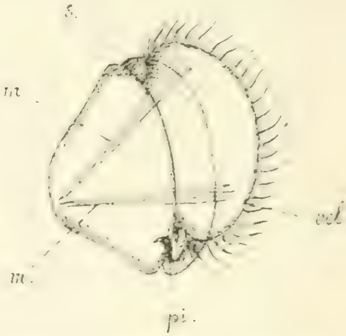
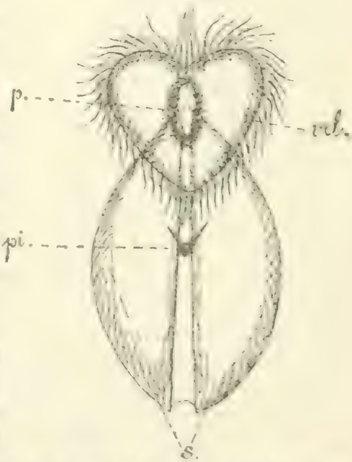


Fig. 2.—Larva of *Dreissena*, looking down from above upon the velum, which is fully expanded. *p*, pigmentation of the velum (*vel.*); *pi*, pigment beneath the oral opening; *s*, shell, which is for the most part concealed by the velum.

Fig. 3.—Older larva of *Dreissena*, with velum greatly expanded, seen from the side. *m*, retractor muscles of the velum (*vel.*); *pi*, pigment; *s*, the two valves of the shell.

towards the rear. When swimming at full speed the larva suddenly halts, and for a longer or shorter time imparts a spinning motion to its velum without moving from the spot. At the smallest disturbance the velum is retracted, the valves of the shell, which are only slightly opened, close with a snap, and the larva sinks to the bottom.

Fig. 4.



Older larva of *Dreissena*, with expanded velum (*vel.*), which in the figure is viewed obliquely. *p*, pigmentation of the velum; *pi*, pigmentation in the vicinity of the mouth; *s*, the valves of the shell.

A striking feature is the bilobed character of the velum; this is especially noticeable at the commencement of expansion, but is also visible in certain positions in the fully expanded state (fig. 4). This condition reminds us strongly of the bilobed velum of the Gastropods. Attention has moreover already been drawn by Ziegler to a similar state of things in the reduced velum of *Cyclas*; yet this condition is not noticeable in *Cyclas* until later stages of development, and owing to the great degeneration which has taken place in the velum in this instance it is less distinctly visible.

The larvæ of *Dreissena* are very minute, and are exceeded in size by various pelagic Infusoria of Lake Tegel. Indeed at first sight they themselves produce the impression of an Infusorian provided with a strong adoral zone of cilia, or they might be mistaken for a Rotifer if the velum happens to be in active rotary motion.

At the season at which the majority of *Dreissena* are engaged in reproduction, this year, therefore, towards the end of the month of June and the beginning of July, the larvæ occur in large numbers on the surface of the water, so that with the help of the fine pelagic net it is then easy to procure material.

The chief features in the larval organization are recognizable from fig. 1—the bivalve shell (figs. 2 and 3, *s*), the velum with its retractors, and a ciliation, also found in the larvæ of other mussels, in the neighbourhood of the anus. As in the *Trochophora*, the oral opening lies behind the powerful zone of cilia of the velum. In older larvæ there appears behind the mouth a peculiar pigmentation, which often has a bilobed appearance (figs. 2–4, *pi*), and which I was at first inclined to regard as the earliest indication of the byssus-gland; the position of the latter, however, would not well agree with this. A closer investigation of the subsequent stages will be necessary before we can decide whether a more important significance attaches to this formation. The fore-gut, which is marked off tolerably sharply from the mid-gut, leads into the wide stomach, upon which two cæcum-shaped evaginations doubtless represent the rudiment of the liver. At an early period the section of the intestine following the stomach forms a coil, which subsequently increases in extent when a lengthening of the intestine sets in.

On the dorsal side the adductor muscle appears early (fig. 1). I have not as yet been able to determine with certainty the nature of a thickening which is found between mouth and anus, yet I am inclined to regard it as the rudiment of the pedal ganglion, owing to the great agreement between its position and that of the pedal ganglion described by Hatschek for the *Trochophora* of *Teredo* *.

It would have been very desirable to settle the presence of the primitive kidney in the *Trochophora* of *Dreissena*, yet in the short time which I was able to devote to the investigation of the younger larval stages I did not succeed in finding it.

* B. Hatschek, "Ueber Entwicklungsgeschichte von *Teredo*." Arbeiten Wien. Zool. Inst. 3 Bd., 1881.

Since this larval organ has not only been proved to exist in the free-swimming *Trochophora* of *Teredo* (Hatschek), but was also described for the very degenerate *Trochophora* of *Cyclas* (Ziegler), it is hardly open to doubt that it is present in *Dreissena* also; the more so since the agreement of the larvæ of Dreissena with those of the marine Lamellibranchs is in other respects complete—a fact to which I would call attention once more. This appears in a peculiarly striking fashion on instituting a comparison with the figures which Lovén (*loc. cit.*) gives of various larvæ (belonging to *Cardium*, *Modiolaria*, *Montacuta*, and other genera which are not further specified). The larva in its youngest stages provided with a bivalve shell exhibits a very remarkable agreement with that of the European oyster, as figured by Huxley *, Möbius †, and Horst (*loc. cit.*). The shape of the shell, too, at first resembles that of the shell of the young oyster-larva. It is almost circular, though it appears flattened on the dorsal surface, owing to two straight lines which there come into contact (fig. 1). It subsequently becomes more circular; with further growth the shell becomes arched; this takes place especially in the region of the cardo, and leads to the formation of the umbo. The shell is now not unlike that of a *Cardium*. It still consists solely of a membrane of conchiolin; the secretion of the calcareous matter does not take place until later.

The larvæ rove about for some eight days, and during the greater portion of this period are found chiefly on the upper surface of the water. In Lake Tegel multitudes of pelagic algæ were collected at the same time, and these doubtless provide the larvæ with sufficient nourishment. When they are still thoroughly capable of active progression by aid of the velum they sink from the surface to the bottom of the water. This may either be explained as resulting from changes which now take place in their organization or may be traceable to the fact that food is perhaps easier of acquisition in the depths.

While the larva was still enjoying a pelagic existence certain changes set in, of which the most important is the formation of the foot. The latter appears as a protuberance between the mouth and anus, and quickly assumes a conical shape. It then grows in length, and is forced to become bent

* H. Huxley, "Oysters and the Oyster-Question," English Illustrated Magazine, 1883.

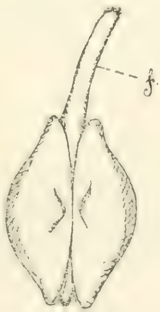
Copied in Jackson's paper "Phylogeny of the Pelecypoda," Mem. Bost. Soc. Nat. Hist. vol. iv. no. viii., 1890.

† K. Möbius, 'Die Auster und die Austernwirthschaft,' Berlin, 1877.

to enable it to obtain accommodation within the shell. In the case of such larvæ as have been collected at the bottom of the aquarium we observe how the foot is extended like a feeler when the animal is at rest, while the shell slightly opens. The velum is then gradually unfolded, and the larva swims away by its aid, to all appearances quite as actively as before. The foot, which is already tolerably developed, is therefore present in addition to the velum. The latter, however, gradually degenerates, and finally the only evidence of its previous existence is the pigmentation of the anterior section of the body, which is still retained for some time.

A further change in the larva results from the greater development of the mantle. This arose in the shape of a fold, which advanced with the shell from the dorsal towards the ventral surface. It now comes into greater prominence, since it protrudes at many points on the free edges of the shell. Between the mantle-fold and the foot the rudiments of the gills were formed. They appear at this time as a few tolerably large laterally compressed papillæ, the approximated edges of which are beset with strong cilia, so that the observer seems to be looking at richly ciliated clefts. The aspect which they present at this stage is very similar to that described for *Mytilus* by Lacaze-Duthiers *. It is difficult to determine whether the rudiments of them are developed in the shape of a fold, which becomes notched at a very early period and so produces the supposed papillæ, or whether they sprout forth as real papillæ. At any rate a few smaller papillæ are added behind to the large ones in front, so that the rudiment of the gills is continued posteriorly in an undulating line, which might perhaps be regarded as the free edge of a fold.

Fig. 5.



Dorsal view of young *Dreissena* crawling, with foot (*f*) much protruded.

Meanwhile the foot has attained very large dimensions and is capable of being protruded a long way from the shell. The young mussel, for such it must by this time be termed, now progresses solely by its aid. We notice how the vermiform-looking foot is stretched far out (fig. 5), goes through the movements of a feeler, and then fixes itself by its extremity; whereupon it contracts and so drags the body after it. The

* Lacaze-Duthiers, "Mémoire sur le développement des branchies des Mollusques Acephales Lamellibranches," Ann. Sc. Nat. 4e sér., Zool. t. v., 1856.

mussel, provided with an almost circular shell, might at this stage be taken for a young *Cyclas*. The velum has degenerated, and in the foot it now possesses a serviceable organ of locomotion, by aid of which it crawls actively about. The mussel consequently passes through a second freely mobile stage. While the body of the young mussel increases in bulk, the growth of the foot is retarded, and thus acquires the stump-like form which it possesses in the adult. The mussel finally becomes fixed *.

The ready mobility of the *Dreissena*-larvæ has doubtless contributed materially to the dissemination of the mussel, which has advanced with quite astonishing rapidity. It is extremely probable that its immigration into Germany did not take place until the second decade of this century (E. von Martens, *loc. cit.*), and nevertheless we find *Dreissena* so widely distributed and occurring in many places in enormous quantities. I have shown above that the larvæ rove about for a pretty long time. If therefore they happen to be in a stream they will be able during this interval to be carried forward for a long distance by the current. Von Martens has shown how the advance of the mussels up stream is brought about by their being attached to vessels and by being transported with timber, &c. The retention of the free-roving larvæ was doubtless of the greatest importance to *Dreissena*. I have already emphasized the fact that owing to the retention of these primary larvæ *Dreissena* differs in a striking degree from other freshwater forms.

* In the discussion on the present subject Prof. von Martens alluded to an observation by Rossmässler, according to which *Dreissena* retains a certain power of mobility, in that it is able to detach itself from its base and fix itself again at a greater or shorter distance. Although the foot, when contrasted with its size in the young state (fig. 5, *f*), has very greatly degenerated in the adult, it nevertheless appears to be used as an organ of locomotion, although to a limited extent, at a later stage of life. I myself indeed had many opportunities of observing the way in which individual specimens, which I had detached from a large mass, climbed high up the side of the aquarium and there fixed themselves. In the case of such isolated individuals this appeared especially to occur when the water in course of time began to go bad. The motion is, however, very slow, and in the course of several days only a very short space is traversed. In so far as I took notice of this point the utilization of the foot as an organ of locomotion appeared to be very incomplete.

That the foot retains a certain capacity for locomotion would, moreover, follow from the observation communicated by Reichel (Zool. Anz. x. 1887, p. 488), according to which in winter *Dreissena* retires into deeper water from the shallower parts near the shore. If this is so, it follows that the byssus, with which the animals are attached, must be thrown off. It is worthy of note in connexion with this statement that *Dreissena* is always found in masses, and the individuals must therefore come together again after having previously separated.

The foregoing is intended merely as a preliminary communication, since, as already mentioned, I purpose to treat the development of *Dreissena* more fully later on. In conclusion I would just remark that Prof. Blochmann writes to me from Rostock that he has found the larvæ of *Dreissena* in the Warnow. Finally, I cannot refrain from expressing in this place also my most sincere thanks to privy-councillor Schulze for the great kindness with which he placed the resources of the Institute at my disposal for the collection of material, which was repeatedly necessary, and afforded me the opportunity of making abundant use of the reservoir in the garden of the Institute, whereby my task was materially facilitated.

XXVIII.—*Remarks on Australian Slugs.* By C. Hedley, F.L.S., Assistant in Zoology to the Australian Museum.

In a recent number (Feb. 1891) of this Magazine exception was taken by my friend Mr. Pilsbry to the treatment of some American slugs by Mr. Cockerell. I also wish, as "one who has studied the species in their native forests," to add my remonstrance against the manner in which the same author has dealt with the Australian representatives in his essay "On the Geographical Distribution of Slugs" (P. Z. S. 1891, pp. 214–226). I hope that I am not overstepping the bounds of courteous criticism by characterizing this article as somewhat superficial though pretentious, and by adding that the conchological fraternity would have been more grateful to this author had he contributed to the treasury of science more "facts and figures" and fewer MSS. names and imperfect generic diagnoses.

The description * of *Limax megalodontes*, Quoy and Gaimard, though considered by Mr. Cockerell not to be very clear, is amply sufficient to debar the entrance of that species into the genus *Aneitea*. The jaw is minutely described and is certainly that of a *Limax*, while the statements that "le manteau assez étendu est ovale [that of *Aneitea* is always triangular] et susceptible sans doute de recouvrir la tête. . . . La couleur de cet individu est d'un blanc jaunâtre parsemé de taches noir. . . . Sa longeur est d'un pouce huit lignes," convince me the French writers had before them the introduced species *L. flavus*, Linn., still common in the same locality.

* Voyage of the 'Uranie,' Zoology, p. 426.

The conclusion has forced itself upon me that all the species of *Limax* described as native to Australasia may be referred to either *L. maximus*, *flavus*, *gagates*, *agrestis*, or *lævis*, all introduced from Europe. Mr. Cockerell prefaces his remarks by assuring his readers that the powers of migration of a slug are extremely limited. Be that as it may, in their race to the antipodes they have far outstripped their shell-bearing relatives. Tasmanian specimens of *L. maximus* were observed to be infested with an acarus, which, unfortunately, I failed to preserve. Should it prove to be identical with the parasitic attendant of the European mollusk, this fact would argue that the animals migrated not in the egg but in the adult stage.

After examining several hundreds of the handsome diamond-slug, *Aneitea Graeffei*, Humbert, from various localities ranging along fourteen degrees of latitude, I reiterate the opinion formerly expressed (Proc. Roy. Soc. Queensland, vol. v. pt. v. pp. 162–173) that only one species of this genus is yet known to inhabit Australia, and that, with all deference to Mr. Cockerell's decision, *A. Kreffti* and *Schutei* are mere synonyms. The colour, size, and shape, as well as all details of the external anatomy, are so obscured in spirit-specimens of slugs that specific characters should be described from such with extreme caution. As instancing the difference between living and preserved specimens I would invite comparison between two figures of *A. Graeffei*, (*a*) 'Mémoires de la Société de Physique et d'Histoire Naturelle de Genève,' vol. xvii. pt. 1, pl. xi. fig. 2, from an alcoholic specimen, and (*b*) 'Proceedings of the Royal Society of Queensland,' vol. v. pt. 5, pl. vii. fig. 1 (published with vol. vi. pt. 1), from life; as well as between those of *Cystopelta Petterdi*, Tate, (*a*) 'Proceedings of the Linnean Society of New South Wales,' (2) vol. v. pt. 1, pl. i. fig. 1, from an alcoholic specimen, and (*b*) *op. cit.* vol. vi. pt. 1, pl. iii. fig. 4, from life.

When Mr. Cockerell writes of *A. Macdonaldi*, Gray, "New Caledonia, and reputed also to occur in the New Hebrides," he has evidently transposed the localities, as a glance at Dr. Macdonald's original description in an early number of this periodical will show. Indeed, it is from the island of Aneiteum, in the New Hebrides, that the genus derives its name. It was also collected in that island by the well-known traveller and zoologist Mr. John Brazier, and is unknown in New Caledonia.

To Australia Mr. Cockerell assigns eighteen species of *Helicarion*. I can only say that Australian naturalists are unacquainted with eighteen, or even with eight, indigenous species of this genus; to have reached this total our author must have impressed every available synonym and enlisted an odd genus or so as well.

"Such species as *H. Cumingi*, Beck, ... might be separated from *Helicarion* by their shells alone, at least subgenerically." In this conclusion he is perfectly correct, but was anticipated some twenty years since by Prof. Semper, who demonstrated anatomically (Reis. im Phil. vol. iii. pt. 1, p. 56) the position of this mollusk in the genus *Xesta*. *H. Hilli*, Cox, should be classified as a *Nanina* (see 'Records of the Australian Museum,' vol. i. p. 136). The fact that Garrett (P. Z. S. 1887, p. 315) throws grave doubts on the Fijian habitat of *Parmella* is disregarded by Mr. Cockerell, who copies the probably fictitious locality from his predecessors. A notice by myself on the genus ('Records of the Australian Museum,' vol. i. pp. 78–80, pl. xi.) appears to have shared the fate of much other molluscan literature, and to have escaped the observation of this author, who should have referred this genus to the Helicarioninæ.

In reference to *Cystopelta* Mr. Cockerell seems to have read my article, which he quotes so approvingly, without having quite understood it. I beg to repeat emphatically that this genus has *not* the teeth of *Testacella*, neither has it the jaw of *Arion*. "Of this," to quote our merry friend, "there is no possible doubt, no probable possible shadow of doubt, no possible doubt whatever." Also that *Cystopelta* has not the slightest resemblance or affinity to either the Testacellidæ or the Selenitidæ. Further, that *Cystopelta* is a much modified and aberrant member of the Helicarioninæ. I believe that any modern malacological student who attentively examines the drawings and descriptions appearing in the Proc. Linn. Soc. N. S. W. (2) vol. v. pp. 44–46, pl. i., and vol. vi. pp. 24, 25, pl. iii. fig. 4, will agree with me.

The classification of our land Mollusca sadly needs revision; but a ramble through the British Museum and a study of text-books are not a sufficient qualification for the task, and it is to be hoped that before Mr. Cockerell again addresses himself to it that he will serve a considerable apprenticeship to biological science with the microscope, dissecting-needle, and sketch-book.

Linnean Hall,
Sydney, N. S. W.,
December 12, 1891.

XXIX.—*Descriptions of new Genera and Species of* Pyralidæ *contained in the British-Museum Collection.* By W. Warren, M.A., F.E.S.

[Continued from vol. viii. p. 70.]

Subfamily *Chrysauginæ.*

Semniomima, gen. nov.

Fore wings with costa very straight, curved only before apex and simple in male; apex blunt; hind margin hardly oblique and faintly bowed. Hind wings triangular, with hind margin only slightly curved. Labial palpi short, straightly porrect, shaggy beneath, the third joint indistinct; maxillary short, hairy; tongue large, scaly; ocelli minute; forehead smooth, flat; antennæ in male *simple*, with very short pubescence; neuration as in *Chrysophila*, Hüb., and *Semnia*, Hüb.

Type *S. flaviceps*, Burm. (*Hypocrita*).

In general appearance, colour, and markings, resembling Hübner's genus *Chrysophila*, but distinguished at once by the simple costa and antennæ of the male.

Subfamily *Pyralidinæ.*

Pindicitora, Wlk.

Type *P. zeuxoalis*, Wlk. xxvii. p. 135.

Pindicitora flavifrons, sp. n.

Fore wings shining violet-black, with a slight pale tinge at the base of the inner margin; a distinct white, bluntly zigzag, transverse line at one third, not quite reaching the costa; a very faint, irregularly sinuous, and somewhat dilated line at four fifths. Hind wings violet-grey, paler towards the base, gradually darkening outwards, with a faintly paler submarginal line, more distinct towards the anal angle. Thorax, antennæ, abdomen, and fringes concolorous with fore wings; collar, base of antennæ, face, palpi, and anal segment of abdomen yellow. Underside shining fuscous, with a violet gloss; legs pale ochreous.

Expanse of wings 10 millim.

One male from Accra.

TRICHAUCHENIA, gen. nov.

Fore wings elongate, narrow; costa straight, hind margin straight, oblique. Hind wing rounded. Palpi porrect, roughly scaled, the last joint drooping; tongue present, rough-scaled; forehead with a short projecting cone of hair; antennæ long, simple in female, in male moniliform, subdentate beneath, each joint armed with a fascicle of long, fine, curling cilia; patagia of male very long, as in *Endotricha*; ocelli wanting, scaling smooth and glossy.

Type *T. dharmsalæ*, Butler (*Euclita*), Ill. Lep. Het. vii. p. 92, pl. cxxxiv. fig. 13.

ACTENIOIDES, gen. nov.

Fore wings elongated; costa straight, in the male somewhat concave in the middle; apex distinct; hind margin obliquely curved. Hind wings rounded, broader than fore wings; ocelli present. Antennæ with the basal joint enlarged, ciliated in the male; labial and maxillary palpi horizontally porrect; tongue small; thorax and abdomen stout in comparison with the size of the insects. Female larger than male; scaling of wings and legs coarse and thick.

Type *A. creperalis* ♀, Swinh. (*Nephopteryx*), P. Z. S. Lond. 1885, p. 877, pl. lvii. fig. 20.

MONOCONA, gen. nov.

Fore wings triangular; costa mainly straight, but slightly concave in the middle; apex rounded off; hind margin curved. Hind wing rounded. Labial palpi short, porrect, loosely fringed beneath with rough hairs, the terminal joint forming a kind of double tuft; maxillary palpi, tongue, and ocelli absent; forehead produced into a horny conical projection, bluntly flattened vertically; antennæ thick, annulated, the basal joint swollen; thorax and abdomen stout; scaling coarse.

Neuration.—Fore wing with first median nervule starting at two thirds, second, third, and lower radial close together, one after the other, from end of cell; first subcostal nervule opposite to first median, second close before end, third and fourth on a common stem, fifth and upper radial beyond; the cell rounded off above and not angulated. Hind wing with the three median nervules and the lower radial all close together from lower end of cell; discocellular angulated; lower portion long, oblique.

Type *M. rubralis*, Warr.

Monocona rubralis, sp. n.

Fore wing red, more or less hidden by a dark fuscous suffusion over the basal third, and sprinkled with whitish scales in the rest of the wing; a large oblique black spot at end of cell; fringe dark cinereous, with black basal line. Hind wing orange-red, fringe as in fore wing. Palpi mottled black and white; head, thorax, and basal half of abdomen dark fuscous; hinder half like hind wing.

Expanse of wings 13 millim.

Two females from California.

This insect, in the Grote collection, bears the MS. name of *Oribates Minzii*, Hy. Edw.; but *Oribates* is already used in the Arachnidæ. It was placed by Grote among the smaller Noctuinæ, but it is indeed a true Pyralid, and related to *Tegostoma* and its allies.

MIMOSCHINIA, gen. nov.

Fore wings with costa straight; apex blunt-pointed; hind margin obliquely curved. Hind wings broad, well rounded. Forehead with a rounded prominence; labial palpi porrect, the apical joint slightly drooping, maxillary palpi porrect above the labial; ocelli distinct; antennæ simple in female, finely pubescent beneath in male. Neuration normal.

Type *M. thalialis*, Wlk. (*Botys*), xviii. p. 582.

The genus is intermediate between *Anthophilodes*, Guen., and *Emprepes*, Led., the forehead not being bifid, as in the former, but prominently rounded, while in *Emprepes* it is nearly flat. It includes three American species—*thalialis*, Wlk., *nuchalis*, Grote, and *elautalis*, Grote—all three of which mimic the markings of Hübner's Noctuid genus *Schinia*.

Subfamily *PYRAUSTINÆ*.

NOCTUELIA, Guen.

Type *N. superba*, Frr. Guen. D. & P. p. 114.

Noctuelia flavifimbrialis, sp. n.

Fore wings fuscous-olive, with a slight gloss, and with the two lines and stigmata faintly darker; first line oblique, second forming a slight angulation inwards below the costa, then a large curve outwards, reaching the inner margin near the first line; orbicular stigma a dark dot, reniform larger, indistinctly hollow; a dark fuscous shade running obliquely from the apex; fringes fuscous. Hind wing dark fuscous, with *pale yellowish* fringes. Underside of both wings dull fulvous.

Expanse of wings 20 millim.

One male from California.

Ennychia, Led.

Type *E. albofascialis*, Tr., Led. W. E. M. vii. p. 355.

Ennychia intrudens, sp. n.

Fore wing reddish fuscous; second line dark, parallel to hind margin, but curved inwards a little below the reniform and preceded by an ochreous band; first line quite indistinct; the basal two thirds of the wing is slightly paler than the marginal third; a small brown spot represents the reniform stigma. Hind wing with the margin blackish, and the dark line is followed as well as preceded by an ochreous band. Head, thorax, and abdomen reddish fuscous; abdomen with white segmental divisions. Underside dull brick-red.

Expanse of wings 12 millim.

One male, New Zealand. Raynor Coll.

Aporodes, Guen.

Type *A. floralis*, Hüb., Guen. D. & P. p. 159.

Aporodes obscura, sp. n.

Fore wings dirty greyish ochreous, powdered with blackish; an indistinct blackish oblique basal line and an outwardly curved exterior line, the two approximating on the inner margin; a large black cell-spot and a smaller dark dot between it and the basal line; costa darkened somewhat above them; the extreme base and the hind margin darkened with blackish scales. Hind wings dark fuscous, fringes of both wings greyish. Head, thorax, and abdomen dark grey, mottled with fuscous.

Expanse of wings 12 millim.

One male in the Zeller Collection sent by Christoph, and therefore most probably from Sarepta.

A very insignificant and obscure-looking insect.

Aporodes versicolor, sp. n.

Fore wings chestnut-brown, with some fine black scales interspersed; the basal third and a diffuse curved exterior fascia pale whitish green; fringes brown. Hind wings blackish fuscous, with fringes whitish, and a sprinkling of the pale greenish scales along the inner margin. Head, thorax, and abdomen blackish, with a few greenish scales intermingled. Underside glossy, dark bronzy fuscous; the inner margin of the fore wings paler; the base of the costa greenish.

Expanse of wings 14–18 millim.

One male, three females, from Washington Territory, North America. The single male is larger than the three females.

Pyrausta, Schrank.

Type *P. cingulata*, Linn.

Pyrausta coccinea, sp. n.

Fore wings blackish, probably with a green tinge when fresh, with a faintly visible dark discal spot, and a whitish spot on the costa, representing the origin of the second line. Hind wing dull crimson, with black hind margin, broad at apex, but thinning out before the anal angle; abdominal margin also blackish. Head and abdomen blackish. Underside of both wings dull reddish. Anal tuft of male whitish.

Expanse of wings 11 millim.

Two examples from California, collected by Lord Walsingham.

Syllythria, Hüb.

Type *S. sanguinalis*, Linn., Hüb. Verz. p. 349.

Syllythria (?) *rubrivena*, sp. n.

Fore wing elongate; apex produced; hind margin oblique; ground-colour canary-yellow; the costa to beyond the middle, the two stigmata, a thin, curved, inner transverse band, a linear, undulated, postmedian band, a broad, oblique, straight, submarginal shade, and all the veins bright carmine. Hind wing yellow, with an abbreviated submarginal red fascia; fringes of both wings pure yellow. Head and thorax yellow; palpi outside and patagia carmine; abdomen yellowish; underside of abdomen and legs red. Underside of both wings yellow, with the costal and exterior margins broadly purple.

Expanse of wings 24 millim.

Two females from Madagascar in the British Museum Collection.

Syllythria subnicalis, sp. n.

Resembles *nicalis*, Gr., but smaller; the same size as *lethalis*. Dull reddish brown, dusted with grey along the inner margin and before the second line, with an indistinctly darker reniform stigma; first line absent or scarcely perceptible; second line, starting from a conspicuous yellowish-white costal spot, forms a very slight curve to the inner margin, never a decided bulge in the centre, as in *nicalis*. Hind wing with a pale yellowish line, only distinct towards the inner margin, beyond which the hind margin is darker. Abdomen reddish grey, with segmental divisions finely whitish.

Several specimens from California.

Blepharucha, gen. nov.

Fore wings elongate, triangular; costa slightly shouldered at base and incurved in middle, convex before apex, the latter blunt; hind margin oblique. Hind wings twice as broad as fore wings; hind margin rounded. Palpi porrect, rostriform; maxillary palpi small; antennæ of male strongly pubescent, of female simple; forehead bluntly prominent; the two transverse lines oblique in opposite directions, approximating on the inner margin.

Type *B. zaide*, Stoll (*Phalæna*).

A South African genus, akin to *Emmelia*, Hüb.

Euctenospila, gen. nov.

Allied to *Blepharucha*, but with the antennæ still more developed, those of the male being quite strongly bipectinated. Fore wing with costa slightly convex near base, incurved in the middle; apex pointed, but not acute; hind margin oblique, slightly bowed; antennæ strongly bipectinated, the pectinations themselves finely pubescent; labial palpi porrect, drooping, maxillary fine, horizontal; tongue developed; ocelli large; abdomen (male) with a decided anal tuft.

Type *E. castalis*, Warr.

Euctenospila castalis, sp. n.

Fore wing pale lemon-yellow, markings rather lustrous, lilac-grey, finely edged with black; a few spots irregularly scattered near the base; first line angulated, with both edges denticulated; second line running at first inwards, forming a sharp indentation below the costa, and then two gradual curves outwards to the inner margin, both edges, as in the first, denticulated; a row of black dots at base of fringes, the top four being expanded into spots, filled up with grey and edged with black, like the two lines; reniform stigma the same, 8-shaped, the lower half the larger, followed by a smaller spot before the second line. Hind wings white, diaphanous, with a central black spot and series of marginal black dots; a largish greyish blotch near the margin towards the anal angle. Head, abdomen, and underside whitish.

Expanse of wings 28 millim.

A male from Abyssinia in the British Museum Collection.

Spilodes, Guen.

Type *Spilodes verticalis*, Linn. S. N. x. p. 335.

Spilodes bicoloralis, sp. n.

Fore wings fuscous, with all the veins pale ochreous, especially towards the hind margin; stigmata edged with blackish; the orbicular long and flattened; the reniform obliquely kidney-shaped; space before each paler; a black line from the base beneath the median and a shorter blackish patch beneath the submedian; a cuneiform exterior line blackish, interrupted by each paler vein; base of fringes dark brown, preceded by a straight pale ochreous space; fringes themselves pale, with a strong dark basal line, and their apices darker. Hind wings *dull yellow*, suffused with cinereous towards the base and along the costa and hind margin, with a dark cell-spot and a blackish curved central fascia; fringes as in fore wing, preceded by a distinct *yellowish* pale space. Head, thorax, and abdomen cinereous. Underside of both wings dull yellowish, with the markings faintly fuscous, but the two stigmata very distinct.

Expanse of wings 30 millim.

One male from Baghdad, evidently related to *scalaralis*, Christoph, and *sedacowialis*, Eversm.

Tritæa, Meyr.

Type *T. affinitalis*, Led. (*Eurycreon*), *T. ustalis*, Meyr. Tr. E. S. Lond. 1884, p. 342.

Tritæa protealis, sp. n.

♂. Fore wing cinereous, varied with ochreous; central field darker, lines indistinct, indicated by difference of tint on either side; first line curved; basal space paler, with a darker patch on the inner margin near the base; second line running at first slightly outward, then parallel to the hind margin, then inwards to beneath the reniform stigma, and lastly vertical to the inner margin; the two stigmata dark, with the space between them paler; the second line is followed by a pale space on costa and sometimes also on the inner margin; a line of black dashes before the fringes, which are silky ochreous. Hind wing greyish fuscous, with faint indications of a paler submarginal band.

In the single female the darker tints throughout are almost black, the paler spaces being by contrast whiter; but this may not be a sexual peculiarity.

Expanse of wings 16 millim.

One female, two males, from S. Lorenzo Island, Callao.

Tritæa ferruginea, sp. n.

Fore wings reddish ochreous, somewhat iridescent, with faint indications of two stigmata and an outer line, which are darker; a row of dark spots along the hind margin. Hind wings glossy, pale ochreous, darker towards the hind margin, showing a faintly darker submarginal band, which forms a darker spot towards the anal angle.

Expanse of wings 16 millim.

One male from Coquimbo.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 11, 1891.—Sir Archibald Geikie, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On *Dacrytherium ovinum* from the Isle of Wight and Quercy." By R. Lydekker, Esq., B.A., F.G.S.

The Author described a cranium and mandible of *Dacrytherium Cayluxi* from the Quercy Phosphorites, which proved the identity of this form with the *Dichobune ovina* of Owen from the Oligocene of the Isle of Wight. The species should thus be known as *Dacrytherium ovinum*. It was shown that the mandible referred by Filhol to *D. Cayluxi* belongs to another animal.

November 25, 1891.—Sir Archibald Geikie, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On the Os pubis of *Polacanthus Foxi*." By Prof. H. G. Seeley, F.R.S., F.G.S.

Hitherto the evidence of the systematic position of *Polacanthus* has not been very precise. The Author has detected the missing pubis as an isolated specimen. This he regards as the anterior portion of the left pubis, and appends a full description of the bone. He furthermore gives a critical account of our knowledge of other pelvic bones of the genus, and is led to associate *Agathaumus*, *Cratæomus*, *Omosaurus*, and *Polacanthus* in near alliance, in the Scelidosaurian division of the Order *Ornithischia*.

December 23, 1891.—W. H. Hudleston, Esq., M.A., F.R.S., Vice-President, in the Chair.

The following communication was read:—

"On Part of the Pelvis of *Polacanthus*." By R. Lydekker, Esq., B.A., F.G.S.

The specimen described in this paper was acquired by the British Museum from the collection of the late Mr. Beckles, and is from the Wealden, probably of the Isle of Wight. It is the central part of a Dinosaurian ilium, with portions of sacral ribs attached.

The point of special interest is a flat plate of bone, evidently a portion of dermal armour, resting on the upper border of the ilium; and this suggests comparison of the specimen with the dorsal shield of *Polacanthus Foxii*. Such a comparison shows that the present specimen belonged to a Dinosaur closely allied to, if not identical with, *P. Foxii*.

January 6, 1892.—W. H. Hudleston, Esq., M.A., F.R.S., Vice-President, in the Chair.

The following communications were read:—

1. "On a new Form of *Agelacrinites* (*Lepidodiscus Milleri*, n. sp.) from the Lower Carboniferous Limestone of Cumberland." By G. Sharman, Esq., and E. T. Newton, Esq., F.G.S.

Among a large series of fossils obtained during the Geological Survey of Cumberland and Northumberland, there are two which are referable to that remarkable and rare group of Echinoderms, the Agelacrinitidae. The more perfect of these specimens is from the Lower Carboniferous rocks near Waterhead, on the River Irthing, and forms the subject of this communication. The disc-like fossil is only about four-tenths of an inch in diameter, and scarcely rises above the shell to which it is attached; nevertheless, it is so well preserved as to allow much of its structure to be studied. It is referred to the genus *Lepidodiscus*, and is seemingly closely related to *L. Lebouri*, described by Mr. Percy Sladen before this Society in 1879; but it also has affinities with *L. cincinnatiensis* and *L. squamosus*. From all these, however, the present specimen differs in having the pyramid in the middle of the interradial space, in possessing shorter arms, and in being much smaller. This fossil is to be named *Lepidodiscus Milleri*, after Mr. Hugh Miller, under whose direction these fossils were collected by Mr. J. Rhodes.

2. "*Archæopneustes abruptus*, a new Genus and Species of Echinoid from the Oceanic Series in Barbados." By J. W. Gregory, Esq., B.Sc., F.G.S.

This genus belongs to a group of Echinoidea which has given some trouble to systematists, owing to the union of the characters of the orders Cassiduloidea and Spatangoidea; the other genera belonging to the group are *Asterostoma*, *Pseudasterostoma*, and *Palæopneustes*. The evidence of the new Echinoid throws light upon the affinities of these genera. The main points suggested by a study of the new species are:—(1) the abandonment of the name *Pseudasterostoma* as a synonym of *Palæopneustes*; and (2) the inclusion of the true *Asterostoma*, *Palæopneustes*, and *Archæopneustes* in the Adete Spatangoidea, whereby the Plesiospatangidæ are left as a more homogeneous family, though bereft of the chief interest assigned to it.

A tabular summary of the nomenclature of the group is given.

The best-known fossil species of *Asterostoma* and *Palæopneustes* occur in Cuba, in deposits referred to the Cretaceous owing to the resemblance of these Echinoids to the common Chalk *Echinocorys scutatus*. The new genus includes a species from the same deposit, which is probably of the same age as the Bissex Hill rock from which the new species was obtained; this is at the top of the Oceanic Series, and belongs to the close of the great subsidence.

MISCELLANEOUS.

Note on Abnormalities in the Crayfish (Astacus fluviatilis). By W. N. Parker, Ph.D.

While a number of crayfishes were being dissected by my students last month I noticed that three of the specimens presented certain abnormalities which, although perhaps not so interesting as the case recently described in this Journal by Benham*, are probably worthy of record.

Specimen I.—On the left side, in addition to the normal pleurobranch of segment 13, a small but well-developed gill was present on the wall of segment 12 in place of the usual rudimentary style. This gill was about three quarters as long as the pleurobranch normally present.

Specimen II.—The last arthrobranch of the left side, *i. e.* the

* "Note on a Couple of Abnormalities," 'Annals,' ser. 6, vol. vii. no. 39, March 1891, p. 256.

posterior arthrobranch of segment 12. was forked. The bifurcation began close above the base, the two branches being nearly equal to one another in size and having the usual structure.

Specimen III.—This specimen presented a partial fusion of the fourth and fifth abdominal segments. Looked at from the tergal side the abnormality could not be seen, but the calcified sternal bars were completely fused from the middle line nearly to the attachment of the appendage on the right side. On the left of the middle line the two sternal bars were separated by a narrow uncalcified portion, and a certain amount of movement between the two segments was still possible, owing to the elasticity of the narrow and partially fused sternal bars. The appendages were normal, but the distance between the attachments of those on segments 4 and 5, left and right, was naturally much less than usual, as the sternal region of these segments was so much reduced in length.

Cardiff,
Jan. 12, 1892.

The Chromatophores of Cephalopods.
By M. Raphaël Blanchard.

The radiating fibres which are found around the chromatophores of Cephalopods have been described by various authors as muscles which are inserted into the enveloping membrane: by contracting they would expand the chromatophore, on relaxing they would permit it to revert to its original condition and to efface itself more or less.

In the year 1882 I showed that, during the changes of form to which they are continually subject, the chromatophores alone are active. As a matter of fact attentive histological study enables me to state that the radiating fibres are neither muscles nor nerves, but simply fibres of connective tissue, presenting a peculiar orientation in the neighbourhood of the chromatophore, with which, however, they have no connexion. Soon afterwards a perfectly similar statement was made by M. Girod; this very year these observations have received further confirmation at the hands of M. Joubin *.

Nevertheless it has been recently stated by M. Phisalix † that "the radial fibres are muscles," and he affirms that the expansive movements of the chromatophore "are determined by the contraction of muscles arranged radially at its equator." He mentions elsewhere the writings of M. Girod, M. Joubin, and myself.

M. Phisalix cites, in support of his opinion, the researches of MM. Paul Bert and Frédéricq; but neither of them has verified anatomically the muscular nature of the radiating fibres; if they attribute this structure to them, it is solely because it was admitted by the naturalists of the period. The interesting experiments made by M. Phisalix, following upon those of the two observers mentioned above, are explained by the intimate union of the chromatophore with the nerves. *I expressly recognized* this union, and the result of my observations appears to me to remain unimpaired.—*Comptes Rendus*, tome cxiii. no. 17 (Oct. 26, 1891), pp. 565, 566.

* Ann. & Mag. Nat. Hist. 1891, viii. p. 111.

† *Vide infrà.*

On the Nature of the Movement of the Chromatophores of Cephalopods. By M. C. Phisalix.

It is stated by P. Bert, in his important memoir on the physiology of the cuttle, that the movement of the chromatophores is due to dilatatory muscles with rapid contractile power. MM. Pelvet and Frédérick were the first to support this view with experiments. Another theory, which owes its origin to anatomical observations, considers these movements to be of an amœboid nature. It was advanced by Harting, and has been maintained by MM. Raphaël Blanchard, P. Girod, and quite recently by M. Joubin. However, the latter author reconciled the theories by admitting the former for the young and the latter for the adult chromatophore, and, as a corollary, the *transformation* of *muscular* into *connective fibres.*

The theory of P. Bert is the only rational one. It was to demonstrate the justice of it that I undertook a series of investigations at the zoological station of Arcachon, where, thanks to MM. Viallanes and Jolyet, I found the material necessary for my task.

Three kinds of movements are distinguishable in the chromatophores.

1. *Tremulous movements.*—In a living Cephalopod, in a state of rest, the chromatophores are constantly agitated by little shocks, which are scarcely visible; it is like an incessant and rapid trembling, and this gives the skin of Cephalopods its characteristic appearance. These movements are under the control of the nervous system; they disappear as soon as the pallial nerve is divided or the chromato-motor centres are injured. In that case the chromatophores diminish still further in diameter and the skin attains its maximum degree of paleness.

2. *Undulating movements.*—These do not set in, as a general rule, until after death. They consist in the maximum expansion followed by the contraction of the chromatophores. Their characteristic feature is that they commence at one or several points and radiate thence in all directions, to reproduce themselves in an irregular and disordered fashion. They are due to the direct stimulation of the skin, and persist for a long time after death.

3. *Movements of functional activity.*—These occur in the living animal only, and serve it as a means of defence. They are the result of reflex actions, which depend entirely on the central nervous system. Accordingly the section of the pallial nerve at the neck suffices to render them impossible in the portion of the body innervated by this nerve. The galvanization of the peripheral extremity of this nerve provokes the dilatation of the chromatophores, which remain in a state of expansion so long as the stimulus continues. It is a veritable *tetanization.* It is produced and ceases *simultaneously* with that of the muscles of the mantle. A single stimulus induces a transitory dilatation, which appears and terminates *simultaneously* with the muscular shock.

Chromato-motor nervous centres.—If we stimulate the central extremity of the pallial nerve we obtain the dilatation of the chromatophores of the opposite side. The centre of the reflex actions is therefore situated at the actual origin of these nerves. We can determine their seat by experiment. By inflicting localized injuries, either with red-hot iron or the scalpel, I have arrived at the following results:—

Sub-œsophageal centres.—The destruction of the median sub-œsophageal lobe causes the paralysis of the chromatophores on the entire surface of the body, which remains absolutely pale. If the injury has only affected one side the paralysis likewise takes place on one side only, but on that opposite to the injury. There is therefore a manifest *crossing* of the nervous fibres in the thickness of the ganglion.

Supra-œsophageal centres.—The removal of the cerebral calotte has no effect on the action of the chromatophores, provided that the injury does not extend to the optic nerves. If, on the other hand, the red-hot needle has reached the level of the optic nerve, it produces, simultaneously with the dilatation of the pupil, the paralysis of the chromatophores of the injured side. It therefore appears that the chromatophores are under the influence of two centres, one for direct effects, the other for those which take place on the opposite side. After the destruction of the former it often happens that the chromatophores of the opposite side remain in a state of permanent dilatation. Now we know that in the normal condition the sensation in the Cephalopods may be expressed by the dilatation of the chromatophores and the intensely black coloration of the skin, or else by their maximum contraction and an extreme pallor. Are these two phenomena regulated by two different centres, a chromato-dilator and a chromato-constrictor? I have not succeeded in completely elucidating this point by experiments.

Excitability of the centres.—This is demonstrated by direct stimulation. We can also operate upon it and modify it by physiological means: thus, it rapidly disappears after copious hæmorrhage, and insensibly diminishes in animals enfeebled by starvation and a sojourn in the aquarium. It increases under the influence of certain poisons. Strychnine and curari act upon it in a characteristic fashion: at each convulsive shock the chromatophores behave like the muscle: their expanding movement commences and ceases *simultaneously* with the muscular shock.

Form and characteristics of the movement.—The movement of the chromatophore is divisible into two stages:—(1) expansion, (2) contraction. In an enfeebled animal the difference of duration between the two stages is so accentuated that we can register it in an indirect fashion, and in this way, by a special arrangement, I have obtained outlines which are as approximate as possible. If we compare these outlines with those of the contraction of the muscles of the mantle we find a striking resemblance.

The radial fibres are muscles.—Of all the characters which have just been enumerated there is not one which cannot be referred to the properties of rapidly contractile muscles; it is, moreover, necessary to eliminate from henceforth the slowly contractile muscles of the skin. The peristaltic movements which are centred in the latter are neither synchronous nor homologous with those of the chromatophore. The cause of the active movement of the chromatophore resides exclusively in the radial fibres. This is directly demonstrable by means of a crucial experiment.

If we completely destroy the centre of a chromatophore with a needle, so as to leave only the periphery intact, the movements of expansion and contraction continue to take place in this intact portion. If, on the other hand, we destroy the radial fibres by a circular lesion, leaving the cell intact, the movements are completely abolished. It is, on the contrary, the central or coloured portion of the chromatophore which, by the influence of its elasticity, exercises the active role in the stage of contraction. This elasticity is easily displayed; a gentle pressure on the centre of a chromatophore is sufficient to flatten it and spread it out; but as soon as the pressure is removed the organ resumes its spherical shape.

To sum up our results: the chromatophore of the Cephalopods is an elastic pigmented sphere, the expansive movements of which are determined by the contraction of muscles arranged radially at its equator, and which reverts to the spherical shape as soon as the contraction has ceased.—*Comptes Rendus*, t. cxiii. no. 16 (Oct. 19, 1891), pp. 510–512.

On the Anatomy of the Male Sexual Organs of the Honey-Bee. By G. Koschewnikoff, Assistant in the University of Moscow.

In my investigations into the structure of the male sexual apparatus of the honey-bee I arrived at the following results.

All existing figures and descriptions of the male sexual apparatus of the honey-bee in zoological and apicultural literature are either incomplete or incorrect. The testis of the bee has two envelopes. The external one, formed by the fat-body, has two kinds of cells—(1) large and flat, with elongated flattened nuclei; (2) irregularly spherical, which are entirely similar to the cells of the fat-body containing fat-globules. The second inner envelope is of the nature of connective tissue, and two layers are to be distinguished in it. In the outer layer we find large cells with oval nuclei, and the inner layer is finely fibrillar, with spindle-shaped nuclei.

The seminal tubules are surrounded by a delicate fibrillar envelope, containing elongated nuclei, and open into a reservoir in the interior of the testis, which is clothed with epithelium. This epithelium enters slightly into the orifice of each separate seminal tubule.

The tracheæ, which everywhere penetrate the testicular envelopes, ramify in the interior of the testis between the several seminal tubules. The belief (Cholodkowsky) that in butterflies there are no tracheæ within the testis is erroneous.

The entire testis of the bee corresponds to only a section of the testis of such a type as, *e. g.*, in *Bombyx mori*. The reservoir, into which all seminal tubules open, is enveloped in a thick membrane of connective tissue containing oval nuclei. From the reservoir the vas deferens is separated off, the epithelial cells and nuclei of which are larger than those of the reservoir. The vas deferens runs for a time within the testis, forms loops there, and, after issuing therefrom, makes several loops, rolling itself into a little ball, and then passes into the seminal vesicle.

The epithelial cells of the seminal vesicle (vesicula seminalis) are very columnar and ranged in annular cylinders ("Ringwalzen"). These cells are of a glandular nature. On the outer side of the epithelium lies an extraordinarily thin connective-tissue membrane, and then follows a muscular layer, which we do not find upon the vas deferens. The deep-lying layer consists of circular and the upper layer of longitudinal muscles. In addition to the closely adhering thin connective-tissue membrane, which envelops the entire vas deferens and the seminal vesicles, these two organs have a special membrane, which is not closely adhering and is a prolongation of the testicular membrane. This membrane completely conceals the vasa deferentia.

The seminal vesicle narrows into a bow-shaped canal, which opens not into the ductus ejaculatorius, but into the glandulæ mucosæ. The epithelial cells, which clothe this canal, are very highly vacuolate, so that they have a spongy appearance. Blind tubes which are described by R. Leuckart * as appendages of the glandulæ mucosæ, and figured in his chart ('Anatomie der Biene'), are nothing else than severed muscles which are attached to the wall of the abdomen, and were described by Swammerdam.

The glandulæ mucosæ have, beneath a thin membrane of connective tissue, a layer of longitudinal muscles; under this is a layer of circular muscles, and then, in addition, we have three groups of deeply-lying longitudinal muscles, which are only developed in that portion of the organ which is nearer the ductus ejaculatorius. These longitudinal muscles press the epithelial layer of the mucous glands into three longitudinal folds. Towards the other end of the mucous gland the deep-lying muscles grow continually narrower, until they finally disappear altogether. Beneath the muscular layer lies a structureless membrane of connective tissue, and then a layer of narrow, columnar, glandular epithelial cells, with oval nuclei.

The ductus ejaculatorius is inserted by means of two chitinous branches into the junction of the two glandulæ mucosæ. This paired portion of the ductus ejaculatorius is completely hidden beneath the muscular layer of the glandulæ mucosæ. The ductus ejaculatorius, as well as the entire copulatory apparatus, is devoid of muscles. (In Girard † and Cheshire ‡ we find it incorrectly stated that the ductus ejaculatorius has a strong musculature.) Beneath the very thin membrane of the ductus ejaculatorius lie

* R. Leuckart, 'Die Anatomie der Biene:' Cassel und Berlin, 1885, p. 13.

† M. Girard, 'Les Abeilles:' Paris, 1885.

‡ Cheshire, 'Bees and Bee-Keeping:' London, 1887.

flattish epithelial cells, and then a thicker, transparent, elastic, and very extensile chitinous layer.

From the end of the ductus ejaculatorius to the external opening of the sexual apparatus we have an uninterrupted chitinous sac, with various kinds of evaginations, folds, and thickenings. The upper portion of this section of the sexual apparatus, termed the "bulb" by Leuckart, is laterally compressed, and has beneath a delicate external membrane very columnar epithelial cells, beneath which there lies a tolerably thick layer of transparent colourless chitin, upon which on each side two large chitinous plates, which are fused together, are fixed. The chitin of these plates has a distinctly granular structure, and the clearer and softer the chitin, the more plainly are the granules visible. In the completely hardened places the granules cannot be seen at all, or only indistinctly.

The portion of the genital sac which follows the bulb of the penis is so strongly chitinized that nothing is to be seen of the epithelial cells. The chitin is thickly covered with stout simple (not branched) hairs, directed inwards, which are larger and thicker at these spots where there are evaginations and folds in the chitinous wall. These structures have, as everyone is aware, a mechanical importance in the act of coition, and have been described a thousand times, but never quite correctly. The exact description of these structures is out of place in a provisional communication, since too many details would have to be alluded to. I will only observe that, with the exception of the above-mentioned chitinous plates of the bulb of the penis, we find no plates in the entire genital sac of the bee, but only evaginations and folds of the chitinous wall.

The detailed description of the genital apparatus will appear in the 'Tageblatt der zoologischen Abtheilung der kais. Gesell. d. Naturw. Anthropologie und Ethnographie.'—*Zoologischer Anzeiger*, xiv. Jahrg., 1891, no. 376, pp. 393–396.

On the "Free-swimming Sporocysts." By M. Braun, of the Königsberg i. Pr. Zoological Museum.

The term "free-swimming sporocyst" has been applied by E. Ramsay Wright * and R. Leuckart † to the single example which has hitherto been discovered of a certain developmental stage of a *Distomum*. I have observed numerous specimens in an aquarium in which I had shortly before placed various freshwater snails from the "bog" ("Bruch") near Rossitten in the Kurischer Lowlands. While, however, the American species is only 1 millim. in length, the specimens from this locality are as much as 6 millim. long, and

* 'American Naturalist,' vol. xix. 1885, pp. 310, 311.

† Die thierischen Parasiten des Menschen &c., 2 Aufl. 2 Bd. pp. 102, 103.

they are also not quite transparent, but coloured sulphur-yellow at the margin, though colourless elsewhere.

The creature as it floats and rests in the water has the shape of a Roman T; the unpaired limb is band-shaped in transverse section and thickened into a knob at the free end. In the latter is to be noticed a yellow opaque body which, when examined under the microscope, proves to be a *Distomum*, usually doubled up, lying in a cavity of the knobbed end, which is beset with rings of papillæ. The paired limbs of the T constitute leaf-shaped movable appendages. Others of these "sporocysts" rest on the bottom of the vessel, lying on the broad side, with the forks of the tail closed or open. The whole assemblage usually rises all at once from the bottom and swims actively about in the water, in the way that our gnat-larvæ do, afterwards floating again in the water—with the knobbed end downwards—or sinking slowly to the bottom.

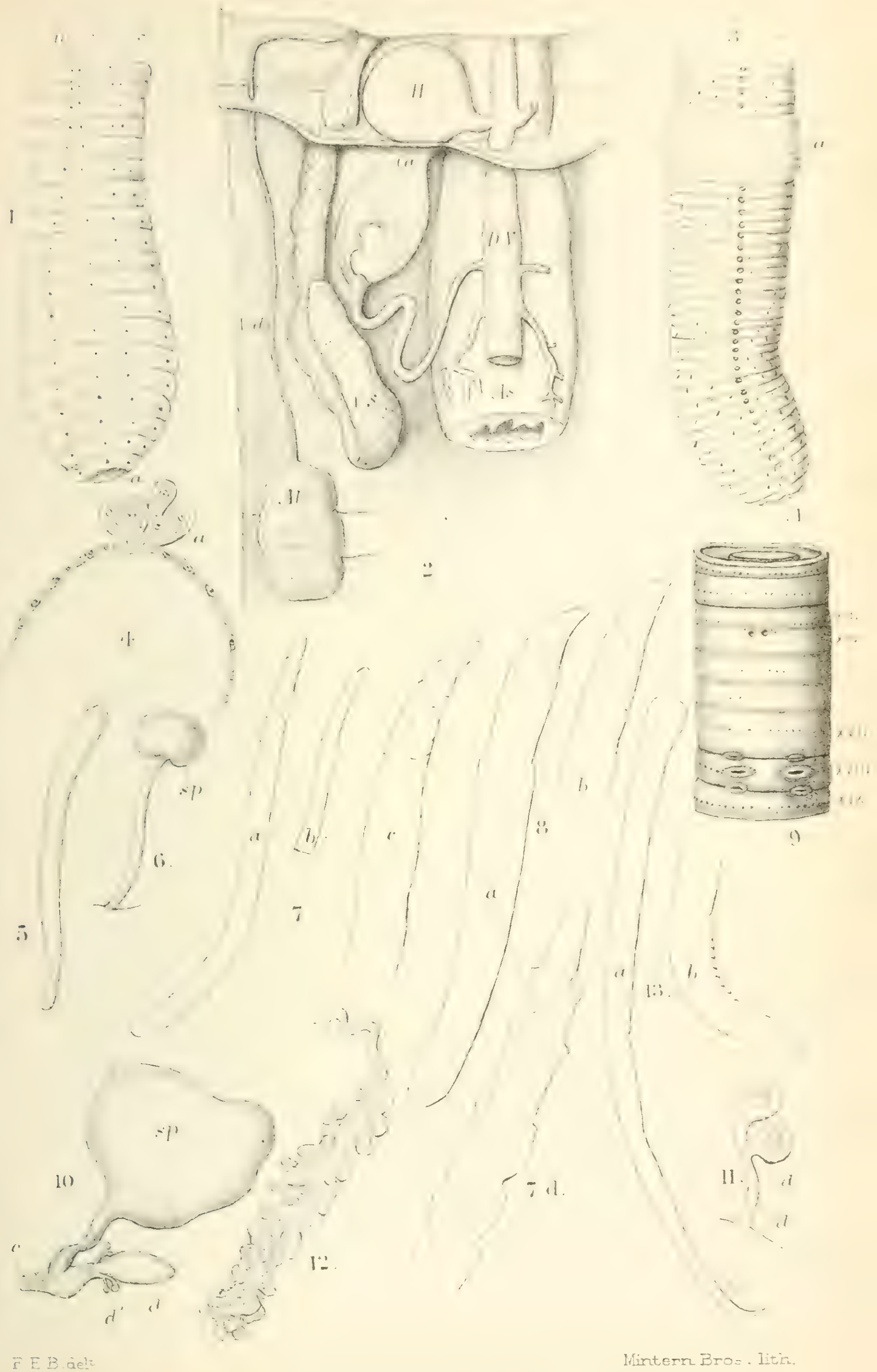
As I had collected various species of snails in the same receptacle, my first task was to separate them, and I soon ascertained that our "free-swimming sporocysts" are developed from *Limnæus palustris*, var. *corvus*. Among fourteen specimens of this species one proved to be infected with transparent sporocysts (four others with rediæ) measuring as much as 2 millim.* in length, in which, as was soon evident, our "free-swimming sporocysts" arise. Yet we have not to deal with this stage, but rather with gigantic Cercariæ with forked tails, the bodies of which, the future *Distomum*, exhibit the usual relations, so long as the Cercariæ are enclosed in the sporocyst which produces them. After the escape the body becomes retracted into a cavity which was previously distinguishable in the swollen commencement of the tail, and remains in this condition.

These ostensible "free-swimming sporocysts" are therefore enormously developed Cercariæ, and resemble *Cercaria macrocerca* and *C. cystophora*, except that they are a furcocercous form.

Unfortunately my endeavours at rearing the *Distomum* by feeding some goldfish with it, which in a few minutes had devoured over a dozen Cercariæ, were not successful; I could not rediscover the flukes either in the intestine, the muscles, or the eyes. I intend, if I obtain some more fresh material, to repeat the experiments with other fish, since a direct development, *i. e.* with the omission of a second intermediate host, is very probable; possibly birds also may play the part of final hosts.

Until the question of the species is decided, the Cercaria may stand as *Cercaria mirabilis*.—*Zoologischer Anzeiger*, xiv. Jahrg., 1891, no. 375, pp. 368, 369.

* [The original has "cm."—Transl.]



F. E. B. del.   Mintern Bros. lith.

R. Mintern del et lith. Mintern Bros. imp.

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[SIXTH SERIES.]

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XXX.—*British Fossil Crinoids.*—VI. Botryocrinus quinquelobus, *sp. nov., Wenlock Limestone; and Note on* Botryocrinus pinnulatus. By F. A. BATHER, M.A., F.G.S.

[Plate XI. figs. 1 & 2.]

EXAMINATION of the numerous British species referred at one time or another to *Cyathocrinus* has brought to light one that certainly does not belong to the genus, but appears referable to *Botryocrinus*. That this species was not recognized in time to incorporate its description in the preceding paper is due partly to the fact that the anal area is not exposed in either of the only known specimens, but chiefly to the unfortunate necessity I am under of examining the specimens in the Woodwardian Museum, where these are placed, by flying "visits, few and far between."

Botryocrinus quinquelobus, sp. n.

1873. *Cyathocrinus quinquangularis*, Phill., apud J. W. Salter, 'Catalogue of Cambrian and Silurian Fossils &c.,' Cambridge, p. 123.

Non *Cyathocrinites quinquangularis*, J. S. Miller, 'Nat. Hist. Crinoidea,' p. 92 (1821).

Non *Cyathocrinus quinquangularis*, Miller, apud J. Phillips, 'Geology of Yorkshire,' pt. ii. p. 206 (1836).

Non *Rhodocrinus* (?) *quinquangularis* (Miller), apud J. Phillips, in Murchison's 'Silurian System,' pl. xviii. fig. 5 (1839).

Non *Cyathocrinus quinquangularis*, Eichwald, 'Silurische System in Estland,' p. 173 (1840).

This species is founded on two specimens in the Woodwardian Museum, Cambridge :—

a/435. Upper Wenlock Limestone, Dudley. Fletcher Coll. (Pl. XI. figs. 1 and 2).

For permission to figure and describe these specimens I am indebted to Prof. T. McKenny Hughes, F.R.S.

Specific Diagnosis.

Cup elegant, widening above. RR projecting very slightly ; facet about ⅔ their width. Arms about seven times length of cup, two-branched, with small armlets. (Anal structures unknown.) Stem comparatively stout and markedly quinquelobate, with alternate-sized ossicles.

Description of the Specimens.

The two specimens are figured on Pl. XI., No. 1 being the large specimen and No. 2 the small. They are both seen from the anterior, and show no trace of anals or of the ventral sac.

Dorsal cup.—In both the plates are a little disturbed and the cup is flattened, so that measurements of its height and width are liable to correction. They are as follows :—

	Height. millim.	Width below. millim.	Width above. millim.
No. 1......	8·5	5	?
No. 2......	6·25	3	11·5 (squashed)

The plates of the cup are smooth, and there is no trace of axial folding.

IBB 5, pentagonal, forming a very slight angle with the stem. Measurements are :—

	Height. millim.	Width below. millim.	Width above. millim.
No. 1	2·4	2·8	3·3
No. 2	2	1·5	2

BB 5, hexagonal ; post.B not seen. Measurements are :—

	Height. millim.	Width below. millim.	Width above. millim.
No. 1	4	3·9	4·8
No. 2	3	3	3·5

RR 5, of normal shape; projecting very slightly towards the facet, less in No. 2. Measurements are :—

	Height. millim.	Width below. millim.	Width above. millim.	Width of facet. millim.
No. 1	3·6	4·8	5·25	3·5
No. 2	2·8	3·5	4·2 (?)	3

Surface of facet not seen. The radials bend inwards very slightly on either side of the facet.

Arms.—In No. 1 :—

I Br number 6 and 8. They taper towards the primaxil. Measurements of I Br_1—3 millim. high and 3·5 millim. wide. Measurements of I ax—4 millim. high. 3·3 millim. wide below, and 4·6 millim. greatest width.

From the primaxil spring two rather massive irregular arms, of rather less width than the primibrachs, bearing small armlets at intervals of one, two, or three ossicles. This gives the main arms a slightly irregular appearance, but by no means so irregular as in *B. ramosus.* About 23 brachials of what we may call the distichal series are visible, and the total length of arm observed is 51 millim. The armlets are very small, the width of the first being 1 millim., or about $\frac{1}{3}$ the width of the main arm at the point where it originates. Thus they approach the pinnules of *B. decadactylus*, but differ from them in their irregular distribution and in the fact that they apparently branch again.

In No. 2 :—

I Br number 5 and 3 and 5 (?). Measurements of I Br_1 are—1·9 millim. high and 3 millim. wide. Measurements of I ax are—2·25 millim. high, 2 millim. wide below, and 2·5 greatest width.

The distichal series are as in No. 1, but the distal part of the arms is lost. At the level where the arms are 1·8 millim. wide, the armlets that spring from them have a width of ·8 millim.

Covering-plates, ventral groove, and axial canal are all unseen.

The Stem in No. 1 is preserved to a length of 49 millim., but there are indications in the matrix of at least 20 millim. more. The mean width of the stem, allowing for compression, is 4·2 millim., while the lumen, which is pentagonal, has a width of ·75 millim. In section the stem is quinquelobate, as seen in the outline beside it in the figure. The lobes are interradial in position. The ossicles are of three sizes: large and projecting; small and less projecting; small and not projecting. The average height of an ossicle is about ·6 millim. The sutures are crenelate, showing that the articular surfaces must be striated.

In No. 2 the stem is preserved to a length of 26 millim. and has a width of about 2·25 millim., and the ossicles have an average height of a little less than ·4 millim.

General Remarks.

The relations of this species to the other described species of the genus are pretty clear. The character of its arm-branching shows that it comes between *B. ramosus* and *B. decadactylus*, and this position is corroborated by the shape of the cup. On the other hand, the quinquelobate stem reminds us of the few stem-ossicles that are known of *B. pinnulatus*, and seems to show that too much stress may have been laid on that character as indicative of advanced development.

To our knowledge of the morphology of the genus the present species adds nothing.

Note on Botryocrinus pinnulatus.

My friend Mr. W. Madeley, of Dudley, wrote me as follows under date 27th Jan., 1892 :—" I send you herewith a specimen of (?) *Botryocrinus*, which I purchased from Mr. Gray's collection. I think this is from the Upper or Thin Limestone at Tividale, Dudley."

The specimen in question turns out to be an example of *Botryocrinus pinnulatus*, one of the species described in "Brit. Foss. Crin., V." (Ann. & Mag. Nat. Hist. ser. 6, vol. vii. p. 402). The specimen, which consists of an almost complete crown and 45 millim. of stem, is fairly well preserved, especially in the lower part, and presents a few points of interest which may here be noted.

Dorsal cup is shaped like that of the type specimen. Its height is estimated at about 8·5 millim.; the width below is 4 millim.; the width above cannot well be estimated, as the cup is much flattened and the plates disarranged.

The following are the measurements of the various plates :—

	Height. millim.	Width below. millim.	Width above. millim.	Width of facet. millim.
IBB ..	2	2·1	2·5	
BB....	3·5	3	3·5	
RR ..	3·2 & 3·5	4·2 & 4·5	? & 5·5	3 & 2·6

The radial facet appears to be smoothly concave, and the axial canal is not separate.

Arms are preserved to a length of 85 millim.; they probably reached at least 90 millim. Thus they were more than ten times the height of the cup, and this suggests that the arms of the type specimen were longer than was thought. The arms agree in essential structure with the type specimen, but throw some light on the peculiarities of branching described for that specimen. The axial canal exists as a mere tongue from the ventral groove in all the arm-ossicles, in which respect this specimen appears to differ from the type, if the appearances presented by that specimen were correctly interpreted. The covering-plates are numerous and minute, and appear to be slightly irregular in arrangement.

I Br, in the two arms seen, number 4 and 7, and average 3 millim. in both height and width.

II Br_2 is axillary and gives off on its outer side a long armlet. The widths of the main arm-branch and the armlet, at the point where the latter originates, are respectively 2·5 and 1·5 millim.; in other words, the armlet is $\frac{3}{5}$ the width of the main branch. The length of the armlet appears almost to equal that of the main branch, and it appears to have borne smaller branches or pinnules. (Fig. 3.)

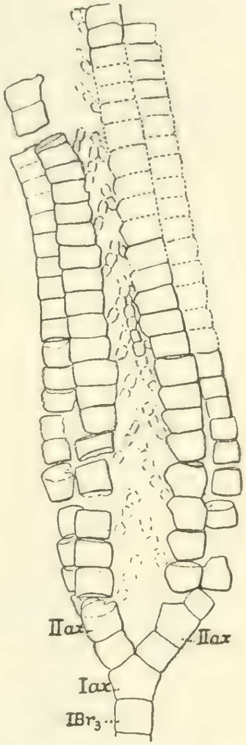


Fig. 3.—Part of Anterior Arm of Mr. Madeley's specimen of *Botryocrinus pinnulatus*; showing the secondary branching, and indications of the pinnules; very slightly diagrammatized. (×2 diam.)

The structure just described suggests that some at least of the secondary arm-branches in the type specimen are not abnormal after all, but that the species does normally branch, in some or all of its arms, on II Br_2. In this respect, then, *B. pinnulatus* would resemble those American species of *Barycrinus* to which allusion was made (*loc. cit.* p. 405), differing from them, however, in the facts that there may be four arms to a ray, not merely three, and that the anterior ray may be so branched no less than the others. It is to be hoped that more specimens of this species may be found, so that this question may be settled; for it is very remarkable that the same species should combine such regularity in the pinnules with irregularity in the arm-branching.

The anterior side of the *Ventral Sac* is partly exposed in the proximal region, and is composed of small plates, which, like the covering-plates, seem to run without distinction into those of the *Tegmen*. Where the plates are disturbed, traces of an articular facet can be distinguished on their upper sides, corresponding to the ridge. (Fig. 2.)

The Stem is pentagonal or slightly quinquelobate, the lobes being interradial in position, while the radial sutures are seen to run down the depressions between them. The ossicles are all ridged, but alternate in size. The width of the stem is 3·2 millim. and the average height of the ossicles is ·36 millim. (Fig. 1.)

Compared with the stem of *B. quinquelobus*, that of the present species is seen to be proportionally more slender and less lobate. All the ossicles, instead of only alternate ones, are ridged, while the ridges are more obvious in the depressions and are of a finer appearance.

The *Horizon* of the present specimen is more compatible with its stage of development than that to which the type specimen was, perhaps erroneously, assigned.

EXPLANATION OF PLATE XI.

Botryocrinus quinquelobus, sp. n.

Fig. 1. *a*/435, Woodwardian Museum, No. 1. Seen from anterior; with drawing of transverse section of the stem. Nat. size.

Fig. 2. *a*/435, Woodwardian Museum, No. 2. Seen from anterior. Nat. size.

Mastigocrinus loreus, gen. et sp. n.

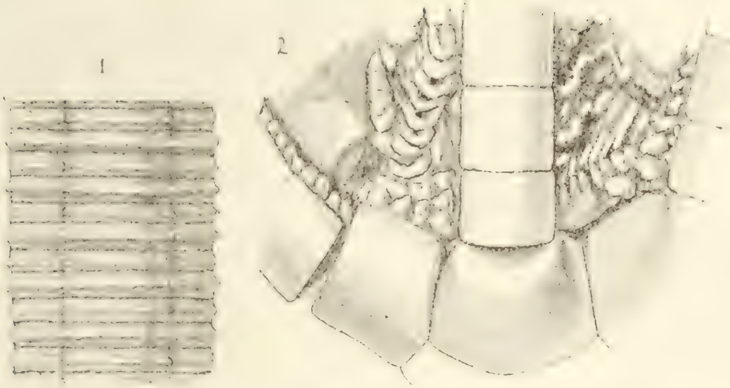
Fig. 3. *a*/493, Woodwardian Museum. (*Cyathocrinus arboreus*, Salter, Cat.) Seen from right posterior interradius. Nat. size.

All figures on this Plate are from drawings by Mr. E. Wilson, Artist to the Cambridge Engraving Co.

XXXI.—*British Fossil Crinoids.*—VII. Mastigocrinus loreus, *nov. gen. et sp., Wenlock Limestone, Dudley.* By F. A. Bather, M.A., F.G.S.

[Plate XI. fig. 3, and Plate XII.]

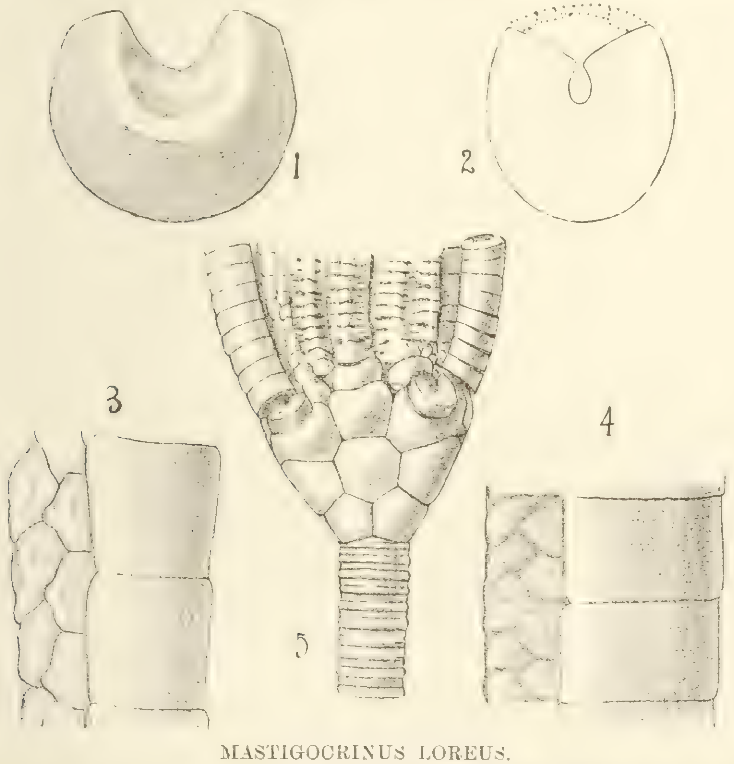
The form described in this paper appears to belong to the family Dendrocrinidæ, series Dendrocrinites. It should therefore have been considered before the Botryocrinites,



BOTRYOCRINUS PINNULATUS.

Fig. 1. Part of the stem, at about one inch from the crown. (× $\frac{10}{3}$ diam.)

Fig. 2. Part of the crown, showing the l. ant., ant., and r. ant. Radials and Primibrachs with Covering-plates; also the anterior side of the Ventral Sac and some plates of the Tegmen. (× 5 diam.)



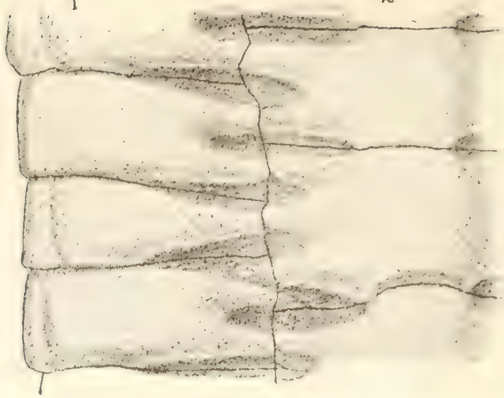
MASTIGOCRINUS LOREUS.

Fig. 1. Anterior facet of l. post. R. from the smaller Dudley Museum specimen. (× 10 diam.)

Fig. 2. Section across a brachial; diagrammatized from the larger Dudley Museum specimen. (× 10 diam.)

Figs. 3 & 4. Portions of arms showing covering-plates, from 133, Mason College. (× 20 diam.) Fig. 4 is the wrong way up by mistake.

Fig. 5. Proximal region of crown and stem, from posterior. 57048, B.M. (×2 diam.)



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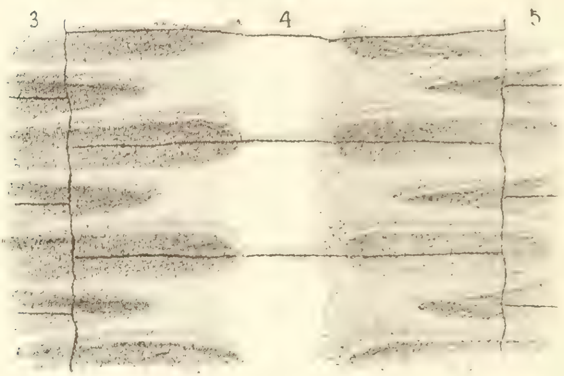

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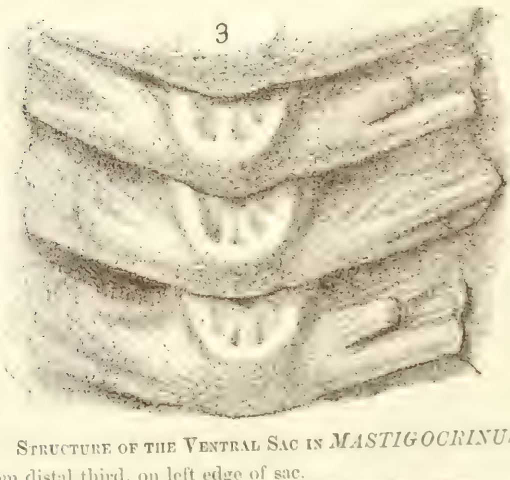
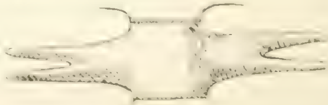


8

STRUCTURE OF THE VENTRAL SAC IN *MASTIGOCRINUS.*

Fig. 6. From distal third, on left edge of sac.
Fig. 7. From proximal third, showing plates in normal position.
Fig. 8. From proximal third, showing plates disturbed and exposing articular facets.
All figures taken from 57048, B.M., and enlarged 20 diam. The small numbers refer to the ridges, as numbered in the text, p. 198.
The *remarque* represents the artist's first and erroneous impression of the structure.



which come in the family Decadocrinidæ. There are two reasons why this was not done: first, that every one who has seen this species, including myself, has regarded it as a *Cyathocrinus*; second, that, until the genera *Botryocrinus* and *Cyathocrinus* were understood, the reasons for separating it from the latter genus would hardly have been appreciated.

Of the genus only the one species is as yet known, though it is probable that several American species will be found to belong to it. The descriptions of genus and species must therefore go together, and a diagnosis of the latter can hardly be given.

Generic Diagnosis.

Cup cyathiform, with plates of medium thickness. I BB 5; BB 5; RR 5. Arms simple, dichotomous, elongate. No R′; *x* hexagonal, in line with RR; Ventral Sac long, flattened, composed of primitively hexagonal plates which are transversely folded. Tegminal plates small, irregular. Stem round, with small pentagonal axial canal, and with radial sutures.

The appearance of the specimens as they lie on the rock, with their long, wavy, delicate arms outstretched, suggests a knout or cat-o'-nine-tails; hence the name, from *μάστιξ*, a scourge.

The type species is founded on the evidence of five specimens, viz. :—

In the British Museum :

57048, a magnificently preserved crown, with 36 millim. of stem, seen from the posterior. Matrix a blue shale. Dudley. From the collection of Mr. John Gray of Hagley. (Pl. XII. fig. 3, and zincotype, figs. 3–8, and fig. 9 on p. 198.)

In the Museum of Mason College, Birmingham :

133, a fairly complete crown, with 24 millim. of stem; seen from left side; rather disturbed and overgrown by Polyzoa. Matrix a rough limestone. Dudley. (Pl. XII. fig. 2.)

In the Museum of the Dudley Geological Society :

(*a*), a portion of a crown, with traces of ventral sac and 66 millim. of stem; seen from anterior. Matrix a blue shale. Dudley. (P. 200, fig. 10.)

(*b*), a smaller crown broken distally, with 8 millim. of stem, seen from posterior. Matrix a blue shale. Dudley. (Pl. XII. fig. 1, and zincotype, fig. 1.)

In the Woodwardian Museum, Cambridge:

a/493, an almost complete specimen, with the crown slightly disturbed; seen from right posterior radius. On a slab of limestone. Dudley. In the Fletcher collection. (Pl. XI. fig. 3, explanation on p. 194.)

For permission to figure the first and last of these specimens my thanks are here given to Dr. Henry Woodward, F.R.S., and Prof. T. McKenny Hughes. For similar favours, as well as for the loan of the specimens in the Mason College and the Dudley Museums, I must express my gratitude to Prof. C. Lapworth and Mr. W. Madeley.

These specimens all appear to come from the Upper Wenlock Limestone; but, as usual, their exact locality and horizon are uncertain. They all belong to one species, for which I propose the name—

Mastigocrinus loreus, sp. n.

1873. *Cyathocrinus* (sp. 9) *arboreus*, J. W. Salter, *nom. nud.*, Cat. Camb. and Sil. Foss. p. 125: Cambridge.

Non *Cyathocrinus arboreus*, Meek and Worthen, Proc. Acad. Nat. Sci. Philadelphia for 1865, p. 160, and Rep. Geol. Surv. Illinois, vol. iii. p. 520 (1868).

Cyathocrinus sp. 11, Salter, *loc. cit.*

The trivial name applied to this species means "provided with lashes," and, besides carrying on the metaphor of the generic name, it alludes to the very fine terminations of the arms.

Detailed Description.

The plates of all the specimens except 57048 B.M. are somewhat displaced, so that the measurements here given refer chiefly to that. For details connected with the Cambridge specimen I am indebted to drawings furnished by Mr. Edwin Wilson, as well as to an excellent photograph sent me by the Cambridge Engraving Co.: the specimen itself I have never seen, as it could never be found when I went to the Woodwardian Museum; for information that it was at last forthcoming I am obliged to Mr. H. Woods. The specimen *a*/497 which Salter labelled "*Cyathocrinus* sp. 11," was also thought to be missing (see Cat. Type Fossils, Woodwardian Mus. p. 39, Cambridge, "1891," 1892); but, through the kindness of Mr. Woods in sending me a rough sketch of it, I am able to refer it, as was to be anticipated, to the present species. The specimen consists of a rather disturbed crown, with 10 millim. of stem, and it shows the delicate finials very well. It is on a large block of limestone, and comes from the Fletcher collection.

Dorsal cup conical, slightly expanding above, much as in *Botryocrinus decadactylus.* The plates are smooth or very finely shagreened, and almost plane. Measurements are :—Height along posterior interradius, 10 millim.; width below, 5·2 millim.; width above, 14 millim., but some of this is due to crushing.

IBB 5, pentagonal, forming a very slight angle with the stem. Measurements are :—

	Height. millim.	Width below. millim.	Width above. millim.
57048 B.M.	3·5	3	3·2
" "	3	3	3·2

In smaller specimens they are rather larger in proportion.

BB 5; 4 are hexagonal, post.B heptagonal. Measurements :—

	Height. millim.	Width below. millim.	Width above. millim.
57048 B.M....	4·5	3·5	4·25 (post.B)
" "	4·75	?	? (r. post.B)

In smaller specimens they are rather larger in proportion.

RR 5, of normal shape; bending outwards towards the facet and curving inwards towards the radial processes, as in *Botryocrinus.* Measurements are :—

	Height. millim.	Width below. millim.	Width above. millim.	Width of facet. millim.
57048 B.M.	3·5	5	5 (?)	4
Cambridge	4	4·9	4·9	3·1

The articular facet (zincotype, fig. 1) has a very faint transverse ridge and the axial canal is not separate.

The Arms are about 11 times as long as the height of the cup; they dichotomize at least 8 times, at rather long intervals, and decrease very gradually both in the diameter and height of the ossicles. All this gives them an exceedingly slender and graceful appearance, especially when they have a delicate wave as in 57048 B.M. Corresponding branches are equal in size, except perhaps occasionally in the extreme distal region, where one branch sometimes appears to be smaller than its fellow.

The ventral groove is a slight wide depression, from which a narrow V stretches to the axial canal which is not separated by stereom (zincotype, fig. 2). The covering-plates are irregular and numerous, as in *Botryocrinus*, but appear to be more or less alternating (zincotype, figs. 3 and 4).

The total length of the arms in 57048 B.M. is 11 centim.

I Br number from 7 to 11, the usual number being 8. Their height is 1·4 millim.; their width 3 millim.

II Br 9, 10, or 11.

III Br from 9 to 14.

IV Br from 12 to 26.

V Br numbers noted 17 and 22.

VI Br numbers noted 16 and 25.

VII Br 15 observed.

VIII Br and IX Br are so small and faint that it is difficult to make out their exact numbers. The width of the finials is about ·25 millim. The distal portions of an arm-branch are figured here (fig. 6), to show that there is no suspicion of pinnules.

Anal structures.—Anal x is hexagonal, resting on the horizontal upper side of post. B, in a line with RR, and supporting three plates, viz. a median proximal plate of similar shape and a small plate on either side between it and the adjacent radials (*rt* and *lt*).

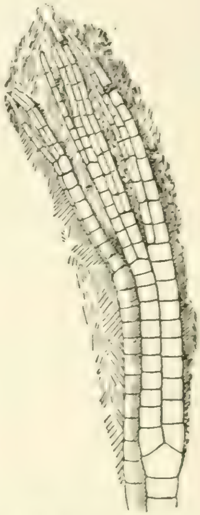


Fig. 9.—*M. loreus.* Distal end of part of l. post. Arm in 57048 B.M. (× 6⅔ diam.)

The Ventral Sac in 57048, where it is magnificently displayed, has a length of 7 centim. At its origin it is 10 millim. wide, but rapidly increases to 13 millim. and then decreases very gradually. It is transversely compressed and is very flat.

In its plan of structure this sac resembles those of *Thenarocrinus*, *Botryocrinus*, and *Dendrocrinus* (what may be called the wickerwork-type, Trautschold's "Angulosi"). Seen from the posterior, 5 ridges are visible, which are from left to right as follows:—(1) ridge starting from *lt*, (2) ridge starting from a plate intercalated between *lt* and median proximal plate, (3) median ridge, starting from median proximal plate, (4) ridge starting from *rt*, (5) ridge on right of *rt* ridge. There are probably three other ridges on the anterior side. This would make the number of ridges 8 in all, in which the genus would agree with *Thenarocrinus* if not with others of the group.

The ossicles are slightly ridged in the middle, and are thrown into strong lateral folds. Primitively the ossicles are hexagonal in outline and alternate with those of adjacent rows, but the simple outline is usually obscured by the folding. The folds on one side of one ossicle usually meet the folds on the adjacent side of two adjoining ossicles. Sometimes, however, there appear to be small intervening plates, in which the folds of the ossicles on either side meet. The stereom is perfectly continuous over the whole surface of the ventral sac, forming the floor of the depressions just as much as the summits of the folds and ridges (zincotype, figs. 6 and 7). That the sac was a very flexible structure is proved by the appearance presented by the upper and lower sutural surfaces of the individual ossicles: when the ossicles are slightly pushed over so as to expose these edges, it is seen that the end of each ridge is a regular articular facet of almost circular outline, marked with depressions for ligament, which depressions run at right angles to the surface of the sac (zincotype, fig. 8). The plates that form ridges 2, 3, and 4 are more or less flat; but those forming ridges 1 and 5, which are at the borders of the sac, are bent round at a sharp angle, the angle itself being rounded and constituting the ridge. In other words, these two ridges form part of both the anterior and the posterior surfaces of the sac. The following are measurements of ossicles from the proximal region of the sac:—In the median ridge (3), height ·83 millim., width 3 millim.; in ridges 2 and 4, height ·7 millim., width 2·6 millim. The ossicles decrease in all dimensions in the distal region of the sac.

The description of the Ventral Sac has been given at considerable length, as the specimen 57048 B.M. shows the structure of this interesting organ more clearly than any other fossil known to me. It is perfectly certain that there are no slits or pores of any kind in this sac; and yet so deceptive is the appearance of the depressions filled with matrix that both Mr. Hollick and Mr. Wilson, experienced scientific artists, drew the plates as though they were quite discontinuous, and as though there were large slits between the folds or finger-like processes. Now, however, Mr. Hollick, after examining the whole surface of the sac with a microscope, and after seeing the matrix cleaned out with needle and brush from some of the most slit-like depressions, is so convinced of his former error that he will hardly permit me to publish the drawing that he first made. This, however, I give in the margin, in order to show how the most careful observer may be misled. These facts seem sufficient explanation of those statements, so often controverted in the present series of papers, as to the presence of slits in the ventral sac of the Fistulate Crinoids.

The Stem attained a length of at least 11 centim. It was round in section, with a width (in 57048) of about 4·5 millim. In the proximal region it is composed of ossicles of three sizes, the larger ones slightly projecting, with an average height of ·4 millim. (zincotype, fig. 5). In the more distal regions (fig. 10) the ossicles are smooth and more equal in height. The sutures are crenelate, indicating radiate striæ on the articular surface. The lumen is small, as in *Botryocrinus*, and from it there proceed five radial sutures, which are usually visible on the outside right up to the dorsal cup. In the distal region of the stem the pentameres show only a slight tendency to the hexagonal shape and semi-alternating arrangement described for *Botryocrinus*. The distalmost end of the Cambridge specimen is smooth and rounded, and this though the whole stem and cup are very slightly disturbed. If this rounding be due to weathering, it would appear to have been accomplished while the creature was yet alive. (Pl. XI. fig. 3.)

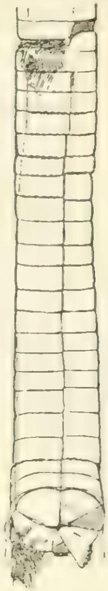


Fig. 10.—Distal part of Stem in the larger Dudley Museum specimen of *M. loreus*. (× $3\frac{1}{3}$ diam.)

General Remarks on the Genus.

In the composition of its cup, in the anal area, and in the simple dichotomy of its arms, this species resembles the species of *Cyathocrinus*, and, were that genus not more strictly defined than it has hitherto been, it would doubtless be referred thither. On the other hand, there are many points, not hitherto recognized as of great importance, in which the present species resembles a very different assemblage of Crinoids. The shape of the cup, especially of the radials, is the same as that of *Botryocrinus*. The ventral sac is of the same structure as that of *Dendrocrinus*, *Botryocrinus*, and *Thenarocrinus*; while the general resemblance of the smaller Dudley specimen to the type specimen of *T. gracilis* (Brit. Foss. Crin. IV., 'Annals,' ser. 6, vol. vii. pl. i. fig. 4) cannot pass unnoticed. The arms are especially like those of *T.*

gracilis, and in a less degree like those of *T. callipygus*; they resemble them not only in their excessive dichotomy, but in the character of the brachials and of the covering-plates. In all these respects they differ from the arms of the Cyathocrinidæ, and in all except the regular dichotomy they resemble the arms of *Botryocrinus*. In the presence of radial sutures and in the arrangement of the columnals the stem resembles that of *Ottawacrinus*, *Thenarocrinus*, and *Botryocrinus*, but approaches nearer the last by reason of its smaller lumen.

From all these facts, then, it appears that the species must find a place in that line of genera that passes from *Dendrocrinus* and *Ottawacrinus* to *Botryocrinus* and its allies. When we inquire into which family it should be placed, the obvious answer is—the Dendrocrinidæ; since the possession of regularly dichotomous arms precludes it from finding a place in the Decadocrinidæ. Further, from the non-pinnulate nature of its arms, it must be placed with the Dendrocrinites.

Comparing it now with the other Dendrocrinite genera, we see that it differs from *Dendrocrinus*, *Homocrinus*, *Parisocrinus*, and *Thenarocrinus* in the total absence of a radianal, in which respect it resembles *Merocrinus* and *Ottawacrinus*. In *Merocrinus*, however, no anal plate of any kind enters into the dorsal cup, so that we are driven back to *Ottawacrinus*.

Ottawacrinus, it will be remembered, has an anal x placed between the radials, but no radianal (see Brit. Foss. Crin. II., 'Annals,' ser. 6, vol. v. pl. xiv. fig. 12); in the main composition of its cup, then, it resembles the present species. The stem of *Ottawacrinus*, too, has very distinct radial sutures. Our new British species cannot, however, be referred to *Ottawacrinus*, for in that genus the anal x is raised by half its height above the general level of the radials, while its upper surface supports only two plates of almost equal size. In *Ottawacrinus*, moreover, the shapes of both basals and radials are curiously irregular on the right side of the cup. The brachials of *Ottawacrinus* are much flatter, and the articular facet extends over the whole width of the radial, so that the arms are closely pressed together below. For the loan of the type specimen of *Ottawacrinus canadensis* I here tender my hearty thanks to its owner and describer, Mr. W. R. Billings, of Ottawa.

This new species, then, appears to be *sui generis*, and it is unfortunately necessary to add to our lists the name *Mastigocrinus*. This genus may be regarded as leading in one direction towards the Botryocrinites, and in another towards the Cyathocrinites.

The addition of this genus to the Dendrocrinites suggests that, after all, *Thenarocrinus*, to which it is so closely allied, may find more fitting companionship with that family-party than with the somewhat peculiar *Carabocrinus*. The latter is in truth a crabbed unsociable animal, whose nature, through the kindness of my Canadian friends, is now becoming better known to me.

EXPLANATION OF PLATE XII.

Mastigocrinus loreus, gen. et sp. nov.

Fig. 1. The smaller specimen in the Dudley Museum.
Fig. 2. 133 Mason College.
Fig. 3. 57048 B.M. (See p. 195.)

From a photograph of the specimens, about $\frac{1}{25}$ larger than nature.

XXXII.—*British Fossil Crinoids.*—VIII. Cyathocrinus: C. acinotubus, *Ang., and* C. vallatus, *sp. nov.*, *Wenlock Limestone.* By F. A. BATHER, M.A., F.G.S.

[Plate XIII.]

HISTORICAL INTRODUCTION.

THE name *Cyathocrinus*, or, as it used to be written, *Cyathocrinites*, was first used by J. S. Miller in 1821 on page 85 of his 'Natural History of the Crinoidea,' and is derived from *κύαθος*, a cup; it has also been used by all subsequent writers on the subject. When, however, we enquire what particular form of Crinoid should be denoted by this name, we are speedily involved in difficulties. Fortunately Messrs. Wachsmuth and Springer, in their 'Revision of the Palæocrinoidea' (I. 79; Proc. 1879, p. 302), have dealt fully with this subject, and their conclusions accord with common sense and with the rules of nomenclature. There are only a few points in which insufficient acquaintance with European material or European literature has led them astray. Since their work is, or should be, in the hands of every serious student of the Crinoids, a short explanation of the position adopted is all that is here required.

The four species referred by Miller to *Cyathocrinus* belong to four different genera, not to mention families and suborders. The first of these, *C. planus*, should of course be taken as the type: the others are now known as *Taxocrinus tuberculatus*, *Crotalocrinus rugosus* (= *C. verrucosus*, Schloth., sp.), and *Parisocrinus quinquangularis*.

As to *C. planus* itself a little difficulty has arisen. Miller's diagnosis of the genus (p. 85) is as follows :—"A Crinoidal animal, with a round or pentagonal column formed of numerous joints, having side arms proceeding irregularly from it. On the summit adheres a saucer-shaped pelvis of five pieces, on which are placed in successive series, five costal plates, five scapulæ, and an intervening plate. From each scapula proceeds one arm having two hands." The generic diagram facing p. 85 shows five pentagonal infrabasals, five basals, of which four are hexagonal (or pentagonal according to the angles formed by the upper sides of the infrabasals) and the fifth heptagonal (or hexagonal), five radials with a deep notch and an articular facet about one third the width of the plate, and a hexagonal anal x in line with the radials. The figures of *C. planus*—1, 2, 3, 4, 5, 6, 7, 8, 9, 29, 30—show that this diagram was taken from that species, and bear out the diagnosis so far as the cup is concerned. Fig. 1, however, shows dichotomous pinnulate arms, and we know of no genus with arms of this character that has a dorsal cup like that shown in the diagram. The Austins' explanation of this was a probable one. They said (Monogr. Rec. & Foss. Crinoidea, p. 61), "Miller's principal figure of this species cannot be depended on, as he appears to have taken the rays of the *Taxocrinus longidactylus* and placed them on the body of the *C. planus*." On this Wachsmuth and Springer remarked (Revision, I. 81, footnote 2), "In supposing these to be the arms of *Taxocrinus*, Austin is certainly mistaken." Austin, however, applied the name *Taxocrinus longidactylus* to a specimen from the Carboniferous Limestone, near Walton Castle in Clevedon Bay, of which a figure had been published by George Cumberland *. This very figure was referred by Miller (p. 86) to *C. planus*, and it is quite likely that the arms of his own fig. 1 were suggested by it. As a matter of fact there can be little doubt that Cumberland's figure represents a *Scaphiocrinus* with two primibrachs, although the pinnules are merely indicated in his drawing by rough shading. The same specimen was figured by Austin, pl. xi. fig. 3 *a*, under the name *Poteriocrinus longidactylus* (p. 88), thus showing that the name *Taxocrinus* was inserted by mistake on p. 61. Mr. W. P. Sladen, in his revision of the "Genus *Poteriocrinus* and allied forms" †, left this species out in the cold; but Messrs. Wachsmuth and Springer referred it

* "Description of some new Fossil Encrini and Pentacrini, lately discovered in the neighbourhood of Bristol," Trans. Geol. Soc. 1st ser. vol. v. part 1, pp. 87–94, with pls. ii.–v.: London, 1819. See pl. iii. fig. 1.

† Proc. West Riding Yorksh. Geol. and Polyt. Soc. vol. vi. (n. s., vol. i.) part iv. pp. 242–253, pl. x. (1877), 1878.

to *Scaphiocrinus* (Rev. I. 114, Proc. 1879, p. 337). Miller's fig. 28 probably represents a *Scytalecrinus*, but the anal area is not very clear; at any rate it does not agree with the diagnosis or diagrams of *Cyathocrinus*. In his diagnosis of the genus Miller stated that the stem had irregular "side arms" or cirri, and such were represented in his figures 26 and 27; but of these the Austins said (*op. cit.* p. 61), they "are not the side arms of any species of *Cyathocrinus*, 26, being a small column, and 27, the column and side arms of a *Poteriocrinus*." No species agreeing in other respects with Miller's diagnosis is known to possess cirri of this nature.

The foregoing specimens were no doubt placed, as was the rest of J. S. Miller's valuable collection, in the Bristol Museum *, where they were shown to L. Agassiz by the then curator, Mr. S. Stutchbury †. But, to the disgrace of the inhabitants of that town, all these treasures have been gradually allowed to disappear from that, their natural resting-place.

There was, however, another specimen figured by Miller (figs. 29 and 30), which was said by him (p. 87) to be "in the Ashmolean Museum at Oxford." The drawings agree perfectly with the generic diagnosis and diagram, and this specimen would be the best to take as the type of the species. Unfortunately, in the transfer from the Ashmolean to the new Museum at Oxford, this, with other important specimens, appears to have been mislaid, and all search for it has up till now been fruitless. It were to be wished that those in charge of some of our museums would remember that they are responsible, not merely to their immediate employers, not to the town, nor even to the nation, but to the whole world now and to come.

J. Phillips, in his 'Geology of Yorkshire' (1836), did not recognize *C. planus*. He figured, however, under the name *C. distortus* (vol. ii. p. 206, pl. iii. fig. 34), a specimen that was obviously of the same species as Miller's figs. 29 and 30. The Austins appear to have studied Miller's type specimens before they were 'conveyed' from the Museum of the Bristol Institution, and they retained the species *C. planus*, figuring (*op. cit.* pl. vii. fig. 4 *c*, *d*) a specimen which was in all probability the original of the cup in Miller's fig. 1, as well as a specimen (pl. vii. fig. 4 *e*) probably the same as that figured by Phillips for *C. distortus*, which species they con-

* See 'The West of England Journ. Sci. and Lit.,' no. 1, pp. 4, 19, 98, and 252: Bristol, Jan. 1835.

† L. Agassiz, 'Poissons Fossiles,' 4[e] livr., feuilleton additionel, p. 52 (1835).

sidered as a synonym of *C. planus*. There is therefore no difficulty in deciding what Miller meant by *C. planus*, and there should consequently be no difficulty in distinguishing the genus *Cyathocrinus*.

Before leaving *C. planus*, however, it may be as well to correct a few mistakes made by the earlier writers, lest they should again prove cause of confusion.

Miller's erroneous ascription of cirri to the species has already been noted. With regard to the arms Miller wrote (p. 87), "they are all tentaculated at alternate sides, and resemble those of Pentacrinus Caput Medusæ." Similarly the Austins, though they scouted Miller's figure of the arms, remarked (p. 60), "The rays were no doubt tentaculated, although none of the specimens show the tentacula." It is certain, however, that tentacula or pinnules are not present in this species.

The Ashmolean specimen figured by Miller showed the base of the anal tube clearly: Miller, however, merely said (p. 87), "this [abdominal] integument is swollen out, and gives the specimen a singular appearance." The Austins regarded this aperture as the mouth. De Koninck and Le Hon* appear to have understood that it was connected with the anus; but neither they nor previous writers were aware that the opening was followed by an anal tube. The plates around the base of this tube were displayed by Miller in his dissected diagram, fig. 30. Wachsmuth and Springer, however (Rev. I. 81, footnote 1) consider that "the four small plates, arranged in the figure in a half circle, are to represent the interradials (oral plates) [deltoids] in the dome, and not the plates of the ventral sac, as might be expected." This cannot be right: the specimen, as proved by fig. 29, possessed no deltoids, while in both figures the letter T points to a larger and irregularly shaped plate which was most probably the madreporite.

Miller distinctly (p. 87), and the Austins in more ambiguous language (p. 59), both stated that the articular facet of the radial was perforated. To the question whether there are any species of *Cyathocrinus* that possess this character we shall recur later on; in the Carboniferous species *C. planus*, at any rate, there is no doubt that in the radial facet the axial canal is not separated from the ventral groove.

* 'Recherches sur les Crinoïdes du Terrain Carbonifère de la Belgique,' Mém. Acad. Roy. Belgique, vol. xxviii. p. 81: Brussels, 1854.

Restriction of the Genus.

Having determined the type species of the genus, we have now to consider various forms that have at different times been confused with *Cyathocrinus.*

It is unnecessary to say more about the separation of *Poteriocrinus* from *Cyathocrinus*, since it differs not only in the anal area but in the possession of pinnules.

Parisocrinus has arms like *Cyathocrinus*, but an anal area like *Poteriocrinus*; hence there is no real reason for confusing the two as has often been done.

J. Hall * extended the diagnosis of *Cyathocrinus* to include forms with a small quadrangular radianal. These forms, however, differ in other respects, besides the presence of a radianal, from *Cyathocrinus*, and doubtless belong to quite a different family—the Decadocrinidæ. In America such forms are represented by *Barycrinus* and *Vasocrinus*: in England it is the Silurian *Botryocrinus* that has been labelled *Cyathocrinus* †; while a Carboniferous fossil that is probably a *Barycrinus* appears to have been considered a *Poteriocrinus.*

De Koninck and Le Hon ‡ gave a diagram of *Cyathocrinus* in which the anal *x* was represented as pentagonal and as supporting two small hexagonal plates. This was probably a mere slip, for neither in *C. planus* nor in *C. mammillaris*, the only species described by them, has the anal *x* that shape. Some specimens of *C. multibrachiatus* from the Keokuk group of North America, that are in the British Museum, appear to have an anal *x* of this shape, but it is not typical of the genus. In fact the diagram given by De Koninck and Le Hon resembles, in this respect at least, that of *Ottawacrinus* alone among the Inadunata. They also give, under the head of *Cyathocrinus*, a diagram of the anal area of a Permian species, of which all we can say is that it certainly is not a *Cyathocrinus.*

The Austins (*op. cit.* p. 66), in reviewing the species ascribed by different authors to this genus, said, "Not one of the so-called *Cyathocrini* of Murchison's Silurian System properly belong to the genus." This is perfectly true: it has long been known that *C. tuberculatus* is a *Taxocrinus*, that *C. pyriformis* (*sic*) is an *Ichthyocrinus*, and that *C. rugosus* is a *Crotalocrinus*; in fact these corrections were made when the plates were reprinted to illustrate Murchison's

* Rep. Geol. Surv. Iowa, vol. i. part ii. p. 622 (1858).

† "Brit. Foss. Crin., V.," Ann. & Mag. Nat. Hist. ser. 6, vol. vii. p. 395, May 1891; and VI., p. 189, *anteà.*

‡ 'Recherches sur les Crinoïdes &c.,' pp. 79 *et sqq.* (1854).

'Siluria' (edit. 3, 1859). The names *Cyathocrinus goniodactylus*, *C. arthriticus*, and *C. capillaris*, of 'The Silurian System' and 'Siluria,' have had a longer existence; indeed it was not till 1878, when Angelin founded *Gissocrinus*, that there was any genus for the reception of those species. They, however, together with various species to which J. W. Salter gave the Catalogue names of *C. scoparius*, *C. squamiferus*, *C.* sp. 1, and *C.* sp. 5, all appear to differ from *Cyathocrinus* in the possession of three infrabasals instead of five, and must therefore be referred to *Gissocrinus*.

Wachsmuth and Springer (Rev. I. 83, Proc. 1879, p. 306) said, "*Palæocrinus* Billings is not distinct from *Cyathocrinus*. The construction of the calyx is identical." E. Billings founded *Palæocrinus* in 'Figures and Descriptions of Canadian Organic Remains,' decade iv. (1859), on p. 24, the type species being *P. striatus* (p. 25); he also referred to the genus *P. angulatus* (p. 45), *P. rhombiferus* (p. 45), and *P. pulchellus* (p. 46). Wachsmuth and Springer (Rev. III. 225; Proc. 1886, p. 149), after examining the type specimens, entirely changed their views with regard to *Palæocrinus*. They said, "The specimen of *P. striatus*, upon which the genus was proposed, is very imperfect, and may be a *Carabocrinus*, *Dendrocrinus*, or a new genus." *P. angulatus* was referred by them, without any doubt, to *Dendrocrinus*. Through the kindness of Dr. A. R. C. Selwyn and Mr. J. F. Whiteaves, the type specimens of Billings's four species, which are the only specimens known, are now before me. As regards *Palæocrinus striatus*, there is no doubt that it is not a *Cyathocrinus*; but a very careful examination has convinced me that neither is it a *Carabocrinus* or a *Dendrocrinus*. I should not, however, like to say whether it can really be regarded as an independent genus. *P. angulatus* also is no *Cyathocrinus*; but I quite fail to see why it should be referred to *Dendrocrinus*: the radianal is small, apparently four-sided, and occupies a position more like that in *Botryocrinus* than that in any other Inadunate genus. The specimens of *P. rhombiferus* and *P. pulchellus* do not show the anal area; for the present therefore the reticence of Messrs. Wachsmuth and Springer concerning them is the best example to follow.

Among the genera that have been confused with *Cyathocrinus* there only remains one worthy of discussion, namely the genus *Sphærocrinus*; and the history of this is somewhat peculiar. The only species of the genus is *S. geometricus*, a fairly well-known form from the Devonian rocks of both Germany and England. The species was founded by Goldfuss † and was referred by him to *Cyathocrinus*. Since the diagnosis of that genus given by Goldfuss was simply a translation of Miller's, it follows that *C. geometricus* was regarded by its author as possessing but one plate in the anal area. Neither the figures of Goldfuss nor that given by J. Phillips in his 'Palæozoic Fossils of Cornwall &c.,' pl. lx. fig. 41* (1841), show the anal plates. The Austins, in their Monograph, p. 61 (1845), likewise referred this species to *Cyathocrinus*, speaking as though there were one anal plate only, placed as in *Cyathocrinus*; in fact the diagram of *Cyathocrinus* on p. 58 is said to be taken from *C. geometricus*. C. F. Rœmer ‡ appears to have found Miller's description of *Cyathocrinus planus* quite unintelligible, and consequently proposed to take Miller's second species, now known as *Taxocrinus tuberculatus*, as the type of *Cyathocrinus*, while he made *C. geometricus* the type of a new genus, *Sphærocrinus*. From his diagnosis of *Sphærocrinus* we learn that he supposed the genus to have only three infrabasals, while he again mentions, though with some doubt, the single anal plate. Rœmer's view was adopted by G. and F. Sandberger in 'Die Versteinerungen des Rheinischen Schichtensystems in Nassau,' pp. 389, 390 (Wiesbaden, 1850–1856). Joh. Müller § was the first to point out the correct structure of *C. geometricus*, describing a new variety of it, or possibly, as he regarded it, a closely allied species, under the name *Poteriocrinus hemisphæricus*. He showed that there were five infrabasals, and that the anal area possessed a radianal, an anal *x*, and another small plate (*rt*) on the right of anal *x*, resting on the radianal. L. Schultze ‖ placed all varieties of this species under the one head *Poteriocrinus geometricus*, and gave figures (Taf. v. figs. 6 *d*, 6 *f*) entirely confirming Müller's description and figures of the anal area. It is odd that Messrs. Wachsmuth and Springer, who refer to both Müller and Schultze, should still have kept this species under *Cyathocrinus* in the first part of their Revision, saying (p. 85), "it has all the characters of *Cyathocrinus*, not only in the construction of the calyx, but also of the vault." In 1886, however (Rev. III. 226; Proc. p. 150), they were inclined to

† 'Petrefacta Germaniæ,' vol. i. part 3, p. 189, tab. lviii. figs. 5 *a*, *b* (1831).

‡ "Beiträge zur Kenntniss der fossilen Fauna des Devonischen Gebirges am Rhein," Verhandl. d. naturhist. Ver. d. preuss. Rheinlande, 8th Jahrg. pp. 363–369: Bonn, 1851.

§ "Ueber neue Echinodermen des Eifeler Kalkes." Abhandl. k. Ak. Wiss. Berlin, Jahrg. 1856, p. 250, Taf. ii. figs. 4, 5, 6, 7 (1857).

‖ "Monographie der Echinodermen des Eifler Kalkes." Denkschr. k. Ak. Wiss. math.-nat. Cl. Bd. xxvi. (1866) p. 51; Wien, 1867.

separate *Sphærocrinus* from *Cyathocrinus*; still this was not on account of any differences in the structure of the cup, but merely because the axial canal in the radials was separated by stereom from the ventral groove. To the question whether this character is of generic importance we shall return immediately; for the present it is enough to state that the description of *Poteriocrinus geometricus* given by Müller and Schultze is proved correct by a large number of specimens in the British Museum. So long as the arms of this species are unknown one cannot definitely say to which genus it belongs; it would probably be safer to place it in *Parisocrinus*, but we may be quite certain that it has nothing to do with *Cyathocrinus*.

A single species, hitherto undescribed, which may be regarded by many as a *Cyathocrinus*, has been separated therefrom and made the type of a new genus, under the name *Mastigocrinus loreus*. The reasons for this have been so fully given in the preceding paper (*anteà*, p. 200) that it would be waste of space to repeat them here. Suffice it to say that no *Cyathocrinus* has yet been found with a ventral sac, a tegmen or a stem like those of *Mastigocrinus*.

Wachsmuth and Springer (Rev. III. 326; Proc. 1886, p. 150) have stated that the possession of a separate axial canal by the radials is a structure that "occurs exclusively in species from the Silurian and Upper Devonian, never in the Carboniferous, neither in *Cyathocrinus* nor other genera." "Whether," they continue, "all species of *Cyathocrinus* from Gothland and Dudley possess this structure, cannot be ascertained from the figures, but if they do, it may form the basis of a separation which seems to us very desirable." Now, even if we were safe in accepting this remarkably broad and dogmatic, though not very clear, statement, intermediate forms might still occur in the Lower and Middle Devonian. Even if they did not, so small a point would hardly be enough to differentiate two genera; for it is no rare thing to find the axial canal separate in one species of a genus, in one individual of a species, or in the earlier brachials of an individual, while it is merely a tongue from the ventral groove in others *. Moreover there do not appear to be any other constant or decided differences between the Carboniferous species of *Cyathocrinus* and such typical Silurian species as *C. acinotubus*, *C. ramosus*, and *C. visbycensis*. As a matter of fact, however, even this difference does not exist, for the axial canal is not separate in the Silurian *C. vallatus*, although

* See "Brit. Foss. Crin.—V. *Botryocrinus*," Ann. & Mag. Nat. Hist. ser. 6, vol. vii. p. 392, May 1891.

it is separate in the closely allied *C. acinotubus*; while it is separate in some individuals of *C. striolatus* from Gotland but not in others. Consequently it seems advisable for the present to retain both Silurian and Carboniferous species in one genus—*Cyathocrinus*—with the following

Generic Diagnosis.

IBB 5, equal, pentagonal. BB 5, hexagonal except post. B, which is heptagonal and supports *x*. RR 5, shield-shaped, with facet circular or elliptical in outline, and occupying from less than $\frac{1}{3}$ to $\frac{2}{3}$ width of R. *x* tetragonal to hexagonal, in line with RR, and about $\frac{2}{3}$ width of R. Arms long, simple, dichotomizing regularly several times; covering-plates alternating, in from 1 to 4 (or 5 ?) rows on either side. Ventral sac composed of usually hexagonal plates, either smooth or slightly folded. Tegmen consolidated by deltoids. Madreporite distinct.

Description of the Genus.

Dorsal Cup cyathiform; with sides convex, straight or convexo-concave; with plates plane or tumid; surface smooth, shagreened, or slightly ridged either radiately or concentrically. No pronounced axial folding.

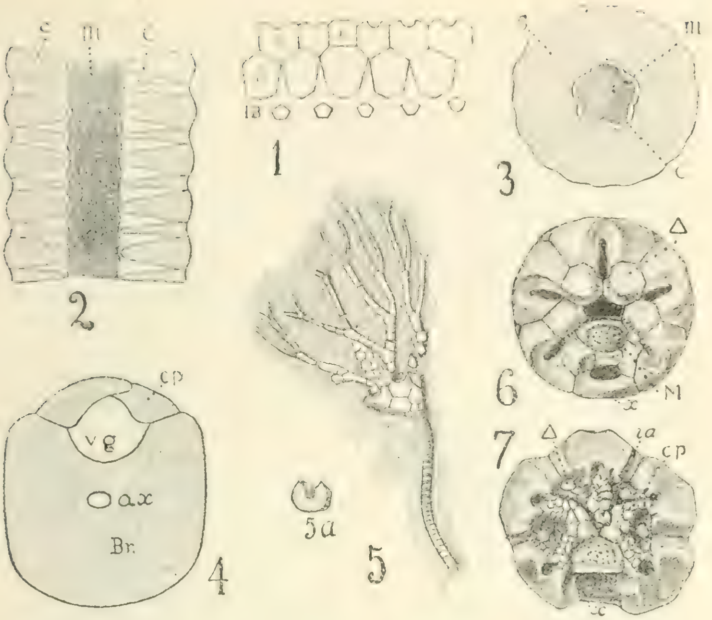
IBB 5; pentagonal; lying at very various angles to stem, and varying very greatly in height.

BB 5; hexagonal, except post.B, which is heptagonal. These also vary much in their proportions, but are usually large.

RR 5; of normal outline; as large as or larger than BB. Articular facet from a little less than $\frac{1}{3}$ to $\frac{2}{3}$ width of plate, usually about $\frac{1}{2}$; circular or elliptical in outline; directed outwards and upwards at very various angles; axial canal may or may not be separated from the ventral groove by stereom. Radial processes curve upwards and inwards to the deltoids.

Arms non-pinnulate, dichotomous; usually long and branching from 5 to 7 times (in Silurian species at least); with more ossicles in each series towards the inner side of each dichotom. Rather stout, not tapering much, and with short ossicles (in Silurian species); or fine, tapering, with long ossicles (in Carboniferous species). Covering-plates well developed; either as solid, alternating series, or in rows of 2 to 5 (?) deep on either side of ventral groove.

I Br from 1 to about 8: the number often varies greatly in



DRAWINGS TO ILLUSTRATE THE MORPHOLOGY OF *CYATHOCRINUS.*

1. The dissected cup; with the anterior radius on the right.
2. Longitudinal median section through ten columnals of *C. acinotubus.* *s*, stereom of ossicle; *m*, matrix filling axial canal; *c*, calcite taking the place of former ligament.
3. Transverse section through the stem of *C. acinotubus.* Lettering as above. Figs. 2 and 3 are both reduced from camera-drawings of E 6004 B.M.; × 5 diam.
4. Transverse section through a brachial (III Br) of *C. acinotubus.* *Br*, body of the ossicle; *ax*, axial canal; *vg*, ventral groove; *cp*, covering-plates. Reduced and restored from camera-drawings of E 1367, B.M.; × 8 diam.
5. A young individual of *C. acinotubus* (?). The extreme length of some of the brachials may be only apparent and due to the difficulty of seeing the sutures; it is, however, noticeable in the young of other genera. From an original drawing of M.P.G. vii $\frac{4}{84}$; nat. size.

5 *a*. A first primibrach of the same, showing that the axial canal is not yet separated from the ventral groove; × 3 diam.

6. Ventral surface of the calyx of *C. planus* with ambulacrals and inter-ambulacrals removed. Δ, deltoids, and M, madreporite; these surround the peristome, and on their edges are seen indentations for the reception of the ambulacrals; *x*, anal. From E 6007, B.M.; × 2 diam.
7. Ventral surface of the calyx of *C. mammillaris*, Phill., with tegmen complete. Δ, deltoids, in great part covered by *ia*, interambulacrals; *cp*, covering-plates, which are irregular; *x*, anal, which is partly broken. From a drawing by Mr. Hollick of E 288, B.M.; nat. size.

the arms of a single specimen; but, in Silurian forms at all events, each species has usually its own limits.

Anal structures.—Anal *x* from tetragonal to hexagonal; it rests on the upper side of post.B, is in line with RR, and about $\frac{2}{3}$ their width. In typical species it supports, by its horizontal upper side, a smaller plate of similar shape, while on either side of it, in the angle between it and the adjacent radial processes, rests a smaller plate of the tube (*rt* and *lt*). Sometimes *rt* and *lt* appear not to touch *x* at all, in which case *x* is four-sided. Sometimes (e. g. *C. multibrachiatus* from the Keokuk) the upper side of *x* is sloped downwards in such a manner that only *rt* touches the RR, in which case *x* is roughly five-sided.

The Ventral Sac consists of more or less hexagonal plates, arranged in fairly regular longitudinal rows. It varies very greatly in size, but appears never to extend to the length of the arms. It is rounded or swollen, and has a rather large lumen. The plates are solid, often slightly tumid, and sometimes show a radiating structure, which may even exhibit itself in slight folding. In typical species of the genus the foldings are never pronounced, nor are the plates transversely elongate; in none are there slits or pores.

The Tegmen comprises 4 Deltoids and a Madreporite (p. 211, fig. 6). The Deltoids rest on the radial processes, and abut laterally on one another and on the Madreporite. The Madreporite is usually cordiform and appears to be pierced by numerous pores.

Ambulacrals (I Amb) pass between the deltoids and madreporite to the actinal centre, in which region they are usually enlarged (and are by some writers considered to be the Orals).

Smaller Interambulacrals (*i I Amb*) are also often present, almost entirely covering the deltoids (p. 211, fig. 7).

The Stem is rarely preserved to any extent, but it seems never to have attained a very great length. It varies much in width; it is round; with a usually quinquelobate lumen, sometimes of large size. Radial sutures have not been observed.

Columnals rather low, and alternating in thickness and height; or very low and equal in size. They have radiating striæ on their articular surface.

There are no Cirri on the stem.

The Root has not yet come beneath my observation.

Species of the Genus.

Although the Austins in 1846 could deny the existence of

Cyathocrinus in Silurian rocks, we now know a considerable number of Silurian species that may be referred to this genus. The Limestone Beds *d* and *f* of Gotland furnish nine species of *Cyathocrinus*, as described in a paper read before the Royal Swedish Academy of Science on Dec. 9th, 1891 *. The Niagara Limestone of America contains *Cyathocrinus cora*, Hall, *C. waukoma*, Hall, and *C. Van Hornei*, S. A. Miller; but other Silurian species from N. America appear to belong rather to *Botryocrinus*. The Wenlock Limestone of England has as yet presented us with only two species, viz. *C. acinotubus*, Ang., also found in Gotland (*d* and *f*), and a species here described for the first time under the name *C. vallatus*.

As shown in the paper above referred to, the *Cyathocrini* of Gotland fall into three groups. The first of these groups has a stem of moderate width, with rather low and alternately ridged columnals and a more or less conical cup. Both our British species come into this group, and the following synopsis shows the main differences between the species of the group :—

a. Cup with straight sides.

a. Plates plane, granular .... *C. Dianæ.*

b. Plates axially folded and striate .... *C. striolatus.*

b. Cup with convexo-concave sides, irregular.

c. Plates plane; smooth or pustulate .... *C. visbycensis.*

d. Plates tumid; smooth or shagreened .... *C. acinotubus.*

c. Cup with convex sides.

e. Plates plane; concentrically ridged and pustulate. . *C. vallatus.*

There are of course many other differences between the species than those shown in the above table, but they can be gathered from the diagnoses.

Cyathocrinus acinotubus, Ang.
(Pl. XIII. figs. 1–13.)

1878. *Cyathocrinus acinotubus,* Angelin, Iconographia, p. 22, pl. xx. fig. 5.

1878. *Cyathocrinus alutaceus* (pars), Angelin, Iconographia, pl. iv. fig. 6 *a*.

1873. *Cyathocrinus* (sp. 6) *monile*, nom. nud., Salter, 'Catalogue of Cambrian and Silurian Fossils &c.,' Cambridge, p. 123.

* F. A. Bather, "The Crinoidea of Gotland, Part I.," Kgl. Svenska Vet.-Akad. Handl. Bd. xxiv. no. 8. In the press.

Cyathocrinus mimus, MS. Museum labels by J. W. Salter.
Cyathocrinus nodulosus, nom. nud. pars, i. e. Museum labels by J. W. Salter, but not the specimen said to be so referred to in Cat. Camb. Sil. Foss. p. 123.

The description, measurements, and diagrams of this species given in this paper are based entirely on British specimens, while in the Swedish paper reference is made throughout to Gotland specimens. Thus any differences due to differing conditions may be more clearly appreciated.

The British specimens examined are the following:—

In the British Museum:

57480, crown and half an inch of stem, seen from the right side, and showing the ventral sac crossing between the arms. Matrix a blue-grey shale. Dudley. From the collection of Mr. S. Allport, and formerly labelled *C. nodulosus*. (Pl. XIII. fig. 1.)

E 1450, crown, free from matrix, which was a very soft yellow shale; shows origin of ventral sac. Dudley. From the collection of Mr. J. Johnson. (Pl. XIII. fig. 2.)

E 5619, the distal end of a ventral sac, referred with hardly any doubt to this species. Dudley. From the collection of Mr. J. Gray, of Hagley. (Pl. XIII. fig. 6.)

57421, crown with 8 to 10 columnals; showing covering-plates well; with a rugose surface produced by weathering. Matrix a blue-grey shale. Tividale, Dudley. (Pl. XIII. fig. 7.)

E 6002, crown with plates of ventral sac well marked, and with a radial facet exposed. Matrix a blue shale. Dudley. Johnson collection. (Pl. XIII. figs. 8 and 11.)

57142, arms with covering-plates and ventral groove well shown. In limestone. Dudley. Gray collection. (Pl. XIII. fig. 10.)

57060, a dorsal cup free from matrix; showing radial facet. Dudley. Gray collection. (Pl. XIII. fig. 11.)

E 6003, dorsal cup, rather broken but very characteristic; showing shagreen ornament. Yellowish matrix. Dudley. From the collection of Mr. J. Rofe. (Pl. XIII. fig. 12.)

E 1367, arms and two thin transverse sections of same. Dudley. Rofe collection. (Zincotype, p. 211, fig. 4.)

E 6004, longitudinal and transverse thin sections of the stem.

Dudley. Rofe collection. (Zincotype, p. 211, figs. 2 and 3.)

57058, basals and infrabasals. Dudley. Gray collection.

57059, a crushed cup. Dudley. Gray collection.

57113, crushed crown and stem-fragment. Dudley. Gray collection.

57141, a crown in hard blue shale. Dudley. Gray collection.

57149, lower part of cup. Dudley. Gray collection.

57362, rather small crown and 1 in. of stem. Limestone. Tividale, Dudley. Gray collection.

57363, arms and upper part of cup. Tividale, Dudley. Gray collection.

57364, crown and $1\frac{1}{4}$ in. of stem. Limestone. Tividale, Dudley. Gray collection.

57365, a small crown, with traces of colour-spots on arms. Tividale. Gray collection.

E 5654, a weathered crown. Matrix a conglomerate of limestone in a yellow marly cement. Probably from Dormington in the Woolhope district (according to Mr. R. Etheridge, F.R.S.). Baber collection.

In the Museum of Practical Geology, Jermyn Street:

vii $\frac{4}{41}$, a young specimen, probably referable to this species, on a slab with *Taxocrinus tuberculatus.* (Zincotype, p. 211, figs. 5, 5 *a*.)

In the Woodwardian Museum, Cambridge:

a/526, 3 well-preserved and characteristic cups, labelled "*Cyathocrinus mimus* (n. sp.)." Dudley. Fletcher collection. (Pl. XIII. figs. 3, 4, 5.)

a/487, 2 or 3 specimens, one showing the covering-plates very well. Labelled "*Cyathocrinus monile.*" Dudley.

In the Oxford University Museum:

A crown showing the ventral sac appearing between the arms. Malvern. Grindrod collection. (Pl. XIII. fig. 9.)

Arms showing the ventral surface and covering-plates. Malvern. Grindrod collection. (Pl. XIII. fig. 10 *c*.)

In the collection of Charles Holcroft, Esq.:

206, arms with very large number of ossicles in internodes. Yellowish matrix, Upper Wenlock Limestone. Wren's Nest, Dudley.

For permission to examine and figure certain of the above specimens my thanks are due to Dr. Henry Woodward, F.R.S., the Director-General of the Geological Survey, Prof. T. McK. Hughes, and Prof. A. H. Green; while a double measure of thanks is due to Mr. Holcroft for allowing me to retain his specimen for several months.

All the above specimens come from the Wenlock Limestone, and many of them come from the Upper Limestone; others, however, are doubtful, and the absence of information prevents us from assigning them to their exact horizon.

The trivial name of this species—derived from *acinus*, a berry, and *tubus*, a tube—probably refers to the blackberry-like appearance of the ventral sac.

Specific Diagnosis.

Dorsal cup bowl-shaped, rather rounded at the base; plates tumid, and smooth or shagreened. Arms rather stout, with rounded ossicles; covering-plates long and conical, from 2 to $3\frac{1}{2}$ to each brachial. Ventral sac large, slightly swollen above; its plates protuberant and rugose. Stem round, of moderate width, with alternate sized ossicles and a quinquelobate lumen.

Description of the Species.

Dorsal Cup is in shape a broad cone, rounded at the base and often projecting radially. The shape, though characteristic (Pl. XIII. figs. 4, 5), is very variable in minor points. Thus, the infrabasals may project at a rather sharp angle with the stem-axis, or may gently curve upwards. The plates, especially the basals, may be very tumid (Pl. XIII. fig. 2); but in a few cases the swelling is inconspicuous. The projection of the radials also varies very much, as seen by comparing fig. 1 with fig. 4 in Pl. XIII. The cup sometimes varies on different sides both in height and in the sizes of its plates, the anterior rays as a rule being the larger in such cases. The average measurements of the cup, as deduced from five specimens, after corrections have been made for compression, are:—Height 13 millim.; width below, 6·9 millim.; width above, 14·8 millim. Extremes of height noted are, in 57365 B.M. 7·2 millim., and in E 6003 B.M. 20 millim. In these and subsequent measurements no account is taken of the young specimen at Jermyn Street or of those in the Woodwardian Museum.

IBB 5, pentagonal and, as a rule, almost equal-sided.

Average measurements, deduced from six specimens, with allowance for variation within the limits of an individual :—Height 3·5 millim. ; width below, 3·7 millim. ; width above, 4·8 millim. Extreme measurements noted are, in 57365 and E 6003 respectively :—Height 2 millim. and 5 millim. ; width below, 2·5 millim. and 4·25 millim. ; width above, 3 millim. and 6·8 millim. In E 1450, which is a medium-sized specimen, the height varies from 2·5 millim. in r. ant. I B to 3·2 millim. in l. post., l. ant., and ant. I BB.

BB 5, hexagonal ; post. B heptagonal. Average measurements, deduced as above :—Height 6·4 millim. ; width below, 5·8 millim., width above, 6·7 millim. Extreme measurements, as above :—Height 3·25 millim. and 10 millim. ; width below, 3·5 millim. and 8 millim. ; width above, 4·2 millim. and 9·5 millim. These measurements do not take the posterior basal into account : that is always a little larger every way than the others ; thus, in E 1450, the measurements of the post. B and of the other BB are as follows :—Height 6 millim. and 5·5 millim. ; width below, 5·75 millim. and 5·4 millim. ; width above, 7 millim. and 6 millim.

RR 5, shield-shaped, often projecting slightly in some or all of the rays. Average measurements, deduced as above, are :—Height to bottom of facet 9·95 millim. ; width below, 13·9 millim. ; width above, 14·9 millim. ; width of facet 8·7 millim. Extreme measurements, as above, are :—Height 3 millim. and 8 millim. ; width below, 4·2 millim. and 9·5 millim. ; width above, 4 millim. and 11·25 millim. ; width of facet 3·25 millim. and 6 millim. The adjacent sides are usually almost parallel in medium-sized specimens, and even converge upwards in small specimens. From the above measurements and others it appears that, while the average width of the facet is ·577 *, or rather more than half, that of the radial, it is proportionally greater in small individuals, *e. g.* ·81 in 57365, and less in large individuals, *e. g.* ·53 in E 6003. The facet is sometimes more to one side of the radial than the other ; it is transversely elliptical in outline (Pl. XIII. fig. 11). A fulcral ridge runs across, a little outside the long diameter, and in the centre of this ridge is the axial canal. The food-groove forms a wide depression on the inner side of the ellipse. Partly owing to the variation in the projection of the radials, the angle at which the facet is directed outwards varies considerably even in the same specimen. In the separate cups found at Klinteberg, in Gotland, which lend themselves to such measurement more

* These numbers are fractions of the width of the radial, not of a millimetre.

readily than the English specimens, the angle with the horizontal varies between 35° and 85°.

The average measurements of the Gotland specimens are considerably greater than those of the English specimens, but no other difference is obvious.

In such very well-preserved specimens as E 6003 (Pl. XIII. fig. 12) a fine shagreen ornament is seen on the cup-plates; this, however, is usually worn away, and it may be doubted, from the smoothness of some otherwise perfect specimens, *e. g.* E 1450, whether it was always present in life. In the fossils its place is occasionally taken by a rough surface, that presents much the same appearance to the naked eye, but which consists of irregular pits rather than elevations (Pl. XIII. fig. 7). This roughness appears to be caused by weathering along the lines of the original intimate structure of the plates. A specimen of this species, so weathered, was named by Angelin *C. alutaceus.*

The Arms dichotomize regularly, and lessen in thickness quite gradually, remaining rather stout even to their extremities. The ossicles are rounded and slightly swollen, and often might be described as moniliform, whence, no doubt, Salter's MS. names of *C. monile* and *C. nodulosus*; sometimes, however, they are more even in thickness. In the proximal region of the arms the brachials are roughly circular in transverse section, but become more laterally compressed in the distal region (zincotype, p. 211, fig. 4). The axial canal is very distinct and is situated just about the middle of the ossicle. The ventral groove is a broad, curved, shallow depression (Pl. XIII. fig. 10 *b*). In the young specimen (zincotype, fig. 5 *a*) the axial canal is not yet separated by stereom from the ventral groove, even in the primibrachs. The covering-plates are long, thick, and conical both in outline and longitudinal section (Pl. XIII. figs. 10 *a*, 10 *c*, and zincotype, fig. 4). They interlock, and run from two to three and a half to each brachial. They are sometimes rather flat and narrow, with parallel sides, at other times more rounded and conical; the former variety is shown in the top left-hand corner of Pl. XIII. fig. 2.

I Br from 3 to 5. When there are 3 then I Br_2 is generally twice as high as I Br_1; when there are 4 then I Br_2 and I Br_3 are usually much higher than the rest; when there are 5 they are all more of a size. Three is by far the commonest number. The number of I Br may vary in the several arms of an individual, but is generally the same.

II Br from 2 to 4. As with I Br, 3 is the usual number, and II Br_2 is often higher than II Br_1.

III Br from 3 to 7. The lower numbers are more usual, and the higher numbers, when they occur, are in the branches on the inner side of the dichotom; thus, the left posterior arm of E 1450 (Pl. XIII. fig. 2) has III Br, counting from left to right, —3 . 4 . . 6 . 4 *. Here, too, the second ossicle is sometimes higher than the first.

IV Br from 3 to 9. In this case the lower numbers are in the branches on the outside of the arm, the higher numbers on the inside of the dichotoms, and the middle numbers on the inside of the arm. This arrangement will be better understood from an actual example: in 57362 B. M. the quartibrachs run thus, from left to right—4 . 8 . . 9 . 7–6 . 6 . . 7 . 5.

V Br from 3 to 11. Generally speaking these numbers follow the same sort of arrangement as in previous series, but the higher numbers are often finials, especially in rather young specimens. Thus in an arm of 57480 B. M. (Pl. XIII. fig. 1), starting from the middle or inner side of the arm and passing towards the outer side on the right, the numbers run as follows, *f* being placed against the finials—6 . 9 . . 8*f*. 6*f*–6 . 9*f*. . 9*f*. 8.

VI Br from 2 to 14. Many of these are generally finials, and in young specimens even the lower numbers are finials. Otherwise the arrangement is much as in the quintibrachs.

VII Br are only found in well-grown specimens. The numbers observed are 3 and 4. They are always finials; but it is of course conceivable that the arms might branch yet once more in an exceptionally well-favoured individual. If, however, finials appear in any one series, it seems to be the rule that all of the ensuing series shall be finials; that is to say, in no single arm does one branch ever get more than one series ahead of the other.

The above numbers do not take account of 206 Holcroft, in which the series are rather longer, 17 being seen in one internode.

Anal structures.—The measurements of anal *x* in E 1450 are as follows:—Height 4·5 millim.; width below, 3·8 millim.; width above, 4·75 millim.; that is to say its width is about $\frac{2}{3}$ that of the adjacent radials (Pl. XIII. fig. 2). It supports a large proximal median plate and a smaller plate on either side (*rt* and *lt*). The latter plates rest partly on the adjacent radials.

The Ventral Sac is about half the length of the arms or

* In this and in the ensuing examples the peculiar spacing of the numbers is an attempt to represent the bilateral symmetry of the arm: the two branches of each dichotom are separated by only a single full-stop.

less; it is rounded and somewhat swollen above (Pl. XIII. figs. 1, 2, 6, 9). The plates of which it is composed are hexagonal in the proximal region, but distally they become irregular in outline. The size of the plates varies considerably, but their transverse diameter is as a rule between 1·5 and 2·5 millim., their vertical diameter being rather less. The plates are sometimes quite smoothly rounded or almost flat (Pl. XIII. fig. 1); sometimes they are slightly folded at the edges, the folds being at right angles to the sutures (Pl. XIII. fig. 9): in E 6002 this folding is very clearly marked, and at the same time it is quite obvious that there are no pores or slits within the folds (Pl. XIII. fig. 8). In the separate distal end of a sac shown in Pl. XIII. fig. 6, the surface of the plates appears rather curiously pitted; this, however, is no doubt due to weathering, and may be compared with the roughness already alluded to (Pl. XIII. fig. 7).

The Tegmen is unknown.

The Stem (Pl. XIII. figs. 1 and 13; zincotype, p. 211, figs. 2 and 3) is round, composed of ossicles which alternate both in height and width with fair regularity. The following are a few measurements of the heights of the ossicles:—In E 6004 (fig. 2, p. 211) the respective heights of the ossicles are about 1·16 millim. and ·59 millim.; in 57362 B. M. they are 1 millim. and ·55 millim.; in 57364 B. M., in a more proximal part of the stem, the ossicles are of three sizes with heights 1 millim., ·75 millim., and ·2 millim. The width of the stem is between 5 millim. and 7 millim. The lumen is quinquelobate and its diameter is about $\frac{1}{3}$ that of the stem, or a little less. The articular surface of each ossicle is slightly concave, and is radiately striated. In the longitudinal section the space between the concave articular surfaces is filled with transparent calcite, while the lumen itself is filled with opaque matrix. This probably results from the fact that the interarticular ligaments decayed more gradually than the axial cord and its blood-vessels, and that, after the place of the latter had been taken by infilling ooze, they themselves were gradually replaced by the infiltration of carbonate of lime. We may now note, both in the longitudinal and transverse (fig. 3) sections, that the stereom of the ossicles is separated from the matrix in the canal by a thin film of calcite; this too, then, must represent some lining membrane or ligament.

The base of the cup is often slightly excavated for the top columnal (Pl. XIII. fig. 4).

Cyathocrinus vallatus, sp. n.
(Pl. XIII. figs. 14–18.)

This species is based on three specimens, viz.:—

In the British Museum:

(*a*) E 6005, a somewhat worn cup in matrix. Gray collection. (Pl. XIII. fig. 18.)
(*b*) E 6006, a cup still more worn, especially in the distal region, and ground down at the sides; in matrix; seen from the right side. Gray collection. (Pl. XIII. fig. 15.)

In the Museum of Mason College, Birmingham:

(*c*) 170, a better preserved cup, showing articular facets for stem and arms; in matrix. (Pl. XIII. figs. 14, 16, 17.)

These specimens all come from the Wenlock Limestone of Dudley, but the exact horizons and localities are uncertain. They are all in a rather yellowish shale, on the top of a limestone; it is therefore probable that they come from the Upper Wenlock Limestone.

For permission to figure the specimens in the British Museum I am indebted to Dr. Henry Woodward, F.R.S.; while for the loan of specimen *c* Prof. C. Lapworth deserves my best thanks.

The trivial name *vallatus*, which means *encircled by a ridge*, refers to the characteristic ornament of the cup-plates.

Specific Diagnosis.

Dorsal cup rather elongate, with convexly rounded sides; plates plane, with a strong concentric ridge at a short distance from the suture, and with irregular concentric or slightly radiating ornament on the inner part. Axial canal not separate. Stem with a large quinquelobate lumen. Arms, ventral sac, tegmen, and stem unknown.

Remarks on the Species.

Dorsal Cup has a somewhat ovoid curve, bulging more in the region of the basals. The measurements of the specimens are as follows:—

	Height millim.	Width below. millim.	Width above. millim.
(*a*)........	23	8 (?)	21 (?)
(*b*)........	23	7·25	23 (?)
(*c*)........	19·75	8	21 (?)

I BB 5, pentagonal, rather wider than high.

	Height. millim.	Width below. millim.	Width above. millim.
(*a*)........	6	4·75	7·75
(*b*)........	5·5	4·2	7
(*c*)........	5·5	4	6·5

BB 5, hexagonal; post.B, seen partially in *b*, heptagonal.

	Height. millim.	Width below. millim.	Width above. millim.
(*a*)........	12	9·5	11·5
(*b*)........	10·2	8·5	11
(*c*)........	10·75	8	10·5

The measurements of post.B are height 12 millim. in *b*; otherwise unknown.

RR 5, shield-shaped; projecting in a slight bulge just below the articular facet, but not curving inwards much towards the radial processes. The facet is smoothly concave, with a very slight trace of a ridge; the axial canal is not separated from the ventral groove by stereom, but, together with it, forms a deep notch. Measurements are:—

	Height. millim.	Width below. millim.	Width above. millim.	Width of facet. millim.
(*a*)....	8·8	12·25	12	6
(*b*)....	8·5 (?)	10	10·5	?
(*c*)....	7·2	10·3	10·3	5

From which it appears that the sides of the radials are almost parallel and that the width of the facet is just half that of the radial. The facet is almost at right angles to the slope of the side and is therefore directed almost upward.

A portion of anal *x* is preserved in *b*. It is about 6·5 millim. high and about 5 millim. wide below.

A portion of *rt* is also preserved in this specimen.

A marked concentric ridge surrounds all the cup-plates at a distance of about ·75 millim. from the suture. There is also an irregular ornament on the plates, which tends to run in concentric circles (Pl. XIII. fig. 18), or may have a more radiate arrangement (Pl. XIII. fig. 14).

The characters of the *Stem* may be inferred from the bottom of the cup, which shows a very large quinquelobate axial canal, shown in Pl. XIII. fig. 17, where it has a mean width of 4·2 millim., or a little more than half the probable width of the stem. The facet for the stem is radiately striated. The stem was therefore probably like that of *C. acinotubus*.

In the general shape of the cup and in its probable stem-characters the species resembles the group of *C. acinotubus*. The shape of the cup is most like that of *C. acinotubus*, and indications of the ridge that is here so marked may also occasionally be seen in that species. The ornament, however, more resembles that of *C. visbycensis*, var. *monilifer*. In the notched facet and imperforate articulation this species differs from most Silurian *Cyathocrini*; but such a stage of development is occasionally presented by *C. striolatus*, which belongs to the same group. The large size of the cup is a character of no great importance, but affords a ready means of distinguishing the species in British collections.

General Remarks on the Genus.

The British specimens do not throw much light on the morphology of the genus, so that there are very few points to which attention need be here directed.

Growth of the cup.—From the various measurements of the plates of *C. acinotubus* given on p. 217, it seems to follow that the facets of the radials, and consequently the arms, are wider in proportion in the young than in the adult; also that the radials are proportionally wider below in the young. This latter fact harmonizes with the statements already made in general terms by Messrs. Wachsmuth and Springer * and Mr. S. A. Miller † as to the infrabasal and basal plates of Crinoids being more largely developed in the young than the other plates of the cup. That statement too, it may be mentioned, is confirmed by the measurements made of the present species. It is extremely interesting to note how closely the growth of this Silurian Crinoid agrees with the growth of the Pentacrinoid larva of a recent *Antedon* ‡. But it would be advisable to tabulate the measurements of large series of many other species before laying down any general laws as to the growth of Silurian Inadunate Crinoids.

The Axial Canal of the Arms.—So much was said about

* Rev. I. 19, Proc. 1879, p. 242.

† "Structure &c. of American Palæozoic Crinoids into Families," Amer. Geol. vol. vi. p. 282, line 11, Nov. 1890; and 'American Geology and Palæontology,' p. 212, Cincinnati, 1889.

‡ See W. B. Carpenter, "Researches on the Structure, Physiology, and Development of *Antedon* (*Comatula*, Lamk.) *rosaceus*," Phil. Trans. 1866, pp. 727, 29, 731.

this in the earlier part of the paper (p. 209), that it is only necessary to point out that a Silurian species is here described, from specimens of mature growth, in which the axial canal is not separated from the ventral groove in the radial facet: in this point *C. vallatus* resembles Carboniferous species of *Cyathocrinus*. Further evidence, if such be needed, to show that the non-separation of the canal is merely a youthful character, and therefore also an archaic one, may be adduced from the young specimen at Jermyn Street (p. 211, fig. 5 *a*). Consequently it is not in itself a character very suitable for the discrimination of genera.

The Covering-plates of the Arms.—It does not appear from the present paper, but it will be seen from the descriptions of the Gotland *Cyathocrini* that, although the number of these that goes to an ossicle is variable, yet there are limits to the variation, by the recognition of which we are often able to determine species when other means fail us.

In describing these structures, Messrs. Wachsmuth and Springer have mentioned (Rev. I. 84, Proc. 1879, p. 307) that the groove "is provided with two rows of from two to five successive movable plates, alternately arranged on opposite sides." It is, however, undoubtedly the case, as shown by Pl. XIII. fig. 10, that the row on either side may be only one plate deep. It is quite true that there are sometimes two plates in the row, a small narrow plate lying at the base of and alternating with each of the regular conical covering-plates (see Angelin, Iconogr. tab. xxvi. fig. 5 *b*). Occasionally too there occur small, usually rather irregular plates, over the middle line, between the two rows of regular covering-plates. This might make three or conceivably four rows on either side (see W. & S. Rev. III. Proc. 1885, pl. iv. fig. 7 *b*). But in asserting that there were sometimes five rows it is possible that Messrs. Wachsmuth and Springer were misled by Angelin's tab. xxvi. fig. 4, which represents the covering-plates of *C. ramosus* (wrongly called there *C. longimanus*); for these plates are marked by transverse lines that divide them into five parts, and produce the impression that each covering-plate is composed of five ossicles, which is not really the case.

The Ventral Sac.—Messrs. Wachsmuth and Springer stated in 1879 (Rev. I. 84) that pores and slits had been observed in the ventral sac of Silurian species of *Cyathocrinus*. This statement has never been withdrawn by them, though in their recent paper on the Perisomic Plates * they seem to imply

* Proc. Acad. Nat. Sci. Philadelphia (1890), Part III. See p. 360, February 1891.

that the ventral sac of the Cyathocrinidæ generally is not perforate. It is possible that they were formerly misled by the erroneous reference to *Cyathocrinus* of many species of *Gissocrinus*, *Botryocrinus*, and such forms in which the ventral sac often appears at first glance to be provided with slits between the edges of the plates. At any rate none of the sacs of the Silurian *Cyathocrini* that have come under my observation appear to possess either pores or slits. Deceptive appearances are sometimes produced by weathering, as described under *C. acinotubus* (p. 220); and sometimes the edges of folded plates are filled with matrix which everyone does not take the trouble to clear away.

The Tegmen.—As none of the British Silurian specimens show the tegmen it is advisable to defer discussion of the many important problems presented by it. Original drawings of two Carboniferous specimens are, however, given (p. 211) in illustration of the description of the genus. The one (fig. 6) shows the deltoids and the madreporite surrounding the peristome; the other (fig. 7) shows how both deltoids and peristome may be covered by ambulacrals and interambulacrals, though portions of the deltoids are still seen peeping out from beneath the interambulacrals. The questions to be decided are these:—What are the true homologies of the plates here called deltoids? Is the madreporite serially homologous with the deltoids? Or is the posterior deltoid represented by *two* plates, one on either side of the madreporite? Are the plates that cover over the peristome, which are sometimes large and fairly regular, sometimes small and irregular, orals or merely large ambulacrals?

EXPLANATION OF PLATE XIII.

Cyathocrinus acinotubus.

Fig. 1. 57480, B. M. A crown with portion of stem, seen from the right side. The ventral sac seen crossing between the arms. Drawn with the camera by Mr. Hollick. (Nat. size.)

Fig. 2. E 1450 B. M. Crown seen from posterior. Drawn with the camera by Mr. Hollick. (Nat. size.)

Fig. 3. *a* 526, Woodwardian Museum. A small cup, seen from below, with one or two columnals attached. Note large size of IBB. From a drawing by Mr. Edwin Wilson, artist to the Cambridge Engraving Co. (Nat. size.)

Fig. 4. *a* 526, Woodwardian Museum. Cup seen slantwise from below, showing projection of radials. One very pentagonal columnal seen inserted in the IBB circlet. From a drawing by Mr. E. Wilson. (Nat. size.)

Fig. 5. *a* 526, Woodwardian Museum. Cup seen from posterior, showing *x* and *lt*. From a drawing by Mr. E. Wilson. (Nat. size.)

Fig. 6. E 5619, B. M. A ventral sac, slightly weathered. From a drawing by Mr. Hollick. (× 2 diam.)

Fig. 7. 57421, B. M. A small portion of the weathered surface of a radial. From a drawing by Mr. Hollick. (× 10 diam.)

Fig. 8. E 6002, B. M. A plate from the proximal region of the ventral sac, to show the folding of the edges. Drawn on stone by the author. (× 3 diam.)

Fig. 9. Grindrod Collection, Oxford. The distal end of the ventral sac appearing between the branches of the anterior arm. Drawn on stone by the author. (Nat. size.)

Fig. 10 *a.* 57142, B. M. Three brachials seen from the side, showing the covering-plates open.

b. 57142, B. M. The ventral surface of three brachials, the covering-plates removed and the ventral groove exposed.

c. Grindrod Collection. The ventral surface of three brachials, the covering-plates *in situ* and closed.

All from drawings by the author. (× 3 diam.)

Fig. 11. 57060 and E 6002, B. M. A radial showing the articular facet, combined from the evidence of these two specimens. From a drawing by the author. (× 3 diam.)

Fig. 12. E 6003, B. M. Portion of surface of a radial, showing shagreen ornament. From a drawing by Mr. Hollick. (× 10 diam.)

Fig. 13. The articular surface of a stem-ossicle from the evidence of numerous specimens. From a drawing by the author. (× 3 diam.)

Cyathocrinus vallatus, sp. n.

Fig. 14. 170, Mason College. A radial seen obliquely from above, to show articular facet; also showing ornament. From a drawing by Mr. Hollick. (× 2 diam.)

Fig. 15. E 6006, B. M. A cup seen from the right side, showing post.B and *x* on the left; outline restored. From drawings by Mr. Hollick and the author. (Nat. size.)

Fig. 16. 170, Mason College. A cup; orientation uncertain. From a drawing by Mr. Hollick. (Nat. size.)

Fig. 17. The articular facet for the stem of the same specimen. From a drawing by Mr. Hollick.

Fig. 18. E 6005, B. M. A much weathered cup; orientation uncertain. From drawings by Mr. Hollick and the author. (Nat. size.)

XXXIII.—*On some Spiders from the Andaman Islands collected by E. W. Oates, Esq.* By Prof. T. Thorell.

Our knowledge of the arachnological fauna of the Andaman Islands is as yet exceedingly limited; so far as I know M. Eugène Simon is the only author who has, in a recently-published paper *, enumerated and described any spiders

* "Études sur les Arachn. de l'Asie mérid. faisant partie des collections de l'Indian Museum (Calcutta).—II. Arachn. recueillis aux îles Andaman par M. R. D. Oldham," in Journ. of the Asiatic Soc. of Bengal, lvii. part ii. no. 3 (1887).

from those islands *. Only two of M. Simon's species were known to arachnologists as inhabiting other parts of Southern Asia, especially Burma and the Malay Archipelago; the rest (five species) were all new to science. To the seven species mentioned by M. Simon I am now able to add fourteen more, captured in Table Island by Mr. Oates, and kindly placed by him in my hands for examination. Though only two of these spiders (*Epeira Oatesii* and *Salticus modestus*) appear to be new, a list of them may, I think, be of some interest, as it affords strong evidence of the conformity of the spider fauna of the Andamans with that of Burma on the one side and the Malay Archipelago on the other; the twelve already-known species belong, in fact, also to the fauna of Burma or to that of the Malay Archipelago, and are even *common* to these two regions, with the exception perhaps of *Argyroepeira pusilla*, from Amboina, of *Sarotes impudicus*, which had hitherto been captured in Burma only, and of *Telamonia Peckhamii*, which had been found in the Nicobar Islands and Sumatra.

The twenty-one species of spiders now known to inhabit the Andamans belong to the following tribes:—Territelariæ (1 sp.), Retitelariæ (2 sp.), Orbitelariæ (10 sp.), Citigradæ (1 sp.), Laterigradæ (2 sp.), and Saltigradæ (5 sp.). Moreover the Tubitelariæ are, in Mr. Oates's collection, represented by a few young specimens belonging to the genera *Clubiona* and *Eutittha*; but these specimens (and that of a *Lycosa*) are not sufficiently developed to be determined or described. Also among the Andaman spiders studied by M. Simon there were young representatives of several genera (*Homalattus*, *Oxyopes*, *Nephila*, [*Meta* = *Argyroepeira*?], *Hersilia*, *Chiracanthium*) that are not included in our lists of the spiders of the islands.

The species contained in Mr. Oates's collection are as follows:—

Tribus *Retitelariæ*.

Fam. **Pholcoidæ**.

1. *Pholcus elongatus*, Vins.

1863. *Pholcus elongatus*, Vins., Aran. d. iles de la Réun., Maurice et Madag. p. 135, pl. iii. fig. 5.

Two adult specimens, a male and a female.

* These species are:—1. *Cytæa albolimbata*, sp. n.; 2. *Cyllobelus miniaceomicans*, sp. n.; 3. *Sphedanus marginatus*, sp. n.; 4. *Gasteracantha annamita*, Sim. (= *G. leucomelæna* (Dol.), Thor.); 5. *Cyclosa albisternis*, sp. n.; 6. *Tetragnatha gracilis* (Stol.); 7. *Satzicus andamanicus*, sp. n.

Fam. **Theridioidæ.**

2. *Theridium rufipes*, Luc.

1842*. *Theridion rufipes*, Luc., Explor. de Algérie, Arachn. p. 263, pl. xvi. figs. 5–5 *d*.

One adult male.

Tribus *ORBITELARIÆ.*

Fam. **Euetrioidæ.**

3. *Argyroepeira pusilla* (Thor.).

1878. *Meta pusilla*, Thor., Studi sui Ragni Malesi e Papuani, II. Ragni di Amboina, &c., in Annali del Museo Civico di Storia Naturale di Genova, xiii. p. 97.

Of this species, which had formerly been found in Amboina only, Mr. Oates has captured an adult female in Table Island. The area occupied by the four middle eyes is in this specimen not perceptibly broader behind than in front; in other respects it appears to be exactly similar in form to the types of the species. The colour shows but a few slight differences. The tarsal joint of the (yellowish) palpi is blackish; the middle area of the back of the abdomen has behind, instead of three pairs of small silver-coloured spots, two longitudinal, nearly parallel, close-set, silver-coloured lines; the sides of the abdomen are blackish, with a long, somewhat oblique, and slightly sinuated silver-coloured band, united anteriorly with the silvery pattern of the back, and they show also a small spot of the same colour, situated more below, near the base. The vulva consists, as in the types, of a small, pale, almost semicircular fovea, surrounded in front and on the sides by a low, backward-curved callus, which is black on the sides and pale in the middle.

The length of the specimen is $3\frac{3}{5}$ millim.; length of cephalothorax $1\frac{3}{4}$, of abdomen $2\frac{1}{4}$ millim.; legs, I. $9\frac{2}{3}$, II. $7\frac{1}{4}$, III. 4, IV. nearly $6\frac{1}{4}$, pat. + tib. IV. nearly 2 millim.

4. *Epeira* (*Cyclosa*) *Oatesii*, sp. n.

Cephalothorace in femina fortiter, in mare vix constricto, aut fere toto piceo, aut fusco-testaceo et saltem in medio piceo; sterno plaga albicanti-flava occupato, quæ interdum, saltem in mare, in lineam anticam et maculas 5 marginales est divulsa; pedibus testaceis, plus minus distincte nigricanti-annulatis; abdomine ante medium dorsi

* According to Simon.

tuberculis duobus parvis munito et postice in conum simplicem retro directum producto, superius cinerascenti-testaceo, dorso plaga nigricante inæquali vel fere rhomboidi antice notato, pone medium vero area magna subtriangula nigricante occupato, quæ fascia longitudinali pallida persecta est et in lateribus flexuoso-dentata: hac pictura tamen sæpe obsoleta.—♂ ♀ ad. Long. ♂ circa $3\frac{2}{3}$, ♀ $4\frac{1}{2}$–5 millim.

Femina.—*E. camelodi*, Thor.*, valde affinis est hæc species, sed minor, et paucis aliis notis distinguenda. *Cephalothorax* ad formam plane ut in ea specie est, inter partes cephalicam et thoracicam fortiter constricta; pars thoracica paullo altior est quam pars cephalica, fovea ordinaria centrali sat magna, vix quadrata sed antice rotundata, et fere in summo partis thoracicæ (non in declivitate ejus antica) locata. *Oculorum* series antica modice sursum curvata est: linea recta laterales infra tangens medios fere in centro secat; series postica fortiter est recurva. Oculi medii postici cum lateralibus anticis seriem rectam formant, si desuperne inspicitur cephalothorax. Area oculorum mediorum paullo longior est quam latior antice, multo latior antice quam postice. Oculi medii antici spatio diametrum suam pæne æquanti sejuncti sunt; medii postici, ut laterales bini, contingentes sunt inter se. *Mandibula* patellis anticis paullo crassiores, plus duplo et dimidio longiores quam latiores, versus basin sat fortiter convexæ. *Pedes* breves: 1^i paris cephalothorace modo circa $2\frac{3}{4}$, non triplo, longiores sunt: pedes 4^i paris pedibus 2^i paris vix longiores. Aculei pauci et debillimi: patellæ anteriores aculeo ejusmodi saltem extus munitæ sunt, et tibiæ pleræque aculeum unum alterumve (vel potius setam) ostendunt. *Abdomen* satis altum, circa dimidio longius quam latius: non parum ante medium, ad $\frac{1}{3}$ longitudinis fere, versus latera, dorsum ejus tubercula duo obtusa erecta parva sed evidentissima ostendit; postice in formam coni sat brevis retro productum est. Desuper visum abdomen subovatum est, antice anguste rotundatum, in lateribus, usque ad $\frac{2}{3}$ longitudinis fere, ample et satis æqualiter rotundatum, dein vero lateribus rectis sensim angustatum et postice subacuminatum. A latere visum antice oblique rotundato-truncatum est, dorso anterius, ante tubercula, convexo-proclivi, dein recto vel paullo concavato, apice retro et paullo sursum directo; postice hoc modo visum valde oblique truncatum et sat altum est abdomen (altitudine hic latitudinem ejus saltem æquante): spatium inter mamillas et apicem abdominis spatium inter eas et petiolum circiter æquat. *Vulva* ex "corpore" circa triplo latiore quam longiore, utrinque convexo et nitidissimo, fusco constat, et ex "scapo" brevi pallido deorsum et retro curvato et directo, qui corpore illo circa triplo angustior est et vix vel parum pone id pertinet: hic scapus basi sat latus et sensim angustatus est, dein vero angustus, parte apicali

* Studi sui Ragni Malesi, II. Ragni di Amboina, &c., *loc. cit.* p. 78.

angusta parum longiore quam latiore, lateribus parallelis, apice rotundato.

Color.—*Cephalothorax* piceus, parte cephalica antice et plaga magna utrinque in parte thoracica fusco-testaceis: sæpius vero fusco-testaceus vel testaceus est, modo in medio, præsertim in impressionibus cephalicis, infuscatus, piceus vel nigricans. *Sternum* nigro-marginatum plaga maxima subtriangula, utrinque ter incisa, albicanti-flava occupatur, quæ interdum in medio inæqualiter infuscata est (an nonnumquam in maculas divulsa?). *Mandibulæ* testaceæ vel fusco-testaceæ, apice nigricantes. *Maxillæ* et *labium* testacea, basi obscuriora. *Palpi* testacei, parte tarsali apice nigricante, parte tibiali interdum ad apicem paullo nigricanti-maculata quoque. *Pedes* testacei, plus minus evidenter nigro-subannulati: femora anteriora apice intus plagam vel maculam nigram ostendunt, sequentia internodia apice plus minus anguste nigra sunt; tibiæ anteriores præterea maculam vel annulum abruptum nigrum versus medium, extus, habent. *Abdomen* cinereo-testaceum, supra macula basali magna nigricante subrhomboidi vel inæquali notatum, quæ interdum angulo suo postico usque inter tubercula duo dorsi pertinet et paullo pallido-maculata est, interdum brevior et postice inæqualiter truncata: postice dorsum area nigricante maxima fere triangula occupatur, quæ paullo pone medium dorsi initium capiens usque ad apicem ejus pertinet, interdum antice cum plaga illa nigricante conjuncta; in lateribus flexuoso-dentata est hæc area, secundum medium fascia inæquali pallida geminata. Latera abdominis pallida nigricanti-variata sunt; spatium inter apicem dorsi posticum et mamillas fascia longitudinali lata nigricante plus minus expressa occupatur. Venter ante rimam genitalem subfuscus vel nigricans est, pone eam aut albicanti-flavus et plus minus nigro-variatus vel reticulatus, aut niger et albicanti-flavo-maculatus; *mamillæ* nigræ in area nigricante vel fusca positæ sunt. In exemplis cephalothorace et pedibus clarioribus et plaga illa basalis et area postica interdum parum distinctæ sunt, et abdomen tunc superius satis æqualiter cinereo-testaceum est totum.

Mas.—*Cephalothorax* vix inter partes cephalicam et thoracicam constrictus, impressionibus cephalicis tamen fortibus et postice sulco transverso conjunctis; a latere visus ante declivitatem posticam parum convexus, pæne rectus et paullo proclivis est, et inter partes cephalicam et thoracicam paullo impressus. Utrinque anterius multo fortius quam in femina sinuato-angustatus est, parte thoracica in lateribus amplissime et fortiter rotundata, parte cephalica lateribus rectis anteriora versus non parum angustata, tuberculo oculorum mediorum anticorum valde prominente; frontis latitudo vix $\frac{1}{3}$ latitudinis partis thoracicæ superat. Fovea centralis subtransversa et profunda postice sulco sat profundo usque ad declivitatem posticam continuatur. Spatium inter oculos medios anticos eorum diametro evidenter minus est; spatia, quibus a lateralibus anticis separantur, hanc diametrum circiter æquant.

Palpi breves, clava femoribus anticis non parum latiore; pars patellaris pæne æque longa ac lata est, supra convexa et seta longa forti erecta nigra munita. Pars tibialis parte patellari vix longior est sed etiam basi ea paullo latior, a basi ad apicem præsertim in latere exteriore sensim dilatata, apice paullo oblique truncato parte patellari circa dimidio latiore, angulo apicis exteriore paullo producto. Pars tarsalis, intus vergens, basi extus procursu ordinario obtuso intus vel sursum curvato munita est; bulbus, sat complicatus, a fronte visus subter, ad apicem extus, dentem fortem nigrum foras directum ostendit et sub eo setam rectam nigram, eam quoque foras directam; fere e medio bulbi subter, magis extus, alia seta gracilior et longior foras et paullo anteriora versus directa bulboque appressa exit. *Pedes* magis aculeati quam in femina sunt; aculei minus debiles quoque. Præter aculeos paucos in femoribus, patellis et tibiis anterioribus, ut et in pedibus posterioribus (præsertim in femoribus 4[i] paris, quæ etiam subter ad basin seriem brevissimam aculeorum parvorum ostendunt), aculeos nonnullos paullo longiores et fortiores in pedibus anterioribus video. In pedibus 1[i] paris tibiæ intus aculeis 1 . 1, metatarsi intus 1 aculeo muniti sunt; tibiæ 2[i] paris (qui ut 1[i] paris cylindratæ et paullulo foras curvatæ sed non incrassatæ sunt) intus 1 . 1 aculeos, subter extus seriem aculeorum majorum 4 (sive 1 . 1 . 1 . 1 aculeos) ostendunt, subter intus vero aculeos minores 1 . 1; præterea supra versus apicem 1 aculeum habent hæ tibiæ. Metatarsi 2[i] paris aculeo gracili saltem extus instructi sunt. Coxæ omnes muticæ. *Abdomen* brevius ovatum est quam in femina, desuper visum postice citius in conum parvum retro directum productum, a latere visum supra fortius et magis æqualiter convexum, mamillis evidenter longius a petiolo quam ab apice abdominis postico remotis.

Color.—*Cephalothorax* totus piceus est, *sternum* fuscum, maculis 5 marginalibus et linea marginali antica flavis circumdatum. *Mandibulæ*, *maxillæ* et *labium* fusco-testacea. *Palpi* ejusdem coloris, clava ferrugineo-fusca. *Pedes* subtestacei, nigricanti-subannulati: femora saltem anteriora ad apicem sat late nigricantia sunt, internodia sequentia (præsertim tibiæ 4[i] paris) apice nigricantia vel nigro-maculata, et tibiæ metatarsique præterea annulo plus minus distincto vel macula hujus coloris versus medium notati. *Abdomen* pæne totum cinereo- vel lurido-testaceum est: pictura distincta in dorso vix ulla (modo vestigia plagæ dorsi anticæ et areæ ejus posticæ video): dorsum ejus punctis 4 majoribus nigricantibus trapezium formantibus anterius notatum est: venter ante rimam genitalem obscurior est, pone eam in formam rectanguli transversi albicanti-flavus, maxillis in area transversa obscura positis.

♀.—Lg. corp. 5; lg. cephaloth. 2, lat. ej. pæne $1\frac{1}{2}$, lat. front. pæne 1; lg. abd. 3, lat. ej. $2\frac{1}{4}$ millim. Ped. I. pæne $5\frac{1}{4}$, II. $4\frac{1}{2}$, III. 3, IV. $4\frac{1}{2}$ millim. longi; pat. + tib. IV. paullo plus $1\frac{1}{2}$ millim.

♂.—Lg. corp. $3\frac{2}{3}$; lg. cephaloth. pæne $1\frac{3}{4}$, lat. ej. paullo plus $1\frac{1}{3}$, lat. front. circa $\frac{1}{2}$; lg. abd. paullo plus $2\frac{1}{3}$, lat. cj. $1\frac{3}{4}$ millim. Ped. I. pæne $4\frac{1}{2}$, II. paullo plus $3\frac{1}{2}$, III. $2\frac{1}{2}$, IV. 4 millim. longi; pat.+tib. IV. pæne $1\frac{1}{2}$ millim.

Of this species Mr. Oates's collection contains a few females and a single male.

5. *Epeira* (*Cyclosa*) *insulana*, Costa.

1834. *Epeira insulana*, Costa, Cenni Zool. &c. p. 65.
1841. *Epeira anseripes*, Walck., H. N. d. Ins. Apt. ii. p. 146.
1842. *Epeira trituberculata*, Luc., Explor. de l'Algérie, Arachn. p. 248, pl. xv. fig. 4.
1877. *Cyrtophora melanura*, Sim., "Études Arachn.: IX. Arachn. recueillis aux îles Philippines," in Ann. de la Soc. Ent. de France, 5[e] sér. vii. p. 72, pl. iii. fig. 9.
1878. *Epeira anseripes*, Thor., Studi &c., II. Ragni di Amboina, *loc. cit.* xiii. p. 81.

The collection contains many examples of this very variable species, among them some few males. The "scapus" of the vulva is wanting (broken) in almost all the adult females.

For synonymy of *Epeira insulana*, Costa, see also Thorell, "Spindlar från Nikobarerna och andra delar af Södra Asien &c.," in K. Svenska Vetenskaps-Akademiens Handlingar, xxiv. no. 2 (1891), p. 150 *.

6. *Epeira Théisii*, Walck.

1841. *Epeira Théisii* [*Theïs*], Walck., H. N. d. Ins. Apt. ii. p. 53; Atlas, pl. xviii. fig. 4.

Only a very young female specimen.

7. *Epeira punctigera*, Dol.

1857. *Epeira punctigera*, Dol. Bijdr., t. de Kennis d. Arachn. v. d. Ind. Archipel, in Tijdschr. v. Nederlandsch Indië, xiii. (ser. 3. iii.), p. 420.

Two males, one adult, the other not fully developed.

The full-grown specimen is rather large (10 millim. long), with the whole cephalothorax of a rusty-brown colour, and the back of the abdomen greyish yellow, without any other pattern than a small whitish ∧ near the base and the ordinary four impressed brownish points. The belly is darker along the middle, with a broad transverse yellow band immediately behind the rima genitalis and two large yellow spots in front of the mamillæ.

* "*Epeira tuberculata*, Luc.," is here a *lapsus calami* for *E. trituberculata*, Luc.

8. *Argiope pulchella*, Thor.

1881. *Argiope pulchella*, Thor., Studi &c., III. Ragni dell' Austro-malesia &c., *loc. cit.* xviii. p. 74.

A single young female.

9. *Gasteracantha brevispina* (Dol.).

1857. *Plectana brevispina*, Dol., Bijdr. &c., *loc. cit.* p. 423.

This appears to be the most common spider of the island. Mr. Oates's collection contains hundreds of specimens, young and full-grown, and among these latter also a few males. The back of the abdomen is in the adult male of a brownish or dirty yellowish colour, with one or two more or less distinctly limited black spots on either side near the lateral angles, and sometimes also with two round paler spots somewhat before the middle, as in most females*. The dorsal tubercle of the female's cephalothorax is rather low and obtuse, sometimes quite truncated at the tip, where it is frequently furnished with two longitudinal, very fine and short furrows, but not cloven so as to form two tubercles.

Tribus *Laterigradæ*.

Fam. **Heteropodoidæ.**

10. *Heteropoda venatoria* (Linn.).

1758. *Aranea venatoria*, Linn., Syst. Nat. ed. 10, I. ii. p. 1035.

Three adult males. The legs of these specimens are distinctly annulated, or, rather, provided with black bands or spots above, especially on the thighs.

11. *Sarotes impudicus*, Thor.

Cephalothorace in fundo ferrugineo-fusco, parte cephalica anterius saturatius colorata, clypeo et genis piceis; mandibulis nigris, labio pæne semicirculato, palpis subpiceis, parte tarsali nigricante; pedibus subferrugineis, femoribus paullo pallidioribus, metatarsis tarsisque piceis et late nigricanti-scopulatis; abdomine ovato, in fundo sordide testaceo vel subfusco, pilis densis flaventibus tecto, pictura distincta carente; vulva ex area cornea fusca constante, quæ postice late et profundissime incisa est, hac incisura parte molli albicante repleta.— ♀ *ad. Long.* 18–25 *millim.*

* For a more detailed description of the male see Thor., Spindlar fr. Nikobarerna, &c., *loc. cit.* p. 59.

1887. *Sarotes impudicus*, Thor. [Viaggio di L. Fea in Birmania e regioni vicine, ii.], Primo Saggio sui Ragni Birmani, in Ann. del Museo Civ. di Storia Nat. di Genova, ser. 2ª, v. p. 241 (= ♂).

Femina.—*Cephalothorax* æque longus ac latus est, latitudine clypei $\frac{2}{5}$ latitudinis maximæ cephalothoracis æquanti, præterea ad formam ut in mare, vix altior quam in eo. Series *oculorum* postica desuper visa recta est, series antica vix vel parum deorsum est curvata. Spatia inter oculos medios anticos et posticos anticorum diametro evidenter paullo majora sunt, et paullo majora quam intervallum inter oculos binos laterales, hoc intervallo diametrum oculi lateralis antici paullo superanti. Spatia subæqualia inter oculos 4 anticos diametrum mediorum eorum æquant. Oculi 4 postici, quorum medii paullo longius a lateralibus quam inter se distant, spatiis triplam mediorum diametrum æquantibus separati sunt. Spatium inter marginem clypei et oculos laterales anticos eorum diametrum æquat, sed spatium inter hunc marginem et oculos medios anticos horum oculorum diametro evidenter minus videtur. Ceterum oculi et *sternum* ut in mare loc. cit. diximus sunt.

Mandibulæ femoribus anticis non parum latiores, patellas 1i paris longitudine æquantes, plus sesqui sed non duplo longiores quam latiores, in dorso ad longitudinem sat fortiter convexæ, læves, nitidæ, pilis rarioribus conspersæ; sulcus unguicularis postice 5 (5º minutissimo), antice 2 dentibus armatus est. *Maxillæ* vix in labium inclinatæ eoque saltem duplo et dimidio longiores; *labium* pæne duplo latius quam longius, apicem rotundatum versus lateribus leviter rotundatis sat fortiter angustatum, pæne semicirculatum igitur. (In mare apicem late rotundato-truncatum versus minus fortiter angustatum est.) *Palpi* mediocres; pars patellaris circa dimidio longior est quam latior, pars tibialis duplo longior quam latior; pars tarsalis duas priores conjunctas longitudine æquat. *Pedes* paullo breviores quam in mare, 2i paris cephalothorace circa $4\frac{1}{4}$ longiores; hi pedes pedibus 1i paris paullo plus tarso suo longiores sunt, pedes 1i paris pedes 4i paris paullo plus tarso suo longitudine superant quoque. Ut in mare scopulati et aculeati sunt pedes. *Abdomen* ovatum, saltem ante partum antice æqualiter rotundatum. *Vulva* ex area cornea elevata utrinque convexa, postice lateribus rotundatis sensim paullo angustata, femora latitudine circiter æquanti, picea constat, quæ postice late et profundissime incisa est, hac incisura circiter ad dimidium longitudinis areæ pertinenti et cute molli albicante repleta: ab apice antico subrotundato hujus partis albicantis sulci duo parvi anteriora versus ducti et appropinquantes in area vulvæ cornea conspiciuntur.

Color.—*Cephalothorax* in fundo ferrugineo-fuscus, parte cephalica anterius paullo obscuriore, clypeo cum genis nigro-piceo; in declivitate postica subtestaceus est, hac area pallidiore subtriangula utrinque linea nigricante limitata. Pube sat densa appressa flavente vestitus est cephalothorax, et anterius pilis sparsus, qui in fronte et in clypeo nigri sunt, præterea ad maximam partem testacei. *Sternum* ferrugineo-fuscum, pilis nigris conspersum. *Mandibulæ* nigræ, tuberculo basali rufo-fusco; pilis nigris sparsæ sunt, sulco unguiculari rufo-ciliato. *Maxillæ* et *labium* nigra, apice picea. *Palpi* picei, basi clariores, parte tarsali nigra; ad maximam partem sordide olivaceo-nigricanti-pilosi et -pubescentes sunt. *Pedes*, metatarsis et tarsis exceptis, in fundo testaceo-fusci, cinereo-testaceo-pubescentes et -pilosi, tibiis paullo obscurioribus et densius pilosis, femoribus subter plus minus obsolete nigricanti-punctatis; metatarsi et tarsi picei sunt, scopulis olivaceo-nigris. Aculei pedum palporumque nigro-picei vel nigri. *Abdomen* in fundo totum cinereo- vel olivaceo-testaceum, pictura distincta nulla; pilis flaventibus undique vestitum est. *Mamillæ* fusco-testaceæ, inferiores subter fuscæ.

♀ ad.—Lg. corp. 25; lg. cephaloth. 10, lat. ej. 10, lat. front. 6; lg. abd. 16, lat. ej. $11\frac{1}{2}$ millim. Ped. I. $38\frac{1}{2}$, II. $42\frac{1}{2}$, III. 31, IV. $34\frac{1}{2}$ millim. longi; pat.+tib. II. 15, pat.+tib. IV. $11\frac{2}{3}$ millim.

The collection contains several examples, adult and young, of both sexes. The males are $15\frac{1}{2}$–$18\frac{1}{2}$ millim. long, with the cephalothorax as long as broad, and as high as in the females; one of them has two yellowish spots on either side of the longitudinal yellowish band on the back of the abdomen at its base. Young specimens are almost totally of a yellowish or brownish-yellow colour.

Of this species only one specimen, a male, had hitherto been found; it was captured at Me-tan-jà, in Burma, by Mr. L. Fea.

Tribus *Saltigradæ*.

Fam. **Salticoidæ**.

12. *Salticus modestus*, sp. n.

Cephalothorace piceo, albo-pubescente, in lateribus late pallidiore; abdomine quoque piceo et albo-pubescente, ovato, non constricto; pedibus piceis, testaceo-lineatis vel apice plus minus late testaceis, trochanteribus 4[i] *paris flavo-testaceis, tibiis* 1[i] *paris subter* 6 *paribus aculeorum longorum armatis, metatarsis hujus paris* 2 *paribus aculeorum ejusmodi, pedibus* 2[i] *paris subter aculeis debilibus*, 2 . 2. *in metatarsis et saltem* 1 . 1 . 1 *in tibiis munitis.*—♀ *jun. Long. saltem* $4\frac{1}{2}$ *millim.*

Femina jun.—*Cephalothorax* paullo plus duplo longior quam latior, paullo pone medium sat fortiter angustatus, parte cephalica, quæ parte thoracica non parum altior est, desuper visa lateribus pæne parallelis anteriora versus vix vel parum angustata, fronte leviter rotundata, pone oculos posticos (qui paullo ante medium cephalothoracis locum tenent) ample rotundata; pars thoracica parte cephalica non parum brevior et angustior est, parum longior quam latior antice, lateribus modo levissime rotundatis posteriora versus non parum angustata, postice late truncata et tenuiter elevato-marginata. Transversim parum convexa, pæne plana est pars cephalica; a latere visa supra modice proclivis et recta est (modo inter oculos anticos paullo magis proclivis), pone (apud) oculum posticum prærupte declivis, hac declivitate recta, ipso dorso partis cephalicæ fere quadruplo breviore et oculi postici diametrum duplam longitudine vix æquante; pars thoracica a latere visa usque ad marginem posticum sat fortiter declivis est, modo anterius paullo convexa, præterea recta. Quadrangulus *oculorum* postice paullo latior est quam antice, paullo latior antice quam longior. Oculi medii antici valde magni sunt, lateralibus anticis circa triplo majores, spatio parvo ab iis remoti et pæne tota diametro sua pone eos positi. Oculi minuti $2^{æ}$ seriei evidenter longius a lateralibus anticis quam a posticis oculis distant. Oculi postici foras eminent, lateralibus anticis paullo minores; vix longius a margine cephalothoracis quam inter se distant. *Sternum* longum et angustum, apice postico rotundato; antice inter coxas 1^{i} paris usque ad labium productum est et hic apice truncatum.

Mandibulæ anteriora versus et paullo deorsum directæ, duplo longiores quam latiores, subcylindratæ, apice late et oblique rotundato-truncatæ, ad ipsam basin subgeniculatæ, præterea sat leviter convexæ; unguis mandibula non parum brevior, oblique intus et retro directus. *Maxillæ* paullo divaricantes, longæ, labio circa dimidio longiores. *Labium* plus dimidio, pæne duplo longius quam latius, apice rotundato. *Palpi* breves, deplanati. Pars patellaris paullo longior est quam latior, a basi ad apicem sensim paullo dilatata; pars tibialis ea saltem duplo latior est, a basi ad apicem sensim non parum dilatata, paullo longior quam latior apice; pars tarsalis parte tibiali etiam paullulo latior et non parum longior est, circa dimidio longior quam latior basi, a basi ad apicem subacuminatum lateribus leviter rotundatis sensim angustata, (dimidiato-) elliptico-triangula fere. Partes tibialis et tarsalis conjunctim laminam magnam formant, quæ mandibulam tegit. *Pedes* breves, graciles, parcius pubescentes; pedes 3^{i} paris paullo longiores quam 2^{i} paris sunt visi (?). Tibiæ 1^{i} paris subter 6 paribus aculeorum appressorum longorum armatæ sunt, metatarsi hujus paris 2 . 2 aculeis ejusmodi. In pedibus 2^{i} paris tibiæ subter aculeos paucos debiles (saltem 1 . 1 . 1 magis extus) ostendunt, et metatarsi hujus paris ut videtur 2 . 2 aculeos parvos subter. Præterea vix aculeati sunt pedes. *Abdomen* ovatum, circa dimidio longius quam latius, æqualiter convexum, neque impressum nec constrictum. *Mamillæ* mediocres.

Color.—*Cephalothorax* supra nigro-piceus, in lateribus testaceo-piceus, pube appressa alba minus dense vestitus. *Sternum* subpiceum. *Mandibulæ* albo-pubescentes, in dorso piceæ, in lateribus clariores. *Maxillæ* et *labium* sordide testacea, basi subpicea.

Palpi picei, parte femorali sordide testacea. *Pedes* ad partem nigricantes vel subpicei, ad partem testacei: 1[i] paris picei sunt, femoribus fascia longitudinali subtestacea supra notatis, coxis, patellis et tibiis testaceis (saltem patellæ tamen linea picea longitudinali utrinque notatis); metatarsi hujus paris fuliginei sunt, fascia longitudinali testacea supra, tarsi nigricanti-testacei. In pedibus 2[i] paris coxæ et femora ad maximam partem picea sunt, sequentia internodia vero testacea, linea longitudinali picea utrinque, per patellam et tibiam usque in metatarsum ducta. Pedes posteriores picei, patellis basi oblique et metatarsi apice testaceis, tarsis testaceis totis, trochanteribus 4[i] paris testaceis quoque. *Abdomen* nigro-piceum, subter paullo pallidius, pilis appressis tenuibus albis sat dense vestitum. *Mamillæ* testaceo-piceæ.

♀ jun.—Lg. corp. $4\frac{1}{2}$; lg. cephaloth. pæne $2\frac{1}{2}$, lat. ej. 1; lg. abd. 2, lat. ej. pæne $1\frac{1}{2}$ millim. Ped. I. circa $5\frac{1}{4}$, II. circa $3\frac{1}{2}$, III. 4, IV. fere $6\frac{3}{4}$ millim. longi; pat.+tib. IV. pæne 2 millim.

One specimen only, a not fully developed female.

13. *Plexippus Paykullii* (Aud. in Sav.)

1827. *Attus Paykullii*, Aud. in Sav., Descr. de l'Égypte, 2[e] éd. xx. p. 172, pl. vii. fig. 22.

A male and a female, both adult.

14. *Telamonia Peckhamii*, Thor.

1891. *Telamonia Peckhamii*, Thor., Spindl. fr. Nikobarerna &c., *loc. cit.* p. 125.

A single nearly adult female. This species had hitherto been met with only in the Nicobar Islands and in Sumatra.

XXXIV.—*An Earthworm from Ecuador* (Rhinodrilus ecuadoriensis). By W. Blaxland Benham, D.Sc. (London), Aldrichian Demonstrator in Comparative Anatomy in the University of Oxford.

[Plate X.]

On November 23, 1889, I received, owing to the kind suggestion of my friend Prof. Jeffrey Bell, two small earthworms from Mr. Edward Whymper for the purpose of identification; and I wish to record my best thanks to that gentleman for allowing me not only to identify them but to retain them for purposes of further research.

The two worms, from their external characters, appeared to be one species at different ages, for in the smaller of the two the clitellum was undeveloped, whereas the larger—which is the subject of the present communication—was evidently mature. Being of this opinion, I cut the smaller worm into a series of sagittal sections and proceeded to dissect the larger; more recently, however, having had the leisure in which to examine these sections, I find that the former presents several important differences from the larger dissected one, and certain peculiar characters, which, at the moment, I have not time to discuss, so that I must leave the worm unidentified for the present.

Of the genus *Rhinodrilus*, Perrier, we at present know three species, all from the neotropical region, viz. *R. paradoxus*, Perrier *, from Caracas, in Venezuela, *R. Gulielmus*, Beddard †, from British Guiana, and *R. Tenkatei*, Horst ‡, from Surinam; the new species, which has affinities with both the latter, was collected at Cayambe, in Ecuador, at a height of 14,000 feet.

Rhinodrilus ecuadoriensis, sp. n.§,

is 3 inches (7·5 centim.) in length, and consists of some one hundred somites. It is thus smaller than any of the previous species, though *R. Tenkatei* approaches it most nearly, being 11·5 centim. in length.

The *colour* of the preserved specimen is perhaps worth recording, though no doubt very different in life; when stripped of its cuticle it was dirty olive-green, the clitellum buff, tending to orange laterally, the tubercula pubertatis being of a deeper brownish tint.

The *chætæ*, as in the other species, are in four couples on each somite, the inner couples being very close to the middle (ventral) line; if this space be taken as the unit (s), the distance between the outer and inner couples is $1\frac{1}{2}\,s$. In *R. Tenkatei* this lateral interspace is *less* than the ventral space, and in *R. Gulielmus* it is equal to *twice* the ventral space.

The chætæ are absent from the second as well as from the

* "Rech. pour servir etc. Lombric. terrestres," Nouv. Arch. d. Mus. d'Hist. Nat. de Paris, viii. 1872, p. 65.

† "On the Structure of a new Genus of Lumbricidæ (*Thamnodrilus*)," Proc. Zool. Soc. 1887, p. 154. Mr. Beddard has recently recognized the characteristic features of *Rhinodrilus* in this worm, to which genus he now refers the species (Quart. Journ. Micr. Sci. xxxi. p. 159, footnote).

‡ "Descriptions of Earthworms," Notes from the Leyden Museum, ix. p. 101.

§ In a strictly etymological sense perhaps "*æquatorius*" would have been preferable.

first somite, so that the first chætigerous somite is the third. *All* the chætæ are ornamented in the manner characteristic for the genus, and somewhat similar chætæ are found in *Urochæta*, *Deodrilus* *, and *Onychochæta* (*Diachæta*) *Windleyi* †, in *Anteus* ‡ and *Geoscolex* §, and in *Microchæta papillata* and *M. Belli* (Benham).

The ornamentation, which consists of a series of transversely-arranged crescentic ridges, is not so pronounced as would appear to be the case in other species; indeed, when the chætæ are mounted in glycerine, the markings might easily be overlooked with a low power, but in spirit and water they are distinctly visible. There are no specially modified "copulatory" chætæ, such as exist in the other species, where they are larger and straight, in *R. paradoxus* on somites xvi. to xix. and in *R. Gulielmus* on the clitellum, or larger and more distinctly marked in *R. Tenkatei*; nor do I find any fascicles of chætæ such as Horst described in his specimens on somites xvii., xviii., and xix.

The *prostomium* appeared from the exterior as a small rounded lobe, but on dissection was found to be retracted, as Beddard found to be the case in his species: it is some two or three times as long as the organ in the majority of earthworms.

The *clitellum* is very distinctly marked, partly from its colour, but chiefly from the thickness of the epidermis and the deep, conspicuous, intersegmental grooves; it is, as in the other species, "incomplete," and occupies somites xiv. to xxv., the last two somites, however, being less distinctly modified on the animal's left side. The latero-ventral boundary of the clitellum is nearer the middle line on somites xiv. to xix., and here involve the inner couple of chætæ; on the posterior somites xx. to xxv. the edge of the clitellum is bordered by a series of glands—the *tubercula pubertatis*—forming a semitranslucent band placed between two couples of chætæ, though nearer to the inner couple. A similar band exists in the other species, and in the case of Horst's and Perrier's species appears to be the only representative of the clitellum, the animals not being quite mature. In *R. Tenkatei* the seven pairs of tubercula traverse somites xx. to xxvi. ||

* Beddard, Quart. Journ. Micr. Sci. xxxi. p. 467.

† Beddard, *ibid.* p. 159.

‡ Horst, 'Notes from the Leyden Museum,' vol. xiii.

§ Beddard, 'Annals,' Feb. 1892.

|| I may say that Horst appears in some doubt as to his numbers, as he places the tubercula on "20th (21st)-26th (27th)"; again, he mentions an "olive-green ring around the body from the 12th (11th) 15th (16th) segment."

in *R. paradoxus* they occur on somites xix., xx., and xxi. In *R. Gulielmus* the clitellum occupies almost the same somites as in the present species, viz. xv. to xxv., the tubercula have an identical position, and the same difference in regard to the ventral limit of the clitellum is noted and figured by Beddard for that species.

The *nephridiopores*, as in other species, are in line with the outer (lateral) couple of chætæ, the first pair being on somite iv.

The *male pores* were quite evident *between* the somites xix./xx., in a line with the second chætæ on each side. This is the position assigned to these pores by Perrier. Neither Horst nor Beddard succeeded in detecting them; but in a specimen of *R. Gulielmus* which I possess I find them to lie between somites xx./xxi. I could not detect any other genital pores on the surface.

There are no dorsal pores.

Internal Anatomy.

There is a great displacement of the internal organs, owing to the infundibulate nature of the septa, so that the organs appear to lie in somites considerably posterior to those to which they actually belong.

None of the septa are strong; in fact they are all particularly thin and transparent, and are therefore difficult to trace, for they overlap one another and allow the organs below them to be seen. But if the septa fail us in apportioning the organs to their true morphological position in the body, we have an excellent guide in the nephridia, which, as Horst noticed in his species, are very conspicuous; and by following them to their external pores I was able to determine the real somites to which the various other organs belong. These *nephridia*, as Beddard found in *R. Gulielmus* and is frequently the case in other genera *, differ in their size and shape &c. in different regions of the body.

The first pair, or "peptonephridia" as I have called them*, differs from the rest both in the greater length of the convoluted tube (Pl. X. fig. 4) and its more glandular appearance, and in the fact that the duct *communicates with the gut* and not with the exterior. The convoluted tube, forming a bilobed glandular-looking mass, lies about halfway along the œsophagus (fig. 2, *n'l.*) at its side; from it the large muscular duct passes forwards and downwards, soon coming to lie

* Benham, "An Attempt to Classify Earthworms," Quart. Journ. Micr. Sci. xxxi. p. 212.

below the pharynx (as in *R. Gulielmus*); when it reaches the level of somite iii. it rises upwards along the sides of this portion of the gut, passes between the two lobes of the "salivary glands," and continuing (fig. 2, *p.n.d.*) forwards enters the muscular wall near the junction of the pharynx and buccal region; into the latter the nephridium probably opens.

In the previous species a similar "peptonephridium" is present; but it opens externally in the second (*R. Gulielmus*) or third somite (*R. Tenkatei*). I searched carefully for any pore on somites ii. and iii., but found none; and it is comparatively easy, despite the small size of the worm, to trace the duct along the course I have just indicated.

When removed from the body the peptonephridium is seen to be composed of a densely coiled tubule, the course of which would be very difficult to follow; it is provided with a funnel of rather larger size than the following ones. The surface of the peptonephridium is covered with a close network of blood-vessels.

I am not quite certain as to the segment to which the funnel belongs; but at any rate it will be seen that this nephridium, like the following, has a considerable length, passing from about the level of the second to that of the eighth somite, and recalls the enlarged thoracic nephridia of many of the tubicolous Polychæta.

The second nephridium (fig. 2, $n.^2$) opens externally on somite iv.; the long duct passes backwards, alongside the pharynx, to reach the convoluted tube at the side of the anterior part of the œsophagus. The following nephridial apertures are regularly arranged, and the ducts of the nephridia extend backwards in a similar way; they are all quite easily followed from their pores to the coiled tubule, and it is the latter which it is important to note particularly.

The coil of the third nephridium is at the side of the œsophagus, behind the second nephridium, that of the fourth still further back, in front of the gizzard; the coil of the fifth nephridium (fig. 2, $n.^5$) lies on the *upper surface of the gizzard* near its hinder end; and since this nephridium belongs to somite vii., the gizzard evidently belongs to the same somite, although thrust back into the following somites. The coils of the sixth and seventh nephridia are close together, immediately *behind the gizzard*, by the side of the "lateral hearts." The eighth nephridium belonging to somite x. has its coiled tubule immediately in front of, and very closely applied to, the sac which contains the first pair of ciliated rosettes, which thus belongs to somite xi. The ninth nephridium is similarly situated with regard to the second ciliated rosettes.

I did not trace out the following nephridia, and am unable to say definitely how many there are in this series. Beddard found fourteen pairs in *R. Gulielmus* following the pepto-nephridium, differing from it and also from the following series, which, commencing in somite xvii., are smaller, have no long duct, and are less readily followed.

The *alimentary tract* (fig. 2) presents a gizzard in somite vii., as determined by tracing out the nephridia; it lies, however, at the level of somites viii., ix., x., appearing to occupy three somites, as Horst describes for *R. Tenkatei*; but the present species agrees with the other two in having the gizzard confined to *one* somite.

Immediately behind it there are the characteristic paired diverticula of the tubular intestine (figs. 2 and 3, *dir.*); they contain crystalline particles which I took to be carbonate of lime; but I obtained no effervescence on treating the organ with weak and with strong acid. Nevertheless they have a structure closely similar to that of the œsophageal (calcareous) diverticula—"glandes de Morren"—in *Lumbricus*, as my predecessors have noted. In the present specimen there are *seven pairs* of these *diverticula*, all very close together, though probably occupying as many somites. The first gland is small and ventro-laterally placed, and might readily be overlooked in a strictly dorsal view; the next three are larger and kidney-shaped; the following three gradually diminish in size and are hemispherical. Both in *R. Tenkatei* and *R. Gulielmus* there are six pairs of these diverticula, agreeing in the main with those just described; and it is a most curious fact that in the "type" of the genus Perrier makes no mention of them. It is true they are hidden by the sperm-sacs and "hearts;" and as all these organs are closely packed together, it is reasonable to think that they were overlooked, though I believe, as I state below, that he *did* see these glands, but mistook them for "hearts."

It is not easy to fix the true position of these diverticula with regard to somites, and it can only be really decided by making longitudinal sections through a complete uninjured specimen. But by tracing other organs we can place them in somites viii. to xvi. or in ix. to xv., which agrees pretty well with Beddard's species, in which he found the six pairs to lie in somites ix. to xiv.

The sacculated region of the intestine begins shortly behind these glands and is provided with a *typhlosole*, fairly well developed, compressed so as to be a thin membrane, and which presents this peculiarity, that its line of origin takes a *spiral course* round the wall of the gut; so that we have, in place of the straight valve commonly found in earthworms, a spiral valve.

The *vascular system* presents the characteristic "intestinal hearts" which Perrier was the first to describe, and which are now known in other genera than *Rhinodrilus*; there are two pairs only of these commissural vessels in the present species, greatly dilated and communicating not with the dorsal, but with the "supra-intestinal" vessel, as Mr. Beddard has figured for his species; they belong to somites xi. and xii., though they appear to lie in somites xiii. and xiv., the first passing between the second and third intestinal diverticula and the second heart between the third and fourth of these.

Immediately in front of these "intestinal hearts" (fig. 3, *i h.*) are three pairs of very much smaller "lateral hearts" (*l.h.*) arising from the dorsal vessel; these three lie close behind one another between the gizzard and the first diverticulum. It is a matter of some uncertainty whether these lie in somites viii., ix., x., or in vii., viii., ix. The dorsal vessel (*d.v.*) is ampullated in somite xv. and in each somite posteriorly, where it lies above the sacculated intestine; but anteriorly to this, in the region of the "intestinal hearts" and intestinal diverticula, it is practically cylindrical, though it gradually diminishes in size, and where the "lateral hearts" leave it it has become quite narrow. The dorsal vessel appears to *terminate behind the gizzard*, for I could see no median vessel beyond this point; Mr. Beddard states (*loc. cit.* p. 158) that anteriorly to the gizzard the "dorsal vessel runs some way above the surface of the œsophagus;" so that it is possible that I had removed it in this region, though it seemed to end quite definitely *behind* the gizzard.

In *R. Gulielmus* there are three pairs of "intestinal hearts" in somites x., xi., xii., the hindermost pair of which is smaller and not dilated; in front of these there are two pairs of narrow "lateral hearts."

In *R. Tenkatei* there are also two pairs of lateral hearts, which, according to Horst, lie in somites xii. and xiii., and behind these are two pairs of "intestinal hearts," passing between the first and second and between the second and third intestinal diverticula.

With regard to *R. paradoxus*, the "intestinal hearts" are stated to lie in somites xx., xxi., and xxii., though whether this apparent position is due to displacement or not can only be settled by a renewed examination of the species; it is, at any rate, a very peculiar position for the "hearts" to occupy.

Perrier (*loc. cit.* p. 70) states that in the three somites immediately anterior to these intestinal hearts there exist as many pairs of "véritables cœurs." I believe that he is dealing really with *intestinal diverticula*, for he states that each of these organs is distinguishable into two very distinct parts:—(1) a superior, white, opaque, more voluminous region of ovoid form, and communicating at its narrow end with a vessel leading from the dorsal trunk; and (2) a more ventrally placed spherical region, with transparent walls, which is swollen with blood, and in relation to the ventral vessel. To quote his words:—"Sur chacun d'eux on distingue deux parties bien distinctes: l'une inférieure, à parois transparentes, gonflée par un sang bleuâtre coagulé, de forme sphérique: l'autre supérieure, blanche, opaque, plus volumineuse, de forme ovoïde, et s'abouchant par son petit bout avec le vaisseau qui conduit au tronc dorsal."

And he speaks of the inferior region as an "auricle" and the superior as "ventricle;" on the walls of the latter, he goes on to state, there can be seen some bluish veins starting from the apex, which soon disappear.

He was led to the above conclusion owing to his having observed, as he thought, a similar "heart" with ventricle and auricle in *Titanus* (i. e. *Geoscolex*, Leuckart).

Now I have examined a specimen of this worm, as I have previously mentioned *, and I find that the organ lying in somite xiii., whose relations were accurately described by Perrier, and which he mistook for a "ventricle," is in reality an intestinal diverticulum, having the same essential structure as the œsophageal glands of *Lumbricus* †.

I believe, then, that the three pairs of organs are the characteristic intestinal diverticula which occur in this region in the other three species of *Rhinodrilus*.

The *genital organs* (fig. 2).—There are two pairs of rather extensive sperm-sacs (*sp.s.*), which meet dorsally to a greater or less extent, and conceal the gizzard, the intestinal diverticula, and other organs in this region of the body. The anterior sac on each side appears to extend through somites viii. to xiii., and the posterior through somites xiv. to xvii.; but more careful observation shows the former to arise in somite xi. and pass forwards into somite vi., and the posterior to extend through somites xii. to xvii. There are two pairs

* "Studies on Earthworms, I.," Quart. Journ. Micr. Sci. xxvi. p. 250.

† Mr. Beddard confirms my view of the matter in his paper in this Journal for February of the present year.

of testes and ciliated rosettes lying in somites xi. and xii., as determined by tracing out the nephridia and other organs; but they come to lie at the level of two somites further back. Each pair of testes and rosettes is contained in a common transversely-placed sac extending below the gut—the "testicular sac" (*t.s.*) as we may term it (the "Samenkapsel" of Bergh, the "median seminal vesicle" of some authors).

The anterior sperm-sacs arise from the sides of the anterior "testicular sac," and the posterior sperm-sacs from the posterior testicular sac. Horst describes a similar arrangement, though, as in the case of the other organs of *R. Tenkatei*, he refers them to a more posterior position than in the present species. Beddard finds the same arrangement and position for these sacs in his species. Perrier found only *one pair* of sperm-sacs and ciliated rosettes, lying "immédiatement en arrière du gésier." But in neither of these species is any mention made of the sperm-sacs extending beyond the segment in which they arise; they appear to be limited to one somite in each case; and the condition here described recalls that usual in the allied family Geoscolecidæ, mihi, viz. in *Geoscolex*, *Urochæta*, and *Diachæta*, where each sperm-sac extends through at least four and usually more somites.

The sperm-ducts were easily traceable from the funnels to the body-wall, and, as I have stated above, open externally on each side between somites xix. and xx. I could find no ovaries, although I looked carefully for them; Beddard and Horst found them in the normal position, viz. somite xiii.

There are four pairs of spermathecæ (*spth.*) concealed by the pharynx [? perhaps that is the reason why Perrier found none; he would have expected them rather more laterally placed than is the case] and lying in somites v., vi., vii., and viii.; each is a nearly globular sac, with a narrow muscular duct, sharply separated from the sac, and passing to the external aperture on the anterior margin of the somite; these pores lie in the same line as the nephridiopores. On the left side of the specimen an additional very small spermatheca occurs in somite iv.

In *R. Tenkatei* there are three pairs of long pyriform spermathecæ in somites vii., viii., and ix., whereas in *R. Gulielmus* there is only one pair of "spherical or pear-shaped pouches" in somite vii.

For the purpose of ready comparison with the other species I will summarize the characters of *R. ecuadoriensis*:—

1. Length 7·5 centim.
2. Clitellum on somites xiv. to xxv.; tubercula on somites xx. to xxv.

3. Male pores xix./xx.
4. The distance between the two couples of chætæ of one side is greater than that between the right and left ventral couples. There are no copulatory chætæ. The chætæ commence on somite iii.
5. The first nephridium opens into the buccal cavity.
6. The gizzard lies in somite vii.; there are seven pairs of intestinal diverticula.
7. There are three pairs of "lateral hearts" and two pairs of "intestinal hearts."
8. The two pairs of sperm-sacs are not confined to the somites in which the testes lie; there are four pairs of globular spermathecæ in somites v., vi., vii., viii.

EXPLANATION OF PLATE X.

Fig. 1. Ventral surface of the anterior end of *Rhinodrilus ecuadoriensis*. *neph.p.*^{2}, pore of second nephridium; *Pro.*, prostomium represented in a protruded condition; *spth.*, spermathecal pores; *tub.*, tubercula pubertatis; ♂, male pore.

Fig. 2. Semi-diagrammatic view of a longitudinal section, derived from a study of a dissection. The left side of the animal and the left sperm-sacs are removed; the organs of the left side only are shown with the exception of the sperm-sacs, those of the right side being seen. The septa and blood-vessels are omitted for clearness' sake, and only the *anterior* nephridia are represented. ♂ indicates the pore of the left sperm-ducts; *cer.*, the cerebral ganglia; *com.*, the circumpharyngeal nerve-commissure; *div.*^{4}, the fourth intestinal diverticulum; *g.*', the subpharyngeal ganglion; *giz.*, the gizzard; *m.*, mouth; *n.*^{2}, *n.*^{5}, the second and fifth nephridia; *n.c.*, ventral nerve-cord; *n.o.*, nephridiopore; *n.t.*, convoluted tube of a nephridium; *n't.*, convoluted tube of the "peptonephridium;" *p.n.d.*, the duct of the peptonephridium, dissected out and entering the buccal cavity; *pro.*, prostomium, partially retracted; *r.m.*, radiating muscles of pharynx; *sal.*, "salivary glands" around the pharynx; *sp.d.*, sperm-duct; *sp.s.*', *sp.s.*^{2}, the anterior and posterior sperm-sacs of the right side; *spth.*$^{1-4}$, the four spermathecæ; *t.s.*, "testicular sacs," enclosing testes and rosettes.

Fig. 3. Dorsal view of the tubular region of the intestine, with the seven pairs of "diverticula" (*div.*', *div.*^{3}, *div.*^{7}) and the vascular system of the region. *D.v.*, dorsal blood-vessel; *i.h.*, the two pairs of intestinal hearts (from the supra-intestinal vessel); *l.h.*, the three pairs of lateral hearts; *s.i.*, sacculated intestine; *t.i.*, tubular intestine.

Fig. 4. The peptonephridium removed entire from the body. *pn.d.*, the duct; *pn.f.*, the funnel; *pn.t.*, outline of the mass of convoluted tubules: the convolutions are very complicated, and the whole is covered by a dense network of blood-vessels, both of which are omitted, though a small portion of the tubule is shown at *t*.

XXXV.—*Description of a new Siluroid Fish from China.* By G. A. Boulenger.

Pseudobagrus eupogon.

D. 1/7. A. 22. P. 1/8.

Upper surface of head smooth and covered with skin; occipital process twice as long as broad, as long as the basal bone of the dorsal spine; head once and one fifth as long as broad. Teeth on the palate villiform, in a crescentic band. Nasal barbels twice and a half as long as the eye; maxillary barbels a little longer than the head, extending to the middle of the pectoral spine; outer mandibular barbels three fourths the length of the head, inner one half. The depth of the body contained six times in the total length (without caudal), the length of the head five times. Dorsal spine serrated behind, half the length of the head. Adipose fin longer than the dorsal, measuring three fifths its distance from the caudal. Pectoral spine strong, one fourth longer than the dorsal, very strongly serrated on the inner edge. Caudal deeply forked. A dark lateral stripe; fins with blackish edge; barbels blackish.

Total length (including caudal lobes) 250 millim.

Shanghai. A single specimen, received from the Shanghai Museum.

XXXVI.—*Description of a new Species of Rail from Laysan Island (North Pacific).* By F. W. Frohawk, F.E.S.

Porzanula Palmeri, sp. n.

Adult male.—The crown, nape, back, tail, and flanks are a light brown having a slight russet hue; the entire upper surface is streaked with dark brown and black, each feather having an elongated blackish centre; the mantle in some specimens is distinctly mottled with white, but in others the white is scarcely perceptible; cheeks, sides of neck, throat, breast, and abdomen leaden or smoke-grey; the feathers on the flanks have each about four ovate white spots faintly outlined with black; wing very small and rounded, 2nd–4th primaries equal and longest, colour of outer webs pale buff, inner webs smoky brown; secondaries and coverts same colouring as the back: bill light green, darkest and inclining to purplish at the tip and culmen; iris ruby; eyelid pale grey-green; tarsus and feet light olive grey-green. Total length about 6 inches, but capable of extending its neck to a considerable length, adding as much as 2 inches or more to the entire length. Wing from carpal joint $2\frac{1}{4}$ inches; bill (culmen) $\frac{7}{10}$ inch; tarsus $\frac{9}{10}$ inch; middle toe, including claw, $1\frac{1}{4}$ inch.

Sexes very similar, but the female generally paler in colour throughout.

Young birds have the underparts pale buff, replacing the grey of the adult.

The nestling is entirely covered with black down, the bill yellowish.

Nest: outside measurement 6 inches across, from $2\frac{1}{2}$ to 3 inches high; inside it measures 3 inches across and 2 inches deep; it is rather loosely constructed of strips of sedge and coarse grass, and woven together with very fine shreds of grass, fibres, and a little down; inside the materials are rather finer.

The eggs are oval, the ends of equal size, average measurements $1\frac{1}{8}$ by $\frac{13}{16}$ inch, and are of a very pale creamy buff flecked with light red-brown and purplish grey, both colours being pale and somewhat indistinct; in some the colouring is much suffused and variable in depth; they also vary in size.

The nest described was found on June 24th, 1891, and contained three eggs.

Locality. Laysan Island, lat. 25° 46′ N., long. 171° 49′ W.

The following notes I have fortunately had the opportunity of making from the living birds now in the collection of the Hon. Walter Rothschild (which are in the charge of Mr. Doggett); they have lately been received from his collector, Henry Palmer, from Laysan Island.

This little rail is of very considerable interest, being new to science, of small size, incapable of flight, very active and swift on foot, apparently very tame and fearless, and easily caught.

I had the opportunity of observing them while they were running about a room, when I noticed they never once attempted to make use of their wings; the only time I noticed them doing so was in springing up to perch.

During the day they keep up an incessant chirping, consisting of from one to three soft, short, and clear notes; but soon after dusk they all, as if by one given signal, strike up a most peculiar chorus, which lasts but a few seconds, and then all remain silent. I can only compare the sound to a handful or two of marbles being thrown on a glass roof and then descending in a succession of bounds, striking and restriking the glass at each ricochet.

The tail is at times held drooping, sometimes elevated, and frequently jerked up and down.

XXXVII.—*Description of a new Species of* Calyptomena *from North-western Borneo.* By R. BOWDLER SHARPE, LL.D., F.L.S., &c.

THE accompanying description applies to a most beautiful bird which has been submitted to the British Museum by Mr. Charles Hose, who procured it on Mount Dulit. It is a larger bird than *C. viridis,* but inferior in size to *C. Whiteheadi,* and differs from both in its bright blue breast.

I propose to call it, after its discoverer,

Calyptomena Hosii, sp. n.

Adult male.—General colour emerald-green, with a black spot on the forehead, nearly concealed by the loral plumes which overhang the bill, the lateral frontal plumes having concealed black bases; on the occiput a spot of velvety black, and a small spot of black on each side behind the ear-coverts; on the lower hind neck another patch of velvety black; on all the median and greater wing-coverts a rounded subterminal spot of black; quills black, externally emerald-green; the innermost secondaries entirely green; upper tail-coverts very long, green like the back, and *entirely concealing a lateral patch of brilliant cobalt-blue feathers;* tail-feathers green, with black shafts, with a broad terminal band of black; throat and entire sides of body emerald-green, the centre of the body bright cobalt-blue from the lower throat downwards; under tail-coverts blue, with greenish bases; under wing-coverts dark emerald-green, and quills black below.

Total length 8·5 inches, culmen about 0·8, wing 5·2, tail 2·4, tarsus 1·0.

Adult female.—Differs from the male in being much duller in colour, more yellowish-green in tint, especially on the under surface, where the lower breast, abdomen, and under tail-coverts are pale blue, not rich cobalt as in the male. The black spots on the forehead, occiput, hind neck, and behind the ear-coverts are entirely wanting, and on the wing-coverts the black spots are confined to the median series only; the tail-feathers are entirely dark green, blackish near the base.

Total length 7·5 inches, culmen 1·7, wing 4·8, tail 2·4, tarsus 0·95.

XXXVIII.—*On some new Mammalia from the East-Indian Archipelago.* By OLDFIELD THOMAS.

THE British Museum owes to Messrs. Charles Hose and Alfred Everett a collection of Mammals from North Borneo, and in working them out the following new species prove to need description. The Mount Dulit species will be more fully described in a general account now in preparation of the Mammals obtained by Mr. Hose in that most interesting locality.

Hemigale Hosei, sp. n.

Size and proportions of *H. Hardwickei*. General colour above from nose to tail uniform dark smoky brown, without dorsal or nuchal markings. A spot on each side of the muzzle, another over each eye, ears, and chin, white. Teeth markedly smaller than in *H. Hardwickei.*

Dimensions:—

(♂) Head and body 540 millim.; tail 320; hind foot 78; basal length of skull 89.

Hab. Mount Dulit, N. Borneo, 4000 feet (*C. Hose*).

Tupaia Everetti, sp. n.

Size large; as large as *T. tana*. Fur short, close, and rather harsh. Tail-hairs scarcely or not longer than those of the body. General colour uniform dull rufous-brown; the head rather more olive-brown; an indistinct ferruginous stripe over each shoulder. Underside similar to upper, but rather paler; throat more rufous. Tail cylindrical, not bushy; its hairs, except at the tip, rarely exceeding 10 millim. in length, its colour quite like that of the back.

Skull with the elongate tapering form of that of *T. tana*, though the muzzle is slightly shorter. Zygomatic vacuities very small, only about 1·5 × 1·0 millim.

Teeth, except $_{\text{i. 3}}$, very large and stout, markedly heavier than those of *T. tana*. $\frac{\text{I. 2}}{}$ nearly twice the height and more than twice the antero-posterior diameter of that of *T. tana*; internal lobes of $^{\text{p. 3}}$ and $^{\text{p. 4}}$ very well developed. First and second lower incisors as usual, but the third one minute and nearly vertical, markedly contrasting with the $\frac{}{\text{i. 3}}$ of *T. tana*, which is well developed and nearly horizontal, like $\frac{}{\text{i. 1}}$ and $\frac{}{\text{i. 2}}$. On the other hand, the lower canine, to match the heavy $^{\text{i. 2}}$, against which it bites, is unusually large and powerful, more than twice the bulk of the corresponding tooth of *T. tana*.

Dimensions (approximate, from skin):—

Head and body 210 millim.; tail, without terminal pencil, 170; hind foot (approximate, from skeleton) 48.

Skull: basal length 54; occiput to nasal tip 64·5; greatest breadth 29; nasal tip to front edge of orbit 30·7; interorbital breadth 17·5; intertemporal breadth 18; palate, length 34, breadth outside $^{\text{m. 1}}$ 16, inside $\frac{\text{m. 1}}{}$ 8·2. Front of $\frac{\text{i. 1}}{}$ to back of $^{\text{m. 3}}$ 33·3; diastema between $\frac{\text{i. 2}}{}$ and $^{\text{c.}}$ 4·4, between $^{\text{c.}}$ and $^{\text{p. 2}}$ * 0·9.

Teeth.—$^{\text{I. 2}}$, height above bone behind 4·8, antero-posterior diameter at base 2·7; canine, height 3, diameter 1·7; $_{\text{i. 3}}$, height 1·5, diameter 0·6; $_{\text{c.}}$, height 5·7, diameter 2·5; combined lengths of $\frac{\text{m. 1–3}}{}$ 10·6, of $\frac{}{\text{m. 1–3}}$ 10·8.

Hab. Zamboanga, W. Mindanao, Philippine Islands.

Type Brit. Mus. 79. 5. 3. 11. Coll. Alfred H. Everett, Esq.

This striking species has in a general way the skull of *T. tana* and the external appearance of *T. ferruginea*, with the skins of which in fact the type has hitherto lain unnoticed in the Museum collection. The distinctness of the two, however, at once became apparent on direct comparison, and in describing it I have much pleasure in connecting with it the name of its collector, to whose labours we are so largely indebted for our knowledge of the zoology of this region.

Since, as Mr. Everett has shown †, the island of Palawan is not, zoologically considered, properly a part of the Philippine Archipelago, the present is, as far as I know, the first record of the genus *Tupaia* in that group.

Tupaia picta, sp. n.

Rather smaller than *T. ferruginea*; more heavily built than *T. dorsalis*. General colour of back olive-grey, coarsely grizzled with yellowish; more rufous posteriorly. Centre of back with a distinct dorsal stripe extending from the withers to the rump, the stripe better defined than in *T. montana*, but neither so long nor so sharply defined as in *T. dorsalis*. Head, hands, and feet dull grizzled olive; sides dark rufous; a distinct shoulder-stripe present. Underside grey, the hairs washed terminally with yellow; chin and chest rich yellow

* The most anterior premolar. Specimens in the Museum show that this tooth changes in *Tupaia*, and is therefore clearly $^{\text{p. 2}}$, the true $\frac{\text{p. 1}}{}$ of Carnivora and Insectivora never changing.

† P. Z. S. 1889, p. 220.

or orange. Tail broad and bushy, evenly distichous, its hairs above basally mixed red and black, at the tip and below brilliant chestnut-rufous.

Skull much as in *T. ferruginea*, but the zygomatic vacuity reduced to a long narrow slit about 4·5 millim. long and only about 1 millim. high.

Teeth also not materially different from those of *T. ferruginea*.

Dimensions of the type (Brit. Mus. 92. 2. 8. 1) *:—

Head and body 185 millim.; tail 162; hind foot 42·5.

Skull: basal length 45; greatest breadth 26·3; nasal tip to front edge of orbit 21; interorbital breadth 15; intertemporal breadth 17·5; palate, length 27·5, breadth outside $\frac{m.1}{}$ 15, inside $\frac{m.1}{}$ 8·5; front of $\frac{i.1}{}$ to back of $\frac{m.3}{}$ 26·4; diastema between $\frac{i.2}{}$ and $\frac{c.}{}$ 4, between $\frac{c.}{}$ and $\frac{p.2}{}$ 1·8.

Hab. Baram, N. Borneo. First collected by Mr. Hose; other specimens since received from Mr. Everett.

This handsome species is readily distinguishable from *T. ferruginea* and *T. splendidula* by its duller body-colour and the presence of a black dorsal stripe; from *T. tana* by its smaller size and shorter muzzle; from *T. dorsalis* by its less defined dorsal line, bushier tail, and heavier teeth; and from *T. montana*, described below, by its brilliantly rufous tail and coarsely grizzled back.

Tupaia montana, sp. n.

Rather smaller than *T. ferruginea*. Dark grizzled rufous above, with an indistinct black dorsal line from the withers to the rump, broadening out and almost indistinguishable over the loins. Tail rather short; above dull grizzled rufous, below more olivaceous yellow, the lateral hairs ringed terminally with black.

Dimensions:—

Head and body of type (♂) (c.) 200 millim.; tail (c.) 140; hind foot 41. Front of $\frac{i.1}{}$ to back of $\frac{m.3}{}$ 27; back of $\frac{i.2}{}$ to front of $\frac{c.}{}$ 4·5.

Hab. Mount Dulit, 5000 feet (*C. Hose*).

Tupaia melanura, sp. n.

Size of *T. minor*. General colour of *T. javanica*, but without the shoulder-stripe. Tail slender, cylindrical, close-

* The specimen selected as the type is one of Mr. Everett's, Mr. Hose's original specimen having an imperfect skull; the latter gentleman is, however, the first discoverer of the species.

haired, as in "*Dendrogale*," but without any terminal pencil; its colour deep shining black, except at the base, where it is like the back. Face coloured as in *T. minor*, not as in "*Dendrogale*."

Dimensions of the type (♀):—

Head and body 125 millim.; tail 136; hind foot 29·7. Basal length of skull 30; front of $\underline{\text{i. 1}}$ to back of $\underline{\text{m. 3}}$ 17·7.

Hab. Mount Dulit, 5000 feet (*C. Hose*).

Sciurus Brookei, sp. n.

Allied to and of the general colour of typical Singapore specimens of *S. tenuis*, Horsf., but distinguished by its much larger size and by its cheeks, anal region, and the proximal inch of the tail beneath being bright rufous.

Dimensions:—

Head and body 205 millim.; tail 144; hind foot 37; basal length of skull (c.) 37.

Hab. Mount Dulit, N. Borneo (*C. Hose*).

Sciurus Lowii, sp. n.

Size and general colour above of *S. tenuis*, Horsf., but darker, sleeker, and more finely grizzled. Ears black-rimmed. Whole of under surface and inner sides of limbs pure white or yellowish white, without admixture of grey. Tail broadly ringed with orange and black. Muzzle of skull markedly longer and interorbital breadth less than in *S. tenuis*; incisors thrown more forward, forming a more open curve, and the lower pair as dull-coloured in front as the upper.

Dimensions of the type, an adult male in skin (probably overstretched):—

Head and body 154 millim.; tail 95; hind foot 33.

Skull: basal length 34; greatest breadth 23·3; nasals, length 12, breadth 5·5; interorbital breadth 11·2; diastema 10·1; palate, length 19·5. Front of $\underline{\text{p. 4}}$ to back of $\underline{\text{m. 3}}$ 6·6.

Hab. Lumbidan, on the mainland opposite Labuan (several specimens collected by Sir Hugh Low); other specimens from Baram (*A. Everett*).

Type Brit. Mus. 76. 5. 2. 14.

The occurrence of a typical grey-bellied short-snouted *S. tenuis* in Mr. Everett's Baram collection proves that this white-bellied form, of which the Museum possesses six specimens, is really distinct from that animal, with which I had hitherto provisionally left it.

The difference in proportion between the skulls of *S. tenuis* and *S. Lowii* is readily shown by the fact that in the former the interorbital breadth is equal to the distance from the front face of the incisors to the middle or back of $^{\text{p. 4}}$, while in the latter it does not reach to the anterior edge of $\frac{\text{p. 3}}{}$.

Tragulus nigricans, sp. n.

Allied to and apparently about the size of *T. napu*, F. Cuv. Arrangement of colours above much as in that species, but the whole of the dorsal and lateral surfaces broadly washed with jet-black, the hairs white at their bases, then dull orange and broadly tipped with black. Nape with the indistinct blackish line found in *T. napu*. Face and sides of neck mixed black and dull fulvous. Chin with the usual naked glandular patch between the rami of the lower jaw. Arrangement of white throat-bands quite different from that of the allied species, perhaps most similar to that of *T. Stanleyanus*. All the stripes very narrow, sharply defined. Anteriorly on each side of the naked space there is a short pure white stripe, which ends abruptly at about the level of the posterior canthus of the eye; these short stripes are completely separated from each other and from the posterior stripes by a dark brown space, the break in their continuity with the latter being not less than one inch in length. Posteriorly the median white stripe, which is very narrow and scarcely broader behind, is bounded on each side, between the lateral white stripes, by deep jet-black fur, strikingly different from the fur in the corresponding position in the other species. Behind the stripes are separated from the white patch between the fore limbs by a broad blackish band. Belly-hairs broadly tipped with black, but the inner sides of the thighs, as usual, white.

Skull and teeth of the only specimen too young and in too bad a condition for detailed comparison; but, comparing the actual sizes of the milk-teeth, $\frac{\text{m. p. 2}}{}$ is much smaller than in a specimen of corresponding size of *T. napu*, $\frac{\text{m. p. 3}}{}$ is slightly smaller, while $\frac{\text{m. p. 4}}{}$ and $\frac{\text{m. 1}}{}$ are of about the same antero-posterior diameter. Similarly below $\overline{\text{m. p. 2}}$ and $\overline{\text{m. p. 3}}$ are each much smaller than in *T. napu*, while $\overline{\text{m. p. 4}}$ and $\overline{\text{m. 1}}$ are of about the same size.

Dimensions of teeth:—

Antero-posterior diameter of $\frac{\text{m. p. 2}}{}$ 7 millim., $\frac{\text{m. p. 3}}{}$ 7·5, $\frac{\text{m. p. 4}}{}$ 5·8, $\frac{\text{m. 1}}{}$ 6·5, of $\overline{\text{m. p. 2}}$ 5·7, $\overline{\text{m. p. 3}}$ 6·6, $\overline{\text{m. p. 4}}$ 8, $\overline{\text{m. 1}}$ 7·2.

Hab. Balabac, Philippine Islands.

Type Brit. Mus. 91. 11. 28. 2. Collected by the Steere Expedition to the Philippines, 1887–88.

It is unfortunate that the only specimen obtained of this new Chevrotain is both young and in bad condition; but its general blackness and the peculiar character of its throat-markings separate it at once from any of its congeners.

XXXIX.—*Descriptions of new Species of Shells from Mauritius and California.* By EDGAR A. SMITH.

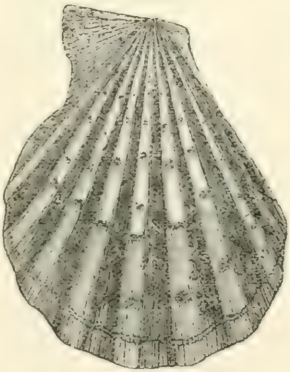
Pecten Crouchi.

Testa compressa, inferne rotundata, ad apicem peracuminata, subæquivalvis, costis validis octo in utraque valva instructa, supra et inter costas radiatim striata, undique microscopice superficialiter reticulata; valva sinistra albida, aurantio vel purpureo plus minus tincta, supra et inter costas saturate purpureo vel sanguineo irregulariter copiose maculata, lineisque angulatis albis inter costas hic illic ornata; valva dextra pallidior, marginem ventralem versus aurantio vel purpureo tincta, inter et supra costas parum maculata; margo cardinis perobliquus, rectilinearis, valde inæqualis, parte postica brevissima, longit. totius $\frac{1}{3}$ vix æquante; auriculæ valde inæquales, radiatim tenuiter costulatæ, postica minima, antica valvæ dextræ inferne profunde sinuata; costæ valvæ sinistræ interstitiis angustiores, valvæ dextræ latiores.

Longit. 38 millim., alt. 46, diam. 11.

Hab. Mauritius.

This beautiful species is distinguished by the very sloping dorsal margins, which converge at the apex at an angle of 75°; the very unequal auricles; the elevated ribs, those of the left valve being narrower than the interstices or the costæ of the other valve; the style of coloration, which, however, is variable; the fine radiating striæ and the microscopic reticulation or shagreened epidermal coating, which everywhere invests the surface and which is easily rubbed off during the process of cleaning. The central ribs of the left valve have about seven raised lines down each, separated by striæ or sulci of about equal width, and the grooves between the costæ are ornamented with about the same number of lines. The valves are whitish within, and, being thin, the blotching of the exterior, especially that of the left valve, is more or less distinctly visible.



This species differs from *P. tigris*, Lam., which in some respects it resembles, in the more sloping dorsal margins, in having fewer and much more elevated costæ, in the style of colouring, and the greater inequality of the auricles.

I have much pleasure in naming this handsome species after Mr. Walter Crouch, the author of several useful papers on the Mollusca and other branches of the zoology of Essex.

Mitra Fultoni.

Testa ovato-fusiformis, omnino nigra, sed ad apicem leviter erosa; anfractus 8, convexiusculi, sutura obliqua sejuncti, lineis incrementi obsolete pliciformibus instructi, sulcisque angustis spiralibus remote sed regulariter punctatis (in anfract. penultimo 5, in ultimo circiter 14) cincti, ultimus infra medium leviter constrictus, supra caudam oblique tenuiter liratus; apertura cæruleo-albida, longit. totius $\frac{1}{2}$ æquans; columella fusca, callo tenui superne albo-calloso induta, plicis quatuor obliquis albidis, suprema maxima, infima minima, instructa.

Longit. 39 millim., diam. 13; apertura $19\frac{1}{2}$ longa, 5 lata.

Hab. Point Abreojos, Lower California.

This species is well characterized by the punctate sulci, the punctures falling in regular longitudinal rows, through which pass well-marked impressed lines of growth. It has, I believe, been confounded with *M. orientalis*, Gray, by some conchologists; but from that species it may be sufficiently distinguished by the above-mentioned feature and the difference of form. The whorls are more convex, the epidermis blacker, and the fine spiral striæ which adorn the surface of that species are scarcely indicated in the present form.

Mitra Fultoni is named after Mr. H. Fulton, from whom the specimens were obtained, and through whose agency the British Museum has obtained many valuable additions.

XL.—*Some Points in the Histology of Cœlenterates.* By Dr. Karl Camillo Schneider*.

In the comparative investigations of various cells and tissues of Cœlenterates, which I commenced at Naples in the month of March, I arrived at certain histo-morphological results, of

* Translated from the 'Zoologischer Anzeiger,' xiv. Jahrg., 1891, no. 375, pp. 370, 371, and no. 376, pp. 378–381.

which I intend to give a brief provisional account in the following pages. I will first consider the Siphonophora. By employing a mixture of osmic and acetic acid, which agreed pretty closely with that adopted by the brothers Hertwig *, I succeeded in determining the presence of ganglion-cells in the feelers and pneumatophore of *Apolemia uvaria* and in the polypes of *Forskalea contorta*, which in the form of the cell and its prolongations do not differ from those with which we are acquainted in the case of the Medusæ and other Cœlenterates. In the same way the epithelium of the disk of *Velella spirans*, as has already been described by Chun † and others, contains typical ganglion-cells. Sense-cells were found at the anterior extremity of the polypes and feelers of *Apolemia*, likewise in accordance with the well-known arrangement. On the other hand, the stem of the two Physophorids alluded to contains highly remarkable and divergent cellular structures. In this case the epithelium consists of cells of very different kinds, between which, however, transitional forms occur. *Forskalea* exhibits on the sides of the stem transversely elongated cells, which send off a process into the interior, and by means of this, which may again divide, they are connected with the longitudinal muscles. Another Physophorid, which I determined to be a young *Halistemma*, in the stem of which the central canal is extraordinarily wide while the septal ridges of the supporting lamella are very low, exhibited these conditions particularly clearly; it follows from this that in the stem we have to deal with epithelio-muscle cells. Circular muscle-fibres are not found: at any rate the superficial prolongations of the epithelial cells, which run transversely and give a transversely rugose appearance to the stem, are not to be regarded as muscular, in spite of their fineness, length, and often very homogeneous appearance, as I shall show in my detailed paper. Their superficial position is also an argument to the contrary. In *Apolemia*, however, we find muscle-substance enclosed in these prolongations of the body of the cell and likewise in the central processes which lead to the longitudinal muscle; nevertheless this is not the case for all cells of the epithelium, although it is not thereby possible to divide the epithelial cells into those which contain muscle and those which do not. In *Apolemia* especially the development of the cells varies in a perfectly astounding way; we find cells

* O. and R. Hertwig, 'Das Nervensystem und die Sinnesorgane der Medusen,' Leipzig, 1878.

† C. Chun, 'Die Gewebe der Siphonophoren, II.,' Zool. Anzeiger, 1882, no. 117.

which, besides the longitudinal muscle, also possess muscular formations running in a transverse and perpendicular direction; others, again, are entirely without the transverse processes, and have a rounded termination upon the surface. (Concerning the remarkable muscular formations, which always lie enclosed in the protoplasm of the cell, I refer the reader to my detailed paper.) The peripherally rounded cells are found in the case of *Forskalea* chiefly upon the dorsal surface. In shape they agree tolerably well with the "neuro-muscular" cells described by Korotneff *, but they have an epithelial and not deep-seated position, and are merely special forms of the epithelial cells in general. Other divergent forms of cells, however, occur. Thus here and there the central process is entirely wanting; the cell may then become very similar to a bipolar ganglion-cell, though it lies at the periphery; however, the processes also divide tolerably frequently, and thus cells also appear which look like typical ganglion-cells, and I was able to determine the subepithelial position of such structures. Nevertheless, however great the similarity may become, there is always something in the cell which tells against the supposition of a nervous element therein. In all respects the Siponophoran stem appears to be in little accord with the customary views as to ganglion-cells in Cœlenterates; this is particularly noticeable in *Forskalea*. In this form we find in the middle line of the dorsal side quite colossal cells beneath the epithelium, which are regarded by Korotneff * as the central nervous system (an interpretation which is adopted by Bedot †). This follows from his description, however, just as little as does the nervous nature of his "neuro-muscular" cells, although I believe all the same that his explanation is admissible. I incline to this view, however, only because I succeeded—difficult process though it is—in satisfactorily isolating these cells, for from the figures of sections, as drawn by Korotneff, every other conclusion is really more probable than his own. Nevertheless Korotneff's views as to what is to be termed nervous are in general very far-reaching; the presence of quite irregular protoplasmic processes upon a cell causes him at once to decide upon their extraordinarily sensitive nature. Yet the giant cells in the stem of *Forskalea* possess offshoots which in length, form, and structure really leave nothing to be desired, and enable us, in all probability with justice, to

* Korotneff, "Zur Histologie der Siphonophoren," Mittheilungen Zool. Stat. Neapel, 5 Bd.

† Bedot, "Sur l'*Agalma Clausi*, n. sp.," Recueil zool. suisse, T. v.

regard the cells as nervous. It is impossible to specify a definite form for the cells; indeed, we are really unable to speak of "separate" cells at all, for not only do very broad and short processes connect the masses of protoplasm, which figure as cells, in the longitudinal direction of the stem, but it is usually the case that instead of one nucleus and a correspondingly smaller size the latter is actually very considerable, and a number of nuclei (I counted as many as five) are present in the interior. These aggregates of cells (in which limits are absolutely indistinguishable) lie with their elongated direction crosswise to the stem; they are in continuity with the rest by means of the short thick connecting portions, and from them there also radiate the nerve-fibres, which are often of extraordinary thickness, ramify like processes of ganglion-cells, run transversely to the stem beneath the epithelium, and probably also penetrate down to the muscles beneath. As regards the structure of these fibres, as well as of the cells and cell-masses, I will merely mention that there is a fluid in their interior which exudes in drops when they are crushed and is perhaps comparable to the hyaloplasm of the ganglion-cells of the higher animals. The finer the processes become—and there are very delicate ones which remind us of those of the Medusæ—the more difficult becomes their distinction from processes of the ordinary epithelio-muscle cells, and they are besides frequently just as irregular as the latter (on this point see the complete paper). In general the amount of fluid too appears to be no certain criterion; on the contrary, it only implies that the cells and cell-offshoots in question are thick and rounded, while this is not the case for the majority of epithelial cells, since they appear as if flattened out perpendicularly to their longitudinal elongation in their deeper parts, and above all in the broad basal process; the protoplasm here has often only the thickness of an even tolerably delicate membrane. In spite of all these odd features it nevertheless appears to me that we must regard the large elements of the dorsal side as nervous, for there is nothing else that could otherwise be considered as such; and although the epithelio-muscle cells are here and there provided with cilia (usually two together), we cannot on that account term them tactile cells with Korotneff, with whom a cilium is sufficient to cause a cell to be regarded as sensitive. I shall endeavour to give further support to my interpretation in my complete work.

At the basal end of the polypes of *Forskalea* there is a thickening of the ectoderm containing structures which at first attracted my attention very forcibly. Subsequently, on examining the nettle-pad ("Nesselwulst") in *Carmarina hastata*, I realized that the two thickenings of the epithelium correspond to one another. I was also at first inclined to recognize a supporting tissue in them, as the Hertwigs * and others have done; but the observation of the living animal taught me that we here have to deal with a centre for the formation of nematocysts. In point of fact the filaments ("Senkfäden") in *Forskalea* and the tentacles in *Carmarina* are supplied with cnidoblasts by the pad. In *Carmarina* the elements are not large, but in *Forskalea*, on the other hand, where the nettle-buds also contain capsules of very considerable size, the whole course of development could be traced with wonderful clearness in their young stages at the seat of formation. I must admit that this is not exactly a very easy task; nevertheless with regard to the series of consecutive stages, as I shall subsequently figure them, I can affirm with tolerable certainty that it corresponds to the actual course of development. In my paper on *Hydra* † I supposed the thread to arise by ingrowth of the protoplasm into the cavity of the capsule, and thereby took the opposite view to Nussbaum ‡ and Jickeli §, who observed a formation of the thread outside the capsule. At the present time, when I too have been able to confirm the mode of formation described by the two authors, I have read with real satisfaction that Bedot ‖, whose papers I unfortunately omitted to consult before, found a development of the threads of the nematocysts in *Physalia* and *Velella* which agrees with that which I described for *Hydra*. The question might easily be asked, Who is right, or is every body right? I am inclined to think that in the case of *Hydra* I overlooked or misinterpreted something or other—I shall, however, investigate the point afresh—and that Bedot did the same; for it seems to me to be not very probable that important differences of this kind should occur in the course of the development of the cnidoblasts in animals which are so closely allied. This conclusion is strengthened by the fact that I believe I am entitled to assume that the thread develops outside the capsule in the Actinians also, as represented by *Adamsia Rondeletii* (see

* O. and R. Hertwig, *loc. cit.*

† K. C. Schneider, "Histologie von *Hydra* &c.," Arch. mikr. Anat. 35 Bd.

‡ M. Nussbaum, "Ueber die Theilbarkeit der lebendigen Materie: II. *Hydra*," Arch. mikr. Anat. 29 Bd.

§ C. F. Jickeli, "Der Bau der Hydroidpolypen, I.," Morphol. Jahrb. Gegenbaur, 8 Bd.

‖ Bedot, "Recherches sur les cellules urticantes," Recueil zool. suisse, t. iv.

subsequent paper). I therefore believe that, starting from the cavity of the capsule, which has previously been formed with the inner wall of the subsequent perfect cyst, the development of the thread proceeds in the protoplasm of the cnidoblast, and that after completion the thread is introverted, commencing with the tip and ending with the thickened basal portion, so that this enters the capsule last. The development of the outer wall of the capsule is the last to take place, and, as it appears to me, does not occur until the spot is reached at which the cyst comes into operation. The extremely interesting formation of the thread, from its histological aspect, will be described in my subsequent paper. The lamellar arrangement in the protoplasm of the cells of the nettle-pad, as described by the brothers Hertwig *, and as is actually seen in animals macerated in a mixture of osmic and acetic acid, is due to the disposition of the thread around the wall of the nematocyst. I did not clearly grasp this point until I examined the pad, both in its living state and when treated with 50 per cent. acetic acid; the latter reagent causes the thread to become sharply defined, though in the living object it is only to be detected with difficulty (as the tissue dies away it becomes more and more distinct). The young cells pass from the pad to the filament in *Forskalea*, but to the tentacle in *Carmarina*. The same is doubtless true for the cnidoblasts of the peronia of the Narcomedusæ and of the mantle-rivets which are found in the Geryonidæ. Thus the presence of mantle-rivets on the sensory bodies also probably points to the fact that the latter represent rudimentary tentacles.

In conclusion, I would just briefly mention that in the investigation of *Alcyonium acaule* I arrived at definite views with regard to the formation of the spicula. In the ectoderm of this form cells occur to which the term indifferent may be applied; these coalesce here and there into groups, and by fusion give rise to structures which are to be considered as matrix-elements of the spicula. They furnish the form of the future spiculum, and then secrete within themselves the calcareous substance, in which the nuclei are at first still distinguishable, but which finally so completely fills the whole that nothing more is to be seen of the organic base and the structure appears homogeneous and shining. This transformation is accomplished in the mesoderm.

* O. and R. Hertwig, *loc. cit.*

MISCELLANEOUS.

On the Earliest Stages in the Development of Sessile-eyed Crustacea. By M. Louis Roule.

I have had the honour of communicating to the Academy several of the most important phenomena presented by the sessile-eyed Crustacea in the course of their embryogeny; some more recent investigations enable me to complete the knowledge already acquired and to prepare a synthesis of the first stages of the development, taking as types *Asellus aquaticus* and *Porcellio scaber*.

The ovule is always rich in nutritive vitellus; nevertheless the bulk occupied by the latter varies according to the species. When it is least in amount the fertilized ovum undergoes a total and radial segmentation, the segments assuming the well-known form of cones, of which the apex is turned towards the centre of the ovule and the base towards the periphery; on the contrary, when its quantity is considerable, as in *Porcellio* for instance, this preliminary segmentation is not manifested. But, whatever be the mode exhibited, after the radial division when it exists, or from the moment that the ovum is mature when it does not appear, the formative vitellus ("vitellus évolutif") does not remain mingled with the nutritive vitellus, but separates from it. This separation does not manifest itself at the same time throughout the ovum; it commences in a zone which corresponds to the future anterior extremity of the embryo. The formative vitellus forms in the first place in this region a little cicatricle, which rapidly organizes itself into cells, to which the nuclei are furnished by the conjugated nucleus, which results from the fusion of the male and female pronucleus effected in fertilization. Fresh quantities of formative vitellus then become isolated from the nutritive vitellus and added to the cicatricle, increasing its mass and dividing likewise into cells; in this way the cicatricle grows and gradually envelops the nutritive vitellus, advancing with regularity from the zone which it occupied until it reaches the pole diametrically opposite; a cellular layer is extended by this proceeding upon the periphery of the ovule, and finally surrounds it.

Arrived at this stage of development, the embryo is constituted by a layer of cells which surrounds a compact mass of nutritive vitellus; this layer is the blastoderm, which will give rise to the three blastodermic layers. To this end the cells of the blastoderm produce a large number of cellular elements, of which some penetrate into the nutritive vitellus, while the rest intercalate themselves between the latter and the blastodermic layer; the development of the two kinds of cells is similar. Several of these elements, collected in two groups placed at the sides of the embryo and not far from the medio-ventral line, arrange themselves in two symmetrical layers which penetrate into the nutritive vitellus, converging towards one another; these two layers, separated from the time of their first appearance, represent the rudiments of the endoderm. The other elements do not arise in limited zones; they are produced by the blastoderm throughout its entire extent, and give rise to the mesoderm. When the blastoderm has thus given birth to the mesoderm and endoderm, it persists as a simple cellular layer around the layers which arise from it, and constitutes the ectoderm. In short, the primitive blastoderm is alone the origin of the three layers; the cells of which it is composed multiply rapidly, and group themselves in two different ways; some remain at the periphery and will form part of the ectoderm, while the rest penetrate into the ovule and represent a meso-endoderm, which will differentiate into the two final inner layers.

One of the most important facts is the diffuse genesis of the mesoderm by almost the entire blastoderm; a second is the double origin of the endoderm, the two original zones being separated by a vast space. These two peculiarities taken together are really characteristic, for we do not meet with them in the condensed developments of the rest of the Cœlomata. Finally, a concluding phenomenon of great value is presented by the enteron or primitive intestine, which hollows itself out in the interior of the embryo without in any way proceeding from a gastrular invagination, and does not even present a trace of such a primordial origin; here, again, is a contrast to the condensed developments of the other Cœlomata. At the present moment I am continuing my investigations and extending them to the Podophthalmata; I shall shortly have occasion to show that they exhibit the same phenomena as the Edriophthalmata, and that the blastodermic depressions, considered by divers authors, by Reichenbach and Bobretzky among others, as gastrular invaginations, have not, in reality, such a significance.—*Comptes Rendus*, tome cxiii. no. 24 (December 14, 1891), pp. 868–870.

A new Mode of Respiration in the Myriapoda. By F. G. Sinclair (formerly F. G. Heathcote), M.A., Fellow of the Cambridge Philosophical Society.

The Scutigeridæ respire by means of a series of organs arranged in the middle dorsal line at the posterior edge of every dorsal scale except the last.

Each organ consists of a slit bounded by four curved ridges, two at the edges of the slit and two external to the latter. The slit leads into an air-sac. From the sac a number of tubes are given off; these tubes are arranged in two semicircular masses. The ends of the tubes project into the pericardium in such a manner that the ends are bathed in the blood and aërate it just before it is returned into the heart by means of the ostia. In the living animal the blood can be seen through the transparent chitin of the dorsal surface surrounding the ends of the tubes; and in the organ and surrounding tissues cut out of a Scutigera directly it is killed, the blood-corpuscles can be seen clustering round the tube ends. If the mass of tubes of a freshly killed specimen are teased out under the microscope in glycerine, they can be seen to be filled with air. The tubes each branch several times. Each tube is lined with chitin, which is a continuation of the chitin of the exo-skeleton. Each tube is also clothed with cells, which are a continuation of the hypodermis. The tubes end in a blunt point of very delicate chitin.

Reasons for supposing these Organs to be Respiratory.

1. There are no other organs which could be supposed to be respiratory in function.

2. The tubes are chitinous, and the chitin grows thin and membranous towards the end, affording a good opportunity for interchange of gases.

3. The tube ends project into the pericardium, so that they are bathed with the blood.

4. The tubes are filled with air.

5. The organ is so placed as to aërate the blood just before it returns to the heart.

6. In Scutigera the dorsal scales do not agree in number with the legs. The organs are arranged on the dorsal scales: that is they are not arranged in correspondence with the mesoblastic or primitive segmentation (see a former paper before this Society, "The Post-Embryonic Development of *Julus terrestris*," 1888). This renders it probable that they are not a primitive development, but a recent modification, agreeing with the fact that all other Myriapods breathe by the more primitive method of tracheæ.

This mode of respiration differs from that in other Myriapods in the following particulars:—

1. The tubes are collected into one definite organ, instead of being distributed about the body.

2. The tubes have no spiral thread.

3. In acting on the blood just before it returns to the heart, so that aërated blood is distributed instead of unaërated.

It resembles the tracheæ of other Myriapods in the following particulars:—

1. In the air-sac into which the tubes open.

2. In the cylindrical form of the tubes.

3. In the branching of the tubes.

The organs resemble the tracheal lungs of Spiders—

1. In the large air-sac.

2. In the number of tubes opening into an air-sac.

3. In the arrangement for bathing the tubes with blood in a blood-sinus.

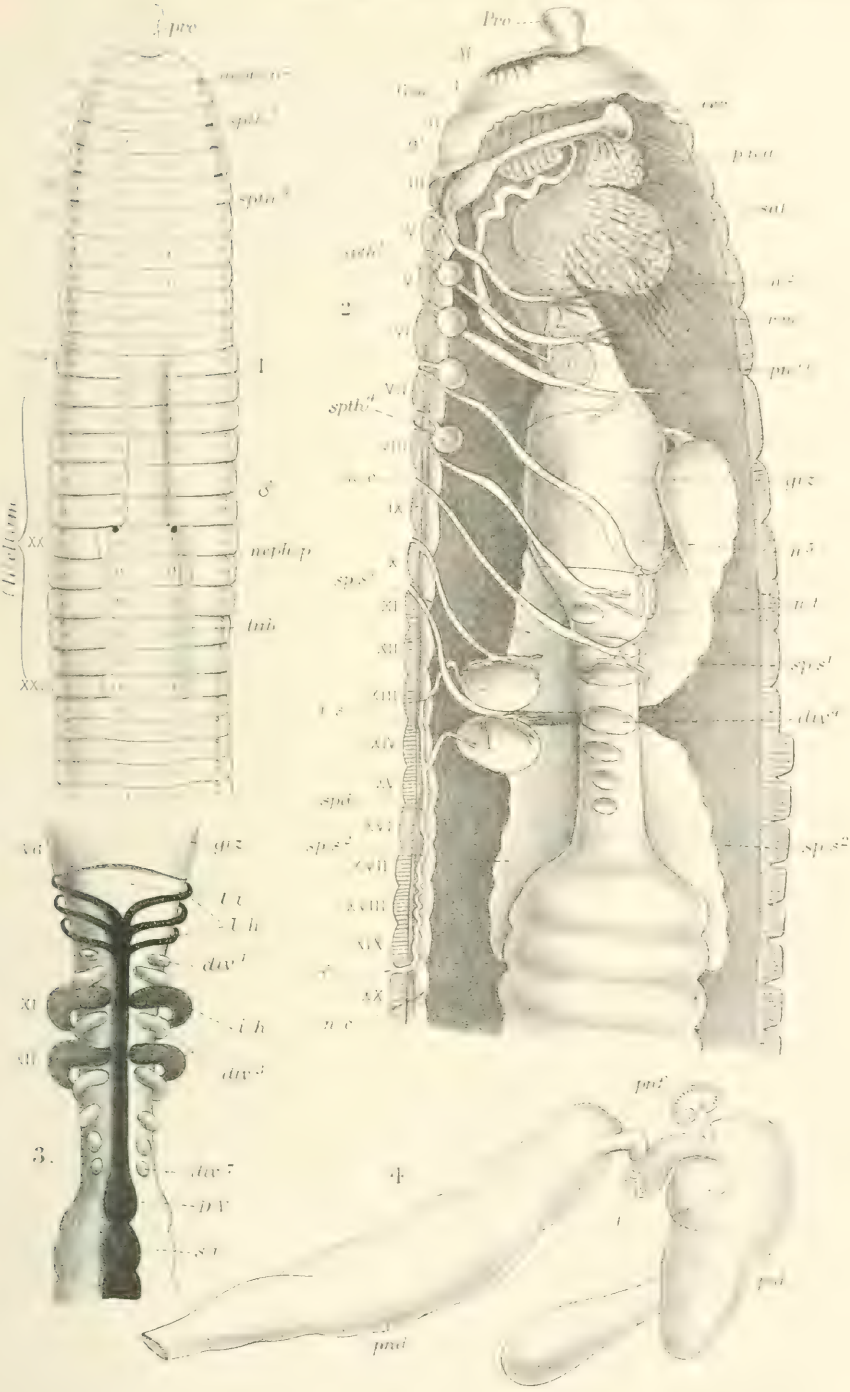
4. In the supply of aërated blood by the heart.

They differ from them in—

1. The form of the tubes, which in Scutigera are cylindrical.

2. In the absence of the membrane which in Spiders surrounds the organ.

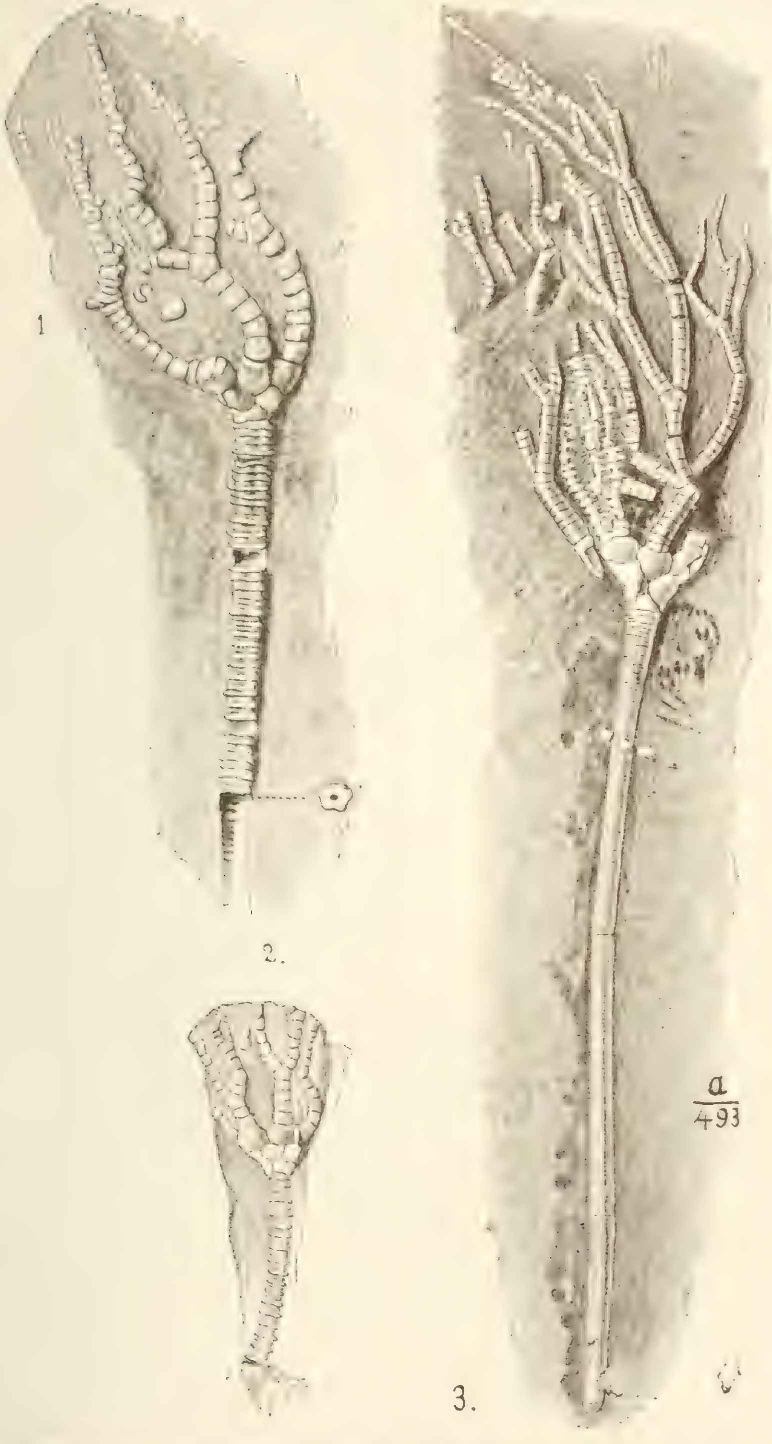
I therefore hold that the respiratory organ in Scutigera holds a position intermediate between the tracheæ of Myriapods and the lungs of Spiders. I hold with A. Leuckart ('Zeitsch. für wiss. Zool.' vol. i. p. 246, 1849, "Ueber den Bau und Bedeutung der sog. Lungen bei den Arachniden") that the tracheæ have developed into the lungs of Spiders and Scorpions, and I think that the organs in question form a series of which the lowest term is the tracheæ, the next the organ of Scutigera, then the lungs of Spiders, and then of Scorpions.—*Proc. Roy. Soc.* No. 303, pp. 200, 201 (Nov. 26, 1891).



Benham del.

Mintern Bros. lith.

RHINODRILUS ECUADORIENSIS.



BOTRYOCRINUS QUINQUELOBUS AND MASTIGOCRINUS LOREUS.

MASTIGOCRINUS LOREUS.

A. T. Hollick lith. Mintern Bros. imp.

CYATHOCRINUS ACINOTUBUS, & C. VALLATUS.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 52. APRIL 1892.

XLI.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91.

By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. Alcock, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Continued from vol. viii. p. 362.]

[Plates XIV. & XV.]

Family **Psalidopodidæ**, fam. nov.

Olfactory flagellum of antennules simple. Mandible deeply divided into molar and incisive processes and furnished with a 2-jointed palp. The exopodite of the first maxillipede is a broad and abruptly incurved falciform plate which does not terminate in a flagellum, and is not expanded at the outer margin into a process. The exopodites of the second and third maxillipedes are undivided, porrect, and membranous flagella. The thoracic appendages from the second to the eighth inclusively have the third (ischiopodite) and fourth (meropodite) joints fused, and are hence all 6-jointed with the exception of the third pair, in which the sixth and seventh joints are in addition fused, and there are hence only five distinct joints; those of the fourth pair are formed as in the Crangonidæ, but, instead of terminating in a subchela, end in two equal and movable blades forming a scissors-like organ; those of the fifth pair, which are the shortest and weakest of the limbs, bear a probably expansile pencil of setæ at the distal end of the propodite, which is the functional last joint of the limb, the dactylopodite being reduced to a minute rudiment; the sixth, seventh, and eighth pairs form a backwardly increasing series of walking legs; the five last pairs are devoid of all traces of epipodites and exopodites.

The thorax is firmly articulated to the abdomen by a strong hinge.

In addition to the functional gills, which are five pleurobranchiæ attached to the posterior thoracic somites from the tenth to the fourteenth inclusively, there is present, on the arthrodial membranes of the thoracic appendages from the ninth to the thirteenth inclusively, a series of five small conical papillæ, which correspond both in number and in position to the arthrobranchiæ of the Glyphocrangonidæ, and are, there is little doubt, to be interpreted as vestiges of gills of the same category.

The body is exceedingly spiny and terminates in front in a powerful recurved rostrum, which is toothed on all its four margins.

PSALIDOPUS, gen. nov.

Body moderately compressed, in shape somewhat like *Palæmon*. Integument firmly chitinized though thin, covered throughout dorsally, from the apex of the rostrum to the end of the sixth abdominal somite, with long symmetrically arranged needle-shaped spines, and between the spines with microscopically small setæ, which are evenly and regularly distributed, and give to the surface a minutely granulated appearance up to the base of the caudal swimmeret, upon which they become developed into a furry pubescence.

The carapace is produced in front into a long ascendant curved rostrum fully twice its own length measured from the frontal to the posterior margin in a straight line; its anterior margin is armed on both sides with four spines, which may be termed the antennulary, antennal, branchiostegal, and subbranchiostegal spines respectively, and with a stout blunt subtriangular deflexed process, against the inner margin of which the rudimentary eye-peduncles are firmly retracted;

a distinct marginal raised rim extends from the subbranchiostegal spines backwards on each side, increasing towards the posterior margin, being especially well-marked posterolaterally, where it rises into a strong and bold ridge, forming at each end of the carapace the posterior boundary of a deep groove; the ridge with the groove concentric therewith constituting the thoracic element of a strong thoracico-abdominal hinge.

The branchiostegites are abruptly inflected, and their free margins, which are closely applied to the bases of the legs, are widely but obtusely angulated inwards opposite to the interval between the first and second pairs of legs anteriorly, while posteriorly they give off a triangular process which abuts against the posterolateral face of the eighth thoracic sternum, and thus serves not only to keep the two elements of the thoracico-abdominal hinge in constant relation of apposition with one another, but also to divide that which answers to the afferent branchial cleft in *Astacus* into two parts, an inferior and a superior: in the former of these the free margin of the carapace is in such close contact with the leg-bases as to leave no passage for water to enter; the latter, on the contrary, is a wide and rigidly-patent oval aperture placing the branchial chamber of its own side in direct communication with the subabdominal cavity, and forms the exclusive inlet for the water required for respiration: whence it follows that all the water which enters the branchial chambers must do so by way of the subabdominal cavity, and that during life a constant circulation must be maintained in this cavity; in the female, in which the special afferent branchial apertures are larger than in the male and the subabdominal cavity forms a spacious brood-pouch, the constant circulation of water in the latter must secure a more perfect aeration of the eggs than would otherwise occur; there is no doubt, in fact, that we have here to do with a mechanism for securing the due aeration of the eggs similar to that which exists in *Encephaloides Armstrongi* and other deep-water Brachyura (Ann. & Mag. Nat. Hist. (6), vii. pp. 259, 266, et 267), wherein the branchial cavities communicate with the brood-cavity by means of canals in the hinder angles of the cephalothorax and, the ordinary direct channels being closed, water for respiration is derived from the brood-cavity.

The rostrum is compressed, and presents four longitudinal spiny ridges—one dorsal, two lateral, and one ventral; the spines of these are all sharp, slender, forwardly curved and inclined, and decrease in length from the base towards the obsoletely bifid apex of the rostrum. The dorsal ridge is continued to the posterior margin of the carapace; its spines are larger, more compressed, and less inclined, though more curved, than those of the rostrum, and subequal, with one or two shorter and slenderer ones intercalated between them here and there. In addition to the dorsal ridge the carapace bears on each side four other longitudinal rows of spines: the first of these runs quite close and subparallel to the dorsal ridge from one end of the carapace to the other; the second commences with the antennulary spine, curves slightly downwards and then slightly upwards to the cervical suture, whence it takes a straight course to the hinder margin, running parallel to the dorsal ridge; the third consists of the antennal spine and of two spines on the posterior half of the cephalic portion of the carapace; the fourth, of five or six spines commencing with the branchiostegal spine, and runs along the middle of the prominent efferent branchial canal, and like the second has its spines connected by a ridge.

The surface of the part of the branchiostegite coinciding with the subjacent branchial chamber is raised into a longitudinally oval convex-topped elevation, which is fringed at the edges with strong spines and bears an irregular row of five or six along its middle. Between the branchial elevation and the almost horizontally inflected portion of the carapace are some smaller spines roughly in the same straight line with those on the efferent branchial canal.

The abdomen is armed along the middorsal line with a spiniferous ridge similar to that of the cephalothorax and extending almost without interruption from the base to the apex, being absent only in the basal half of the fifth tergum, on the sides of its terga and pleura with symmetrically arranged spines similar in form to those of the dorsal ridge, and on the edges of each of its pleura with several exceedingly long and slender needle-like spines, besides smaller ones; the number, form, arrangement, size, and direction of these spines, which vary within small limits in all of the above respects from specimen to specimen, will be best understood by reference to the accompanying figures. The first abdominal somite is produced in front on each side at the junction of the tergum with the pleuron into a short, stout, bifid, and incurved process, which forms the abdominal element of the thoracico-abdominal hinge, and is received into the groove in the hinder margin of the side of the carapace already described. The pleura of the second abdominal somite are much more expanded in the female than in the male. The telson is elongate-triangular or obclavate in outline, its margin being at first rounded and then tapering in straight or very slightly concave lines to the triangular apex; its dorsal surface, which is covered with a furry coating of minute appressed spinules, is transversely convex and traversed longitudinally by a deep groove, while its ventral surface is deeply excavated gutter-like and glabrous.

The eye-peduncles are very small and immovably retracted outwards against the extraorbital angle, being ankylosed at base to the ophthalmic sternum; a distinct constriction limits off a wider and almost spherical apical or corneal portion from a narrower basal portion; the latter bears on its inner and inferior side, near the base, a minute papilla; the corneal portion is smooth and polished, and does not exhibit the slightest trace either of superficial faceting or of subjacent pigmentation; the eyes appear, in fact, to be in exactly the same degenerate condition as those of *Nephropsis Stewarti*, and it is certain can be capable at most of appreciating differences in the intensity of the light.

The peduncle of the antennules is subcylindrical; its first joint is about equal to the two remaining joints taken together, crested on the infero-internal margin, the crest running into an acicular spine some distance from the apex, and produced at its outer base into an oval digitate scale-like process; the second and third joints subequal, the latter armed with an acicular spine about the middle of its extero-superior face; flagella equal in length, the outer the thicker (much the thicker in ♂), and bearing olfactory filaments to within a short distance of its extremity.

The second joint of the antenna is armed with three spines on the outer apex; the scale is a narrow, firmly chitinized, oblong plate, with an acute triangular somewhat inturned point; it is strengthened and stiffened not only by its greatly thickened outer margin, which terminates some distance from the apex of the part in a prominent spine, but also by a stout midrib and a slight thickening of the apical and inner margins. The flagellum is very long.

The mandible is very distinctly divided into molar and incisive processes by a deep and almost rectangular notch, in which the palp is lodged. The incisive process is a thin, excessively sharp, and slightly recurved knife-like plate. The stout molar process may be described either as an irregular four-sided prism with one angle broadly rounded off or as an irregular three-sided prism with one side convex; its trapezoidal or subtriangular masticatory surface is concave with sharp edges. The palp is robust, two-jointed; the apex, with the greater part of the inwardly directed outer edge of its oval terminal joint, is beset with stiff setæ.

The coxopodite of the first maxillæ is much shorter and wider than the basipodite; the endopodite is a short, simple, and undivided finger-shaped joint with a few setæ on its outer apex, and the exopodite appears to be represented by a firmly chitinized round conchoidal plate, the convex face of which is turned downwards and backwards.

The coxopodite of the second maxillæ is but little shorter but much narrower than the basipodite, not extending nearly so far towards the middle line; the basipodite is subdivided; the endopodite differs from that of the first maxillæ only in being somewhat larger; the anterior lobe of the scaphognathite is much broader than the posterior lobe, in which the apical fringe is developed into excessively long and fine setæ.

In the first maxillipedes the coxopoditic plate is rudimentary and furnished with limp hairs, the functional jaw being entirely formed by the basipodite; the endopodite is a narrow slightly curved and knife-like pointed plate, the exopodite is a broad and abruptly incurved falciform plate, and the epipodite is two-leaved.

The second maxillipedes have only five distinct joints, the third and fourth joints of the typical malacostracous limb being indistinguishably fused together; the first joint bears a triangular epipodite, the second a long, tapering, undivided and membranous exopodite, the third is about as long as the second, but only about half its thickness, the fourth is short, about half as long as the third, the fifth is broadly subtriangular and does not enter into the formation of the functional jaw, which is wholly formed by the very short and broad wedge-shaped sixth joint.

The external maxillipedes present only five distinct joints, the sixth and seventh, as well as the third and fourth, joints being indistinguishably fused together. The first and second, which are ankylosed together, are short, stout, and subequal: the first bears a small oval and subpedunculated hard process, probably representing an epipodite; the second, a flagellar exopodite, similar to that of the second maxillipedes; the third joint, forming the functional jaw, is an obclavate compressed sclerite, and is strongly curved to the configuration of the underlying appendages; its inner margin bears no fringe of setæ; the fourth and fifth joints are slender, cylindrical, and fringed with narrow, transverse, scale-like rows of setæ on the inner edge; the fourth is a little shorter than the third and exactly half of the fifth, which latter is almost straight, and tapers beyond the middle of its length very slightly and gradually to a bluntish point bearing a few stiff setæ.

The legs of the first pair are built upon the same plan as those of the Crangonidæ, which they closely resemble, and from which they chiefly differ in their scissors-like extremity. They present but six distinct true joints, one of the blades of the terminal scissors having to be interpreted as a movably articulated prolongation of the propodite, and the third and fourth joints being all but indistinguishably fused together. The first two joints are short. The third joint, which is strongly curved like the corresponding joint of the external maxillipede, increases slightly in thickness from the base to the apex, where its upper margin is prolonged into a sharp needle-like spine preceded by a few spinules. The fourth joint, short and obconic, also bears a similar spine in corresponding position. The fifth joint, or propodite, is oblong and somewhat compressed, it bears at the distal end two equal and movably articulated toothed knife-like blades—one answering to the fixed prolongation of the propodite, the other to the dactylopodite of the typical crustacean chela,—which are evidently capable of playing upon one another like the blades of a pair ot scissors or shears.

The legs of the second pair are also only six jointed, the third and fourth joints being all but indistinguishably fused together. They differ remarkably in form from the preceding. The first two joints are as in the legs of the first pair. The third joint is a cylindrical rod armed with a few minute spinules on the upper margin, which terminates in a sharp spine. The fourth joint is also cylindrical, but shorter and much thinner than the preceding, and unarmed. The fifth joint, likewise cylindrical, is about half as long as the preceding and tapers slightly to its apex, where it bears a compactly coned pencil of possibly expansile setæ. The sixth joint is a minute, transversely elongated, nodular rudiment, lodged in a notch of the upper and outer margin of the distal end of the propodite.

The three remaining pairs of legs are quite different from their predecessors, and are substantially alike, differing from one another only in length and in the degree to which the fusion of their third and fourth joints has been carried. They are typical ambulatory limbs. The second only slightly exceeds the first, while the last, owing mainly to the great elongation of its propodite, greatly exceeds the second in length. They are roughly cylindrical and are armed below and on the contiguous parts of their sides throughout with sharp spinules, which in the fourth joint or meropodite assume an arrangement in two rows on the ventral edges of the joint, while the apices of the meropodite and of the obconic carpopodite each bear one median dorsal and at least one lateral outstanding spine larger than the rest. In the last of these legs the third joint is fixedly united to the fourth, the division between the two perfectly retaining its primitive distinctness; in the second the union is more perfect, but the division may be readily made out on the inner side; while in the first the union is more perfect still, and the primitive distinctness of the parts is scarcely traceable; so that the fusion of the two joints in question becomes more and more perfect as we pass from behind forwards until at last it is no longer possible to distinguish them. The compound joint is curved, like its predecessors in the series, to fit the convex ventral surface of the thorax. Their terminal joint forms a stoutish curved and acuminately-pointed claw. There is no trace either of epipodites or of exopodites on any of the legs.

The protopodites of the abdominal appendages are long, being more than half the length of the rami in the first pair, and less than half their length in the succeeding pairs. The apical half more or less of their carinated outer margin is armed with small spines, which increase in length towards the apex, near to which there is usually a single spine that is much larger than the rest. Near their base on the posterior face a transverse suture divides them into a long distal and a short and incomplete proximal joint. Their rami are all long-lanceolate and undivided membranous plates, with the exception of the inner ramus of the first pair; this is in both sexes only about one third the length of the outer and is pyriform or obclavate in outline; flat and flexible and fringed with setæ on both edges in the female, it appears convex and stiff and glabrous and somewhat subulate or acuminate in the male, owing to the apical half more or less of its edges being folded up into a sort of tube, and owing to the fringe of its outer margin being reduced to short and simple setæ; the outer ramus of the first pair is in both sexes narrower than either of the rami of the succeeding pairs. In the appendages of the second to the fifth pairs inclusively the inner ramus is shorter and narrower than the outer, and is furnished near its base on the inner side with a short cylindrical *appendix interna*, provided at its apex with minute hooks for attachment to its fellow of the opposite side. In the second pair in the male there arises from the inner ramus, in front of and slightly internal to the *appendix interna*, a tapering finger-shaped *appendix masculina*, and the second joint of the protopodite is subdivided by a false joint into two approximately equal parts.

The rami of the sixth pair of abdominal appendages are firmly chitinized, rigid, oval plates, the outer almost twice the width of the inner; the former is strengthened by a stout midrib and by a thickening of the outer margin, which terminates a good way from the apex in a prominent spine of the same size and character as that of the antennal scale; an inflexible diæresis extends inwards from the base of this spine up to the midrib. The inner ramus is strengthened by a similar midrib, from near the base of which a ridge extends obliquely inwards and backwards to the inner margin.

The legs of the first to the third pairs of opposite sides touch one another in the middle line, and their sterna are hence invisible without dissection; those of the last two pairs, on the contrary, are wider apart and their sterna are plainly visible and have the form of an inverted T, the cross stroke of which is, in the hinder and larger of the two, produced forwards, between the bases of the legs of the last pair and over its own down-stroke, as an acute angular (♂) or semicircular (♀) plate, beneath the sides of which the genital apertures can in the male be concealed.

The branchial formula is as follows:—

Somites and their appendages.	Podobranchiæ.	Arthrobranchiæ.	Pleurobranchiæ.	
VII.	0(*ep.*)	0	0	$=0+ep.$
VIII.	0(*ep.*)	0	0	$=0+ep.$
IX.	0(*ep.r.*)	*r.*	0	$=0+r.+ep.r.$
X.	0	*r.*	1	$=1+r.$
XI.	0	*r.*	1	$=1+r.$
XII.	0	*r.*	1	$=1+r.$
XIII.	0	*r.*	1	$=1+r.$
XIV.	0	0	1	$=1$
	$2ep.+ep.r.$	$+5r.$	$+5$	$=5+5r.+2ep.+ep.r.$

35. [*Psalidopus Huxleyi*, sp. n. (Pl. XIV. figs. 1, 2, 7.)

♀. Stouter. Thoracic and abdominal sterna unarmed. No tubercle between the last spine of the dorsal ridge and the posterior margin of the carapace.

Colour in life brilliant old-ivory white or straw-colour.

	millim.
Total length from apex of rostrum to tip of telson in a straight line	141
Length of rostrum from supra-orbital margin in a straight line	51·5
Length of carapace from supra-orbital to posterior margin	28·5
Length of abdomen from middle of anterior margin of first tergum to tip of telson	63
Length of telson	19·5
Length of antennal scale	21
Width of ,, ,, ...	6
Length of antennulary flagella	37

A single ovigerous female was taken on April 12, 1888, 7½ miles east of N. Cinque Island, Andaman Sea, in 490 fathoms.

It carried twelve very large eggs, which in spirit measure no less than 3·8 × 2·7 millim.]

36. *Psalidopus spiniventris*, sp. n.
(Pl. XIV. figs. 3–6 *a*, 8; Pl. XV. figs. 1–10.)

♂ ♀. Slenderer. Two posterior thoracic and all the abdominal sterna with an erect spine in the middle line. A conical tubercle between the last spine of the dorsal ridge and the posterior margin of the carapace.

Colour in life deep-sea pink with white points.

	Male. millim.	Female. millim.
Total length from apex of rostrum to tip of telson in a straight line	106	128·5
Length of rostrum from supra-orbital margin in a straight line (tip gone in male)	40	51·5
Length of carapace from supra-orbital to posterior margin	20	25
Length of abdomen from middle of anterior margin of first tergum to tip of telson	47	59
Length of telson	15	18
Length of antennal scale	16	19
Width of ,, ,,	3·3	5
Length of antennulary flagella	37	35

An adult male and female, with one young specimen, were obtained at Station 116, 405 fathoms.

A small pair, in which the rostrum is much larger in the female than in the male, have come to light in the sorting of past seasons' collections. They were taken 8 miles S.E. of Cinque Island, Andaman Sea, in 500 fathoms.

Colour in life "more of a boiled lobster tint" [*i. e.* than other Crustaceans obtained at the same time and described in the same notes as pink and blood-red], "deepest on the spines" (*G. M. Giles*).

EXPLANATION OF THE PLATES.

Plate XIV.

Fig. 1. *Psalidopus Huxleyi*, ♀, from the left side. Nat. size.
Fig. 2. The caudal swimmeret of the same, from above. Nat. size.
Fig. 3. *Psalidopus spiniventris*, ♀. Peduncle of the left antennule, from above. ×4.
Fig. 4. Left antennal scale of the same, from above. Nat. size.

Fig. 5. Left leg of the first pair of the same, from the outside. ×4.
Fig. 6. Left leg of the second pair of the same, from the outside. ×4.
Fig. 6 *a.* Apex of propodite of same, to show the rudimentary nodular dactylopodite.
Fig. 7. *Psalidopus Huxleyi*, last thoracic sternum with bases of legs of last pair of female. Nat. size.
Fig. 8. *Psalidopus spiniventris*, last thoracic sternum with leg bases of male. Nat. size.

PLATE XV.

Figs. 1, 1 *a.* *Psalidopus spiniventris*, mandible. ×5.
Fig. 2. First maxilla. ×5.
Fig. 3. Second maxilla. ×5.
Fig. 4. First maxillipede. ×5.
Fig. 5. Second maxillipede. ×5.
Fig. 6. Third maxillipede. ×2.
Fig. 7. Left abdominal appendage of the first pair in female. ×2.
Fig. 8. Left abdominal appendage of the second pair in female. ×2.
Fig. 9. Left abdominal appendage of first pair in male. ×2.
Fig. 10. Left abdominal appendage of second pair in male. ×2.

XLII.—*Description of a new Genus and some new Species of Heterocera from Central America.* By HERBERT DRUCE, F.L.S.

Fam. Ægeriidæ.

ÆGERIA, Fabr.

Ægeria armasata, sp. n.

Primaries and secondaries hyaline, with a slightly yellowish tinge, the costal, outer, and inner margins of the primaries edged with yellowish brown, the veins of both wings yellowish brown, those of the secondaries being the darkest; the fringe of the secondaries dark brown. The underside of both wings light yellow. The palpi and front of the head yellow; the antennæ dark brown, yellowish at the base; the thorax and abdomen blackish brown, with a yellow line at the base of the abdomen; the anal tuft yellowish brown; the legs orange, banded with black.

Expanse $1\frac{1}{4}$ inch.

Hab. Mexico, near Durango city (*Becker*).

A fine species, very distinct from all others known to me.

Ægeria mardia, sp. n.

This species is allied to *Ægeria tryphoniformis*, Walker, from which it differs as follows:—The primaries and secondaries are quite hyaline, with the streak at the end of the cell and the spot at the apex bright orange-red instead of pale yellowish brown; the head, thorax, and abdomen black instead of yellow, as in *Æ. tryphoniformis*; the anal tuft large and bright orange-red; antennæ black; palpi orange.

Expanse $\frac{3}{4}$ inch.

Hab. Mexico, near Durango city (*Becker*).

Melitta, Hübn.

Melitta Beckeri, sp. n.

Primaries greenish brown, very thickly irrorated with pale green scales, the fringe greenish brown: secondaries hyaline, with all the veins bright orange-red, the marginal line black, the fringe dark brown. The underside of the primaries pale yellow near the apex, which is greenish brown; the secondaries the same as above. The head and thorax greenish brown, the same colour as the primaries; the palpi yellow; antennæ black; the abdomen blackish brown; the anal tuft yellow; the hind legs long and very thickly clothed with hair, that nearest the base on the outer side being pale yellow, that on the tibia and tarsus black on the inner side, bright orange on the outer side, almost white close to the ungues. The underside of the abdomen is banded with yellow.

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

Hab. Mexico, near Durango city (*Becker*).

This fine species is allied to *M. satyriniformis*, Hübn., from which it is at once distinguished by the orange-red veins of the secondaries and much paler green primaries.

Fam. Saturniidæ.

Metosamia, gen. nov.

Male.—Head rather small. Thorax broad. Abdomen short and thick, not extending to the middle of the inner margin of the secondaries. Antennæ very deeply pectinated, more so than in the genus *Samia*. Palpi very minute; legs stout and rather short, thickly clothed with hairs. Primaries with the costal margin very much arched from the middle to the apex, which is very pointed, the outer margin very deeply concave and dentated between the veins; the anal angle rounded; the inner margin straight; the cell very broad and much shorter than in *Samia*. Secondaries: the costal margin very much rounded to the apex, which is quite pointed; the outer margin deeply concave to the middle, then almost straight to the anal angle, dentated slightly between the veins; the inner margin slightly curved from the abdomen, the anal angle rounded.

Type *Metosamia Godmani.*

Saturnia montezuma, Sallé, will also come into this genus. Both species will be figured in the 'Biologia.'

Metosamia Godmani, sp. n.

Male.—Primaries and secondaries uniform bright orange-brown; primaries with nearly two thirds of the costal margin broadly edged with greyish brown, thickly irrorated with white scales; a large white spot at the base of the wing close to the thorax; a large V white mark at the base of the cell and a large hyaline oval spot at the end of the cell bordered with pale yellow and edged with a very fine black line; a pinkish-white line partly crosses the wing near the base; a rather wide black submarginal line edged with pinkish-white scales extends from the costal margin close to the apex to the inner margin just above the anal angle: secondaries crossed below the middle from the costal margin to the anal angle by a black line corresponding to the one on the primaries, but only edged with pinkish-white scales from the end of the cell to the anal angle; a small hyaline spot at the end of the cell broadly bordered with pale yellow, edged with a rather wide black line, the black line on the upperside being divided into two by a narrow line of bluish-white scales. Underside: both wings reddish brown, thickly irrorated round the outer margins and at the base of the secondaries with black and pinkish-white scales. The head, front of the thorax, and base of the tegulæ greyish brown, thickly irrorated with white hairs; the thorax, abdomen, tegulæ, and legs bright orange-brown; the antennæ pale yellowish brown.

Expanse 7 inches.

Hab. Mexico, Oaxaca (*F. D. Godman*).

This very grand insect was obtained by Mr. Godman during his last visit to Mexico. I at first thought it might possibly be the species described by Sallé as *Saturnia montezuma*; but having recently received a careful drawing of that species made from the type, and since then a very fine specimen of that species, it at once proved that the insect I have very much pleasure in naming after Mr. Godman is exceedingly distinct.

TELEA, Hübn.

Telea aurelia, sp. n.

Male.—Primaries and secondaries pale fawn-colour; primaries crossed from the costal to the inner margin by a very wide black band, edged on both sides with a waved black line, which is edged on the inner side with pink and white scales; the costal margin thickly irrorated with white scales from the base almost to the apex; the apex streaked with pink and white, with a rather large black spot on the costal margin; a large hyaline spot at the end of the cell, bordered with reddish fawn-colour and then broadly with black, the basal half of the black ring being thickly irrorated with bluish-white scales; a narrow, straight, fawn-coloured line extends from the costal margin close to the apex to the inner margin above the anal angle: secondaries, the central part of the wing dusky black; a large hyaline spot at the end of the cell very broadly bordered with deep black, which is thickly irrorated on the inner side with pale blue scales; a submarginal pale fawn-coloured line extends from the costal margin to the anal angle. Underside pale fawn-colour, thickly irrorated with white scales, with the markings very similar to those above, but of a dark brown colour. The head, underside of the thorax, and legs dark brown; the collar and front of the thorax greyish white, the thorax and abdomen pale fawn-colour; the antennæ yellowish brown.

Expanse $5\frac{3}{4}$ inches.

Hab. Mexico, near Durango city (*Becker*).

This species is very distinct from any known to me.

Fam. **Hepialidæ.**

PHASSUS, Walker.

Phassus marcius, sp. n.

Primaries pale greyish brown, thickly marked with grey and darker brown lines; a double row of blackish-brown elongated spots crosses the wing from the costal margin near the apex to the inner margin, and a row of elongated curved lines extends round the outer margin from the apex to the anal angle; a rather long metallic gold streak broken into three spots at the end of the cell, beyond which, nearer the outer margin, are two very minute metallic gold dots: secondaries pale greyish brown, palest at the base, with several indistinct darker markings on the costal margin close to the apex. The head, thorax, and abdomen pale greyish brown.

Expanse $4\frac{2}{10}$ inches.

Hab. Mexico, near Durango city (*Becker*).

A fine distinct species, allied to *P. argentiferus*, Walker.

XLIII.—*Observations on the Dentition of Mammals* *. By W. Kükenthal †.

We do not yet possess a satisfactory explanation of the tooth-change of Mammals, as was shown by M. Schlosser ‡ only a short time ago.

The conjecture that both series of teeth have been derived from the Reptiles is at once opposed by a number of statements, according to which in the lower orders of Mammals tooth-change is either entirely absent, or, as in the case of the Marsupials, is confined to one premolar. Flower's § hypothesis, afterwards considerably expanded by Oldfield Thomas ‖, that the milk-dentition represents a fresh acquisition on the part of the higher Mammals, and that the permanent series alone is the original one, could therefore be supported by many weighty reasons. From among the large number of views which differ from this in more or less material points, I will here merely allude to that of Baume ¶, according to which both series of teeth have had merely a secondary origin. For Baume supposes that owing to the shortening of the jaws which set in in the course of the evolution of Mammals, the originally numerous and similar teeth could no longer find room in one series, so that a portion of them became displaced and were able to appear only later on, as the permanent dentition.

* I intend to give a detailed exposition of the present investigations in the second volume of my 'Vergleichend-anatomischen und entwickelungsgeschichtlichen Untersuchungen an Waltieren' (Denkschriften der mediz.-naturw. Gesellschaft in Jena, Bd. iii.).

† Translated from a separate impression from the 'Anatomischer Anzeiger,' vi. Jahrgang (1891), no. 13, pp. 364–370.

‡ M. Schlosser, "Die Milchbezahnung der Saugetiere," Biolog. Centrabl. 1890.

§ W. H. Flower, "On the development and succession of the Teeth in the Marsupialia," Phil. Trans., 1867.

‖ O. Thomas, "On the homologies and succession of the Teeth in the Dasyuridæ, with an attempt to trace the history of the evolution of the Mammalian Teeth in general,' Phil. Trans. vol. 178, pp. 443–462.

¶ Baume, "Versuch einer Entwickelungsgeschichte des Gebisses": Leipzig, 1882.

Baume, like many other investigators, therefore regards as the original form a dentition consisting of numerous similar teeth, and consequently starts from the Edentates and especially the Toothed Whales as the primary type; I therefore commence by examining the latter.

Toothed Whales: The Toothed Whales are very generally considered as homodont; Weber*, however, is right in considering the tusk of the Narwhal and the lower canine of the Ziphioids to be vestiges of a former dissimilarity of dentition. In an embryo of *Phocæna communis* of nearly full time, I find a heterodont dentition tolerably sharply marked, since out of the twenty-five teeth in each half of the jaw, the posterior seven have two and sometimes three cusps.

If on the one hand it is open to doubt whether the Toothed Whales have an entirely homodont dentition, nevertheless on the other it has been regarded as an absolutely certain fact that the Toothed Whales are monophyodont, and that the single series of teeth which appears belongs to the permanent dentition. Weber, who adopts afresh an idea previously expressed by Julin†, is alone in suggesting the hypothesis ‡, that the dentition of the Toothed Whales comprises both series of teeth, which, owing to the enlargement of the jaws, were all able to appear at the same time.

My investigations in this direction so far embrace a considerable number of embryos of *Beluga leucas*, *Globiocephalus melas*, and *Tursiops tursio*; this is what I have discovered: The dentition of the Toothed Whales is a true milk-dentition, or, better, it belongs to the first dentition, which is permanent. Irrefragable proof of this is furnished by the appearance of rudiments of second teeth internally to those which persist; it is true that the former are considerably smaller and do not reach the surface, but they nevertheless possess a distinct crown of enamel, and even the characteristic enamel pulp.

In the Toothed Whales, therefore, the germs of both dentitions are found, and this cuts the ground from beneath those hypotheses which start from them as typical monophyodont animals; Weber's hypothesis, also, is no longer tenable.

Whalebone Whales: The Whalebone Whales, for which, since they have genetically nothing to do with the Toothed Whales, I claim a special order within the Mamma-

* Weber, 'Studien über Säugetiere': Jena, 1886, p. 196.

† Ch. Julin, "Recherches sur l'ossification du maxillaire inférieur, et sur la constitution du système dentaire chez le fœtus de la *Balænoptera rostrata*," Arch. de Biologie, 1880.

‡ Weber, *op. cit.* p. 134.

lian class *, have, as is well known, germs of teeth in the first third of their fœtal life; these are subsequently absorbed. Among recent investigators Julin † and Weber ‡ widened the difference which Eschricht § previously stated to exist between the nine anterior teeth and the posterior ones, by affirming that the latter are not simply conical but have several cusps, and that the dentition is absolutely heterodont.

My own investigations were carried out upon thirty different specimens of large jaws of fœtal Whalebone Whales, including *Megaptera boops*, *Balænoptera rostrata*, *Balænoptera Sibbaldii*, and *Balænoptera musculus*, which were partly preserved whole and partly divided into series of sections made in the three chief directions. In the first place I dispute such a difference as has been stated to exist between the nine anterior and the posterior teeth; the appearance of teeth which seem to have several cusps is, in my preparations ot older jaws, occasioned by the process of absorption, which begins at the tip ||. The posterior teeth are somewhat more convex than the anterior ones, but throughout are simply conical, with the exception of cases, which are of quite isolated occurrence, where a pair of neighbouring teeth are apparently fused together. The position of double teeth of this kind (three separate teeth or even four may also be united together) scarcely follows any definite rule; in a few cases they also occur among the first nine teeth, and even on this account they cannot correspond to the supposed molars, according to Julin's interpretation. Are these double teeth secondary fusions, or do they represent primitive conditions? Embryology furnishes the answer. A series of seven embryos of *Balænoptera musculus*, measuring from 43 to 82 cm. in length, shows that the number of the double teeth diminishes considerably with increasing growth, while the number of the separate tooth-tips in each half of the jaw remains constant at fifty-three. In the youngest stages nine or even fifteen teeth are fused together; in the following ones five, four, and three, and in the oldest only two. The same result, the diminution of the double teeth with increasing growth, is furnished by the comparison of younger and older embryos of other species of Whalebone Whales. It follows from this

* W. Kukenthal, "Ueber die Anpassung von Säugetieren an das Leben im Wasser," Zoologische Jahrbücher, 1890; Ann. and Mag. Nat. Hist. ser. 6, vol. vii. pp. 153–179.

† Julin, *loc. cit.*

‡ Weber, *loc. cit.*

§ Eschricht, 'Untersuchungen über die nordischen Waltiere': Leipzig, 1849.

|| *Vide* also Pouchet et Chabry, "Sur l'évolution des dents des Balænides," Compt. Rend. Ac. Sc. Paris, tome 94, no. 8, pp. 540–542.

that the double teeth represent an original condition, and are therefore to be regarded as molars, and further that CONICAL TEETH, WITH SINGLE TIPS, ARISE FROM MOLARS BY DIVISION. We have thus learnt a method by which numerous homodont teeth arise from a small number of heterodont molars. I shall subsequently adduce the palæontological facts which substantiate such an origin of homodont from heterodont dentitions; I would here only further allude in all brevity to an analogous phenomenon which occurs in a Bearded Seal (*Phoca barbata*) from Spitzbergen.

Owing to mechanical causes (hard food, consisting of mussels, besides the final reason, which is the incomplete calcification of the teeth) the molars in the specimen before me have worn away, and, with the exception of the last, have each become more or less completely separated into two, which present an absolutely similar appearance; instead of five molars, we consequently find seven and eight unicuspid teeth.

The results of my embryological investigations decide the question whether the teeth of Whalebone Whales belong to the first or the second series, in so far as they show that rudiments of a second series of teeth are still present; the cord of epithelium in question is for the most part fused with the enamel-germ of the actual tooth, which therefore essentially corresponds to the first series. The teeth belonging thereto resemble in this the so-called true molars of all other mammals, which, as they have no precursors in the milk-dentition, are assigned to the second series, although they must be regarded as having arisen from the fusion of the rudiments of both dentitions. (In the case of the first molar this is often still distinctly demonstrable; it is to be seen with especial clearness in embryos of *Spermophilus leptodactylus*, for instance.)

I refer the peculiar transformations of the dentition in pelagic mammals, which have just been described, to mechanical causes, terminating with diminished calcification, which, as being necessary for the diminution of the specific gravity, is a phenomenon of very frequent occurrence in pelagic mammals, and, as has already been shown, also gave the first stimulus which led to the occurrence of hyperphalangy, as well as the loss of the dermal armature of the Toothed Whales*.

* In my paper on the "Adaptation of Mammals to Aquatic Life" (Zool. Jahrbücher, 1890 [Ann. and Mag. *loc. cit.*]), I explained these views in greater detail. Of the former presence of a dermal armature in Toothed Whales, which I inferred from grounds of comparative anatomy and embryology (Anat. Anzeiger, 1890, p. 237), I am now able to adduce palæontological proofs also.

EDENTATES: embryos of *Dasypus novemcinctus* exhibit the typical formation of successors for the first seven teeth; a successor is wanting only in the case of the last tooth. The occurrence of tooth-change in this animal has already been demonstrated by Tomes. Moreover in the lower jaw of the embryos I find not eight teeth, but eleven, of which the three first are smaller and do not cut the gum. I am now also able to mention a second Edentate which has rudiments of two dentitions: this is *Dasypus villosus*. This phenomenon consequently appears to be of very general occurrence among the armadilloes. Whether actual tooth-change really takes place is of no consequence for my purpose; I merely affirm the presence of rudiments of milk and second teeth.

MARSUPIALS: Flower, who was afterwards followed by Thomas, bases his hypothesis that the milk-dentition is a secondary acquisition on the part of the higher mammals, on what takes place in Marsupials, in which either no tooth-change or only the change of a third premolar occurs. The dentition of Marsupials is very generally assigned to the second series, and the precursor of the third premolar regarded as a milk-tooth. My own investigations upon this group have so far extended only to the study of a series of young specimens of *Didelphys* of different sizes. On the basis of these investigations I assert that THE PERMANENT SET OF TEETH IS TO BE ASSIGNED TO THE MILK, OR FIRST DENTITION, and that only one second tooth, the subsequent third premolar, occurs. I can easily furnish the proof of this, as soon as it is granted, that the two dentitions are also distinguishable from the point of view of morphology, besides being so from the physiological standpoint of the difference in the time of their appearance. The rudiments of the two dentitions, which have a common origin in the primitive dental fold, are so disposed, that the first set of teeth is developed from the outer one, and the second from the inner. Now my preparations show that this is the case not only in the third premolar, but that the tooth-rudiments lying in front of it, especially those of the incisors, also possess on the inner side, branching off from the neck of the epithelial invagination, a distinct twig of epithelium with a knobbed end; and this must be regarded as the earliest rudiment of the enamel-organ of the second tooth. It at all events follows from this that the entire dentition of the opossums is to be ascribed to the first and not to the second series. The mainstay of the hypothesis of Flower and Thomas, that the milk-dentition has been secondarily acquired by the higher mammals, is thus destroyed.

The following conclusions result from the foregoing investigations into the dentitions of mammals. The rudiments of both dentitions occur not only in the higher mammals, but also in the lower orders of Marsupials, Edentates, Odontocetes, and Mystacocetes. THE EARLIEST MAMMALS WERE DIPHYODONT. The monophyodont and homodont condition of many mammals, *e. g.* the Toothed Whales, has been secondarily acquired. Within the mammalian class, ascending from the lowest to the highest forms, we see how the second dentition gains the upper hand more and more as regards form and function, while in the lower forms the first dentition is predominant. In the rudimentary stage both dentitions are of equal value; embryology gives us no support for the often-expressed assertion that one of the two dental rudiments has arisen in dependence upon the other; they are both sisters, whose mother is the simple invagination in the jaw, which we term the dental fold ('Zahnleiste').

Now can we discover a bridge which connects the dentition of Mammals with that of their ancestors, the Reptiles?

There are no absolute differences between the mammalian and reptilian tooth, as has already been shown by Seeley *; not one of the characters of the mammalian tooth is perfectly constant; the loss of any one of them is an approximation to the reptilian tooth, and conversely reptilian teeth often assumed characters belonging to those of mammals. The replacement of teeth moreover occurs in reptiles to a still greater extent than in mammals, since several series of teeth may follow one another, the rudiments of which, as in the case of the second dentition of mammals, are formed internally to the first. The idea of deriving the dentition of mammals from that of reptiles therefore does not appear to me to be too hazardous; of the several series of teeth which are found in reptiles, only two still persist in mammals.

In conclusion I would subjoin the following attempt to explain the origin of molar teeth in mammals, while freely admitting its purely hypothetical nature. Owing to our investigation of tooth-germs in Whalebone Whales, we have become acquainted with the phenomenon of the division of the molars in mammals, whose jaws become elongated, into a multitude of conically pointed structures, resembling the teeth of reptiles. Conversely, have not the molars of mammals also arisen in this way, in that, in consequence of the reverse process, a shortening of the jaws, which the ancestors of existing mammals underwent in the course of their trans-

* H. G. Seeley, "On the Nature and Limits of Reptilian Character in Mammalian Teeth," Proc. Roy. Soc. Lond. vol. xliv. pp. 129-141.

formation from reptile-like progenitors, a number of simple, conical reptile-teeth came together to form each mammalian molar? Palæontology is in favour of my view; the oldest known mammals, e. g. *Triconodon* from the Upper Jura, exhibit molars of the typical structure requisite for our idea, each consisting of three similar conical tooth-segments, lying one behind the other and fused together. The admirable papers of Cope, Osborn, Schlosser, and others have shown that from the triconodont, that is the tricuspid type, the molars of all mammals may be derived.

A multitude of questions as to the specialization of the teeth within the various orders, the teeth with continuous growth, the formation of roots, &c., still remain to be answered; I shall make the attempt to do this in a detailed account of my investigations.

Jena, June 5, 1891.

XLIV.—*The Dentition of* Didelphys: *a Contribution to the Embryology of the Dentition of Marsupials* *. By W. Kükenthal †.

In the case of *Didelphys* the dental formula $\frac{5}{4}\ \frac{1}{1}\ \frac{3}{3}\ \frac{4}{4}$ is very generally accepted. The tooth-change is limited to one tooth, the last premolar, as was first discovered by Gervais and Flower to be the case in Marsupials. By this discovery the older view that in Marsupials the whole of the teeth are replaced with the exception of the four molars was finally overthrown. The question, however, now arose as to how the dentition of Marsupials was to be regarded, *i. e.* whether it corresponds to the milk-dentition or to the permanent series of other Mammals. While Owen was rather inclined to adopt the former view, the latter was maintained by Flower,

* Translated from a separate impression from the 'Anatomischer Anzeiger,' vi. Jahrgang (1891), nos. 23 and 24, pp. 658–666.

† In a paper which was recently published in this periodical, entitled "Einige Bemerkungen über die Säugetierbezahnung" (Anat. Anz. 1891, p. 369 [*vide suprà*, "Observations on the Dentition of Mammals," pp. 279–285]), I have already alluded to the chief result of my investigations, which formed the subject of an address delivered on the 30th of May of the present year in the Aula of our University. But, in consequence of the delay which has arisen in the setting-up of my detailed statements owing to the compositors' strike, I am now induced to give herewith a somewhat closer proof of my assertions, at least as regards the Marsupials.

thus laying the foundation of the theory that the milk-dentition has been secondarily acquired by the Mammalia, and occurs in Marsupials only in a single case (the third premolar). Although Flower's deduction was by no means generally accepted, the conception of the Marsupial dentition as belonging to the permanent or, to speak more correctly, the second series of teeth, was universally adopted. Thus it is supposed by Winge *, who otherwise in opposition to Flower regards tooth-change as an old arrangement, inherited from the lower Vertebrates, that the milk-dentition in the Marsupials has been lost, with the exception of one milk-tooth, the precursor of the third premolar. A higher grade would therefore have to be assigned to the dentition of Marsupials than to that of the majority of Mammals. "But if, contrary to all probability, it should appear that the Marsupial teeth in question have never had precursors in the course of either ontogeny or phylogeny, they would correspond to the milk-teeth in other Mammals; but they would be milk-teeth developed to such an extent that in respect of their form &c. they would have to be compared with the teeth of the second series in other Mammals."

Our knowledge of the dentition of Marsupials received a further and very material advance in consequence of Oldfield Thomas's paper †, in which the homologies of the various teeth are determined and the typical Marsupial dentition stated as consisting of 5 incisors, 1 canine, 4 premolars, and 4 molars. Reduction set in, and gave rise to the dentition of the various Marsupials; that of *Didelphys* arose in consequence of the loss of the second premolar. The third premolar, which is provided with a precursor, should therefore really be termed the fourth premolar. Thomas follows Flower in regarding the milk-dentition as having been secondarily acquired within the Mammalian class, and consistently follows out this idea. He himself points out that, besides other things, the possible discovery of the rudiments of a successor in the case of Marsupial teeth which exhibit no tooth-change would be fatal to his theory.

It was this consideration which guided me in my own investigations. If in the course of development rudiments of second

* Herluf Winge, "Om Pattedyrenes Tandskifte, isaer med Hensyn til Taendernes Former." Vidensk. Meddel. fra den naturh. Foren. in Kjøbenhavn, 1882, p. 52.

† Oldfield Thomas, "On the Homologies and Succession of the Teeth in the Dasyuridæ, with an Attempt to trace the History of the Evolution of Mammalian Teeth in general." Philosophical Transactions of the Royal Society (London, 1887).

teeth should be present, internal to rudiments of teeth which are subsequently cut, the proof would thus be furnished that the series of teeth which arrives at development belongs not, as was hitherto generally believed, to the second, but to the first dentition. Thus it would be shown that the milk-dentition is not to be regarded as a new and secondary acquisition within the Mammalian class.

The very fact that the third milk-premolar is cut at about the same time as the other premolars, whereupon the molars appear, commencing from the first, and that the third premolar which replaces it develops much later than the other teeth, especially than its two neighbours*, gives ground for the conjecture that the third milk-premolar belongs to the same series as the rest of the teeth which are situated in front of it. This difficulty of regarding the third milk-premolar and the other teeth as belonging to two distinct series was felt by Winge, who believed he was able to remove it by explaining that the other teeth, in spite of belonging to the second dentition, are cut simultaneously with the single milk-tooth because their precursors are wanting. Perfect clearness is naturally attainable only by means of an embryological investigation. The material at my disposal consisted in the first place of a number of lower jaws of young stages of *Didelphys*, for which I am indebted to the kindness of Prof. M. Fürbringer; my thanks are also due to Dr. Kraepelin, the Director of the Natural History Museum at Hamburg, who afterwards handed over to me for treatment a number of well-preserved young specimens of *Didelphys*, through the heads of which series of frontal sections were made. The two smallest embryos examined measured 1 centim. in length from the rump to the nape of the neck.

I select the upper jaw for the purpose of description, since the conditions in it are more distinct than those in the lower. Throughout the entire length of the upper jaw there runs a cord of epithelium, the dental fold ("Zahnleiste"), close beneath the epithelium of the cavity of the mouth; in front it is not sharply separated from the epithelium of the oral cavity, but further back, on the contrary, it lies at a greater depth. The rudiments of the enamel-organs of the five incisors appear as knobbed thickenings of the dental fold. Nothing is yet to be seen of the invagination of the enamel-organ by the dental papilla; no indication whatever of the latter is as yet presented by the rudiments of the incisors. The connective tissue surrounding the epithelial knob has

* *Vide* Thomas, *loc. cit.* p. 452.

Fig. 1.

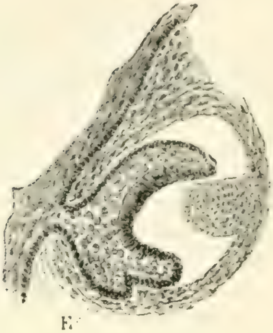


Fig. 3.

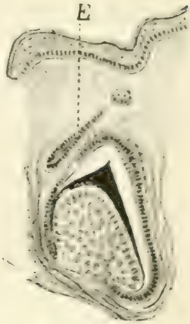


Fig. 2.

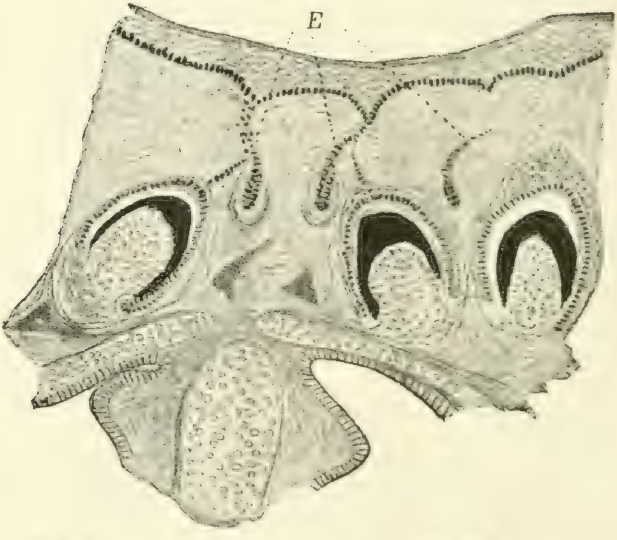


Fig. 5.

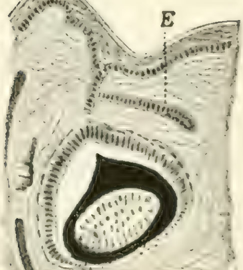
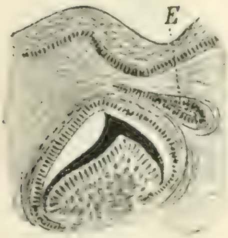


Fig. 6.

Fig. 7.

Fig. 4.



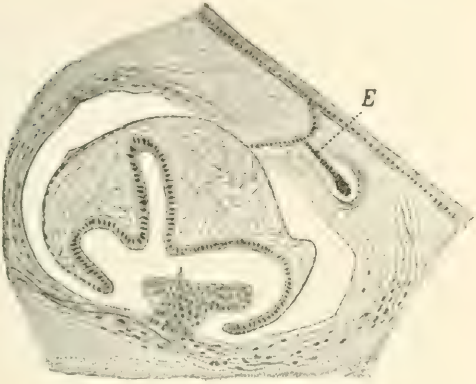
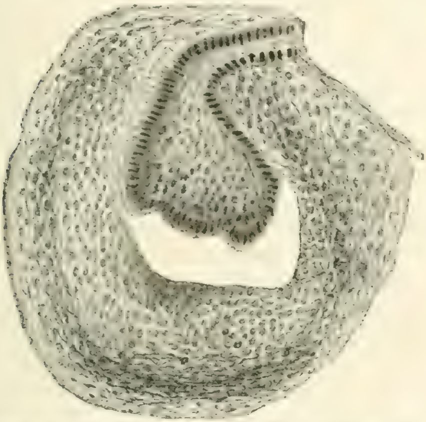


Fig. 8.



All the figures represent frontal sections through the upper jaw.
E denotes the rudiment of the enamel-organ of the second teeth.

Fig. 1.—Frontal section through the upper jaw of a young *Didelphys* measuring 1 centim. from rump to nape. The third premolar with the rudiment of the enamel-organ of the second tooth.

Fig. 2.—The first and second incisors of the upper jaw of a young *Didelphys* 3·2 centim. in length.

Fig. 3.—Third incisor of the upper jaw of a young *Didelphys* 2·5 centim. in length.

Fig. 4.—Fourth incisor of the upper jaw of a young *Didelphys* 3 centim. in length.

Fig. 5.—Fifth incisor of the upper jaw of a young *Didelphys* 3 centim. in length.

Fig. 6.—Third premolar of the upper jaw of the 3-centim. stage.

Fig. 7.—Second molar of the upper jaw of the 3·2-centim. stage.

Fig. 8.—Rudiment of the successor of the second molar of the upper jaw at the 3-centim. stage.

The figures are sketched with the help of the camera lucida. Figs. 1 and 8 with Zeiss's objective D and eyepiece no. 2, reduced by one half; figs. 2–7 with Zeiss's objective A and eyepiece no. 2, reduced by one third.

become disposed in closer concentric strands, and forms the earliest rudiment of the dental sac. The rudiment of the canine tooth is considerably larger; in the free end of the enamel-organ there is a slight indentation corresponding to the rudiment of the dental papilla, which is beginning to appear, and which is recognizable as a number of close-packed cells. The first and second premolars are scarcely distinguishable from the dental fold, while the third premolar, which comes next to them, is the most developed of all teeth (*vide* fig. 1). The enamel-organ has assumed a cap-shaped form simultaneously with the commencement of the development of the dental papilla. The inner epithelium (the enamel-membrane) exhibits the typical form of the long columnar cells, and the enamel-pulp likewise begins to develop. Internally to the wall of the jaw the enamel-organ becomes indented by an ingrowth of connective tissue and assumes a lobate form. Another series of sections from an embryo 1 centim. in length, the development of which is slightly more advanced, shows how the ingrowth of connective tissue produces further back a complete separation of the inner epithelial knob from the outer one, the original enamel-organ. The lobe which is thus constricted off can only be regarded as the earliest rudiment of the enamel-organ of the successional tooth.

Shortly after this the dental fold comes to an end, without forming any further rudiments of enamel-organs. The third premolar is therefore at this young stage far the most developed of all dental rudiments, and already exhibits the earliest indication of the enamel-organ of the successional tooth, while the rest are scarcely differentiated from the dental fold. The conditions in the lower jaw are precisely similar, though the rudiments are still less developed.

The next embryo selected for examination was considerably larger, measuring 2·5 centim. Here we find the development of the teeth greatly advanced. Commencing with the incisors, we see how a strong cap of dentine is differentiated by the odontoblasts. In the enamel-organ the enamel-pulp has become almost completely obliterated owing to the vigorous growth of the dental papilla. The internal enamel-epithelium consists of very columnar and narrow cells regularly disposed side by side; the external one forms a not altogether thin layer of flattened cells above it. The continuity of the enamel-organ with the epithelium of the cavity of the mouth is still preserved; at the same time, however, we also notice how, in the case of each of the incisors, from the tolerably broad neck a cord of epithelium projects on the inner side of the dental rudiment and has a more or less distinctly swollen termination. The canine which follows has already attained a considerable size; nothing more than remains of an epithelial cord lying on the inner side of it is still to be seen. Its base has still not entirely disappeared from the frontal sections, when the rudiment of the first premolar is already visible above it. The latter also exhibits on the inner side a cord of epithelium with a rounded end running from the neck of the enamel-organ. It was in vain that I sought in the gap, which occurs between this premolar and the one immediately following, for a possible tooth-rudiment which had disappeared, the existence of which has been rendered so probable by Thomas's investigations: I found nothing whatever; on the contrary, the gap appeared to be relatively smaller than in the adult. The second premolar, which comes next (which is therefore the third according to Thomas), did not show the looked-for cord of epithelium, which only appeared again beside the third premolar. The dental rudiment itself is already well developed in all parts; the epithelial cord lying on the inner side of it ends in a knobbed swelling of considerable size. This concludes the investigation of the premolars; the next sections show us the conditions in the case of the molars. I was very much astonished when I saw internally to the rudiment of the first molar also, a short but distinct cord of epithelium running close beneath the epithelium of the cavity of the mouth, and still more so when the second molar also exhibited a similar epithelial cord. The conditions here were very distinct: the short and somewhat bent neck of the epithelium of the enamel-germ gave off on the inner side a lateral cord, which was of tolerable length and which thickened at the end laterally, on the inside of the dental rudiment, into a knobbed swelling of considerable size, precisely as we saw in the case of the third premolar. In connexion with this attention must also be directed to the following points:—The lateral knob of epithelium lies at a tolerable distance on the inside of the rudiment of the second molar, which has already completely developed its separate cusps; these have the same number and arrangement as in the adult animal. Moreover, the epithelial knob is absolutely lateral and not posterior in position: it has already disappeared in sections in which the rudiment of the second molar is still distinctly present. Rudiments of teeth beyond the second molar are not yet to be found.

I am now able to furnish abundant confirmation of the foregoing results, in consequence of the examination of two stages somewhat more advanced in development and measuring

3 and 3·2 centim. from rump to nape. The epithelial cords and their knobbed swellings are traceable with the utmost distinctness on the inside of the dental rudiments (*vide* figs. 2–7).

We now come to the interpretation of the facts observed. In all three larger stages we see the dental rudiments distinctly developed, and moreover an epithelial cord running close to and on the inside of them, which arises from the neck of the enamel-organ and is provided with a swollen free end. In these lateral cords of epithelium we have before us PERFECTLY TYPICAL RUDIMENTS OF THE EARLIEST STAGES OF THE ENAMEL-ORGANS OF SUCCESSIONAL TEETH, and they are indicated with special distinctness in the case of the whole of the incisors; remains of these rudiments are also seen in the case of the canine as well as in that of the first molar, and it was only in the case of the second premolar that I did not succeed in discovering them. A valuable subject for comparison is furnished by the third premolar, to which a successional tooth actually appears later on. Now the rudiment of the enamel-organ of its successional tooth agrees so entirely with that of the rudiments of the other successional teeth that there is nothing to prevent their homologization. The discovery of rudiments of successional teeth in the case of teeth other than the third premolar, which Thomas himself declared would be fatal to his hypothesis, has therefore been achieved, and moreover not in the case of one, but in that of almost all teeth. It is for the present a matter of indifference to us whether these enamel-organs of the rudiments of successional teeth undergo still further development or become rudimentary at an early period; in any case the nature of the dentition of *Didelphys*, and, as I shall immediately add, in all probability that also of the rest of the Marsupials, is settled. THE PERMANENT DENTITION OF THE MARSUPIALS BELONGS TO THE FIRST SERIES, THE MILK-DENTITION; RUDIMENTS OF THE SECOND DENTITION ARE ACTUALLY PRESENT IN AN EMBRYONIC CONDITION, BUT WITH THE EXCEPTION OF THE THIRD PREMOLAR IT DOES NOT CUT THE GUM.

A few words yet remain to be added as to the rudiments of the so-called true molars, the molars. The smallest stage, 1 centim. in length, showed as yet no trace of a rudiment either in the upper or in the lower jaw. It was only in the three subsequent larger stages that rudiments of these teeth could be detected, and here they were nearly equally far advanced in development. In the upper jaw the first and second molars were present, in the lower jaw the first, second, and third. In all cases development was already far advanced;

the separate cusps of dentine were well developed, while the spaces between the several cusps of the tooth were filled with enamel-pulp, which was surrounded by a very columnar internal and a flat external enamel-epithelium.

As has already been mentioned, a cord of epithelium running in a lateral direction is also present in the case of the first molar. The cord is, however, very little developed; it runs continuously backwards, and at the level of the dental rudiment of the second molar it comes into connexion with the enamel-organ of the latter; but simultaneously it sends off inwards a second strong cord of epithelium of considerable length, which terminates with a knobbed swelling (*vide* fig. 8). The swelling is surrounded by close-packed strands of connective tissue, arranged concentrically, and exhibits at its free end two slight indentations, while at the same time in the connective tissue, which lies beneath, the first beginnings of a papilla become visible. The structure does not lie as it might be behind the large rudiment of the second molar, but to one side of it, placed at a considerable distance towards the interior; and I can therefore not regard it otherwise than as the rudiment of a successional tooth. Thus it is demonstrated that the second molar (and naturally the first also) is in its origin in no way different from the teeth lying in front of it. THE TWO FIRST SO-CALLED MOLARS OF THE UPPER JAW BELONG TO THE FIRST DENTITION.

Shortly after the successional tooth has disappeared from the scene the second molar also disappears further backwards, and no indication appears of the rudiment of the last two molars. It is reserved for further investigations, prosecuted upon more comprehensive material, to display the earliest rudiments of these.

In the lower jaw the development of the molars has advanced further; the third molar also is already developed, somewhat smaller, it is true, than the preceding one, but still already provided with all its cusps. Here the conditions are such that, from the first molar onwards, an epithelial cord runs uninterruptedly through the posterior portion of the lower jaw, and, flattened out like a plate, passes above and laterally on the inside of the dental rudiments. It soon comes to pass that this cord has no longer any connexion with the epithelium of the cavity of the mouth, since the latter withdraws more towards the middle in consequence of the growing together of the margins of the upper and lower jaws. At each enamel-organ of the three molars a branch now passes off from this broad and very conspicuous epithelial cord, so that in each case the appearance of a dichotomic division is presented. The enamel-organs of the molars are therefore here also in connexion with an epithelial cord, which is prolonged laterally on the inside of the dental rudiments; we have in this case also the representation of the origin of teeth of the first dentition before us, although rudiments of the second dentition are not distinctly formed. The epithelial cord terminates further back in a knobbed swelling, which is perhaps the earliest rudiment of the fourth molar.

Although the facts may yet be considerably amplified by further investigations, nevertheless I consider that I may already maintain that embryology furnishes no support for attributing the first two so-called molars of the upper jaw and the first three similar teeth of the lower jaw to another dentition than that to which are attributed the rest of the teeth which lie in front of them. There are no molars at all, but premolars. The dentition of *Didelphys* which cuts the gum and is permanent therefore belongs (with the exception of the last molars, which appear at a late stage of development) to the first series, or the milk-dentition.

XLV.—*Descriptions of new Genera and Species of* Pyralidæ *contained in the British-Museum Collection.* By W. Warren, M.A., F.E.S.

[Continued from p. 179.]

Micractis, gen. nov.

A subdivision of *Botys*. Characterized by the presence of a small raised linear dash close to the base immediately beneath the interno-median vein of the fore wing of the male. The females are always larger and generally paler than the males.

Type *M. nubilalis*, Hüb. (*Pyralis*).

Micractis sanguinealis, sp. n.

Fore wing deep yellow, more or less thickly suffused with dull red, the costa throughout deeper; lines themselves reddish; first curved outwardly, preceded by a yellowish space, the basal area up to it suffusedly reddish; central space between the two lines thickly suffused with red, the two stigmata deeper; second line, slightly serrated, forms a distinct outward curve in the middle, and is followed by a broadish yellow fascia, the outer edge of which is likewise serrated; beyond this the whole hind margin is densely reddish fuscous; fringe dark cinereous. Hind wing yellow, with greyish-fuscous margin and an indistinctly expressed central shade. Head, palpi, and thorax reddish; legs white; abdomen yellow. Underside dull yellowish grey.

Expanse of wings 24 millim.

One male from Japan.

Opsibotys, Warr.

Opsibotys, Warr. Ann. & Mag. Nat. Hist. 1890 (ii.), p. 474.

Opsibotys latipennis, sp. n.

Fore wings pale straw-colour, with the markings yellowish, viz. the costa, the two stigmata, and the two lines, the first of which is very indistinct and the second denticulated; a faint undulating submarginal line. Hind wings with a central spot, a curved central fascia, and a faint submarginal one yellowish. In the male the yellowish parts are tinted also with grey. Thorax and abdomen straw-colour; head and collar yellowish. Underside dirty ochreous, with all the markings very faint.

Expanse of wings 30 millim.

One female, one male, from Japan.

The species reminds one of a *Micractis*, but the male is without the characteristic marking of that genus. Both wings are rather broad.

Opsibotys ocellalis, sp. n.

Fore wing fuscous-brown, elongate; first line invisible, second strongly serrated, the serrations thrown up by a slightly paler shade beyond it; a conspicuous pale yellowish-white spot at end of cell; fringes concolorous. Hind wing with second line repeated; fringes with pale apices.

Expanse of wings 36 millim.

One male from Japan.

Related to the American species *mustelinalis* and *fumoferalis*.

Sericoplaga, gen. nov.

Like *Opsibotys* in structure, but distinguished by the shape of the fore wings, of which the apex is produced and pointed and the hind margin concave in the upper half and bulging out in the lower; the scaling is smooth and glossy and the fringes white. Superficially it bears a resemblance to the East-Indian genus *Leucocraspeda*, Warr.

Type *S. externalis*, Warr.

Sericoplaga externalis, sp. n.

Fore wings reddish ochreous, glossy, dusted with fuscous, the costa greyish at the base; lines dark grey, first line denticulated, oblique, approaching second on the inner margin, second line also denticulated, starting from the costa at two thirds, forming a large curve for the first half of the wing and running deep inwards along the first median nervule to below the reniform stigma, and thence obliquely to inner margin; a small dark spot in the cell beyond first line and a lunular mark at end of cell; fringe with basal third dark grey, apical two thirds silvery white. Hind wings like fore wings, with only the second line represented. Head, thorax, and abdomen concolorous with fore wings. Underside whitish, with only the outer line and base of fringes dark brownish.

Expanse of wings 26 millim.

One female from Texas, in Zeller Collection.

ANTHOCRYPTA, gen. nov.

Related to *Opsibotys*. Fore wings elongate; costa slightly sinuous, strongly convex before apex, which is prominent but not acute, as in *Sericoplaga*; hind margin sinuous, but much less distinctly so than in *Sericoplaga*, the subapical sinus and lower convexity being much fainter; scaling fine and glossy. Labial palpi *not rostriform*, but shortly porrected horizontally, the last joint quite small and bluntly rounded; maxillary palpi very fine; tongue rather large; abdomen lengthened, extending beyond hind wings; antennæ simple in both sexes, in the male only showing faint traces of pubescence. On the under surface of the male hind wings is a brown patch, as if burnt, embracing the median and submedian nervules.

Type *A. subinquinalis*, Guen. (*Ebulea*), D. & P. p. 362.

GLAUCONOË, gen. nov.

Fore wings elongate; costa convex only before apex, which is distinct, but not acute; hind margin oblique. Hind wings well rounded. Labial palpi triangular, rather drooping, much shorter than in *Opsibotys*; antennæ long, two thirds the length of fore wing, filiform in both sexes, and very finely and shortly pubescent in male; abdomen long, in male with a distinct, generally darker, anal tuft; scaling dull, slightly iridescent; markings very indistinct or obsolete.

Type *G. deductalis*, Wlk. (*Botys*), xviii. p. 659.

Glauconoë subflavalis, sp. n.

Fore wings dull yellowish ochreous, towards the inner and hind margins almost wholly suffused with dull leaden-grey; the basal area, the costa broadly between the lines, and shortly beyond the second line remaining yellow; first line simply curved, second forming an angular prominence outwards in the middle; the intermediate space darker grey; a dark grey lunule at end of cell. Hind wings grey, slightly mixed with yellowish, with a faintly darker, paler edged, central fascia. Head, thorax, and abdomen yellow. Underside pale ochreous, with only the cell-spots and outer line a little darker.

Expanse of wings 40 millim.

One female from Madagascar.

G. ceadesalis, Wlk. (*Botys*), from Ashanti, of which the type is in the British Museum Collection, as well as another example from Kilimanjaro, may be the male of *subflavalis*; but in them there is no trace of yellow scaling.

Glauconoë fuscescens, sp. n.

Fore wings dull grey, with no markings whatever except a dark lunule at end of cell and a small spot before it. Hind wings wholly dull grey. Underside paler, whitish.

Expanse of wings 36 millim.

One male from Sumatra.

NOTASPIS, gen. nov.

Resembles *Ostrinis*, Hüb., in shape of wings, especially in the strongly convex costa of the fore wing, but of stouter build; distinguished by the great length of the labial palpi, which are quite three times as long as the head; the third joint as long as the second, which projects beyond it at its base both above and below; maxillary palpi erect, triangular, cut straight off above; antennæ in male finely but distinctly ciliated; last segment of thorax with two snow-white lateral spots; second segment of abdomen with a large central one.

Fore wing with the exterior transverse line closely approximating to the hind margin. Hind wing without markings.

Type *N. tranquillalis* (*Botys tranquillalis*, Led. W. E. M. vii. pp. 371, 466, pl. ix. fig. 16).

In the male the whole of the central field between the two transverse lines is filled up with red-brown; in the female of Lederer's figure this is only partially the case.

TERASTIODES, gen. nov.

Distinguished from *Notaspis*, Warr., by the shape of the fore wings, which are much narrower, with a nearly straight costa; hind margin for the upper two thirds vertical, then suddenly oblique to the anal angle, so forming a decided elbow; inner margin a little concave before the anal angle; labial palpi only as long as the head, triangular, with the terminal joint short, hardly visible; maxillary short, erect; antennæ of male pubescent only; last segment of thorax with two silvery lateral spots of raised scales; second segment of abdomen with one large central one; penultimate segment with a silvery white belt.

Type *T. ochracealis* (*Terastia*), Wlk. xxxiv. p. 1308.

The similarity in ornamentation of the abdomen which occurs in two so widely separated species as *Notaspis tranquillalis* and *T. ochracealis* is noticeable; in other respects they do not appear to be in any way related.

STENOCHORA, gen. nov.

Fore wings elongate, in female with the apex somewhat produced and the hind margin sinuous, being slightly concave just below the apex and above the anal angle, in the male with the hind margin very oblique and simple, the apex being bluntly rounded. Hind wings rounded. Both wings broader in female than male. Palpi porrect, rostriform as in *Opsibotys*; antennæ moniliform in both sexes, slightly pubescent in male; abdomen long, in male with a distinct anal tuft.

Type *S. lancinalis*, Guen. (*Rhodaria*), D. & P. p. 160 (*B. expeditalis*, Led. W. E. M. vii. pp. 372, 466, pl. ix. fig. 15).

AGLAOPS, gen. nov.

Fore wings with costa nearly straight, convex before apex, which is distinct; hind margin obliquely curved. Hind wings rounded. Palpi porrect, rostriform, comparatively large; antennæ simple in both sexes, very finely pubescent in male; middle tibia of male enormously enlarged and flattened; abdomen of female short, stout, of male elongated, slender; scaling fine, pulverulent; markings two lines—the first vertical, the second sinuous, denticulate—and two stigmata. Hind wings without markings.

Type *A. furnacalis* (*Mecyna*), Meyr. Tr. E. S. 1886, p. 264.

Hyalorista, gen. nov.

Fore wings elongate, three times as long as wide; costa straight; hind margin oblique. Hind wings likewise somewhat elongate. Palpi rostriform, long for the size of the species; forehead slightly protuberant; ocelli present; antennæ simple, slightly pubescent in male; scaling fine and smooth.

Type *H. tæniolalis* (*Rhodaria*), Guen. D. & P. p. 172.

A natural group of insects hitherto comprehended within the elastic limits of *Botys*; of comparatively small size and delicate structure, with the usual markings almost wholly absent; both wings showing a dark marginal suffusion; the hind wings nearly transparent.

Hyalorista imitans, sp. n.

Fore wings yellow, suffused with darker towards the costa; an oblique, broadish, purplish-grey band near the base, and another submarginal; the outer edge of the former and the inner edge of the latter rather irregular; an indistinct dark ocelloid spot at end of cell; traces of an exterior line appear on the costa and in the disk. Hind wings whitish yellow, yellow only along the inner margin, with an indistinct darker submarginal band and a distinct purplish-grey blotch on the inner margin. Head, thorax, and abdomen rather deep yellow. Underside dull yellowish, with the markings faintly darker.

Expanse of wings 14 millim.

Three males from S. Paolo.

Resembles *tæniolalis*, but smaller and much more indistinctly marked.

Adeloides, gen. nov.

Characterized by the enormous length of the antennæ and the difference in the shape of the fore wings of the sexes. Male with fore wing very narrow; the apex produced; the hind margin very oblique. Female with fore wing broader, rounded, shaped like *Hoterodes*. Hind wing of male wholly white, triangular, being produced towards the anal angle; of female white, with dark margin, rounded. Antennæ of female setaceous, as long as, or longer than, fore wing; of male more than half as long again. Palpi porrected, drooping, pointed; ocelli present; tongue present; abdomen of male very long.

Type *Adeloides cinerealis* (*Hoterodes*), Moore, P. Z. S. 1867, p. 94.

ARCHERNIS, Meyr.

Type *A. octoguttalis*, Feld., Meyr. Tr. E. S. 1887, p. 220.

Archernis pubescens, sp. n.

Fore wings dull greyish yellow, suffused more or less with fuscous grey; first line brown, close to base, second line much curved outwards in the middle and running in to quite half the length of the wing on the inner margin; three whitish semitransparent spots, one between the two stigmata in the cell, one on the costa on the inner side of the second line, the third in the middle of the disk, on the outer side of the second line, in the angle formed where it turns vertically towards the inner margin; submarginal space generally clearer yellow than the rest of the wing; fringes yellowish. Hind wings pale yellow, with a brown central spot and sinuous central line. Head and thorax suffused with fuscous grey; abdomen yellowish. Underside like upper, but paler.

Expanse of wings 24 millim.

Several of both sexes from N. China and N. India (Dharmsala).

Nearest to *A. purpurescens*, Moore (*Samea*), from the Andamans.

MESOTHYRIS, gen. nov.

Fore wings with costa nearly straight, slightly convex before apex, which is blunt; hind margin rounded. Hind wings rounded. Palpi shortly rostriform; antennæ (in female) filiform; cell in both wings very short, hardly one third of the length of the wing; first median nervule starting immediately before the end of cell, third and radial on a long footstalk, second from the stalk halfway between first and the origin of the other two. This neuration obtains also in the hind wing, where also the two costal branches are on a long stalk; owing to the shortness of the cell the two stigmata are very close to the base of the wing; between them is a scaleless white transparent spot.

Type *M. aluensis* (*Botys*), Butler, Ann. & Mag. Nat. Hist. 1887, ii. p. 123.

The male will very likely exhibit further peculiarities.

PRODASYCNEMIS, gen. nov.

Fore wings with the costa slightly indented in the centre, especially in male, convex before apex, which is very slightly produced; hind margin obliquely curved. Hind wings rounded. Palpi porrect, long, rostriform; maxillary palpi and tongue distinct; scaling hairy; fringes long. Distinguished by the fore tibiæ of the male, which at their lower end have a large rounded cushion of scales. Wings without markings.

Type *D. inornata*, Butler (*Botys*), Ill. Lep. Het. iii. p. 76, pl. lix. fig. 12.

APLOGRAPHE, gen. nov.

Like *Prodasycnemis*, but without the tuft of scales on the fore leg; wings smoothly scaled; shorter and broader than in *Prodasycnemis*; without markings, except in *bisignata*, which has the stigmata manifest.

Type *A. bisignata*, Butler (*Scopula*), Ill. Lep. Het. vii. p. 98, pl. cxxxv. fig. 11.

Aplographe fulvalis, sp. n.

Fore wings wholly dull fulvous, the costa just darker. Hind wings slightly paler. Fringes, head, and thorax concolorous. Underside paler, without markings.

Expanse of wings 24 millim.

One female from the Cape of Good Hope.

Aplographe umbrosalis, sp. n.

Fore wings dull greyish yellow. Hind wings more grey on their basal half. Fringes pale yellowish. Head, thorax, and abdomen concolorous. Underside like upper, but with the base of the fore wings greyer.

Expanse of wings 24 millim.

One female from N. China.

Near *A. inornatalis*, Leech (*Botys*).

NASCIA, Curt.

Type *N. cilialis*, Hüb., Curt. Brit. Ent. xii. 599.

Nascia citrinalis, sp. n.

Fore wings pale straw-colour, tinged with yellowish towards the hind margin, with a yellowish spot at end of the cell and slightly darker below the costa; fringes silvery white, with a dark leaden-grey base. Hind wings pale straw-colour, tinged with grey, much greyer along the costa; fringes also straw-colour. Head, thorax, and abdomen concolorous. Underside paler, with a brown subcostal streak in the fore wing.

Expanse of wings 28 millim.

One female from Dharmsala.

Distinguished at once by its smoothness and total absence of markings or streaks.

[To be continued.]

XLVI.—*Notes on the Palæozoic Bivalved Entomostraca.*— No. XXX. *On Carboniferous Ostracoda from Mongolia**. By T. RUPERT JONES, F.R.S., and JAMES W. KIRKBY, Esq.

[Plate XVI.]

THE Ostracoda figured on the accompanying Plate represent the leading forms of a series of specimens brought to Russia from Mongolia, in a small collection of Carboniferous fossils, by the eminent traveller M. G. N. Potanin, and which have been selected and sent to us by M. P. N. Wenjukoff, of the Geological Museum in the Imperial University at St. Petersburg.

Most of the species, if not all, are well known also as British fossils; but we think them of sufficient interest for special notice on account of their coming from so distant a locality. It was previously known that certain of these species enjoyed a great range in time, being common to both

* No. XXIX. appeared in the Ann. & Mag. Nat. Hist. for October 1890.

Carboniferous and Permian strata; it is now evident that they had a very wide geographical range.

The specimens chiefly belong to species of *Bairdia.* They have evidently been obtained from a hard dark-coloured limestone. Nearly all of them are complete carapaces, not single valves. The particulars sent to us as to locality are that they were found in the "Carboniferous Limestone of the River Bardun, falling into the River Ezsin, South Mongolia" *.

The following brief notes refer to the species and varieties determined by us.

1. *Leperditia Okeni* (Münster), and var. *inornata* (M'Coy). (Pl. XVI. figs. 1 and 2.)

Leperditia Okeni, Jones and Kirkby, 1865, Ann. & Mag. Nat. Hist. ser. 3, vol. xv. p. 406, pl. xx. figs. 1–3; and var. *inornata* (M'Coy), *op. cit.* vol. xviii. 1866, p. 44.

Several examples of this species and its varieties occur in this set of Ostracoda. Fig. 1 represents a good example of the typical form. Fig. 2 is from a specimen that agrees closely with the variety *inornata* (M'Coy). There are other individuals belonging to a variety larger than either of these, being fully one ninth of an inch long and more oval in outline. These are similar to an unnamed form (hitherto grouped with the species) from Holwell, in Somerset, and other localities.

L. Okeni (with its varieties) is a common and widespread species in the Carboniferous-Limestone series. In these rocks it occurs in England, Scotland, and Ireland; and it has been found in strata more or less equivalent in Nova Scotia, Belgium, Germany, Russia †, and now in Mongolia.

2. *Bythocypris bilobata* (Münster). (Pl. XVI. fig. 3.)

Cythere bilobata, Münster, Jones and Kirkby, Ann. & Mag. Nat. Hist. ser. 3, vol. xv. 1865, p. 409, pl. xx. fig. 10.

There are three examples of this species, all of which are similar, both in size and in other respects, to British specimens.

This species occurs in the Carboniferous Limestone of Russia, Bohemia, Belgium, and England.

* See also 'La Faune du Calcaire Carbonifère Inférieur du Bardoun en Mongolie,' par P. Venukoff: 8vo, St. Petersburg, 1888, in Russian and French, pp. 211 and 225.

† See Ann. & Mag. Nat. Hist. ser. 4, vol. xv. 1875, p. 54.

3. *Bythocypris* (?) *cuneola*, Jones and Kirkby, var. (Pl. XVI. fig. 4.)

Bythocypris (?) *cuneola*, J. & K., Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. 1886, p. 250, pl. vi. figs. 1 and 2.

Fig. 4 represents a single specimen of a small Ostracod that is doubtfully identified with *B.* (?) *cuneola*. It has about the same size and general appearance, but its extremities are too nearly alike; and its edge-view is scarcely cuneiform enough for exact agreement with that species. It may, however, be a variety of it.

B. (?) *cuneola* is a common species in the Carboniferous-Limestone series of the North of England and Scotland.

4. *Bairdia curta*, M'Coy. (Pl. XVI. fig. 5.)

Bairdia curta, M'Coy, Jones and Kirkby, Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 567, pl. xxviii. figs. 1–8.

The specimen here figured is a nearly perfect individual of *B. curta* (there are other specimens more or less imperfect), and it shows the elegant form and broad subangulate anterior extremity characteristic of this species.

B. curta was the first-discovered representative of the genus, and, though now well known as a British Carboniferous fossil, it is nowhere abundant, nor had it until now been found out of the British Isles.

5. *Bairdia subelongata*, Jones and Kirkby. (Pl. XVI. fig. 6.)

Bairdia subelongata, J. & K., Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 573, pl. xxx. figs. 1–11 and 16.

Many of the specimens of this small set of Mongolian Ostracoda belong to *B. subelongata*; and, though one of the most typical has been chosen for illustration, there are others showing much the same range of variation that obtains in series of British specimens, as noticed in our memoir on *Bairdia* (Quart. Journ. Geol. Soc. 1879).

B. subelongata is a well-known species from the Carboniferous-Limestone series of Scotland and the north of England.

6. *Bairdia plebeia*, Reuss. (Pl. XVI. figs. 7 and 8.)

Bairdia plebeia, Reuss, Jahresb. Wetterau. Ges. 1854, p. 67, fig. 5; Jones and Kirkby, Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 569, pl. xxviii. figs. 9–19.

There are several examples of this common species, though they are not so abundant or so well developed as those from many British localities. Those figured are the most typical, others show some varietal differences.

B. plebeia is perhaps the best known of the Carboniferous *Bairdiæ*, at least in Britain. It is also known from the Carboniferous strata of Russia. It was first found as a Permian species, and as such it is one of the most common Ostracods of the Magnesian Limestone of England and of the Zechstein of Germany.

7. *Bairdia brevis*, Jones and Kirkby.
(Pl. XVI. fig. 9.)

Bairdia brevis, J. & K., Quart. Journ. Geol. Soc. vol. xxxv. p. 575, pl. xxxi. figs. 1–8.

There are a few examples of this species, and they are not to be distinguished from those known to us from the Carboniferous-Limestone series of Scotland and England, where it is not an uncommon fossil.

8. *Bairdia amputata*, Kirkby. (Pl. XVI. fig. 10.)

Bairdia amputata, Kirkby, Transact. Tyneside Field-Club, vol. iv. 1859, p. 155, pl. xi. fig. 22.

This species is represented by five or six individuals, in all of which its subpentagonal outline is well marked. The specimens show the valves to have been coarsely pitted.

B. amputata is found in the Carboniferous-Limestone series of Scotland and the north of England, and in the Permian rocks of Durham.

9. *Bairdia ampla*, Reuss. (Pl. XVI. fig. 11.)

Bairdia ampla, Reuss, Jahresb. Wetterau. Ges. 1854, p. 68, fig. 7; Jones and Kirkby, Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 571, pl. xxviii. figs. 20–23, and pl. xxxii. figs. 17 and 18.

Fig. 11 evidently represents *B. ampla*, although the carapace is rather longer than in some examples of the species, not more so, however, than in others found in British Carboniferous strata.

B. ampla is known as a British species in the Carboniferous-Limestone series, though it was first found in the Zechstein of Germany. We have also figured and described Carboniferous specimens of it from Russia *.

* Ann. & Mag. Nat. Hist. ser. 4, vol. xv. 1875, p. 56, pl. vi. fig. 5.

10. *Bairdia grandis*, Jones and Kirkby.
(Pl. XVI. fig. 12.)

Bairdia grandis, J. & K., Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 572, pl. xxix. figs. 1 and 2.

Of *B. grandis*, as known in Carboniferous strata, there are several finely developed and characteristic specimens in this collection, the one figured being one of the best.

Whether this robust form of *Bairdia* is exactly the same as the Permian Ostracod described and figured by one of us in 1859 as *B. plebeia*, Reuss, var. *grandis*, is not quite clear, for the latter is only known to have occurred once, and then in an imperfect condition. There is no doubt, however, as to these Mongolian specimens being the same as the Carboniferous Ostracod which we here and elsewhere refer to as *B. grandis*. They are the same in size, general form, thickness of the shell, and other particulars characteristic of the species.

B. grandis occurs in the Carboniferous-Limestone series of Scotland, and less rarely in the same series of the north of England.

11. *Bairdia Hisingeri*? (Münster), var. *Mongoliensis*.
(Pl. XVI. fig. 13.)

Bairdia Hisingeri (Münster), Jones and Kirkby, Quart. Journ. Geol. Soc. vol. xxxv. 1879, p. 570, pl. xxix. figs. 4–10.

Besides the species already noticed there is another form that scarcely agrees with any described *Bairdiæ*. It is probably nearest to *B. Hisingeri*, with which, as a variety, we place it at present. It differs from good examples of that species in the dorsal border being straight in the middle and then inclined strongly to the front, also in its longer and more definite anterior and posterior slopes, and in its more rounded anterior extremity. Its carapace is thus highest at the anterior third, and its general form is decidedly more elegant than that of *B. Hisingeri* proper. We distinguish it as var. *Mongoliensis*.

EXPLANATION OF PLATE XVI.

(All the figures are magnified about 25 diameters.)

Fig. 1. *Leperditia Okeni* (Münster). Carapace, showing left valve.
Fig. 2. *Leperditia Okeni* (Münster), var. *inornata* (M'Coy). Carapace, showing left valve.
Fig. 3. *Bythocypris bilobata* (Münster). Carapace, showing right valve.

Fig. 4. *Bythocypris? cuneola*, J. & K., var. Carapace, showing right valve.
Fig. 5. *Bairdia curta*, M'Coy. Carapace, showing right valve.
Fig. 6. *Bairdia subelongata*, J. & K. Carapace, showing right valve.
Fig. 7. *Bairdia plebeia*, Reuss. Left valve.
Fig. 8. *Bairdia plebeia*, Reuss. Carapace, showing right valve.
Fig. 9. *Bairdia brevis*, J. & K. Left valve.
Fig. 10. *Bairdia amputata*, Kirkby. Carapace, showing right valve.
Fig. 11. *Bairdia ampla*, Reuss. Left valve.
Fig. 12. *Bairdia grandis*, J. & K. Carapace, showing right valve.
Fig. 13. *Bairdia Hisingeri?* (Münster), var. *Mongoliensis*, nov. Carapace, showing right valve.

XLVII.—*Notes on the Variation of the Genus* Arion, *Fér.* By Walter E. Collinge, Assistant Demonstrator in Zoology, St. Andrew's University.

The diversity of opinion that at present exists as to specific and varietal forms in this genus induced me some time ago to collect a large quantity of the different species and varieties from many parts of the country for careful comparison and anatomical examination. Some *Arion empiricorum*, Fér., which are at present under observation, are of interest in that they approach a Portuguese form described some little time ago by Simroth, viz. var. *Bocagei*. From the descriptions below it will be seen that these variations are so slight that it would be absurd to name them individually; and as they are likely to occur elsewhere I now describe them, hoping thereby to save future collectors from adding to an already overburdened nomenclature.

The specimens I have were collected in Yorkshire; but allied forms have also been found in Ireland by Dr. Scharff * and at Guernsey by Mr. Brockton Tomlin †.

Arion empiricorum, Fér.

Var. *Bocagei*, Simroth.—Sides blackish, back decidedly paler or white. Portugal.

Subvar. nov.—Sides blackish, back grey; margin of sole light yellow. Ireland (*Scharff*).

Subvar. nov.—Sides blackish, back light bluish grey; foot whitish, margin of sole white. Yorkshire (*Collinge*).

* Trans. Roy. Dublin Soc. vol. iv. ser. ii. p. 560, pl. lvi. fig. 16.
† 'British Naturalist,' p. 46 (1891).

Subvar. nov.—Sides blackish, back greyish; margin of sole light brown. Yorkshire (*Collinge*).

Subvar. nov.—Animal drab colour; foot deep yellow, margin bright orange. Guernsey (*Roebuck*).

After a careful examination of a number of brown and red forms of *A. empiricorum* I am much inclined to group Mr. Roebuck's var. *brunneus* as a subvar. of var. *rufus*, L. The variety *subreticulatus*, Ckll., might also be grouped as a subvariety of var. *reticulatus*, Roebuck. There can be little doubt but that the var. *fallax*, Ckll., of *A. hortensis*, Fér., is merely a form of var. *subfusca*, C. Pfr. The var. nov. *albipes* lately described by Mr. Cockerell * is a very unsatisfactory one, being made from a single immature specimen. The white sole is such an unusual occurrence in *A. hortensis* that it is important; but specimens frequently show light-coloured soles in a young condition.

The many perplexing forms of *Arion* which are at present engaging the attention of conchologists cannot be rightly assigned to this or that species from a mere examination of the external parts, and it is to be hoped that future collectors will abstain from adding useless synonyms to the list until they obtain a better knowledge of the anatomy.

XLVIII.—*Notes on Dr. W. Kükenthal's Discoveries in Mammalian Dentition.* By OLDFIELD THOMAS.

THE two important papers by Dr. W. Kükenthal recently published †, and translated in the present number of the 'Annals' ‡, render necessary a few words on the bearing that the discoveries therein announced have on the theories of tooth-descent current here and on the Continent.

On the first and most essential question as to the origin of the present Mammalian diphyodontism, *i. e.* the possession of two more or less complete sets of teeth, a milk and a permanent set, two conflicting views have been advocated—(1.) that this diphyodontism was present in the earliest Mammalia, and has become reduced in the different orders to different degrees, the lowest orders being paradoxically the most

* 'The Conchologist,' vol. i. p. 33 (1891).

† Anat. Anz. vi. pp. 369 and 658 (1891).

‡ *Suprà*, pp. 279, 285.

advanced in reduction; and (II.) that Mammals were primitively monophyodont and that the milk-dentition was superadded as a secondary development, the development being naturally most advanced in the highest orders.

The latter view was adopted and carried out in great detail by myself *, and therefore now that Dr. Kükenthal's discoveries have shed a new light on the subject I am impelled to express the revised opinion that they have induced me to form.

The second of the two theories referred to had as its primary basis the nearly complete monophyodontism of the Marsupials, and the moment these were proved to have been ever more largely diphyodont than they are at present the whole case would fall to the ground. And such proof seems now to have been found by Dr. Kükenthal in the nearly complete set of rudimentary successional teeth discovered by him in embryos of *Didelphys*; which can hardly be interpreted otherwise than he has done, namely as rudiments of a previously functional second set of teeth.

Such being the case I am now for my own part prepared to admit that Mammals must have been originally diphyodont and that their regular diphyodontism was probably in direct succession to the irregular polyphyodontism of their Reptilian ancestors, or may even have existed in what were in other respects members of the latter class.

At the same time it is evident that on this view many of the known facts seem to become more instead of less difficult of interpretation. Thus the fact that *Triconodon*, one of the earliest known Mammalia, changed a single tooth only †, and that the very one which changes in the modern Marsupials, now appears most inexplicable, and is alone almost calculated to stagger belief in primitive diphyodontism.

This problem, however, may be left for time to unravel, but its existence is sufficient to excuse those who, before these latest discoveries were made, could not bring themselves to believe in that view of the ancestral history of Mammalian teeth.

The same fact, combined with the presence of four undoubted premolars (of whichever "series") in so many of the earliest Marsupials, renders it also difficult, if not impos-

* Phil. Trans. 1887, p. 443.

† The specimen of *Triconodon* (*Triacanthodon*) figured in my paper has, by the kind permission of Dr. Woodward, been carefully developed beneath all the cheek-teeth, and reexamined by the light of Dr. Kükenthal's discoveries. No other successional teeth, however, besides that below p.^{4} are present in the jaw.

sible, to follow Dr. Kükenthal in his homologization of the changing tooth of Marsupials with p.[3] instead of p.[4], as it has usually been considered to be, even if the missing premolar has left no trace of its former presence in the position (next anterior to "p.[3]") which I suggested it had most probably occupied. The problem as to the homologies with each other of the Placental and Marsupial teeth is one that will need much further, and especially palæontological, evidence for its solution; but comparing the dentition of *Triconodon* with those of both groups, it is difficult to avoid coming to the conclusion (1) that the changing tooth of Marsupials is homologous with the changing tooth, the fourth premolar, of *Triconodon*; (2) that the four premolars of *Triconodon* are homologous with the four premolars of the typical Placental dentition*; and, as a consequence, (3) that the changing premolar of Marsupials is homologous with p.[4] of Placental Mammals.

But if once the primitive diphyodont theory be admitted, the homologization of the Marsupial molars with the milk series is as likely as with the permanent, for originally all the teeth would have been in duplicate, the posterior as well as the anterior, and either set would be as likely to be suppressed as the other. And furthermore, if this homology of Dr. Kükenthal's is confirmed, and it seems well founded, in all probability the same will prove true of the Placental molars †, which we have as yet no real reason for knowing to be serially homologous with the permanent more than the milk set. In fact any presumption there may be one way or the other is rather in favour of the Placental Mammals having retained the same set as the lowlier and earlier Marsupials.

* Of course, as Mr. Bateson has shown (in his paper read before the Zoological Society on Feb. 2—not yet published), one may easily attempt to carry this principle of the individual homologization of teeth too far, as no doubt in my efforts to find a nomenclature by which we could name each Marsupial tooth I have myself done in my catalogue of that order. Still, without entering into this question before the publication of his paper, I may claim that the above is by no means a straining of the true principles of tooth homology.

One possibility, however, would take away the value of the above suggestion, namely if it were shown that neither *Triconodon* nor any of the other 4-premolared Mesozoic mammals were marsupials at all; but they have been considered as such by all palæontologists, and the changing of the last premolariform tooth is certainly not an argument against their being so.

† The close resemblance of mp.[4] to the molars both in form and structure has already suggested this homology to several observers, although it has hitherto usually been explained by the adaptive necessity for a grinding-tooth at the back of the tooth-row during youth.

I do not quite understand why, merely on account of the milk origin of the Marsupial molars, Dr. Kükenthal says of the Marsupials "there are no molars at all, but premolars," for the words molar and premolar in no way imply either difference or identity of series, and the "molars" are simply the non-changing posterior teeth either of Placentals or Marsupials, whether homologized with the milk or permanent series. In fact if the Placental molars are also of milk origin their complete homology with the Marsupial posterior non-changing teeth accentuates the right of the latter to bear the name "molar."

Should, again, further research prove this to have been the origin of the Placental molars, Dr. Kükenthal's extraordinary and, to all appearance, most unlikely theory as to the fusion of teeth of the permanent and milk sets in order to form the molars will fall to the ground *.

Of other interesting points in Dr. Kükenthal's papers a reference may be made to his theory as to the production by fission of the many simple unicuspid teeth of Cetacea out of compound multicuspid teeth, such as are found in other Mammals. Combined with the fact that real congenital fission does occasionally take place in Seals and other Mammals, as pointed out by Mr. Bateson †, this brilliant suggestion undoubtedly sheds a new light on the origin of Cetacean teeth, and Dr. Kükenthal may well be congratulated on his clever interpretation of the facts. At the same time his ideas on analogy and methods of evolution would appear to be somewhat peculiar when he describes as analogous to such a congenital fission the common mechanical wearing down of a seal's teeth to the roots, whence by the loss of the crown two "teeth" are formed out of each one. Such a multiplication of teeth may occur in any rooted-toothed animal if it only live long enough, and can hardly be considered more "analogous" to true fission than the cleavage of a man's jaw by a battle-axe is analogous to hare-lip.

Another way, and one perhaps more probable, by which Cetaceans may have obtained their numerous teeth is also rendered possible by Dr. Kükenthal's observations on their embryology. Instead of trusting to the comparatively rarely occurring fission, the ordinary process of hypsodontism applied to narrow multicuspid teeth, such as those of certain

* For all evidence as to this remarkable suggestion we have the mere statement "Beim ersten Molaren ist dies oft noch deutlich nachweisbar, besonders schön z. B. an Embryonen von *Spermophilus leptodactylus*."

† In the paper already referred to.

Seals *, might easily and naturally produce a large number of small separate teeth, united to each other in embryonic stages but separate in after life. The different laminæ of the elephant's molars, produced, as we know, simply by hypsodontism, are perfectly separate from one another until just before eruption, and might easily come up as separate teeth did the needs of the animal require it. And in the Cetacea the gradual † lengthening of the separate cusps, combined with firstly the later and later development, and finally the total disappearance, of the connecting "crown," would be a *modus operandi* so simple and so much in accord with what is now going on in many instances, that I think the balance of probability is rather in its favour as compared to the theory of multiplication based on spasmodic fission ‡. It is, however, difficult to see how the relative claims of the two suggestions can be adjusted, for Dr. Kükenthal's observations are equally consistent with either, and direct palæontological evidence on the subject we can hardly hope to obtain.

Dr. Kükenthal's suggestion of the converse of the fission process, *i. e.* the fusion of separate teeth, as a means whereby the comparatively few and compound teeth of Mammals might have sprung from the many simple teeth of Reptiles, strikes me, on the other hand, as being by no means so happy. Not only is its *modus operandi* almost inconceivable, and quite unlike anything that is now going on, so far as we can see, but it is also quite uncalled for, as the number of teeth in the primitive Mammalia, commonly from 14 to 16 on each side of each jaw, so far from being much less, is actually *more* than that found in many of the Anomodontia §, certainly the

* E. g. *Ogmorhinus.*

† Indeed this process is by no means necessarily very gradual or slow, for within the single genus *Procaria* we have both brachyodont and hypsodont species, while the closely allied genera *Gerbillus*, *Meriones*, and *Rhombomys* present us, in the order named, with a complete transition from brachyodont *Mus*-like teeth to perfectly hypsodont, rootless, ever-growing teeth, with the laminæ entirely distinct from one another throughout. The close alliance of these genera in other respects shows in how short a period of geological time such great dental changes may take place.

‡ The striking fact observed by Dr. Kükenthal of the identity in number of the cusps of the young compound teeth with the total number of the adult simple teeth is decidedly in favour of the method now suggested, but, on the other hand, the appearances presented by the teeth of the early Cetaceans, such as *Squalodon*, seem to be on the whole more suggestive of fission than development by hypsodontism.

§ Of the Dicynodontia there are either no marginal teeth at all or only a single pair, while of the Theriodontia *Cynosuchus* has 11 or 12, *Æluro-saurus* 8 to 10, and *Lycosaurus* 9 or 10, while *Empedias* has 14 to 16 and *Titanosuchus* 16 or 17 on each side of each jaw. See Lydekker, Cat. Foss. Rept. B. M. iv. pp. 71–101 (1890).

most Mammalian of all the Reptilia. This fact is alone sufficient to discredit Dr. Kükenthal's theory.

Dr. Kükenthal seems to credit the advocates of primitive monophyodontism with supposing that the present single dentition of the Cetacea is an unmodified survival of the earliest monophyodont condition; but this is not the case, that view having never been taken, so far as I know, by any one but Baume, and by him on the basis of a wholly different theory. I myself* have supposed the ancestors of the Cetacea to have passed through a more or less diphyodont stage, and to have afterwards lost one of their two sets of teeth.

Dr. Kükenthal is to be congratulated on the brilliant results that have attended his investigations, and I trust that he will continue his efforts to find out the true homologies of the different teeth, and thereby facilitate the work of those who for systematic purposes need to have correct names under which these important organs can be compared and described.

XLIX.—*On some undescribed* Cicadidæ, *with Synonymical Notes.* By W. L. Distant.

I have had submitted to me for identification a number of species belonging to this family contained in the collections of the South-African Museum at Cape Town and the Australian Museum at Sydney. The new species from these sources and others which I have recently received are here described, with a few synonymical notes and corrections resulting from some perfunctory and hasty work in other quarters. The legacy of bewilderment left to students of the Cicadidæ by the late Mr. Francis Walker is already so sufficing that it is earnestly to be hoped that such difficulties be not increased by other writers unfamiliar with the family. Like all other zoological groups Cicadidæ require study, but have, unfortunately perhaps, been as much obscured in printed matter as has proved to be the fate of most families of the Rhynchota.

Cicadinæ.

Pœcilopsaltria Trimeni, sp. n.

Head and pronotum fulvous and moderately pilose, meso-

* *T. c.* p. 458.

notum and abdomen black. Head with a rectangular hollow fascia on front, anterior margins of vertex angularly enlarged at junction with front, a transverse fascia between the eyes and the area of the ocelli, black. Pronotum with a central longitudinal fascia transversely extended anteriorly and posteriorly, the incisures and lateral margins black. Mesonotum with two obconical fasciæ on anterior margin, the basal cruciform elevation, a sinuated fascia connecting same with the obconical spots, and lateral and posterior margins ochraceous. Abdomen above moderately pilose, anterior margins of the tympana ochraceous, segmental margins clothed with ochraceous hairs. Body beneath and legs ochraceous; head, sternum, and opercula greyish; anterior margin of head, lateral margins (excluding extreme edge) of sternum, a basal spot to face, spots and streaks to femora and tibiæ, and some small central spots to abdomen, black.

Tegmina fulvous, mottled with dark fuscous, the venation ochraceous at base and subsequently piceous towards apex; costal membrane ochraceous, its base and the basal cell largely black. Wings black, the base irregularly ochraceous to about centre, the outer margins broadly pale hyaline and with a creamy white spot at the apex of the black coloration.

Rostrum reaching the posterior coxæ, opercula moderately overlapping at centre.

Long. ♂ 26 millim.; exp. tegm. 80 millim.

Hab. S. Africa, Bushman Land (*Warden*). Cape Town Mus. and Coll. Dist.

The peculiar coloration of the wings will render this species easily recognizable.

Pœcilopsaltria Peringueyi, sp. n.

Closely allied to *P. Trimeni*, but differing in the following characters:—The head is more conical and less truncate in front, the lateral margins of the pronotum are more acutely angular in dilatation, the face is broader, the abdomen beneath with black fasciæ on the segments, and the wings without the ochraceous basal area, being wholly black, with the exception of the creamy white spot near apex and the broad pale hyaline outer margins.

Long. ♂ 24–26 millim.; exp. tegm. 68–78 millim.

Hab. S. Africa, Damara Land (*G. Tatton*). Cape Town Mus. and Coll. Dist.

Thopha sessiliba, sp. n.

Body above dark ochraceous. Head with the margin of front and a broad facia between the eyes pale castaneous. Pronotum with the incisures pale castaneous, the lateral and posterior margins stramineous. Mesonotum with four obconical castaneous spots, the central pair smallest. Abdomen above castaneous, the base ochraceous, the apical segment thickly greyishly pilose. Body beneath ochraceous; the face, fascia between face and eyes, legs, abdomen, and inflated tympana castaneous; anterior margins of tympana beneath ochraceous.

Tegmina and wings pale hyaline, the venation ochraceous, becoming darker towards apices. Tegmina with the costal membrane and the basal cell ochraceous; anterior margin of basal cell and anterior margin of claval area dark castaneous; claval area pale sanguineous.

Long., excl. tegm., ♂ 42 millim.; exp. tegm. 126 millim.

Hab. Australia, Sydney.

This species differs from *Thopha saccata*, A. & S., the only other described species of the genus, by the much more strongly sessile eyes, a character alone which will instantly separate the species. Besides this structural feature, the colour is much paler, the body almost glabrous above, and not pilose as in *T. saccata*; the head, sternum, and opercula beneath ochraceous and not very dark castaneous, and the abdomen is narrower and more attenuated.

Tibicininæ.

Graptotettix thoracica, sp. n.

Head, pronotum, and mesonotum bright pale ochraceous, abdomen pale sanguineous. Eyes fuscous. Pronotum with the posterior, lateral, and anterior (as far as behind eyes only) margins castaneous, and with two jet-black central, discal, curved fasciæ. Mesonotum with four pale castaneous obconical fasciæ, the central pair smallest. Abdomen above ochraceous near base. Body beneath and legs sanguineous; head beneath, anterior coxæ, and lateral margins of sternum ochraceous; spots on coxæ black. (In the specimen described the apex of one posterior femur and its tibia is almost black, the other posterior leg is uniformly sanguineous.) Tegmina and wings pale hyaline, more or less completely tinged with castaneous (in the specimen described more so on one tegmina and wing than on the other), the venation ochraceous or castaneous.

Long., excl. tegm., ♂ 28 millim.; exp. tegm. 75 millim.

Hab. Burma, Momeit.

This is a Burmese representative of the genus, hitherto only represented by a single Himalayan and Chinese species, *G. guttatus*, Stål. From this species it is differentiated by its totally different colour and markings of pronotum; the front of the head is also more angulated and the face more angularly tumid.

Mogannia effecta, sp. n.

Mogannia effecta, Walk., MS.

Body and legs very dark bluish black; tegmina with the basal half bluish black, this colour broadly margined at base, costal area, claval area, and just before its extremity with sanguineous.

Var. *a*.—The black area of tegmina streaked with pale fuscous and the sanguineous margin to same very dull on costal area and almost absent on claval area.

Var. *b*.—The venation in black area of tegmina sanguineous and concolorous with the surrounding margins.

Long., excl. tegm., 17–19 millim.; exp. tegm. 42–48 millim.

Hab. North-east India, Sumatra.

This is a common North-Indian species and of a very distinctive pattern and coloration of tegmina.

Bæturia bicolorata, sp. n.

Head, pronotum, and mesonotum pale greenish; abdomen warm ochraceous, its apex green. Eyes pale fuscous. Head beneath, sternum, and legs pale greenish, abdomen beneath ochraceous. Tarsi ochraceous.

Tegmina and wings pale hyaline, the venation greenish or ochraceous; costal membrane of tegmina and the extreme bases of tegmina and wings pale greenish.

Rostrum reaching posterior coxæ, with its apex black; anterior femora with three distinct spines.

Long., excl. tegm., ♀ 23 millim.; exp. tegm. 65 millim.

Hab. New Guinea, Fly River. Austr. Mus., Sydney, and Coll. Dist.

A *Bæturia* of striking bicoloration, of which at present I have only seen two female examples.

Tibicen (*Quintilia*) *Wealei*, sp. n.

Body above and beneath with the legs black; body beneath with a broad, lateral, pale ochraceous fascia on each side extending from eyes to apex of abdomen. Head with the eyes brownish ochraceous and a small ochraceous spot at base. Pronotum with a central, elongate, ochraceous spot and with the incisures brownish. Cruciform elevation at base of mesonotum ochraceous, black at centre and near its apices. Apices of femora and base of tibiæ narrowly ochraceous. Tympana, opercula, and three indistinct longitudinal series of very small spots to abdomen (one central, the other two lateral) dull greyish.

Tegmina and wings hyaline, the tegmina slightly infuscate, the venation black dotted with ochraceous; transverse veins at the bases of apical areas broadly and darkly infuscated, and a series of dark blackish marginal spots at the apices of longitudinal veins to apical areas; wings with an angulated blackish fascia situate on the transverse veins at the bases of the apical areas; wings and tegmina narrowly ochraceous at base.

The rostrum just passes the intermediate coxæ, the anterior femora have two large and robust spines and a third, small and indistinct, near apex; the head is broad and between the eyes is moderately truncate.

Long., excl. tegm., ♂ 19 millim.; exp. tegm. 45 millim.

Hab. S. Africa (*Mansel Weale*).

This species is allied to *T.* (*Quintilia*) *vitripennis*, Karsch, from which it is distinguished by the dark central fascia to the wings; in general appearance it somewhat resembles the Indian species *T. subvittata*, Walk.

MASUPHA, gen. nov.

Allied to *Cicadatra*. This genus is to be recognized principally by the tegmina, in which the basal cell is large, broader at base than at apex, and not twice longer than its extreme breadth; the costal margin of the radial area is more or less curved and gibbous, and the inner ulnar area is distinctly broader at base than at apex.

Masupha ampliata, sp. n.

Body above blackish or very dark castaneous; head and thorax moderately pilose, more thickly so beneath than above. Head with a large ochraceous spot on the anterior margins of vertex adjoining front; eyes pale fuscous. Pronotum with the margins and a central longitudinal fascia ochraceous, the incisures brownish. Mesonotum with two central, linear, ochraceous fasciæ, which are thickened posteriorly, the lateral margins very narrowly ochraceous and the cruciform elevation ochraceous, with its anterior margin blackish. Abdomen with almost the posterior halves of the segments ochraceous. Legs, rostrum (excluding apex), opercula, and central area of abdomen beneath ochraceous; streaks and spots to legs, outer basal angles of opercula, and the face castaneous.

Tegmina and wings pale hyaline and talc-like, their bases narrowly ochraceous, marked with fuscous; tegmina with the venation ochraceous or pale fuscous, the costal membrane and inner margin of claval area ochraceous, the transverse veins at the bases of second, third, and fourth apical areas infuscated, and some irregular fuscous spots or shadings on the longitudinal veins of the third, fourth, fifth, and seventh apical areas. Wings with the venation ochraceous and with some submarginal fuscous spots or shadings on the longitudinal veins to the third, fourth, fifth, and sixth apical areas.

Long., excl. tegm., ♂ 21 millim.; exp. tegm. 63 millim.

Hab. S. Africa, Ookiep. Cape Town Mus. and Coll. Dist.

A striking and uncommonly marked species; the pale wings and tegmina with their submarginal maculation, the ochraceously fasciated abdomen, and the gibbous costal margin to the radial tegminal area render it easily recognizable.

Masupha delicata, sp. n.

Very closely allied to the preceding species *M. ampliata*, but differing by its larger size and much less gibbously produced costal margin to the radial area of the tegmina; the abdomen above is more ochraceous, with a large black basal spot, the front of the head is pale castaneous, with two central darker lines, the body is much more uniformly ochraceous beneath, and the submarginal spots to tegmina and wings are paler and more obscure.

Long., excl. tegm., ♂ 23–27 millim.; exp. tegm. 65–72 millim.

Hab. S. Africa, Ookiep and Bushman Land. Cape Town Mus. and Coll. Dist.

The two species above described are structurally distinct by the length and shape of the tegmina.

Callipsaltria bicolorata, sp. n.

♂. Body black; apical margins of vertex of head, pronotal margins, two very obscure obconical spots to mesonotum, apices of cruciform elevation, apical margins of abdominal segments (some effaced), lateral margins of sternum, a spot at base of face, rostrum (excluding apex), and apex of abdomen beneath dull ochraceous; the rudimentary opercula greenish grey; legs black, spotted with ochraceous.

Tegmina and wings pale hyaline, the venation brownish or fuscous; costal membrane to tegmina ochraceous.

♀ (var.?). Transverse veins at the bases of second and third apical areas infuscated.

Long., excl. tegm., ♂ 20, ♀ 18 millim.; exp. tegm., ♂ 46, ♀ 45 millim.

Hab. S. Africa, V. Wyks Vley (*Alston*). Cape Town Mus. and Coll. Dist.

The largest of the species of *Callipsaltria* yet described.

Psilotympana infuscata, sp. n.

Head and thorax above black; abdomen reddish, with the base and a central longitudinal fascia black; apical margins of front and apex of head, posterior and lateral margins of pronotum, two curved central fasciæ to mesonotum, connected with the cruciform elevation and posterior margins of abdominal segments, ochraceous. Body beneath and legs pale ochraceous and moderately pilose; sulcation and striations of face, streaks to femora and tibiæ, and some small coxal spots, blackish.

Tegmina and wings pale smoky hyaline, tegmina with the veins fuscous and with slight marginal infuscations; wings paler.

Long., excl. tegm., ♂ 17 millim.; exp. tegm. 38 millim.

Hab. S. Africa, Hex River Valley. Cape Town Mus. and Coll. Dist.

This species is allied to *P. fusiformis*, Walk., from which it can at once be separated by the infuscated tegmina.

Fidicina Mülleri, sp. n.

Head, pronotum, and mesonotum dark olivaceous, sometimes almost black; abdomen above blackish; body beneath and legs dark olivaceous or blackish and strongly pilose; apices of the femora and bases of the tibiæ narrowly pale ochraceous; posterior tibiæ pale olivaceous, with the apices pitchy; rostrum (excluding apex) pale olivaceous. Eyes olivaceous; body above sparingly pilose, lateral margins of the abdomen prominently greyishly pilose.

Tegmina and wings pale hyaline, the venation ochraceous or fuscous; tegmina with the basal cell, costal membrane, postcostal area and base of claval area blackish; the transverse veins at the bases of the apical areas all darkly infuscated, and a submarginal series of small fuscous spots on the apices of the longitudinal veins to apical areas; wings with the base and half of anal area blackish, containing three ochraceous spots, the lowermost of which is somewhat bifid.

Long., excl. tegm., ♂ ♀ 31 millim.; exp. tegm. 90 millim.

Hab. Brazil, Santa Catarina.

This species is allied to *F. pullata*, Berg, but differs at once from the description of that species by the peculiar ochraceously-spotted black basal area of the wings.

The female now before me is much paler in coloration than the male.

Carineta tracta, sp. n.

♀. Head, pronotum, and mesonotum ochraceous; abdomen above castaneous. Head with two spots on front, the apical margins of vertex and the area of the ocelli black. Pronotum with a central subtriangular spot near base, with a small rounded spot on each side, black. Mesonotum with two central obconical spots, from which on each lateral margin a short line emerges, a central linear and two rounded spots in front of the cruciform elevation, a spot at the lateral margins, extreme basal margin, and a spot on anterior angles of basal cruciform elevation, black. Head beneath and sternum ochraceous, legs and abdomen beneath very dark castaneous; coxæ, apices of femora, bases of tibiæ, and posterior tarsi (excluding apices) ochraceous; two central longitudinal fasciæ to face, a spot between face and eyes, base and apical half of rostrum, very dark castaneous.

Tegmina and wings pale hyaline, the venation ochraceous and fuscous; tegmina with the costal membrane ochraceous; wings with a rather large fuscous marginal spot at apex of anal area, and a short ochraceous and black marginal streak at basal margin of same.

Long., excl. tegm., ♀ 28 millim.; exp. tegm. 82 millim.

Hab. Ecuador.

A species somewhat allied to *C. postica*, Walk., by the markings of the wings, but differing from that species by the larger, more robust, and differently coloured and ornamented body, much wider pronotum, shorter and broader head, &c.

Carineta centralis, sp. n.

Body above castaneous and pilose; head with the eyes, a central spot to front, apical margins of vertex, and a spot at base greenish ochraceous. Pronotum with the margins, a central fascia bifurcate posteriorly, and with some ovate discal markings, greenish ochraceous. Mesonotum with two central obconical spots, beneath and bounding which is a large triangulated spot, the lateral margins and basal cruciform elevation, greenish ochraceous. Abdomen with three longitudinal greenish-ochraceous fasciæ, one central and two lateral. Head beneath, sternum, and legs ochraceous, body beneath dark castaneous; apices of rostrum and tarsi pitchy.

Tegmina and wings pale smoky hyaline; the venation brownish ochraceous; tegmina with two indistinct fuscous longitudinal streaks in each apical area, and a marginal series of fuscous linear spots. Wings with a central fuscous spot near end of radial area, the apical margin and inner basal margin of anal area infuscated, and an outer marginal series of fuscous linear spots.

Long., excl. tegm., ♂ 21 millim.; exp. tegm. 65 millim.

Hab. Ecuador.

Apart from other characters this species may be recognized by the central fuscous spot to the wings, which, with the fasciated abdomen, allies it to *C. trivittata*, Walk., from which, however, it differs by its larger size, absence of dark spots to tegmina, the more produced and conical frontal portion of head, uniformly narrow central sulcation to face, &c.

Carineta matura, sp. n.

♂. Body and legs warm dull ochraceous. Head with the basal margin and area of the ocelli black, the front with two marginal blackish streaks. Pronotum with a narrow, dark, central, longitudinal line, on each side of which is an obliquely curved and dentate black line, a short black streak near each lateral margin, and lateral and inner basal margins also black. Mesonotum with two central black-bordered obconical spots on anterior margin, on each side of which is a longer and more acute spot, a waved and pointed spot in front of the cruciform elevation, and a short black basal streak on each side of the same. Abdomen above and beneath with the lateral margins strongly and palely pilose. Beneath the anterior and intermediate coxæ are spotted with pale fuscous, and the abdomen is marked with a central longitudinal fascia of the same colour.

Rostrum with the apex fuscous and reaching the posterior coxæ.

Tegmina and wings pale hyaline, the venation dull ochraceous.

Long., excl. tegm., 15 millim.; exp. tegm. 46 millim.

Hab. Venezuela.

The most closely allied species to the one here described is *C. calida*, Walk.

Melampsalta rosacea, sp. n.

♂. Head greenish ochraceous. Pronotum and mesonotum pale greenish, the last with two obscure obconical spots at anterior margin, and with two dark greenish but obscure fasciæ on each side. Abdomen rosy castaneous. Head and thorax beneath greenish ochraceous; legs pale greenish, with the apices of the tibiæ and the tarsi pale fuscous. Abdomen beneath paler than above, with the segmental margins narrowly ochraceous. Opercula pale greenish, obliquely directed inwardly, concavely narrowed on each side near base, and with their apices rounded.

Rostrum greenish ochraceous, its apex pitchy and just passing the intermediate coxæ. Anterior femora armed beneath with three strong spines.

Tegmina and wings pale hyaline, the first with the basal portion of venation greenish, remainder and that of wings pale fuscous.

Long., excl. tegm., 23 millim.; exp. tegm. 59 millim.

Hab. New Caledonia and Ruk Island.

A female specimen from New Caledonia now before me has the abdomen as dark beneath as above, with an obscure, central, longitudinal, pale fuscous fascia.

Melampsalta convicta, sp. n.

Body above brownish ochraceous. Head with the frontal margins and the area of the ocelli black. Pronotum with three small and very obscure black spots near anterior margin, the incisures also somewhat darker. Mesonotum with four obconical black spots, the outermost two very long, and two rounded spots in front of the anterior angles of the basal cruciform elevation, black. Abdomen with transverse fasciæ at the anterior segmental margins and a series of lateral marginal spots, black. Body beneath brownish ochraceous; the disk of lateral striations to face, apex of rostrum, and a basal spot to abdomen black; femora pale castaneous.

Tegmina and wings pale hyaline, the venation ochraceous; tegmina with the postcostal area infuscated.

Anterior femora with three distinct and robust spines, the apical one smallest. Abdomen (♂) very much attenuated to apex, which is also elongate.

Long., excl. tegm., ♂ 19 millim.; exp. tegm. 56 millim.

Hab. Norfolk Island.

A species to be superficially recognized by the attenuated abdomen and the infuscated postcostal area to the tegmina.

Melampsalta abdominalis, sp. n.

Body above black. Head with a central spot to front, apical margins of vertex, a central spot near base, and the eyes ochraceous. Pronotum with a central discal elongated spot, beneath which are two small transverse spots, ochraceous. A spot on each side of the cruciform elevation and the metanotal margin ochraceous. Abdomen with two oblique reddish ochraceous macular fasciæ on the last three segments, and in the female two elongate sulphureous spots at the base of the anal appendage. Head beneath and sternum black; a spot at base and the margins of face, a marginal spot near insertion of antennæ, coxal margins, legs and abdomen beneath reddish ochraceous; longitudinal fasciæ to legs, the anterior tibiæ, tarsal claws, central basal spots, and a series of marginal spots to abdomen black.

Tegmina and wings pale hyaline, the venation blackish; costal membrane and postcostal area of tegmina ochraceous.

Long., excl. tegm., ♂ ♀ 20 millim.; exp. tegm. 58–60 millim.

Hab. Australia, Victoria (*Stephen Barton*). Austr. and Tasmania Mus., Syd., and Coll. Dist.

In one varietal female specimen now before me the lateral ochraceous, macular, abdominal fasciæ extend over the last four segments, with a central spot of the same colour on the preceding segment.

This species is allied to *M. Landsboroughi*, Dist., but is especially to be distinguished by the abdominal markings.

Melampsalta extrema, sp. n.

Head, pronotum, and mesonotum black. Abdomen ochraceous, with the basal margin and the two apical segments black; a central longitudinal spot to the penultimate segment and the posterior margin of the apical segment ochraceous. Head with the front excluding two marginal spots, anterior marginal angles of vertex, and the ocelli ochraceous; eyes pale brownish. Pronotum with the margins, and a central longitudinal fascia, on each side of which are discal curved and transverse streaks, ochraceous. Mesonotum with two central fasciæ thickened posteriorly, the lateral margins and basal cruciform elevation (excluding anterior angles and central margins) ochraceous. Body beneath and legs ochraceous, femora streaked with castaneous; a broad central fascia to face, head beyond face, coxal fasciæ, sternal spots and basal angles of abdomen black.

Tegmina and wings pale hyaline, their bases very narrowly ochraceous, the venation generally fuscous; costal membrane to tegmina ochraceous, with its outer margin narrowly fuscous. Wings with the inner margin and outer apical angle of claval areas infuscated.

Female with the upper surface of the abdomen ornamented with transverse central segmental black spots, and the two terminal segments are not wholly black as in the male.

Long., excl. tegm., ♂ ♀ 18 millim.; exp. tegm. 47 millim.

Hab. N.W. Australia, Roebourne. Austr. Mus., Syd., and Coll. Dist.

A distinct species, to be primarily distinguished by the colour of the abdomen, the thoracic markings of the upper surface, and the fuscous markings on the claval area of the wings.

Melampsalta rotundata, sp. n.

♂. Body above black and moderately greyishly pilose. Head with the anterior angles of vertex, an indistinct central linear basal spot, and the ocelli ochraceous. Pronotum with the basal margin and some indistinct anterior and posterior marginal spots ochraceous. Mesonotum with two central linear and inwardly angulated fasciæ, the lateral margins and basal cruciform elevation ochraceous. Abdomen (excluding basal segment) with transverse ochraceous segmental fasciæ, and macularly marked with grey pilosity. Margins of face, legs, and abdomen beneath ochraceous; femoral streaks and bases of tibiæ blackish.

Tegmina and wings pale hyaline, the venation ochraceous, becoming fuscous towards apex; tegmina wide, arched, and rounded.

Female.—From the specimen now before me generally paler in hue than the male.

Long., excl. tegm., ♂ ♀ 14–15 millim.; exp. tegm. 31 millim.

Hab. South Africa, Stellenbosch. Cape Town Mus. and Coll. Dist.

A very distinct South-African species, defined by the broad and rounded tegmina, approaching in this respect the peculiar facies of some Australian species.

Synonymical Notes.

The following synonymy refers to two South-African species, of which I was able during the lifetime of my late friend Dr. Signoret to compare the types in his collection made by the late Dr. Stål, with those of Mr. Walker in the British Museum :—

Tibicen (*Quintilia*) *primitiva.*

Cicada primitiva, Walk. List Hom. i. p. 218. n. 171 (1850).
Tibicen primitiva, Stål, Œfv. Vet.-Ak. Förh. 1862, p. 485.
Tibicen (*Quintilia*) *hæmatinus*, Stål, Hem. Afr. iv. p. 40. n. 18 (1866).
Quintilia hæmatina, Karsch, Berl. ent. Zeitschr. xxxv. p. 121. n. 52 (1890).

Tibicen (*Quintilia*) *monilifera.*

Cicada monilifera, Walk. List Hom. i. p. 219. n. 172 (1850).
Tibicen monilifera, Stål, Œfv. Vet.-Ak. Förh. 1862, p. 485.
Tibicen (*Quintilia*) *maculinervis*, Stål, Hem. Afr. iv. p. 33. n. 8 (1866).

In the 'Journal of the Linnean Society' (Zoology), vol. xxiv. pp. 128–131 (1891), Mr. Kirby has described as new four species of Cicadidæ from Ceylon. These descriptions may be interpreted as follows :—

Dundubia mixta, Kirby, *l. c.* p. 128, = *Cicada viridis*, Fabr. Syst. Rhyng. p. 39. n. 28 (1803), excl. syn.

Pomponia Greeni, Kirby, *l. c.* p. 129, = *Pomponia Ransonneti*, Dist. Ann. & Mag. Nat. Hist. ser. 6, vol. i. p. 372 (1888).

Pomponia elegans, Kirby, *l. c.* p. 130, = *Terpnosia* * *psecas*, Walk. List Hom. i. p. 65. n. 28 (1850).

Cicada apicalis, Kirby, *l. c.* p. 131, = *Tibicen nubifurca*, Walk. List Hom., Suppl. p. 28 (1858).

* *Terpnosia*, gen. nov. Closely allied to *Pomponia*, but with the tympana almost entirely uncovered, thus locating the genus in the subfam. Tibiceninæ. (More fully described and figured in my forthcoming part of the 'Monograph of Oriental Cicadidæ.')

In the 'Transactions of the New Zealand Institute,' vol. xxiii. p. 49 (1890), Mr. G. V. Hudson has published a paper on "New Zealand Cicadæ" *.

Cicada muta, Huds. *l. c.* p. 51.—Mr. Hudson thus refers to the well-known *Melampsalta muta*, Fabr., and describes several varieties which apparently belong to two distinct species—*M. muta*, Fabr., and *M. angusta*, Walk. These varieties have also previously been described by Walker as distinct species, while Mr. Hudson again describes under the name of *Cicada aprilina* (*l. c.* p. 53) another form of the Fabrician species. The synonymy is as follows :—

Melampsalta muta.

Tettigonia muta, Fabr. Ent. Syst. 4, p. 23. n. 35 (1775) ; Syst. Rhyng. p. 43. n. 53 (1803).
Cicada muta, Oliv. Enc. Méth. v. p. 757. n. 48 (1790).
Cicada cutora, Walk. List Hom. i. p. 172. n. 116 (1850).
Cicada ochrina, Walk. List Hom., Suppl. p. 34 (1858).
Melampsalta muta, Stål, Œfv. Vet.-Ak. Förh. 1862, p. 484.
Cicada muta, Huds. (part.), Trans. N. Zeal. Inst. xxiii. p. 51 (1890).
Cicada aprilina, Huds. *ibid.* p. 53 (1890).

Melampsalta angusta.

Cicada angusta, Walk. List Hom. i. p. 174. n. 121 (1850) ; Stål, Œfv. Vet.-Ak. Förh. 1862, p. 482.
Cicada rosea, Walk. List Hom. i. p. 220. n. 173 (1850).
Cicada bilinea, Walk. List Hom., Suppl. p. 34 (1858).
Melampsalta rosea, Stål, Œfv. Vet.-Ak. Förh. 1862, p. 484.
Cicada muta, Huds. (part.), Trans. N. Zeal. Inst. xxiii. p. 51 (1890).

Cicada tristis, Huds. *l. c.* p. 52, = *Melampsalta scutellaris*, Walk. List Hom. i. p. 150. n. 88 (1850).

Cicada iolanthe, Huds. *l. c.* p. 53, belongs to the genus *Melampsalta*. In a book entitled 'An Elementary Manual of New Zealand Entomology,' bearing date 1892, Mr. Hudson gives a figure of a *Cicada iolanthe*, sp. n., without any description or reference to his previous description in the

* This family name should be more correctly spelt "Cicadidæ," especially as Mr. Buckton has even more erroneously used the term "Cicadæ" for nearly the whole of the British Homoptera ('Monog. of the British Cicadæ,' by G. Bowdler Buckton, 1890–91). "Philosophical entomologists" who contemn "systematic entomologists" must at least be protected by their weaker brethren from forming wrong conclusions on careless systematic work.

Trans. New Zeal. Instit. for 1890. This figure must be ignored, as the colour is unlike the species and the venation portrayed is also different from any known genus of Cicadidæ.

Cicada cassiope, Huds. *l. c.* p. 54, = *Melampsalta nervosa*, Walk. List Hom. i. p. 213. n. 166 (1850).

L.—*Contributions towards a General History of the Marine Polyzoa*, 1880–91.—*Appendix*. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from vol. viii. p. 480.]

'Annals,' August 1881 (p. 65 sep.).

Mucronella teres, sp. n.

Syn. *Mucronella lævis*, MacGillivray, Trans. Roy. Soc. Victoria, July 1882; Prodr. Zool. Vict. decade xii. p. 64, pl. cxvi. fig. 3.

There can be no doubt that MacGillivray's *M. lævis* is identical with the present species, of which it must rank as a synonym. The only differences between the two as described are that in *M. lævis* three spines are present in front of the oœcium on each side, whilst in the specimens which I examined there were only two, and that the small nodular projection on the inner face of the mucro in *M. teres* is not noted by MacGillivray. These points are quite immaterial.

Ibid. (p. 65 sep.).

Mucronella spinosissima, sp n.

This species is identified by Waters* with *Mucronella Peachii*, var. *octodentata*, Hincks, and Miss Jelly has taken the same view in her 'Catalogue;' but I am quite unable to accept their decision. *M. spinosissima* is, I have no doubt, identical with the fossil form from New Zealand described by Waters (*loc. cit.*); it agrees with his diagnosis even in

* "Tertiary Cheilostomata from New Zealand," Quart. Journ. Geol. Soc. for Feb. 1887, p. 56.

minute particulars *, but it differs essentially from *M. Peachii*, var. *octodentata*. From the latter it is distinguished by its lageniform cells, the tall, neck-like, tubular peristome, which is more than suberect, sometimes standing up almost at right angles to the cell-wall, the rim bearing at the back and round the sides about eight rather short spines set closely together, the front margin carried up into a somewhat broad mucro, often bi- or tridentate, and by its recumbent oœcium. It is also furnished with an oral denticle, but it differs in form and position from that of the variety *octodentata*. The cells of *M. spinosissima* are very ventricose below, the surface is smooth and shining, and a line of small circular pores runs round the margin. I have no doubt of its distinctness from the British form.

In my "Report on the Polyzoa of the Queen Charlotte Islands" I have described a supposed variety of the present species under the name *M. spinosissima*, form *major* †. Further consideration has convinced me that the supposed variety is really a distinct species, with some marked characteristics, of which the tubular structure in the cell-wall is probably the most important. I propose to name it *Mucronella perforata*.

Miss Jelly also ranks *Lepralia multispinata*, Busk, as a synonym of the variety *octodentata* ‡. Upon this I can only remark that the general character and the details of structure seem to me strikingly dissimilar in the two forms. This must be apparent, I think, on a comparison of Mr. Busk's figure with my own. I may direct attention specially to the enlarged figure of the orifice of *L. multispinata* §, which represents a totally different structure from that which is characteristic of *M. spinosissima*.

In his 'Challenger' Report (part 1, p. 160) Busk has described a variety of *Mucronella ventricosa*, which he has named *multispinata* and which he was inclined to think might be identical with my *M. Peachii*, var. *octodentata*. His form, he contends, must be referred to *M. ventricosa* rather than to *M. Peachii*, and judging from the detailed account which he has given of it there can be little doubt that he is right. On the other hand, some of the most

* It is furnished, like the fossil species, with the broad, flat, oral denticle, directed downwards and overhanging a large portion of the orifice, mentioned by Waters. It may be added that the upper margin of the primary orifice is distinctly crenulate.

† "Report Pol. Q. C. I." p. 27 (sep.), pl. iii. fig. 3.

‡ 'Synonymic Catalogue,' p. 195.

§ Quart. Journ. Micr. Sci., "Zoophytology," n. s. i. p. 78, pl. xxxii. fig. 6.

distinctive features of *M. Peachii* are present in my variety—the smaller cell, the absence of striation on the front wall, the less massive mucro, and the comparative smallness of the oral denticle. The two forms are probably distinct; Mr. Busk's figure in the 'Challenger' Report can hardly be referred to the var. *octodentata*.

M. Peachii and *M. ventricosa* are closely allied species and have recently been united by Lorenz. They are liable to much variation, but there is a strongly marked character about the normal *M. ventricosa*.

Ibid. (p. 66 sep.).

Mucronella tricuspis, sp. n.

Syn. *Exochella longirostris*, Jullien, Mission du Cap Horn, Bryozoaires, vol. vi. 1888, p. 55, pl. iii. figs. 1–4.

I can see no difference of any moment between this species and *Exochella longirostris*, Jullien. The pores round the margin of the cell in the latter are wanting in my specimens of *M. tricuspis*; but this is a variable character and has no diagnostic value. The difference may be due to the degree of calcification. Except in this one particular there is a close agreement between Dr. Jullien's figure (fig. 4), which is an admirable one, and my own.

As for the genus *Exochella*, it seems to me to be superfluous. It is founded on a single character of no special importance—the elongate tooth on the lower margin of the orifice, "forming a kind of spur," and dividing the lower lip of the peristome into two distinct portions. If genera are to rest on such slight foundations they may be indefinitely multiplied and will lose altogether their significance and value as representative of leading morphological types.

Additional Loc. Tierra del Fuego; Chiloe Archipelago (*Darwin*); Simon's Bay, Cape of Good Hope; Prince Edward Island, 80–150 fath. (*Busk*, '*Chall.*' *Rep.*); Port Phillip Heads and New Zealand (*MacG.*). Fossil: Petane (*Waters*); Ile Hoste, baie Orange; Canal du Beagle, au sud de l'île Gable (*Jullien*).

Ibid. (p. 66 sep.).

Rhynchopora longirostris, sp. n.

Not identical with *Mucronella tubulosa*, Hincks (see 'Annals' for August 1891, p. 172).

Ibid. (p. 68 sep.).

Cellepora granum, sp. n.

For synonyms see Miss Jelly's 'Catalogue.'

Waters has remarked that this species is closely allied to *Lagenipora spinulosa*, Hincks, and *L. lucida*, H. There are no doubt points of resemblance, but the differences in the structure of the zoœcium &c. are probably of sufficient importance to justify us in referring them to distinct genera. The first of these species (*L. spinulosa*) he considers to be probably identical with *Cellepora bicornis*, Busk *. I am indebted to Dr. Günther's courtesy for the opportunity of examining specimens of the latter from the 'Challenger' Collection, and I am inclined to think that they are distinct forms. One of the marked features of *L. spinulosa* is the strongly reticulated surface of the cells. They are completely covered below the tubular peristome with rather large roundish foramina closed in by a silvery-white membrane and surrounded by a raised line, forming a distinct network over the cell-wall. This is the usual and characteristic structure, though occasionally in certain states it may be more or less obscured. Of this there is no mention in Busk's description of *Cellepora bicornis*, nor is there a trace of it in the specimens which I have examined. A few large circular pores are present along the margin of the cell and sometimes round the orifice.

The aviculiferous processes in *C. bicornis*, which are tall and stout, are placed at the front of the peristomial orifice ("præoral," according to Busk), and above them are frequently two spinous processes; in *L. spinulosa* they rise on each side close to the *upper* margin, and immediately below the oœcium, when present. In this species the front margin of the orifice (peristomial) is elevated above the rest, somewhat everted, plain or trimucronate; in *C. bicornis* it is usually sinuated between the aviculiferous processes †.

The avicularium of this species is minute as compared with that of the 'Challenger' form. There are also differences in the oœcium. That of *C. bicornis* is small, globular, smooth and glossy, with a roundish foramen closed in by membrane ("fissure," Busk) in front, surrounded by a raised line; while that of *L. spinulosa* is semicircular, usually placed far back, and often considerably below the orifice of

* 'Challenger' Report, part 1, p. 202, pl. xxx. figs. 1 and 12.

† These processes appear to rise from the primary orifice.

the peristome, the front flattened, and surrounded by an arched line, within which the surface is minutely pitted. The cells also differ in shape in the two species—those of *C. bicornis* are very much swollen below and erect; the walls are smooth and entire. The large spatulate avicularia are not present in *L. spinulosa*.

Additional Loc. Off East Moncœur Island, Bass Straits, 38 fath. (*Busk*, '*Chall.*' *Rep.*); New Zealand; Port Jackson, 8 fath.; Naples (*Waters*).

Ibid. (p. 68 sep.).

Lunulites incisa, sp. n.

This species seems to belong to the genus *Conescharellina*, d'Orb. A question arises as to its specific name. Haswell described it in 1880 as *Conescharellina conica*; my account of it appeared in 1881. So far therefore as time is concerned Haswell's name has precedence. But it has been suggested by Mr. Waters that as a *Batopora conica* and *Lunulites conica* had been previously published, Haswell's name should be rejected and *incisa* retained. How far this will hold good can only be settled when the genera of the Selenarian family have been more accurately determined.

Ibid. (p. 69 sep.).

Membranipora roborata, sp. n.

In the original account of this species I have left its systematic position undetermined, referring it provisionally to *Membranipora*. But I have no longer any doubt that it is rightly placed in this genus. Its zoœcium is strictly conformed to the Membraniporidan type; the mere habit of growth we now know to be absolutely immaterial, whilst the curious modification of the radical fibres (or tubes) is associated with the most diverse zoœcial characters and has no generic significance. I am therefore unable to accept Mr. MacGillivray's genus *Craspedozoum* *, which, so far as *the essential points* in the diagnosis are concerned, is a synonym of *Membranipora*. The peculiarity in the radical tubes occurs in *Microporella*, in *Menipea*, in *Schizoporella* (probably), and no doubt elsewhere. This structure is specially liable to modifications correlated with diversities of habitat, and has no significance as an indication of genetic affinity.

* "Descriptions of new or little-known Polyzoa," part ix. fig. 4.

MacGillivray describes two species which he regards as new, *C. ligulatum* and *C. spicatum*; but the differences between these forms and *M. roborata* must be regarded, I think, as merely varietal. The unilaminate condition of the zoarium has certainly no specific value; cases are not rare in which the bilaminate structure and the unilaminate occur in one and the same species. The other points relied upon—the more slender branches, the occurrence of one avicularium instead of two, the slight differences in the spines, and the spike-like process on the oœcium—are all well within the limits of specific variation *.

Ibid. (p. 70 sep.).

Membranipora amplectens, sp. n.

This interesting form is entitled to rank as the type of a new genus on the ground of the remarkable structure of its ovicelligerous cells. The oœcium itself is not merely a variation upon the ordinary form, but has a distinct morphological character.

Family **Membraniporidæ.**

HETEROŒCIUM, gen. nov.

Zoœcia pyriform, aperture large, occupying about two thirds of the front, closed in by a membranous covering and furnished with marginal spines (calcareous); immediately below the aperture a tall articulated spine. *Oœcium* borne on gigantic cells, which are elongate and of considerable width, extending over almost the whole of the aperture, which is covered by a roof composed of rib-like processes springing from the opposite sides of the cell-wall, and bending slightly inward so as to meet in the centre, where their extremities are soldered together, whilst they are united laterally by a calcareous expansion, the oral arch pointed; *ovicelligerous cells* placed between the divergent lines of zoœcia at a bifurcation.

This form is nearly allied, so far as the structure of the zoœcium is concerned, to the group of Membraniporidæ which Busk (following d'Orbigny) has referred to the family Electrinidæ †, but is separated from it and from all the Cheilo-

* *C. ligulatum* and *C. spicatum* are placed amongst the synonyms of *Membranipora roborata* in Miss Jelly's 'Catalogue.'

† 'Challenger' Report, pt. 1, p. 77.

stomatous genera by its oœcial characters. Its ovicelligerous cell differs essentially from the *gonœcium* or sexual cell which occurs amongst the *Adeoneæ*. The latter is an enlarged and otherwise modified zoœcium set apart for reproductive functions. In the present genus there is a true external oœcium or special chamber for the reception of the embryo, but instead of being an appendage of the zoœcium, as is usual, it is an integral part of it, occupying the whole of the upper (or anterior) portion of the cell which is inclosed by a ribbed roofing. This bears a close resemblance in structure to the front wall of the Cribriline zoœcium, and like it has originated in a modification and adaptation of the marginal spines.

The morphological history, then, of the oœcium in this form is unique and its structural elements differ altogether from those which are met with in ordinary species. There is certainly a valid claim to generic rank.

In the absence of living specimens and of specimens preserved in spirit it is hardly possible to interpret the structure and its functions fully; but we may hope that the observations of the Australian naturalists will soon enable us to complete the history.

Ibid. (p. 72 sep.) *.

Membranipora variegata, sp. n.

This species appears to be identical with *M. echinata*, d'Orb. (Voy. Amér. mérid. pt. 4, p. 16). D'Orbigny does not mention the pedicellate avicularia, and his diagnosis is wanting in fulness; but there can be no doubt that he had the present species in view. It will rank as *M. echinata*, d'Orbigny.

Additional Loc. Chili and Peru (*d'Orb.*); Queen Charlotte Islands (*Dr. Dawson*).

Ibid. (p. 73 sep.).

Diachoris (*Beania*) *distans*, sp. n.

Waters ("Australian Bryozoa," 'Annals' for August 1887, p. 94) identifies this species with *Diachoris spinigera*, MacG. He says, "There is considerable irregularity in the number of spines, and from this specimen I consider that *D. distans*, Hincks, is too closely allied to be separated as a species."

* See also 'Annals' for February 1882, ser. 5, vol. ix. p. 81 (sep.).

I have already pointed out the many and important differences which there are between the two forms. A comparison of MacGillivray's figure with my own will show that they are more or less dissimilar in almost every element of the structure. It is not the mere *number* of the spines which is different; the difference in character is much more important. MacGillivray's description, "long, slender, incurved spines," does not apply to those of *B. distans*. Their form and arrangement, as shown in his figure, offer a complete contrast to those of the present species *.

It is unnecessary that I should repeat here the careful comparison of the two forms which is embodied in the original account of *B. distans*; but I may emphasize the differences in the avicularia, of which enlarged figures are given.

'Annals,' Feb. 1882 (p. 80 sep.).

Membranipora pilosa, Linn., form *multispinata*.

This form was referred doubtfully to *M. pilosa*, but I now regard it as a distinct species which will rank as *M. multispinata* (see the original description, *loc. cit.* and the figure on plate v.).

[To be continued.]

BIBLIOGRAPHICAL NOTICES.

Catalogue of the Type Fossils in the Woodwardian Museum, Cambridge. By Henry Woods, B.A., F.G.S. With a Preface by T. McKenny Hughes, M.A., F.R.S. 8vo. 180 pp. Cambridge, 1891.

To enable biologists to be within their rights, and not to infringe on those of others, in giving original names to new genera of animals and plants, there have been provided published lists (and very lengthy catalogues they are) of the appellations already appropriated; and lists of specific names are available to a limited extent; but still the recorder of a new species has to be *assured* whether or no his specimens differ from or agree with already published forms; and to this end it is requisite that he should *see* those that have been already described, the published figures and descriptions not being always satisfactory.

* 'Polyzoa of Victoria,' decade v. p. 32, pl. xlvi. figs. 3.

These particular specimens or *published types* (by no means often real biological types of species or genera) have unfortunately in many cases been mislaid, or even lost; but to ensure that in future palæontological workers should be able to find and examine them, it has been proposed that catalogues should be made of such "types" existing in public and private museums. The Bristol Museum has already supplied such a list, and the Catalogue before us is one of such a desirable series. It contains notes on 1666 specimens that have been either described or alluded to (with or without figures) in books and memoirs, with references to authors, works, localities, and formations; also to donors and collectors; adding synonyms and occasional notes.

Of these published "types," then, in the Woodwardian Museum palæontologists may find: fossils of doubtful alliance, 17; plants, 37; sponges, 22; graptolites, 29; corals, 126; echinoderms (in seven divisions), 122; worms, 13; polyzoans, 43; brachiopods, 143; lamellibranchs, 291; gasteropods, 267; other molluscs, 141; trilobites, 136; decapods, 34; phyllocarids, 24; other crustaceans, 15; fishes, 75; reptiles, 74; other vertebrates, 17.

This book is well and clearly printed. There are but few verbal errors to be noted besides those in the "Corrigenda,"—such as *Anomozamites minus* [*minor*], from the careless copying of a former specific name; so also *Acidaspis erinaceus* instead of *erinacea*, and p. 45, *Trachyderma lævis* [*ve*]; p. 115, *Trochonema bijugosa* [*sum*]; p. 126, *Crioceras occultus* [*tum*]; p. 169, *Doratorhynchus validum* [*dus*]; *Bowmani*, at p. 146, and *Philippi*, at p. 169, are misspelt, and the diphthongs are dropped in *Mæandrina* and *Thamnastræa*. At p. 154 "*Glyphæa*" should be *Glyphea*, and *sublevis* should be *sublævis*. These are flaws in a book of nomenclature. The degradation of the rightful capitals in specific terms derived from proper names, and the capricious reduction of *ii* in genitives to a single *i*, are nomenclatural faults due to the mistaken notions of the neo-classicists. We should have liked that their puristic notions had been better directed, and that they had printed *Lindstrœmia* and *Gœpperti* with real diphthongs instead of with the modified vowel of the Germans; so also *Münsteri* should be *Muensteri*.

Delagoa Bay: its Natives and Natural History. By Rose Monteiro. With Illustrations. G. Philip and Son, 1891.

This brightly-written little book is from a lady whose name is well known at Kew Gardens for the dried plants and seeds she has sent home, and also to many entomologists as a collector of insects; the frontispiece showing nine new species of African butterflies which she discovered during her second visit to Delagoa Bay. The author was no novice in African life, for she had already been in Angola with her husband, the late J. J. Monteiro, an Englishman of Portuguese descent, who wrote an excellent work on Angola and the Congo, and who died on the first visit of the pair to Delagoa Bay, whither they had gone with expressly scientific aims. Notwithstanding its sad associations Mrs. Monteiro speaks well of this port, which she calls "the finest natural harbour of South Africa;" adding that the fever and ague are much over-rated or largely due to indiscretions in eating and drinking; while she makes fun of her troubles with the lazy, drunken, thievish Kafir servants, and even extracts some amusement from the insect plagues, which are the worst of all and omnipresent. Many practical hints are given respecting the killing, baffling, or circumventing these last nuisances; and the experiences of the *Papalata* or "collecting lady" are told with a brightness of style which in noway detracts from their scientific value. Each chapter is illustrated with charming vignettes by A. B. and E. C. Woodward, after original sketches by the author; among the best being *Breviceps mossambicus* devouring ants, and *Solpuga fatalis* in ambush, waiting for his antagonist—a weird picture. From first to last this work maintains its interest, and there is not a suspicion of padding about it.

La Plume des Oiseaux : histoire naturelle et industrie. Par Lacroix-Danliard.—*L'amateur d'Oiseaux de Volière.* Avec 51 Figures dessinées d'après Nature. Par Henri Moreau. Baillière et fils: Paris, 1891.

The plan of the first work is to give a sketch of the birds which yield feathers or down useful to man, the history of the preparation of these productions, the markets for them, and their commercial importance. On these or similar lines it is easy to compile a loose treatise on birds in general, especially on those of which woodcuts are available, many of them being very old acquaintances. Accuracy is not a distinguishing characteristic; for instance, in fig. 42, which, we are expressly told, is a representation of one of the ostrich-parks in Algeria, the birds have *three* well-developed toes on each foot, and in fig. 41 the ostrich pursued by a mounted Arab is similarly gifted. The letterpress has no scientific value, but as a book for young people who wish to improve their knowledge of French it can be recommended, as being more interesting than the works usually put into their hands.

The second work is far superior to the preceding as regards the letterpress, for the author is evidently no mere compiler, but has a practical acquaintance with cage-birds. For young students of French this book has the same advantages as the former, but it is more "serious," and consequently less entertaining, though of greater practical utility.

MISCELLANEOUS.

Note on Mr. Minchin's Paper on Ascetta.
By R. v. Lendenfeld.

In the 'Quarterly Journal of Microscopical Science' (vol. xxxii. p. 260) Mr. Minchin argues against the statement—made, as he says, by me—that the central cavity of *Euplectella aspergillum* is a pseudoscular tube forming part of the inhalant system.

In reply to this I must observe that I never said anything of the kind, and that in perusing the passages of my 'Monograph of Horny Sponges,' from which Minchin quotes, I fail to see how he could so far misunderstand my statements. What I do say is "*that I think it may not be impossible that in some of the cup-shaped or tubular Hexactinellida*" the central cavity may be pseudoscular (inhalant). I never said that the central cavity *is* inhalant in *any* Hexactinellid, not to speak of *Euplectella*, where such an assumption would be quite preposterous.

As a foreigner I am unable to express myself in English as clearly as I might desire; but nevertheless I feel that in this case some hostile motive must have prompted Minchin to so surprising an interpretation of my statements.

I can only say, (1) that I never doubted the exhalant nature of the central cavity in *Euplectella*; (2) that I fail to see how any one can gather from my statements such a meaning as Minchin imputes to them; (3) that I uphold all my statements and conclusions on this subject as correct and logical; and (4) that I regret to see a misinterpretation of this kind used by a student of natural history as a weapon in a scientific controversy.

University, Innsbruck,
March 8, 1892.

Gymnorhynchus reptans, *Rud., and its Migration.*
By M. R. Moniez.

Among the parasites of marine fishes one of the most curious is certainly *Gymnorhynchus reptans*, which is harboured by several hosts, and is in particular very common in the rough sun-fish (*Orthagoriscus mola*), in which it inhabits by preference the liver and muscles. This species is distinguished from the other species of Tetrarhynchidæ which are known in the larval state by the curious appendage which is found at the extremity of the vesicle into which the animal retracts the anterior portion of its body, after the manner of a Cysticercus. This appendage, which, in our species, may attain the length of a metre, forms an inextricable network in the tissues of the host, and it is extremely difficult to extricate it entire; a cyst protects the parasite throughout the whole of its length.

Gymnorhynchus reptans was hitherto unknown in the perfect state: I have had the good fortune to meet with it in this state in *Oxyrhina glauca*. Baron de Guerne found at Concarneau in the intestine of this shark some worms of large size, which he was good enough to hand over to me to study; they unquestionably belong to this species.

The individuals observed reach the length of 30 centim., while the breadth of the neck scarcely exceeds that of the initial portion of the chain; but this organ is much thicker, since it attains a depth of 2 millim., while the first segments only measure about half a millimetre; the ripe segments are almost square, measuring 4·5 to 5 millim. in breadth by 5 to 6 millim. in length; they are swollen in the middle and marked at this point with a broad brown spot, which corresponds to the mass of ova; the other segments diminish successively in size until we come to the head.

Contrary to what was supposed by van Beneden, the vesicle into which the anterior portion of the larva retracts itself, as well as its enormous appendage, do not pass over to the final animal and do not become sexual; they are digested by the new host, and of this exceedingly long animal there remains absolutely nothing but the neck and that diminutive portion of the tissues which prolongs it, and which we formerly called the *generative zone*, at the expense of which the chain of segments is formed.

We may ask ourselves what is the morphological significance of the appendage which prolongs the vesicle of *Gymnorhynchus* in the larval state—an appendage which is not found or which is very rudimentary in the forms allied to this species: there is no doubt that this is a structure perfectly comparable to that which we have pointed out in several Cestodes of the type of *Tænia serrata*, which exists in many other Cestode larvæ, if not in all, and which we notice in particular in all those Cysticerci recently found in freshwater Crustacea. This portion of the body, which corresponds to the hexacanth embryo, develops but little, or frequently falls off at an early period, remaining simply indicated at the extremity of the Cysticercus by an umbilicus of which we have explained the mode of formation. It is necessary to note that, in the particular case of *Gymnorhynchus*, the appendage is not degenerating, and that it retains a large degree of vascularity and does not show any laceration in the centre; it is a mistake, moreover, to have represented it as jointed, since it only presents simple folds in its entire length.

I would add, in conclusion, that the dimensions of *Gymnorhynchus* in the perfect state prevent the conclusion, advanced by Orley in a positive manner, that the Cestodes of the cartilaginous fishes are always of small size.—*Comptes Rendus*, tome cxiii. no. 24 (December 14, 1891), pp. 870, 871.

On Coral-Reefs of the East-African Coast.
By Dr. A. Ortmann, of Strassburg.

Since the publication of a more detailed treatise upon the subject of my investigations into the coral-reefs of the German East-African coast will still require some time, I venture to communicate herewith a brief account of the most important of the results which have been gained.

The entire East-African coast-region, so far as I explored it, from Zanzibar southward to Mikindani, is one of negative shore-displacement. I was able to collect proofs of this at the most widely different spots; just as, moreover, similar observations are already available for two localities (Zanzibar and Songa-Songa Isl.). It is probable that the same movement extends to the greater portion of the East Coast of Africa.

The development of the coral-reefs also corresponds to this negative movement: they accompany the coast throughout and are true shore reefs ("Strandriffe"). Their horizontal extension in the direction at right angles to the coast is in close connexion with the slope of the sea-bottom from the shore-line to deep water. Where great depths are found close to the shore (which occurs in our territory chiefly in the south, near Lindi and Mikindani) there is only a narrow shore reef; but where the sea remains shallow to a greater distance from the coast (*e. g.* in the Mafia and Zanzibar Channels) not only does the shore reef attain a greater breadth, but also isolated reefs are found further outside. I term the latter SHALLOW-WATER REEFS ("Flachseeriffe"). (J. Walther has adopted the name PELAGIC REEFS for similar formations in the northern part of the Red Sea: *cf.* J. Walther, "Die Korallenriffe der Sinaihalbinsel," Abh. K. sächs. Ges. Wiss. 24 Bd., 1888.)

I was nowhere able to observe a formation of barrier-reefs or atolls, and after a careful study of the English Admiralty charts their occurrence appeared to me to be improbable, even at spots which I did not visit. As TRUE barrier-reefs and TRUE atolls I regard, be it well understood, only those which respectively exhibit a channel or lagoon of great depth and rise from very deep water. I am firmly convinced that formations of this kind can only arise in a region of positive shore-displacement, and that those cases are of rare and unusual occurrence in which they appear in stationary regions. In this respect, therefore, I abide by the old theory of Darwin and Dana, in opposition to the views recently published by Guppy, who would deduce the existence of negative shore-displacements from the actual presence of atolls. The very absence of such reef-formations in our territory is an indirect proof that in regions with negative shore-displacement atolls and the like are not formed. I regard the atolls of the Straits of Jubal in the Red Sea, which are figured by J. Walther (*loc. cit.*) not as TRUE atolls, in the sense given above, but as atoll-like formations, resulting from the peculiar peripheral growth of the corals, which can be observed on a small and large scale in every coral-reef. Moreover the difference between the two formations has already been pointed out by Langenbeck *, who has also endeavoured to show that Guppy's theories are untenable.

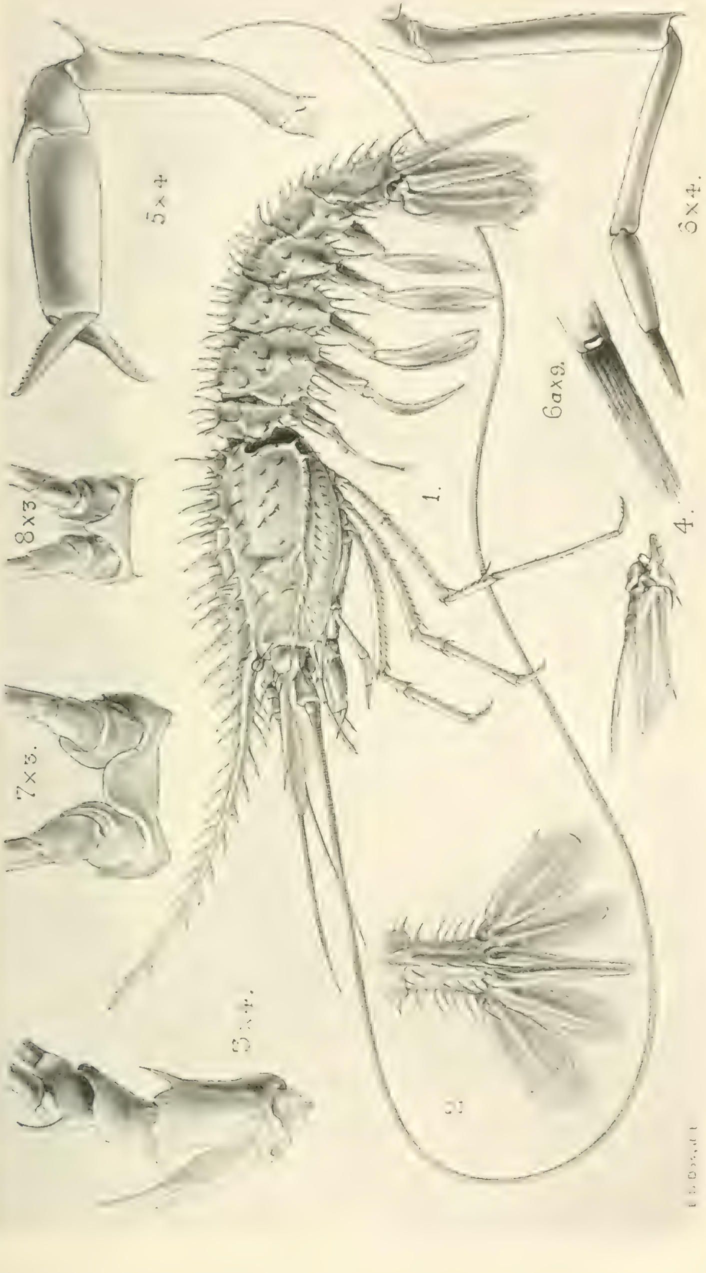
As regards the more special study of the reefs, I have chiefly devoted my attention to determining the way in which the reefs are composed of the various forms of corals, how the latter are distributed upon the reefs, and what is the nature of the bottom upon which they rest. I cannot here enter into details, but would lay special stress on two points only. The observation has already been noted in various quarters, that Stony Corals may be temporarily deprived of water and exposed to the sun and the open air without perishing. I made precisely the same discovery upon the reefs near Dar-es-Salaam. Certain forms (*Porites*, *Goniastræa*, *Cœloria*, *Tubipora*) lie for hours during the ebb-tide, which is a very low one in that region, freely exposed to the air, but live and thrive exceedingly. That this faculty is wanting in other forms is shown at once by the fact that a number of species are met with in the company of those mentioned above, at the same altitude of the reef, but are there found only in holes and pools, so that they are always covered by water.

The following observation is also important. I found at certain points of the reefs near Dar-es-Salaam extensive banks of living corals, resting upon a foundation which was quite loose. The latter consisted of detritus (sand and gravel), which was held together by sea-wrack, and in this wrack were numerous corals, some of which were of but little thickness, while others formed large blocks, of which, moreover, entire banks were composed. All these blocks lay loose upon the bottom; I was able, provided their weight was not so considerable as to offer resistance, to lift them up or roll them over with ease. This observation is interesting in so far as it has been maintained by J. Walther (*loc. cit.*), that coral-reefs could only become established upon a firm (rocky) bottom; which may, indeed be correct enough so far as regards the forms mentioned by him (the umbrella-shaped Madrepores). There are, nevertheless, forms of corals (I am here alluding to species of the genera *Psammocora*, *Montipora*, and *Lophoseris*) which are capable of thriving upon a looser bottom in large blocks and forming banks. Such banks may then again furnish a basis for other corals.

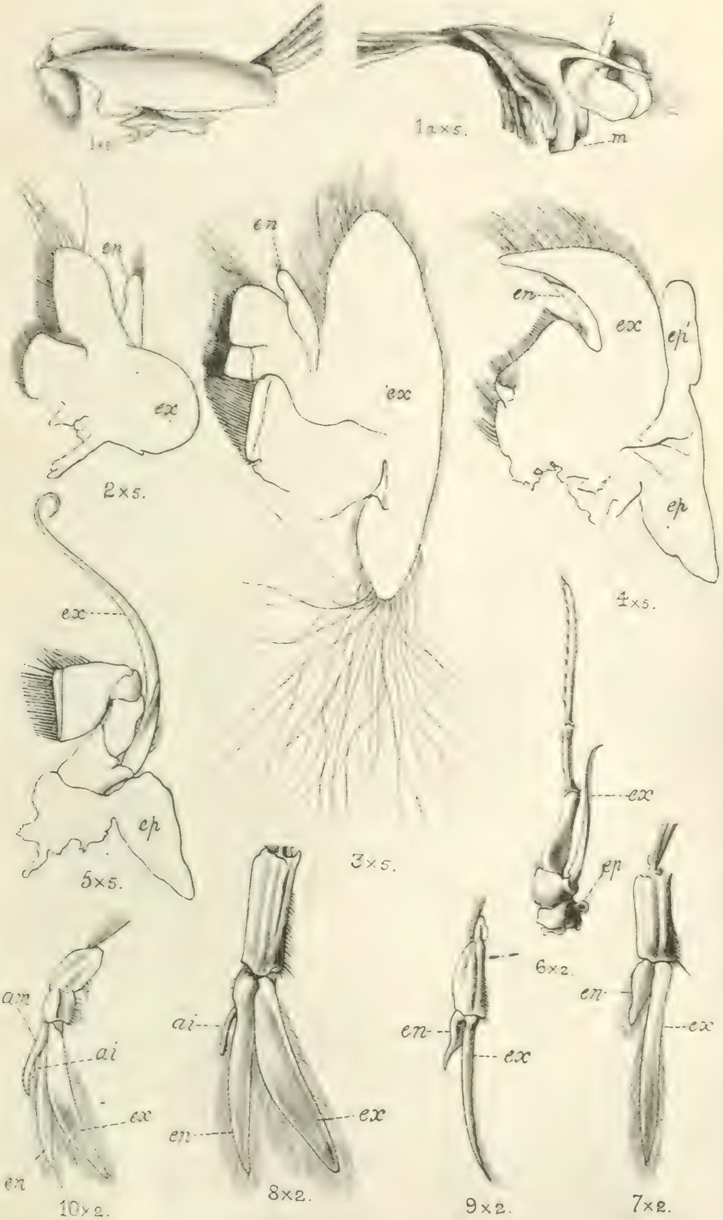
In accordance with the negative shore-displacement I also found an old coral-bed above the present level of the sea. The one which I examined *in situ* is of quite recent date, yet older raised beds of this kind doubtless occur in the region in question. The coral structure is for the most part no longer recognizable in the fossil beds.

The coral-fauna of Dar-es-Salaam is closely allied, as might at once be conjectured from its geographical position, to that of the Red Sea (*cf.* Klunzinger). Yet we here already find a few Pacific types, which are wanting in the Red Sea.—*Zool. Anzeiger*, xv. Jahrg., no. 381 (Jan 11th, 1892), pp. 18–20.

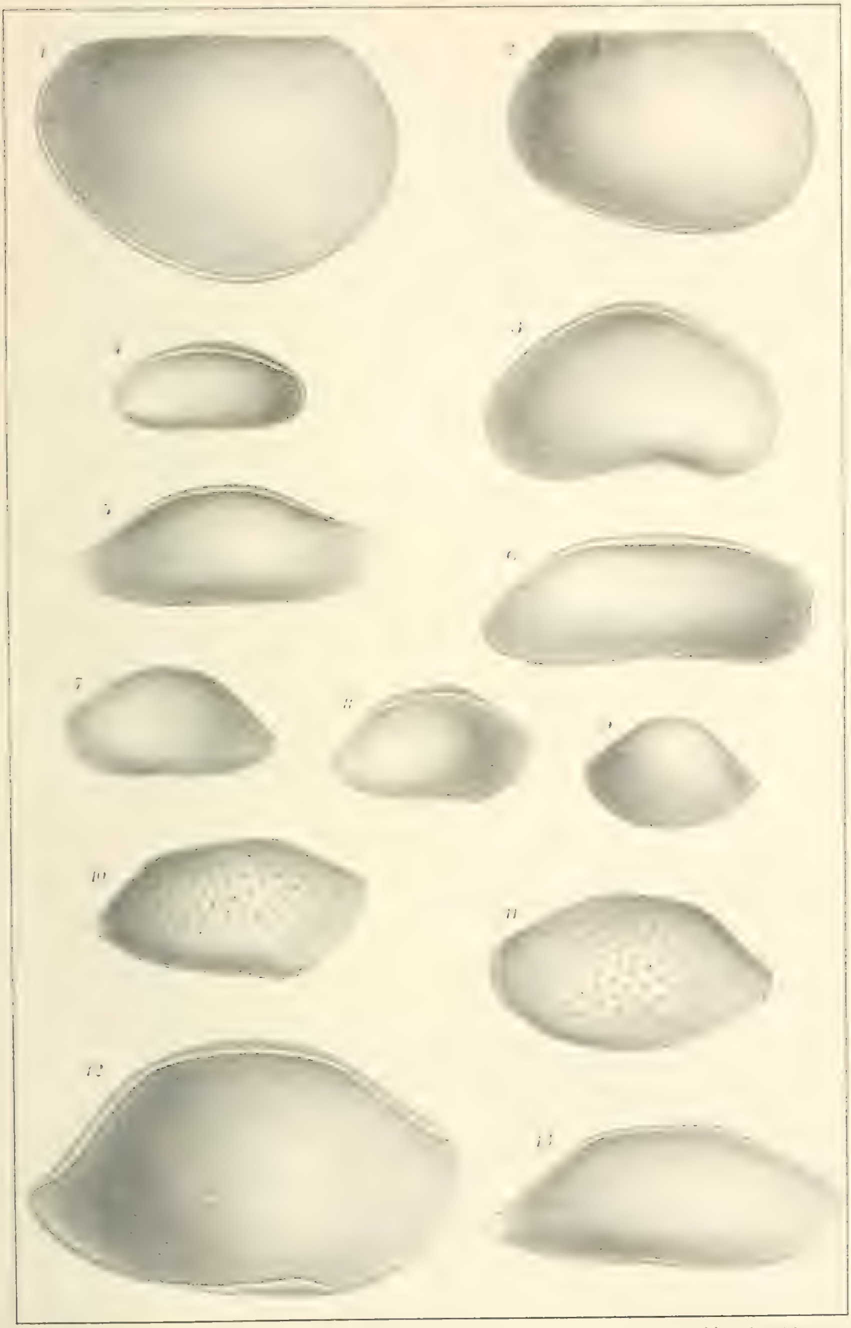
* Langenbeck, 'Die Theorien über die Entstehung der Koralleninseln &c.': Leipzig, 1890.



1, 2, & 7 PSALIDOPUS HUXLEYI.
3–6, & 8 P. SPINIVENTRIS.



PSALIDOPUS SPINIVENTRIS



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CARBONIFEROUS OSTRACODA FROM MONGOLIA.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 53. MAY 1892.

LI.—*On some new Species of* Histeridæ. By G. Lewis, F.L.S.

The greater part of the species dealt with in this paper are contained in the collection of Mr. Fry, who has recently received them from Burmah, Perak, and Sumatra; but I have also included in it some descriptions of others which have come to me from other sources. Two species are from Tasmania, taken by Mr. J. J. Walker during his visit last year, and there are three species found by myself in Japan and Ceylon.

The genus *Cylistix* has hitherto been considered an American genus, and the occurrence of two species in Central Asia is a matter of much interest, and I believe there is a third in the Museum from the Andaman Islands. Having alluded to the distribution of *Cylistix*, I may mention the curious fact that the genus *Hister* has as yet no representative in either Australia or New Zealand, and if Mr. Walker fails to find any at Port Darwin or other places from which he at this time dates his letters, the negative evidence of their absence will be greatly increased.

Last December, in the Ann. Mus. Civ. Genova, I gave a list of the Histeridæ taken in Burmah by Signor Fea, amounting to about ninety species; the Burmese fauna is added to here by the addition of four very interesting insects taken by Mr. Doherty.

List of Species arranged systematically.

Apobletes nigritulus.
Platysoma jejunum.
—— carolinum, *Payk.*
Cylistix asiatica.
—— orientalis.
Pachycrærus ritsemæ, *Mars.*
Psiloscelis limatulus.
Hister rugistrius.
—— famulus.
Epierus nemoralis.
Xestipyge Fryi.
Notodoma solstitiale.
—— rufulum.
Eretmotus Leprieuri, *Mars.*
Triballus onustus.
—— opimus.
Trypeticus Dohertyi, *Lew.*
—— nemorivagus.
—— prædaceus.
Teretrius Walkeri.
Onthophilus tuberculatus.
—— sculptilis.
Epiechinus taprobanæ.
—— birmanus.
Abræus mikado.
Acritus shogunus.
—— tasmaniæ.

Apobletes nigritulus, sp. n.

Oblongo-ovatus, complanatus, niger, nitidus; pronoto stria antice late interrupta; elytris punctato-striatis, striis 1^{a}–4^{m} integris, 5^{a}–6^{a} abbreviatis.

L. $2\frac{1}{2}$ mill.

Oblong-oval, black, shining; the head with a few large punctures mixed with small and fine ones of various sizes, ocular stria broad and rather deep, forehead lightly impressed; the thorax, lateral stria somewhat sinuous, fine in the middle, well-marked at the base and strong at the anterior angle, ceasing behind the eye; there is a line of scattered punctures similar to those on the head on each side well away from the margin, the disk is sparsely pitted with an extremely fine punctuation, the edge of the base is punctured from the angle to a point opposite the fourth stria, scutellar spot scarcely visible; the elytra punctate-striate, striæ 1–4 complete, fifth apical, reaching just beyond the middle, sutural much shorter, neither reaching the middle nor the apex, apical margins a little punctured; the propygidium and pygidium punctured like the sides of the thorax; the prosternum with fine punctures like the thoracic disk and some large punctures on each side of the anterior lobe, bistriate, striæ widening out from each other in front of the coxæ; the mesosternum smooth, bisinuous anteriorly, but the sinuosities are extremely feeble, the stria is strong and complete, the suture well-marked; the metasternum has scattered points, which become obsolete in the median area; the anterior tibiæ are 5-dentate.

This species should be placed next to *A. striatellus*, Mars.
Hab. Madagascar (Tamatave).

Platysoma jejunum, sp. n.

Late ovatum, depressiusculum, piceum, nitidum; elytris striis 1^a–3^m integris, 4^a–6^m apicalibus; propygidio pygidioque undique punctatis.
L. 3 mill.

Broadly oval, rather depressed, pitchy red, shining; the forehead microscopically punctulate, stria strong and complete, feebly sinuous behind the mandibles, little bowed in front; the thorax smooth, stria entire, lateral interstice broadest before the middle, scutellar spot very fine; the elytra, striæ evenly and well impressed, 1–3 complete, the first little bent and following the outline of the wing-case, 4–5 straight, equal in length, apical, and nearly reaching the middle; the propygidium and the pygidium, the whole surface of these segments is densely punctured, there is no smooth or raised margin whatever to either; the prosternum, lobe rather densely punctulate, keel without striæ; the mesosternum is broad, feebly sinuate behind the keel, anterior angles a little oblique, stria complete, sternal plates and first segment of abdomen impunctate, sutures faintly visible, metasternal lateral stria is stronger than the mesosternal stria and these striæ do not quite join; the anterior tibiæ are 4-dentate, tarsal grooves nearly straight.

This species is not similar to any of the described species by reason of its breadth and comparative flatness. It may be placed near to *P. exortivum*, Lew., a species resembling *jejunum* in the tarsal grooves. The sculpture of the propygidium and pygidium is characteristic.

Hab. Perak (low country). One example.

Hister cinnamomeus, White, 1846, = *Platysoma carolinum*, Payk., 1811.

I have examined White's type in the Museum, and I think there can be no doubt that the locality given by him is a wrong one: he was probably misled by the collector.

Cylistix asiatica, sp. n.

Oblonga, nigra, nitida; pronoto parum dense punctato; elytris striis 1^a–4^m suturalique integris, 5^a basi interrupta; prosterno haud striato.
L. $5\frac{1}{4}$ mill.

Oblong, parallel at the sides, rather convex; the forehead excavated, distinctly punctured between the eyes, stria transverse, sinuous, oblique near the eyes, ocular tubercle conspicuous; the thorax wholly punctate, marginal stria fine and sinuous at the sides, obscurely crenulate behind the neck; the elytra, striæ well impressed, 1–3 complete, third turning towards the second at the apex, fourth broken before the base, fifth apical, nearly reaching the middle, sutural nearly complete, terminating behind the scutellum; the propygidium irregularly punctate, subfoveolate at the sides; pygidium evenly and rather densely punctured; the prosternum, keel carinate, widening out at the base, without stria, anterior lobe sparsely punctulate; the mesosternum rather widely emarginate in front, stria strong at the sides, fine and scarcely meeting behind the emargination; the metasternum is bistriate on each side, each stria well separated; the sternal plates are smooth; the anterior tibiæ are 4-dentate.

This species is certainly congeneric with *Hister cylindricus*, Payk., which is the type of the genus *Cylistix*, Marseul.

Hab. Perak (low country). One example.

Cylistix orientalis, sp. n.

Oblonga, parallela, nigra, nitida, supra punctulata; fronte transversim impressa; pronoto stria interna brevissima; elytris striis 1^{a}–3^{m} integris, 4^{a} dimidiata, 5^{a}–6^{a} basi abbreviatis; prosterno bistriato.

L. $3\frac{3}{4}$ mill.

Oblong, parallel at the sides, black, shining; the forehead transversely impressed, stria strong and oblique over the eyes, angulate in front of them, and very fine within the frontal impression; the thorax evenly but not densely punctured, with some fine points dispersed between the coarser punctures; the elytra, the first stria is complete and continues along the base of the elytra, and in continuing turns towards the suture just before reaching the scutellum, forming thus a margin to the base of each elytron, the second and third are complete, the third joining the margin formed by the first at the base, fourth apical, shortened and punctiform in the middle, fifth longer and punctiform from the middle, sixth longer and not ending in punctures; between the fifth stria and the suture are scattered dorsal punctures; the propygidium and pygidium are clearly and somewhat densely punctured; the prosternum, keel carinate, widening and bistriate at the base, anterior lobe sparsely and obscurely punctured; the mesosternum is widely and feebly emarginate, stria complete, but not easy to see behind the emargination, as the sternum is depressed at that part, at the sides it is strong and straight; the metasternum, laterally bistriate, striæ oblique and parallel to each other; the anterior tibiæ are 4-dentate.

This species also belongs to *Cylistix*, and in one of its characters, namely the proximity of the metasternal striæ, it resembles *C. cylindrica*, Payk., more than *C. asiatica*.

Hab. Siam (Renong). One example.

Pachycrœrus violaceipennis, Lew., 1891,
=*P. ritsemæ*, Mars.

I find now that I was in error in regard to this species. I was misled by Marseul's description of the frontal striæ. It seems to me that there are two striæ, but Marseul calls one a suture: perhaps his example was somewhat abraded.

Psiloscelis limatulus, sp. n.

Oblongo-ovalis, niger, nitidus, supra punctulatus; fronte foveolata; elytris striis integris, 5ª suturalique antice conjunctis.
L. 4½ mill.

Oval-oblong, rather convex, black, shining; finely and somewhat densely punctured above; the forehead longitudinally foveolate, stria complete, straight in front, angulate behind the mandibles; the thorax with four feeble impressions, two on each side, two fine marginal striæ, one of which continues behind the head, and well within the margin is an internal stria very slightly abbreviated at both ends, leaving a wide interstice in front, which gradually narrows towards the posterior angle; the elytra, striæ 1–4 complete, fifth and sutural also complete and joined at the base; the propygidium and pygidium are densely punctured, with some very fine points between the larger ones; the prosternum, keel narrow in front, widening out triangularly at the base, margined laterally with a fine clearly marked stria; the mesosternum is truncate anteriorly, with a fine marginal stria; the sternal plates and first segment of the abdomen are more finely punctured than the upper surface; the anterior tibiæ are 6–7-dentate.

This species is smaller than *P. Castelnaudi*, Mars., and differs in three essential points, viz. the forehead has a deep fovea, the thorax has an internal lateral stria, and the fifth and sutural elytral striæ join at the base.

Hab. Assam (Patkai Mountains). One example.

Hister rugistrius, sp. n.

Ovalis, convexus, niger, nitidus; fronte punctulata, biimpressa, stria antice recta utrinque interrupta; elytris striis 1^a–3^m integris, 4^a et 5^a apice conjunctis; propygidio pygidioque dense ocellato-punctatis.

L. 7 mill.

Oval, convex, black, shining; forehead distinctly and somewhat densely punctulate, stria deep and straight anteriorly, interrupted on either side, with two shallow impressions close behind it, mandibles externally marginate; the thorax, disk impunctate, lateral marginal stria very fine, external wide and rugose, shortened before the base, internal also wide and rugose, approaching the external posteriorly and turning inwards after passing it, fine and crenulate behind the head, interstice irregularly punctured, punctures clustered at the anterior angle; the elytra, striæ (including the internal sub-humeral) wide and deep, with the edges crenulate, 1–3 entire, fourth sometimes complete but very fine in the middle, sometimes widely interrupted, with a short stria at the base and an apical appendage which joins the fifth, which is equally short, the sutural is apical but rather long and posteriorly turns away from the suture; the propygidium and pygidium are densely punctured, punctures distinctly ocellate, at the apex of the pygidium there is a small fovea, more or less distinct, with a narrow smooth margin behind it; the prosternum is without sculpture; the mesosternum is feebly sinuous in front, stria complete, margin narrow; the anterior tibiæ are tridentate, the others multispinous.

This species should be placed close to *H. metallicus*, Lew., from India.

Hab. Mandan, Bengal (*Cardon*, 1891).

Hister famulus, sp. n.

Ovatus, niger, nitidus; antennis pedibusque piceis; pronoto utrinque striato, stria brevi oblique impressa; elytris 1^a-4^m integris, 5^a apicali, suturali dimidiata.

L. 3 mill.

Oval, convex, black, shining; the forehead, stria complete and somewhat straight anteriorly, feebly sinuous laterally; the thorax transverse, marginal stria very fine and complete, invisible at the sides when viewed from above, internal lateral stria oblique, short, and much abbreviated at both ends, and it is well within the margin; the elytra, striæ 1–4 complete, fourth much finer than the third, fifth short and apical, sutural a little longer, reaching beyond the middle; the propygidium is rather finely punctulate, punctures scattered; the pygidium with finer punctures and smooth at the apex; the prosternum is carinate, without striæ; the mesosternum is obsoletely produced anteriorly (like that of *H. dentipes*, Lew.), marginal stria fine and complete, of the same form, but not joined to that of the metasternum; anterior tibiæ 4–5-dentate.

This small species is allied to *H. myrmidon*, Mars., and others; the short thoracic stria resembles that of *H. cœlestis*, Mars., but it is quite free of punctures.

Hab. Sumatra (Merang).

Epierus nemoralis, sp. n.

Ovalis, convexus, niger, nitidus, supra tenuiter punctulatus; elytris striis integris, 4^a basi incurvata; mesosterno antice subrecto.

L. $2\frac{1}{2}$–$2\frac{3}{4}$ mill.

Oval, convex, black and shining; the forehead sparsely and finely punctulate, with a short, rather deep stria over the eye; the thorax is finely punctulate, with large punctures scattered on the sides and disk, scutellar fovea very feeble, on the edge of the base is a single row of punctures, stria well-marked at the sides, fine behind the neck; the elytra are without the larger punctures of the thorax, striæ crenulate and complete, the sutural being only a little shortened behind the scutellum, the fourth stria turns conspicuously towards the fifth near the base, the fifth turns feebly to the suture, the sutural striæ are straight, the interstices between the first and third striæ are the widest especially behind the middle; the propygidium and pygidium (except the apex) punctured like the thorax; the prosternum is feebly and very sparsely punctulate, striæ widening out a little behind, but less so anteriorly; the mesosternum a little broad, stria complete, nearly straight in front, and continuing down the sides of the metasternum; the anterior tibiæ are multispinose; the legs and antennæ reddish.

This species is larger and more oval than the Asiatic species known to me; the fourth stria being bent inwards at the base seems to be a good differential character.

Hab. Assam (Patkai Mountains).

Xestipyge Fryi, sp. n.

Ovata, convexa, nigra, nitida; fronte distincte punctata; elytris striis 1^a–4^m integris, 5^a–6^a brevibus; pygidio utrinque profunde foveolato.

L. $2\frac{1}{4}$ mill.

Oval, convex, black and shining; the head striate over the eyes only, sparsely punctate, punctures round and each one distinct; the thorax smooth on the disk, with a broad margin of very distinct punctures at the sides, at the base there are two large, shallow, scutellar punctures close to each other and five or eight smaller and deeper punctures set along the basal edge; the elytra, striæ 1–4 complete, 5–6 apical, but passing beyond the dorsal centre and punctiform at the ends, 4–6 being somewhat crenulate; the propygidium is transversely rather thickly punctured; the pygidium is smooth in the median area, with two large and deep foveæ, one on each side at the base, apex with a few large punctures; the prosternum, the keel is broad and rather short, with well-marked lateral striæ, feebly sinuous near the coxæ, hamate in front; the mesosternum feebly emarginate, marginal stria complete, obsoletely crenulate, transverse stria slightly bent in the middle, with eight or nine crenulations, and continuing along the sides of the metasternum; the first segment of the abdomen has large punctures posteriorly and at the sides; the anterior tibiæ are 3–4-dentate.

This species is the most remarkable in this series. It is congeneric with *Homalister ornatus*, Reitter, 1880, and it is doubtful whether *Xestipyge* was sufficiently characterized by Marseul to be given precedence; otherwise it has some years' priority.

Hab. Burmah (Ruby Mines). One example.

Notodoma solstitiale, sp. n.

Globosum, flavo-rufum, nitidum; pedibus flavis; elytris striis 1^a–2^a integris, 4^a et suturali antice conjunctis, interstitiis impunctatis; mesosterno stria transversa nulla.

L. $2\frac{1}{8}$ mill.

Globose, yellowish red, shining; the forehead with shallow punctures, not closely set, eyes a little obliquely placed; the thorax clearly and evenly, not densely punctured, marginal stria well-marked; the elytra are pale in colour at the base, but without definite white spots, striæ 1–2 are complete, third absent, fourth and a sutural joined at the base, interstices impunctate; the propygidium and pygidium almost impunctate; the prosternum keel-shaped as an elongate triangle, with a few scattered punctures, lateral striæ necessarily oblique; the mesosternum, marginal stria complete, suture visible, but there is no transverse stria; the metasternum, median stria semicircular, not arched like those of *N. fungorum* and *globatum*, and evenly crenulate, crenulations not widened out; the legs are flavous, anterior tibiæ denticulate.

This small species resembles *N. rufulum*, but the forehead is less wide and there is no transverse stria to the mesosternum, which is a very remarkable character.

The chief difference between *N. fungorum*, Lew., and *globatum*, Mars., is that the interstices to the elytral striæ are punctate in the latter and smooth in the former, and it is a matter for notice in a family where the elytral striæ are usually good specific characters that in all the pale-coloured species the striation is so similar. In *N. bullatum*, Mars., which is a dark-coloured species, there is a third stria.

Hab. Perak (high lands). One example.

Notodoma rufulum, sp. n.

Globosum, rufum, nitidum; pedibus flavis; elytris striis 1ª–2ª integris, 4ª et suturali antice conjunctis, interstitiis impunctatis; mesosterno stria transversa crenulata.

L. 2 mill.

Globose, yellowish red, shining; the forehead with scattered shallow punctures and wider between the eyes than in *N. solstitiale*, eyes also not oblique; the thorax, marginal stria fine, feebly crenulate behind the neck, clearly and evenly, not densely punctured; the elytra striate, like those of *N. globatum*, Mars.; the propygidium and pygidium feebly and sparsely punctulate; the prosternum sparsely punctured, points shallow, lateral stria not well defined, little sinuous at the coxæ, not approaching near to each other in front; the mesosternum, anterior stria crenulate, the crenulations widening out as the stria passes down the side of the metasternum, transverse stria straight, crenulate, crenulations of equal width; the metasternum, median stria arched and crenulate, crenulations widened out and of somewhat unequal width; the legs and antennæ are flavous.

Of the described species this closely resembles *N. solstitiale*, but it has a transverse mesosternal stria. The metasternal stria also has a narrower span and the crenulations are wide and irregular.

Hab. Borneo, Martapura (*Doherty*).

Eretmotus approximans, Fairm., 1884, = *E. Leprieuri*, Mars., 1862.

Baron Bonnaire has kindly lent me the type of Fairmaire's species, and I feel sure the above determination is correct.

Triballus onustus, sp. n.

T. agresti, Mars., similis, sed multo major; pronoto stria antice haud interrupta.
L. 3 mill.

Oval, convex, black, shining; the head not thickly punctulate, with a few large points intermixed, stria strong before the eyes, evanescent anteriorly; the thorax is punctured like the head, with the lateral stria continued behind the neck; the elytra are finely punctulate on the disk, with larger punctures, much scattered, at the sides and on the posterior area; the pygidium is punctured like the head, except that the punctulation is more dense; the prosternum feebly punctulate, bistriate, striæ obscurely crenulate; the mesosternum, stria anteriorly interrupted, transverse stria nearly straight and crenulate throughout, surface very sparsely and finely punctulate; the metasternum with a few larger punctures before the posterior coxæ.

This species is extremely like *T. agrestis*, Mars., but it is much larger and the thoracic stria is continued behind the neck. *T. agrestis* also has no frontal stria.

Hab. Zanzibar (*Raffray*).

Triballus opimus, sp. n.

Breviter ovalis, convexus, niger vel obscure æneus, nitidus; *T. bombæ* proximo affinis et simillimus.
L. $3\frac{1}{8}$ mill.

Short-oval, black, or with an æneous tinge, antennæ and legs reddish; the forehead obscurely punctulate, triangulate before the antennæ, with a stria on each side which does not quite meet in front, epistoma rugose, over the eye is a short ill-defined sulcus; the thorax, lateral stria ceases at the anterior angle, punctures fine and sparse and varying in size, along the basal edge there is a continuous line of points, some oval, some acicular; the elytra, disk almost smooth, but laterally scattered punctures of various sizes are visible; the sculpture of the propygidium and pygidium is limited to a fine and scattered punctuation; the prosternum is broad and short, bistriate, striæ divergent before and behind, anterior lobe transverse, with the rim flavous; the mesosternum, lateral stria fine, interrupted anteriorly, transverse stria evenly crenulate and straight.

T. opimus and *T. bomba*, Mars., are the largest species of *Triballus* known.

Hab. Martapura, S.E. Borneo (*Doherty*, 1891).

Note.—Since I formed the genus *Idolia* (Ann. & Mag. Nat. Hist. 1885, xvi. p. 214) nearly a dozen species have been described, and it seems likely this number will be greatly increased. Some of the species exhibit the sternal sutures, and some possess specific characters similar to certain species of *Triballus*, so that I think now the two genera should be placed together.

Trypeticus Dohertyi, Lew., Ent. Mon. Mag. 2nd ser. vol. ii. p. 186.

There are three male examples (measuring $4\frac{1}{2}$ millim.) in Mr. Fry's collection which I think are small specimens of this species. All the differences I see in them relate to size and to the want of the two thoracic elevations behind the ridge near the neck. That this should be the case only corresponds to what we see throughout the Coleoptera, that sexual differences are more or less obliterated in small individuals. There are a few genera in the Histeridæ in which it is quite as important for a describer to know both the sexes as it is in the Lucanidæ, but these genera are limited in number. The anterior angles of the thorax in the male of *T. Dohertyi* are rectangular, and almost so in the female also.

Trypeticus nemorivagus, sp. n.

Cylindricus, parum robustus, niger, nitidus; pronoto angulis anticis haud rectangulatis; prosterno rugoso-punctato, margine laterali valido.

L. $3\frac{3}{4}$ mill.

Cylindrical, rather robust, black and shining; the male, snout with shallow punctures, triangular, flat, margined with a carina, the forehead irregularly punctured between the eyes and microscopically strigose; the female snout is impressed, not carinate, with two very small and not very distinct tubercles at the apex; the thorax in the male parallel laterally, anterior angles rounded off, impressed near the eyes, rather densely punctured anteriorly, punctures on the disk and posteriorly more scattered, a fine median line is smooth and terminates in a slight ridge behind the neck, the female has the smooth line but no ridge, and the anterior angles are more convex; the elytra are punctured more finely than the thorax; the propygidium and pygidium are evenly, not densely punctured, the latter is feebly convex in the female, and less so in the male; the prosternum closely and roughly punctate, truncate at both ends, lateral striæ very strong, joined anteriorly; the mesosternum is less closely punctured with similar stria behind the coxæ.

This species is much more robust than *T. Dohertyi*, Lew., and there are no thoracic tubercles, the thoracic anterior angles are not rectangular, but well rounded off, and the prosternal lateral striæ are much stronger.

Hab. Burmah (Ruby Mines).

Trypeticus prædaceus, sp. n.

Cylindricus, brunneo-piceus, nitidus, undique punctatus; fronte inter oculos minute foveolata; propygidio utrinque prominulo.

L. 3–$3\frac{1}{4}$ mill.

Cylindrical, pitchy brown, shining, anterior angles of the thorax reddish; the head faintly punctured, and between the eyes there is a small fovea in both sexes; the snout in the male is somewhat flat and triangular, but a little sinuous at the sides, and a little wide at the apex, margined with a stria which is best marked at the sides; the female has the snout concave, striæ obsolete, and the apex is furnished with two minute tubercles; the thorax somewhat densely punctured, some punctures, especially those behind the anterior angle, are ocellate, anterior angles in the male depressed and a little acute close to the eyes, behind the neck a fine carina occupies about one fourth of the length of the thorax, the female anterior angles rounded off and not depressed; the elytra, punctuation distinctly finer than that of the thorax; the propygidium rather densely punctured, projecting at the sides; the pygidium is convex in the female, impressed on each side in the male, and in both sexes punctured like the propygidium; the prosternum in the male is wider in front than behind, sparsely punctured, punctures round and shallow, lateral striæ widen out a little anteriorly and do not join, in the female the prosternum is truncate; the mesosternum agrees in both sexes, there is a lateral sulcus on each side behind the coxæ, punctures sparse and oblong; the metasternum has a median furrow, and is punctured like the mesosternum; the abdominal segments, punctures round and not very thickly set, the segments 3–4 are thickened at the outer edge, and, like the propygidium and pygidium, stand out one from another; on the first segment there is a short intercoxal lateral sulcus.

Hab. Perak (low country).

Teretrius Walkeri, sp. n.

Cylindricus, niger, nitidus, undique punctatus; prosterno grosso punctato et minute strigoso; metasterno parum sparse punctato; pygidio apice rugoso-punctato.

L. $1\frac{3}{4}$–2 mill.

Cylindrical, black, shining, club of antennæ red, legs pitchy black; the forehead convex, punctate, punctures most scattered on the disk; the thorax similarly punctured, stria complete, strong at the sides, especially behind the middle, very fine anteriorly; the elytra with like punctures, margined at the base, with a small smooth space behind the humeral angle; the propygidium and pygidium are clearly and rather densely punctured, the apical half of the latter is impressed, strigose, and more densely pointed; the prosternum somewhat thickly punctate, punctures large and with their interspaces minutely strigose; lateral striæ well defined and divergent from their bases; the mesosternum triangularly and rather acutely produced anteriorly, stria complete, margin smooth, well defined, and somewhat raised, punctured and strigose like the prosternum; the metasternum and first segment of the abdomen much more sparsely punctured and the strigosity disappears, segments 3–5 have a row of punctures along their edges; the anterior tibiæ 7–8-dentate, posterior 3-spinose.

This species is the second known from the Australian region; it seems to have been captured in company with *Teretriosoma somerseti*, Mars. It is one of Mr. J. J. Walker's most recent discoveries.

Hab. Tasmania, Hobart, and Launceston (*J. J. Walker*).

Onthophilus tuberculatus, sp. n.

Suborbicularis, convexiusculus, niger, subopacus; elytris 6-costatis, 1^a–3^m interruptis, 5^a valida, integra; propygidio tuberculato.

L. $2\frac{1}{4}$ mill.

Suborbicular, rather convex, black, and somewhat opaque; the forehead is punctate, with a median carina before the neck, and in front of the carina is an elevated ridge shaped like an inverted V, thus ↑; the thorax, margin clearly elevated, edge emarginate behind the anterior angle, and conspicuously angulate well before the posterior angle, surface deeply punctate, punctures anteriorly round, posteriorly oval or somewhat elongate, 6-costate, two outer costæ shortest and parallel to the thoracic edge, the others are much elevated and equidistant, the two median costæ are a little the longest and turn from each other at the base; the elytra 6-costate, with the outer margin and the two sutural edges also elevated, 1–3 costæ are twice broken by two transverse depressions, the third costa being very remarkable as the median portion viewed sideways looks like a conspicuous nodule, the fifth costa is the strongest, the sixth weakest, both the last complete, the interstices are very clearly carinulate, with a single row of equidistant punctures. The elytra are in part reddish. The propygidium has three tubercles transversely placed in the middle, the centre one somewhat linear; the pygidium closely punctate, with an elevation thus ⋔ in the middle; the prosternum has large, deep, and closely-set punctures, striate at the coxæ; the mesosternum bisinuous anteriorly, and with the metasternum has very large punctures or foveæ set somewhat in transverse lines, and on the median area of the metasternum are two triangulate smooth spaces; the first segment of the abdomen has a line of seven foveæ along the anterior edge; legs and antennæ piceous.

Hab. Burmah, Ruby Mines (*Doherty*).

Onthophilus sculptilis, sp. n.

Ovalis, convexiusculus, subæneo-niger, parum nitidus; fronte haud costata; elytris 3 carinis elevatis, interstitiis obscure punctato-carinulis; pygidio basi transversim elevato.

L. 2 mill.

Oval, rather convex, little shining; the forehead is wholly punctate, little uneven, slightly elevated behind the insertion of the antennæ, not carinate or costate; the thorax, narrowly marginate, obtusely angulate before the base, 6-costate, outer costa shortest, with a wide interstice between it and the second, the second is shorter than the third but parallel to it, the two centre costæ reach the margin behind the neck, and gradually turn inwards anteriorly, but do not meet, the surface is punctured like that in *O. tuberculatus*; the elytra are 3-costate, with an intervening carina corresponding to the second, fourth, and sixth striæ; below the shoulder is a transverse depression which crosses the first costa to the second carina (or fourth stria), the interstices are obscurely carinulate with intervening punctures; the propygidium punctate, with a median elevated line and a small tubercle on each side near the outer edge; the pygidium also is wholly punctate, with a transverse ridge before the base; the prosternum closely punctate, punctures large and deep; the mesosternum bisinuous anteriorly, with a fine marginal stria; the meso- and metasterna are sculptured like the last species, but the punctures or foveæ are smaller, and the median spaces of the metasternum are clearly and evenly punctulate; the first segment of the abdomen has a line of eleven punctures on the anterior edge, and several additional foveæ at the side. The smoother parts of the under surface are somewhat æneous, and the head and thorax have a bluish metallic tinge.

The general facies of this *Onthophilus* agrees with that of *O. alternatus*, Lec.

Hab. Burmah, Manipore, alt. 7000 feet (*Doherty*).

Epiechinus taprobanæ, sp. n.

Orbicularis, niger, opacus; metasterno antico utrinque profunde foveolato. *Onthophilo arboreo* simillimus at major.

L. 2 mill.

Orbicular, opaque, setose; the head very rugose, with a median carina before the neck and one on each side; on the edge of the clypeus are five shallow pits; the thorax with some large punctures on the disk, with traces of carinæ behind the head, and two lateral sulci usually filled with squamous matter; the elytra are costate, with rows of large punctures in the interstices, the punctures gradually becoming smaller towards the apices, where they cease to be; the prosternum is bicarinate, carinæ gradually approaching anteriorly, surface between them smooth, anterior lobe with large punctures; the mesosternum has two large polygonal depressions, one on each side, and a small median sutural fovea; the metasternum has two large and very deep foveæ, one in each anterior angle, the anterior edge of each fovea joins the mesosternal depression. These foveæ are not seen until the sterna are freed of scales. The pygidium is very setose, but when abraded a few large punctures are seen on the surface.

This species is different to *Onthophilus hispidus*, Mars., but whether Marseul's description applies (as he thought it did) to *O. hispidus*, Payk., is more than doubtful. I rely on the sculpture of the sterna for specific characters.

Hab. Ceylon. I found this species at Ballangoda in 1882.

Epiechinus birmanus, sp. n.

Suborbicularis, niger, opacus, hispidus; prosterno utrinque carinato; mesosterno metasternoque in medio foveolatis. *O. arboreo* simillimus, sed magis ovatus.
L. $1\frac{3}{4}$ mill.

Suborbicular, opaque, setose; the head rugose, and when abraded of scales and setæ an obsolete median and two lateral carinæ may be seen; the thorax has two lateral sulci on each side, and when cleaned, large scattered punctures are visible on the disk; the elytra are costate, with rows of large punctures in the interstices; the prosternum is bicarinate, the border formed of the carinæ joins in front, where the inner edge of the carina is arcuate, the outer truncate, the anterior lobe has scattered punctures, punctures smaller than in *E. taprobanæ*; the mesosternum has a round median fovea and on each side of it a many-sided depression; the metasternum has also a median fovea, but it is oval, and in front of it on either side, obliquely placed, are two depressions of somewhat corresponding size and shape; the pygidium is punctate and rugose.

The specimens which represent this species have been referred to in the Ann. Mus. Civ. Genova, 1888, ser. 2, vi. p. 645, as *Onthophilus hispidus*, Payk., but it is now evident to me that it is not Paykull's species.

Hab. Burmah, Bhamo (*Fea*).

Abræus mikado, sp. n.

Ovatus, globosus, rufo-brunneus, nitidus; antennis pedibusque flavis; supra vix dense punctulatus; mesosterno metasternoque grosse et parce punctatis.
L. 1 mill.

Oval, globose, reddish brown, shining, head darker, antennæ and legs paler; the forehead sparsely punctured; the thorax and elytra evenly punctured, punctures shallow and not very thickly set, thoracic marginal stria complete, but very fine behind the neck; the propygidium and the pygidium are feebly and indistinctly punctulate; the prosternum a little wider than long, feebly and obscurely punctured, lateral striæ slightly widen out from the base, the base very feebly sinuous; the meso- and metasterna and the first segment of the abdomen is evenly but not thickly covered with somewhat large and shallow punctures, the punctures being largest and most closely set at the widest part of the metasternum.

Hab. Japan. I found this species in *Cossus*-burrows at Kiga, Konosé, Nara, and in S. Yezo.

Acritus shogunus, sp. n.

Ovalis, convexus, nigro-piceus, nitidus; antennis pedibusque brunneis; pronoto linea basali aciculato-punctato in medio tenuiter arcuata; elytris sparse punctatis, dorso aciculato-rugosulis; prosterno bistriato, utrinque truncato.
L. 1 mill.

Oval, convex, nearly black, shining, antennæ and legs pale brown; the head feebly punctured; the thorax evenly and clearly, not closely, punctured, antiscutellar stria very feebly arched in the middle, and following the margin to the sides; stria punctate, punctures aciculate, posteriorly within the stria the surface is strigose; the elytral punctuation somewhat finer than that of the thorax, with a longitudinal strigosity between the points; the pygidium impunctate, minutely and transversely strigose; the prosternum, outline similar to that figured for *A. acupictus*, Mars. (Mon. 1856, fig. 17), with a few scattered punctures, and surface microscopically strigose; the mesosternum, marginal stria interrupted anteriorly, suture feebly visible and with the metasternum and first abdominal segment clearly but sparsely punctate.

Hab. Japan. I obtained a single example at Sapporo.

Acritus tasmaniæ, sp. n.

Ovalis, convexus, brunneus, nitidus; supra punctulatus; prosterno bistriato, striis antice et postice divaricatis.
L. 1 mill.

Oval, convex, brown, shining; the head very finely and sparsely punctulate; the thorax, stria complete, punctures rather sparse, small anteriorly, gradually becoming larger toward the base, at the edge before the scutellum is a row of punctures, but there is no definite antiscutellar line like that figured for *A. acaroides* and others by Marseul (Mon. 1856); the elytra are sculptured similarly to the thorax, except at the apical margins, which are, like the pygidium, almost smooth; the prosternum rather long, bistriate, striæ rather widely divergent before and behind, feebly and very sparsely punctured; the mesosternum, suture almost invisible, marginal stria fine and a little interrupted anteriorly, like the metasternum it is sparsely punctulate.

Hab. Tasmania (*J. J. Walker*, 1891).

LII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91. By J. WOOD-MASON, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. ALCOCK, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Continued from p. 275.]

Family **Acanthephyridæ.**

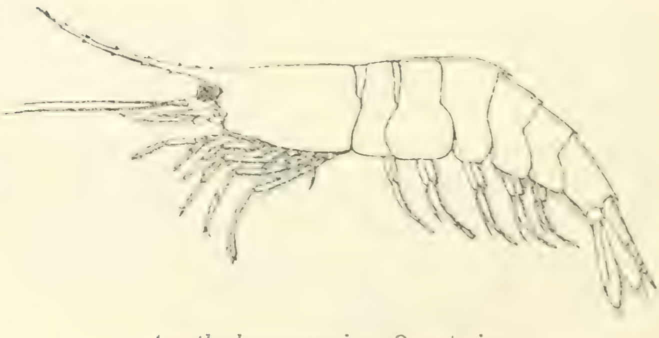
ACANTHEPHYRA, A. Milne-Edwards.

37. *Acanthephyra sanguinea*, sp. n.

♀. Closely allied to *A. Agassizii*, S. I. Smith, ♂ (*A. purpurea*, A. M.-Edw., ♀), from which it differs in the minute size of the spines of the anterior margin of the carapace, which are so small as to be scarcely discernible by the unaided eye; (?) in the armature of the telson, which bears only five pairs of dorsal spinules besides three longer and subequal terminal ones; in its longer and slenderer rostrum, which is fully twice the length of the antennal scale; and in its less elongated abdomen.

Colour in life deep crimson.

Fig. 1.



Acanthephyra sanguinea, ♀, nat. size.

Length, from tip of rostrum to tip of telson, 92 millim.; of carapace, from supraorbital to posterior margin, 18 millim.; of rostrum, from same point to tip, 26·5 millim.; of antennal scale 13 millim.; of abdomen 50 millim.; of telson 14·5 millim.

One female from Station 106, 1091 fathoms, one immature in fragments from Station 107, 738 fathoms, and a third from Station 117, 1748 fathoms.

♂. A male of about the same size as that of *A. Agassizii* figured by Prof. S. I. Smith was obtained in a previous season $7\frac{1}{2}$ miles east of North Cinque Island, in the Andaman Sea, in 490 fathoms. It has a decidedly less elongated abdomen than *A. Agassizii*; its carapace has much the same shape, but the rostrum shows no signs of becoming porrect and reduced in length as in that species, for although it is broken off just in front of the third tooth of the lower series, it still extends fully to the end of the antennal scale.

Length, from supraorbital margin to tip of telson, 83 millim.; length of carapace, from supraorbital to posterior margin, 23·25 millim.; of antennal scale 15·25 millim.; of abdomen to tip of telson 59 millim.; of telson 17·25 millim.

38. *Acanthephyra armata*, A. M.-Edw.

Acanthephyra armata, A. M.-Edw. Ann. d. Sc. Nat. Zool. (6) xi. 1881, 4, p. 12, et Rec. Fig. Crust. 1883; Spence Bate, 'Challenger' Macrura, 1888, p. 744, pl. cxxv. fig. 2, ♂ var.

One fine male from Station 116, 405 fathoms.

Colour in life crimson.

Length, from tip of rostrum to tip of telson, 144 millim.; of carapace, from supraorbital to posterior margin, 35 millim.; of rostrum, from same point, 34 millim., from front of inferior spine to tip 17 millim.; of antennal scale 26 millim.; of abdomen to tip of telson 75 millim.; of telson 18 millim.

It differs from Milne-Edwards's figure in the following points:—The rostrum is of the same length as the carapace; its basal spines are only four in number; the spine of its inferior margin arises midway between its base and its apex, and is much more nearly opposite to the middle than to the apex of the antennal scale. The branchiostegal spine is continued backwards along the side of the carapace as a very strong ridge half as long as the antennal scale. The fringes of the legs are greatly developed, reminding one of those of the last two pairs of legs in *Sergestes*. The spines of the third to the sixth abdominal terga are equal.

It differs from the specimen figured and described by

Fig. 2.

Acanthephyra armata, ♂, var., nat. size.

Spence Bate in the form and the armature of the rostrum, in the smaller spinous processes of the abdominal terga, and in the more highly developed fringes of the legs. The dactylopodite of the last pair of legs is incorrectly represented by Spence Bate as equal to those of the two preceding pairs.

39. *Acanthephyra microphthalma*, S. I. Smith.

Acanthephyra microphthalma, S. I. Smith, Proc. U. S. Nat. Mus. 1885, p. 502; Ann. Rep. Comm. Fish. 1886, p. 65, ♂ ♀, pl. xiii. fig. 3, ♂.
Acanthephyra longidens, Spence Bate, 'Challenger' Macrura, 1888, p. 735, pl. cxxiv. fig. 4, ♂.

Two males from Station 117, 1748 fathoms.

Colour in life deep crimson.

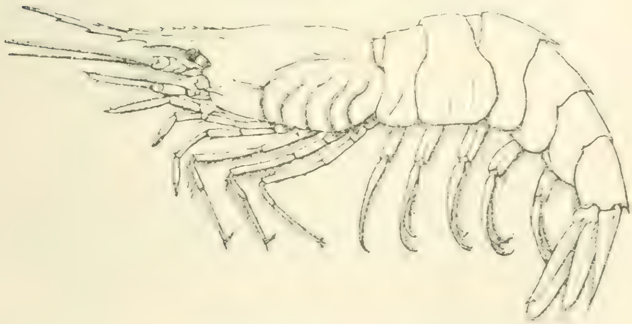
In one specimen the rostrum is armed with five teeth, and probably also in the other, in which it is broken off just beyond the fourth tooth.

40. *Acanthephyra eximia*, S. I. Smith.

Acanthephyra eximea, S. I. Smith, Rep. U. S. Comm. Fish. 1884, p. 32, 1886, pl. xiv. fig. 1, ♂.
Acanthephyra Edwardsii, Spence Bate, 'Challenger' Macrura, 1888, p. 747, pl. cxxvi. fig. 1, ♂.

♀. Differs from the male in its longer and more styliform

Fig. 3.



Acanthephyra eximia, ♀, nat. size.

rostrum, which extends by about one third of its length beyond the antennal scale.

Colour in life crimson.

Length, from tip of rostrum to tip of telson, 100 millim.; of carapace, from supraorbital to posterior margin, 22·5 millim.; of rostrum, from same point to apex, 26 millim.; of antennal scale 15 millim.; of abdomen, from base to tip of telson, 53·5 millim.; of telson 14·5 millim.

One specimen from Station 116, 405 fathoms.

♀ juv. Differs from the above in the rostrum only extending by a portion of its unarmed tip beyond the extremity of the antennal scale.

Length, from tip of rostrum to tip of telson, 58 millim.; of carapace, from supraorbital to posterior margin, 13·75 millim.; of rostrum, from same point to apex, 11 millim.; of antennal scale 9·75 millim.; of abdomen, from base to apex of telson, 35 millim.; of telson 10 millim.

Colour in life bright red.

One specimen from Station 112, 561 fathoms.

♀ jun. Much smaller than the above, the rostrum slightly ascendant, straight or only very faintly curved, short, extending about to the end of the second third of the antennal scale.

Length of carapace 10 millim.; of rostrum 5·25 millim.

Rostrum $\frac{7}{4}$-toothed.

Colour in life deep crimson.

One much younger specimen, with another of the same age as that from Station 112, from Station 109, 738 fathoms.

The above series of specimens proves that the rostrum increases in length from extreme youth to adolescence.

An adolescent male was taken in a previous season 8 miles south-east of Cinque Island, in the Andaman Sea, in 500 fathoms.

Rostrum $\frac{7}{4}$-toothed.

Colour in life deep transparent blood-red.

41. *Acanthephyra brachytelsonis*, Spence Bate.

Acanthephyra brachytelsonis, Spence Bate, 'Challenger' Macrura, 1888, p. 753, pl. cxxvi. fig. 7, ♀; Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. p. 195, ♂.

One adolescent male from Station 113, 683 fathoms.

Colour in life bright red.

Two adolescent males and one young female were taken in a previous season $7\frac{1}{2}$ miles east of North Cinque Island, in the Andaman Sea, in 490 fathoms.

Our series of specimens proves that the rostrum undergoes great changes in form and in length from youth to maturity.

Fig. 4.

Acanthephyra brachytelsonis, ♂, nat. size.

In our youngest specimen it is short and porrect, scarcely extending beyond the second third of the length of the antennal scale, and being much shorter than the carapace. In a somewhat older specimen it is decidedly ascendant, though still straight, and longer—reaching to the apex of the antennal scale—though still much shorter than the carapace. In a still older specimen it has almost completely attained the length and the upward curvature it has in adolescent specimens, though it is still distinctly shorter than the carapace. It is as long or longer than the carapace in all our adolescent specimens of both sexes, except the two largest, and in these, which are males, it is slightly shorter than the carapace; whence it may with some confidence be inferred that, as in *A. eximia*, *A. Agassizii*, S. I. Smith, and *A. angusta*, Spence Bate, it does not surpass the antennal scale in fully developed males. It is from $\frac{5\text{–}11}{3}$-toothed.

In all our specimens the eye is much as in Spence Bate's figure of *A. angusta*, not as in his fig. 7, pl. cxxvi., in which the so-called ocellus is represented as round and separate from the rest of the eye.

It appears to us probable that *A. angusta* is the adult male of *A. brachytelsonis*, the difference between the two in the number of the rostral spines being explained by the loss of the apical spine of the lower series in the process of reduction of the rostrum from the adolescent to the adult condition in the former; and possible that *A. brachytelsonis* itself will prove to be identical with *A. eximia*, since the former differs from the latter only in having one spine less on the inferior margin of the rostrum, and since Spence Bate includes amongst the specimens referred by him to the former individuals with the same number of spines as in the latter.

42. *Acanthephyra curtirostris*, W.-M.

Acanthephyra curtirostris, Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. p. 195, ♂.

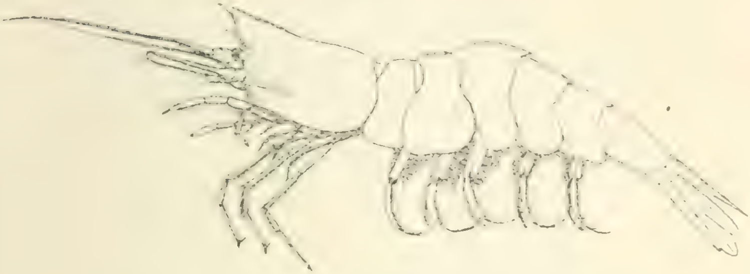
♀. Differs from the male only in its slightly more produced rostrum.

♂ ♀. The rostrum is $\frac{8\text{–}9}{1}$-toothed.

♂. The telson bears 9–10 pairs of dorsal spinules and 5 somewhat longer apical ones, the median of which is apparently fixed.

	♂ (type). millim.	♀ (type). millim.
Length from tip of rostrum to tip of telson	83	c. 77
Length of carapace from supraorbital to posterior margin	19	17·75
Length of antennal scale	14	13·5
Length of abdomen to end of telson..	56·5	c. 53
Length of telson	18	—·—

Fig. 5.



Acanthephyra curtirostris, ♀, nat. size.

One young male from Station 108, 1043 fathoms, and an adult male and an ovigerous female from Station 114, 922 fathoms.

Colour in life deep crimson, as in all previously obtained specimens.

Hoplophorus, Milne-Edwards.

As in *Acanthephyra* the crest of the fourth abdominal tergum is notched near its hinder end.

43. *Hoplophorus gracilirostris*, A. Milne-Edwards.

Aplophorus gracilirostris, A. M.-Edw. Ann. Sc. Nat. Zool. (6) xi. 4, p. 6, 1881, et Rec. Fig. Crust. 1883, ♂.
Hoplophorus Smithii, Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. p. 194, 1891, ♂ juv.

One male from Station 112, 561 fathoms.

Colour in life bright red.

As compared with our previous specimens it is larger, measuring about 62 millim. in length from the tip of the rostrum to the tip of the telson; the rostrum is a trifle shorter, but bears the same number of teeth, and the antero-inferior angle of the first abdominal pleuron is decidedly produced.

The right eye-peduncle has been neatly and cleanly excised without injury to any of the surrounding parts.

Another male from Station 115, 188–220 fathoms, is larger still, measuring about 77 millim. in length. The rostrum is still shorter and bears only $\frac{11}{7}$ teeth. The antero-inferior angle of the first abdominal pleuron is much as in the preceding specimen.

The left antennule has been cut clean off at the articulation between the basal and the second joints of the peduncle.

The latter of these specimens agrees exactly with Milne-Edwards's figure of *H. gracilirostris* in Rec. Fig. Crust., this being so, and all our specimens belonging without doubt to one species, *H. Smithii* is no longer maintainable as a distinct species and must be suppressed.

Our series proves that the rostrum in the male decreases in length from adolescence to maturity, as in some *Acanthephyræ*; but whether it is shorter than the carapace in very early life, subsequently growing to the length it has in the adolescent animal, there is at present no evidence to show.

An ovigerous female was taken in a former season in the Bay of Bengal, in lat. 19° 35′ N., long. 92° 24′ E., in 272 fathoms. It measures about 59 millim. in length. The rostrum, which is weak and somewhat deformed, and moreover has lost its tip, is only $\frac{10}{4}$-toothed. The pleura of the first and the second abdominal terga are soft and membranous and larger than in the male, more especially the latter of the two; and they form the lateral walls of a capacious incubatory pouch for the eggs. The appendages are smaller and are attached much further below the level of their sterna than in the male, being carried downwards towards the edges of the pleura by pillar-like prolongations of their bases, especially the anterior pair, which are attached quite close to the edges of the pleura. The two anterior abdominal sterna too appear to be more strongly arched upwards, whereby the height and hence the capacity of the pouch is still further increased.

The eggs are few in number, only eighteen having been found beneath the abdomen of our specimen, and large, measuring 2·4 and 1·6 millim. in major and minor diameters respectively.

Family **Alpheidæ**.

Genus ALPHEUS, Fabricius.

44. *Alpheus*, sp.

A male and an ovigerous female from Station 115, 188–220 fathoms

A larger male was taken in a previous season in the Bay of Bengal, in lat. 20° 17′ 30″ N., long. 88° 50′ E., in 193 fathoms.

Colour in life transparent blood-red.

As each of these specimens wants one of the great chelæ, we reserve the description of the species until complete specimens shall be available.

Family **Pandalidæ**.

DORODOTES, Spence Bate.

45. *Dorodotes reflexus*, Spence Bate.

Dorodotes reflexus, Spence Bate, 'Challenger' Macrura, p. 678, pl. cxvi. fig. 3; Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. 1891, p. 195, ♂ ♀.

Three females (two of them ovigerous) and three immature specimens from Station 111, 1644 fathoms.

Colour in life bright pink; legs crimson; carapace transparent, greasy.

HETEROCARPUS, A. Milne-Edwards.

46. *Heterocarpus Alphonsi*, Spence Bate.

Heterocarpus Alphonsi, Spence Bate, 'Challenger' Macrura, 1888, p. 632, pl. cxii. fig. 1; Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. 1891, p. 196, ♂ ♀.

Four males and four females (one ovigerous) of different ages from Station 112, 561 fathoms.

Colour in life bright pink.

The specimens were highly luminous when brought on board (see Introduction, vol. viii. p. 16).

This species had previously been taken in lat. 6° 32′ N., long. 79° 37′ E., off Colombo, in 675 fathoms (one male); in lat. 6° 29′ N., long. 79° 34′ E., in 597 fathoms (one very large ovigerous female); and twice in the Andaman Sea, in 590 fathoms (one male and two females).

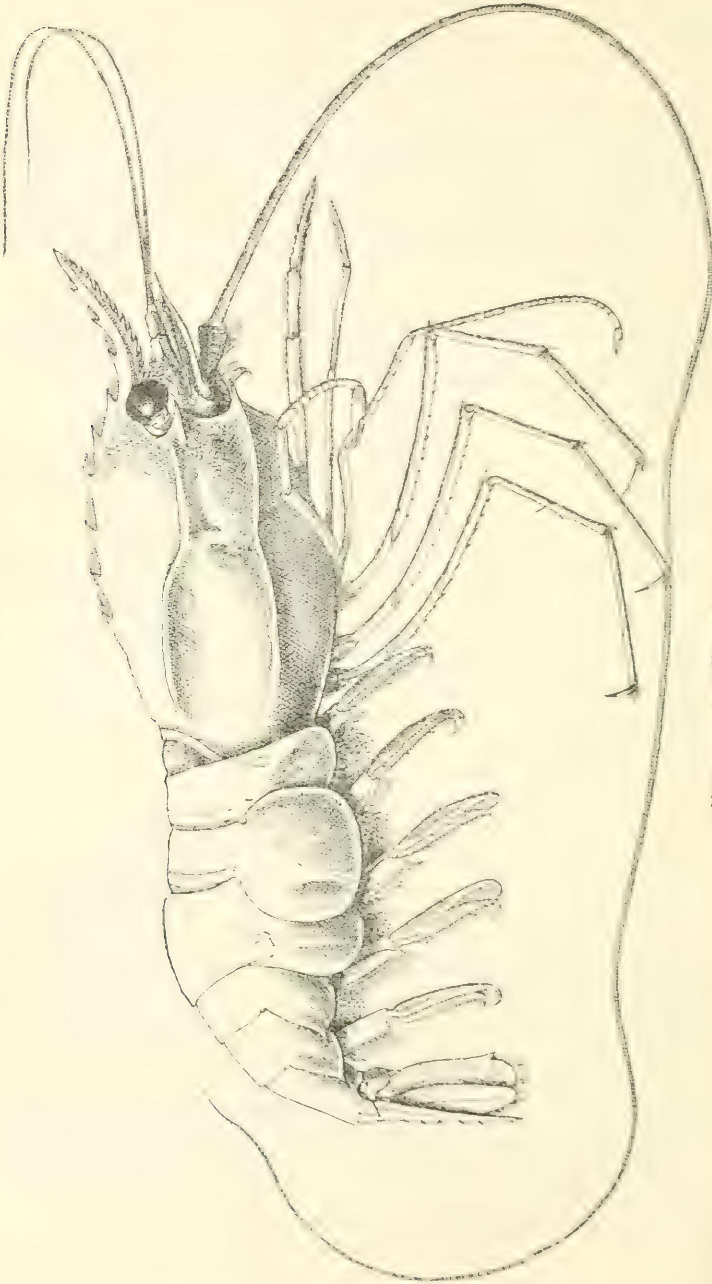


Fig. 6.

Heterocarpus gibbosus, ♀, nat. size.

47. *Heterocarpus carinatus*, S. I. Smith.

Pandalus carinatus, S. I. Smith, Bull. Mus. Comp. Zool. x. 1882–83, p. 63, pl. x. figs. 2–2 *f*, et pl. xi. figs. 1–3, ♀.
Heterocarpus ensifer (A. M.-Edw.), = *Pandalus carinatus* (S. I. Smith), A. Milne-Edwards, Rec. Fig. Crust. 1883, ♀.

One small specimen from Station 155, 188–220 fathoms.

48. *Heterocarpus ? gibbosus*, Spence Bate.

Heterocarpus gibbosus, Spence Bate, 'Challenger' Macrura, 1888, p. 634, pl. cxii. fig. 2, juv.

Eight males and four ovigerous females from Station 115, 188–220 fathoms.

Colour in life pink, with the legs pink and white.

One pair (the male with deformed rostrum) from Station 120, 240–276 fathoms.

This species had previously been obtained off Port Blair in 271 fathoms (two males), and in lat. 20° 17′ 30″ N., long. 88° 50′ E., in 193 fathoms (one young specimen with a still longer rostrum than in Spence Bate's figure).

Spence Bate described the species very imperfectly from an immature specimen.

We give a figure of an adult female measuring 138 millim. in length from tip of rostrum to tip of telson in a straight line.

Pandalus, Leach.

49. *Pandalus* prox. *quadridentatus*, A. M.-Edw.

Pandalus quadridentatus, A. M.-Edw. Rec. Fig. Crust. 1883.

One fine male from Station 112, 561 fathoms.

Colour in life bright pink.

The rostrum is armed with $\frac{5}{16}$ teeth.

One immature specimen with imperfect rostrum from Station 116, 405 fathoms.

Colour in life red.

It has the same number of teeth on the base of the rostrum as the male from Station 112.

50. *Pandalus* prox. *martius*, A. M.-Edw.

Pandalus martius, A. M.-Edw. Rec. Fig. Crust. 1883.

Many specimens of both sexes, immature as well as adult, from Station 115, 188–220 fathoms.

Colour in life pink; eggs light blue.

There are only 7–8 teeth on the base of the rostrum.

51. *Pandalus*, sp.

One pair (the female ovigerous) from Station 112, 561 fathoms.

Colour in life light pink.

One ovigerous female from Station 115, 188–220 fathoms.

One ovigerous female from Station 116, 405 fathoms.

Colour in life pink.

A small species, allied to some European forms, of which we have no specimens for comparison.

[To be continued.]

LIII.—*Remarks on Australian Slugs.*

By T. D. A. Cockerell, F.Z.S., Institute of Jamaica.

As my own idea of "courteous criticism" is very different from Mr. Hedley's, I shall not attempt to reply to the opinions regarding my conduct expressed in this Magazine, pp. 169–171 (Feb. 1892).

With regard to matters of fact it is not quite the same, as, if Mr. Hedley's statements were not contradicted, they might pass as valid among those not specially acquainted with slug-literature. I will therefore discuss them one by one.

(1). *Limax megalodontes.*—Any one may see by reference to my paper that I expressed much doubt as to its being an *Aneitea*. It seemed to me very unlikely that *L. flavus* could have been in Australia at such an early date; but later, having read some observations by Mr. Musson, I expressed the opinion that it might be *L. flavus* after all (Brit. Nat. 1891, p. 120).

(2). "The conclusion has forced itself upon me," says Mr. Hedley, that all the Australian *Limaces* have been introduced from Europe. I have said nothing to the contrary, except that I provisionally regard the *Amalia* as endemic. It *may* be *gagates*, but writers have usually considered it distinct, and nobody has satisfactorily proved the supposed identity. It was Mr. Hedley himself who named an Australian species *Limax queenslandicus*, and regarded it as distinct until Dr. Simroth said it was *lævis*.

(3). I think anybody reading my paper will see that when

I refer to the limited powers of migration among slugs the *natural* means only are intended. It is notorious that these are *extremely* limited. I give many instances of slugs being carried long distances (from Europe to St. Helena, New Zealand, &c., for example) by *artificial* means. Also it may be observed that many species of shell-bearing mollusks have been carried quite as far; there is a whole crop of synonyms originating in European species taken to the antipodes.

(4). Mr. Hedley is of the opinion that *Aneitea Graeffei*, *Krefftii*, and *Schutei* are one species. Any one may see by reading my paper that I doubted their distinctness: I say, "Probably the number of species will be considerably reduced when they are better known." Excellent authorities have considered them distinct, and I did not feel justified, with the material I had, in lumping them. The differences I observed were not those between living and preserved specimens, but between specimens preserved in exactly the same way, and the alteration due to contraction &c., being a common factor, need not seriously interfere.

(5). *Aneitea Macdonaldi* was named by Gray, who had New-Caledonian specimens; he *supposed* these the same as Macdonald's unnamed slug from Aneiteum, but it has been since doubted whether this was the case. (As to this matter and the distinction of *T. Krefftii* from its allies, see Mr. E. A. Smith, P. Z. S. 1884, p. 273.)

(6). Eighteen species of *Helicarion* are on record from Australia; I do not say they are all distinct, but I am not in a position to reduce the number with certainty. When they have been *shown* to be less than eight in a satisfactory manner, it will be time enough to alter the statistics.

(7). I did not say that Semper had not placed *H. Cumingi* in *Xesta*. My point simply was that certain species, *usually placed in Helicarion*, might be separated from it, at least subgenerically. It was not within the scope of my paper to go into further details, especially as the present state of knowledge does not allow any approximately final subdivision to be made.

(8). I quoted *Parmella* as a slug-like genus which is referred by authors to the *Vitrina*-group. I had "grave doubts" myself, but could not go into the details of the matter without unduly enlarging my paper.

(9). I placed *Cystopelta* on the characters given by Tate, who described it. Mr. Hedley examined a species, possibly not the same as Tate's, found in Australia, and arrived at different conclusions. Admitting the weight of his remarks, I inserted a qualifying footnote. What more could I have done?

(10). At the beginning of his article Mr. Hedley alludes to MS. names and imperfect diagnoses. It seems almost superfluous to state that there are no MS. names in my paper. The generic diagnoses are purposely short; but the species in the new genera and subgenera are elsewhere described in detail, with the exception of *Neojanella dubia*, which is described on p. 217. *Pseudaneitea* spp. have been described and their anatomy figured by Simroth. *Pseudaustenia* has similarly been fully described and figured by Godwin-Austen. *Imerinia* has its type in specimens which I consider to be identical with *Veronicella Grandidieri*, C. & F., already described. *Aneitella* has been described and figured by Mr. E. A. Smith; the anatomy of this and of *Neojanella* remains unknown because the British-Museum types must not be cut up. There is no other generic or subgeneric name in my paper that has not been used and characterized before.

Now I think I have shown that on every single point mentioned, Mr. Hedley's criticism is without sufficient reason. Nobody appreciates more than the present writer the labours of students like Mr. Hedley in special faunæ; but is it fair that they should grumble at others, who, with less material, hesitate to assert what they cannot know with certainty?

Kingston, Jamaica,
Feb. 19, 1892.

LIV.—*On the Scale-like and Flattened Hairs of certain Lepidopterous Larvæ.* By A. S. Packard.

The late Dr. T. W. Harris * described an *Acronycta*-larva, which he called *Acronycta americana*, as "beset with a few long black bristles dilated at the end," and added, "the long, black, spear-headed hairs grow from the skin and not from warts." The same larva was also figured on p. 305 of my 'Guide to the Study of Insects' (fig. 236). Mr. A. G. Butler †

* 'Entomological Correspondence of T. W. Harris,' edited by S. H. Scudder. Boston, 1862.

† "On the Natural Affinities of the Lepidoptera hitherto referred to the Genus *Acronycta* of Authors," Trans. Ent. Soc. Lond., Dec. 1879, p. 313.

refers to the larva of *Acronycta alni* as "much resembling both in colour and in its clavate hairs the larva of *Tinolius*," the latter being figured on pl. xi.; the large, strong, clavate hairs of this form, *Tinolius eburneigutta*, Walker, which is a semilooper, and from its black colour a very conspicuous animal, are represented as being from one fourth to one third as long as the body and are situated on the first two or three segments of the abdomen, this being the most prominent part, forming the loop when the creature is in motion. These are the only cases known to me of the occurrence of flattened hairs, with the exception of the case described by Burmeister and quoted below.

Scale-like Setæ.—In examining the median dorsal tufts on the second and third thoracic segments of the European *Gastropacha quercifolia* I found that they are composed of broad lanceolate-oval scales*, which are opaque and dark steel-purple in colour, with the surface quite regularly striated, though not invariably so, while the striæ do not appear to extend to either end. They vary in shape and in size, some being narrow and with a simple point at the distal end, while the majority are variously notched or toothed. They thus appear to be true scales, like those on the wings of adult Lepidoptera.

Scales from the dorsal thoracic tufts of *Gastropacha quercifolia.*

In *Gastropacha americana* the scales forming the dorsal tufts, both on the two hinder thoracic segments and on the eighth abdominal one, are very different from those of the European species; they are dark and opaque, but are long, narrow, and flat, very gradually increasing in width to the end, which has a single notch. From this notch an impressed line or stria extends along the middle of the scale for some distance.

Setæ flattened at the end.—In *Gastropacha quercifolia* the lateral tufts along the body each contain a few long hairs with flattened ends, varying in shape from oval to triangular, with the ends often very broad and ragged, bearing from one to

* These scales were briefly referred to in my article entitled "Hints on the Evolution of the Bristles, Spines, and Tubercles of certain Caterpillars," Proc. Bost. Soc. Nat. Hist. xxiv. p. 512, 189 (1890).

four very irregular teeth. No striæ are perceptible, and the hairs throughout are pale, colourless, and transparent.

On examining the lateral tufts of *Gastropacha americana* I found some similar very long hairs with the ends flattened and of extraordinary form. These hairs usually project beyond the simple hairs; some of them end in regular lanceolate-oval shapes with the point much attenuated, others are broader, while some are oval and very broad at the truncated end, which terminates in a fine attenuated point, at the base of which are usually three attenuated teeth. They are similar in shape to those of *Gastropacha quercifolia*.

On turning over the beautiful plates of Burmeister's 'Atlas of the Lepidoptera of the Argentine Republic' I found that the author represents on pl. xxii. fig. 9 the similar long hairs of *Clisiocampa proxima*. They are much more regular than any I have seen, and are much flattened and expanded at the ends, with from three to five long slender teeth. They are also represented as striated longitudinally, with either beads or clear spots in the expanded portion. These hairs are visible to the naked eye. Burmeister remarks (p. 52) that Stoll has figured (Suppl. de Cramer, pl. xix. fig. 5) a similar larva with the same kind of hairs, *à palmette terminale*, situated on the first and last segments of the body. He names it *Bombyx ephomia* (pl. xxxv. fig. 6, of the same volume). Walker refers this species with doubt to the genus *Oxytenis*. Burmeister adds: "Some other species of the genus *Clisiocampa* have the same kind of hairs placed at each end of the body."

I have been unable to discover these flattened hairs in *Clisiocampa americana* or in *C. neustria* of Europe. In *C. sylvatica* the hairs on the lateral thoracic tubercles are tapering and finely barbed, with scattered, slender, spike-like, smooth, simple setæ. Perhaps the latter are the homologues of the flattened setæ. In *Heteropacha Rileyana* of the central United States there are no dorsal tufts, and consequently no dorsal scales like those of its ally *Gastropacha*; but certain of the hairs in the lateral tufts are flattened at the end, which is very long and slender and lanceolate-oval, with the tip much attenuated *.

In the Noctuina these hairs with flattened ends probably occur in nearly all the hairy and pencilled species. In the

* In *Tolype velleda* there are no such scales or hairs with flattened ends as in *Gastropacha*; those on the dorsal tubercles of the thoracic and eighth abdominal segments being simple, tapering, with large, scattering, spike-like, dark, opaque setæ, these latter being perhaps the homologues of the dark scales of *Gastropacha*.

larva of *Acronycta hastulifera*, A. & S., many of the barbed hairs forming the black pencils are flattened at the end and black, but not striated.

These specialized and highly differentiated dark scale-like setæ appear to be of use in rendering the dorsal tufts more conspicuous, the caterpillars being very hairy, and thus probably inedible by birds. It should be observed that the larva of *Gastropacha americana*, in which the dorsal tubercles and the scales are much smaller than in the European *G. quercifolia*, is rendered at least equally conspicuous by the two transverse bright scarlet bands disclosed behind the second and third thoracic segments when the insect is creeping. These appear to be entirely wanting in the European species.

Finally, the occurrence of these scales, so much like those of adult Lepidoptera, is an interesting example of the acceleration of development of the setæ in the larval stage, and it is not improbable that in the ancestors of certain of the Lasiocampidæ they were characters acquired during the later stages of their larval lifetime.

Providence, R. I., U. S. A.

LV.—*On the* Ophideres princeps *of Guenée and its utter dissimilarity in Structure and Pattern from the* Ophideres princeps *of Boisduval.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

In the 'Voyage of the 'Astrolabe'' (Lépidoptères, p. 245) M. Boisduval described a moth from Dorey, New Guinea, under the name of *Ophideres princeps*; he characterized it as allied to *O. materna*, Cramer, and as having "the front wings blackish, slightly clouded, dusted with black and a little varied with greenish, with four white spots, grouped in pairs; the lower wings yellow with a kidney-shaped patch and a black border, and the fringe intersected with whitish." This is probably one of the innumerable varieties of the wide-ranging *O. fullonica*.

In the third volume of his 'Noctuélites' M. Guenée describes and figures a West-African species (with M. Boisduval's locality) as *O. princeps*—evidently without taking the trouble to look up the description in the 'Voyage of the 'Astrolabe,'' with which the African species hardly corresponds in a single particular, inasmuch as the front wings, even in the female, only exhibit one isolated white spot; the lower wings also being orange, with a uniform black border and no kidney-shaped patch, but with the base of the wings also blackish, a marginal series of buff spots, and the fringe opposite to these spots intersected with pure white.

In his 'Catalogue of Lepidoptera Heterocera' Walker again neglected to look up the original description, but blindly followed M. Guenée, although he indicated his belief that the Museum specimen was from West Africa.

In his 'Monograph of Ophideridæ' Mr. Moore again followed Walker, stating that *Ophideres* must be restricted to its type *O. princeps*, and adopting for *O. fullonica* the name *Othreis*, Hübner (which is, of course, synonymous with *Ophideres* if we admit that typical *O. princeps* is *O. fullonica*).

The *Ophideres princeps* of Guenée, Walker, and Moore thus remains without a generic or specific name, and may be called *Halastus intricatus*. We have it from Old Calabar, Sierra Leone, Ambriz, and the River Niger. The family must now be called Othreidæ.

LVI.—*On the Radula of* Paludestrina Jenkinsi, *Smith, and that of* P. ventrosa, *Mont.* By B. B. Woodward, F.G.S., F.R.M.S.

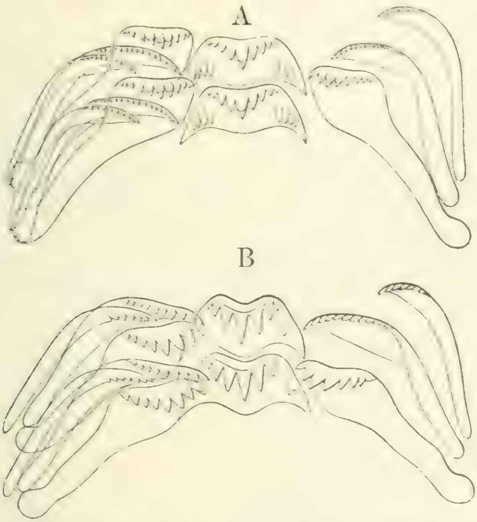
When in the autumn of 1889 my friend and colleague Mr. E. A. Smith had under observation the specimens of *Paludestrina* (=*Hydrobia*) to which he afterwards gave the name of *P. Jenkinsi* *, he handed some examples to me with the request that I would examine the radula and compare it with that of *P. ventrosa*, Mont. At that time these two species were thought to be very closely allied, and, indeed, with some it was a disputed point, since conceded, whether *P. Jenkinsi* were anything more than a variety of *P. ventrosa*.

Pressure of work at the time, followed by prolonged ill-health, prevented the completion of the investigation, or all doubts as to the specific distinctness of the two forms might speedily have been set at rest, as the accompanying notes and descriptions will serve to show.

At the very first glance a dissimilarity in character is

* Journ. Conch. vi. (1889) p. 142; figured in 'Essex Naturalist,' iv. p. 214.

evident. The transverse rows of teeth are slightly more arched in *P. ventrosa* than they are in *P. Jenkinsi*; in the former, moreover, the admedian teeth alternate with and project slightly between the central ones, whereas in the latter they are nearly in a line with, and stand clear of, the median teeth, so that the whole radula has the appearance of being more sharply divided into longitudinal areas. The contrast between the respective median teeth is yet greater. In *P. ventrosa* the central cusp of the rachidian is as long as half the width of the tooth, and is flanked on either side by three others, whilst the single basal denticle on each side is barely visible; in *P. Jenkinsi*, on the other hand, the length of the central cusp is not more than one third the width of the whole tooth; four or even five minor cusps flank this central one to right and left of it, and four basal denticles stand out conspicuously on either hand below the crest of the tooth.



Portion of Radula of:—A. *Paludestrina Jenkinsi,* Smith
B. *Paludestrina ventrosa,* Mont.

Two rows of teeth are in each case shown on the left of the median tooth in their undisturbed position. On the right the teeth of a single row are drawn apart.

The remaining differences are best seen from the figures. The following brief descriptions, with approximate micromeasurements, of the radulæ of these two species are founded on several specimens of each.

Paludestrina ventrosa.

Radula measuring $60 \times 16\ \mu$ and having 40–45 rows of seven teeth each.

Median (or rachidian) tooth ($2{\cdot}5\ \mu$ in width) bears 7 cusps, of which the central one equals in length half the width of the crest of the tooth. Basal denticles one on each side, inconspicuous. The crest of the tooth viewed in its position in the radula is markedly concave.

Admedian tooth bears 9 cusps inclined inwards towards the median line of the whole radula; base prolonged outwards in a shank which reaches almost to the margin of the radula and which terminates in a thickened knob-like end.

Laterals long, slender, and curved, with numerous small cusps, which in the outer one are difficult to resolve. The inner lateral is more sharply curved at the point where the cusps cease; in the outer one the curve is far more symmetrical throughout.

Formula: $\frac{\mathrm{M}}{7}+\frac{1}{9}+\frac{2}{x}$.

Paludestrina Jenkinsi.

Radula measuring $86\text{–}93 \times 20\ \mu$ and having 60–70 rows of seven teeth each.

Median tooth bearing 9, or sometimes even 11, cusps, of which the central one is about one third the width of the crest. This last is less concave in outline than in *P. ventrosa*. Basal denticles four on either side, very conspicuous.

Admedian tooth bearing 9–11 cusps, inclined inwards, but slightly less so than in the preceding species; in other respects it is very similar.

Laterals long and slender, nearly straight in the shank, and sharply curved at the free end. Cusps numerous and easily visible.

Formula: $\frac{\mathrm{M}}{9\text{–}11}+\frac{1}{9\text{–}11}+\frac{2}{x}$.

LVII.—*Observations on two rare British Nudibranchs* (Lomanotus genei, *Verany, and* Hancockia eudactylota, *Gosse*). By F. W. Gamble, B.Sc., Assistant to the Beyer Professor of Zoology, Owens College, Manchester.

[Plate XVII.]

While working last summer at the Plymouth Laboratory of the Marine Biological Association I obtained a single specimen of each of these species during successive weeks from the same part of Plymouth Sound. Finding that my *Lomanotus* possessed certain peculiarities of which I could find no adequate description or figures, and that *Hancockia* had only been taken on one previous occasion on the British coasts (by Mr. A. R. Hunt in Tor Bay, 1877), I observed and drew the living animals with the following results.

Lomanotus genei, Verany. (Pl. XVII. figs. 1 and 2.)

Specimens referable to this species have been taken from time to time on our coasts. Mr. Garstang, in his recent report *, has collected these cases and added a number which have occurred at Plymouth. The following description of my own specimen agrees closely in certain points, such as size, colour, and general structure, with that of his two dark individuals †.

Length half an inch.

Colour dark brown, with irregular yellowish spots; the papillæ each with a dark band below a white tip. The general tint agreed closely with that of the *Fucus* on which I found it after being dredged, and upon which it lived in captivity.

Oral veil with two prominent processes on each side, the outer ones being the larger. Rhinophores retractile within calyx-like sheaths, clavate, laminated at the base, with smooth truncate tips. Sheath-margins each produced into five papillæ of very definite shape when expanded. These papillæ, like those of the oral veil and pleuropodium, are capable of contraction and dilatation. Pleuropodium consisting of four well-marked lobes on each side. The centre of each lobe is dorsal and close to the middle line. It is marked by the large dorsal papilla. The sides of the lobe extend anteriorly and posteriorly in a ventral direction, enclosing a slightly concave area, and bearing papillæ. Posteriorly the lobes become slightly irregular and meet on the dorsal surface. Foot slender, produced anteriorly into recurved processes. Genital aperture beneath and slightly in front of the first large dorsal papilla of the right side. Anus beneath the second.

My attention was first drawn to the characteristic form and changes of shape assumed by the dorsal papillæ. These changes consisted of contraction from an extended definite shape to a more or less bulbous triangular one. So far as I

* "Complete List of Plymouth Opisthobranchs," Journ. Mar. Biol. Assoc. (n. s.) i. no. 4.

† "Report on Nudibranchs of Plymouth Sound," Journ. Mar. Biol. Assoc. I. ii. 1889, p. 187.

am aware none of the terms used by previous authors on this subject do justice to the form of the extended pleuropodial papilla. The interest of the matter is increased by the fact that the tips of the "calyx-sheath" have the same power of contractility, and that their extended form agrees with that of the dorsal papillæ. The velar processes also when extended are of a very definite shape (see figs. 1 and 2).

On gently touching the centre of the right side of the animal with a clean sable brush three events occurred almost simultaneously; the rhinophores previously expanded were sharply retracted within their sheaths; the velar processes were extended; and the dorsal papillæ of the right side, especially those near the point of the brush, were erected from a previously oblique position, the large papillæ markedly directing their whitish tips towards the brush. The effect might be almost said to be "bristling." The papillæ of the left side were only feebly affected. On repeating the experiment at different points I found that when the stimulus is applied just behind the rhinophoral sheath the large postero-external sheath-papilla directed its tip obliquely backwards towards the point of attack, the first primary pleuropodial papilla directing its tip forwards. Several times I observed a single fully-expanded papilla move independently in an oblique plane from an anteriorly directed position to a posteriorly directed one. The "erection" and movement of the papillæ is brought about in the same way by natural stimuli. These movements led me to suspect the presence of cnidocysts. In spite, however, of the examination of the living animal and of sections of young specimens $\frac{1}{16}$ inch long (for the use of which, together with help in many ways, I am indebted to my friend Mr. Walter Garstang), I have hitherto been unsuccessful; indeed Bergh *, in his description of the genus, has stated "cnidocystæ nullæ" as a diagnostic character.

On some occasions I observed the peculiar lashing movements of the whole body already noticed by Mr. Garstang †. Thus, on pushing the animal laterally with a brush until its foothold gave way, it bent upon itself and executed a series of very vigorous S-shaped movements from side to side, the ventral surface of the foot being kept at about the same position on the surface of the water, the rest of the body inverted downwards. On another occasion it voluntarily

* "Die Cladohepatischen Nudibranchien," Zool. Jahrbücher, Bd. v. (1890).

† "First Report on Nudibranchs of Plymouth Sound," Journ. Mar. Biol. Assoc. (n. s.) I. ii. 1889, p. 189.

loosened its hold of the side of the glass vessel and progressed slightly by means of these contractions. Again, after floating foot upwards for some time, it would wriggle to the bottom and immediately gain a footing.

My specimen was quiet during the day. In the morning I found that it had crawled out of the dish where it had been placed overnight. This was done constantly, and indicates nocturnal habits. During the three weeks that I kept my specimen no spawn was deposited; hence probably it was immature.

As regards the significance of these observations. Continual changes of form in the pleuropodial papillæ during life have been noticed by Dr. Norman in his species, *L. Hancocki* *. The complete similarity, however, both in characteristic form and power of coordinative movement possessed by these papillæ in common with those of the "calyx-sheath" apparently escaped him, and is an additional argument in favour of the view advanced by Mr. Garstang †, that such sheaths contain a "pleuropodial element."

Hancockia eudactylota, Gosse. (Pl. XVII. fig. 3.)

A specimen of this species was dredged last summer (1891) on *Delesseria* in Plymouth Sound, as I have already recorded ‡. Mr. Hunt, the original discoverer of this form, dredged the only previous British specimen on the same Alga in Tor Bay in 1877. This was described by Mr. Gosse § under the name *Hancockia eudactylota*. In 1886 Prof. Trinchese, apparently in ignorance of Gosse's paper, described ("Ricerche Anatomiche sul Genere *Govia*" ||, 1886) four specimens dredged near Naples, defining them as two species of a new genus, *Govia rubra* and *G. viridis*. Although the internal anatomy of *Hancockia* is unknown, it seems probable that the genera *Govia* and *Hancockia* will be united, as indeed has been done by Dr. Norman in his "Revision" (this Journal, vol. vi. 1890, pp. 79, 80). Carus ('Prodromus Faunæ Mediterraneæ,' vol. ii. pt. 1, p. 208) writes the genus *Govia*, Trinch., adding in brackets (*Hancockia*, Gosse).

The Plymouth specimen was about a quarter of an inch in

* Norman, Ann. & Mag. Nat. Hist. 1877, xx. p. 518.

† "Complete List of Opisthobranchs at Plymouth," Journ. Mar. Biol. Assoc. (n. s.) i. no. 4, p. 430.

‡ "The Occurrence of *Hancockia* at Plymouth," *ibid.* (n. s.) vol. ii. no. 2, p. 193.

§ Ann. & Mag. Nat. Hist. ser. 4, vol. xx. 1877, p. 316.

|| Mem. della R. Acc. delle Sc. dell' Instituto di Bologna, ser. 5, vol. vii.

length when expanded. This is only half the length of Mr. Hunt's specimen. Colour a purplish-rose, very similar to the *Delesseria* on which it lived. Too much stress should not be laid on this point, however, since Mr. Hunt's example, although apparently found on the same weed *, was olive in colour. The mid-dorsal and lateral lines of the upper surface darker. The epidermis of the upper surface is of a bluish-green hue, as Gosse has already noticed (*loc. cit.* p. 317). On the sheaths of the rhinophores are scattered bluish-white spots; semilunar markings of the same kind occurred at the base of the pleuropodial lobes (compare Trinchese's figure of *Goria rubra*). Body widest behind the head, gradually tapering posteriorly. Head with an oral veil bearing four papillæ on each side, the second anterior one being the largest. These papillæ were constantly changing their shape during life, as Gosse and Trinchese have recorded. Rhinophoral sheaths erect, cylindrical, the margin subdivided into about ten rounded projections. This agrees closely with the figure and description of the sheaths of *Goria viridis*. Those of *G. rubra*, on the other hand, have plain margins. Rhinophores with a rounded, bulbous, laminated base, terminating above in a smooth columnar tip. Pleuropodium produced into four lobes on the right and five on the left, the fifth being rudimentary. The first pair of lobes are opposite, the rest gradually becoming alternate, as in Trinchese's figure of *Goria rubra*. Each lobe is concave externally and is composed of seven papillæ, one being dorsal and median, three anterior, and three posterior. The foot is rounded anteriorly, posteriorly it ends in a slightly bifid tail, as in *Goria* (Trinchese, *loc. cit.* p. 183 and my fig. 1). The anal papilla very small, cylindrical, situated halfway between the first and second lobes of the right side. Genital opening near dorsal surface between the rhinophore and the first dorsal lobe of the right side.

In the appended table I have compared the different specimens of *Hancockia* and *Goria*. Although they all agree in main points, no two individuals do so in detail.

* Gosse, *loc. cit.* p. 316, note.

	Name.	Length.	Colour.	Characters of Velar Papillæ.	Margin of Rhinophoral Sheath.	Pleuropodium.		
						Characters.	Number of Lobes.	
							Right side.	Left side.
1.	*Govia rubra*, Tr.	10 mm.	Purplish rose. Brightest on rhinophoral sheaths, dorsal and velar papillæ. Dorsal surface with irregular white spots.	5 on each side; 3 large lateral, 1 small anterior and posterior.	Plain.	Lobes of 7–8 papillæ.	5; the 5th most posterior.	5
2.	*G. rubra*, Tr.	13 mm.	Colour as in No. 1.	4 on each side.	Plain.	Lobes of 7–8 papillæ.	5	6; the 6th most posterior.
3.	*G. rubra*, Tr.	Not given.	Bright chestnut. White spots forming a line marking position of pleuropodial ridge.	5 on each side.	Plain.		Number not	stated.
4.	*G. viridis*, Tr.	14 mm.	"Verde pistacchio."	4 on each side.	Divided into about 10–12 rounded projections.		3	4
5.	*Hancockia eudactylota*, Gosse. Mr. Hunt's specimen.	12·5 mm.	Olive. Gosse figures whitish spots marking the pleuropodial ridge, becoming more irregular posteriorly.	3–4 on each side alternating with as many small ones (Gosse, *loc. cit.* p. 317).	Furnished with subconical points along its edge.	Lobes of 11 irregularly notched leaflets.	3	3
6.	*H. eudactylota*. Plymouth specimen.	7 mm.	Purplish rose. White spots at base of pleuropodial lobes as in *Govia*.	4 on each side.	Divided into about 10 rounded projections.	Lobes of 7 papillæ.	4	5; the 5th most posterior.

From this table it would appear that *Govia rubra*, Tr., differs specifically from *G. viridis*, which may hereafter be united with

Our knowledge of the internal anatomy of these forms is limited to the preliminary paper by Prof. Trinchese before referred to. The cutting-edge of the jaw is short and armed with a single series of 15–16 teeth, the first two or three of which are simple, the rest set with extremely fine tubercles. Radula triseriate; the teeth of the median row with lateral denticles; the lateral teeth broad, unarmed ("quasi omnino illi Galvinarum similis," Bergh *). Salivary glands large. Liver diffuse, with anterior and posterior branches, the latter supplying the dorsal papillæ. The nervous system similar to that of Æolidiidæ. Eyes well developed. Otocysts with a single otolith. Penis unarmed. The spermatozoa similar to those of Æolidiidæ. *Hancockia* appears to be mature when about half an inch in length. Trinchese describes ripe generative products at this stage, and Gosse has figured and described the spawn deposited by a specimen of this size. The ribbon was in the form of two complete figure-of-eight coils, the ova being irregularly scattered. My specimen was only a quarter of an inch long, and during the fortnight that I kept it no spawn was shed.

I stimulated *Hancockia* to see if the dorsal papillæ would respond, as they do in *Lomanotus*; no effect, however, followed. The presence of cnidocysts in the genus described by Trinchese as occurring at the tips of the pleuropodial lobes (*loc. cit.* pp. 186, 189, and plate, figs. 8 and 14) makes its behaviour contrast still more with that of *Lomanotus*.

While gliding over the bottom of the vessel in which it lived it would sometimes stop, raise the anterior part of the body, and, with the velar tentacles and the rhinophores well expanded, it would sway from side to side. In a short time the action ceased and the animal went straight to the *Delesseria* on which it lived. Unfortunately I made no experiments to ascertain whether *Hancockia* responds to shadows as stimuli. The large eyes noted by Trinchese would be in favour of such reaction. *Hermæa bifida*, which lives on *Delesseria*, and certain Eolids have been shown by Mr. Garstang to respond †.

As regards the systematic position of *Hancockia*. Gosse placed it in the Tritoniidæ; Trinchese, Bergh, Norman ‡, and Carus place it in the Dotonidæ; Bergh, however, adding: "Bei der Formulirung der Charaktere der Dotoniden ist auf

* "Die Cladohepatischen Nudibranchien," Zool. Jahrb. v. p. 53.

† Garstang, "Complete List of Plymouth Opisthobranchs," Journ. Mar. Biol. Assoc. (n. s.) i. no. 4, p. 423.

‡ "Revision of British Mollusca," Ann. & Mag. N. H. vol. vi. 1890, p. 79.

die Hancockien oder Govien keine Rücksicht genommen, weil die Stellung dieser merkwürdigen, gleichsam mehrere Familien verbindenden Gattung, bei der bisherigen nur vorläufigen Untersuchung Trinchese's, noch ganz unsicher ist." I will only allude here to one view implied rather than expressed by Mr. Garstang *. He compared a lobe of the pleuropodium of *Hancockia* with one of the four arcuate lobes of the "raised curtain" forming the pleuropodium in *Lomanotus*. The side view which I give of the latter genus shows that the lobes are distinct and that the breaks occur between the segments having the large dorsal papillæ as their centres (Pl. XVII. fig. 2).

EXPLANATION OF PLATE XVII.

Fig. 1. Plymouth specimen of *Lomanotus genei*, Ver., seen from the dorsal surface. × 6. The papillæ are extended.

Fig. 2. The same, from the right side. × 6. Papillæ about ⅔ expanded. *a*, genital papilla; *b*, anal papilla. These were inserted from the preserved specimen.

Fig. 3. Plymouth specimen of *Hancockia eudactylota*, Gosse, from dorsal surface. × 14. In this view only three papillæ of each pleuropodial lobe are shown.

LVIII.—*On two new Central-African Antelopes obtained by Mr. F. J. Jackson.* By OLDFIELD THOMAS.

By the kindness of Messrs. Rowland Ward and Co., of Piccadilly, I have been entrusted with the examination of the skulls and scalps of two antelopes, a Hartebeest and a Wildebeest, sent home by the well-known explorer and naturalist Mr. F. J. Jackson.

Although probably in neither case, as will be seen below, are these specimens absolutely the first of their respective forms which have been sent to Europe, both seem to require new names, the one specific and the other subspecific.

Firstly, with regard to the Hartebeest. In 1859 Mr. Petherick sent home from the Bahr el Gazal "several heads of both sexes" of a Hartebeest referred by Dr. Gray † to *Alcelaphus bubalis*, but of which a female skull, the only remnant of the series now in the British Museum, appears to belong to

* *Ibid.* p. 429.

† Ann. & Mag. Nat. Hist. (3) iv. p. 296 (1859).

the *caama* type, with V-shaped horns. Another similar specimen from the Bahr el Gazal, also female, was sent to the Museum in 1884 by Mr. F. Bohndorff. Noticing their relationship to *B. caama*, about a year ago I made many endeavours to find out what had become of Petherick's male specimens or to get hold of another, but without avail. That a *caama*-like species occurred in this region was clear, for Heuglin* also speaks of the occurrence on the White Nile of a Hartebeest which "scheint mit *A. caama* zusammenzufallen," and it was therefore with much pleasure that in Mr. Jackson's hartebeest I recognized a species very possibly identical with that observed by Petherick, Heuglin, and Bohndorff. At the same time it must be said that while the horns of Petherick and Bohndorff's specimens correspond with small and slender female *caama* horns, those of Mr. Jackson's skull equal or exceed in size the very largest male *caama* horns that I have seen. Male specimens, with skins, from the Upper Nile are therefore needed to confirm or upset this identification.

I propose to call the species

Bubalis Jacksoni, sp. n.

Similar in essential characters, in size and proportion of skull, and in the curves and direction of the horns to the South-African *B. caama*, but distinguished by the uniform pale colour of the face, which matches that of *B. tora* and is entirely without any trace of the black frontal and nasal patches characteristic of that species. Hair of nasal region reversed upwards for only about 4 or $4\frac{1}{2}$ inches from the hairy point between the nostrils †.

Hab. Country between Lake Victoria Nyanza and Lake Naivasha. Its northward range depends on the correctness of my identification of Heuglin's and Petherick's animals with it, and this must of course remain doubtful until further information is obtained.

* N.O.-Afr. ii. p. 123 (1877).

† The extent of the reversed hair on the face seems to be characteristic of the different species of the genus. Thus it extends up to between the eyes in *B. caama*, or even to the horns, while in *B. major*, *tora*, and *Cokei* it is confined to about $1\frac{1}{2}$ or 2 inches on the tip of the muzzle. In *B. Lichtensteini* it is reversed on the nasal region, points downwards on the anterior frontal, and is then again reversed up to the base of the horns. No doubt larger series than I have been able to examine will show these characters to be more or less variable; but the species are all so closely allied to one another that any characters which may help to separate them are worthy of mention.

The following is an extract from Mr. Jackson's letter to Messrs. Ward and Co.; and his remarks being quite borne out by an examination of the specimen, I feel myself at liberty to publish them:—

"I do not think it is likely to extend further south, but of course it may extend to the Cape for what we know; if it is *Alcelaphus caama* it may do so, but I am inclined to doubt its being the same as the S. African animal. I seem to have an idea that the one at the British Museum is very much darker and the horns different, but this is only from memory, and I cannot be sure. Up north all along the top of the Elgeyo Escarpment (continuation of Mau) into Turquel to the north and north-east of Mount Elgon it is very common, and takes the place of *A. Cokei*. Round Baringo it is fairly plentiful, but some marches south of Njemis the *A. Cokei* takes its place."

While the presence or absence of the face-markings is in this group, owing to its constancy in the adult, a very good character, the distinction of this species rests largely on geographical considerations. The true *B. caama* is purely South African *, and its range is absolutely shut off from that of *B. Jacksoni* first by *B. Lichtensteini*, which covers all the Zambesi region and Nyassaland, and then further north by *B. Cokei*, these two species being members of totally different groups of the genus, and neither of them at all closely allied either to *B. caama* or to *B. Jacksoni*.

The following are the measurements of the typical skull of *B. Jacksoni*:—

Basal length 406 millim., greatest breadth 140, length of nasal bones 220; profile, length from tip of nasals to top of frontal crest between horns 450. Distance from tip of horn to end of muzzle in a straight line 888 (=35 in.).

Horns: greatest length round curves in front 528; circumference at base 305 (=12 in.); distance from tip to tip 220.

It is with great pleasure that I connect with this magnificent new antelope the name of Mr. Jackson, whose discoveries, both zoological and geographical, in the region which it inhabits have rendered his name familiar to all interested in our East-African possessions.

The second antelope, the Wildebeest or Brindled Gnu, is one which is likewise allied to a South-African species, but

* Selous (P. Z. S. 1881, p. 763) says, "It does not extend its range northward of the saltpans near the Botletlie River . . . and is unknown in the Matabele and Mashuna countries."

although its differential characters are of almost as important a nature as in the case of the Hartebeest, there is no interruption in the range, and therefore, as intermediate specimens will certainly be found, I propose only to make a subspecies of it.

It may be called

Connochætes taurinus albojubatus, subsp. n.

Distinguished from *C. taurinus typicus* by the long mane which runs along the centre of the throat being white instead of black, including the tufts on each side of the angles of the lower jaw. Coloration in other respects the same.

Skull somewhat shorter, especially in the muzzle, and the anteorbital depressions more strongly marked. Horns directed somewhat downwards on each side instead of horizontally outwards, and their bases much more expanded and with prominent bosses on their upper aspects.

Measurements of the typical skull :—

Basal length 430 millim., greatest breadth 198; occiput to nasal tip 428; nasals, length 215.

Horns *: greatest length round curve behind 494 ($=19\frac{1}{2}$ in.); greatest circumference at base 842 ($=13\frac{1}{2}$); greatest spread, measured to the outer side of the horns, 652 ($=25\frac{3}{4}$); tip to tip 414 ($=16\frac{3}{8}$); tip to tip round outer curve and across forehead 1186 ($=46\frac{3}{4}$).

Hab. Uganda (*F. J. Jackson*).

Although I have taken Mr. Jackson's fine example as the type of this new subspecies, I believe it will be found that many of the East-African specimens hitherto considered to be the common form really belong to it. Certainly several Kilima-njaro heads that I have seen have white throat-manes, while the South-African specimens invariably have black ones. In fact it seems probable that, just as the recently described *Oryx callotis*, with its long black ear-tufts, represents in East Africa the *O. gazella* and *O. beisa*, so *C. taurinus albojubatus* represents throughout that region the typical black-throated race. Where the two forms, if at all, pass into one another remains to be seen; but it is evident that they are certainly different geographical races, and ought to have different names accordingly.

* All these measurements are very difficult to take with any exactness, and probably no two observers would make them precisely the same.

LIX.—*Descriptions of new Genera and Species of* Pyralidæ *contained in the British-Museum Collection.* By W. Warren, M.A., F.E.S.

[Continued from p. 302.]

Tanaophysa, gen. nov.

Fore wings elongate, broadening towards the apex; costa convex; apex blunt; hind margin curved, oblique. Hind wings rather narrow; hind margin slightly curved. Palpi porrect, rostriform; tongue present; antennæ simple in both sexes; distinguished by a scaleless patch in the male fore wing; on leaving the cell the last two subcostal nervules are slightly curved downwards for half the distance between the end of the cell and the hind margin, and the whole of the space between them is without scales and diaphanous.

Type *T. adornatalis*, Warr.

Tanaophysa adornatalis, sp. n.

Fore wings bright yellow, brownish along the costa, especially towards the base; an indistinct obliquely curved first line near the base and another exterior of the ordinary shape; a small dot in the cell near the first line and a larger one at the end of the cell. Hind wings like fore wings, with the exterior line repeated; fringes of both wings concolorous. Head, thorax, and abdomen all yellow. Underside whiter.

Expanse of wings, ♀ 32, ♂ 24 millim.

A pair from S. Paolo in the British-Museum Collection.

Diacme, gen. nov.

Fore wings with costa straight till just before apex, where it is strongly curved; hind margin oblique, slightly indented beneath apex, so that the wings appear subfalcate. Hind wings also bluntly subfalcate; the hind margin in the male cut off nearly straight from inner to anal angle; fore wings in male longer and narrower than in female, but not so exaggeratedly as in *Stenophyes*, Led. Antennæ in male finely pubescent; labial palpi short, blunt, porrect; abdomen of male with two small lateral fan-shaped tufts of erect scales on either side of the penultimate segment.

Type *D. phyllisalis* (*Samea*), Wlk. xix. p. 936.

Pessocosma, Meyr.

Type *P. iolealis*, Wlk., Meyr. Tr. E. S. 1884, p. 301.

Pessocosma suffusalis, sp. n.

Fore wings sandy ochreous, the lines dark brown, broadly edged with white, and not reaching either margin; the exterior, starting below the costa, is represented by six dark intraneural spots, preceded by a broadish, and followed by a narrow, white space, and ends in a larger white spot in the middle of the inner margin, immediately underneath the reniform stigma, which is narrow, dark-margined, and with a white centre; fringes chequered, dark and light. Hind wings white, with a sandy-coloured marginal band, which is broadest at the inner angle and is preceded by a sinuous brown submarginal line; towards the base are three round dark-edged spots filled in with sandy ochreous, the two nearer the base, of the same size and small, the third, nearer the centre, much larger. Head, thorax, and abdomen sandy. Underside like upper, with the markings more distinct. In one of the examples the markings are almost entirely lost in the sandy suffusion.

Expanse of wings 24 millim.

Two males from Goya and Pernambuco respectively.

Niphograpta, gen. nov.

Fore wings with costa straight, slightly indented in the middle; apex blunt; hind margin rounded. Labial palpi porrect, roughly haired, the joints indistinguishable; maxillary absent; tongue slight; head rough; antennæ (female) filiform, annulated; ocelli present; markings, two dark transverse lines and three large stigmata; second line followed by a series of white lunules; costa with four subapical dark dashes, as in *Udea* and its allies.

Type *N. albiguttalis* (*Epichronistis?*), Warr. Tr. E. S. 1889, p. 289.

Aphytoceros, Meyr.

Type *A. lucusalis*, Wlk., Meyr. Tr. E. S. 1884, p. 320.

Aphytoceros nigrolinealis, sp. n.

Fore wings satiny white, towards the base and along the inner margin suffused with black-brown, most intensely near the base; first line thick, curved, partly obscured by the basal suffusion; exterior line thin and interrupted from the costa as far as the radial, thence to near the anal angle forming a broad black streak, preceded at its lower end by two parallel brown-black streaks running at right angles to it, the upper one the finer of the two, from below the reniform stigma to the anal angle; orbicular stigma oval, reniform kidney-shaped, both distinct, filled up with yellowish, the reniform with a smaller flat oval attached to it at the top; a cloudy, fuscous, submarginal line, most distinct towards the costa, where it is formed by roundish wedge-shaped markings; fringes white, with a black dot at the end of each vein. Hind wings white, with a thick mass of blackish scales close to the base, a yellow, dark-edged, ocelloid, discal spot, and a blackish submarginal line, more or less interrupted in the middle, visible as a thin curved line from the costa, and becoming a thick black blotch near the anal angle; the apex also with a blackish blotch; fringes as in fore wings, but with an indistinct small blackish dot in the fringe beyond each basal dot. Head, thorax, and abdomen more or less covered with intense black-brown scales; palpi and antennæ brownish. Underside of abdomen and legs whitish; underside of wings like upper.

Expanse of wings 34 millim.

One female from Goya.

Aphytoceros longipalpis, sp. n.

Fore wings white, with the base and inner margin suffused with dark tawny fuscous, leaving, however, the veins paler; first line fine, brown, curved, separated from the basal blotch by a narrow white interspace; exterior line brown, double, the outer fainter than the inner portion, starting from costa close before the apex and running straight as far as the second median nervule, where it is slightly elbowed externally, then running inwards between the first and second median nervules to touch the base of the reniform stigma, where it again curves round and is lost in the suffusion of the inner margin; reniform stigma oblique, quadrangular, yellowish, with fine dark edges; fringe white. Hind wings white, with a large discal spot, yellow-centred and broadly edged with brown; a brown submarginal line, which forms a deep sinus inwardly in the middle, so as to touch the discal spot, and is followed by an indistinct fuscous shade; two lines of more or less erect dark scales from the base, one along the median vein, the other broader, near the interior margin. Head, face, and thorax white; abdomen more suffused with brown-black; palpi and antennæ brown. Underside like upper, with markings showing through, and an additional round dark fuscous spot at the anal angle of hind wing.

Expanse of wings 27 millim.

One female from the Transvaal.

This species differs from the rest of the genus in the shape and length of the labial palpi, which are thin, divaricate, the second and third joints each as long as the width of the head.

DIDYMOSTOMA, gen. nov.

Characterized especially by the labial palpi, which are apparently double, the ordinary second joint erect in front of face, the terminal porrect, straight; from the base of the second is porrected a tuft resembling the terminal joint; maxillary invisible; ocelli (?); tongue strongly developed; antennæ (of male) laminated and pubescent beneath, somewhat contorted, and slightly thickened shortly above the base. Wings hyaline, with brown patches; fore wing slightly falcate and elbowed above anal angle.

Type *D. euphranoralis* (*Botys*), Wlk. xix. p. 1004.

DICHOTIS, gen. nov.

Fore wings long and narrow, like *Noorda*, Wlk., with costa nearly straight; hind margin vertical, except lower third, which is rather sharply oblique. Labial palpi porrect, not so long as in *Noorda*; maxillary erect, *divaricate*, with apex broader; tongue present; ocelli small; antennæ (female) simple; scaling rather thin. Fore wing with traces of two darker lines and a stigma. Hind wings white, semitransparent, without markings.

Type *D. teneralis* (*Botys*), Led. W. E. M. vii. pp. 370, 462, pl. viii. fig. 10.

EBULEA, Guen.

Type *E. crocealis*, Tr., Guen. D. & P. p. 359; Moore, Ceyl. iii. p. 345.

Ebulea fumipennis, sp. n.

Near *fumalis*, Gn., but smaller; with fore wing narrower, more vinous-coloured, as far as can be made out from the two rubbed examples in the Walsingham Collection; the direction of the first line is more oblique; mainly distinguished by the hind wings, which are wholly suffused with dark fuscous hairy scales.

California, two females.

Ebulea (?) *straminea*, sp. n

Fore wing straw-colour, irregularly dusted with tawny-coloured scales, more especially at the base and along the hind margin; first line tawny, strongly curved outwards, oblique; second line, tawny fuscous, makes a large outward curve, and then approximates to the first line on the inner margin; orbicular and reniform stigmata slightly darker, edged finely with brown; fringe tawny at base. Hind wing whitish, without markings, with pale tawny fringe. Head, abdomen, and underside straw-colour; outside of labial palpi tawny.

Expanse of wings 20 millim.

Two females from California.

Ebulea (?) *pulverulenta*, sp. n.

Fore wings bone-colour, dusted with rusty or fuscous atoms, especially towards the hind margin; first line blackish from one eighth of costa to one third of inner margin, slightly curved outwards; second line from four fifths of costa to four fifths of inner margin, starting from a black costal spot, running irregularly straight to above the anal angle, then turning abruptly basewards for a short distance, and again at right angles to the inner margin; in the disk before the elbow of this line is an indistinct dark blotch; fringe concolorous, with a fine dark basal line. Hind wings sandy fuscous, without markings. Head, thorax, and abdomen all bone-colour. Underside sandy ochreous, with the exterior line visible in both wings and a dark discal spot in the hind wings.

Expanse of wings 24 millim.

Two females from Dharmsala.

UDEA, Guen.

Type *U. ferrugalis*, Hüb., Moore, Ceyl. iii. p. 349.

Udea sabulosalis, sp. n.

Fore wings whitish ochreous, dusted with dull rust-colour, most thickly in the submarginal area and along the costa; stigmata large and filled up with the same colour, united to the costal streak; first line hardly visible, touching the inside of the orbicular stigma; second, ferruginous, runs near to and nearly parallel with the hind margin, only making a small indentation above the inner margin; four subapical costal dashes, dull ferruginous. Hind wing without markings, whitish ochreous. Head and abdomen the same.

Expanse of wings 26 millim.

Two females from Coquimbo.

Udea indistinctalis, sp. n.

Fore wings pale grey, tinged with fawn-colour and sparsely dusted with blackish atoms; lines and stigmata indistinctly darker, the latter edged with black atoms; exterior line thick, bluntly denticulate; central area of wing slightly paler than the rest; a row of small dark dots before the base of the fringes which have a darker medial line. Hind wings dark ochreous, dusted with grey, with an indistinct dark discal spot and a submarginal line, beyond which the rest of the wing is darker; outer half of fringes paler. Head, thorax, and abdomen cinereous fawn-colour. Underside whitish ochreous, dusted with darker, and all the markings very indistinct.

Expanse of wings 26 millim.

One female from the Sierra Nevada, N. America.

Distinguished from others of the genus by the length and narrowness of the fore wings, in which it resembles the other two American species *itysalis*, Wlk., and *helviusalis*, Wlk.

Udea inhospitalis, sp. n.

Both wings dark glossy fuscous, with the usual markings just distinguishable. Head, thorax, abdomen, and fringes all concolorous. Underside very glossy, with the markings rather more distinct.

Expanse of wings, ♀ 20, ♂ 18 millim.

One female, two males, from Patagonia.

Udea nigripunctata, sp. n.

Fore wings dull fuscous; first line indistinct, curved; second line fine, black, consisting of small blunt denticulations, each followed by a paler space; a series of very minute black dots or points before the fringes, which are concolorous with the wing; orbicular stigma small, indistinct; reniform, black, conspicuous. Hind wings rather paler, without distinct markings. Underside paler, with the spots and lines dark and quite distinct.

Expanse of wings 16 millim.

One male from Callao.

Distinguished at once by the black reniform stigma.

Cybolomia, Led.

Type *C. pentadalis*, Led. W. E. M. vii. p. 420.

Cybolomia extorris, sp. n.

Fore wings grey, tinged with ochreous, sparsely scaled; transverse lines dull white; first at one third, inclined outward to the median vein, where it is bent slightly inwards, forming a slight angle, then running straight or slightly concave to the inner margin; second line, at two thirds, forms an outward curve, nears the first line below the median, and then runs straight to the inner margin; at the end of the cell an elongate white dot, representing the reniform stigma; the second line starts from a short black dash on the costa, which is preceded by a longish and followed by a short white dash; another long white dash before the apex; fringes dark grey, with two inconspicuous whitish dashes below the apex and one above the anal angle. Hind wings dull grey, without markings. Abdomen, head, &c. all dull grey.

As large as *C. siccalis*.

Two male specimens from Lord Walsingham's collection, from the west United States of America, but with no *exact* locality given.

Pachynoa, Led.

Type *P. thoosalis*, Wlk. xviii. p. 737 (*Walkeri*, Led. W. E. M. vii. p. 391, pl. xiii. fig. 2).

Pachynoa limitata, sp. n.

Differs from *purpuralis*, Wlk., by its restricted dark markings and smaller size. Front wings pale yellow; costa red-brown, with a red-brown protuberance embracing the reniform stigma and a second smaller one beyond; the two not uniting to form a central band as in *purpuralis*, and having no rosy margin; base of both wings red-brown, much less in extent than in *purpuralis*, ending in the hind wing about halfway down the inner margin; faint traces of two darker yellow sinuate lines on both wings towards the hind margin.

One male from Borneo.

Hemiscopis, Warr.

Type *H. suffusalis*, Wlk. (*Scopula*), Warr. Ann. & Mag. Nat. Hist. 1890 (ii.), p. 476.

Hemiscopis cinerea, sp. n.

Wings fuscous cinereous, with only a *slight* purplish gloss, which is more apparent between the hind margin and the outer line, where the wings are free from the numerous darker atoms with which the central and basal portions, before each line, are covered; transverse lines dark brown, not rust-coloured; fringes entirely dark, with a very fine uninterrupted pale line at the base, preceded by an equally fine dark line along the hind margin. In the hind wing the dark line is slightly bent before the hind margin, which it reaches, indistinctly, at one third from the anal angle; costal region of hind wing only slightly paler. Palpi dark fuscous, not rufous. Underside of both wings pale glossy cinereous, the lines and stigma showing through.

Expanse of wings 22–26 millim.

Two males from Japan.

Hemiscopis expansa, sp. n.

Fore wing glossy violet-fuscous, with an ochreous tinge towards the hind margin; first line fine, oblique, at one third, slightly rust-coloured; second line much as in *suffusalis*, dark brown, somewhat indistinct, in consequence of the darker suffusion on either side of it; stigma hardly visible; fringe dark fuscous violet, with a fine pale line at base, before which the hind margin is narrowly darker. Hind wing with the costal fourth clear pale ochreous; the rest of the wing pinkish fuscous, the inner third decidedly paler than the middle, the line abbreviated, starting from the edge of the costal pale space and stopping short just before the hind margin, where it is deflexed towards the anal angle parallel to the hind margin; fringe as in fore wings. Head, face, and thorax purplish fuscous; abdomen cinereous. Underside of *both* wings pale glossy ochreous, more or less suffused with dull fuscous; the stigma and second line showing darker.

Expanse of wings 30 millim.

One female from Dharmsala.

BŒOTARCHA, Meyr.

Type *B. cunealis* (*B. crassicornis*, Meyr. Tr. E. S. 1884, p. 306 (nec Walk.)).

Bœotarcha cunealis, sp. n.

Fore wings pinkish fuscous, slightly glossy; a pale lemon-yellow central fascia, irregularly edged on both sides with purplish, more oblique than that in *B. crassicornis*, Walk., and much narrower on the inner margin than on the costa; space before the hind margin pale clear yellow, with a fine dark line from before the apex round the hind margin, beyond which the fringes again are yellow. Hind wings with only the costa pale, the rest of the wing being dark fuscous; fringe yellowish. Head, face, thorax, and abdomen pinkish cinereous. Underside of abdomen whitish; pectus pale yellow; palpi pale yellow, unspotted; tibiæ all spotted alternately purplish and white.

Expanse of wings 28 millim.

One female, Port Darwin.

[To be continued.]

LX.—*On the Anatomy and Embryology of the* Phalangiidæ. By VICTOR FAUSSEK *.

MY Russian memoir has just appeared, under the title "Studien über die Entwicklungsgeschichte und Anatomie der Afterspinnen (Phalangiidæ)" (Arbeit. Petersb. Naturf. Gesellschaft, Abt. Zoologie, Bd. xxii. Lief. 2 [Arbeit. aus dem zootomisch. Kabinet d. Petersb. Universität]), and in order to render my paper more readily accessible to readers abroad I offer the following *résumé* of the more important results of my investigations, some of which have already been published in two smaller provisional communications †; I shall at the same time refer to the figures which accompany my memoir.

1. My researches were conducted upon the ova of two species of *Phalangium*—*Cerastoma cornutum*, L., and *Opilio parietinus*, Herbst. The ova of these differ from one another in the structure of the chorion and in certain conditions necessary for their development. The ova of *C. cornutum* are of a yellowish colour, which is due to a multitude of yellow granules covering the chorion; in the case of *Opilio parietinus* the chorion possesses no yellow granules and the ova are pure white. The ova of *Cerastoma cornutum*, which

* Translated from the 'Biologisches Centralblatt,' xii. Bd. no. 1 (Jan. 15, 1892), pp. 1–8.

† Biol. Centralbl. viii. 12 (1888); Zool. Anzeiger, no. 353 (1891).

were laid in autumn, at once commenced to develop at the temperature of an ordinary room, and within one and a half to two months the whole cycle of development was completed, and the young animals emerged and throve perfectly well throughout the entire winter. The ova of *Opilio parietinus* perished under the same conditions, and were capable of further development only after passing the winter in a normal state, when I placed them upon the ground. Besides these two species I also had a few ova of larger size belonging to a species which I failed to determine.

2. With regard to reagents, Flemming's mixture gave the best results, in addition to Perenyi's fluid and sometimes (for the earlier stages) hot absolute alcohol. I did not study the formation of the segmentation nuclei. The earliest stages which I examined showed the ovum divided up into a compact mass of cells; in each of the large segments there lay a large nucleus (Taf. i. figs. 6 and 7 of the Russian memoir). The ovum consequently undergoes total segmentation and passes through a morula stage. The first blastoderm (ectoderm) cells split off from the superficially situated blastomeres, as is correctly described by Henking*. The segmentation nuclei do not come to the surface of the ovum, but all remain within the blastomeres. In the Araneidæ, as may be gathered from the investigations of Morin †, total segmentation also takes place and the ova pass through a blastula stage, having a large segmentation cavity. In *Phalangium* a solid morula is formed, and the ectoderm cells are produced by being split off, as it were, by delamination.

3. The entire ovum gradually becomes clothed with a layer of flat ectoderm cells, and thus passes into the bilaminar stage. After the formation of the ectoderm the inner egg-membrane (oolemma) becomes considerably thicker, so that two layers can be distinctly distinguished in it, which, however, are closely apposed to one another and never separate. There is an evident secretion of cuticular substance by the ectoderm cells, which gives rise to the formation of a kind of embryonic membrane; yet this new cuticular membrane does not form an independent envelope, but serves to thicken the oolemma. This subsequent secondary thickening of the *membrana vitellina* by the formation of a new cuticular layer secreted from the ectoderm is comparable to the formation of

* Henking, "Untersuchungen über die Entwicklung der Phalangiden." Zeitschrift f. wiss. Zoologie, 45 Bd.

† Morin, "Ueber die Entwicklung der Spinnen" (in Russian), Zeitschrift der Neurussischen Gesellschaft in Odessa, xiii. Bd. (1888).

that blastodermic membrane which is produced from the blastoderm in many Crustacea (figs. 7 and 11).

4. The germinal disk arises at one pole of the ovum by multiplication of the ectoderm cells. The newly formed lower layer of the primitive streak represents the mesoderm, since the endoderm is differentiated from the beginning. Among the cells of the lower layer a group is separated off from the commencement, the cells of which are distinguished by their size and peculiar appearance. The separation of this group of cells even precedes the formation of the primitive streak; as early as the time when the ectoderm clothes the ovum with a cellular layer this group of cells already projects as a little cluster into the interior of the ovum (figs. 9, 10, 11). This cluster lies, as is subsequently to be seen, in the posterior portion, although not quite at the end, of the ventral streak, and consequently forms a local thickening of the ectoderm, which arises almost simultaneously with the mesoderm, and afterwards furnishes the germ-cells.

5. The nuclei of the large endoderm cells frequently suffered from the effects of the reagents, and then appeared to be destitute of a membrane (fig. 8); but they were well fixed by means of Flemming's fluid, and presented the appearance shown in figs. 7, 9, 11, 12, and 13. The nuclei, which are figured in Henking's paper mentioned above, also seem to me (at least in some cases) to have suffered from the fixative fluids, and therefore to exhibit no membrane and no sharp outlines. That which, for instance, he considers to be several nuclei in one cell (*vide* his fig. 37), I am inclined to regard as being nucleoli of a large nucleus, the membrane of which is destroyed. At the time of the formation of the mesoderm the nuclei of the endoderm become considerably larger, so that in comparison with the cells of the germinal disk they appear quite gigantic. They possess a sharp contour and are very poor in chromatin; almost the whole of the colourable substance of the nucleus is concentrated in a nucleolus, which is very glistening and takes a deep stain. We often meet with figures which seem to point to amitotic nuclear division (fig. 13); it appears that this nuclear division is also followed by division of the cell (fig. 12). At any rate the endoderm cells never become multinuclear, and even cells with two nuclei are rare. I succeeded in determining a similar characteristic nuclear structure in the endoderm (yolk-cells) of the Araneidæ also, in the earlier stages of their development; this had not previously been described by any author (*Tegenaria*, figs. 14 and 15). In Araneidæ and Phalangiidæ there consequently occurs a fragmentation of the

nucleus in Ziegler's * sense; the nuclei, however, do not lose their histogenetic property (see below). The study of the fragmentation of the nuclei has led me to wonder whether it may not be that the so-called "secondary mesoderm" of the Crustacea (*Astacus*, according to Reichenbach) represents no cellular elements, but nuclei in the state of fragmentation.

6. The mesoderm is formed, as has been stated, from the ectoderm; but during the first period of development a few elements of endodermic origin are also added to it; these are large cells which split off from the endoderm cells (figs. 13 and 16). A small number of them separate from the endoderm cells lying peripherally immediately beneath the primitive streak, and are soon indistinguishable from the cells of the latter; for this reason I was unable to ascertain their subsequent fate.

7. It has already been mentioned that the rudiment of the germ-cells appears in the ectoderm at a very early period and projects into the interior of the ovum. In the earliest stages differences in the germinal rudiment may already be perceived in certain ova. In some cases the rudiment consists of cells with large nuclei, but in others their nuclei do not differ much from those of the cells of the primitive streak. The first stage in the further development of the rudiment of the sexual organs consists in its separation from the ectoderm; its cells become superficially covered by a layer of ordinary ectoderm cells (fig. 17). In somewhat later stages the rudiment of the sexual organs lies sunk in the abdominal nervous system (figs. 18 and 19); after the nervous system withdraws into the cephalothorax, however, the germinal rudiment remains in the abdomen behind the cephalothoracic ganglia, where it now appears between two layers of mesoderm, *i. e.* enclosed in the cœlom (figs. 19, 20, and 21). In subsequent stages the germinal rudiment with the large nuclei considerably increases in size, and after the emergence of the embryo serves to form the female generative organs (figs. 20, 22, 23, 27, 28, and 29). The germinal rudiment of the second kind (that which consists of cells with small nuclei) remains of inconsiderable size and becomes transformed into the male gene-

* Ziegler, "Die Entstehung des Blutes bei Knochenfischembryonen." Archiv f. mikrosk. Anatomie, 30 Bd. While my memoir was in the press there appeared the interesting papers of Ziegler on "Die biologische Bedeutung der amitotischen (direkten) Kernteilung im Tierreich." Biologisches Centralblatt, xi. Bd. nos. 12 and 13 [Ann. & Mag. Nat. Hist. ser. 6, vol. viii. Nov. 1891, "The Biological Import of Amitotic (Direct) Nuclear Division in the Animal Kingdom," pp. 362–380], and Frenzel, "Zur Beurteilung der amitotischen (direkten) Kernteilung," *ibid.* no. 18, of which I was unable to avail myself.

rative organs (figs. 24, 25, and 26). During the first two months of post-embryonic life the further development of the female germinal rudiment and the transformation of the embryonic germ-cells into egg-cells can be easily traced in young Phalangiidæ (figs. 27 and 28). I did not succeed in investigating the final development of the male germinal rudiment; in young harvest-men the latter appeared as a tolerably small group of cells lying in the abdomen immediately behind the nervous system, and, like the female rudiment, separated from the latter and from the body-wall by a layer of loose connective tissue (figs. 25 and 25). In size the male rudiment is far inferior to the female during the same period of development. These embryonic germinal rudiments form in the first place the commencement of the actual germ-glands, *i. e.* ovary or testis as the case may be; other portions of the reproductive organs, male as well as female, are completely wanting at the time when the young emerge, and their formation devolves entirely upon the post-embryonic development. The female as well as the male germinal rudiments are enveloped in an extremely delicate *membrana propria* containing very small scattered nuclei. In *Phalangium* therefore there takes place a very early separation of the germ-cells, similar to what we find in *Moina*, *Chironomus*, and the Aphidæ.

8. The endoderm cells preserve their general form and structure without any changes worthy of remark until the later stages of development; they merely become somewhat smaller. But the fragmentation of the nuclei continues for only a limited period. When the nervous system begins to develop the nuclei of the endoderm cells have already lost the characteristic signs of fragmentation; they have now become smaller and no longer possess their former peculiar structure. The definitive formation of the mesenteron takes place quite at the end of the embryonic development, after the external form of the embryo is already complete, the nervous system concentrated in the cephalothorax, and the portions of the alimentary canal which are derived from the ectoderm (stomodæum and proctodæum) are fully developed. The visceral layer of the mesoderm forms folds, which penetrate deep into the yolk and divide it into separate masses (the subsequent hepatic sacs). The central portion of the yolk remains undivided and forms the actual mesenteron. At the close of the embryonic development the endoderm cells appear to undergo a process of degeneration; they lose their contour and the yolk-spherules lie at liberty; in some cases small roundish nuclei, which are sometimes amœboid

and sometimes larger, are found between them. At the periphery of the yolk, where the splanchnic layer of the mesoderm adjoins it, there appears (even before its division into the future hepatic sacs) a number of small cells with small round nuclei; these cells, which in all probability split off from the large endoderm cells, settle down upon the visceral layer of the mesoderm and form the epithelium of the mesenteron. Thus it is not the endoderm cells themselves but their derivatives which give rise to the epithelium of the mid-gut (figs. 31 and 32).

9. The coxal glands of an adult harvest-man consist of three divisions:—(1) the inner end is expanded in the form of a sac, and constitutes the terminal vesicle; (2) the terminal vesicle narrows and passes into a very long convoluted tube, the tube of the coxal gland, which has long been known (Malpighian vessel); (3) the tube empties itself into a large thin-walled sac (urinary bladder), which opens to the exterior at the side in the cephalothorax, between the coxæ of the third and fourth pairs of legs. The terminal vesicle of the coxal gland has hitherto never been described. It is situated in the cephalothorax as an elongated saccule, at the side of the ganglionic mass surrounding the œsophagus, at the base of the third pair of legs; at the anterior end the saccule bends downwards and somewhat inwards, runs a little way backwards, and terminates blindly near, and on the inside of, the external opening of the coxal gland (fig. 50, *es*′). In transverse sections we therefore see two lumina, one above the other (fig. 23, es^2, es^1); but on scrutinizing a series of sections we can easily convince ourselves that both lumina pass into one another anteriorly, while posteriorly the lower saccule (the doubled-down anterior end of the terminal vesicle) ends blindly and the upper one becomes narrower and passes into the tube (fig. 50, es^1, es^2, cox^2; fig. 34, es^2; fig. 35, cox^2). This tube, at first excessively thin (figs. 50 and 35, cox^2), becomes gradually wider, and passes into the long-known convoluted tube, the "Malpighian vessel" of Plateau, the true significance of which was first recognized by Loman *. The tube of the coxal gland forms a complicated coil, passes towards the dorsal side of the body, where it makes a loop running parallel with the heart, then returns

* Plateau, "Sur les phénomènes de la digestion, etc. chez les Phalangides," Bull. Acad. Belg. 1876; Rossler, "Beiträge zur Anatomie der Phalangiden," Zeitschr. f. wiss. Zool. Bd. 34, 1882; Loman, "Altes und Neues über das Nephridium (die Coxaldrüse) der Arachniden," Bijdr. tot de Dierkde. N. A. M. 14 Aufl., 1888. The recent paper by Sturany ("Die Coxaldrüsen der Arachnoiden," Arch. Zool. Instit. Wien, 9 Bd., 1891) came into my hands after my memoir was quite finished.

towards the ventral surface, and opens into the urinary sac (figs. 34, 35, and 50, *cox*, *cox*[1]). The latter (figs. 33, 34, 35, and 50—*HS*, *O. HS*) extends a long way backwards into the abdomen, while in front it stretches beyond the point of attachment of the third pair of legs; with its anterior blind end it closely adjoins the bow-shaped bend of the terminal vesicle (fig. 50). Not far from its anterior end there issues from the urinary sac a tolerably narrow duct, which passes downwards and opens to the exterior between the coxæ of the third and fourth pairs of legs (Loman) (figs. 33, 50—*O. HS*). It was impossible to examine the histological structure of the terminal vesicle more closely, since this portion of the gland was found to be in a rather bad state of preservation in the preparations. The structure of the tube (figs. 37, 38) did not exhibit any considerable deviations from the typical structure of coxal glands, as, for instance, it has been described by Lankester and others in *Scorpio*, &c. The wall of the urinary sac (fig. 36, surface view) consists of a *membrana propria* with small and a pavement epithelium with large nuclei; muscle-fibres were not found in it. The remainder of the chapter on the coxal glands is devoted to an analysis of the papers upon the coxal glands of the Arachnids, especially to a criticism of the views of Eisig*, according to which the coxal glands are homologous not with the nephridia, but with the setæ-forming glands ("Borstendrüsen") of the Annelids. I may sum up my own views as follows:—(*a*) the coxal glands of *Phalangium* consist of three divisions—terminal vesicle, tube, and urinary sac; (*b*) the same divisions are found in the antennary glands of the Crustacea†; (*c*) these three divisions are homologous with the three portions of the nephridium of *Peripatus* (and Annelids), with the funnel and terminal vesicle (in *Peripatus*—in Annelids the adjoining portion of the cœlome), the tube, and the expansion of the latter at its distal end; (*d*) the coxal glands of *Limulus* and Arachnids, as well as the excretory organ of the *Zoëa* of *Eryphia* described by Lebedinski ‡, and the antennary and shell-glands of the Crustacea are homologous with the nephridia of *Peripatus* and Annelids; (*e*) Eisig's hypothesis as to the homology of the coxal glands of the Arachnids with the

* Eisig, "Die Capitelliden," Fauna und Flora des Golfes von Neapel, xvi. Monographie, 1887, i. p. 374 *et seq.*

† The "nephro-peritoneal sac" of the Decapods according to Weldon (Weldon, "The Renal Organs of certain Decapod Crustacea," Quart. Journ. Micr. Sci. 1891, vol. xxxii.) probably corresponds to an extraordinarily developed urinary sac.

‡ Lebedinski, "Entwicklung von *Eryphia spinifrons*," Zeitschrift der Neurussischen Naturf. Ges. in Odessa, Bd. xvi., 1889 (in Russian).

spinning-glands of *Peripatus* and the setæ-forming glands of the Annelids proves to be untenable.

10. The cephalothoracic glands described by Krohn are constituted in the final stages of development as two pyriform invaginations of the ectoderm at the side of the two eyes (figs. 40, 41, and 47, *c. dr.*). In the ectoderm cells of the glands there commences at an early period the secretion and accumulation of a dark pigment which forms two black spots upon the surface of the embryo, which is still perfectly white; these spots are visible like the eyes through the egg-membranes. Simultaneously with the glandular structures which have been described there exists in the embryo a pair of provisional organs of a glandular character. In *Cerastoma cornutum* these appear as two groups of large cells, lying one on each side in the cephalothorax near the eyes. Externally these cells are directly covered by the ectoderm, and they appear to be separated from the body-cavity by a thin *membrana propria.* In addition to a large nucleus the cells of this organ enclose peculiar concretions, which take a deep stain from carmine. Although covered by the ectoderm these cells nevertheless possess a communication with the outer world by means of a special aperture, through which the concretions which are formed in them are conveyed to the exterior. In the sections a compact mass of these excretions generally lies at this aperture (figs. 39, 40, 41, 44, and 45). In another undetermined species of *Phalangium* the glandular structure of this organ was even more pronounced. In this case it consisted of a tolerably large hemispherical complex of cells, which projected freely into the body-cavity and was attached to the ectoderm by a relatively smaller portion (figs. 42, 43, 46, and 47); the apices of the columnar and distinctly defined pyramidal cells of this organ met together in a point, while their broad bases formed a hemispherical surface. In each cell a large nucleus was situated not far from the base, while the excretory products were accumulated nearer the apex. The external aperture of the gland had the form of a small pit, filled with secretion deeply stained by carmine; short rods of this secretion radiated from this pit between the apices of the cells (fig. 43). But these glands had not exactly the same structure in all preparations of this species of *Phalangium*; in some cases they were suggestive of those of *Cerastoma cornutum* (fig. 48). At the same time the embryos investigated were all at the same stage of development. I have consequently found in two species of *Phalangium* during embryonic development a peculiar glandular organ, which lies in a single pair in the cephalothorax,

between the eyes and the cephalothoracic glands on each side, and probably has an excretory function. In the two species examined this organ exhibited considerable differences in structure. The organs are purely embryonic; in the youngest specimens of harvest-men which I was able to examine I no longer found any trace of them. I failed to elucidate their fate during the transition to post-embryonic life. This pair of glands reminded me forcibly of the dorsal organ of the Mysidæ, as recently described by Nussbaum * and Butschinski †. Although I did not succeed in observing its first appearance, I nevertheless consider it to be very probable that it appears, precisely like that of *Mysis* (at least in the case of the second species of *Phalangium*), in the form of an invagination of the ectoderm. Similar organs have been observed by Watase ‡ in *Limulus*, where they were also found to resemble the dorsal organs of *Mysis*. Kingsley and Patten, however, consider these organs in *Limulus* to be of a sensory character §. As regards *Phalangium* the glandular character of "the lateral or dorsal organs" cannot be open to the slightest doubt, as is proved by the numerous concretions enclosed in their cells and their excretion to the exterior.

LXI.—*Description of a Third Species of the Genus* Nyctophilus. By OLDFIELD THOMAS.

THE genus *Nyctophilus* was in Dr. Dobson's 'Catalogue of Bats' ‖ considered to consist in 1878 of only a single species, the Australian Long-eared Bat, *Nyctophilus timoriensis*, a species with very much the facies, and evidently taking the place in Australia, of the European Long-eared Bat, *Plecotus auritus*. In 1888 ¶ I had the pleasure of describing a second species of the genus from New Guinea, *N. microtis*, which

* Nussbaum, "Zur Embryologie von *Mysis chamæleo*," Zeitschr. Neuruss. Naturf. Gesellschaft in Odessa, xii. Bd., 1887.

† Butschinski, "Zur Entwicklungsgeschichte der Mysiden," Zeitschr. Neuruss. Naturf. Gesellschaft in Odessa, xv. Bd., 1890.

‡ Watase, "On the Structure and Development of the Eyes of *Limulus*," Johns Hopkins Univ. Circ. vol. viii.

§ Kingsley, "The Ontogeny of *Limulus*," Zool. Anz. 1890; Patten, "On the Origin of Vertebrates from Arachnids," Quart. Journ. Micr. Sci. xxxii., 1890.

‖ P. 172.

¶ Ann. & Mag. Nat. Hist. (6) ii. p. 226.

had so much shorter ears than *N. timorensis* as to have no general resemblance to *Plecotus*; and I now have to describe a third species with ears smaller still, so small, in fact, as to be not longer than those of average species of *Vesperugo*. In other respects the new species is absolutely a *Nyctophilus* and shows no approach to other Vespertilionine genera; so that the long ears of *N. timorensis* may be presumed to be a later development within the genus, and, judging by the abundance and wide distribution of the species, a most successful one.

The type specimen of the new species was obtained by Mr. J. J. Walker, of H.M.S. 'Penguin,' to whose exertions the National Museum is indebted for very large collections in various branches of natural history, and in whose honour I propose to name it

Nyctophilus Walkeri, sp. n.

Allied to *N. microtis*, Thos., but considerably smaller and with smaller ears; these, when laid forwards, do not quite reach to the nose-leaf; they are, however, connected across the forehead by a band about 2 millim. in depth, and in this respect resemble those of *N. timorensis*; besides being shorter they are decidedly narrower than those of *N. microtis*, and their inner margin is much less convex; the small lobe on the inner surface of the base of the outer margin is, as in *N. microtis*, short and well defined, instead of being long and passing gradually at each end into the main outer margin, as is the case in *N. timorensis*.

Other characters apparently as in *N. microtis*, except that the teeth are smaller and weaker in proportion, and the fur is shorter and paler in colour, especially on the under surface, where the hairs are tipped with dirty white.

Dimensions of the type (an adult female in alcohol):—

Head and body 45 millim.; tail 36; ear, length above crown 10·5, breadth 9·5; tragus, length of internal margin 4·3; forearm 33·5; lower leg 15; hind foot 5·5; calcar 12. Tip to tip of upper canines 3·4.

Hab. Adelaide River, Northern Territory, Australia.

BIBLIOGRAPHICAL NOTICE.

L'Évolution Sexuelle dans l'Espèce humaine. Par le Dr. Henri Sicard, Doyen de la Faculté des Sciences de Lyon. Avec 94 figures intercalées dans le texte. Paris: Libraire F. B. Baillière et Fils, 1892.

This little volume contains much information relating to the development of animals and the peculiarities of their life-history in all its main outlines, beginning with the asexual forms—parthenogenesis establishing a "passage" to the sexual. Sexual evolution in the Darwinian sense—that is, from the variability where the cause is unknown, gradually developed by natural selection—finds little or no place in it, notwithstanding its title. But we have numerous facts respecting secondary characters, amounting in some species to dimorphism. Sexual selection, it is contended, tends to develop such characters, for, as the greatest dissimilarity favours progress, whatever has the effect of diminishing it "is in opposition to the teaching (*données*) of biology." "Many points remain obscure," our author admits: for instance, among insects the occurrence of apterous females in species closely allied to others where the sexes are scarcely distinguishable.

Perhaps the most valuable part of the work is the account of the development of the embryo, including a notice of the once hotly-contested gastræa-theory. "Differentiation of the sexes" and "of secondary sexual characters in general" follow. The seventh chapter applies to man only—his anatomy and "mental constitution." The concluding chapter treats of the various races of mankind, illustrated by a number of characteristic portraits, and giving many curious details: the love of ornamentation seems predominant among the males of savages.

Briefly, the work is a useful summary, a few still-disputed points excepted, of the present condition of our knowledge.

MISCELLANEOUS.

On the Genus Polychrysia *of Hübner (a Group of Plusiid Moths).* By Arthur G. Butler, F.L.S., F.Z.S., &c.

In his 'Verzeichniss bekannter Schmettlinge,' at p. 251, Hübner founded a genus *Polychrysia* on the single European species *P. moneta*. The characters given for his genus were, as usual, valueless; but the genus itself is a good one and must be adopted. It is synonymous with the genus *Deva* of American authors and of Walker's 'Supplement,' but has nothing to do with the typical species of that author's genus.

Walker described his genus *Deva* in the twelfth volume of his 'Catalogue of Lepidoptera Heterocera,' p. 962, and included in it two species, *D. stimulans*, = *Plusiodonta Thomæ*, Guen., and *D. conducens*, = *P. chalcytoides*, Guen. On the following page he described another new genus, *Gadera*, with two species, *G. incitans* and *G. repellens*, both without localities, though he concluded that *G. repellens* was Brazilian. As a matter of fact both are natives of Jamaica.

Now as *P. compressipalpis*, from the United States, is the type of *Plusiodonta*, and differs from all the other species associated with it in its pectinated antennæ, and as the species of *Deva* and *Gadera* differ from one another in no character whatever, the bulk of the species of Guenée's genus *Plusiodonta* fall into *Deva*, Walker; whilst the species referred to *Deva* by Walker, Grote, and myself subsequently, fall into *Polychrysia*, Hübner.

The genus *Polychrysia*, in my opinion, is a true Plusiid (whereas *Deva* belongs to the Calpidæ); it differs from typical *Plusia* in its enormously developed Deltoid palpi, the terminal article of which is curved, compressed, and tapering, the fringe of scales being elongated below the article; the outer margin of the primaries is usually, but not invariably, subangulated.

The genus *Polychrysia* will include *P. splendida*, = *Deva splendida*, from Japan; *P. c-aureum*, = *Plusia c-aureum*, from Europe; *P. mikadina*, = *Plusia mikadina*, from Japan; *P. purpurigera*, = *Deva purpurigera*, from the United States; *P. moneta*, = *Plusia moneta*, from Europe; and *P. palligera*, = *Deva palligera*, from the United States.

Of the above species *P. c-aureum* and *P. mikadina* are nearly allied, but the former has the golden marking on the centre of the primaries of a -shape, whereas that on *P. mikadina* is comma-shaped, ; at the same time it is quite possible that a large series will prove this to be an insufficient distinguishing character.

Dr. von Lendenfeld on the Central Cavity in Euplectella. By E. A. Minchin.

In the last number of this Journal (April 1892, p. 337) Dr. von Lendenfeld calls me to task for having, as he says, attributed to him the statement (which he well terms "preposterous") that the central cavity of *Euplectella aspergillum* is a pseudoscular tube forming part of the inhalant system. He adds that he never doubted the exhalant nature of the central cavity in *Euplectella* and that he fails to see how any one can gather from his statements such a meaning as I impute to them.

No one would gather from reading Dr. von Lendenfeld's note that everything I inferred as to his opinions was supported by full quotations from his writings, and I will therefore content myself by merely amplifying what I have already written.

In the first place I quoted from his 'Monograph of the Horny

Sponges,' p. 757 (by a misprint it came out p. 717), as follows:—"In the tubular *Euplectella aspergillum* and in allied forms the central cavity . . . appears as a preoscular tube." In other words, the central cavity is of exhalant nature. Well and good! But on the very next page of the same work we read, "The cribriform membrane which is stretched over the wide terminal pseudoscula of *Dendrilla cavernosa*, covering the entrances to the vestibular cavities, is very remarkable. I do not hesitate to compare it directly to the terminal sieve of *Euplectella aspergillum*. I think it may not be impossible that in some of the cup-shaped or tubular Hexactinellida the central cavity is, like that of *Dendrilla cavernosa*, an inhalant vestibule, and not a præoscular tube." That is to say, the sieve-membrane covering the central cavity in *Euplectella* is compared directly with a similar sieve covering an inhalant space in another sponge. The only rational conclusion from such a homology appeared to me to be that the central space in *Euplectella* was to be regarded as inhalant also. In commenting on these statements I concluded by saying it was not necessary to point out the contradictions in which the author had landed himself. I only hope I have made it clear how I gathered from Dr. von Lendenfeld's statements the meaning I imputed to them. I do not quite follow Dr. von Lendenfeld's meaning when he speaks of a "hostile motive" having prompted me in my interpretation of his statements, and cannot but deprecate the introduction of personalities into a scientific argument.

Zoological Station, Naples,
April 8, 1892.

On some Specimens of Dendroclava Dohrnii, *Weismann.* By Dr. Raffaello Zoia.

On the 23rd October, 1891, the Director of the Zoological Station at Naples, with his usual courtesy, gave me some hydroids (*Sertularella*, *Eudendrium*, *Campanularia*) which the fishermen had brought from the coasts of Nisida. Amongst these were a few small colonies of hydrosomæ which at first sight appeared to me to be very similar to *Corydendrium*, although perhaps the zooids were somewhat smaller than those of *Corydendrium parasiticum*. One of these colonies grew from the stalk of a *Campanularia* in the same manner in which the trunks of *Corydendrium parasiticum* spring from those of *Eudendrium*, so that the resemblance between the two was the more striking.

On bringing these hydroid colonies under the microscope, I observed some medusoid buds under the neck of the zooids; and in this, as well as in other respects, the hydroids corresponded exactly with the *Dendroclava Dohrnii* described by Weismann, whose observations, as far as I know, have never yet been called in question.

These colonies were about 2 centimetres in height, somewhat copiously ramified, and bearing branches on the right and the left of the trunk, although less frequently on the latter side than in the case of those described by Weismann. The cœnosarc not only at the base of the colony, but also close to the summit, is formed, or rather issues, from two tubes described by Weismann, the outer one being smooth and straight, while the inner one has undulating lines. The zooids are club-shaped, with about twelve scattered tentacula, of which some were rather longer than the rest.

The medusoid buds proceed from a distinct pedicle, attached to the stalk of the supporting hydrosoma. From their structure, as Weismann observes, it is obvious that they become liberated and able to float away. I kept my colonies for two or three days, living in vessels in which the sea-water was constantly changed and kept in motion, and I was thus able to obtain a certain number of medusa-like zooids, which swam freely about like the medusæ of a *Bougainvillia* or a *Podocoryne*, and on comparing them with the medusoid buds of *Dendroclava* it was evident that they were the ultimate evolutionary forms of the latter.

The detached medusæ of *Dendroclava Dohrnii* are somewhat larger than those of *Podocoryne carnea*. They have a well-developed umbrella with prolongations: the manubrium, or pedicle, is on the other hand small, not reaching farther than the middle of the umbrella, and is somewhat bottle-shaped with small ramifications at its mouth. About halfway down appear four yellow-green radiated spots, "the gonophores," which have a smooth surface. There are four radiated canals, which are flattened as in the family *Tiaridæ*. At the base of these there is a delicate longitudinal fibrillation. Of the eight marginal tentacles four are radial in continuation with the radial canals and four are intermediate, the base of all being excessively dense, while the lower side, as well as the distal extremity, bears an orange-coloured spot (ocello).

Weismann considers that this medusa should be placed in the family *Tiaridæ* (Hæckel), and in the subfamily of the *Pandæidæ*, while it may possibly be referred to the genus *Pandæa* (Lesson) or to *Conis* (Brandt). A close examination of the adult zooids shows that they have the characters of the *Tiaridæ* * and of the subfamily *Pandæidæ*, but cannot be referred to the genus *Conis*, as they have no double crown of tentacles bearing ocelli on the shorter and upper of those bodies. This form may possibly not admit of being included in the genus *Pandæa*; at any rate I am unable to detect those urticating threads (Nesselstreifen) of the umbrella which distinguish the latter genus.

The polypoid form has been referred by Weismann to the family *Clavidæ*. If, however, we follow Allman † the fact of its having gonophore medusoids would lead us rather to place it in the family

* E. Hæckel, 'Das System der Medusen.' Jena, 1879, 1 Theil, 1 Hälft, p. 40.

† A. F. Allman, 'A Monograph of Gymnoblastic, or Tubularian Hydroids,' 1872, London.

of the *Turridæ*, from which we must at the same time remove the genus *Corydendrium*, which Allman had included in it on account of the uncertainty which still exists to its reproductive organs.

In regard to the habitat of this form, I may observe that my specimens were found in a very different condition from those of the first specimen described. Weismann had a colony which had been taken from a depth of 70 to 80 metres. On this account he refers to *Dendroclava Dohrnii* as a form living at great depths. My specimens on the contrary had been taken off the coasts of Nisida, and it is only necessary to glance at a bathymetric map of the Gulf of Pozzuoli to see that the island of Nisida is surrounded by waters of very inconsiderable depth.—*Bolletino Scientifico*, N. 3 e 4, Anno 1891.

On the Development of Bythinia tentaculata. By Dr. R. v. Erlanger, of the Heidelberg Zoological Institute.

Having been occupied for a long time with the embryology of Gastropods, I thought it desirable to test upon another Prosobranch the observations which I had made upon *Paludina vivipara*. For this purpose *Bythinia tentaculata* appeared to me to be most advantageous, since all the stages of development are to be had in any quantity, and the youngest are very suitable for sections on account of their relative size. Another circumstance strengthened me in my intention. *Bythinia* has already been the subject of a lengthy paper by P. Sarasin *, whose results were by no means to be reconciled with those which I had attained in the case of *Paludina*. The sequel will show that in almost all important points I have arrived at precisely opposite views to Sarasin, and that the development of *Bythinia* possesses a great similarity to that of *Paludina*.

After the expulsion of the directive vesicles the segmentation proceeds in the manner which is typical for the majority of Gastropods, and conforms closely to that of *Planorbis* and *Neritina*. Immediately after the division into two it becomes evident that the cells of the germ do not all divide simultaneously, but that the macromeres which are first formed gradually give rise to a large number of micromeres. I traced the segmentation as far as the stage with forty-eight cells; I did not succeed in following it further, on account of the excessive number of segments. By the time this stage is reached a segmentation-cavity of considerable size has been developed, which soon afterwards acquires its greatest dimensions. At the vegetative pole the four macromeres only are present, while the micromeres, which give rise to exclusively ectodermal elements, gradually diminish in size from the vegetative to the animal pole. The macromeres exhibit precisely the same arrangement as the corresponding cells in *Planorbis*. The anterior and posterior are in contact with one another, forming a sharply

* P. Sarasin, 'Entwicklungsgeschichte der *Bythinia tentaculata*.' Inaugural-Dissertation. Wiesbaden, 1882.

defined furrow between them, while the two lateral cells are separated from one another by the anterior and posterior ones. Thus the blastula already exhibits a bilaterally symmetrical structure.

The hindermost macromere may be termed the endo-mesoderm cell, since it divides into two cells, of which the one retains the position of the posterior macromere, while the other, moving in the longitudinal axis, passes more towards the animal pole. This cell then similarly divides into two, but in the direction of the longitudinal axis, and the two cells thus produced are the primitive mesoderm cells, which lie next one another on both sides of the longitudinal axis, dorsally to the posterior macromere.

After these processes have taken place the three other macromeres divide, but simultaneously with the fourth, which had superseded the endo-mesoderm cell, and furnish the endoderm cells of the wall of the archenteron. In the meantime the blastula flattens out dorso-ventrally, since the endoderm cells which have arisen from the macromeres, as well as the two primitive mesoderm cells, are surrounded by the ectoderm and pressed into the segmentation-cavity. With progressive flattening of the germ the archenteron is gradually formed by invagination of the endoderm, its walls being constituted by the progeny of the four macromeres. The flattening finally becomes so great that the segmentation-cavity is reduced to a cleft, while the blastopore forms an elongated oval which is situated in the longitudinal axis.

During this time the two primitive mesoderm cells, which on the invagination of the endoderm had come to lie at the hinder pole in the segmentation-cavity, have given rise to a mesodermic band on either side of the archenteron. Simultaneously with this the embryo has also lost its rounded form, and when seen from the ventral or dorsal surface appears as a spherical triangle with nearly equal transverse and longitudinal axes, and with the apex directed forwards and rounded angles.

At the next stage the blastopore forms a long slit, which occupies the whole length of the ventral side. The communication between the archenteron, which possesses a tolerably wide cavity, and the exterior persists at about the middle of the blastopore, while the edges of the blastopore elsewhere grow together. The mouth proceeds directly from the persisting communication between the blastopore and the exterior. The first traces of the velum now also appear in the shape of a double row of clear ciliated ectoderm cells, which form a girdle directed obliquely to the longitudinal axis, and which bisects the longitudinal axis in the dorsal median line and in the ventral median line passes in front of the anterior end of the blastopore. The mesoderm has become bilamellar and forms a saccule on each side on the right and left, which pass into one another at the hinder pole and gradually grow out forwards and dorsally. The cœlom lying between the two layers of the mesoderm is distinctly visible.

The archenteron soon changes its shape. It is broader in front, with a wider lumen, and narrows towards the hinder end, whereby its lumen becomes correspondingly smaller. In lateral view it is dorsally convex, ventrally concave. The shell-gland now appears upon the dorsal surface of the hinder end as a thickening of the ectoderm, and simultaneously the rudiments of the cerebral ganglia arise as lateral thickenings of the velar area. At this stage there further arises the glandular portion of the primitive kidney as a little heap of mesoderm cells. At the hinder end of the blastoporal groove a little pit is observable, which marks the spot at which subsequently the contracted end of the archenteron breaks through the ectoderm to form the anus.

The œsophagus arises by an invagination of the ectoderm at the spot where the mouth had originated from the blastopore, and exhibits in front of the mouth two large clear cells which belong to the velum. The velum itself is distinguished by the very large size of its cells, which show the concretions described by Sarasin, and are ciliated. It extends a very long way backwards.

Soon after this the foot is formed as a protuberance of the ectoderm on the ventral side behind the mouth. The œsophagus itself already exhibits the evagination of the radula pouch. Shell-gland and cerebral plates continue to increase in size, and the mesoderm grows round the archenteron more and more in a dorsal direction, while ventrally it gives rise to a considerable mass of cells, which is the rudiment of the pericardium.

The primitive kidney is brought into communication with the exterior by means of an ectodermal excretory duct lying beneath the hump-shaped lateral projections of the velum.

The embryo now grows more lengthwise, and its anterior end is distinctly marked off from the posterior, which bears the shell-gland, since it is separated from it by the foot. The kidney arises on the right side from a thickening of the pericardium; the latter has moved more towards the right and in a dorsal direction, owing to the torsion which now comes into play. The mantle-ridge appears somewhat later, and simultaneously there is formed in its vicinity a small invagination of the ectoderm, the rudiment of the excretory duct of the kidney.

In the rudiment of the pericardium, which was hitherto solid, a lumen arises, the pericardial cavity; the same thing happens in the kidney; the two lumina come into connexion with one another by a narrow opening, while the kidney itself opens by its excretory duct into the mantle-cavity, which has arisen through the outward growth of the edge of the mantle. The heart is formed as an invagination of the wall of the pericardium; it becomes constricted in the middle, and is thus divided into the auricle, which is situated in front, and the ventricle, which lies behind.

The ganglia arise in precisely the same way as in *Paludina* *, as separate thickenings of the ectoderm, which sever themselves from their place of origin, sink inwards, and then, and not before, come into connexion with one another by means of commissures and connectives. There is nothing to be seen of a continuous ingrowth of

* R. v. Erlanger, "Zur Entwicklung von *Paludina vivipara*," Zool. Anzeiger, no. 357 (1891).

ectoderm lying in the median longitudinal axis, from which, according to Sarasin, the pedal, intestinal, and visceral ganglia proceed, and which he homologizes with the ventral nerve-cord of the Annelids.

In opposition to Sarasin I must lay stress upon the following points. There is in *Bythinia* a separate mesoderm, which arises from the endoderm, and the development of which from the two primitive cells is traceable step by step. The archenteron proceeds from an invagination of the endoderm. The whole mid-gut, *i. e.* stomach and liver, as well as end-gut (if we can use the term at all as applied to mollusks), arises from the archenteron, which always exhibits a distinct lumen. The mouth proceeds directly from the blastopore, accompanied by an invagination of the ectoderm, which forms the œsophagus; consequently a complete closure of the blastopore does not take place. The anal opening corresponds to a small pit at the hinder end of the blastoporal groove. Primitive kidney and kidney, apart from their ectodermic excretory ducts, are of mesodermic origin: the same is true for the heart and pericardium. The ganglia arise completely separate from one another, and do not come into connexion until afterwards.—*Zoologischer Anzeiger*, xiv. Jahrg., 1891, no. 376, pp. 385–388.

On certain Reproductive Phenomena in Cirrhipedes. By M. A. Gruvel.

The history of the preliminary phenomena of fertilization in the Cirrhipedes is little known. Darwin, relying on the anatomical characters (length of the penis) and on the observation that the ova are not ripe at the same time as the spermatozoa, concluded that reciprocal fertilization must take place, but never actually witnessed it. I was fortunate enough, during my stay at the seaside *, to make a few interesting observations on this subject.

I had in a tank of the aquarium several specimens of *Balanus* (*B. tintinnabulum*) which had been living for some time and were adult: my attention was attracted by the very peculiar movements of one of them.

The movements of the cirri were accelerated, then all at once the latter stopped, opened behind, and from the midst of them there arose a sort of very mobile tentacle, which was moved to the right, to the left, backwards, and in every direction, as if seeking for something: this was the penis. Soon a contraction set in and emission took place; the penis then resumed its position between the cirri, which also resumed their ordinary movements, until the occurrence of a fresh series of similar phenomena.

My attention once directed to this point, I was not long in discovering analogous phenomena in *Lepas anatifera*.

Individuals of the latter species embrace one another to a certain extent with their cirri. It frequently happens that the fertilized

* These investigations were carried out at M. de Lacaze-Duthiers' laboratory of experimental zoology at Roscoff during the months of August and September, 1891.

animal seizes the penis of the male between its cirri and drags it inside its valves, where it retains it, unless the latter, as is often the case, penetrates thither by itself. The animals remain in this way, pressed one against the other, producing little movements of contraction. Emission takes place, and the sperm is always deposited, in the form of a gelatinous mass, beneath the ovigerous frenum on each side of the body. On each occasion that I noticed it it was the smaller animal of the two that played the part of the male.

If there are several specimens of *Lepas* or *Balanus* whose spermatozoa are ripe surrounding another individual which is ready to be fertilized, it is not unusual to see several of them participating in the fertilization of the same individual.

Another phenomenon is frequently witnessed which is strange enough to be worthy of mention. Two *Balani* (*B. tintinnabulum*) are attached to the same fragment of rock, both of small size, and both with the cirri extended in the same direction. The hindermost one wishes to fertilize its neighbour: it tries, but its penis is too short and cannot reach as far as the orifice of the chamber in order to deposit its sperm there. Then, by a simple process which might be termed ingenious, it turns abruptly in its chamber about three quarters round, and thus diminishing the space which separates them by the length of the orifice of the chamber, it is able to succeed in fertilizing its neighbour.

From these facts, and others which cannot find a place in this note, we must conclude that the ordinary mode of fertilization in the Cirrhipedes is reciprocal. When this method is rendered impossible, by various circumstances, more especially by the fixation of the animals, self-fertilization may also take place.

There is no actual copulation, but merely approximation of the sexes and deposition of fertilizing matter in the neighbourhood of the oviferous females.

It was impossible to determine the existence of reciprocal fertilization in *Pollicipes*: I am inclined to believe that in this case there is only simple self-fertilization.—*Comptes Rendus*, t. cxiii. no. 20 (Nov. 16, 1891), pp. 706–708.

On the Embryogeny of Sagitta. By M. S. Jourdain.

Observations made on the development of *Sagitta* have led me to differ from Kowalewsky and Bütschli in my conception of the formation of the archenteric cavity, which appears in these animals at the *gastrula* stage. According to the naturalists mentioned, this cavity, which is simple at first, should divide at its anterior region into three lobes, while preserving its simplicity in its posterior portion. The lateral lobes of the tripartite region would constitute the general body-cavity: the median lobe would form the digestive canal of the perfect animal. This view appears to me to be erroneous.

The archenteric cavity, open behind at the blastopore, which occupies the region of the future anus, gives rise not to the general cavity (*partim*), but really to the digestive canal. Consequently, the lining of the portion enclosed by embolé represents not mesoblast, but hypoblast.

According to this, the development of the digestive canal must be understood to proceed as follows:—At the oral pole of the ovum there appears a depression, which is clothed by the epiblast which is driven inwards. This depression, becoming deeper, pushes back the subjacent layer, that is to say the hypoblast, which yields and becomes eaten away after a certain time. In this way a communication is established between the hypoblastic cavity and the exterior, by the medium of a permanent mouth. As a matter of fact the archenteron does appear trilobed in front, but the lobes belong to the digestive canal. Later on, the lateral lobes commence to degenerate and disappear. Then the blastopore closes, and the anus is formed in its vicinity.

At the same time as the atrophy is taking place in the lateral lobes of the archenteron, a delamination sets in between the epiblast and hypoblast, and a mesoblastic cavity is formed, which will subsequently become the general body-cavity of the animal.

In proportion as the posterior portion of the embryo increases in size, the separation between the two layers increases, and there is constituted posteriorly a spacious cavity, traversed by two mesenteric bands, of mesoblastic origin, which attach the digestive canal to the somatic walls. These mesenteries are finally absorbed in the posterior region of the body, where the somatic cavity is single in the adult.

On the sides of the terminal intestine cellular proliferations arise at an early period, whence are derived the male and female organs. The latter, therefore, are not developed, as has been asserted, in the cavity of the intestine, but outside it, in the space resulting from the delamination of the epiblast and hypoblast, of which we have spoken above. We found it impossible to determine with certainty the part played by each of these two layers in the formation of the genital glands, and consequently to discover whether Édouard van Beneden's theory is here confirmed.

We have nothing to add to what has been stated as to the mode of formation of a cephalic and somatic section of the general body-cavity.

We ascertained that the musculature, which is tolerably complex in the cephalic region, is derived from the mesoblast of the corresponding division.

We were not able to study in sufficient detail the development of the nervous system. Nevertheless, from the ensemble of our observations upon the embryogeny of *Sagitta*, we suspect that this type is not so distant from the Vertebrates as is generally supposed.

Sagitta, the Ascidians, and *Amphioxus* appear to us to constitute a special group, in which we observe the appearance of the earliest lineaments of the Vertebrates, and which, for this reason, we might designate by the title "Prevertebrates."—*Comptes Rendus*, t. cxiv. no. 1 (Jan. 4, 1892), pp. 28, 29.

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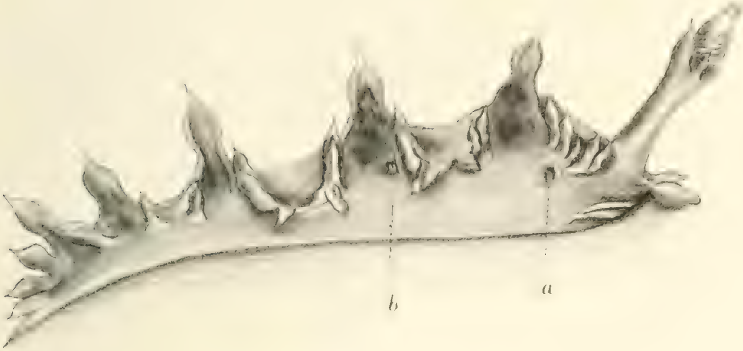

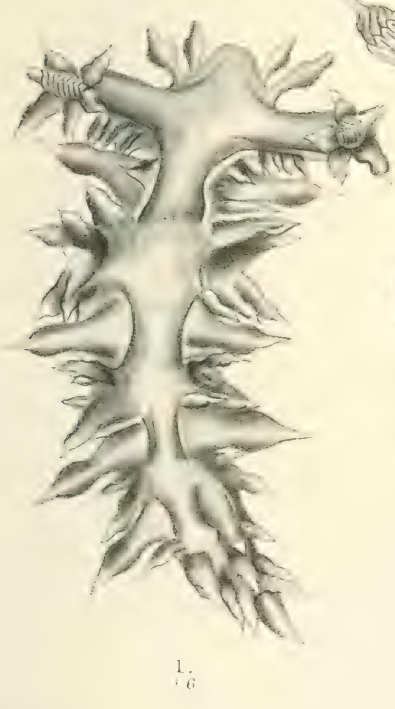

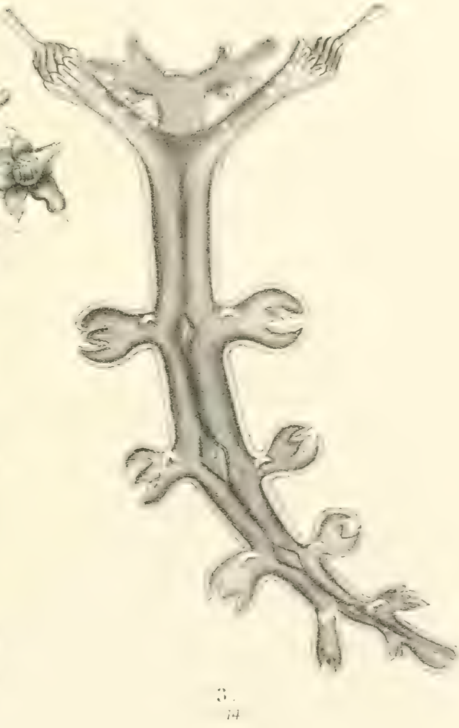

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 54. JUNE 1892.

LXII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander Richard Frazer Hoskyn, R.N.**, *commanding.*—Series II., No. 3. *On Utero-gestation in* Trygon Bleekeri. By A. ALCOCK, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Plate XIX.]

CONTENTS.

§ 1. *Introduction.*

ONE of the most interesting of the discoveries made by the 'Investigator' in recent years is that there are certain Elas-

* This paper was far advanced before the lamented death of Captain Hoskyn, and so I leave it associated with his name, whose breadth of mind, whose high intellectual reach, and whose generous concessions to the interests of science are an irreparable loss to naval exploration.

mobranch fishes in which the female develops during pregnancy a vast system of uterine glands that secrete a nutrient fluid, or uterine milk, for the nurture of the developing embryo.

In this paper there will be given a detailed account of the phenomenon as lately reinvestigated in the species—*Trygon Bleekeri*, Blyth—in which it was first noticed by us.

As is well known, reproduction among the Elasmobranchii is effected by the internal impregnation of the female.

In some, as in the familiar instance of the ray, the female after impregnation lays eggs, which are enveloped in a tough leathery capsule secreted by the oviduct.

In others, as familiarly exemplified by many sharks, the egg undergoes its changes and the embryo completes its development in the terminal part of the oviduct, which is now enlarged and elaborated to form a true uterus for the reception and retention of the embryo. In this case, as has long been known, a true placenta is formed, differing from the Mammalian placenta in the particulars which follow from the one main general fact that it is the yolk-sac, instead of an allantois, that furnishes the fœtal part of the structure.

There is yet a second method of viviparity known to occur among the Elasmobranchs, and to some particulars of it this paper is devoted. In this method while, on the one hand, the egg is retained and the embryo nourished within an oviductal enlargement or uterus, on the other hand no sort of vascular connexion is formed between the parent and the fœtus. Here the expenditure of tissue comes altogether from the maternal side, the whole of the egg being devoted to the fœtus and none of it being set aside to form vascular absorbent structures.

In passing, one cannot but remark upon the interesting fact that in the primitive Elasmobranch group we find in co-existence all the methods of reproduction that occur in the higher Vertebrate phyla, namely (1) oviparity, with large-yolked eggs enclosed in a more or less rigid shell, (2) viviparity, with the formation of a placenta, and (3) aplacental viviparity.

So far as we are at present aware the method of uterogestation now under consideration reaches its perfection in the Batoidei; and of the six families into which this suborder is divided it has been observed in three, namely the Torpedinidæ, the Trygonidæ, and the Myliobatidæ.

In *Torpedo*, as Professor Wood-Mason and I have elsewhere recalled, it was investigated in furthest detail by Dr. John Davy, who, in pregnant females,* noticed (1) fœtuses lying naked in the uterus and unattached to it by any form of placenta, (2) a glairy milky or bloody fluid, which he supposed to be in some way absorbed by the fœtus, and (3) the gradual increase in weight of the fœtus as gestation proceeded. Davy left unsettled the questions (1) of the immediate origin of the milky fluid, (2) of its immediate destination, and (3) of the direct manner of increase in size of the embryo.

It has been reserved for the 'Investigator,' thanks to the profusion of the Batoid fishes in the warm estuaries of the Coromandel coast, to extend and amplify the observations of Davy, and to draw a more finished and exact picture of the aplacental viviparity of this interesting group. The material collected by the 'Investigator' confirms the older observations as to (1) the absence of any structural connexion between fœtus and mother, (2) the presence of a creamy albuminous fluid in the gravid uterus, and (3) the increase of the fœtus in size and weight as pregnancy advances; while it adds to our knowledge the following necessary facts:—(4) the presence of special secretory glands in the mucous membrane of the gravid uterus, (5) the existence of arrangements for conducting the uterine secretion into the pharynx of the fœtus, and (6) the presence of the unchanged or little changed secretion in the alimentary canal of the fœtus.

As references to original papers are appended, it is not necessary here to do more than mention that the above observations have been made, and in every instance verified at least once, in *Trygon Bleekeri*, Blyth, *Trygon walga*, M. & H., *Pteroplatæa micrura* (Bl. Schn.), and *Myliobatis Nieuhofii* (Bl. Schn.). In the first-named species, which was the first to come under my notice, the observations were made under particularly unfavourable circumstances, and I therefore seek an opportunity, in describing a second pregnant female of this species recently captured by the 'Investigator,' to make some corrections and numerous additions to my original report.

§ 2. *The Pregnant Female and the Gravid Uterus of* Trygon Bleekeri.

A female of *Trygon Bleekeri*, Blyth, measuring in extreme length, from tip of snout to tip of tail, 9 feet 7 inches, in length of disk 3 feet, and in greatest breadth of disk only an inch and a half less, was caught in Cocanada Bay (at one of the mouths of the river Godávari) on the 12th January last. The abdomen was distended, being strongly convex instead of flat.

On opening the abdomen the internal organs of generation, consisting of a large ovary and oviduct, are found on the left side only. In my original paper ('Journal of the Asiatic Society of Bengal,' vol. lix. pt. ii. p. 53), describing a large female of this species taken in one of the estuaries of the river Mahánadi in December 1888, I stated that the right oviduct alone was present. I was writing from rough notes taken when the specimen, which was hopelessly large for preservation, was hastily dissected by the dim light of a ship's lantern in one of the scuppers of the ship; and I think it very probable that I may have mistaken my bearings, for these reasons—first, that owing to the position of the large spiral gut on the right side we have an obvious physical preference for the development of the left oviduct, and secondly, that in all the pregnant rays that I have since dissected, where only one oviduct is present it is always the left.

The terminal portion of the (left) oviduct formed a large oval fleshy tumour or uterus, the end of which projected into the cloaca like an "*os uteri*" into a vagina. On opening this a single male fœtus was found to fill its cavity, the fœtus lying naked, tightly folded, and unattached in any way to the parent. It had the following dimensions:—Extreme length, from tip of snout to tip of tail, 3 feet, length of body-disk 8 inches, and breadth of body-disk 8 inches. On removing it attention is next attracted to the sticky, greasy, creamy material which is smeared over the inner surface of the uterine wall, and when this is removed the uterine mucous membrane is exposed. The mucous membrane has a shaggy appearance, owing to the presence of a dense crowd of long filamentous villi; it is of a vivid scarlet colour, owing to its vascularity, and has an odour much like that of raw beef.

On dividing the uterus all down one side and turning it inside out under water the villi are beautifully seen. They clothe the whole organ so thickly—like the bristles of a broom or like a thick coarse fur—that the surface from which they spring is entirely concealed. In a square of a quarter of an inch (after contraction in spirit) there are about 210 villi, and as the internal superficial dimension of the uterus (after contraction in spirit) is about 20 square inches, the total number of villi must be about 67,200.

Beneath (1) the villi, which constitute the mucous membrane, the wall of the uterus in transverse section shows, from within outwards, (2) a submucous stratum in which is a very distinct *muscularis mucosa* of both longitudinally and circularly disposed fibres—the former greatly predominant—

running into the bases of the villi; the contraction of the circular fibres, the bundles of which curve into the bases of the individual villi, would chiefly shorten the villi, while the contraction of the longitudinal fibres would chiefly compress the villi together, both actions serving equally to squeeze out the milk from the glands, which, as we shall presently see, make up so large a part of the villi: outside the submucosa is (3) a thick layer of muscular fibres in an encircling band, (4) an equally thick layer of longitudinally-arranged muscular fibres, and (5) a loose fibrous coat in which many large blood-vessels run.

§ 3. *The Secretory Uterine Villi, or Trophonemata.*

For these Professor Wood-Mason and I have elsewhere used the term trophonemata (or "nursing filaments"), to denote their milk-secreting function, since the word "villus," in its associations with human physiology, has now come to connote the very opposite function of absorption. They vary in length, in the specimen under description, from half an inch to an inch and a quarter, the usual length being about three quarters of an inch; in breadth they range from about $\frac{1}{50}$ inch near the base to $\frac{1}{20}$ inch near the tip; and in thickness they are about $\frac{1}{100}$ inch through the centre, and about $\frac{1}{250}$ of an inch through either margin.

They are thus quite flat throughout, and are distinctly spathulate at their free end. They usually arise separately and are unbranched; but often two or three, and sometimes as many as twenty, are found to branch from a single stout peduncular base. Running longitudinally up the centre of each, in strong relief, is a cylindrical swelling which, as will presently be seen, is the single central vein.

When a trophonema is stained (in carmine) and examined under a low power what first arrest attention are the blood-vessels. Running along the edge on each side is seen (1) an arteriole which at the tip, without any subdivision, becomes simply confluent, so that the lateral marginal framework of the trophonema is a long narrow arterial loop.

In the concavity of this loop, coursing down the middle of the trophonema, is (2) a large vein, half as broad again as either of the arterioles; it is only at the tip of the trophonema that the vein shows any subdivision into affluents.

The arterial loop and the vein come clearly into view on deep focusing; a superficial focus displays (3) a dense polygonal meshwork of capillaries over the whole surface of the trophonema.

By careful focusing we find that the entire capillary network and the edge of the trophonema in which the arterial loop runs are covered by a layer of pavement epithelium. With very little teasing in glycerine the arterial loop can be cleanly stripped from the rest of the trophonema, except at the very tip.

This, then, is what is seen on simple examination of a magnified trophonema—a pair of lateral arterial pillars meeting to form a long narrow arch, a central venous column standing in the middle of the archway, and a superficial lattice-wall of capillaries enclosing the whole. From this point of view a trophonema is simply a long compressed cone of blood-vessels.

It must be particularly mentioned that the dimensions above given apply only to the specimen under description. In the Mahánadi specimen the trophonemata were shorter and very much finer and more delicate. And it may be broadly stated that in all the species of Batoids hitherto examined in this connexion on board the 'Investigator' the trophonemata vary in size with every individual.

In a transverse section of a trophonema we see (1) the sections of the artery standing out on each side like a pair of ears, (2) the large vein occupying the centre, and, arranged almost in a ring round the vein, close together (and perpendicular to (3) the sections of the superficial capillaries), (4) a number of glandular follicles which have next to be described. We also see (5) sections of capillaries round the arteries and between the glands.

§ 4. *The Glands of the Uterine Villi, or Trophonemata.*

As above implied, the glands occupy only the middle part of a section—about the middle two thirds of a transverse section made anywhere through the basal half of a trophonema; there are none at the edge of the trophonema where the arterial loop runs. They are somewhat club-shaped and lie close together, being separated from one another, those of the same side by capillary channels, and those of the opposite faces of the trophonema by the central vein and by the deep capillaries, as well as by a small amount of connective tissue. They lie in pocket-like depressions, and show (in section) the following structure:—(1) a broadish vestibule, lined by short columnar epithelium, and (2) an usually double bulbous base (the gland proper), each bulb consisting of a compact wedge of large broad-based tapering cells arranged like the coats of an onion in vertical section.

In any transverse section of a trophonema we find the vestibules of some of the glands opening widely to the surface between transverse sections of two superficial capillaries, others issuing by narrowed openings between two more or less obliquely cut capillaries, while others again end blindly, being covered by a superficial capillary in longitudinal section, which itself lies beneath a layer of pavement epithelium.

It may now be stated that the examination of numerous sections made in various planes shows that the glands are faintly compound, and that they consist of a collecting well or vestibule, into the bottom of which the short lumina of the true secreting bulbs open on all sides.

A very delicate basement membrane delimits the glands in their bulbous portion.

The epithelium, as above noticed, is of two kinds: in the bulbs it consists of large, long, broad-based tapering cells, in which a single nucleus lies close to the basement membrane; in the vestibule or well we find short columnar or almost cubical cells in which the single nucleus is more central.

The nucleus stains deeply with carmine, the rest of the cell, which is faintly granular, taking the stain very lightly.

In some of the vestibules lightly stained coagula are noticed.

There are other unimportant histological details; but the main facts which sections exhibit are that a trophonema consists essentially of a dense vascular network, encasing in its meshes simple glands with bulbous loculi, protected by a layer of pavement epithelium which is fenestrated over the openings of the glands. The amount of connective tissue, except at the very base of the trophonema, is insignificant, and the trophonemata are practically built of blood-vessels and secreting epithelium.

It is not easy to make an exact estimate of the number of glands borne on a single trophonema, and the following calculation can only be regarded as a probable approximation. Taking the area of the orifice of a vestibule at an average of ·001 square millimetre, and, since in any one plane at least two glands open into every vestibule, assuming that the space between the vestibules occupied by superficial capillaries is given up to an equivalent of vestibular orifices, and calculating the glandular surface of an average trophonema at 22·8 square millimetres, we should get in each trophonema 22,800 glands.

§ 5. *The Nature of the Secretion.*

The amount of secretion available for examination was so small—only about a fluid drachm, including débris of trophonemata—that no satisfactory results have been obtained.

The capture was at a distance from the ship, and to guard against putrefaction the secretion was removed and bottled and covered with strong (rectified) spirit. By the action of the spirit it was at once coagulated.

When fresh it looked like custard, or, rather, like thin pus; it was viscid, had a sticky greasy feel, and a heavy sweetish meaty smell. Prolonged heat at 212° Fahr. leaves a translucent horny cake (albumin). Fresh Fehling's solution gave no reaction (no sugar), but the quantity tested was so small that the inference must be quite uncertain. A greasy white film (probably fat) was left wherever the secretion touched the bottle.

A portion of the clot macerated in water, stained in carmine, and examined in glycerine, shows an abundance of formed elements. Besides epithelium, which may perhaps be adventitious, there are to be seen crowds of round granular cells of a uniform diameter of about $\frac{1}{2000}$ of an inch. Of these some, though quite transparent, possess no nucleus at all, fewer others have two or more nuclei, while the great majority have a single small excentric nucleus. There are also to be observed free nuclei.

In the Mahánadi specimen the secretion, which was abundant glairy and turbid, was tested only for albumin, and coagulated in lumps when heated.

The secretion thus seems to vary; and it may be mentioned that in *Pteroplatæa micrura*—a viviparous fish allied to the Trygons, and one which carries its young in the same way—the secretion changes with the advance of gestation.

As to the nature of the secretion, then, all that can at present be predicated is that it is very rich in albumin and that it contains a remarkably large proportion of corpuscles and nuclei.

§ 6. *The Fœtus of* Trygon Bleekeri.

On removing the fœtus we are first attracted by the large size of the spiracles, which are full of the creamy uterine secretion.

It may perhaps be of advantage to recall the fact that the spiracles are the first pair of branchial clefts, which, in many

Elasmobranch fishes, remain as direct channels between the pharynx and the external medium.

There is also noticed a small external yolk-sac about as big as a raisin, with a thread-like stalk which perforates the body-wall, and, expanding, is attached to the anterior end of the spiral gut on the ventral aspect.

The yolk-sac is empty and is evidently dwindling; in the more advanced fœtus of the Mahánadi specimen it had altogether disappeared.

On opening the abdomen of the fœtus the greatly distended spiral gut is seen lying to the right *, and the left lobe of the liver to the left *. The stomach is small and empty and is pushed up beneath the pectoral arch.

The small short duodenum, which is guarded at the pylorus by a stout valve-like fold, is, like the anterior part of the spiral gut, full of coagulated lumps of the uterine secretion. The posterior three-fourths of the spiral gut is stuffed with viscid, grumous, bile-stained matter.

The rectum is sharply constricted off from the spiral gut and looks like a solid cord; dorsal to it lies the rectal gland in a fold of mesentery common to it and the testes, to which last it is intimately adherent.

The liver is of large size and perfectly colourless; the spleen is also large.

The left testis is several times larger than the right, perhaps because the pressure of the distended spiral gut has hindered the growth of the latter.

The external gill-slits are closed; their anterior edges are finely pectinated.

On laying open the capacious pharynx the wide internal orifice of the spiracle is displayed. It lies in the same plane with the branchial clefts proper, and symmetrically with them, so that its homodynamy with them is of diagrammatic plainness, and it differs from them chiefly in being widely open, while they are closed by the close approximation of the branchial bars.

It only remains further to remark, concerning the fœtus, that while its generic and subgeneric characters are quite distinct, it has not yet acquired its full specific characters. Except for a large centro-dorsal boss surrounded by a few small tubercles its skin is quite smooth; its tail-spine is well developed, but entirely sheathed in skin. Its colour is much like that of the adult, but lighter, being uniform brown dorsally and olive-grey below except along the abdomen.

* *I. e.* of the fœtus.

[The colours of the mother are dark brown dorsally and olive-brown ventrally, except on the thorax and abdomen, which are blotched with white.]

§ 7. *Recapitulation and Conclusion.*

To recapitulate: in *Trygon Bleekeri*, as twice observed in the pregnant state, we find a single uterus containing a single naked fœtus unattached structurally to the mother; we find the uterine mucous membrane to be produced into long villi which consist almost exclusively of blood-vessels and glands; and we find the viscid, turbid or milky, and richly albuminous secretion of the latter free in the uterine cavity. In the present case the secretion is observed unchanged in the spiracles, and in coagula filling the "duodenum" and the anterior part of the spiral gut, of the fœtus.

Elsewhere Professor Wood-Mason and I have shown that in the nearly related *Pteroplatœa micrura* the uterine villi (trophonemata) actually pass into the spiracles of the fœtus; and I have quite recently observed this same disposition of the trophonemata in *Trygon walga*.

The specimen from which these particulars have been recorded was too large for preservation; its skin has been sent to the Indian Museum.

Besides the classical text-books and the classical memoir of Johannes Müller, "Ueber den glatten Hai des Aristoteles" (Abhand. Ak. Wiss. Berl. 1840), the following papers refer specially to the subjects of the uterine villi and aplacental viviparity of the Batoidei:—John Davy, "Observations on the Torpedo," Phil. Trans. 1834; Trois, "On the Uterine Villi of *Myliobatis noctula* [and *Centrina Salviani*]," Atti del Instituto Veneto, vol. ii.; Haswell, P. L. S., N. S. Wales, vol. iii. 1889, on *Urolophus*; Alcock, "Observations on the Gestation of some Sharks and Rays," Administration Report of the Marine Survey of India for the Official Year 1888–89, and Journ. As. Soc. Beng. vol. lix. part ii. (*Trygon Bleekeri* and *Myliobatis Nieuhofii*); Wood-Mason and Alcock, "On the Uterine Villiform Papillæ of *Pteroplatœa micrura*," Proc. Roy. Soc. vol. xlix., and "Further Observations on the Gestation of Indian Rays," Proc. Roy. Soc. vol. l. (*Trygon walga*, *Pteroplatœa micrura*, and *Myliobatis Nieuhofii*).

EXPLANATION OF PLATE XIX.

Fig. 1. The distal half of a trophonema, × 10, showing *m*, the non-glandular margin in which runs *a*, the artery; and *g*, the glandular centre with *v*, the central vein.

Fig. 2. The tip of a trophonema, × 42, showing *c*, the superficial capillary plexus; the other letters as before.

Fig. 3. Transverse section of a trophonema in its basal half, × 188; *m*, *a*, *v* as before; *c*, the superficial capillaries of the glandular centre, and *c'*, the superficial capillaries of the non-glandular margin, in section; *g*, a gland in vertical, and *g'*, one in obliquely transverse section.

P.S.—Since the above was written I have been fortunate enough to obtain two female specimens of *Trygon Bleekeri*; in both the *left* oviduct alone is developed.

LXIII.—*Description of a new Species of* Antedon *from Mauritius.* By F. Jeffrey Bell, M.A.

[Plate XVIII.]

The Trustees of the British Museum have lately acquired some specimens of an *Antedon* from Mauritius which not only appears to be "new," but to present some very interesting relations to a group of already known species.

The group which the late Dr. P. H. Carpenter called (Chall. Rep. Comat. p. 227) the *palmata*-group consisted of bidistichate species with an unplated disk and a first pinnule smaller than its successors.

Of these some have a pinnule on the third brachial, and of those with two or more postradial axillaries some have the rays free laterally. Of these, three species—*A. tuberculata*, *A. spicata*, and *A. indica*—have the second pinnule stiff and styliform, of twelve to eighteen much elongated joints. With them the Mauritian species is to be placed, but it is to be distinguished from them by the following characters:—

(1) The marginal projections at the sides of the rays are continued on to the most proximal brachial joints.

(2) The second pinnule, though "stiff and styliform," is not extraordinarily so, and the joints, though no more than twenty, are not abnormally long.

(3) The disk is as small as in *A. indica*, and the centrodorsal occupies the whole of its aboral surface.

The following appear to be the diagnostic characters of this new species, which may be called

Antedon emendatrix.

An *Antedon* of the "*palmata*-group" of P. H. Carpenter, in which the disk is exceedingly small; the centro-dorsal, which is coextensive with its aboral surface, has about twenty-two pits, and the cirri have about twenty-five joints; the second half or distal set of these joints are spiny. The arms are little more than ten in number or may be more than twenty; the third brachial has a pinnule; the second pinnule is larger than the third; the rays are free laterally; the second pinnule is stiff and styliform, has about twenty joints, most of which have their distal edge projecting and serrated; the radials, distichals, and most prominent brachials have marginal projections which are not very prominent; the third pinnule is only half as long as the second; the third radial is very little longer than the second. The third brachial is a syzygy, and there is not another till the twenty-fifth joint.

Colour purple-madder, the pinnules grey.

Spread about 150 millim.; diameter of disk 6 millim.

Hab. Mauritius.

This is really a very interesting species, inasmuch as the comparatively large number (twenty) of joints in the second pinnule makes it intermediate between Dr. Carpenter's set (p. 225) of forms in which the second pinnule has from twelve to eighteen much elongated joints and that in which the same pinnule has twenty-five or more joints which are not specially elongated. It has many points of resemblance to *A. indica*, but its spinose cirri, its second pinnule, and its rare syzygies are sufficient to distinguish it. An examination of Mr. Smith's type of *A. indica* shows that in that species the rays have marginal projections. It would be instructive to get a large series of specimens of that species, of *A. spicata* and *A. tuberculata*. At present we are in the stage of making species of *Antedon*, and we must continue to do so till we have larger and finer series before us. Then another part of our work will begin!

EXPLANATION OF PLATE XVIII.

Fig. 1. *Antedon emendatrix*; general view from the side. Nat. size.
Fig. 2. Portion of disk and arms. × 3.
Fig. 3. Portion of arm after last axillary. × 2.
Fig. 4. Second pinnule. × 4.

LXIV.—*Descriptions of new Genera and Species of* Pyralidæ *contained in the British-Museum Collection.* By W. Warren, M.A., F.E.S.

[Continued from p. 397.]

Trischistognatha, gen. nov.

Fore wings elongate; costa straight, slightly and gradually convex at apex, which is blunt; hind margin oblique, hardly curved, with a very slight indentation above the anal angle. Hind wings rounded. Antennæ laminated, a little thicker in male than in female; tongue present; ocelli minute; labial palpi with all three joints very distinct; first and second securiform, the first twice as broad as the second, third shortly rostriform; maxillary palpi like the third joint of the labial; abdomen of male with rather long anal tuft; hind tibiæ with two pairs of spurs, the inner very much longer than the outer; scaling fine and smooth. Wings semidiaphanous; neuration normal.

Type *T. palindialis* (*Spilodes*), Guen. Delt. & Pyr. p. 380.

Tholeria, Hüb.

Type *T. illiberalis*, Hüb. Verz. p. 354.

Tholeria stigmosalis, sp. n.

Fore wings with base, inner and hind margins dull reddish; central area whitish, with the costa, the two stigmata, and the veins round them black-brown; the stigmata themselves filled up with reddish; the white interspaces finely dusted with dark atoms; a faint trace of a curved exterior line at the extremity of the white central space; fringe dark brown. Hind wings pearly white, with an irregular, narrow, reddish-brown marginal suffusion, which here and there runs up a little way along the veins; fringe white, slightly tinged with reddish towards apex. Head, palpi, antennæ, and thorax dull reddish; abdomen darker brown, with segmental divisions white; collar fawn-colour, paler than either head or thorax. Underside: fore wings pearly white, tinged with yellowish, with only the hind margin and stigmata reddish. Hind wings like the upperside, but with the costa reddish brown, tinged with yellow, and with an irregular reddish projection from it towards the centre.

Expanse of wings 30 millim.

Four males from S. Paolo.

Cirrochrista, Led.

Type *C. ætherialis*, Led. W. E. M. vii. p. 441, pl. xvii. fig. 9.

Cirrochrista margarita, sp. n.

Fore wings satiny white, transparent; costa and hind margin irregularly tawny brown, the former with a triangular projection at one third and a larger one at two thirds; a smaller one between them and another between the first and the base; on the inner margin at one third a tooth-shaped brown marking nearly touches the first larger costal projection; another large projection from the hind margin similarly all but touches the second larger costal one; apical region occupied by two snow-white spots, the exterior the smaller and separated from the larger one by a fine fulvous line; fringe whitish, tinged with fulvous. Hind wings pure white, with a mixed rosy and yellow narrow hind margin and a narrow rosy stripe running up the wing along the inner margin. Head, thorax, and abdomen white; vertex of head, collar, top of last segment of thorax and of all abdominal segments red-brown; palpi and outside of all tibiæ more or less tinged with brown. Underside yellowish white, with markings of the upperside showing through.

Expanse of wings 24 millim.

Two males from S. Paolo.

Ramila, Moore.

Type *R. marginella*, Moore, P. Z. S. 1867, p. 667.

Ramila angustifimbrialis, sp. n.

Pearly white; costa fulvous, the streak thinning out towards the apex; first line appearing only as a very small projection from the costal streak, second line slightly more distinct for a short distance from the costa, and again on the middle of the inner margin; discocellular vein thinly marked with fulvous, but thickening into two dots at the ends; fringe white, fulvous-tinged, with a fulvous basal line, which is itself preceded by a row of almost contiguous darker dashes at the ends of the veins. Hind wing like fore wing, with traces of two fine fulvous transverse lines, visible only near the inner margin. Abdomen, underside, middle and hind legs white; palpi, sides of thorax level with the costal streak of fore wing, and fore tibiæ fulvous.

Expanse of wings 22 millim.

One female from Burmah.

PHLYCTÆNIA, Hüb.

Type *P. sambucalis* (Schiff.), Hüb. Verz. p. 359.

Phlyctænia ferruginealis, sp. n.

Fore wings fuscous cinereous, coarsely scaled; the markings nearly all obliterated; the paler ground-colour showing only as faint yellowish patches towards the middle of the first and second lines. Hind wings whitish ochreous, partially suffused with fuscous, especially towards the hind margin, and with a curved submarginal line. Underside paler.

The markings of the fore wings are the same as in *P. arenacea*, of which species it is not improbable that it may turn out to be the male.

Expanse of wings 24 millim.

One male from Rio Janeiro.

Phlyctænia paolinalis, sp. n.

Fore wings yellowish ochreous, inclining to orange, finely dusted with fuscous; basal half of costa fuscous; first line bent, or even angulated externally, in the middle; second sinuous, not denticulate; submarginal denticulate, fairly distinct; fringe with darker basal and medial line; stigmata distinct. Hind wings yellowish white, with a distinct, submarginal, curved line and fuscous shade before fringe. Head, thorax, and abdomen yellowish ochreous. Underside dull ochreous, with few markings.

Expanse of wings 20 millim.

One female, four males, from S. Paolo and Rio Janeiro.

Phlyctænia arenacea, sp. n.

Fore wings pale sandy ochreous, dusted with darker; first line wavy, nearly vertical, at one third; second sinuous and denticulate, forming a moderate sinus in middle; faint traces of a submarginal darker line; fringe glossy, with a darker medial line; stigmata indistinct; orbicular dot-like; reniform lunate. Hind wings white, with basal and medial line of fringes fuscous; an indistinct trace of an abbreviated submarginal line. Underside dull ochreous, with darker suffusion; external line of both wings distinct; veins of fore wings dark. Head, thorax, and abdomen all sandy ochreous.

Expanse of wings 24 millim.

Four females from Theresopolis, Rio Janeiro, and S. Paolo.

Hyaloplaga, gen. nov.

Distinguished from *Phlyctænia*, which in shape and appearance it much resembles, by several structural differences. Labial palpi not rostriform, but bluntly triangular, slightly porrected upwards. In the male the hind wings have a very prominent shoulder near the base. Fore wings with the submedian nervure somewhat distorted, curved downwards towards the interno-median fold, and with a small tuft of hairs on the upper surface near the base. Antennæ thick, laminated and downy beneath. Female with normal wings.

Type *H. pulchralis* (*Hydrocampa*), Moore, P. Z. S. 1867, p. 90.

Loxocreon, gen. nov.

Fore wings elongate; costa straight, hind margin obliquely curved. Hind wings rounded, slightly indented beneath apex. Labial palpi broad, triangular, porrect; maxillary palpi short, erect; tongue and ocelli present; eyes large; patagia of male prolonged, as in *Omiodes*, but not to nearly the same extent; abdomen stoutish, of the male prolonged. Wings smoothly and thickly scaled, with oblique markings.

Type *L. continuatalis*, Wllngrn. (*Salbia*).

An isolated group peculiar to the Sandwich Islands, but certainly not *Omiodes*, as Mr. Meyrick makes them.

Autocosmia, gen. nov.

Fore wing with straight costa, deflexed only just before the apex, which is produced, but not acutely; hind margin straight, oblique. Labial palpi porrect, rather long; maxillary upright, small; tongue developed; ocelli present; antennæ (female) simple; forehead conically projecting; hind legs with outer spurs peculiarly short; scaling smooth; the veins all finely delineated in white.

Type *A. concinna*, Warr.

The only species, from N.W. America, is separated from *Cosmocreon* by its conical, not rounded forehead, the smoothness of the scaling, and the peculiar neatness of the markings.

Autocosmia concinna, sp. n.

Fore wing sienna-brown, with the costa to beyond middle broadly smooth chestnut, which colour also reaches the inner margin at the base; the edges of the two stigmata, the median nervure, the second and third median nervules as far as the second line, the submedian, with an oblique streak running into it from the median below the orbicular stigma, the interno-median vein, the sinuous second line, a line before the dark base of the fringe, and one on each side of the head, all delicately and concisely snow-white; fringes themselves brown-grey, with darker central line; between the middle of the second line and the white hind marginal line is a small undefined greyish-white patch. Hind wings brownish fuscous, without markings. Underside the same, with the second line showing white in *both* wings. Abdomen fuscous; head, thorax, and outside of labial palpi chestnut-brown; legs and underside of abdomen whitish.

Expanse of wings 15 millim.

COSMOCREON, gen. nov.

Fore wings elongate, narrow at base, widening considerably towards hind margin; costa straight, convex only just before apex, which is blunt; hind margin simply curved; inner margin bulging slightly near the base. Hind wings rounded, twice as broad as fore wings. Labial palpi porrect, rostriform, rather roughly scaled; maxillary small, nearly upright, broad at apex; tongue long; ocelli present; antennæ pubescent in male; forehead with a rounded protuberance; thorax and abdomen rather stout.

Type *B. albiceralis*, Grote, Bull. U. S. Geol. Surv. iv. p. 678.

The genus will also include *B. allectalis*, Grote.

EUERGESTIS, Hüb.

Type *E. extimalis*, Scop. (*E. margaritalis*, Hüb. Verz. p. 354).

Euergestis consimilis, sp. n.

Closely allied to *E. extimalis*, but distinguished by the much darker tint of the marginal blotch and fringes and by the outer line itself, which, instead of being composed of separate dots, forms a distinct and, near the costa, serrated line.

One specimen, from the Grote Collection.

MESOGRAPHE, Hüb.

Type *M. straminalis*, Hüb. (*M. stramentalis*, Hüb. Verz. p. 354).

Mesographe junctalis, sp. n.

Fore wings straw-colour, with the basal third and the hind margin broadly bronzy fuscous; the fuscous tinge of the basal area extends further along the costa and inner margin, so that its outer edge is concave; reniform stigma filled up with fuscous, connected above with the dark costa and obliquely below with the marginal band; fringes fuscous. Hind wings straw-colour, with the same margin as fore wings and a broadish fuscous-grey inner edge. Head, thorax, and abdomen bronzy fuscous, the latter ringed with paler. Underside like upper, but less distinctly coloured.

Expanse of wings 24 millim.

One male from Japan.

Akin to *M. limbata*, but slightly smaller and darker.

ANOMOSTICTIS, gen. nov.

Diastictis (Hüb. Verz. p. 355), of which the type is *argyralis* (Hüb. Zutr. figs. 113, 114), cannot stand, as it was already employed by Hübner himself at p. 288 of the 'Verzeichniss' for a genus of Geometræ, with *artesiaria*, Schiff., for type.

I propose to substitute the above term for *Diastictis*, to include *argyralis*, Hüb., *fracturalis*, Zell., and *cæcalis*, Warr.

Anomostictis cæcalis, sp. n.

Fore wings dull fuscous, sometimes with a suffusion of fulvous, slightly paler on the inner side of the exterior line; lines and stigmata very obscure; first line hardly distinguishable at all, owing to the deeper suffusion near the base; exterior line rectangularly sinuous, forming a distinct sinus outwards in the middle and a smaller curve inwards above and below it; reniform stigma a dark dot. Hind wings slightly paler, more fulvous, and darker towards hind margin, with the exterior line of fore wings reproduced. Head, thorax, and abdomen very dark fuscous. Underside slightly paler, with the markings also indistinct.

Expanse of wings 18–24 millim.

One female, two males, from California.

The single female is intermediate in size between the two males.

Cornifrons, Led.

Type *C. ulceratalis*, Led. W. E. M. 1858, p. 147, pl. iv.

Cornifrons pulveralis, sp. n.

Fore wings whitish, coarsely and thickly dusted with greyish ochreous; first line at fully one third, somewhat obscure towards the costa, forming a small tooth outwards on the median vein, then running obliquely basewards, and ending in a dark spot on inner margin; second line from costa at four fifths, dark grey, minutely denticulate, curving inwards at the middle, and thence running parallel to first line; reniform stigma dark grey; space between second line and hind margin clouded with dark grey, with indications of a paler submarginal line; fringes chequered. Hind wings whitish grey, with a dark curved submarginal line, beyond the middle of which is a paler patch. Head and thorax cinereous; abdomen paler. Underside dull grey, with indistinct markings.

Expanse of wings 26 millim.

One male, one female, from Nevada, N. America.

Acharana, Moore.

Type *A. otreusalis*, Wlk., Moore, Ceyl. iii. p. 285.

Acharana rudis, sp. n.

Like *Pachyzancla stultalis*, but larger and more roughly scaled; more suffused with pale greyish fuscous over both wings; costa darker; abdomen pale ochreous grey.

One female, two males, from Japan.

Acharana minoralis, sp. n.

Fore wing glossy greyish fuscous; the lines still darker; first line slightly oblique, second curving obliquely outwards for two thirds of the wing, then running inwards to beneath the reniform, thence straight to the inner margin; reniform stigma a white lunule. Hind wing like fore wing, but without the white spot. Abdomen glossy grey, with the segmental divisions white.

Expanse of wings 16 millim.

One female from Accra.

Acharana maledicta, sp. n.

Fore wings dark fuscous cinereous, darker towards costa and hind margin; exterior line forming a distinct three-toothed projection below the middle of the wing; first line preceded and second line followed by a distinct pale space; stigmata black, distinct. Hind wings with the exterior line of fore wings reproduced. Head and thorax dark fuscous; abdomen paler, ochreous. Underside duller and paler, with the markings clearer.

Expanse of wings 20 millim.

One female from Pitcairn's Island.

Acharana descripta, sp. n.

Extremely like *Pachyzancla stultalis*, Wlk., but smaller, and with the hind margin of the hind wings nearly straight, not rounded.

One female from S. Paolo.

Acharana simplex, sp. n.

Fore wings clear pale ochreous, with the two stigmata and transverse lines neatly marked, fuscous, and a dark line at base of fringes. Hind wings with discal dot and line distinct. Head, thorax, and abdomen concolorous. Very much like *verminalis*, Guen., from Sierra Leone, but with the hind margin more oblique and the second line hardly forming a sinus outwards in the middle of the wing.

Expanse of wings 20 millim.

Two males from Bombay.

Acharana olivescens, sp. n.

Fore wings dull bronzy fuscous olive, with a purple tinge towards the costa, and deeper fuscous towards the hind margin; the lines indistinct, exterior denticulate and slightly edged with paler; a distinct dark discal spot in both wings.

Expanse of wings 28 millim.

One female, one male, from Ecuador.

Acharana indistincta, sp. n.

Both wings entirely dull dark fuscous, the lines and stigmata only just visible. Hind wings rather darker than fore wings; fringe of hind wings sometimes whitish. Abdomen dark fuscous, with white segmental divisions; anal tuft of the male blackish.

Expanse of wings 30 millim.

Two males, two females, from Japan.

Near *A. tristrialis*, Bremer, but larger and much darker.

Acharana elongalis, sp. n.

Fore wings fuscous, with a purplish tinge, rather glossy. Hind wings darker; all the lines very indistinct; a distinct black discal spot in each wing, which in the fore wing is preceded by a smaller more obscure one; fringes glossy, concolorous. Head and thorax dark fuscous; abdomen paler, somewhat ochreous.

Expanse of wings 28 millim.

One male from Formosa.

The species may be distinguished at once by the elongated fore wings, so much narrower than the rest of the group. In this respect it resembles *Stenomeles agavealis*, Wlk., but the hind wings are broad and well rounded.

Acharana fuscescens, sp. n.

Like *A. rudis*, Warr., but larger; dark fuscous cinereous, generally slightly paler beyond the lines; abdomen dark fuscous.

Expanse of wings 28 millim.

Three examples from Japan.

STENOMELES, gen. nov.

Fore wings elongate, narrow, quite four times as long as wide; costa straight, very gradually convex before apex; hind margin very oblique. Hind wings triangular, twice as long as broad, with the hind margin nearly straight from inner to anal angle. Palpi as in *Acharana*; antennæ long, in the male pubescent; collar and patagia clothed with coarse loose scales; abdomen in both sexes long, reaching beyond the hind wings.

Type *S. agavealis* (*Botys*), Wlk. xviii. p. 575.

PRIONOPALTIS, gen. nov.

Fore wings broadish; costa convex before apex; hind margin faintly sinuous, being slightly incurved below apex and elbowed above the anal angle; scaling fine, glossy. Labial palpi broad, porrect, as in *Acharana*; maxillary erect, behind the labial, rather broad at apex; tongue present; ocelli large; antennæ with angular joints, which in the male project like the teeth of a saw.

Type *P. sericea*, Warr.

Prionopaltis sericea, sp. n.

Fore wing glossy fuscous, rather broader than is usual in the genus; first line very indistinct, slightly oblique, second line also indistinct, bounded below the costa, from which it starts vertically, by a pale yellowish-white blotch, beneath which its middle third shows three distinct teeth, and the lower third one larger tooth; fringes concolorous, with a fine pale line along their base; stigmata darker, but indistinct; the orbicular small, close to the first line; the reniform larger, in the middle of the wing. Hind wing with the second line repeated, and followed by a pale space throughout its course. Head, thorax, and abdomen all fuscous.

Expanse of wings 24 millim.

Three females from Dharmsala.

Prionopaltis consocia, sp. n.

Fore wings not quite so broad as in *P. sericea*; the costa straighter towards the apex; silky brown, as in *sericea*, from which it is distinguished as follows: the pale subcostal patch at the beginning of the second line is larger, more distinctly tridentate behind; the end of the line on the inner margin is distinctly marked as a small angulated blotch; the base of the reniform stigma is marked by a minute yellowish dot; all the fringes concolorous, without the bright pale basal line of *sericea*.

Expanse of wings 26 millim.

One male from Japan.

Prionopaltis (?) *suffusalis*, sp. n.

Fore wing fuscous brown; the lines the same colour, indicated only by a few yellowish dots, which follow their course; a small yellow spot before the orbicular stigma; a square blotch between the two stigmata, and a large, irregular, oval one between the reniform and the second line; below the median vein is a wedge-shaped yellowish mark between the first median nervule and the median vein itself, and below it a square blotch. Hind wing with the second line more visible; a large brown central spot, connected by a second with the outer line; central space irregularly yellow; fringes concolorous.

Expanse of wings 28 millim.

One female from Japan.

RHECTOCRASPEDA, gen. nov.

Characterized by the hind wing (of the male), which is peculiarly contorted beneath at the anal angle opposite veins 1 *a*–1 *c*, and bears on either side of the contortion a curled wisp of hairs. Fore wing with costa slightly concave in the middle, strongly curved before apex, which is blunt; hind margin obliquely curved. Hind wing with a decided inflection below apex as well as contorted at anal angle. Labial palpi shortly porrect, broad; maxillary invisible; tongue present; antennæ visibly pubescent beneath, each joint with a short spine; ocelli present.

Type *R. periusalis* (*Botys*), Wlk. xviii. p. 564.

CAMPTOMASTIX, gen. nov.

Fore wing with gradually convex costa, slightly curved, not very oblique hind margin; not more than twice as long as broad. Hind wing by comparison narrow. Labial palpi very long, porrect and thin, third joint half as long as second; maxillary absent; tongue present; ocelli large and conspicuous; antennæ (of male) with enlarged basal joint, finely ciliated throughout, suddenly bent under at one third, flattened and broadened at the curve, which is laterally serrated and bears longer silky hairs, thence thinning out towards the apex. *Central field of fore wing clothed with lengthened raised hairs.*

Type *C. pacalis* (*Botys*), Leech, ♀, = *Diplotyla longipalpis*, Butler, ♂.

Meyrick's genus *Diplotyla* has upright palpi.

AGRAMMIA, Guen.

Type *A. matronalis*, Guen. Delt. & Pyr. p. 406.

Agrammia cervinalis, sp. n.

Fore wing and thorax fawn-colour; costa whitish. Head and palpi luteous. Hind wings white, with darker fringes. Abdomen fawn-colour.

Expanse of wings 26 millim.

Two males from S. Paolo.

Agrammia lutealis, sp. n.

Head, thorax, palpi, antennæ, and fore wings bright luteous, without markings. Hind wings pale straw-colour, yellower towards the hind margin. Underside paler yellow.

Expanse of wings 24 millim.

A pair from S. Paolo.

CHORISTOSTIGMA, gen. nov.

Fore wings elongate; costa straight, but before apex rather strongly convex; apex somewhat produced; hind margin oblique, slightly sinuous. Hind wings rounded. Labial palpi horizontally porrect, rostriform; maxillary small; tongue and ocelli present; antennæ of female simply filiform, of male short, thick, laminated, curved backward over the head; forehead slightly produced and rough-scaled; scaling fine and thick, but not glossy; markings, two lines and stigmata, the latter remote from each other.

Type *C. plumbosignata* (*Botys*), Fernald, Ent. Am. iv. p. 37, superficially reminding one of *Syllythria*, but at once distinguished by the structure of the antennæ.

Choristostigma elegantalis, sp. n.

Fore wing pale yellow, with tawny markings; costa suffused with tawny along basal half; first line indistinct, brown; second line brown, rising nearer hind margin than usual, runs parallel to it as far as the second median nervule, then curves upwards and inwards, touching the base of the reniform stigma, and running along the median nervure nearly to the orbicular stigma, finally reaches the inner margin at about the middle; a submarginal brown shade runs parallel to it, touches it at the elbow, and then forms apparently with its lower portion a continuation of the reniform stigma; all the nervules brownish towards the hind margin, with brown dots at their extremities; orbicular stigma a flattened oval ringed with brown and filled up with ground-colour; reniform large, constricted in middle, edged with brown, and filled up with lilac-grey. Hind wing yellowish white, with dark central spot and faint traces of a curved submarginal band. Underside yellowish, dusted with fuscous; all the markings clearer.

Expanse of wings 20 millim.

Two males from California.

MIMUDEA, gen. nov.

Fore wing elongate, pointed; costa straight; hind margin obliquely sinuous. Labial palpi long, porrect; second joint rough-haired above, straight beneath; terminal joint small, smooth, rounded; maxillary palpi erect, small; antennæ laminated, short, curved, with serrate joints, slightly pubescent beneath in male; tongue slight; ocelli present. Female larger and paler than male; male with a distinct anal tuft. Markings, two transverse lines and two stigmata, the latter separated by a pale discal spot; the reniform also followed by a large subcostal pale blotch.

Type *M. olivalis*, Warr.

Mimudea olivalis, sp. n.

Fore wing (female) olive-yellowish, suffused with olive-fuscous; costa, the two transverse lines and the two stigmata darker fuscous; first line slight, curved, second broader, especially in its lower half, where it becomes a broad shade and unites with the reniform stigma; a small straw-yellow spot before and a larger one beyond the reniform stigma. Hind wing olive-fuscous, paler at base, with a dull central band and row of dark marginal dots.

Male smaller, fuscous grey, without any yellowish tinge, and the pale spots whitish; the central space between the two lines wholly dark fuscous.

Expanse of wings, ♀ 16, ♂ 14 millim.

Two females, two males, from S. Paolo.

Mimudea flavinotata, sp. n.

Male.—Fore wing cinereous fuscous, the two lines only faintly discernible, the second preceded on costa by a large straw-coloured spot; a smaller round one standing on the disk between the two stigmata, which are scarcely otherwise discernible. Hind wing dull ochreous, with darker hind margin and faint central line.

Female yellowish, very similar to the female of *M. olivalis*, but without the fuscous-olive suffusion, and larger.

Expanse of wings 18 millim.

One female, one male, from Rio Janeiro.

Mimudea subrosea, sp. n.

Fore wings dull rosy grey; first line fuscous, at one third, nearly vertical; second line from two thirds of the costa, where it is preceded by a large irregularly triangular yellow spot, ending as a vertical line near the centre of the inner margin, approximate and parallel to the first line; a pale yellow spot between the stigmata, which are scarcely discernible; fringe yellowish. Hind wings fuscous, with yellowish fringes. Head, thorax, and abdomen rosy grey; anal segment of abdomen yellow.

Expanse of wings 12 millim.

One female, S. Paolo.

In the specimen above described the abdomen is unusually short and apparently malformed.

PACHYZANCLA, Meyr.

Type *P. stultalis*, Wlk. (*P. mutualis*, Meyr. Tr. E. S. 1884, p. 315 (part)).

Pachyzancla dissimilis, sp. n.

Resembles *stultalis*, Wlk., but smaller, the transverse lines not preceded or followed by a paler space; first line less oblique, nearly vertical, second line without any denticulations in the middle and lower thirds; the general ground-colour of both wings more uniformly fuscous.

One female from Accra.

LXV.—*Notes on Dr. C. Flach's Synonymic List of the European* Trichopterygidæ. By the Rev. A. MATTHEWS.

FOR the last few years the time which I have been able to devote to entomology has been fully occupied in investigating the Corylophidæ; but since that study has been almost finished, I have lately turned my attention to collecting materials for a second part of my 'Trichopterygia Illustrata,' and I find that such a work is much needed, for, since the publication of the first part in 1872, the number of the Trichopterygidæ has been nearly doubled by the discovery of fresh species in various parts of the world, especially in America, through the exertions of Mr. Crotch, Mr. Champion, Dr. Le Conte, Dr. Horn, and Mr. Casey.

Thus it has happened that until a few weeks ago I was unaware of the existence of an important essay on the European species of Trichopterygidæ from the pen of Dr. C. Flach, published in the 'Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien,' vol. xxxix. 1889, pp. 481-532.

In this essay Dr. Flach has revised, or, rather, attempted to reconstruct, the nomenclature of the whole family, and my purpose in the present paper is to consider the alterations proposed by Dr. Flach and to set plainly before entomologists my own views, where they differ from those of Dr. Flach, and, having done this, to leave it in their hands to form an unprejudiced opinion on the comparative merits of the systems in question.

The changes of nomenclature proposed by Dr. Flach form a leading feature in his essay and require special notice. The manner in which he has treated the genus *Ptilium* exhibits a characteristic example of his style. He has, in fact, adopted an arrangement suggested long ago by Col. Motschulsky, dividing this very complex genus into many subgenera. The creation of what are termed subgenera has always appeared to me objectionable for many reasons: it is impossible to define a subgenus with accuracy sufficient to enable a student to determine the proper position of any doubtful species; if this could be done, and the subgenus proved to exhibit unmistakable anatomical characters, it would become a true genus, and must be designated as such in any subsequent work. Col. Motschulsky's separation of *Ptinella* from *Ptilium* is a clear proof of the truth of what I have said, for no one since his time has ever thought of reuniting those two genera. If it had been possible I would willingly have retained *Micrella*, *Oligella*, and other genera which he proposed at the same time as *Ptinella*; but I could find in these no true persistent generic characters; the differences which they exhibit are merely specific, *e. g.* the short transversely-jointed antennæ of *P. Kunzei* merge gradually through other species whose thorax is equally devoid of channels into the long slender-jointed antennæ of *P. exaratum*, and the same may be said of their superficial sculpture and other differences. I found therefore that generic separation could not be supported by anatomical evidence, and was content to retain in the old genus the greater part of its former species, distinguishing its various divisions by sculptural characters alone —thus avoiding the confusion of a multiplicity of indefinite generic terms. But even if subgeneric names should be deemed advisable, I consider it unjust as well as uncourteous to appropriate to your own credit names previously published by another author, although they be but imperfectly characterized. Be this as it may (for genera are at the best mere arbitrary divisions, depending on the peculiar ideas of individual authors), in dealing with species greater caution is required. The characters which distinguish species are mainly superficial; anatomical variation, though often useful, can only be regarded as accessory; length of limb, form of outline, and superficial sculpture must always form the principal specific factors—colour and size, except when uniformly persistent, are of minor importance.

But, on the other hand, anatomical characters, especially the organs of the mouth and the comparative shape and disposition of the various parts of the external skeleton, must be regarded as the only true generic distinctions.

Such, I believe, are the rules by which generic or specific separations should be regulated. But all these rules seem to have been disregarded in the nomenclature of the Trichopterygidæ with which Dr. Flach concludes his essay.

Before entering into a detailed examination of this nomenclature I must premise that in my own collection there are authentic types from the collections of M. Allibent and Col. Motschulsky of the greater number of the species described by those authors, together with types of their own species kindly presented to me by Dr. Aubé, MM. C. Brisout de Barneville, Fairmaire, Reiche, Thomson, Hampé, and other friends, so that I may fairly consider that I am in a position to speak with some amount of accuracy on their respective merits; and with these preliminary remarks I will now turn to the unwelcome task of examining the nomenclature of the Trichopterygidæ published by Dr. Flach.

The first genus in this list which requires notice is *Ptenidium*, divided in the following manner into four subgenera:—

PTENIDIUM, Erichson.

Matthewsium, Flach.

- *ovulum*, Flach.
- *Gressneri*, Gillm.
- *Lederi*, Flach.
- *lævigatum*, Gillm.
  - *atomaroides*, Matth., ex typ.
  - *Bruckii*, Matth.
- *turgidum*, Thoms.

Wankowiezium, Flach.

- *intermedium*, Wank.
  - ? *Wankowiezii*, Matth.
  - Var. *Weisëi*, Flach.
- *Brenskei*, Flach.

Ptenidium.

- *Pensigi*, Flach.
- *turgidulum*, Flach.
- *fuscicorne*, Erichs.
  - *picipes*, Matth.
  - *obscuricorne*, Mots.

laticolle, Hochh.
Heydeni, Flach.
myrmecophilum, Mots.
    formicetorum, Kraatz.
    Kraatzii, Matth.
pusillum, Gyll.
    apicale, Erichs.
    evanescens, Marsh.
    punctatum, Mots.
    terminale, Hald.
  Var. *corpulentum*, Lucas.
  Var. *atomaroides*, Mots.
  Var. *maroccanum*, Flach.
Brisouti, Matth.
    nitidum, Bris.
    evanescens, Mots.
  Var. *longicorne*, Fuss.
  Var. *orientale*, Flach.
obotritis, Flach.
punctatum, Gyll.
    alutaceum, Gillm.
    littorale, Mots.

Gillmeisterium, Flach.

nitidum, Heer.
    pusillum, Erichs.
    4-*foveolatum*, Allib.
    minutissimum, Steph.
  Var. *insulare*, Flach.
  Var. *Matthewsii*, Flach.
    lævigatum, Gillm.
    punctatum, Steph.
Reitteri, Flach.

If the characters on which these subgenera are founded result in the combination of such miscellaneous groups as those exhibited in the foregoing list, they must be radically false and deceptive. *P. Gressneri* shows the most striking dissimilarity in form and outline to every other species of *Ptenidium*, unless it be to Dr. Flach's new species, with which I am unacquainted. *P. lævigatum*, Gillm., is very closely allied to *P. nitidum*, Heer. My own description of this species was made from an example presented to me by Dr. Aubé, which had been verified by Gillmeister himself, and therefore authentically typical. *P. atomaroides* (whether assigned to myself or to Col. Motschulsky) can be associated with no other than *P. evanescens*. If by the words "ex typ." (appended to this name in his list) Dr. Flach means to insinuate that he received the type from myself, I can only say that I never sent an example of any species whatever to Dr. Flach, although I have offered to do so, and I positively decline to be considered responsible for mistakes made by other people. But the expression "ex typ." may account for many of the errors of nomenclature contained in this list. I have myself suffered from the careless manner in which specimens are often named and then distributed as types of certain species; and the same misfortune may have, and probably has, happened to Dr. Flach. *P. Bruckii* is conspicuously distinct from all its congeners. *P. turgidum* I described from a type I received from M. Thomson; it is allied to *P. formicetorum* alone. In his next subgenus Dr. Flach has placed *P. intermedium*, Wank.; but this is so closely allied to *P. evanescens*, Marsh., that it seems strange to have placed them so widely apart.

Of the ten species contained in his subgenus *Ptenidium* four are introduced by Dr. Flach himself, and are all unknown to me; but throughout the *Ptenidia* it would be difficult to find among the older species five more totally dissimilar than those which he has grouped together in this division, namely, *P. fuscicorne*, *formicetorum*, *evanescens*, *Brisouti*, and *punctatum*. In his last subgenus, *Gillmeisterium*, Dr. Flach has placed but two species, *P. nitidum* and *P. Reitteri*; the synonymy assigned to the former of these is, as far as I can judge, correct, with the exception of *P. lævigatum*, Gillm. I need not repeat again what I have said only a few lines above respecting this species, but, should any doubt exist, must refer its solution to the description and figure given by Gillmeister himself or to those in the 'Trichopterygia Illustrata."

The genus *Euryptilium* is placed next in succession, and in this genus Dr. Flach has included *Ptilium marginatum*, Aubé. It seems to me that Dr. Flach is right in adding this species to *Euryptilium*, for the apex of the elytra is entire and its whole form and sculpture very similar.

Among the *Ptilia* the subdivisions and the combination of species become more numerous and still more perplexing. In his first subgenus Dr. Flach places *P. Kunzei* alone, but amalgamates under that name *P. brevicolle*, whose thorax is one half shorter, and *P. rugulosum*, which has long and slender antennæ and exhibits striking differences in outline and sculpture. The next subgenus, *Trichoptilium*, contains but one species, *T. Sahlbergi*. The figure of this insect (pl. xi. fig. 3) clearly proves that it cannot possibly be included in any part of the genus *Ptilium*, since its thorax overlaps the shoulders of the elytra, a formation hitherto only found in *Actidium* and *Microptilium*. Then follows the subgenus *Typhloptilium*, containing *T. exilipes* and two others unknown to me. From types received from Herr Reitter *T. œdipus* is identical with a species which I formerly described under the name of *Ptilium obcæcatum*. I would at that time have willingly separated this species from *Ptilium*, but could find no distinct generic difference, and did not consider the rudimentary condition of its eyes to be of itself sufficient. The next subgenus, *Ptiliolum*, commences with *P. oblongum*, a name long ago superseded by *Spencei*, Allib., and to this are added as synonyms *Foersteri* and *fuscipenne*; the latter of these is the type (received from Prof. Foerster) from which I described *P. Foersteri*. Dr. Flach then makes *P. angustatum*, Erichs., into a distinct species, although he had just before quoted that name as a synonym of *P. oblongum*, and finishes *Ptiliolum* with two new species. The last subgenus of this group is *Euptilium*, containing *croaticum*, *caledonicum*, and one new species. Then having inserted the genus *Actidium* in the most unintelligible manner among the normal *Ptilia*, Dr. Flach appropriates Motschulsky's name *Oligella* for the purpose of forming a genus to receive *P. foveolatum* alone. To this succeeds the absurd introduction of Motschulsky's *Micridium vittatum* among some of the most normal species of *Ptilium*. The shape and length of the posterior legs is alone sufficient to separate *Micridium* by a long interval from *Ptilium*, without entering at all into the numerous anatomical differences which exist between those two genera. But this is not all; Dr. Flach has incorporated with *Micridium vittatum* two almost normal species of *Ptilium*, *P. Halidaii* and *P. angulicolle*, which resemble *Micridium* in the transparency of their elytra and in that alone. Then, after the intercalation of *Millidium*, Dr. Flach proceeds to enumerate the remaining *Ptilia* as species of his subgenus *Ptilium*.

I have now examined in detail the whole arrangement of the Ptiliina; to proceed in the same way through the Trichopterygina would but entail the constant repetition of similar remarks and prove wearisome to the reader. The same confusion of synonymy pervades the whole list; it is very conspicuous in *Ptinella* (Neuglenes), but seems to reach its climax in *Trichopteryx*.

I fully believe that Dr. Flach's new species are true and genuine, the characteristic portraits of those which he has figured speak for themselves; but, if I can judge by types of some others received from Herr Reitter, the differences on which they have been separated are far less distinguishing than those which exist between many species unceremoniously grouped together by Dr. Flach as mere synonyms; and in what way to account for the synonymy exhibited in his list is far beyond my comprehension.

I have myself long passed the conventional term of human life, and would gladly welcome the appearance of any one who would carry on the work which has been my study for more than fifty years, but not in such a fashion as this.

Gumley, Market Harborough,
March 1892.

LXVI.—*Descriptions of some new Species of Asiatic* Saturniidæ. By F. Moore, F.E.S.

1. *Antheræa pulchra.*

Male.—Varied with ochreous red on the basal area, orange-yellow along the apical border, and olive-grey on hind margins, the outer borders olive-grey; ocelli oval, with thick black outer ring, slightly protuberant at upper and lower end of the cell; submarginal band dark red, very slightly white-bordered; subbasal bands prominent, black; two transverse discal, dusky ochreous-brown, lunular fasciæ, both clouded anteriorly on the fore wing and blackish on the hind wing, the inner discal fascia being very narrow and the outer one broad.

Female.—Varied deep orange-brown; with two darker discal fasciæ as in the male; outer borders paler; submarginal band broad, with prominent white border; ocellus of fore wing protuberant at upper and lower end of the cell, the black border thickened at the lower protuberance; ocellus of hind wing less protuberant.

Expanse $5\frac{3}{4}$ inches.

Hab. Satara Hills, Bombay (*Coussmaker*).

A larger insect than the three following: distinguishable from them in the male by the broader dusky outer discal band and much narrower inner discal fascia, the latter crossing the wing outside the cell on both wings; the interspace between the subbasal dusky band and the submarginal band is also wider.

2. *Antheræa fasciata.*

Male.—Pale brownish ochreous; discal area slightly tinted with reddish ochreous, apical border yellowish ochreous, outer borders pale olive-brown; submarginal band dusky pink and slightly whitish-bordered; ocelli small, bluntly oval; subbasal bands, outer discal lunular band on fore wing, and discal encircling wavy band on hind wing prominently blackish; a suffused discal fascia across both wings.

Female.—Deep ochreous yellow, brightest across the disk, outer border much paler, submarginal band dusky red, narrow, and broadly white-bordered; ocelli large, oval; discal bands as in the male, prominently black.

Expanse, ♂ $4\frac{3}{4}$, ♀ $5\frac{1}{4}$ inches.

Hab. Satara Hills, Bombay (*Coussmaker*).

Distinguishable by its somewhat woolly appearance, especially observable in the female, the male having a prominent broad, dusky, lunular outer discal band on the fore wing and a prominent similar encircling discal band on the hind wing, the latter approaching nearer to the ocellus.

3. *Antheræa olivescens.*

Male and female.—Pale olive-brown, the outer borders paler; submarginal band deep purple-red, bordered with pinkish white, that on the fore wing sinuous; ocelli bluntly oval, the black ring thick in the female; subbasal band pinkish brown, white inner-bordered; a darker olive-brown suffused discal fascia crossing both wings, and a similar coloured narrower lunular fascia contiguous to the submarginal band.

Expanse $5\frac{1}{4}$ inches.

Hab. Satara Hills, Bombay (*Coussmaker*).

4. *Antheræa ochripicta.*

Male.—Reddish ochreous, with paler olive-grey borders; subbasal and submarginal band deep red, the latter slightly white-bordered; ocelli small, almost circular, talcose centre small.

Female.—Ochreous or orange-yellow, brightest across the disk; the base pale greyish ochreous; subbasal band ochreous red; submarginal band pink, prominent white-bordered.

Expanse, ♂ $4\frac{3}{4}$, ♀ 5 inches.

Hab. Satara Hills, Bombay.

Smaller than *A. olivescens.* In the male the outer discal dusky lunular band is further from the submarginal band.

Reared from cocoons received in 1874 from Capt. G. Coussmaker.

5. *Antheræa versicolor.*

Male. — Varied deep ochreous brown; outer borders ochreous, tinged with olive; ocelli oval ($\frac{4}{12}$ in. in diameter and $\frac{6}{12}$ in length), talcose centre large; submarginal red band broad, the white outer border narrow on the fore wing and broken into dentate marks on the hind wing; an indistinct dusky subbasal band, a medial discal and contiguous lunular fascia on the fore wing. Hind wing with an indistinct dusky subbasal band extending close to and round the ocellus to the anal margin.

Female.—Ochreous or greyish brown; ocelli large, oval ($\frac{5}{12}$ in. in diameter and $\frac{8}{12}$ in length); discal area dusky brown; submarginal red band broad and broadly pink-white bordered; the discal encircling dusky band prominent and touching both upper and lower ends of the ocellus.

Expanse, ♂ 5, ♀ $5\frac{1}{2}$ inches.

Hab. Purulia, Maumbhoom, W. Bengal.

Of smaller size than either *A. mylitta* or *A. nebulosa* (of which latter species I have Hutton's typical specimens), and is distinguished by having a different shaped ocellus, the male having the submarginal red band much nearer to the ocelli and the encircling discal dusky band on hind wing touching the ocellus.

6. *Antheræa Hartii.*

Male and female.—Upperside dark purplish ochreous-brown, the base of the wings and the body being more or less reddish brown; both wings with a rounded ocellus of from two tenths to three tenths of an inch in diameter, encircled by a blackish line, with the centre talcose, the outer half being chrome-yellow and the inner half purplish red, the latter colour also extending more or less paler round the outer yellow half; crossing the middle of the wing is a more or less blackish wavy shade, which imperceptibly passes through the ocelli, and an oblique blackish, rather straight submarginal line extends halfway between the margin and the ocellus on the fore wing and at three fourths on the hind wing, this line in the female being exteriorly purplish-bordered and slightly grey-speckled towards the apex of the fore wing; in the female also the base of the costal border is likewise slightly grey-speckled; in some specimens of the female the outer border of the hind wing is almost entirely covered with chrome-yellow scales, these yellow scales also being scattered on the border of the fore wing; cilia deep chrome-yellow.

Expanse of wings $4\frac{1}{2}$–$4\frac{3}{4}$ inches.

Hab. Newchwang, Manchuria, N. China. In Coll. Moore.

The adult larva of *A. Hartii* (in alcohol) is 4 inches in length. Colour green, with two dorsal rows of short hairy tufts composed of a few fine divergent hairs, and two lateral rows of smaller similar tufts, one being on each segment in each series, and the two dorsal tufts on the third and fourth segment on slightly raised prominences; a smaller tuft also on each of the fore legs; at the base of the anterior tufts and the dorsal and lateral tufts is usually a sparkling gilt spot; the feet, underside, and front of head also slightly hairy; head with black spots in front and a lateral upward streak; front legs with black streaks and pads on the middle, and hind legs also black; spiracles narrow, blackish. Cocoon pale ochreous white, attached by a long slender peduncle to a twig of the food-plant, and partly enveloped with the leaves.

The natives rear the larva, in a semi-domesticated state, on oak trees, it being stated that two broods are obtained within the year.

Named after Sir Robert Hart, through whose interest specimens were collected and forwarded to Mons. Natalis Rondot.

7. *Antheræa borneensis.*

Female.—Upperside dark ochreous yellow. Fore wing with grey-speckled costal border; a prominent ordinary narrow, outer discal, transverse, blackish band with white-speckled pink outer border; a broad, very bluntly ovate ocellus with small talcose centre, the inner half of the ocellus being light red, with traversing incurved white line, the outer half greyish purple and externally edged by a black line, which is slightly thickened at its upper end and then extends to the costal vein; a subbasal, transverse, indistinct, slender, nearly erect pale red line, and a darker similar short line crossing the cell; a red broad streak also within the cell from near its base and extending beyond the transverse line; a narrow, indistinct, darker ochreous fascia crossing the middle of the wing and passing through the outer edge of the ocellus. Hind wing with a similar very bluntly ovate ocellus having a talcose centre, and the upper end of its black outer line terminating in a large yellow-centred longitudinal streak; a prominent outer discal, narrow, transverse, blackish band as on fore wing, extending close to the ocellus; a red, narrow, subbasal angulated line from inner margin extending above and round the upper part of the ocellus; a darker ochreous medial fascia from below the ocellus to inner margin. Thorax grey-speckled; head, antennæ, and legs dark ochreous; eyes brownish; thorax and abdomen ochreous yellow.

Expanse $6\frac{1}{2}$ inches.

Hab. S. Borneo. In coll. F. Moore and Singapore Museum.

This species is nearest allied to *A. Helferi*, the female of *borneensis* differing on the fore wing in the more prominent transverse outer discal line, a larger ocellus having a talcose centre (the ocelli in *Helferi* being blind), in the red dash within base of the cell, and in the darker ochreous indistinct middle fascia extending across the wing through the outer edge of the ocellus (in *Helferi* it extends midway between the ocellus and discal line). On the hind wing *borneensis* also differs in the prominent outer discal line, larger and talcose-centred ocellus, and the medial dark ochreous fascia (not present in *Helferi*). From the allied *A. yamamai* of Japan, the female *borneensis* differs on the fore wing in the less obliquity of the outer discal line, differently shaped ocellus, the red dash at base of the cell, and different position of the medial ochreous fascia (which in *yamamai* extends through the middle of the ocellus); on the hind wing in the different curvature of the outer discal line and smaller as well as different-shaped ocellus.

8. *Antheræa Ridlyi.*

Female.—Upperside with the inner area dark ochreous yellow, clouded with reddish ochreous, the outer borders broadly dark purplish brown. Both wings have a large rounded ocellus with a broad talcose centre, the inner border of the ocellus being crimson with white traversing line, the outer border olive-brown, the encircling line black and that on the fore wing thickened at base of the subcostal branch; crossing the discal area are two reddish-black sinuous lines, the inner line broadest and touching the ocelli; a medial broad fascia and two subbasal angulated fasciæ; costal border of the fore wing and front of thorax grey-speckled; head, body, and legs reddish ochreous; antennæ brown.

Expanse, ♀ $5\frac{5}{8}$ inches.

Hab. North Borneo. In coll. F. Moore and Singapore Museum.

This species is allied to *A. larissa* (Westwood, 'Cabinet of Oriental Entomology,' pl. xxiv. fig. 1) of Java. It is distinguishable from the same sex of that species by the very considerable darker colour, broader transverse sinuous markings, and larger ocelli.

9. *Antheræa surakarta.*

Male.—Upperside pinkish brownish-ochreous. Fore wing with grey-speckled costal border; with a broad suffused brownish-ochreous anterior shade before the apex; a narrow dusky excurved subbasal line, a short incurved similar line crossing the cell near its base, an oblique inner discal similar line commencing from below the apex, which is lunular anteriorly and sinuous posteriorly; beyond this line is a conspicuous ordinary pink-bordered, dusky, discal line, which is almost straight; ocellus small and bluntly oval, a quarter of an inch in vertical diameter, outwardly lined with black, the talcose centre being narrow. Hind wing with an indistinct dusky angulated subbasal line, which almost imperceptibly curves below the anterior margin and returns sinuously across the discal area, beyond which is an indistinctly defined ordinary pink-bordered, sinuous, outer discal line; ocellus small, one quarter of an inch in vertical diameter, rounded, talcose centre very minute.

Female.—Upperside ochreous yellow; costal border grey-speckled. Fore wing with a pale whitish-bordered subbasal line and an outer discal, whitish-bordered, slender, pinkish line; an indistinct darker ochreous narrow shade crossing the middle of the wing through the ocellus; the ocellus very large, irregularly elongated outwardly, three quarters of an inch in longitudinal length, brownish ochreous, black-lined outwardly, talcose centre large and longitudinally oval, and crossed by the discocellular veinlet. Hind wing with a darker ochreous narrow shade crossing the middle; outer discal pinkish line with narrow lunulated outer border; ocellus longitudinally bluntly oval, ochreous brown, with oval talcose centre and black outer line. Body ochreous yellow; collar grey; head and front legs bright ochreous yellow; antennæ reddish ochreous.

Expanse, ♂ 5, ♀ 6 inches.

Hab. Java (*Horsfield*). Type in coll. British Museum.

LXVII.—*British Schizopoda of the Families* Lophogastridæ *and* Euphausiidæ. By the Rev. Canon A. M. Norman, M.A., D.C.L., F.R.S., &c.

In Bell's 'History of British Stalk-eyed Crustacea' a single species of these families was described which had been found by Couch in the stomach of a mackerel at Polperro. It was named *Thysanopoda Couchii*, Bell, and is the *Nyctiphanes Couchii* of the present paper.

In 1861 I briefly described in the Brit. Assoc. Report, from Shetland, *Ctenomysis alata*, Norman, which is the *Lophogaster typicus* of M. Sars.

In 1868 I recorded in the "Last Report of Shetland Dredging" (Brit. Assoc. Report) *Thysanopoda norvegica*, M. Sars, = *Nyctiphanes norvegica* of this paper. The younger specimens there referred to subsequently proved to be referable to *Thysanoessa neglecta*, Kröyer.

In 1872 Mr. G. Sim recorded in the 'Scottish Naturalist,' as found at Aberdeen, *Rhoda Jardineana*, Sim (= *Boreophausia Raschii*, M. Sars), *Thysanoessa aberdonensis*, Sim (= *Thysanoessa neglecta*, Kröyer), and under a name *Thysanoessa borealis*, Norman (non G. O. Sars, 1882) the *Nematoscelis megalops* of the present paper. Mr. Sim wrote:—"This species [*T. aberdonensis*] is found in considerable abundance on our sandy beach in the months of March and April, along with *T. borealis*, a species named by the Rev. A. M. Norman, for the identification of which I am much obliged to that gentleman. The principal difference between *T. borealis* and *T. aberdonensis* is in the first pair of feet, which in *T. borealis* are terminated with from eighteen to twenty long sharp spines, all proceeding from the extremity of the limb, while in *T. aberdonensis* eighteen spines are arranged along the sides of the last segment of that member, and two more placed on the wrist. The body and rostrum also differ in the two species." Mr. Sim here greatly exaggerates the number of spines at the extremity of the limb, which are (usually) eight; but one of my mounted specimens might well be mistaken to have sixteen, since the animal being about to cast its skin, the whole of the new spines are seen within the old ones, and would easily deceive in such a mounted specimen if the observer was not prepared for the deception. In consequence of this inaccuracy with respect to the number of spines it appears to me that the specific name *T. borealis* must yield to the later name *Nematoscelis megalops*, G. O. Sars.

In 1887 Professor M'Intosh first recorded *Thysanoessa tenera*, G. O. Sars (= *T. longicaudata*, Kröyer), as British (Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 140).

Lastly, *Boreophausia inermis*, Kröyer, was first published as British by Messrs. Brook and Hoyle in their paper "On the Metamorphoses of British Euphausiidæ" (Proc. Roy. Soc. Edinb. 1888, p. 414).

Such were the first records of the species of Lophogastridæ and Euphausiidæ which at the present time are known to live in our seas. As there is no account of them in any English work, and I consequently have specimens frequently sent to me to name, I have thought it desirable to write the following notes on this interesting group of oceanic Crustaceans, which are found either as surface swimmers or in deep water at some distance from land.

The descriptions of the families are in great measure condensed and slightly modified from the works of G. O. Sars.

Synopsis of Families, Genera, and Species.

Suborder SCHIZOPODA.

Legs furnished with exopodites used for swimming. In rare instances the first pair of legs formed for prehension, more usually this pair, as all the remaining legs, are simple. Ova borne below the carapace between the posterior pair or pairs of legs, usually enclosed in a marsupial sac formed by leaf-like processes which are developed from the base of the legs.

Fam. I. **Lophogastridæ.**

Maxillipeds robust; the exopodite imperfectly developed, consisting of a single joint; the epipodite very large and projecting within the branchial cavity. First legs with terminal joint obtusely rounded, and densely hirsute; remaining legs having a well-developed nail. Branchiæ arborescent, complex, the largest branch freely projecting beneath the body, the remaining branches concealed by the carapace. Marsupium composed of seven pairs of plates. Caudal limbs (pleopods) well developed in both sexes. No phosphorescent organs. Inner uropods not furnished with an auditory apparatus at their base. Telson very large, in general form as in the Macrura.

Fam. II. **Euphausiidæ.**

Maxillipeds elongate, pediform; exopodite well developed, epipodite rudimentary or wanting. Legs without dactylus, posterior pairs more or less imperfectly developed. Branchiæ wholly exposed to view. Egg-pouch, when present, not formed of plates attached to bases of legs. Caudal limbs (pleopods) well developed in both sexes. Phosphorescent organs present at the bases of the first and of the penultimate legs and also on the abdomen between the pairs of pleopods*. Inner uropods not furnished with an auditory apparatus at their base. Telson very slender and tapering to an acute point, giving off on either side at a short distance from the extremity a very large spine-formed process, which extends far beyond the end of the telson itself.

Fam. III. **Mysidæ.**

Maxillipeds strong, with exopodite well developed, natatory, and the epipodite lanceolate and projecting within the branchial cavity. First legs differing from the following, used as gnathopods; remaining legs slender, usually without, rarely with, a terminal nail. No true branchiæ present. Marsupial pouch usually composed of two or three pairs † of leaf-like processes springing from the hinder pairs of legs. Pleopods in female small and rudimentary, in male natatory and often remarkably modified to assist in copulation. Inner uropods with an auditory apparatus at the base. No phosphorescent organs. Telson very variable in form, but never as in the Euphausiidæ.

Fam. I. **Lophogastridæ.**

Genus Lophogaster, M. Sars.

Carapace tridentate in front, the lateral teeth as much developed as the central, this portion of carapace advanced in front of the eyes, the peduncles of which are completely concealed by it, and the eyes themselves are protruded on either side. Peduncle of

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* The genus *Bentheuphausia* is, however, not furnished with these organs.

† In the genus *Boreomysis* there are seven pairs.

antennules remarkably broad and flattened, their inner flagella small, the outer greatly developed. Antennal scale broadly triangular, breadth subequal to length; inner margin ciliated, outer not ciliated, serrated on the edge, serrations four to six. All the legs biramose as in other Schizopoda. Telson very large and much longer than the uropods; extremity narrowly truncate, with a strong spine at each corner, between which the termination is serrated and furnished with two setæ. Outer uropods one-jointed .... *L. typicus.*

Fam. II. Euphausiidæ.

All the legs subequal .... A.
First legs much longer than the rest.................. B.

A.

Basal joint of antennules furnished at the extremity with an erect, conspicuous, leaf-like appendage .... *Nyctiphanes.*

Basal joint of antennules without any erect leaf-like appendage at the extremity .... *Boreophausia.*

B.

The long first legs having the two terminal joints armed with spiniform setæ on both margins .... *Thysanoessa.*

The long first legs greatly produced and very slender, last joints naked (without any lateral setæ), the extremity terminating in a bunch of greatly developed porrected spines, these spines serrated .... *Nematoscelis.*

Genus Nyctiphanes.

A spine on side of carapace behind the middle. Rostrum nearly obsolete, ocular lobes of carapace produced into spine-like points. No dorsal spine over base of telson .... *N. norvegica.*

No lateral spines on carapace. Rostrum distinct, shortly triangular, lobes of carapace over eyes not at all produced. A dorsal spine over base of telson .... *N. Couchii.*

Genus Boreophausia.

Rostrum narrow, about as long as first joint of antennules; no spine on the sides of the carapace; a spine over the base of the telson; telson longer than uropods.. *B. inermis.*

Rostrum triangular, shorter than first joint of antennules; a spine on each side of the carapace in front of the middle; no spine over the base of the telson; telson subequal to or rather shorter than uropods .... *B. Raschii.*

Genus Thysanoessa.

No spine on side of carapace. Antennal scale elongated and narrow, the extremity bluntly but narrowly rounded. First joint of antennules shorter than combined length of the two following joints. A spine over the base of the telson .... *T. neglecta.*

No spine on side of carapace. Antennal scale elongated and very narrow, inner margin gradually sloping to meet the outer, with which it unites at a terminal point. First joint of antennules longer than combined length of two following joints. No spine over the base of the telson...................... *T. longicaudata.*

Genus Nematoscelis.

No spine on sides of carapace. Eyes very large, constricted across the middle. First legs longer than the body in adult .... *N. megalops.*

A species has been found on the Norwegian coast—*Euphausia pellucida*, Dana (=*E. bidentata*, G. O. Sars)—which will probably be also met with in our own seas. It may at once be distinguished from all the foregoing by these characters:—

Two spines on each side of the carapace, one about the middle and the other behind it. Antennal scale broad and widely truncated at the extremity. First joint of antennules furnished with a leaf-like lappet (smaller than in *Nyctiphanes*) which is cut into two or many digital processes. The ventral preanal spine is *trifid.*

In the following list the words *Mus. Nor.* (Museum Normanianum) indicate that specimens from *all* the localities and collectors cited in the sentence preceding are in my collection. For instance, examples of *Lophogaster typicus* are in my possession from all the localities given except "South of Cape of Good Hope."

Synonymic List, with Habitats.

Suborder SCHIZOPODA.

Fam. I. **Lophogastridæ.**

Genus LOPHOGASTER, M. Sars, 1856, = *Ctenomysis*, Norman, 1861.

Lophogaster typicus, M. Sars.

1856. *Lophogaster typicus*, M. Sars, Forhand. Skand. Naturf. Möde i Christiania, p. 160.
1862. *Ctenomysis alata*, Norman, Brit. Assoc. Rep. for 1861, p. 151.
1862. *Lophogaster typicus*, M. Sars, Christiania Universtetsprogram (Besk. over *Lophogaster typicus*, en mærkværdig form af de lavere tiföddede Krebsdyr), pp. 1–37, pls. i., ii., iii.
1869. *Lophogaster typicus*, Norman, "Last Report Shetland Dredging," Brit. Assoc. Rep. for 1868, p. 265.
1885. *Lophogaster typicus*, G. O. Sars, Report 'Challenger' Schizopoda, p. 14, pl. i. figs. 1–7.

Shetland, 1861 and 1868 (*A. M. N.*); 'Porcupine' Exped., 1869, Stat. 6 and 11 off S.W. of Ireland, in 90 and 1630 fath., Stat. 67 and 68 East of Shetland, 64 and 75 fath.: *Mus. Nor.*

Distribution. Bergen and Hardanger Fiords, Norway (*A. M. N.*); Fosse de Cap Breton, Bay of Biscay, 35–60 fath. (*A. M. N.*); Messina (*Zool. Stat. Naples*): *Mus. Nor.* South of the Cape of Good Hope, 98–150 fath., 'Challenger' Stats. 141, 142 (*G. O. Sars*).

Fam. II. **Euphausiidæ.**

Genus 1. NYCTIPHANES, G. O. Sars, 1883.

1. *Nyctiphanes norvegica* (M. Sars).

1856. *Thysanopoda norvegica*, M. Sars, Forhand. Scand. Naturf. Möde i Christiania, p. 169.
1863. *Thysanopoda norvegica*, M. Sars, "Om Slægten *Thysanopoda* og dens Norske Arter" (Christ. Vidensk. Forhand.), p. 2 (separate copy).
1863. *Thysanopoda nana*, id. ibid. p. 15 (junior).
1863. *Thysanopoda norvegica*, Goës, "Crust. decap. podoph. marina Sueciæ &c." (Œfvers. Vet.-Akad. Förh.), p. 13 (separate copy).
1866. *Thysanopoda norvegica*, G. O. Sars, Beret. Sommeren 1865 foretagen Zool. Reise, &c., p. 15.
1869. *Thysanopoda norvegica*, Norman, "Last Report Shetland Dredging," Brit. Assoc. Rep. for 1868, p. 265.
1874. *Thysanopoda norwegica*, Buchholz, Zweite deutsche Nordpolarfahrt, vol. ii. p. 285.
1879. *Thysanopoda norvegica*, S. I. Smith, "Stalk-eyed Crust. Atlantic Coast of N. Amer.," Trans. Connec. Acad. vol. v. p. 89.

1882. *Thysanopoda norvegica*, G. O. Sars, Oversigt af Norges Crust. i. p. 50.

1883. *Nyctiphanes norvegica*, G. O. Sars, "Prelim. Notices on Schizopoda of 'Challenger'" (Christ. Vidensk. Forhand.), p. 24 (separate copy).

1886. *Nyctiphanes norvegica*, Norman, Report Scotch Fishery Board, p. 157; and Ann. & Mag. Nat. Hist. ser. 5, vol. xix. 1887, p. 92.

Shetland, 1861; off Valentia, Ireland, 1870; Loch Fyne, 1855 (*A. M. N.*); Banff (*T. Edward*); Firth of Clyde (*D. Robertson*); East Scotland (*Prof. Ewart*); Moray Firth (*F. Scott*); Loch Goil, Loch Long (*Dr. J. Murray*): *Mus. Nor.* Firth of Forth (*J. B. Henderson*).

Distribution. Norway (*M. Sars*); Bay of Biscay (*A. M. N.*); off coast of Portugal, taken by Mr. Davidson in 'Porcupine,' 1870; 'Porcupine,' 1869, Stat. 64, lat. 61° 10′ N., long. 2° 21′ W.; Faroe Channel, 'Triton' Exped., 1882 (*Murray*); off Eastport, N.E. America (*S. I. Smith*): *Mus. Nor.* Lat. 75° N., long. 12° E. (*Goës*); off the Naze (*Metzger*); in great abundance off N.E. America and in Gulf of St. Lawrence (*S. I. Smith*).

2. *Nyctiphanes Couchii* (Bell).

1853. *Thysanopoda Couchii*, Bell, Hist. Brit. Stalk-eyed Crust. p. 246.

Polperro, Cornwall, stomachs of mackerel (*R. I. Couch*); Cornish coast, 1881 (*Dr. Day*); Polperro (*W. Laughrin*); Banff (*T. Edward*); off Valentia, Ireland (*A. M. N.*): *Mus. Nor.*

Nyctiphanes Couchii is quite distinct from *N. norvegica*, and specimens from all the above sources agree in the characters I here give to distinguish it from the latter species.

Nyctiphanes norvegica.—A spine on each side of the carapace behind the middle. Rostrum scarcely developed, so short as to leave the base of the eye-stalks exposed. Lobes of carapace over the eyes drawn out into slender spine-like points, these points projected as far as, or further forward than, the rostral lobe. No spine over the base of the telson.

Nyctiphanes Couchii.—A much smaller and more delicate species, usual length about 13 millim. No lateral spines on carapace. Rostrum more developed than in *norvegica*, in shape broadly and bluntly triangular, concealing the base of the eye-stalks; lobes of carapace over the eyes not produced. A spine over the base of the telson as well as a small ventral preanal spine. In the male, of which some examples occurred at Banff, the antennules, in addition to the usual reflexed membranous leaflet of the first joint, have another reflexed membranous leaflet at the end of the second joint of the peduncle, the distal portion of the leaflet being cut into digitated processes*.

Nyctiphanes Couchii is very like *N. australis*, G. O. Sars ('Challenger' Report, p. 115, pls. xx. and xxi. figs. 1–7), except that in the former there is a spine at the base of the telson and a small preanal spine, which are absent in the latter. The male also of *N. Couchii* agrees most closely with *N. australis* in the form of the hinder margin of the carapace and the sexual developments of the pleopods (*vide* 'Challenger' Report, pl. xxi. figs. 3, 4, 6, 7). As regards the first pleopod, the likeness is not merely one of general character, but the serrated edge of the one margin and the single seta of the lateral lobe of the other margin are identical. But with respect to the male antennules, no leaflet corresponding to that of the second joint in *N. Couchii* is described or figured in *N. australis*.

Genus 2. Boreophausia, G. O. Sars, 1883.

(*Vide* Sars, Prelim. Notices Schizopoda 'Challenger' Exped., Christ. Vidensk. Forhand. 1883, p. 11 (separate copy); but I am not aware that the genus has as yet been defined.)

1. *Boreophausia inermis* (Kröyer).

1849. *Thysanopoda inermis*, Kröyer, Voyage en Scandinavie &c., Crust. pl. vii. fig. 2 *a–t*.
1856. *Thysanopoda inermis*, Kröyer, "Monog. Slægten *Sergestes*," Vidensk. Selsk. Skr. 5 Række, vol. iv. p. 294, pl. v. fig. 24.
1879. *Thysanopoda inermis*, S. I. Smith. "Stalk-eyed Crust. Atlantic Coasts N. Amer.," Trans. Conn. Acad. vol. v. p. 91.
1882. *Euphausia inermis*, G. O. Sars, Oversigt &c. (*l. c.*), p. 51, pl. i. fig. 15.
1887. *Boreophausia inermis*, H. J. Hansen, *l. c.* p. 53.

Banff (*T. Edward*); Shetland, 1868 (*A. M. N.*); Moray Firth (*T. Scott*): *Mus. Nor.* Clyde district (*Brook and Hoyle*).

Distribution. West Norway (*G. O. Sars*); Eastport, N.E. America (*S. I. Smith*): *Mus. Nor.* Greenland (*Möller &c.*, fide *H. J. Hansen*); E. America from south of Cape Cod northwards (*S. I. Smith*); Gulf of St. Lawrence, as *T. neglecta* (*J. T. Whiteaves*); Spitsbergen (*Goës*).

* This leaflet is similar in general character to that attached to the *first* joint of the antennular peduncle in the genus *Euphausia*.

2. *Boreophausia Raschii* (M. Sars).

1863. *Thysanopoda Raschii*, M. Sars, "Om Slægten *Thysanopoda*" &c. (Christ. Vidensk. Forhand.), p. 14 (separate copy).
1872. *Rhoda Jardineana*, G. Sim., "Stalk-eyed Crust. N.E. Coast of Scotland," in 'Scottish Naturalist,' p. 6 (separate copy), pl. iv. fig. A.
1882. *Euphausia Raschii*, G. O. Sars, "Oversigt af Norges Crustaceer," i. (Christ. Vidensk. Forhand.), p. 51 (separate copy).
1886. *Boreophausia Raschii*, Norman, Fourth Annual Report Fishery Board of Scotland, p. 156; Ann. & Mag. Nat. Hist. ser. 5, vol. xix. 1887, p. 91.
1887. *Boreophausia Raschii*, H. J. Hansen, "Oversigt over det vestlige Grönlands Fauna af malac. Havkrebsdyr" (Vidensk. Middel. fra den naturh. Foren. i Kjöbh.), p. 53 (separate copy).

Firth of Forth (*J. B. Henderson*); Loch Fyne, 70 fath. (*A. M. N.* in 'Medusa,' 1885); Lochs Goil and Long and between Cumbrae and Bute (*Dr. J. Murray*); East of Scotland (*Ewart*): *Mus. Nor.* Loch Broom (*Brook and Hoyle*); Aberdeen (*Sim*).

Distribution. Norway, Christiania Fiord (*M. Sars*), west coast (*G. O. Sars*); Greenland (*Möller &c.*, fide *H. J. Hansen*); German North Polar Exped. (*Buchholz*).

Genus 3. Thysaonessa, F. Brandt, 1851.

1. *Thysanoessa neglecta* (Kröyer).

1849. *Thysanopoda neglecta*, Kröyer, Voyage en Scandinavie &c., Crust. pl. vii. fig. 3 *a–d*.
1851. *Thysanopoda* (*Thysanoessa*) *longipes*, F. Brandt, in Middendorff's Sibirische Reise, Bd. ii. Th. i. p. 128, pl. vi. figs. 1–14.
1872. *Thysanoessa aberdonensis*, G. Sim, "Stalk-eyed Crust. N.E. Coast of Scotland," in 'Scottish Naturalist,' p. 7 (separate copy), pl. v. figs. 1–8.
1882. *Thysanoessa borealis*, G. O. Sars, Oversigt &c. (*l. c.*), p. 52, pl. i. figs. 16–18.
1887. *Thysanoessa neglecta*, H. J. Hansen, *l. c.* p. 54.

Shetland, 1861 (*A. M. N.*); Aberdeen, 1868 (*G. Sim*); Firth of Forth (*T. Scott*): *Mus. Nor.* Loch Seaforth, N.B. (*Brook and Hoyle*).

Distribution. West Norway (some of Kröyer's types from Copenhagen Museum); Eastport, N.E. America (*S. I. Smith* *): *Mus. Nor.* Western and northern Norway and Finmark (*G. O. Sars*); Siberian coast (*Brandt*); Greenland (*H. J. Hansen*).

* I found a single specimen accidentally mixed with a number of *Boreophausia inermis* which were kindly sent to me by Prof. S. I. Smith. I do not remember that it has been recorded previously from the United States.

2. *Thysanoessa longicaudata* (Kröyer).

1849. *Thysanopoda longicaudata*, Kröyer, Voyage en Scandinavie &c., Crust. pl. viii. fig. 1 *a–f*.
1882. *Thysanoessa tenera*, G. O. Sars, "Oversigt af Norges Crust. i." (Christ. Vidensk. Forhand.), p. 53 (separate copy), pl. i. figs. 18, 19.
1887. *Thysanoessa longicaudata*, H. J. Hansen, "Overs. over det vestlige Grönlands Fauna af malak. Havskrebsdyr" (Vidensk. Middel. fra den naturh. Foren. i Kjöbh.), p. 54 (separate copy).

Thrown up in enormous quantity in St. Andrew's Bay, April 22, 1886, and sent to me by Prof. M'Intosh for determination, who wrote subsequently that this species, together with *Nyctiphanes norvegica*, occurred "so densely that the tidal wave was crowded with them, and miles of sand were strewed with their bodies which the receding wavelets left in streaks and curves" *. In 'The Naturalist' of this month (May 1892) Mr. Thomas H. Nelson, in his 'Ornithological Notes from Redcar,' writes (p. 144):—"February 10th, 11th, and 12th. Attracted by the number of Kittiwakes (*Rissa tridactyla*) to be seen about a mile out at sea, I procured a boat and went off to ascertain the cause of this vast assemblage of gulls; both east and west, as far as the eye could reach, their graceful white forms were visible, many busily engaged dipping into the water and others flying overhead and then darting down to pick up some object from the surface. I shot two or three examples and found that their mouths were full of small Crustaceans, with which the sea was literally alive; heaps of these were afterwards washed ashore by sea-winds, and afforded a feast for starlings and other frequenters of the tidal line." Mr. Nelson sent to me a small bottleful of the Crustaceans for determination. The mass of them were *Euthemisto compressa*, Goës, an Amphipod allied to *Hyperia*, which had not been previously observed on our coast. There were also several examples of *Nematoscelis megalops*, G. O. Sars, and one of *Thysanoessa longicaudata*, Kröyer (*Mus. Nor.*).

Distribution. Greenland, 'Valorous' Exped., Stat. 8; Faroe Channel, 'Triton' Exped., 1882 (*Mus. Nor.*), lat. 59° N., long. 51° W. (*Olrik*, fide *Hansen*). Kröyer's original examples were from lat. 61° N., long. 13° W., and lat. 60° N., long. 11° W. (*Hansen*), Western Norway and Varanger Fiord, Finmark (*G. O. Sars*).

* Ann. & Mag. Nat. Hist. ser. 5, vol. xix. 1887, p. 140.

Genus 4. NEMATOSCELIS, G. O. Sars, 1883.

Nematoscelis megalops, G. O. Sars.

1872. *Thysanoessa borealis*, Norman, MS in Sim, "Stalk-eyed Crust. N.E. Coast of Scotland" ('Scottish Naturalist'), p. 8 (separate copy).
1882. *Nematoscelis megalops*, G. O. Sars, "Prelim. Notices of Schizopoda of 'Challenger' Exped." (Christ. Vidensk. Forhand.), p. 27 (separate copy).
1885. *Nematoscelis megalops*, G. O. Sars, Report 'Challenger' Schizopoda, p. 127, pl. xxiii. figs. 5–10, and pl. xxiv.

Nematoscelis is remarkable on account of the very great length of the first pair of feet, which are even longer than in *Thysanoessa* and differ markedly in character. In mature *Nematoscelis megalops* these legs exceed the length of the body, the meral and two following joints are very long and slender, especially the meros, and at the extremity of the meros the limb is capable of being bent back upon itself. The meros has a row on each side of small nearly appressed spinules and also several falcate-shaped spines, which look as if they might serve the purpose of grasping the propodos when bent back upon the meros. The carpus is quite smooth, the propodos is almost naked, but there are two or three small spinules towards the extremity, and at the extremity are two porrected and greatly developed spines, which, with six other similar spines springing from the last joint (dactylus?), form a remarkable terminal brush to the limb. These eight terminal spines are serrated in a very peculiar spiral manner, and the serrations point backwards. The ventral preanal spine in the Scotch examples is either bifid, as figured by Sars, or simple.

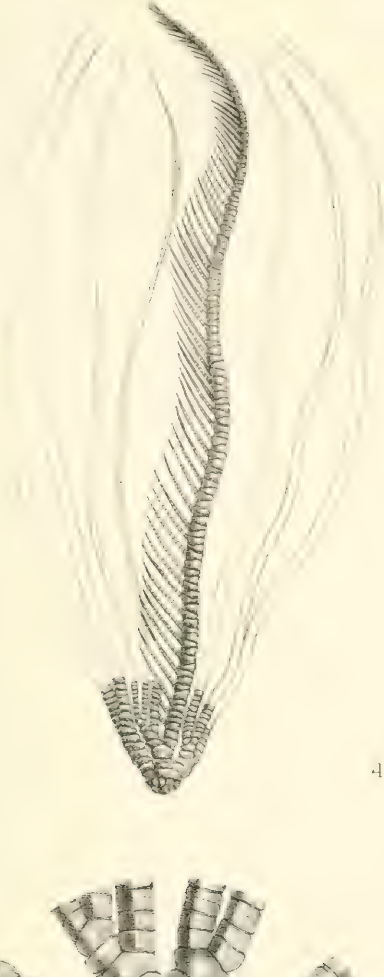
The British examples appear in all respects to agree with Sars's description and figures of *N. megalops*, except that he writes of the first legs that the meros and subsequent joints lack "every trace of marginal bristles, being quite naked throughout, save at the apex." This is not quite correct as regards the specimens I have seen. I think it well for the present to refer these to *N. megalops*; but if the form should hereafter prove distinct my name *N. borealis* can be adopted.

Specimens not full-grown have the first legs shorter than the body, the eyes smaller and with faint traces of bilobation, the antennal scale proportionately shorter, and thus come rather suspiciously near to *N. microps*, G. O. Sars.

Banff, 1862 (*T. Edward*); Aberdeen, 1868 (*G. Sim*); Firth of Forth, 1892 (*T. Scott*); Redcar, Yorkshire, April 1892 (*T. H. Nelson*): *Mus. Nor.*

In the 'Challenger' Expedition *N. megalops* was found in the middle of the South Atlantic on the line between Buenos Ayres and Tristan d'Acunha at Stations 331, 332, and 333. It was also taken in the North Atlantic off Nova Scotia.

1. nat. size



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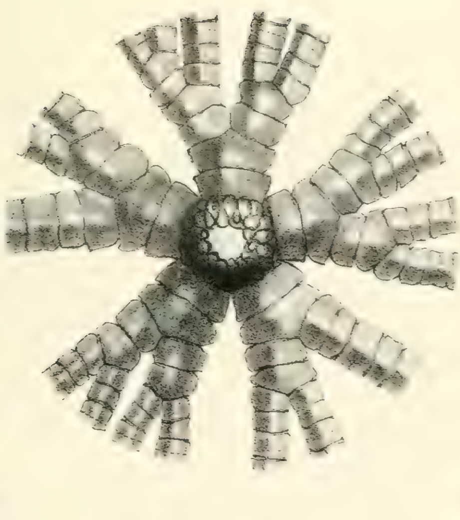


R. J. Mintern del. et lith. Mintern Bros. imp.

Fig. 1.

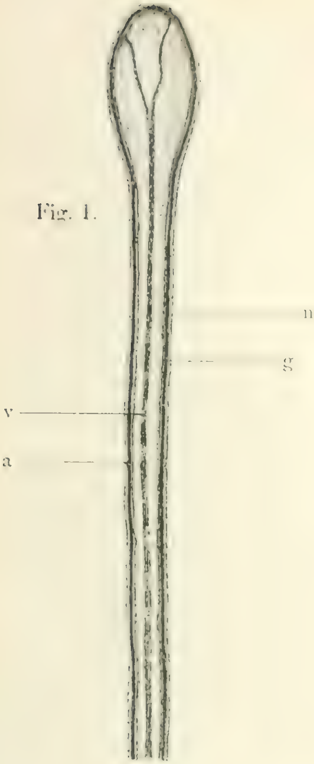
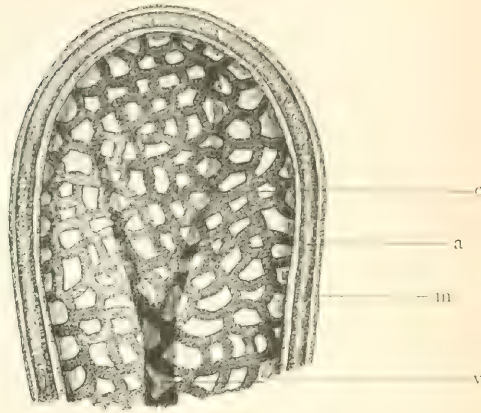


Fig. 2.



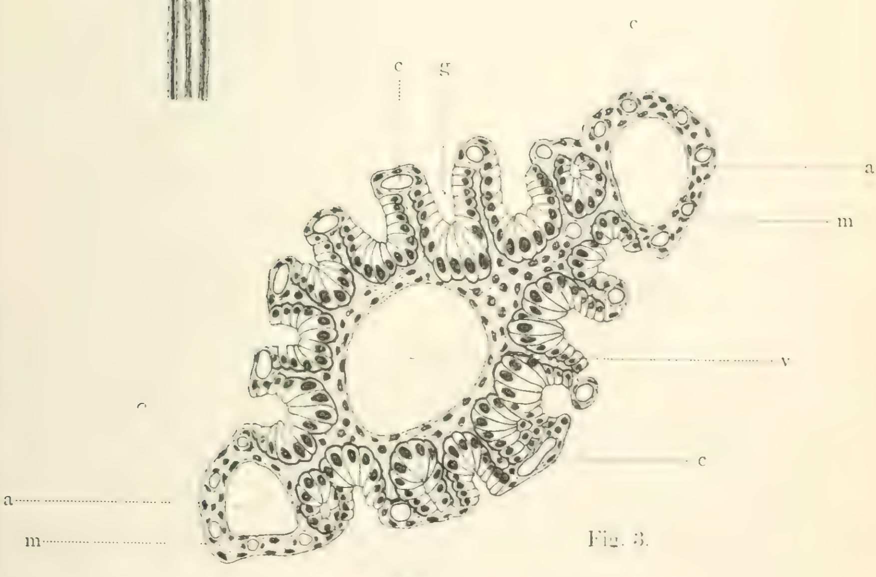


Fig. 3.

TRYGON BLEEKERI.

LXVIII.—*Critical Observations on Frenzel's Mesozoon* Salinella: *a Biological Sketch.* By Prof. STEFAN APÁTHY*.

IN the 'Zoologischer Anzeiger' for 1891, no. 367, pp. 230 *et seq.*†, and in the 'Biologisches Centralblatt,' Bd. xi. pp. 577 *et seq.*‡, Frenzel described a new animal, on which he bestowed the name *Salinella* §. The creature is a tube provided with two apertures—mouth and anus—and its wall consists of a SINGLE LAYER OF CELLS. The cells on the ventral surface are similar to one another and finely ciliate; it is only around the mouth, which is not quite terminal in position, that certain of the cells are provided with stouter cilia. On the dorsal side the cells bear short setæ instead of cilia. The surface of all the cells which is turned towards the intestinal cavity is likewise finely ciliate. Food-particles are found in the intestine in a solid form. Frenzel is led to believe that intracellular digestion does not take place.

By the discovery of *Salinella* our store of facts received a very material addition, since the creature in question, as it appears to me, serves to a certain extent to fill the gap between *Volvox* and *Trichoplax*. For the comprehension of the most primary forms of multicellular life *Salinella* seems more important than the Orthonectids and Dicyemids, in which we find a genealogical stage, certainly a very ancient one, at the best merely restored by parasitism as a fully-developed animal.

A large number of questions of the highest biological importance can be connected with *Salinella*; but although in *Salinella* Frenzel furnishes an important contribution for our comparisons, he himself, in criticizing it and the problems connected with it, does not make sufficient use, for the purposes of comparison, of the store of facts already available. The result is that certain difficulties, which are indeed present,

* Translated from the 'Biologisches Centralblatt,' xii. Bd., no. 4 (Feb. 29, 1892), pp. 108–123.

† Ann. & Mag. Nat. Hist. ser. 6, no. 49, Jan. 1892, pp. 109–111, "A Multicellular Infusorian-like Animal."

‡ Ann. & Mag. Nat. Hist. *loc. cit.* pp. 79–84, "The Mesozoon *Salinella*."

§ Under the title "Untersuchungen über die mikroskopische Fauna Argentiniens," Frenzel publishes a detailed description, with figures, in the last part of the 'Archiv für Naturgeschichte' (58 Jahrg., i. Bd., 1 Heft, pp. 66–96, Taf. vii.). This was issued last December, but it did not come into my hands until later. In this paper Frenzel adds to his previous statements nothing that is essentially new; I therefore consider it unnecessary to discuss it further at present.

appear to him to be greater than, when considered from the comparative standpoint, they actually are.

In what follows I only hope to apply to an interesting concrete case nothing but what is well known and generally admitted, while venturing to add thereto certain reflections of my own.

"It is a well-known fact," says Frenzel in his second paper (*loc. cit.* p. 577*), "that between unicellular and multicellular animals there hitherto stretched a gulf which was wider than that between the vegetable and animal kingdoms; for indeed the two latter, in spite of the advances which we have made in knowledge, are even to-day hardly separable from one another." But the further our knowledge progresses the less will such a separation be possible, and the less moreover shall we consider it to be necessary: the animal and vegetable worlds have been developed in two different directions from a common basis, the non-nucleate Protoblasts. I totally disbelieve that it is permissible to institute such comparisons in the natural sciences. A gulf, if it is once present, can be neither smaller nor greater than any other.

Between animals and plants a gulf might well exist; but happily it does not. It is nevertheless only in relatively quite recent times that our store of facts has been so far enriched as to render it possible to bridge over the gulf, which, from the standpoint of earlier knowledge, was only too evident. It is possible that, among the forms at present existing, there is a gulf between Protozoa and Metazoa; it is possible, nay even very probable, that it does not really exist at all, and that our array of facts only needs to be further amplified in order to bridge it over. The transition also from the unicellular to the multicellular plants is to-day quite a gradual one: why should it be otherwise from the unicellular to the multicellular animals? Frenzel contributes a very considerable pillar to the bridge, and withal exerts himself, in developing his paper, to make the gulf appear deeper and broader than it is. Our science does not deserve such an extremely pessimistic conception of its present position; although in a general way I consider pessimism—but without relapsing into resignation and exclaiming "*Ignorabimus*"!—active pessimism, to be more fruitful than activity in an exaggeratedly optimistic direction. Frenzel, however, also overlooks stones which are already in existence for the building of the future bridge between Protozoa and Metazoa.

Frenzel moreover does the modern zoologist injustice when

* Ann. & Mag. Nat. Hist. *loc. cit.* p. 79.

he says (Biol. Centralbl. *loc. cit.* p. 577; Ann. & Mag. Nat. Hist. *loc. cit.* p. 80) :—"In the systematic arrangement of the group (*i. e.* the Protozoa) we are even obliged, hard though it will be for every modern zoologist, to allow ourselves to be swayed by physiological considerations, since here the purely morphological and embryological foundations are insufficient." In cases in which "unfortunately far too little attention is paid" to a "by no means unimportant difference . . . . perhaps in consequence of the fact that it arises in the first place from physiological conditions only," this does not occur because it would be hard for a modern zoologist to take physiological considerations into account, but because there are unfortunately still far too many zoologists who are one-sided in their views, *i. e.* not modern. It appears to me that precisely the perception that differences of a purely physiological nature exist between organisms, especially unicellular ones, which are not to be distinguished morphologically (*i. e.* anatomically and embryologically), is one of the most important acquisitions in biology; for it teaches us that the most essential differences—at least in my opinion—between organisms are independent of the degree of development which their organization has attained; and that protoplasm, or, better, Protoblasts—for independent protoplasm, without forming any kind of Protoblast or living being (*Lebewesen*), has no existence at all—is subject to material differences even in the non-organized condition.

Indeed, we must even arrive at the conclusion—in a manner which I will perhaps indicate more closely upon another occasion—that in the non-organized condition there already were AT LEAST as many original kinds of Protoblasts as there are to-day REALLY INDEPENDENT forms of living beings, or, we might say, QUALITIES OF LIFE; probably, however, there were many more. It may be that new qualities of life, in spite of the diversity of gradually developing forms of life, did not subsequently come into existence at all; for new and different FORMS OF LIFE may arise by gradual change of shape from apparently similar QUALITIES OF LIFE, the difference between which, though present from the beginning, does not become perceptible until a higher grade of development is reached. Yet it is probable that the qualities of life which were originally present cannot all have sustained the struggle for existence until now.

More or less visible gulfs between the various forms of life are and must be present, therefore, if we would in any way identify the idea of difference with that of a gulf. The apparent size of such a gulf may in the first instance depend upon the paucity of our supply of facts; it is, however, on the other hand merely a matter of arbitrary valuation: essentially it makes no difference whether an abyss, which we cannot cross, is ten metres or a hundred metres wide. A difference is a difference, and can really be neither greater nor smaller than any other.

And wherefore must we exclude the Protozoa "from Häckel's fundamental principle of biogenesis"? To what extent is our knowledge of the Protozoa to upset this principle? For if there really are living creatures which are to be EXCLUDED from the fundamental principle of biogenesis, the latter is entirely invalidated. But has it recently been proved that we are confronted with insuperable difficulties if we assume that, in the case of the Protozoa also, ontogeny recapitulates phylogeny? It is true that the number of distinguishable conditions of form through which the individual life of a unicellular animal passes is much smaller than that of the series of forms in its phylogeny must have been. Yet we see the same abbreviation—relatively still more—among the Metazoa also, and, just as in the Metazoa, the series of forms in the Protozoa often becomes somewhat more complete only in a cycle of several generations. In the same way larval adaptations and other cœnogenetic conditions of form must play a perhaps even greater part among the Protozoa than they do in the case of the Metazoa.

If phylogeny is really repeated in ontogeny it must be possible to rediscover in the individual development of a Protozoon THE INITIAL STAGE ALSO OF THE NON-NUCLEATE PROTOBLAST, THE STAGE OF THE MONERA. The same demand must, however, be presented to the Metazoa also; for in their case, too, phylogeny cannot have proceeded from the nucleate Protoblast, but rather from the non-nucleate primary stage of all living forms. But the ontogeny of every Metazoon has hitherto appeared to commence with the stage of the egg-cell (or the reproductive cell in general), therefore with the nucleate Protoblast. Yet I now find it possible, owing to the discovery of the general diffusion of centrosomes (attraction-spheres) and their, so to speak, leading rôle in cell-division, to trace back the ontogeny of the egg-cell also, and consequently that of all Protozoa, to the stage of the *Monera*. But the stage of the non-nucleate Protoblasts is at the present time always passed within the mother-cell, before delimitation of the daughter-cells occurs; for as soon as division has taken place in the centrosoma, the attracted area of which is equivalent to the unit of the Protoblast, therefore to its individuality, the parent individual has ceased to exist;

and the two daughter individuals are, although less separated than they subsequently become, already present before the nucleus has divided.

THE NUCLEUS OF THE PARENT INDIVIDUAL WHICH REMAINS UNDIVIDED BELONGS TO NEITHER OF THE DAUGHTER INDIVIDUALS; THE LATTER ARE THEREFORE IN THE STAGE OF THE NON-NUCLEATE PROTOBLAST. But since, for the FULL ACTIVITY of the Protoblast, the nucleus has become an organ of already indispensable importance, they must in the ontogeny receive a nucleus much earlier than may have been the case in the phylogeny. The appearance of important organs relatively earlier in ontogeny than in phylogeny is an occurrence which has indeed met with general acceptation since the writings of Fritz Müller. The unappropriated parent nucleus, which is left behind, is the more unable to lead an independent life, and relapses into its constructive parts: the daughter individuals hasten to divide among themselves this material, which is so important for the building-up of their further organization, and to construct from it a nucleus for themselves, after the pattern of that of the parent form. CONSEQUENTLY THE OBJECT ALSO OF THE MORE OR LESS COMPLICATED FORMS OF NUCLEAR DIVISION APPEARS TO BE NOTHING FURTHER THAN AN ONTOGENETIC ABBREVIATION OF THE PHYLOGENETIC PROCESS OF THE FORMATION OF THE NUCLEUS FROM THE MATERIAL SUBSTRATUM, TO WHICH THE HEREDITARY SPECIAL PROPERTIES ARE UNITED. THIS SUBSTRATUM, THOUGH NOT AS YET CONCENTRATED IN THE SHAPE OF THE NUCLEUS, AN ORGAN SUBSEQUENTLY SO IMPORTANT, CERTAINLY BELONGED ALSO TO THE NON-NUCLEATE STAGE IN THE PHYLOGENY*. Since, therefore, the nucleus, although as an organ more important than ever, has been to a certain extent dethroned, the Protoblast without a nucleus, no matter whether or not there still exist non-nucleate forms capable of independent life, may assume its rights once more.

The non-nucleate Protoblast, therefore, as the initial stage

* The further circumstance that daughter-cells which have been produced by simple fission do not (or less frequently) form other organs also (chromatophores, vacuoles in plants, circlets of cilia, collars, &c. in Protozoa) quite afresh by themselves, but acquire them by division of the organs in question belonging to the parent-cell, must, I consider, likewise be regarded as an ontogenetic abbreviation of the original process of the origin of those organs. In cases, however, where the ontogeny of the cell reproduces its phylogeny more faithfully, *e. g.* in the development of unicellular and multicellular creatures from spores, the organs of the parent-cell, with a view to formation of spores, degenerate before division takes place, and the daughter-cells or their successors are obliged to reconstruct these organs, with the exception of the nucleus, afresh for themselves.

of development, can be rediscovered in ontogeny also, and indeed both among the Protozoa and the Metazoa as well. The ontogeny of a Metazoon individual does not commence with the stage of the fertilized or unfertilized egg-cell in process of division from which the Metazoon is built up; but the individual itself, which is represented by the mature egg-cell, has a past of its own which was possibly of great length, and which commenced with the non-nucleate stage within that germ-cell, from whose division into two it immediately proceeded as an unripe egg-cell.

I am unacquainted with any facts—it may be that my knowledge is insufficient for the purpose—which would render the theory of morphogeny inapplicable to the Protozoa, especially as, between the visible stages of the development of their organization, there may be others which are invisible. Development may even attain the highest stage of unicellular existence without evolving further organization; for it consists in a series of transformations of the PROPERTIES of the Protoblast, in imitation of the sequence of events in the phylogeny, wherein each arrangement of organs corresponding to the particular stage of development is only potentially combined with the succession of these transformations—that is, the latter includes only the capacity to produce such organization should circumstances require it.

In this manner it seems to me that the egg-cell ontogenetically arrives at the highest stage of unicellular existence which has been present in the phylogeny of that form of life; and all its daughter-cells and subsequent descendants, the constituents of the Metazoon body, have the capacity to reach the same stage, and must endeavour to reach it by the same way, starting from the stage of the non-nucleate Protoblast. The rapidity of the development varies according to the conditions under which the particular cell commences and continues to maintain its individual life. The greater portion of the cells of the Metazoon body, however, owing to the conditions which obtain at an earlier or later stage of the ontogeny of the latter, is compelled actually to develop the organization which belongs to this particular stage, although it may not be exhibited by other cells of the body. Those cells which, at whatever stage, really have to develop their organization, are hindered in their potential further development owing to immediate one-sided adaptation, are usually enfeebled in consequence of the performance of special functions, and never attain the highest stage of development, to which at their origin they were, so to speak, historically predestinated. It is only the reproductive cells, or, if two kinds of them are present, only the egg-cells, which enjoy such favourable conditions as to virtually pass through in their own ontogeny the whole unicellular phylogeny of the species, and thereby to be able to transmit to their successors the complete character of that form of life.

Yet pretty frequently in the vegetable kingdom, but more rarely in that of the animals, cases also indisputably occur in which cells which had already adapted themselves to a special function, and which we should therefore be inclined to term working cells ("Arbeitszellen") in contrast to the reproductive cells, under certain circumstances rejuvenate themselves as it were, resume their virtual further development, and consequently, when they have arrived at the highest unicellular stage of their species, themselves become reproductive cells. But if, in consequence of excessive specialization or of the accumulation of aplasmatic cell-products, they have forfeited their capacity to virtually attain the highest unicellular stage, the daughter-cells which may be produced from them will also be unable to arrive at anything of the kind, and will never, even virtually, reach a higher stage of development than their parent-cell. For this reason the successors of already specialized tissue-cells can never do anything else than at the utmost develop, multiply, or regenerate the same tissue; and it is only in consequence of this that the working cells can never produce from themselves a new, independent, multicellular individual, similar to the mother.

Perhaps I am not mistaken if I consider that the theory of morphogeny appears to be inapplicable to the Protozoa only for the same reasons as those which are the cause of difficulties in the interpretation of the embryological stages among the Metazoa also—upon which, moreover, the differentiation of the body-cells likewise depends; and (briefly to repeat once more what has already been stated) these reasons themselves depend upon the fact that the different cells arrive at a different grade of virtual development, the highest possible stage of which is actually attained by the egg-cell alone: then, remaining stationary at an earlier or later stage, they display an organization which differs according to their conditions, at the same time adapting themselves in one direction and becoming far too much exhausted to be able to have a further future.

I will not, however, weigh every sentence of Frenzel's article so precisely, although indeed we only weigh that which appears to us to be worth weighing. Otherwise I might be charged with fault-finding. I hope nevertheless that Frenzel is not one of those who are at once inclined to regard every reflection against their train of thought as "an attempt to pick holes" ("Anbohrungen").

In his article Frenzel lays most stress upon the supposed gulf between Protozoa and Metazoa, which is stated to be caused by the fact that the digestion of the Protozoon cell is intra-cellular, while among the Metazoa, on the contrary, where extra-cellular digestion prevails, the intra-cellular mode "is only met with in isolated and exceptional cases." In opposition to this I consider—and in so doing I am supported by the leading existing authorities—that the way in which the cell feeds in the Protozoa and Metazoa is least of all adapted to form a gulf between them. Quite on the contrary!

Among the Protozoa it may be a matter of momentary adaptation whether the digestion of one and the same animal is extra- or intra-cellular. And among the Metazoa intra-cellular digestion is not only not of isolated occurrence, but in the whole of the lower forms is, so to speak, predominant; in many, as *e. g.* in the Sponges, such a digestion is perhaps exclusively present. Moreover it is not "only the endoderm cells which can be concerned therein;" but also, and indeed chiefly, the amœboid cells of the mesenchyma, which, even in the highest Metazoa, as so-called phagocytes, continue to practise this faculty of theirs which they have retained from the Protozoon stage. Should we desire to construct a Metazoon out of Protozoa, we should not find, as Frenzel believes, any physiological difficulty at all in the mode of nutrition. Since the several individuals in the colony also would each digest for itself by the intra-cellular method, we could perfectly well get "beyond a simple Protozoon colony" and obtain a "typical Metazoon." If we take into consideration the more recent facts of comparative embryology and physiology among the lowest Metazoa, we arrive at the result that the several cell-individuals of the Metazoon, which continually relinquish more and more of their independence (in my opinion because the race of Protoblasts which is represented by them continually forfeits more and more of its vital energy), have on that account long retained the faculty of digesting their food for themselves. It is probable that this faculty was first lost in the ectoderm cells and then in those of the endoderm, while, on the contrary, the cells of the mesenchyma, even in the highest forms, are to-day still able to digest for themselves.

In opposition to Frenzel, we must entirely agree with Metschnikoff "that this mode of digestion represents one of the few properties of the Metazoon organism which have been transmitted from the Protozoa, and consequently furnishes a CONNECTING LINK, however small it be, between the two groups" *. We should certainly be confronted with great difficulties, although not on the ground of nutrition, if we would construct Metazoa from Infusorian-like unicellular animals, such as the "larva" of *Salinella*. But we must not select precisely the most improbable possibility. The very earliest Metazoa are, as is generally agreed, to be derived from Flagellate-like creatures; and among the Flagellata it is really only a question of the stage of development whether the digestion of an animal is extra- or intracellular; the different conditions of form through which the cell passes in its life are also characterized by different modes of nutrition. In their different phases of life the Protozoa may resemble Amœbæ, Flagellata, or Ciliata, or may pass through all three conditions (Catallacta of Hæckel). The same is also true of a large number of cells in the body of the Metazoon. Should we actually wish to consider holophytic Flagellates as ancestral forms of the Metazoa, in which connexion a very pretty transition is realized by *Volvox*, it is easy to believe that, so soon as a communication between the central cavity and the exterior became established, or in some other way a gastral cavity arose, the cells gave up their holophytic mode of life, to pass for the first time to an extracellular method of digestion. We even find that real highly organized plants are also capable of digestion on occasions, and indeed of extra-cellular digestion, like the insectivorous plants. In criticizing the relationships of the Flagellates it is of no importance whatever whether a particular form possesses holophytic or saprophytic nutrition; not only among closely allied genera are some holophytic (e. g. *Chlamydomonas* and *Cryptomonas*) and the others (*Polytoma* and *Chilomonas*) saprophytic, but the mode of nutrition also changes within the genus (the various species of *Euglena*); nay, it is even possible for one and the same form in its predominant phase of life to pass from the holophytic to the saprophytic mode of existence by losing its chlorophyll (e. g. *Chlorogonium* and *Carteria*). The transition is, however, very easy between saprophytic forms, and therefore such as really do not digest, and those which are capable of digestion, and as a matter of fact the digestion is for the most part intra-cellular, in correspondence with the amœboid form which has been assumed (*e. g.* in septic Monads), though

* E. Metschnikoff, 'Untersuchungen über die intrazellulare Verdauung bei wirbellosen Tieren,' Wien, 1883, p. 2.

occasionally also extra-cellular. For how could we designate otherwise than as extra-cellular digestion the capacity of certain Bacteria to dissolve by their secretions caoutchouc and other substances which are difficult to assail and to absorb them as nutriment?

That extra-cellular digestion is of such limited occurrence among the Protozoa, nay even that it can only take place under exceptional circumstances, is solely due to external conditions, which render extra-cellular digestion a physical impossibility for the majority of the Protozoa. Under the term digestion we understand only the process of the conversion of solid nutriment into a solution or into a fine emulsion. In this the chief part is played by the digestive secretions and ferments. In extra-cellular digestion the food is exposed to the influences of the cell-body externally to the latter; in intra-cellular digestion, however, this takes place within the body of the cell. Now how should a Protozoon, supposing it to be possible for the digestive juices to be produced at all without immediate stimulation of the protoplasm, secure their effect upon the food outside its body? The Protozoon must, in order to be able to digest, in order to render possible the operation of the digestive juices upon its food, incorporate its nutriment. But if this can also take place outside the cell, in consequence of the position of the cells in the colony, it will be possible to omit the incorporation of the food into the cells.

It is therefore in no way wonderful that the change in the mode of life of the former Protozoon, produced by living together with other cells in the consolidated, individualized, and differentiated colony, or in the Metazoon, should entail an alteration in its habits. In the first place it was of great advantage to be able to store up in an intestinal cavity much more nutriment than the several cells were in a position to secure all at once. An intra-cellular digestion was no longer unavoidable; but it gradually became for the majority of the cells of the body also impossible. THE VERY FACT OF THEIR REMAINING TOGETHER IN A COLONY, AND THEIR INCAPABILITY TO LIVE INDEPENDENTLY, ARE SIGNS OF THE INDIVIDUAL DEBILITATION OF THE SEVERAL PROTOBLASTS; in consequence of further exhaustion the majority of the cells, and gradually also the endoderm cells, forfeit the capacity for active, amœboid changes of form; in compensation for the rest of the colony, however, the endoderm cells become specialized for the preparation of digestive juices and ferments, *i. e.* the consequence of their debilitation is the transformation of their protoplasm to digestive juices, and moreover without the application of a direct stimulus to it. The great caducity of endoderm cells (and of gland-cells altogether) is a character of very general occurrence.

Were we able, says Frenzel, "still to regard the latter (*i. e.* the intestinal cells) at all events as Protozoon cells, this view would be absolutely inadmissible for the former, the cells of the mesoderm and ectoderm . . . ." I do not at all see why. The intestinal cells with intra-cellular digestion correspond to holophytic Protozoa; the rest of the cells of the body correspond partly to saprophytic Protozoa, because, thanks to the labours of other cells, they need only to feed, but not to digest their food; in part, however, the body-cells (especially those of the mesenchyma) are likewise holophytic Protozoa, and remain so even when the intestinal cells have long lost the faculty of intra-cellular digestion. In more primitive cases the intestinal cells themselves digest; they subsequently lose this faculty, and henceforth expend their energies in the production of digestive juices; the latter, however, are not sufficient for the digestion of the food-matter, and the wandering amœboid cells have to assist more or less with their power of intra-cellular digestion. The intestinal cells continue to be Protozoa, with which other body-cells, likewise corresponding to Protozoa, live together in a kind of symbiosis: their services to one another are reciprocal, so that their functions are consolidated into a physiological whole. Not only do the intestinal cells feed the rest, but a large portion of the latter also make provision for the intestinal cells: oxygen is in the widest sense food, just as much as albumen, fat, and carbohydrates.

I believe that I have sufficiently demonstrated in the foregoing that it is precisely the physiology of digestion which causes least difficulties in deriving the Metazoa from the Protozoa; but also the other "gulf" between Protozoa and Metazoa, which Frenzel likewise emphasizes, and which is occasioned by the multilaminar character of the Metazoa, appears to us less great when we take into consideration the following facts.

As a single-layered multicellular animal we are now also acquainted with *Salinella*, besides *Volvox*. The next stage, with the representatives of which we have closer acquaintance as adult animals, already consists—to leave *Trichoplax adhærens* out of consideration—of three layers, since in them a mesoderm, or, better, mesenchyma, is already present between ectoderm and endoderm; for of animals which in the adult stage also would correspond to the typical Gastrula, and consist merely of ectoderm and endoderm, we have no knowledge.

The most cogent proof that the ancestral form of the Metazoa was the *Gastræa*—an animal with intestinal cavity and oral aperture, composed of ectoderm and endoderm, without mesoderm—is therefore wanting. WE REQUIRE THIS FORM, HOWEVER, AS A TRANSITIONAL STAGE, ONLY IF WE WOULD HAVE THE NEXT STEP IN THE SEQUENCE OF THE PHYLOGENETIC DEVELOPMENT, STARTING FROM THE BLASTULA-FORM (*BLASTÆA*), TO CONSIST IN AN INVAGINATION.

It is true that for a *Gastrula* to arise by invagination is MECHANICALLY the simplest mode of further development, and therefore it is that ontogeny, which always strives after abbreviation and simplification, so often adopts this method, especially among the higher types; therefore, on the other hand, it is also natural and easily explainable that the next stage in ontogeny after the *Blastula* is the *Gastrula* without mesoderm. But the question arises whether a similar formation of a *Gastrula* is also the PHYSIOLOGICALLY simplest possibility in the further development from the *Blastæa*. It does not appear to me that it is. The method of forming the endoderm which is physiologically the simplest, and therefore probably genealogically the oldest, is that which commences with immigration into the inner cavity of ectoderm cells, which have been forced out of connexion with the epithelium and have become amœboid, *i. e.* formation of the endoderm by apolar multilocular inward growth (Metschnikoff). The growth is apolar, because only by subsequent adaptation (accumulation of yolk) could the original polarity of the ovum be so far increased as already actually to effect a differentiation of the *Blastula*-cells, a greater difference between the hypoblast and epiblast. The cells which penetrated into the cavity of the *Blastula* afterwards gradually arranged themselves again in the manner of an epithelium to form the endoderm, after the communication of the *Blastula*-cavity with the exterior by means of the blastopore had furnished an incentive thereto. Perhaps an open *Blastæa* of this kind is even more archaic than the closed vesicle, and in that case the incentive alluded to would not have subsequently occurred, but would have been present from the beginning. I would remind the reader of the development of *Volvox*, where the young but already perfect colonies close their opening only after leaving the parent.

Now it cannot have happened either that all the immigrant cells were utilized for the formation of the endoderm, or that with the completion of the endoderm the immigration from the ectoderm at once came to an end; it is much more probable that the cells of the mesenchyma also should be augmented in the same way from among the endoderm cells, which were by this time multiplying to excess. But then it is absolutely impossible to see why precisely such a form of animal should exist, as one in which only so many ectoderm cells become amœboid as are necessary for the formation of the endoderm, in order not to leave any over in the shape of so-called mesoderm. The formation of the endoderm was indeed neither the object nor the cause, but merely the consequence of the immigration. As a matter of fact, such a bilaminate animal as represented by the *Gastræa* can neither have existed in phylogeny nor be in existence to-day.

That the *Gastrula* is nevertheless present in ontogeny is, as has already been mentioned, to be explained from the fact that the immediate incentive to the further development of the body from the *Blastula*, which in phylogeny was a more physiological process, dependent in a higher degree upon the individuality of the cells, has here, in ontogeny, become a more mechanical necessity. The phylogenetic method is longer, and therefore in ontogeny it is adopted merely in the case of very primitive forms (certain Porifera and Cnidaria), as opposed to which the more developed forms have gradually selected a shorter, because more mechanical, way to the same end.

Now the various colonies of Flagellata, and especially *Volvox*, present us with the highest stage of colony-formation among unicellular creatures, nay even with the most primitive multicellular animal, which already appears to possess an integral individuality. At the same or a somewhat higher stage, but developed from other unicellular ancestors, we also find *Salinella* *, likewise an animal formed of an epithelial layer of cells, with an internal cavity. Now more and more cells—probably because they are weaker or stronger than their neighbours, and perhaps also because, owing to the axis of fission having been possibly somewhat oblique, they were situated more towards the interior—become continually forced from the epithelial position (if they are stronger than the rest they set themselves free), and passing into an amœboid stage reach the inner cavity. It is possible that *Trichoplax adhærens* corresponds to precisely this stage, in which, with the communication between the internal cavity and the exterior, the incentive to a secondary epithelial

* That cells are found upon the ventral surface which are somewhat differently constituted to those upon the dorsal side, is in this case (as also in that of *Trichoplax*) the immediate result of the creeping, and no longer floating, mode of life, and would in itself indicate no higher position than that of *Volvox*.

arrangement of the cells which have wandered into the original cavity is also wanting. But so soon as a communication was constituted between the cavity of the *Blastula* and the exterior by means of a mouth-opening, there was also provided the incentive for the immigrant cells to arrange themselves again like an epithelium, this time as an endoderm, and to pass from the Gymnomyxa form into a Corticata phase once more. Thus we already have the true Metazoon, a Cœlenterate, or one of the Porifera before us. In this series of stages we nowhere miss the *Gastræa*.

A greater difficulty than those advanced by Frenzel appears to me to consist in the fact that it is not easy to form an idea as to how the single individuality of the Metazoon has arisen from the separate individualities of the Protozoa, which at first composed a loose colony as ancestral form. This, however, is at once a question which directly touches upon the relationship between the soul of the Protozoa and that of the Metazoa, that is really the question of the soul in general!

Frenzel finally observes something also in the development of *Salinella* which is said to be difficult to harmonize with our previous knowledge. He speaks of a hypotrichous Infusorian-like unicellular animal, which he regards as the LARVAL STAGE of *Salinella*. "This nevertheless leaves a difficulty of considerable importance to be surmounted," he adds, "in that the transition from the single cell with intra-cellular digestion to the adult animal with extra-cellular digestion is enigmatical and completely unexplained." I would not consider this phenomenon to be so very enigmatical, even should the fact be established that the digestion of *Salinella* is really enzymatic, and not intra-cellular, like that of the majority of the lower Metazoa. This point, however, has already been sufficiently disposed of. Let us at once proceed to consider WHETHER A UNICELLULAR ANIMAL, WHATEVER ITS STRUCTURE, *can be considered* AS THE LARVA OF A MULTICELLULAR FORM.

That stage in the ontogeny of the multicellular animal which, while still unicellular, immediately precedes the multicellular condition, and is therefore the highest unicellular stage, we term, whether fertilized or unfertilized, the ripe EGG-CELL. In the case of *Salinella* we have before us—if I rightly comprehend the meaning of a phenomenon observed by Frenzel—the product of an act of copulation, we might say a zygospore; there can in this case be no question of an actual egg-cell, for there is no difference to be observed between the two copulating cells, and in fact in *Salinella* there are no special reproductive cells at all. All the cells in the body have the power of multiplying the species, and, singularly enough, the colony does not first relapse into its constituents (like, *e. g.*, *Pandorina*), but TWO ENTIRE ANIMALS become fused together and form a common cyst. Unfortunately Frenzel was unable to trace the further phenomena within the cyst. It is, however, hardly possible to imagine anything else than the fusion of each pair of cells of different origin. If, as Frenzel writes, a continuation of cell-multiplication really takes place within the cyst, this in all probability happens before the copulation of the several cells. Unfortunately, too, Frenzel did not directly observe that the separate similar cells in the cyst pass into the unicellular Ciliate form which he has described.

Should that Infusorian really be a developmental stage of *Salinella*, it cannot nevertheless, as has already been stated, be termed a larva. The ova of many other animals also are capable of movements, particularly amœboid ones, and of feeding in the INTRACELLULAR fashion upon the neighbouring cells, such as is the case, among others, in *Tubularia* and *Hydra*; and not only can this be done by the unfertilized, immature, reproductive cell, but also, as is well known, by the fertilized one, as, for instance, in the case of certain Platyhelminthes, where, in addition to a larger number of yolk-cells, only a few fertilized egg-cells are found in the egg-capsule. The sole difference between *Salinella* and the other known cases of active egg-cells is that the latter have only to incorporate and digest the nutritive material which is already stored up for them; while on the other hand the fertilized ovum (or zygospore) of *Salinella* has itself to acquire its food by its own activity, in order to be able to proceed with the building-up of its body. Therefore it is that the faculty of reproducing the organization of the highest unicellular ancestral form in the highest unicellular stage of *Salinella* does not, as is the case in the majority of ova, remain virtual and latent. The necessity of accumulating the building-material for further development by its own activity only sets in in the case of *Salinella* earlier than in that of all other multicellular animals. In point of fact much more is demanded from an independent cell in *Salinella* than in higher animals, where the separate cells always retain less of the activity and independent energy of their unicellular ancestors. For the rest, however, the transition from the "cell with intra-cellular digestion to the adult animal with extra-cellular digestion" in the case of *Salinella* is by no means more enigmatical and unexplained than the fact that from egg-cells with amœboid digestion Metazoa develop whose body-cells—partly indeed themselves digest throughout life—for the greater part, however, are endowed with extra-cellular digestion or none at all.

The further ontogeny of *Salinella* also, subsequent to the already active unicellular stage, exhibits nothing extraordinary. Frenzel writes:—"For it is precisely the further development of this larva, incomplete though my study of it was, which proves that it does not develop into the perfect animal by means of ordinary division, much as a colony is formed from a single Choanoflagellate, but by a far more complicated process, which we may most fitly term endogenous cell-formation." We may, however, designate the segmentation of all Metazoa whatever, and even the formation of the daughter-colonies of the Volvocineæ, as endogenous cell-division ("cell-formation"). In very many cases the egg-cell has a distinct cell-membrane, and the processes of fission, in which segmentation consists, always proceed within this membrane; it often happens that it is only the already tolerably advanced larva or the almost perfect animal that leaves the cell-membrane of the parent-cell, the egg-cell. Even more distinct endogenous cell-division than in the case of the holoblastic ova is the segmentation in the meroblastic eggs, where, as for instance in the egg of the fly, the limits of the daughter-cells within the cell-membrane of the parent-cell are for a long time absolutely indistinguishable from one another.

It is indeed in the chief degree the circumstance that the daughter-cells remain in organic connexion with one another, and that they have no longer the strength to separate, which has replaced societies of cells by the higher category of colonies; and a still more intimate union of the cells, in connexion with their endogenous origin in the egg-cell and in consequence of their further individual debilitation, characterizes the Metazoa, and makes of them a single individual, an indivisible physiological whole.

That the daughter-cells and subsequent descendants of the Metazoon egg-cell have now no longer the power to separate from one another, and lead an independent cell-life like Protozoa or like the unicellular ancestors of the species, is a fact. It remains to be asked, what is the cause of this? It cannot be a change of habit owing to the living together for so long in the cell-colonies of the ancestors, for the latter is itself the first consequence of the cause for which we are seeking. I consider that the cause is to be found in a certain debilitation of the genus of Protoblasts with which we have to deal; and the latter is again nothing more than the consequence of that change in all protoplasms (vital qualities) which sets in as time goes on, even without special external influences, and which we are only able to detect through its combined effect and its further consequences, and then term simply development. A continuous and inevitable change in the condition (mobile condition?) of matter in general is the common destiny of the universe, and is the equivalent of existence and the progress of the world. In speaking of phylogenetic development we refer this general change only to one special case, to that of living beings, where it proceeds at different rates according to the qualities of the Protoblasts, but everywhere essentially in the same direction and according to the same laws.

Certain cells in the Metazoon, owing to their peculiarly favourable conditions of life, attain to more of the original independent vital energy of the unicellular ancestors than do the rest: these cells are the reproductive ones. The egg-cell of *Salinella* proves the originality (low stage of development) of the species also through the very fact that, as a simple cell-individual, it possesses even more vital energy than does the egg-cell in all Metazoa. In a general way it is perhaps possible to advance the proposition, somewhat paradoxical though it appears, that THE HIGHER ORGANIZATION OF THE MULTICELLULAR INDIVIDUAL IS TO BE REGARDED AS THE CONSEQUENCE OF THE GRADUAL DEGENERATION OF THE SEPARATE CELL-INDIVIDUALS WHICH COMPOSE IT.

To briefly sum up what has been stated in the foregoing pages, I consider *Salinella* as a highly valuable and interesting discovery precisely because, in opposition to Frenzel's view, it at once fits in thoroughly well with our present biological theory as to the origin of the Metazoa, and, so to speak, fills a gap in the series of facts for our deductions. Frenzel is certainly quite right when he states in the concluding words of his article ('Biologisches Centralblatt;' Ann. & Mag. Nat. Hist. *loc. cit.*) that there are isolated links in Nature "for which we cannot find a place in our system, beautifully and ingeniously constructed though it is, and which tend to prove how little Nature is amenable to a dogmatic treatment on our part, a treatment which unfortunately appears to take the upper hand too much in the biological sciences, and which would gladly exclude everything which does not fit into its narrow frames." Happily, however, this great truth does not apply to *Salinella*! *.

Kolozsvár,
October, 1891.

* I have already given expression to views as to the simplest living beings, the impossibility of separating the ideas of life and individuality, and the import and causes of reproduction (fission) &c., which are in

BIBLIOGRAPHICAL NOTICES.

An Elementary Manual of New-Zealand Entomology. By G. V. Hudson, F.E.S. With 21 coloured plates. 8vo, 128 pp. London: West, Newman, and Co.

This little book bears a somewhat misleading title. The text consists mainly of a series of short descriptions of the habits and metamorphoses of various New-Zealand insects. This branch of the subject, dealing with the life-histories of insects, is well treated, and the descriptions, being based to a great extent upon the author's own observations, are likely to prove a useful addition to entomological literature. In a Manual of Entomology, however, we look for a better treatment of the anatomy and classification of insects than is to be found in the half-dozen pages allotted to them in the present volume. A few such statements as that "the functions of the antennæ are, at present, extremely doubtful," and the reference to the Malpighian tubes as "biliary vessels," sufficiently prove that, on the physiological side of his subject, the author might with advantage have consulted some good modern text-book of biology or entomology.

The amateur would not miss much, in fact, by passing over the first chapter, which is somewhat curiously headed "General Observations." In the second chapter "on collecting" he will find some useful hints. The remaining chapters, which, with the plates, form almost the entire bulk of the volume, contain the descriptions

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certain respects in close connexion with the statements of K. C. Schneider ("Ein Beitrag zur Phylogenie der Organismen," Biol. Centralbl. xi. Bd., pp. 739–744, Dec. 31, 1891). I expressed these views many years ago in various papers (among others "Die lebende Materie und die Individualität" (in Hungarian), Budapesti Szemle, 1884), and in a series of lectures as *Privatdozent* at the University of Budapest (1888), as also recently in my capacity as a professor at Kolozsvár. A portion of these latter lectures appeared last year in a series of articles in the 'Sitzungsberichten der mathem.-naturw., Sektion des Siebenbürgischen Museumvereins,' under the title of "Die einzelligen Lebewesen von dem Gesichtspunkte der Vielzelligen." A summary of my results in German will be published in the next part of the above-mentioned 'Sitzungsberichte.' Shortly stated, my theory regards the (non-organized) Protoblasts (="Zoen" of K. C. Schneider) as units of the third stage (third power) of matter in general (the first power are the atoms in the elements, the second power the molecules in the chemical compounds), and naturally, as living units of the first stage. The foregoing paper, which reproduces some of the results alluded to, was written immediately after the appearance of Frenzel's article in this Magazine, and only extraneous circumstances prevented me from sending it to the press sooner.

already referred to. These provide interesting reading, and will go far to compensate for the deficiencies of the book in other respects.

The plates seem on the whole well up to the average. In some of the figures we miss that attention to structural detail which was to be expected from an artist who is at the same time the author of a work on entomology. The beetle represented at fig. 2, pl. ii., as having three-jointed tarsi and six-jointed antennæ gives a very erroneous idea of the characters of the family Tenebrionidæ, to which it is said to belong. The neuration of the wings is, in some cases also, less accurate than is desirable in a work where the beginner has to rely almost wholly upon the figures for the identification of the species as well as for a knowledge of the structural characters of families. This leads us to notice that the author has introduced into the book a certain number of species which he refers to as new. He figures but does not describe them, nor does he give any clue as to where descriptions of them may be found. If he wishes to obtain recognition from the systematic entomologist for the names he has given to these species he would do well to publish brief technical descriptions of them.

Notwithstanding the defects pointed out we trust that this work may succeed in the purpose for which it was written, of inducing the youths of New Zealand to take a more active interest in entomological science.

On the Modifications of Organisms. By DAVID SYME. Melbourne: George Robinson and Co. London: Kegan Paul, Trench, and Co.

SOME idea of the spirit of this book may be gathered from the following sentence:—"Darwin describes the action of natural selection as preservative and accumulative, but properly speaking it is a purely destructive process. It is heredity and not natural selection which is preservative and accumulative."

In a very vigorous fashion Mr. Syme denies almost every statement which Darwin relied on, maintaining that he "has practically abandoned his theory altogether when he admits that the tendency to vary in the same manner is so strong that whole species may be modified without the aid of any form of natural selection." He asserts that "Darwin's language is wanting in precision, and his definitions and theories are variable and contradictory," even to forgetting his own statement of what natural selection is. The survival of the fittest should be the result of natural selection or the struggle for life; yet Darwin uses the three terms as synonymous. But, according to Mr. Syme, "it is the organism which struggles, not, however, to select this or that variation, but to adapt itself to its environment." Darwin, with good reason (except, perhaps, as to size and colour), was not disposed to give the environment much weight.

"One of the most singular of Darwin's conclusions" is, says Mr. Syme, "that it is the female that selects the male, and not the male that selects the female;" yet on the next page we find that "the female selects the handsomest and most valiant male:" further, that the sexual struggle is not between the males, but "is rather a struggle between the opposite sexes." Much that has been written on this subject is purely conjectural.

The following will probably be new to many:—"Butterflies put up their wings and expose their underside to the action of the sun;" they "have their brilliant non-protective tints on the upper surface of their wings, while the underside is almost invariably protectively coloured." Again, "when chased," we are told, "they suddenly disappear by alighting on some object coloured like themselves, whereby they escape observation, and so confident are they that they remain motionless even when an enemy approaches within a few inches of them."

One of the objections to natural selection—unnoticed by Mr. Syme, but not unnoticed by Darwin himself—is the diversity of means for the same end.

The fertilization of plants by insects is discussed at length. Darwin believed that their relationship was mutually beneficial. Mr. Syme, on the contrary, asserts "that insects of all kinds are in various ways destructive to plants," and he denies that flowers owe their conspicuous colours to insects.

There is no date and there is no index to this book, which only consists of 164 pages. There are several misspellings—such as "*englossa*," "*Artimia*," "*strachys*," "*belliafolia*," "decimination," &c.; printed in London, and the author probably in Melbourne, may sufficiently account for such errors. Nevertheless we shall be glad to see Mr. Syme again; right or wrong, his book is undoubtedly suggestive.

MISCELLANEOUS.

Some Anatomical Characters of Hyperoodon rostratus. By M. E.-L. Bouvier.

I have had the opportunity of studying, at the marine laboratory of Saint-Vaast, a female *Hyperoodon*, measuring 7·20 m. in length, which had stranded on the beach near Fort de la Hougue.

The animal had a short time previously given birth to a young one; its mammæ were full of milk, the internal organs of generation contained a large quantity of sanguinolent matter, and the annular folds of the vagina, which represent a more or less perfect *os uteri*, were scarcely indicated. The mammæ are at least 1·15 m. long, with a maximum breadth of 0·22 m., and are only a few centimetres thick; each of them is traversed by a longitudinal duct, which commences abruptly about 10 cm. from the anterior extremity, and continues, without greatly increasing its calibre, as far as the reservoir situated beneath the teat; besides this two large lateral ducts open into this reservoir, which is of comparatively small size. The milk is yellowish white, of the consistency of cream; it has an agreeable nutty flavour. The mammæ are covered throughout their entire length by a layer of the cutaneous muscle; this layer must be the most active agent in the phenomena of compression which produce the emission of the milk; in front it acts chiefly by means of its external aponeuroses, which are here almost the only covering of the mamma; posteriorly the muscle itself is applied directly to the gland. The cutaneous muscle is elsewhere very well developed, and in several regions of the flanks exceeds 4 cm. in thickness. In front it covers at certain points the prolongations which are sent off, to a distance of 1 m. behind the junction of the lips, by the spongy and largely areolar tissue, which contains the spermaceti oil in abundance.

The stomach is composed of ten successive chambers. The capacity of the first is nearly equal to that of the nine other chambers; its mucous membrane is covered with convolutions which are grouped round three perfectly distinct centres. The nine subsequent chambers form a mammillated mass, which is very sharply separated from the first; they are separated from one another by perforated septa, which were described a long time ago; the first is at the most as large as the fist, the last, on the other hand, is of enormous size. In the duodenal dilatation, which is greatly developed, we observe a little ampulliform swelling at the orifice of the hepato-pancreatic duct; besides this it presents a large semi-lunar valvular fold in front of the point where it passes into the narrow duodenum. There are a number of little glands at the posterior extremity of the rectum, in the immediate vicinity of the anus. The liver is divided into two lobes, one of which is situated to the right, the other to the left; to the right lobe is attached a small dorsal one.

The aortic trunk is greatly swollen at its exit from the heart; immediately above the sigmoid valves it gives rise to two coronary arteries, and exhibits, besides, a perforated *ductus arteriosus* which brings it into connexion with the pulmonary artery. The thoracic plexuses are much less developed than those of the Delphinidæ, but more so than those of the Mysticetes. Instead of extending to the further end of the thoracic chamber, the network terminates posteriorly at the level of the sixth rib. The plexus of the right side, which alone I was able to examine, is traversed, a short distance from its external border, by a longitudinal artery which starts from the right brachio-cephalic trunk, and which probably represents the internal thoracic artery. The intercostal arteries are separated at their origin, and take part, like the foregoing artery, in the formation of the plexuses. There is only a single renal artery on each side; but we find two renal veins, a large one in front, and a much smaller one behind. The obliterated umbilical arteries, which terminate at the summit of the bladder, are connected with the hypogastric arteries, which each divide into two branches and form, in spite of their small size (the little finger can scarcely be inserted into them), the sole source of the blood contained in the enormous genital arterial plexus. This plexus completely covers the anterior portion of the vagina, the uterus and its cornua; but it does not extend in front into the broad ligament.

The venous plexuses appear to be little developed, and those of the psoas are wanting as in the Mysticetes. On the other hand, there is a venous sinus in each of the large lobes of the liver, and the sinus of the vena cava inferior assumes enormous proportions. A large longitudinal vein traverses the right thoracic plexus, and receives three large branches at least from the medullary cavity; it is by this vein, which functionally replaces the absent azygos veins, that the blood of the medullary veins returns into the vena cava anterior. In short, judging by all the characters with which we are so far acquainted, the circulatory apparatus of *Hyperoodon* appears to approach that of the terrestrial ancestral forms of the group, less, however, than that of the Mysticetes, but much more than that of the non-Ziphioid Cetodonts.—*Comptes Rendus*, t. cxiii. no. 17 (Oct. 26, 1891), pp. 563–565.

On Self-pollination in Amsonia Tabernæmontana. By Thomas Meehan.

To my mind the number of plants which have their flowers constructed for self-fertilization is so large, that it would seem hardly worth particularizing them but for the industrious work of noting the opposite characteristics which prevails in our scientific serials. It seems not fair to true science that only one side of nature's story should be told. This is why I record some self-fertilizing cases.

It has been left to me to point out that only those plants which have other means of persistence than by seeds have flowers which are wholly dependent on external agents for pollination, and also to show that while flowers which have arrangements for self-fertilization are abundantly fertile, those which cannot make use of pollen without assistance are frequently barren, and are at a sad disadvantage in making their way through the world. So clearly has this been worked out to my mind, that when a plant is found abundantly fertile it is fair to assume that it must be arranged for self-pollination. In Asclepiadaceæ, with the large majority of the flowers barren, we may theoretically assume insect agency,—with many abundantly fertile Apocynaceæ we may assume self-fertilization.

I have already shown that the Madagascar periwinkle, *Vinca rosea*, with every flower fertile in American gardens, is a self-fertilizer. Another of the same order, *Amsonia Tabernæmontana* (the form known as *A. salicifolia*, Pursh), is abundantly fertile. I watched the flowers this season, satisfied that they would be found arranged for self-pollination. The plants proved, as usual, abundantly fertile. On one panicle there were twenty-nine pairs of follicles that matured; there were many others that had been evidently fertilized, but failed to reach maturity through lack of nutrition.

Showy as the blue flowers are, and we might suppose, in view of prevailing speculations, made so in order to be attractive to insects, the arrangements are such that no insect, not even the ubiquitous thrips, can gain entrance to the nectary. The mouth of the tube is so densely matted with hair that *Faux clausa* is the term used in the description of the species by Latin authors. If a pollen-clothed tongue were thrust through the mass it would be thoroughly cleaned, and in like manner the flower's own pollen would be brushed back when the insect withdrew its tongue. But a greater difficulty presents itself. The capitate stigma with its surrounding rim completely fills the upper portion of the tube. There is no space for an insect's tongue to get past the stigma. But even could this rubicon be passed, a dense mass of hair presses close against the style, and the most powerful insect known to the writer could hardly force a passage. The entrance of insects is completely blocked. To provide for pollination the anthers curve over and rest on the stigma, and the pollen on ejection from the anthers can do no more than cover the stigma.

In many plants which have flowers that are generally fertilized by their own pollen the arrangements will often permit of pollination from some other; but in the case of this *Amsonia* nothing but self-pollination is possible.

To those who may not have flowers for comparison the figure of this plant in 'Botanical Register,' pl. 151, will aid in making some of the above-noted points clear.—*Proc. Acad. Nat. Sci. Philad.* March 29, 1892, p. 162.

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